CONCH STROMBUS AS INDICATOR OF METAL CONTAMINATIONS IN SOUTHERN AND EASTERN JOHOR WATERS

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"Telah timbul berbagai kerosakan di darat dan di laut dengan sebab apa yang telah dilakukan oleh tangan manusia; (timbulnya yang demikian) kerana Allah hendak merasakan mereka sebahagian dari balasan perbuatan-perbuatan buruk yang mereka telah lakukan, supaya mereka kembali (insaf dan bertaubat)"

Al-Rum: 41

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ABSTRACT

Water quality of the Johor coastal areas especially from Straits of Johor has long shown high level of metals. Conch *Strombus* which colonize near the shore ecosystem is exposed to metals in the aquatic environment. This study was carried out to evaluate the use of *Strombus* as an indicator of metals contamination at Johor coastal area. Moreover, *Strombus* is also a popular food source with high commercial value in the southern part of Peninsular Malaysia. Therefore, assessment on the metal status is crucial since direct consumption of contaminated seafood would cause adverse effect to human health. *Strombus's* specimens, sediment and seawater samples were collected during spring low tide from July 2010 to July 2012 at seven different sites. There were three species of *Strombus* found during this study i.e *Strombus canarium*, *Strombus urceus* and *Strombus aratrum*. *Strombus canarium* turned to be the most abundance and highly distributed compared to other species. The metal concentrations (As, Cd, Cu, Pb and Zn) in the sediment, seawater and soft tissues of *S. canarium* were analyzed using inductively coupled plasma mass spectroscopy (ICP-MS). All of the metal concentration except for As exceeded the permissible limit of Malaysia Marine Water Quality Criteria (MMWQC) for Class E where Zn shows the highest range in water (0.002-0.165 mg/L) as well as in sediment (23.903-56.286 µg/g dry weight). Overall, high concentrations of metals were recorded at western part of Johor Straits. Metal content in sediment could be classified as polluted with Cu (7.247-46.868 µg/g dry weight) according to the Environmental Protection Agency (EPA) sediment quality. *S. canarium* also contained high accumulation of Zn (13.270-22.082 mg/kg wet weight). Nevertheless, all metal concentration in the soft tissues of *S. canarium* was within the recommended limit of Food and Agriculture Organization (FAO) and World Health Organization (WHO). On the other hand, experiments on toxicity were also carried out and reported as median lethal concentration (LC50). Abnormal behavior such as secretion of mucus in large quantities was observed, especially at high concentration of metals. Cu appeared to be more toxic than other metals with the value of LC50, 0.261 mg/L. Generally, the result indicates that the *S. canarium* can be employed as bio-indicator for metal contamination since they tend to reflect the quality of surrounding environment.

ABSTRAK

Kualiti air di kawasan laut Johor terutamanya Selat Johor telah lama menunjukkan tahap bacaan logam yang tinggi. Gonggong *Strombus* yang mendiami ekosistem pantai terdedah kepada logam di dalam persekitaran akuatik. Kajian ini dijalankan untuk menilai kegunaan *Strombus* sebagai penunjuk pencemaran logam di kawasan laut Johor. Tambahan pula, *Strombus* merupakan sumber makanan laut yang popular dan memiliki nilai komersial yang tinggi di bahagian selatan Semenanjung Malaysia. Oleh itu, penilaian terhadap status kandungan logam adalah penting kerana pengambilan terus makanan laut yang tercemar boleh mengakibatkan kesan buruk terhadap kesihatan manusia. Spesimen *Strombus*, sampel sedimen dan air telah dikumpul sewaktu air surut dari Julai 2010 sehingga Julai 2012 di tujuh kawasan berlainan. Sebanyak tiga spesis *Strombus* dijumpai iaitu *Strombus canarium, Strombus urceus* dan *Strombus aratrum. Strombus canarium* adalah yang paling banyak ditemui dan mempunyai taburan yang luas berbanding dengan spesis lain. Kepekatan logam (As, Cd, Cu, Pb and Zn) di dalam tanah, air dan tisu *S. canarium* dianalisis menggunakkan induktif ditambah plasma spektrometri jisim (ICP-MS). Semua kepekatan logam kecuali As melebihi had yang dibenarkan oleh Kriteria dan Piawaian Air Laut Malaysia (MMWQS) untuk Kelas E di mana Zn menunjukkan julat tertinggi (0.002-0.165 mg/L) begitu juga di dalam sedimen (23.903-56.286 µg/g berat kering). Secara keseluruhan, kepekatan logam yang tinggi telah dicatatkan di kawasan barat Selat Johor. Kandungan logam dalam sedimen boleh dikelaskan sebagai tercemar dengan Cu (7.247-46.868 µg/g berat kering) berdasarkan kualiti sedimen oleh Agensi Perlindungan Alam Sekitar (EPA). *S. canarium* juga mengandungi pengumpulan Zn yang tinggi (13.270-22.082 mg/kg berat basah). Walaubagaimanapun, semua kepekatan logam dalam tisu lembut *S. canarium* berada dalam had yang dibenarkan oleh Pertubuhan Makanan dan Pertanian (FAO) dan Pertubuhan Kesihatan Sedunia (WHO). Sementara itu, eksperimen ketoksikan juga dijalankan dan dilaporkan sebagai kepekatan yang menyebabkan kematian sebahagian organisma (LC50). Penghasilan mukus dalam kuantiti yang banyak diperhatikan pada kepekatan logam yang tinggi. Cu didapati lebih toksik berbanding logam lain dengan nilai LC50, 0.261 mg/L. Secara keseluruhan, keputusan kajian menunjukkan *S. canarium* boleh digunakan sebagai penunjuk biologi untuk pencemaran logam di mana spesies ini cenderung untuk mencerminkan kualiti persekitaran.

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LIST OF ABBREVIATIONS

AMWQC	ASEAN Marine Water Quality Criteria
As	Arsenic
ASTM	American Society for Testing and Materials
Cd	Cadmium
Cu	Copper
DO	Dissolved Oxygen
DOE	Department of Environment Malaysia
FAO	Food and Agriculture Organisation
MMWQS	Malaysia Marine Water Quality Standard
Pb	Lead
WHO	World Health Organisation
Zn	Zinc

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Geographically, Malaysia has two regions, namely Peninsular Malaysia and East Malaysia which are separated by the South China Sea. Peninsular Malaysia is surrounded by the Johor Straits on the southern coast and the Malacca Straits on the western coast. East Malaysia faces the Sulu Sea and Celebes Sea on the eastern coast. The total coastline of Malaysia is approximately 4,800 kilometers in length and contains one of the largest continental shelf areas within the tropical world which is supported by a rich biodiversity owing to variation of marine ecosystems, including sea-grass, mangroves, seashore and coral reefs (Mazlan *et al*., 2005). Nevertheless, these ecosystems are fragile and greatly influenced by environmental changes. Since the quality of marine ecosystems have a significant part in the sustainability of marine resources, any sources of contamination may be a great threat to the ecosystem (Mustafa and Ariffin, 2011).

In recent years, Malaysia has undergone progressive development that has induced many environmental issues. Increased human activities have put more pressure on coastal and marine ecosystems. Unsustainable practices of development and population growth along the coastline have led to increased sources of contaminations, habitat degradation and a decline of marine life. These practices have also created conflicting interests between economic growth and conservation of natural ecosystems. Although it is known that many coastal habitats and ecosystems are under threat, yet the coastal residential areas are heavily depended on (Arifin *et*

al., 2012). Contaminant from land based activities has been keyed out as a major sources towards marine contamination in Malaysia (Gasim *et al*., 2013).

Johor is located on the southern tip of the Peninsular Malaysia and bordered by two major straits; Johor Straits on the southern coast and Malacca Straits on the western coast. The coastal resources in Johor are relatively rich and could be considered more diverse compared with other coastal areas in Malaysia. Consequently, these coastal areas are extremely affected by human activities associated with urbanization, industrial growth and agriculture. The eastern coast of Johor is known for its tourism activities due to its beautiful beaches and islands, whereas the Johor and Malacca Straits are known as polluted areas. Despite being exposed to a great deal of environmental stress, the Johor Straits are an important ecosystem as the areas are linked up with seagrasses, mangroves and intertidal mudflat. These ecosystems play a significant function as home grounds and food sources for a wide diversity of aquatic life. Hence, a lot of unique species such as gastropods; *Strombus canarium*, bivalves; *Perna viridis* and horseshoe crabs; *Carcinoscorpius rotundicauda* and *Tachypleus gigas* reside abundantly in the Johor Straits compared to other places (Yap *et al*., 2004; Cob *et al*., 2009a; Hajeb *et al*., 2009).

Over the past 17 years, the eastern part of the Johor Straits was described as more polluted than the western part, since most of the ports (Pasir Gudang, Tanjung Langsat) and heavy industries (petrochemical plants, electrical power plant and construction facilities) are located on the eastern coast (Wood *et al*., 1997; Eugene *et al*., 2013). However, the western coast is currently facing rapid development (Figure 1.1). The coastal zones of Johor are 64 km in length and have been assigned under the Iskandar Development Region (IDR) to accelerate the growth of the economy. The Port of Tanjung Pelepas (PTP) located at the Sungai Pulai estuary is included under the IDR in order to enhance economic achievement. On the other hand, the 2100 MW Tanjung Bin power plant is on the opposite coast. A 40.5 ha oil bunker island constructed in front of the Tanjung Bin power plant is an island for the storage of fuel and diesel.

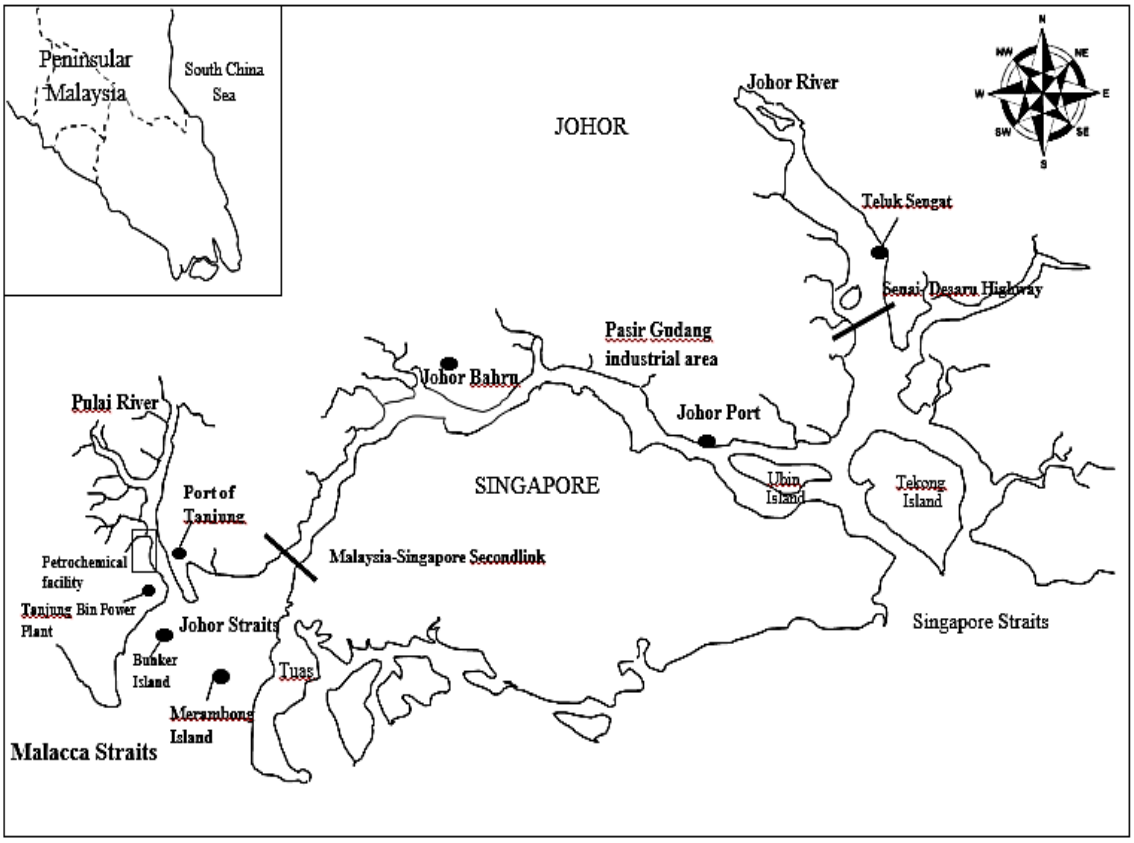

Figure 1.1: Location of Johor Straits

Indeed, two major developments take place involving petrochemical and maritime industries next to the Tanjung Bin Power Plant and there is a petrochemical facility on a man-made island near Tanjung Bin. This industry is expected to handle various petroleum products which included industrial and marine fuel oils, diesel, jet fuel and biodiesel. Furthermore, according to the Municipal Council of Johor Bahru Tengah (MPJBT), the coastal line of the villages will be developed as an industrial region of Tanjung Pelepas consisting of light and medium industries, housing areas and agriculture purposes. The area is faced with Tuas, Singapore, an industrial zone in the western region of Singapore which consists of incinerator plants, power supplies and chemical industries. Thus, massive developments on both sides lead to significant physical and chemical changes in the surrounding environment (Zulkifli *et al*., 2010).

Additionally, a massive reclamation of land is currently undergoing between Tanjung Kupang and Tuas area. The reclamation started in early 2014 with an

approximate size of 926 hectares of land intended to be used for a stadium and luxury homes which will be known as Forest City (Shan, 2014). This huge site has completely destroyed the largest seagrass bed in Peninsular Malaysia. Huge piles of sand were dumped on the seagrass bed and the proposed connecting road has caused mangrove areas to be cleared. The water has become cloudy due to the high sediment loading which has caused adverse effects to marine life.

Pollutants as a result from human activities enter the aquatic systems and integrate into the biota and interfere with chemical and biological processes in the water column and sediments (Figure 1.2). Among the pollutants, metals are considered as a severe environmental issue due to their persistent and non-biodegradable properties (Al-Ahmary, 2013). Metals such as zinc, copper and iron are important elements which are nutritionally essential to living beings, however, they can have adverse effects when they are consumed more than the specified limits (Krishna *et al*., 2014). Conversely, there are metals that have higher levels of concern, such as arsenic, cadmium, lead and tin. They have been categorized as heavy metals due to their toxic and carcinogenic potential.

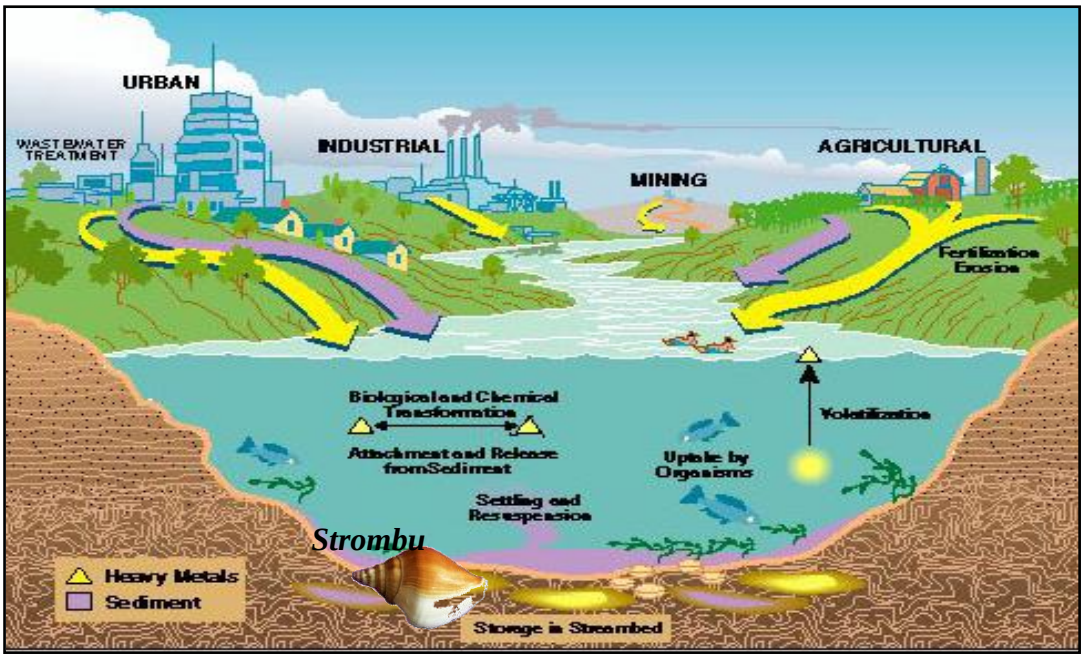

Figure 1.2: The cycle of metal contaminants as they are released from anthropogenic sourcing to the aquatic environment. They can be circulated in water or stored in sediments (Garbarino *et al.*, 1995).

Aquatic organisms accumulate metals from the contaminated water and sediments which then causes the metals contaminants to enter the food chain through predators eating contaminated aquatic organisms. The capability of metals to bio-accumulate and transfer through food chain could lead to greater environmental problems (Hasyimah *et al*., 2011). Humans are on the top tier of the food chain and consume a large amount of seafood. The consumption of metal-contaminated seafood may expose humans to health problems. A previous survey has demonstrated that progressive and irreversible accumulation of Pb in human bodies can impair the functions of the kidney and liver (Anim *et al*., 2011). Long-term intake of Zn (150 – 2000 mg/day) will induce sideroblastic anaemia, leukopenia and hypochromic microcytic anaemia (Nriagu, 2007).

Generally, metals are released into the aquatic environment through natural processes such as soil erosion or rock weathering at low levels that will not cause any adverse effects on living organisms. However, Cuong, (2005), Ong and Kamaruzzaman, (2009) and Said *et al*., (2013) have reported that intensive dredging, reclamation and shipping activities in Johor coastal areas had led to the enrichment of metals in the aquatic environment. Arsenic (As), cadmium (cadmium), copper (Cu), lead (Pb) and zinc (Zn) are common metals that have been identified in seawater and accumulated in coastal sediment and marine life of Johor. Yap *et al.,* (2012a) observed high levels of Zn in the Johor Straits which partially originates from the direct discharge of boiling water from mussel processing factories at Kampung Sungai Melayu. The discharged from those anthropogenic activities have focused attention on the risk to coastal and estuarine ecosystems, which are considered as sensitive environments.

The constant release of metal pollutants may lead to the deterioration of the environmental quality (Adnan and Ismail, 2014). The deleterious effect of aquatic organisms would frequently occur as a consequence of high levels of metals in the water and sediment (Bashir *et al.*, 2012). This was reflected by a decrease of the existence of gastropod species as Cob *et al*., (2009b) found high mortality values for *Strombus canarium* from the Johor Straits as a result from water pollution. Moreover,

Yusof *et al*., (2003); Amin *et al*., (2006) and Hadibarata *et al*., (2012) observed higher concentrations of metals (As, Cd, Cu, Pb and Zn) in the marine life (*Perna viridis* and *Nerita lineata*) from Johor areas which exceeded the limit of Malaysia Food Regulation.

However, there are limited studies concerning the toxic effect of metals on gastropod available, especially in Malaysia's coastal waters (Vedamanikam and Shazili, 2008; Shuhaimi-Othman *et al*., 2013). Most of the studies focused on the accumulation of metals in the sediment, water and other aquatic organisms (Yap *et al*., 2011a; Alina *et al*., 2012; Hadibarata *et al*., 2012). The influence of metals on aquatic organisms could be investigated using toxicity tests. During the toxicity test, groups of selected organisms were exposed to test the substance under a controlled environment to determine the potential adverse effects. Dam *et al*., (2008) emphasized that the use of toxicity testing for environmental impacts, risk assessment and water quality guideline derivation is well established and forms a key component of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

The present study focused on marine gastropod, *Strombus* which is widely distributed in the coastal waters of Johor. The genus *Strombus* is a worldwide tropical group of mesogastropods species that belongs to the Strombidae family. They can be found in soft or muddy sediment, often in colonies and within areas of low to medium seagrass densities. Among the *Strombus* species, *Strombus canarium* is reported to occur abundantly in many parts of Southeast Asia's marine environment (Cob *et al*., 2009a). In Malaysian waters (Figure 1.3), they are present in the seagrass bed area, and along coastal and sheltered islands, especially on the southern coast of Peninsular Malaysia (Purchon and Purchon, 1981; Poutiers, 1998; Cob *et al*., 2009a). Adult and juvenile versions of these species are ecologically important as grazers of seagrass detritus, epiphytic algae and diatom. The *Strombus* also an important food sources for rays, dugongs and volute snails such as *Melo melo*, and *Cymbiola nobilis* to prey on (Brownell and Stevely, 1981). Tabugo *et al.,* (2013) reported that the *Strombus* species are also valued by humans as food items, while their shells are exploited for

ornamental purposes. *S. canarium* or locally known as 'siput gonggong' is a popular seafood delicacy and has high economic values (Bujang *et al*. 2006).

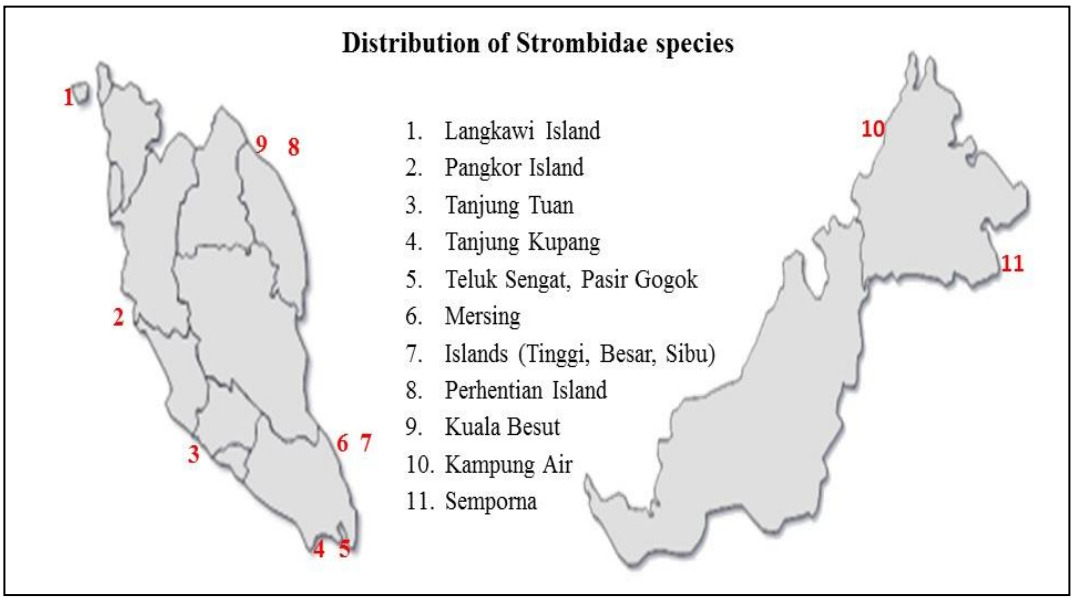

Figure 1.3: Distribution of Strombidae species in Malaysia's coastal areas (Purchon and Purchon, 1981; Ridzwan and Kaswandi, 1995; Poutiers, 1998; Cob *et al*., 2009a).

A study conducted by Cob *et al*., (2009b) mentioned that there is limited information regarding its ecology and fisheries which lead to unsustainable habitat destruction of the genus *Strombus*. Moreover, there is also no regulation concerning fisheries of this species in Malaysia. Therefore, this study investigates the occurrence of *Strombus* species and also their tolerance to metal contamination. Determination of the *Strombus* capability to tolerate metals provides useful information concerning the survival of the species and is an effort to restore depleted natural populations of these species. Currently, their habitats are extremely exposed to coastal contamination induced by anthropogenic factors, which can likewise contribute to their depletion. *Strombus* may accumulate metals through water, ingested sediments and other food particles. Due to this exposure, the bioaccumulation of metals is possibly higher and thus has potential to cause adverse effects to themselves and also their predators.

1.2 Problem Statement

The coastal areas of Johor are highly impacted by human intervention associated with reclamation, urbanization and industrial activities. Unsustainable practices from those activities have focused attention on the risk to coastal and estuarine ecosystems which are considered as sensitive environments. Among pollutants, metals received more concern due to their high toxicity and effect on the environment. Marine gastropod *Strombus* are widely distributed in the coastal waters associated with a sandy mud bottom in seagrass areas and usually close to estuaries. As a part of benthic invertebrate communities, species of *Strombus* are important in the biodiversity of maintaining healthy ecosystems and also comprise an important trophic component of detrital based estuarine food webs (Amin *et al*., 2009).

From literature reviewed, the *Strombus* have been reported abundantly in contaminated areas such as the Johor Straits compared with other places. Consequently, they are highly exposed to various type of contaminants originated from anthropogenic activities and sea-based sources. It also shows that they are very tolerant to the exposure of contaminants and have been revealed as potential bio-indicators of environmental stress in coastal ecosystems. Moreover, as a deposit feeder, *Strombus* also feed on sediment containing diatoms, bacteria and detritus by swallowing particles or browsing particles in order to scrape off organic biofilms. Due to their feeding requirements, they inhabit fine-grained and organic rich sediments due to increased food availability (Mauffret *et al.*, 2009). Therefore, *Strombus* may accumulate metals from dissolved and particulate sources whether essential or not, all of which could possibly cause toxic effects. Moreover, metals contained in their system may reflect the condition of the surrounding environment. Nevertheless, *Strombus* are a popular as a seafood delicacy and have a high market value. Since their consumption has increased nowadays, it is important to assess the metal accumulation in their soft tissues to ensure it will not have adverse effects on human health.

1.3 Objectives of the Study

The objectives of this study are as follows:

1. To quantify the occurrence of *Strombus* species in southern and eastern coast of Johor
2. To determine metal contamination in water, sediment and *Strombus* in southern and eastern coast of Johor
3. To determine the lethal concentration (LC50) of metals in *Strombus* and identify the effects of metal on their mortality. LC50 is defined as the certain concentration of metal which will lead to 50% of organisms experiencing acute toxicity that will cause death
4. To evaluate the potential of *Strombus* as bioindicator of metal contamination

1.4 Scope of the Study

The following scopes of study have been keyed out in order to accomplish the aims. The scopes are as follows:

a) For determination of the occurrence of *Strombus:*
    1. The study is conducted mainly in the Johor coastal area since the area is known as their habitat. The study areas involved intertidal zones associated with seagrass beds, mangroves and sandy mudflats
    2. The specimens were collected during the spring low tide which occurs only twice a month
    3. Stratified random sampling with time search was used for assessing the occurrence of gastropod.

b) Metal concentration in water, sediment and *Strombus*

1. Physical characteristics of water, such as dissolved oxygen, temperature, pH and salinity have been measured *in situ* and also taking water samples for laboratory analysis.
2. Sediment was sampled using a sediment corer and was preserved prior the analysis, whereas *Strombus's* specimens for the toxicity test were kept in moist sediment during transportation to the lab.
3. Analytical parameters for water samples were referred to the Malaysian Marine Water Quality Standard (MWQS) and ASEAN Marine Water Quality Criteria (AMWQC).
4. Sediment quality was evaluated according to the EPA sediment quality proposed and New York sediment criteria
5. Analysis of the metal in *Strombus* and the status were determined based on guidelines recommended by Malaysian Food Regulation, World Health Organization (WHO) and the Food and Agriculture Organization (FAO).

c) Median lethal concentration (LC50) of metals on *Strombus*

1. Acute toxicity tests conducted according to the method recommended by the American Society for Testing and Materials (ASTM), 2007. The LC50 value was determined using the 96-hours static renewal condition.
2. The metals exposed to *Strombus* included cadmium, copper, lead and zinc.
3. The LC50 values were calculated using Probit analysis.
4. Observation of behavior responses of *Strombus* during exposure were recorded

1.5 Significance of the Study

Gastropods are an important component of mollusk communities in Malaysia coastal waters both in ecological and economical aspects. The gastropod fauna of Malaysia are rather well recognized from the study by Purchon and Purchon, (1981) although, little progress on collection and documentation of marine gastropods have been made since then. Moreover, Wong and Arshad, (2011) also found that the information on gastropods in Malaysia is still inadequate and makes it impossible to assess the rate of population lost. Hence, this study provides the current status of *Strombus* species, particularly in coastal areas of Johor.

During a preliminary survey and from literature, most of the species were abundant in Johor's coastal areas. However, their habitat has been threatened by development. Tanjung Kupang seagrass bed was the largest seagrass bed in Peninsular Malaysia (Green and Short, 2003) and also one of the *Strombus's* habitat that faced a significant threat from the reclamation works. As the seagrass bed at Tanjung Kupang was rapidly being destroyed by reclamation works indicated since early 2014, the present study probably one of the last documentation regarding the occurrence of *Strombus's* species at the area. Moreover, the *Strombus's* habitat at Tanjung Bin will be wiped out due to the expansion of Tanjung Bin Power Plant and the adjacent petrochemical industry. Surrounded by mass development and exposure to various types of pollutant creates unfavourable conditions for *Strombus* and they may face extinction. Hence, documentation of the species is significantly important for the environmental health status, conservation planning, and to serve the public.

Metals are released into the Johor coastal area from various sources. Metal is transported by being dissolved in water, volatized into the atmosphere or stored in the coastal sediment. The species of *Strombus* that are among the largest and abundant mollusc in this area have an increased possibility to accumulate metals in their body. On the other hand, the metal concentrations in *Strombus* needs to be investigated since its consumption has increased and high levels of metals in its tissues may cause adverse effects on human health (Cob *et al*., 2009b). Moreover, this gastropod is also a part of the marine life's diet, such as volute snails, rays and dugong. The status of

water quality and sediment in its habitat may also determine whether the *Strombus* population is affected by their surrounding environment especially through accumulation of the metals contamination. The bioaccumulation of metals in living organisms is particularly significant as an indicator of exposure since they were often used to provide reliable assessments of metal levels in polluted ecosystems. Although there were other marine organisms that have been suggested as a bio-indicator, those will never be appropriate to represent the problem of marine ecosystem as a whole. Therefore, the capability of *Strombus* species to accumulate metals encouraged selection of this species as a biological indicator of metals contamination at Johor Straits and thus be an indication of the quality of the surrounding environment.

REFERENCES

Abbas, F. M. A., Ahmad, A., Ismail, N. and Easa, A. M. (2007). Multivariate Analysis of Heavy Metals Concentrations in River Estuary. *Environmental Monitoring and Assessment*. 143,179-186.

Abbott, R.T. (1960). The Genus *Strombus* in the Indo-pacific. *Indo-Pacific Mollusca*. 1(2), 33-144.

Abbott, R. T. (1991). *Seashells of South East Asia*. Graham Brash, Singapore.

Abdallah, A. T. and Moustafa, M. A. (2002). Accumulation of Lead and Cadmium in the Marine Prosobranch *Nerita saxtilis*, Chemical Analysis, Light and Electron Microscopy. *Environmental Pollution*. 116(2),185-91.

Abdallah, M. A. M. (2013). Bioaccumulation of Heavy Metals in Mollusca Species and Assessment of Potential Risks to Human Health. *Bulletin Environmental Contamination Toxicology*. 90:552–557

Abdullah, M. H., Sidi, J. and Aris, A. Z. (2007). Heavy Metals (Cd, Cu, Cr, Pb and Zn) in *Meretrix meretrix Roding*, Water and Sediments from Estuaries in Sabah, North Borneo. *International Journal of Environmental & Science Education*. 2(3), 69 – 74.

Abdel-Tawwab, M., El-Sayed, G. O. and Shady, S. H. H. Acute Toxicity of Water-born Zinc in Nile tilapia, *Oreochromis niloticus* (L.) fingerlings. (2011). P*roceedings of the 9th International Symposium on Tilapia in Aquaculture*. April 22-24. Shanghai, China.

Abdurahman, S. W., Yunus, K. and Saad, S. (2011). Spatial and Temporal Variation of Zinc (Zn) and Cadmium (Cd) in the Bottom Sediments of Pahang River-estuary, Pahang, Malaysia. *Proceeding of UMTAS: Empowering Science, Technology and Innovation Towards a Better Tomorrow*. July 11-13. Kuala Terengganu, Terengganu.

Abedi, Z., Khalesi, M., Eskandari, S. K. and Rahmani, H. (2012*).* Comparison of Lethal Concentrations (LC50-96 H) of Cdcl2, Crcl3, and Pb (NO3)2 in

Common Carp (*Cyprinus carpio*) and Sutchi Catfish (*Pangasius Hypophthalmus*). *Iranian Journal of Toxicology*. 6 (18).

Abowei, J. F. N. (2010). Salinity, Dissolved Oxygen, pH and Surface Water Temperature Conditions in Nkoro River, Niger Delta, Nigeria. *Advance Journal of Food Science and Technology*. 2(1), 36-40.

Adiana, G., Shazili, N. A. M. and Ariffin, M. M. (2011). Cadmium, Manganese and Lead Distribution in the South China Sea off the South Terengganu Coast, Malaysia during Post-Monsoon and Pre-Monsoon. *Journal of Sustainability Science and Management*. 6(2), 181-192.

Adnan, N, A, F. and Ismail, T. H. T. (2014). The Accumulation of Fe, Pb, Zn, Ni and Cd in *Nerita lineata* and *Thais bitubercularis* Obtained from Tanjung Harapan and Teluk Kemang, Malaysia. In Aris, A. Z., Ismail, T. H. T., Harun, R., Abdullah, A. M. and Ishak, M. Y. *From Source to Solution*. (pp. 397-401). Singapore: Springer Science and Business Media

Ahmad, A. S. (1996). Distribution of Some Heavy Metals in the Kemaman Coast, Terengganu. *Master Thesis*. Universiti Pertanian Malaysia.

Ali, N. A., Hanid, N. A. and Jusoh, A. (2011). The Potential of a Polysulfone (Psf) Nanofiltration Membrane as the End Stage Treatment Technology of Aquaculture Wastewater. *Desalination and Water Treatment*, 32(1-3), 242-247.

Ali, R. A. S. and Bream, A. S. (2010). The Effects of Sewage Discharge on the Marine Gastropod *Gibbula* sp., Collected from the Coast of Al-Hanyaa, Libya. *Egyptian Academic Journal Biological Science*. 2(2), 47-52.

Alina, M., Azrina, A., Mohd Yunus, A.S., Zakiuddin, S. M, Effendi, M. I. H. and Muhammad R. (2012). Heavy metals (Mercury, Arsenic, Cadmium, Plumbum) in Selected Marine Fish and Shellfish along the Straits of Malacca. *International Food Research Journal*. 19(1), 135-140.

Alongi, D, M. (2008). Mangrove Forest: Resilience, Protection from Tsunamis and Responses to Global Climate Change. *Estuarine, Coastal and Shelf Science*. 76, 1-13.

Al-Ahmary, K. M. (2013). Removal of Cd (II) Ions from Aqueous Solutions, by Adsorption onto *Junipers Procera* Roots. *International Journal of Basic and Applied Sciences*. 2(3), 215-222.

American Society for Testing and Material (ASTM). *Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates and Amphibians*. United State, E729-96. 2007.

Amiard, J. C., Amiard-Triquet, C. Barka, S., Pellerin, J. and Rainbow, P. S. (2006). Metallothioneins in Aquatic Invertebrates: Their Role in Metal Detoxification and Their Use as Biomarkers. *Aquatic Toxicology*. 76, 160-202.

Amin, B. (2004). Concentration of Heavy Metals in Molluscs and Sediment from Sei Jang Estuary. *Ilmu Kelautan Maret*. 9 (I), 431-436.

Amin, B., Ismail, A., Arshad, A., Yap, C. K. and Kamarudin, M. S. (2006). A Comparative Study of Heavy Metal Concentrations *Nerita lineata* from the Intertidal Zone between Dumai Indonesia and Johor Malaysia. *Journal Coastal Development*. 10, 19-32.

Amin, B., Ismail, A., Arshad, A., Yap, C. K. and Kamarudin, M. S. (2009). Gastropod Assemblages as Indicators of Sediment Metal Contamination in Mangroves of Dumai, Sumatra, Indonesia. *Water Air Soil Pollution*. 201, 9-18.

Amusan, A. A. S., Anyaele, O. O. and Lasisi, A. A. (2002). Effects of Copper and Lead on Growth, Feeding and Mortality of Terrestrial Gastropod *Limicolaria flammea* (Muller, 1774). *African Journal of Biomedical Research*. 5, 47-50.

Anim, A. K., Ahialey, E. K., Duodu, G. O., Ackah, M. and Bentil, N. O. (2011). Accumulation Profile of Heavy Metals in Fish Samples from Nsawam, Along the Densu River, Ghana. *Research Journal of Environmental and Earth Sciences*. 3(1), 56-60.

Anu, P. R., Jayachandran, P. R., Sreekumar, P. K. and Nandan, S. B. (2014). A Review on Heavy Metal Pollution in Cochin Backwaters, Southwest Coast of India. *International Journal of Marine Science*. 4 (10), 92-98.

Arifin, Z. (2011). Heavy Metals Concentrations in Water, Sediment and Biota on Kelabat Bay, Bangka Island. *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 3(1), 104-114.

Arifin, Z., Puspitasari, R. and Miyazaki, N. (2012). Heavy Metal Contamination in Indonesia Coastal Marine Ecosystems: A Historical Perspective. *Coastal Marine Science.* 35 (1), 227-233.

Arularasan, S., Lyla, P. S., Kesavan, K. and Khan, S. A. (2010). Recieps for the Mesogastropod-*Strombus canarium. Advance Journal of Food Science and Technology*. 2(1), 31-35.

Avila-Poveda, O. H., Aldana-Aranda, D. and Baqueiro-Cardenas, E. R. (2006). *America Malac. Bulletin*. 21, 93-98.

Azman, S., Chiang, B. C. W., Ismail, R., Jaafar, J., Said, M. I. M., Salmiati. (2012). Effect of Land Use on Coastal Water and *Perna viridis* at Johor Straits, Malaysia. *International Journal of Environmental Science and Development.* 3(3), 237-239.

Aziz, N. A., Azlan, A., Ismail, A., Alinafiah, S. M. and Razman, M. R. (2013). Quantitative Determination of Fatty Acids in Marine Fish and Shellfish from Warm Water of Straits of Malacca for Nutraceutical Purposes. *BioMed Research International.* Article ID 284329, 12 pages, 2013. doi:10.1155/2013/284329

Barker, G. M. *Mollusc as crop pests*. CABI Publishing; USA. 2002.

Bakus, G. J. (2007). *Quantitative Analysis of Marine Biology Communities: Field Biology and Environment.* U. S. S. John Wiley & Sons, Inc.

Baldi, A. (1999). Biodiversity in Hungary: Advantages and Limitations of Taxonomically Complete Faunal Inventories. *Natural Areas Journal*. 19 (1), 73-78.

Banning, R., Camstra, A. and Knottnerus, P. (2012). *Sampling Theory, Sampling Design and Estimation Method*. The Hague: Statistic Netherlands.

Bashir, F. A., Shuhaimi-Othman, M. and Mazlan, A. G. (2012). Evaluation of Trace Metal Levels in Tissues of Two Commercial Fish Species in Kapar and Mersing Coastal Waters, Peninsular Malaysia. *Journal of Environmental and Public Health*, 1-10.

Bashir, F. H., Othman, M. S., A. G. Mazlan, Rahim, S. M. and Simon, K. D. (2013). Heavy Metal Concentration in Fishes from the Coastal Waters of Kapar and Mersing, Malaysia. *Turkish Journal of Fisheries and Aquatic Sciences*. 13, 375-382.

Baynes, R. E. and Hodgson. (2004). *Absorption and Distribution of Toxicants. A Textbook of Modern Toxicology*, Third Edition. John Wiley & Son. Inc.

Berandah, F. E., Kong, Y. C. and Ismail, A. (2010). Bioaccumulation and Distribution of Heavy Metals (Cd, Cu, Fe, Ni, Pb and Zn) in the Different Tissues of *Chicoreus capucinus* Lamarck (Mollusca: Muricidae) Collected from Sungai Janggut, Kuala Langat, Malaysia. *EnvironmentAsia*. 3(1), 65-71.

Blackmore, G and Wang, W. (2004). The Transfer of Cadmium, Mercury, Methylmercury and Zinc in an Intertidal Rocky Shore Food Chain. *Journal of Experimental Marine Biology and Ecology*. 307, 91-110.

Borkow, G. and Gabbay, J. (2005). Copper as a Biocidal Tool. *Current Medicinal Chemistry*. 12(18), 2163-2175.

Boulding, E. G., Holst, M. and Pilon, V. (1999). Changes in Selection on Gastropod Shell Size and Thickness with Wave-exposure on Northeastern Pacific Shores. *Journal of Experimental Marine Biology and Ecology*. 232, 217–239.

BPP-PSPL UNRI. *Studi Distribusi dan Eksploitas Siput Gonggong di Lokasi Coremap II Kabupaten Lingga*. Universitas Riau. 2010.

Breslin, V. T and Sanudo-Wilhelmy, S. A. (1999). High Spatial Resolution Sampling of Metals in the Sediment and Water Colum in Port Jefferson Harbor, New York. *Estuaries*. 22 (3A). 669-680.

Briggs, D. (2003). Environmental Pollution and the Global Burden of Disease. *British Medical Bulletin*. 68 (1), 1-24.

Brooks, S. J. and Waldock, M. (2009).Copper Biocides in the Marine Environment. In: T. Arai *et al*. (ed.) *Ecotoxicology of Antifouling Biocides*. Barrack Road, Weymouth, Dorset, UK.

Brownell, W. N. and Stevely, J. M. (1981). The Biology, Fisheries, and Management of the Queen Conch, *Strombus gigas*. *Marine Fisheries Review*. 43(7).

Brown, R.J., Galloway, T.S., Lowe, D., Browne, M.A., Dissanayake, A., Jones, M.B. and Depledge, M. H. (2004). Differential Sensitivity of Three Marine Invertebrates to Copper Assessed using Multiple Biomarkers. *Aquatic Toxicology*. 66,267-278.

Budin, K., Sakari, M., Praveena, S. M., Ismail, N. and Jalimin, A. Concentrations of Cd, Pb, Cu and Zn in Gastropods Available in Major Markets of Kota Kinabalu, Sabah. In Proceeding of *2nd International Conference on Environment, Agriculture and Food Sciences* (ICEAFS'2013) August 25-26, Kuala Lumpur (Malaysia); 2013.

Bujang, J. S., Arsad, A. and Zakaria, M. H. (2006). Distribution and Significance of Seagrass Ecosystems in Malaysia. Aquatic Ecosystem Health and Management Society. 9(2), 203-214.

Burger, J. and Gochfeld, M. (2005). Heavy Metals in Commercial Fish in New Jersey. *Environmental Research*. 99(3), 403-412.

Burton, A. G. (2002). Sediment Quality Criteria in Use around the World. *Limnology*. 3, 65-75.

Cabral, H. N. and Murta, A. G. (2004). Effect of Sampling Design on Abundance Estimates of Benthic Invertebrates in Environmental Monitoring Studies. *Marine Ecology Progress Series*. 276, 19-24.

Cappenberg, H. A. W. (1997). Pertumbuhan *Strombus urceus* (Moluska) di Teluk Kotania, Seram Barat. *Seminar Kelautan LIPI-UNHAS*. 4-6 Juli. Ambon, 346-350.

Cao, L., Wang, W., Yang Y, Yang, C., Yuan, Z., Xiong, S. and Diana, J. (2007). Environmental Impact of Aquaculture and Countermeasures to Aquaculture Pollution in China. Environmental Science Pollution Research. 14 (7):452–462.

Cheng, W. H., Yap, C. K., Zakaria, M. P., Zaharin, A. and Tan, S. G. (2013). Concentrations of Cu, Fe and Pb in *Nerita lineata* Collected from Selected Sites in Peninsular Malaysia and the Snails's Utility as a Biomonitor of Pb. *Pollution Research*. 32(2), 211-216

Cheung, S. G., Tai, K.K., Leung, C.K. & Siu, Y.M. (2002). Effects of Heavy Metals on the Survival and Feeding Behaviour of the Sandy Shore Scavenging Gastropod *Nassarius festivus* (Powys). Marine Pollution Bulletin, 45: 107–113.

Chim, C. K., Neo, M. L. and Loh, K. S. (2009). The Status in Singapore of *Strombus (Dolomena) Marginatus Sowerbyorum* Visser & Man In't Veld, 2005. (Mollusca: Gastropoda: Strombidae). *Nature in Singapore*. 2, 379-384.

Chongprasith, P., Utoomprurkporn, W. and Rattikhansukha, C. (1999). ASEAN Marine Water Quality Criteria for Cadmium. Marine Environment Division, Water Quality Management Bureau, Pollution Control Department.

Choo, C.K., (2006). Save Our Seahorses (SOS) Volunteers Handbook. 1st Ed. Department of Marine Science, Faculty of Maritime and Marine Science, University College of Science and Technology Malaysia (KUSTEM).

Chua, T.E., R. Natarajan and Ross, S.A. (1998). Analysis of the State of the Marine Environment of the Straits of Malacca and Singapore. *Singapore Journal of International & Comparative*. 2, 323- 349.

Cob, Z. C., Arshad, A., Bujang, J. S. and Ghaffar, M. A. (2008). Sexual Polymorphism in a Population of *Strombus canarium* Linnaeus, 1758 (Mollusca: Gastropoda) at Merambong Shoal, Malaysia. *Zoological Studies*. 47(3), 318-325.

Cob, Z. C., Arshad, A., Bujang, J. S. and Ghaffar, M. A. (2009a). Species Description and Distribution of *Strombus* (Mollusca: Strombidae) in Johor Straits and its Surrounding Areas (Pemerihalan Spesies dan Taburan *Strombus* (Mollusca: Strombidae) di Selat Johor dan Kawasan Sekitarnya). *Sains Malaysiana*. 38 (1), 39–46.

Cob, Z. C., Arshad, A., Bujang, J. S. and Ghaffar, M. A. (2009b). Age, Growth, Mortality and Population Structure of *Strombus canarium* (Gastropoda: Strombidae): Variations in Male and Female Sub-population. *Journal of Applied Sciences*. 9 (18), 3287-3297.

Cob, Z. C., Arshad, A., Ghaffar, M. A., Bujang, J. S. and Muda, W. L. W. (2009c). Development and Growth of Larvae of the Dog Conch *Strombus canarium* (Mollusca: Gastropod), in the Laboratory. *Zoological Studies*. 48 (1), 1-11.

Cob, Z. C., Arshad, A., Bujang, J. S., Bakar, Y., Simon, K. D. and Mazlan, A. G. (2012). Habitat Preference and Usage of Strombus canarium Linnaeus, 1758 (Gastropoda: Strombidae) in Malaysian Seagrass Beds. Italian Journal of Zoology. 1-9.

Coeurdassier, M., De Vaufleury, A. and Badot, P.M. (2003). Bioconcentration of Cadmium and Toxic Effects on Life-history Traits of Pond Snails (*Lymnaea palustris* and *Lymnaea stagnalis*) in Laboratory Bioassays. *Archives of Environmental Contamination Toxicol*ogy. 45, 102-109.

Crossland, C. J., Kremer, H. H., Lindeboom, H. J. and Marshall. Coastal Fluxes in Anthropocene. In: Crossland, J.I; Le Tissier, M. D. A (Eds.). *The Land-Ocean Interactions in the Coastal Project of the International Geosphere – Biosphere Programme*. Springer. 2005.

Cubadda, F., Conti, M. E. and Campanella, L. (2001). Size-dependent Concentrations of Trace Metals in Four Mediterranean Gastropods. *Chemosphere*. 45, 561-569.

Cunha, I., Mangas-Ramirez, E., and Guilhermino, L. (2007). Effects of Copper and Cadmium on Cholinesterase and Glutathione S-transferase Activities of Two Marine Gastropods (*Monodonta lineata* and *Nucella lapillus*). *Comparative Biochemistry and Physiology*, Part C 145, 648 – 657

Cuong, D. T. (2005). *Measurement and Behavior of Heavy Metals in the Marine Environment of Singapore.* PhD Thesis. National University of Singapore;

Cuong, D. T., Bayen, S., Wurl, O., Subramanian, K., Wong, K. K. S., Sivasothi, N. and Obbard, J. P. (2005). Heavy Metal Contamination in Mangrove Habitats of Singapore. Marine Pollution Bulletin. 50: 1713–1744.

Cuong, D. T., Karuppiah, S. and Obbard, J. P. (2008). Distribution of Heavy Metals in the Dissolved and Suspended Phase of the Sea-surface Microlayer Seawater Column and in Sediments of Singapore's Coastal Environment. *Environmental Monitoring Assessment*. 138, 255–272.

Dam, R. V., Harford, A., Houstan, M., Hogan, A. and Negri, Ap. (2008). Tropical Marine Toxicity in Australia: A Review and Recommendations. *Australian Journal of Ecotoxicology*. 14, 55-88.

Davis, J. E. (2003). Population Assessment of Queen Conch, *Strombus gigas*, in the St. Eustatius Marine Park, Netherland Antilles. St. Eustatius Marine Park.

Davis, M. L. and Masten, S. J. (2004). *Principles of Environmental Engineering and Science*. McGraw-Hill Higher Education.

Davis, M. (2005). Species Profile Queen Conch, *Strombus gigas*. *SRAC Publication*. 7203, 1-12.

Davis, M. and Garr, A. (2006). Availability and Toxicity of Copper and Zinc in the Florida Keys: Implications for Queen Conch Larval Recruitment. Poster for Harbor Branch Oceanographic Institute, Florida Atlantic University.

Delgado, G. A., Chiappone, M., Geraldes, F. X., Pugibet, E., Sullivan, K. M., Torres, R. E. and Vega, M. (1998). Abundance and Size Frequency of Queen Conch in Relation to Benthic Community Structure in Parque Nacional del Este, Dominican Republic. Proceedings of the *50th Gulf and Caribbean Fisheries Institute*. 1-31.

Deocadiz, E.S. (1999). *ASEAN Marine Water Quality Criteria for Arsenic*. ASEAN-Canada CPMS-II Cooperative Programme on Marine Science.

Desmond, M., Hepburn, C. and McLeod, R. (2012). Metal Concentrations within the Sediment of Hawksbury Lagoon/Matainaka. University of Otago, New Zealand

Dien, F. Y. *Assessment of Heavy Metal Contamination of Fish and Shellfish Sold in Sabah*. Bachelor Degree. Universiti Malaysia Sabah; 2009.

Dody, S. (2011). Pola Sebaran, Kondisi Habitat dan Kemanfaatan Siput Gonggong (*Strombus turturella*) di Kepulauan Bangka Belitung. *Oseanologi dan Limnologi di Indonesia.* 37 (2), 339-353.

DOE (Department of Environment). (2011). Malaysia Environmental Quality Report. Ministry of Natural Resources and Environment Malaysia.

Dol, M., Yaakup, A. and Zain, Z.H.M. (2008). Land Cover Changes at Sungai Pulai Estuary Using Landsat ™Imagery and Spatial Analyst. *International Conference on Environmental Research and Technology* (ICERT). 30 May. Penang, Malaysia.

Edward, F.B., Yap, C.K., Ismail, A. and Tan, S.G. (2009) Interspecific Variation of Heavy Metal Concentrations in the Different Parts of Tropical Intertidal Bivalves. *Water Air Soil Pollution.* 196, 297- 309.

Eggleton, J. and Thomas, K.V. (2004). A review of factors affecting the release and bioavailability of contaminants during sediment disturbance events. Environment International. 30, 973 – 980.

Eisler, R. (1993). Zinc Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Contaminant Hazard Review Report 26. U.S Department of the Interior, Fish and Wildlife Services, Biological Report 10.

Eisler, R. (1988). Lead Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Contaminant Hazard Review Report 14. U.S Department of the Interior, Fish and Wildlife Services, 85(1.14).

Erlambang, T. and Siregar, Y. I. (1995). Ecological Aspects and Marketing of Dog Conch *Strombus canarium* Linne, 1758 at Bintan Island, Sumatra, Indonesia. *Special Publication Phuket Marine Biology Center*. 15,129-131.

Eschweiler, N., Molis, M. and Buschbaum, C. (2009). Habitat-specific Size Structure Variations in Periwinkle populations (Littorina littorea) Caused by Biotic Factors. *Helgol Marine Research*. 63, 119-127.

Eugene, Ng, Y. J., Yap, C. K., Zakaria, M. P. and Tan, S. G. (2013). Assessment of Heavy Metal Pollution in the Straits of Johore by Using Transplanted Caged

Mussel, *Perna viridis*. *Pertanika Journal of Science and Technology*. 21 (1), 75 – 96.

Ezeonyejiaku, C. D., Obiakor, M. O. and Ezenwelu. (2011). Toxicity of Copper Sulphate and Behavioral Locomotor Response of Tilapia (*Oreochromis niloticus*) and Catfish (*Clarias gariepinus*) Species. Online Journal of Animal and Feed Research. 1(4), 130-134.

FAO (Food and Agriculture Organization). 1983 Compilation of legal limits for hazardous substances in fish and fishery products. FAO Fish Circ. 464, 5-100.

Fathi, H. B., Othman, M. S., Mazlan, A. G., Arshad, A., Amin S.M.N. and Simon, K. D. (2013). Trace Metals in Muscle, Liver and Gill Tissues of Marine Fishes from Mersing, Eastern Coast of Peninsular Malaysia: Concentration and Assessment of Human Health Risk. *Asian Journal of Animal and Veterinary Advances*. 8, 227-236.

Flora, S. J. S., Mittal, M. and Mehta, A. (2008). Heavy Metal Induced Oxidative Stress & Its Possible Reversal by Chelation Therapy. *Indian Journal Medical Resources*. 128, 501-523.

Floren, A. S. (2003). The Philippine Shell Industry with Special Focus on Mactan, Cebu. Coastal Resource Management Project of the Department of Environment and Natural Resources, United States Agency for International Development.

Fraga, C. G. (2005). Relevance, Essentiality and Toxicity of Trace Elements in Human Health. *Molecular Aspects of Medicine*. 26, 235-244.

Garbarino, J. R., Hayes, H., Roth, D., Antweider, R., Brinton, T. I. and Taylor, H. (1995). *Contaminants in the Mississippi River*. Virginia. U. S. A. U. S. Geological Survey Circular 1133,

Garcia, A., Bernardez, P. and Prego, R. (2013). Copper in Galician Ria Sediment: Natural Levels and Harbour Contamination. *Scientia Marina*. 77S1, 91-99.

Gasim, H. A., Hashim, A. M., Bakri, P. Z. M., Samsuri, M.Z., Rais, N. L. A. and Noor, N. D. M. (2013). Marine Pollution at Northeast of Penang Island. *Research Journal of Applied Sciences, Engineering and Technology*. 6 (8), 1348-1353.

Gerhardt, A. (1995). Monitoring Behavioural Responses to Metals in *Gammarus pulex* (L.) (Crustacea) with Impedance Conversion. *Environmental Science and Pollution Research*. 2(1), 15-23.

Glazer, R. and Quintero, I. (1998). Observations on the Sensitivity of Queen Conch to Water Quality: Implications for Coastal Development. Proceeding of the 50th Gulf and Caribbean Fisheries Institute. 50, 78-93.

Govind, P. and Madhuri S. (2014). Heavy Metals Causing Toxicity in Animals and Fishes. *Research Journal of Animal, Veterinary and Fishery Science*. 2(2), 17-23.

Green, E. P. and Short, F. T. (2003). World Atlas of Seagrasses. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press. Berkeley, USA.

Guven, K., Ozbay, C., Unlu, E. and Satar, A. (1999). Acute Lethal Toxicity and Accumulation of Copper in *Gammarus pulex*(L.) (Amphipoda). *Journal of Biology*. 23,513-521.

Gupta, S., and Singh, J. (2011).Evaluation of Mollusc as Sensitive Indicator of Pollution in Aquatic System: A Review. *The IIOAB Journal*. 2(1), 49-57.

Gupta, L., Nandy, A., Banerjee, K. and Talapatra, S. N. (2015). Biomonitoring of River Ganga Bank by Identifying Mollusc Species as an Indicator. *International Letters of Natural Sciences*, 37, 71-77.

Hadibarata, T., Abdullah, F., Yusoff, A. R. M., Ismail, R., Azman, S. and Adnan, N. (2012). Correlation Study between Land Use, Water Quality and Heavy Metals (Cd, Pb and Zn) Content in Water and Green Lipped Mussels *Perna viridis* (Linnaeus.) at the Johor Straits. *Water Air Soil Pollution*. 223, 3125-3136.

Hasyimah, N. A. K., James, N. V. The, Y. Y. Lee, C.Y. and Pearline, N. H.C. (2011). Assessment of Cadmium (Cd) and Lead (Pb) Levels in Commercial Marine Fish Organs between Wet markets and Supermarkets in Klang Valley, Malaysia. *International Food Research Journal*. 18, 795-802.

Hajeb, P., Christianus, A., Ismail, A., Zadeh, S.S. & Saad, C.R. (2009). Heavy Metal Concentration in Horseshoe Crab (*Carcinoscorpius rotundicauda* and *Tachypleus gigas*) Eggs from Malaysian Coastline. *Biology and Conservation of Horseshoe Crabs*. 455-463.

Hajeb, P. and Jinap, S. (2011). Mercury Exposure through Fish and Seafood Consumption in the Rural and Urban Coastal Communities of Peninsular Malaysia. *World Journal of Fish and Marine Sciences*. 3(3), 217-226

Hamzah, A., Kipli, S. H., Ismail, S. R., Una, R., Sarmani, S. (2011). Microbiological Study in Coastal Water of Port Dickson, Malaysia (Kajian Mikrobiologi Air di Pesisiran Pantai Port Dickson, Malaysia) *Sains Malaysiana*. 40(2), 93–99.

Hedge, L.H., Knott, N.A. and Johnston, E.L. (2009). Dredging Related Metal Bioaccumulation in Oysters. *Marine Pollution Bulletin*. 58,832–840.

Hellou, J. (2011). Behavioural Ecotoxicology, an "Early Warning" Signal to Assess Environmental Quality. *Environmental Science Pollution Research*. 18, 1–11.

Heng, S. B. High Lead, Mercury Content in Johor Straits. Retrieved from News Straits Time, October 27, 2004.

Hii, Y. S., Law, A. T., Shazili, N. A. M., Rashid, M. K. A., Lokman, M., Yusoff, F. M. and Ibrahim, H. M. (2006). The Straits of Malacca: Hydrological parameters, biochemical oxygen demand and total suspended solids. *Journal of Sustainability Science and Management*. 1(1), 1-14.

Hobbs, D. A., Warne, M.S. and Markich, S. J.(2005). Evaluation of Criteria Used to Assess the Quality of Aquatic Toxicity Data. *Integrated Environmental Assessment Management*. 1(3), 174-80.

Holt, J. T. and Proctor, R. *Dispersion in Shallow Seas. Encyclopedia of Ocean Sciences.* San Diego; Academic Press. 2001.

Hubner, R., Astin, K. B. and Herbert, R. J. H. (2009). Comparison of Sediment Quality Guidelines (SQGs) for the Assessment of Metal Contamination in Marine and Estuarine Environments. *Journal of Environmental Monitoring*. 11, 713-722.

Hughes, J. M., Chapman, H. F. and Kitching, R. L. (1987). Effects of Sublethal Concentrations of Copper and Freshwater on Behaviour in an Estuarine Gastropod *Polinices sordidus*. *Marine Pollution Bulletin*. 18 (3), 127-131.

Huiwen, C. and Yinglan, S. (2007). Management of Marine Cage Aquaculture. Environmental Carrying Capacity Method Based on Dry Feed Conversion Rate. *Environmental Science Pollution Research*. 14 (7), 463-469.

Ibrahim, Z., Hashim, N. B., Latiff, A. A. A., Halim, H., Kamal, N. H. M. and Haron, N. F. (2008). *Experimental Investigation of Behaviour of Thermal Effluent in*

Free Surface Flow (Kajian Eksperimen Terhadap Kelakuan Efluen Terma di dalam Aliran Saluran Terbuka). Report for Research Vote: 78123.

Idriss, A. A. and Ahmad, A.K. (2012). Concentration of selected heavy metals in water of the Juru River, Penang, Malaysia. *African Journal of Biotechnology*. 11(33), 8234-8240.

Ismail, A. and Saed, K. Trace Metal Concentrations in Five Fish Species from Bagan Lalang Coastline (Sepang), Malaysia. In: Shazili, N. A. M., Yunus, K., Ahmad, A. S., Abdullah, N. and Rashid, M. K. A. *Heavy Metal Pollution Status in the Malaysian Aquatic Environment.* Aquatic Ecosystem Health and Management. 2000.

Ismail, A. (2006). The Use of Intertidal Molluscs in the Monitoring of Heavy Metals and Organotin Compounds in the West Coast of Peninsular Malaysia. *Coastal Marine Science*. 30(1), 401-406.

Iwegbue, C. M. A. (2008). Heavy Metals Composition of Livers and Kidneys of Cattle from Southern Nigeria. *Veterinarski Arhiv*. 78 (5), 401-410.

Jantataeme, S., Kruatrachue, M., Kaewsawangsap, S., Chitramvong, Y., Sretarugsa, P. and Upatham, S. E. (1996). Acute Toxicity and Bioaccumulation of Lead in the Snail, Filopaludina (Siamopaludina) Martensi Martensi (Frauenfeldt). *Journal Science Social Thailand*. 22: 237-247.

Jacob, P. G., Zarba, M. A. and Salem, A.A. (1980). Results of Toxicity Tests with Marine Organisms of Kuwaiti Coast. *Indian Journal of Fisheries*. 27 (1–2), 111–122.

Jacob, C., Maret, W. and Vallee, B. L. (1998). Control of Zinc Transfer Between Thionein, Metallothionein, and Zinc Proteins. *Biochemistry*. 95, 3489-3494.

Javanshir, A. (2012). May Simultaneous Exposure to Different Heavy Metals Influence the Bioaccumulation of Each Metal by *Littorina saxatilis* (Gastropoda; Littoriniidae). *Turkish Journal of Fisheries and Aquatic Sciences*. 12, 603-612.

Kaiser, M.J., Attrill, M.J., Jennings, S., Thomas, D.N., Barnes, D.K.A., Brierley, A.S., Polunin, N.V.C., Raffaelli, D.G., Williams, P.J.B. (2005). *Marine Ecology Processes, System, and Impacts*. United State Of America: Oxford University Press 2005.

Kamaruzzaman, B. Y., Ong, M. C., Rina, S. Z. and Joseph, B. (2010). Levels of Some Heavy Metals in Fishes from Pahang River Estuary, Pahang, Malaysia. *Journal of Biological Sciences*. 10(2), 157-161.

Kamaruzzaman, B. Y., Rina, Z., John, B. A. and Jalal, K. C. A. (2011). Heavy Metal Accumulation in Commercially Important Fishes of South West Malaysian Coast. *Research Journal of Environmental Sciences*. 1-8.

Kanakaraju, D., Jios, C. and Long, S. M. (2008). Heavy Metal Concentrations in the Razor Clams (Solen spp) from Muara Tebas, Sarawak. *The Malaysian Journal of Analytical Sciences*. 12 (1).

Kannappan, T., Shanmugavelu, M. and Karthikeyan, M. M. (2013). Concentration on Heavy Metals in Sediments and Mangroves from Manakudy Estuary (South West Coast of India). *European Journal of Biological Sciences*. 4(4), 109-113.

Kang, S., Choi, M., Oh, I., Wright, D. A. and Koh, C. (1999). Assessment of Metal Pollution in Onsan Bay, Korea using Asian Periwinkle *Littorina brevicula* as a Biomonitor. *The Science of the Total Environment*. 234, 127-137.

Kaly, U.L. (2004). Review of Land-Based Sources of Pollution to the Coastal and Marine Environments in the BOBLME Region. Retrieved from http://projects.csg.uwaterloo.ca/inweh/display.php?ID=5583

Ke, C. and Wang, W. (2002). Dominance of Dietary Intake of Cadmium and Zinc by Two Marine Predatory Gastropods. *Aquatic Toxicology*. 56, 153-165.

Kerdthep, P., Tongyonk, L. and Rojanapantip, L. (2009). Concentrations of Cadmium and Arsenic in Seafood from Muang District, Rayong Province. *Journal Health and Res*. 23(4): 179-184.

Kim, K. T., Kim, E. S., Cho, S. R., Park, J. K., Ra, K. T. and Lee, J. M. (2010). Distribution of Heavy Metals in the Environmental Samples of the Saemangeum Coastal Area, Korea. *Coastal Environmental and Ecosystem Issues of the East China Sea*. 71-90.

Kocar, B. D. and Fendorf, S. Arsenic Release and Transport in Sediment of the Mekong Delta. Interdisciplinary Studies on Environmental Chemistry-Environmental Pollution and Ecotoxicology. In: M. Kawaguchi, K. Misaki, H. Sato, T. Yokokawa, T. Itai, T. M. Nguyen, J. Ono and S. Tanabe. *Interdisciplinary Studies on Environmental Chemistry*. Center for Marine Environmental Studies; Ehime University, Japan 6, 117-124 (2012).

Koh, H., Lim, P., Midun, Z. (1991). Management and Control of Pollution in Inner Johore Straits. *Environmental Monitoring and Assessment*. 19(1), 349-359.

Kraepiel, A. M. L., Chiffoleau, J. F., Martin, J. M., Morel, F. M. M. (1997). Geochemistry of Trace Metals in the Gironde Estuary. *Geochimica et Cosmochimica Acta*. 61, 1421-1436.

Krishna, P. V., Rao, K. M., Swaruparani, V. and Rao, D. S. (2014). Heavy Metals Concentration in Fish *Mugil cephalus* from Machilipatnam Coast and Possible Health Risks to Fish Consumers. *British Biotechnology Journal*. 4(2): 126-135.

Kumar, D. S. and Srikantaswamy, S. (2013). Influence and Effects of Industries on Geochemical Behaviour of Heavy Metals in Soil. *Journal of Science, Computer Science and Engineering and Technology*. 2(1):1-12.

Kuwabara, J. S., Chang, C. C. Y., Cloern, J. E., Fries, T.L., Davis, J. A. and Luoma, S. N. (1989). Trace Metal Associations in the Water Column of South San Francisco Bay, California. *Estuarine, Coastal and Shelf Science*. 28, 307-325.

Lai, F. S., Ahmad, J. S., Zaki, A. M. Sediment Yields from Selected Catchments in Peninsular Malaysia. *Proceedings of the Exeter Symposium. Erosion and Sediment Yield: Global and Regional Perspectives*. July. 1996.

Lai, H. J., del Alamo, J. C., Rodríguez-Rodríguez J. and Lasheras, J. C. (2010).The Mechanics of the Adhesive Locomotion of Terrestrial Gastropods. *The Journal of Experimental Biology*. 213, 3920-3933.

Lakshmi, P.S. and Rao, Y.P. (2002). Evaluation of Cadmium Toxicity on Survival, Accumulation and Depuration in an Intertidal gastropod, *Turbo intercostalis*. *Water, Air and Soil Pollution,* 134, 229-238.

Landis, W. G., Hughes, J. S. and Lewis, M. A. (1993). Environmental Toxicology and Risk Assessment, Volume 1. ASTM International. United States of America.

Latiolais, J. M., Taylor, M. S., Roy, K., Hellberg, M. E. (2006). A Molecular Phylogenetic Analysis of Strombid Gastropod Morphological Diversity. *Molecular Phylogenetics and Evolution*, 41, 436–444.

Law, A. T. and Singh, A. (1986). Distribution of Manganese, Iron, Copper, Lead and Zinc in Water and Sediment of Kelang Estuary. *Pertanika*, 9, 209–217.

Lee, A. (2010). *Metal Concentrations in the Sediment of the Thames River and New London Harbor*. Master thesis. Southern Connecticut State University.

Leung, K. M. Y., Morgan, I. J., Wu, R. S.S., Lau, T.C., Svavarsson, J. and Furness, R. W. (2001). Growth Rate as a Factor Confounding the Use of the Dog Whelk *Nucella lapillus* as Biomonitor of Heavy Metal Contamination. *Marine Ecology Progress Series*. 221, 145-159.

Levit, S. M. (2010).*A Literature Review of the Threat Posed by Cadmium to Fisheries from Mining in the Bristol Bay Basin*. The Nature Conservancy, Center for Science in Public Participation. Montana.

Lias, K., Jamil, T. and Alia, N. S. (2013). A Preliminary Study on Heavy Metal Concentration in Marine Bivalves Marcia Marmorata Species and Sediment Collected from the Coastal Area of Kuala Perlis, North Malaysia. *Journal of Applied Chemistry*. 4(1), 48-54.

Ling, T. S. (2007). *Analysis and Assessment of Sediment Quality in a Typical Malaysian River*. Master Thesis. Universiti Teknologi Malaysia.

Ling, T., Kho, C. and Nyanti, L. (2012). Spatial and Temporal Variations of Heavy Metals in a Tropical River. *World Applied Sciences Journal*. 16 (4), 550-559.

Luo, W., Lu, Y., Wang, T., Hu, W., Jiao, W., Jonathan, E. N., Khim, J. S. and Giesy, J. P. (2010). Ecological Risk Assessment of Arsenic and Metals in Sediments of Coastal Areas of Northern Bohai and Yellow Seas, China. *AMBIO*. 39, 367–375.

Luoma, S. N. and Rainbow, P. S. (2005). Why is Metal Bioaccumulation so Variable? Biodynamics as a Unifying Concept. *Environmental Science and Technology*. 39, 1921-1931.

Looi, L. J., Aris, A. Z., Johari, W. L. W., Yusoff, F., M. and Hashim, Z. (2013). Baseline Metals Pollution Profile of Tropical Estuaries and Coastal Waters of the Straits of Malacca. *Marine Pollution Bulletin*. 74, 471-476.

Lymer, D., Funge-Smith, S. Clausen, J. and Miao, W. (2008). Status and Potentia of Fisheries and Aquaculture in Asia and the Pacific. Food and Agriculture Organization of the United Nations. Regional Office for Asia and Pacific. Bangkok.

Mance, G. *Pollution Threat of Heavy Metals in Aquatic Environments*. New York, USA: Elsevier Applied Science Ltd.. 1987.

Mandal, B. K. and Suzuki, K. T. (2002). Arsenic Round the World: A Review. *Talanta*. 58, 201-235.

Margret, M. S., Santhiya, M., Mary, M. T. and Jansi, M. (2013). Comparative Study on the Biochemical Compositions of Four Gastropods along the Kanyakumari Coast. *World Journal of Fish and Marine Sciences.* 5 (6), 637-640.

Mathews, S. *Arsenic Hyperaccumulation by Pteris Vittata L.-Arsenic Transformation, Uptake and Environmental Impact*. PhD Thesis. University of Florida; 2011.

Marchis, M. D., Ciraolo, G., Nasello, C. and Napoli, E. (2012). Wind and Tide Induced Currents in the Stagnone Lagoon (Sicily). *Environmental Fluid Mechanics*. 12(1), 81-100.

Mauffret, A. , Rico-Rico, A., and Temara, A. (2009). Exposure of the Marine Deposit Feeder *Hydrobia Ulvae* to Sediment associated LAS. *Environmental Pollution*. 158, 529-535.

Mazlan, A. G., Zaidi, C. C., Wan-Lotfi, W. M. and Othman, B. H. R. (2005). On the Current Status of Coastal Marine Biodiversity in Malaysia. *Indian Journal of Marine Sciences*. 34(1):76-87.

McKenzie, L. (2008). Proceedings of a *Workshop for Mapping and Monitoring Seagrass Habitats in North East Arnhem Land, Northern Territory*. Seagrass-Watch HQ, Australia. 9-25.

Mier, K. L. and Picquelle, S. J. (2008). Estimating Abundance of Spatially Aggregated Populations: Comparing Adaptive Sampling with Other Survey Designs. *Canadian Journal of Fisheries and Aquatic Sciences*. 65 (2), 176-197.

Min, K. S., Kee, K. P., Tien, S. K., Heng, L. Y. and Surif, S. (2011). Analisis Proksimat dan Logam Berat dalam Tisu Kerang (*Anadara granosa*) di Beberapa Tapak Akuakultur di Semenanjung Malaysia. *Sains Malaysiana*. 40(2), 139–146.

Miyashita, T., Takami, A. and Takagi, R. (2012). Molecular Cloning and Characterization of the 50-Flanking Regulatory Region of the Carbonic Anhydrase Nacrein Gene of the Pearl Oyster *Pinctada fucata* and Its Expression. *Biochemical Genetic*. 50, 673-683.

Mlay, A. P., Wagner, G. M. and Mgaya, Y. D. (2001). *A Comparative Study of the Ecology of Four Sandy/Muddy Shores in the Dar es Salaam Area*. In Richmond, M. D., and Francis, J. (Eds.) Marine Science Development in Tanzania and Eastern Africa. Proceeding of the 20th Anniversary Conference

on Advances in Marine Science in Tanzania. 28 June – 1 July. Zanzibar, Tanzania, 375-399.

Mohamat-Yusuff, F., Zulkifli, S. Z., Ismail, A., Yusof, M. K., Otake, T. (2012). Field Survey and Spatial Distribution of Tropical Neogastropod, Thais spp., along Malaysian Coastal Area. *Acta Biologica Malaysiana*. 1 (1), 9-17.

Mokhtar, M., Praveena, S. M. , Aris, A. Z, Yong, O. C. and Lim, A. P. (2012). Trace metal (Cd, Cu, Fe, Mn, Ni and Zn) Accumulation in Scleractinian corals:A record for Sabah, Borneo. *Marine Pollution Bulletin*. 64, 2556-2563.

Moloukhia, H. and Sleem, S. 2011 Bioaccumulation, Fate and Toxicity of Two Heavy Metals Common in Industrial Wastes in Two Aquatic Molluscs. *Journal of American Science*. 7(8), 459-464.

Mukherjee, D. P. and Bhupander, K. (2011). Assessment of Arsenic, Cadmium and Mercury Level in Commonly Consumed Coastal Fishes from Bay of Bengal, India. *Food Science and Quality Management.* 2, 19-30.

Mustafa, M. and Ariffin, M. (2011). Protection of Marine Biodiversity from Pollution Strategies in Malaysia. *International Journal of Bioscience, Biochemistry and Bioinformatics*. 1(4), 276-281.

Nakisah, M. A., Mamat, J. and Shazili, N. A. M. Analysis of Heavy Metals in Soft Tissues of *Thais Aculeata*, a Gastropod Taken from Chendering Beach, Terengganu as an Attempt to Search for Indicator of Heavy Metal Pollution in the Aquatic Environment. *Proceedings of the 1st International Conference on Natural Resources Engineering & Technology 2006*. Putrajaya, Malaysia. 2006.

Nasution, S. (2011). Kandungan Logam Berat Kadmium (Cd) dan Tembaga (Cu) pada Sedimen dan Siput *Strombus canarium* Pantai Pulau Bintan. *Jurnal Natur Indonesia*. 13(3), 262-268.

Nasution, S. and Siska, M. (2011). Kandungan Logam Berat Timbal (Pb) pada Sedimen dan Siput *Strombus canarium* di Perairan Pantai Pulau Bintan. *Jurnal Ilmu Linkungan*. 5(2), 82-93.

National Audit Department Malaysia. (2010). *Synopsis on the Audit of Financial Management and Activities of Federal Statutory Bodies and Management of Subsidiary Companies.* Auditor General's Report Federal Statutory Bodies for the Year 2010.

Nazahiyah, R., Yusop, Z. and Abustan, I. (2007). Stormwater Quality and Pollution Loading from an Urban Residential Catchment in Johor, Malaysia. *Water Science and Technology*. 56 (7), 1–9.

Neff, J. M. *Bioaccumulation in Marine Organisms*. Effects of Contaminants from Oil Well Produced Water. Amsterdam; Elsevier Science Publisher. 2002.

Ngah, M. S. Y. C., Hashim, M., Nayan, N., Said, Z. M., Ibrahim, M. H. (2012). Marine Pollution Trend Analysis of Tourism Beach in Peninsular Malaysia. *World Applied Sciences Journal*. 17 (10), 1238-1245.

Nicolaidou, A. and Nott, J. A. (1998). Metals in Sediment, Seagrass and Gastropods near a Nickel Smelter in Greece: Possible Interactions. *Marine Pollution Bulletin*, 35(5), 360-365.

Nor, H. A.K., James N. V., Teh, Y.Y., Lee, C.Y.and Pearline Ng, H.C. (2011). Assessment of Cadmium (Cd) and Lead (Pb) Levels in Commercial Marine Fish Organs Between Wet Markets and Supermarkets in Klang Valley, Malaysia. *International Food Research Journal*, 18, 795-802.

Nordberg, G. F., Fowler, B. A., Nordberg, M. and Friberg, L. *Handbook on the Toxicology of Metals*. Third Edition. United States of America Academic Press. 2007.

Norimah, A. K., Safiah, M., Jamal, K., Haslinda, Zuhaida, H., Rohida, S., Fatimah, S., Norazlin, Poh, B. K., Kandiah, M., Zalilah, M. S., Manan, W. M. and Azmi, M. Y. (2008). Food Consumption Patterns: Findings from the Malaysian Adult Nutrition Survey (MANS). *Malaysia Journal Nutrition*, 14 (1), 25 – 39.

Nriagu, J. (2007). *Zinc Toxicity in Humans*. In Nriagu, J. O., (Ed.) *Encyclopedia of Environmental Health* (pp. 801-807). Burlington: Elsevier.

Oaten, J. F., Hudson, M. D., Jensen, A.C. and Williams, I. D. (2015). Effects of Organism Preparation In Mettallothionein and Metal Analysis in Marine Invertebrates for Biomonitoring Marine Pollution. *Science Total Environment*, 518-519, 238-247.

Oforka, N. C., Osuji, L. C. and Onwuachu, U. I. (2012). Estimation of Dietary Intake of Cadmium, Lead, Manganese, Zinc and Nickel due to Consumption of Chicken Meat by Inhabitants of Port-Harcourt Metropolis, Nigeria. *Scholars Research*. 4(1), 675-684.

O'Dea, A., Shaffer, M. L., Doughty, D. R., Wake, T. A. and Rodriguez, F. A. (2014). Evidence of Size-select Evolution in the Fighting Conch from Prehistoric Subsistence Harvesting. Proceedings of the Royal Society B. 281:20140159. Retrieved from http://dx.doi.org/10/1098/rspb.2014.0159.

Ong, M.C. and .Kamaruzzaman, B. Y. (2009). An Assessment of Metals (Pb and Cu) Contamination in Bottom Sediment from South China Sea Coastal Waters, Malaysia. *American Journal of Applied Sciences*. 6 (7), 1418-1423.

Ong, G. H., Yap, C K., Maziah, M., Suhaimi, H. and Tan, S. G. (2012). An Investigation of Arsenic Contamination in Peninsular Malaysia Based on *Centella asiatica* and Soil Samples. *Environmental Monitoring Assessment*. 185 (4), 3243-3254.

Othman, R., Hatta, F. A. A. and Shafiai, S. (2014). Biomonitoring Agent for Heavy Metals Run Off from Acid Sulfate Soil of Aquaculture Industries in Selangor, Malaysia. International Conference on Global Trends in Academic Research, June 2 -3, Kuala Lumpur, Malaysia.

Otitoloju, A. A. and Don-Pedro, K. N. (2002). Establishment of the Toxicity Ranking Order of Heavy Metals and Sensitivity Scale of Benthic Animals Inhabiting the Lagos Lagoon. *West African Journal of Applied Ecology*. 3, 31-41.

Pandeswara, S. L. and Yallapragada, P. R. (2000). Tolerance, Accumulation and Depuration in an Intertidal Gastropod, *Turbo intercostalis*, Exposed to Cadmium. *Marine Environmental Research*. 50(1), 104-105.

Palpandi, C. and Kesavan, K. (2012). Heavy Metal Monitoring using *Nerita crepidularia*-Mangrove Mollusc from the Vellar Estuary, Southeast Coast of India. *Asian Pacific Journal of Tropical Biomedicine*. S358-S367.

Pe´rez-Lo´pez, M., Alonso, J., No´voa-Valin˜as, M. C. and Melgar, M. J. (2003). Assessment of Heavy Metal Contamination of Seawater and Marine Limpet, Patella vulgata L., from Northwest Spain. *Journal of Environmental Science and Health*. A38 (12), 2845–2856.

Petcey, F., Ulm, S., David, B., McNiver, I. J., Asmussen, B., Tomkins, H., Richards, T., Rowe, C., Leavesley, M., Mandui, H. and Stanisc, J. (2012). 14C Marine Reservoir Variability in Herbivores and Deposit-Feeding Gastropods from an Open Coastline, Papua New Guinea. *Proceedings of the 6th International Radiocarbon and Archaeology Symposium. 54: 967-978*.

Polizzotto, M. L., Kocar, B. D., Benner, S. G., Sampson, M. and Fendorf, S. (2008). Near-surface Wetland Sediments as a Source of Arsenic Release to Ground Water in Asia. *Nature*. 454, 505-509.

Posada, J. M., Ivan, M.R., Nemeth, M. (1999). Occurrence, Abundance, and Length Frequency Distribution of Queen Conch, *Strombus gigas* (Gastropoda) in Shallow Waters of the Jaragua National Park, Dominican Republic. *Caribbean Journal of Science*. 35 (1-2): 70-82.

Poutiers, J. M. (1998*). Gastropods. In The Living Marine Resources of the Western Central Pacific FAO,* In Carpenter K.E., Niem V.H. Volume 1: *Seaweeds,Corals, Bivalves and Gastropods.* (pp. 363-646). Rome.

Praveena, S. M., Radojevic, M., Abdullah, M. H., Aris, A. Z. (2008). Application of Sediment Quality Guidelines in the Assessment of Mangrove Surface Sediment in Mengkabong Lagoon, Sabah, Malaysia. *Iranian Journal Environmental Health Science Engineering*. 5 (1), 35-42.

Praveena, S. M., Siraj, S. S., Suleiman, A. K. and Aris, A. Z. (2011). A Brush Up on Water Quality of Port Dickson, Malaysia. *Research Journal of Environmental Sciences*. 5, 841-849.

Putri, L. S. E., Prasetyo, A. D., and Arifin, Z. (2012). Green Mussel (*Perna viridis* L.) as Bioindicator of Heavy Metals Pollution at Kamal Estuary, Jakarta Bay, Indonesia. *Journal of Environmental Research and Development*. 6 (3), 389-396.

Purchon, R. D. and Purchon, D. E. A. (1981). The Marine Shelled Mollusca of West Malaysia and Singapore Shelled Mollusca of West Malaysia and Singapore. Part 1. General Introduction and an Account of the Collecting Stations. *Journal Mollusc Study*. 47, 290-312.

Pyatt, A. J., Pyatt, F. B. and Pentreath, V. W. (2002). Lead Toxicity, Locomotion and Feeding in the Freshwater Snail, *Lymnaea stagnalis* (L.). *Invertebrate Neuroscience*. 4, 135-140.

Qadir, M., Yasmin, N., Naeem, A., Sharif, M. and Afzal, F. (2011). Impact of Marine Pollution at Karachi Coast in Perspective of Lyari River. *Journal Agriculture and Environmental Science.* 10(5), 737-743.

Radojevic, M., Praveena, S. M. and Abdullah, M. H. (2008). Statistical Perspective and Pollution Indicator in Mengkabong Mangrove Sediment Sabah. *Modern Applied Science*. 2(4), 131-143.

Radwan, M. A. and Salama, A. K. (2006). Market Basket Survey for Some Heavy Metals in Egyptian Fruits and Vegetables. *Food and Chemical Toxicology.* 44(8), 1273-1278.

Rahman, M. A., Hasegawa, H., Lim, R. P. (2012). Bioaccumulation, Biotransformation and Trophic Transfer of Arsenic in the Aquatic Food Chain. *Environmental Research*. 116, 118–135.

Ramakritinan, C. M., Chandurvelan, R., Kumaraguru, A. K. (2012). Acute Toxicity of Metals: Cu, Pb, Cd, Hg and Zn on Marine Molluscs *Cerithedia cingulata G*., and *Modiolus philippinarum H. Indian Journal of Geo-Marine Sciences*. 41(2), 141-145.

Raspor, B., Dragun, Z., Erk, Ivankovic, D. and Pavicic, J. (2004). Is the Digestive Gland of *Mytilus galloprovincialis* a Tissue of Choice for Estimating Cadmium Exposure by Means of Metallothioneins? *Science Total Environmental*. 333, 99-108.

Rath, S., Sahu, M. C., Dubey, D., Debata, N. K. and Padhy, R. N. (2011). Which Value Should be used as the Lethal Concentration 50 (LC50) with Bacteria? *Interdiscipline Science Computer Life Science*. 3,138-143.

Ravi, N. (2010). Johor Straits 'A Giant Toxic Sink'. New Straits Times. 28 August. Retrieved from http://www.ecologyasia.com/news-archives/2010/aug-10/NST_100828_1.htm.

Rhind, S. M. (2009). Anthropogenic pollutants: a threat to ecosystem sustainability? *Philosophical Transactions of the Royal Society B: Biological Sciences*. 384(1534), 3391-3401

Ricciardi, A and Bourget, E. (1998). Weight-to-weight Conversion Factors for Marine Benthic Macroinvertebrates. *Marine Ecology Progress Series*. 163, 245-251.

Ridzwan, B. H. and Kaswandi, M. A. (1995). Hidupan Marin Intertidal: Sumber Makanan Penduduk Daerah Semporna, Sabah (Intertidal Marine Life as a Source of Food in Semporna District, Sabah). *Malaysian Journal of Nutrition*. 1, 105-114.

Rittschof, D. and McClellan-Green, P. (2005). Molluscs as Multidisciplinary Models in Environment Toxicology. *Marine Pollution Bulletin*. 50, 369-373.

Rizo, O. D., Reumont, S. O., Fuente, J. V., Arado, O. D., Pino, N. L., Rodriguez, K. D., Lopez, J. O. A., Rudnikas, A. G. and Carballo, G. A. (2010). Copper,

Zinc and Lead Bioaccumulation in Marine Snail, Strombus gigas from Guacanayabo Gulf, Cuba. *Bulletin Environmental Contamination Toxicology*. 85, 330-333.

Rizzo, A. and Glasson, J. (2012). Iskandar Malaysia. *Cities*. 29, 417-427.

Sabri, S., Said, M. I. M. and Azman, S. (2010). Seagrass at Tanjung Kupang-Merambong Shoal. *Proceedings of the ITS & UTM International Conference on Sustainable Urban Environment*. 8-10 October. ITS Surabaya, Indonesia.

Sabri, S., Said, M. I. M. and Azman, S. and Goto, M. (2013). Seagrass at South Western Coast of Johor. *Journal of Sustainability Science and Management*. 8 (1), 73-79.

Said, M. I. M., Sabri, S. and Azman, S. (2013). Arsenic, Cadmium and Copper in Gastropod *Strombus canarium* in Western Part of Johor Straits. *World Applied Sciences Journal*. 23 (6), 734-739

Saion, E., Wood, A. K., Sulaiman, Z. A., Alzahrany, A. A., Elias, M. S. and Siong, W. B. (2007). Determination of Heavy Metal Pollution in Depth Profile of Marine Sediment Samples from the Straits of Malacca. *Fresenius Environmental Bulletin*. 16 (10). 1279-1287

Sany, S. B. T., Sulaiman, A. H., Monazami, G. H. and Salleh, A. (2011). Assessment of Sediment Quality According to Heavy Metal Status in the West Port of Malaysia. *World Academy of Science, Engineering and Technology*. 74, 639-643.

Sany, S. B. T., Salleh, A., Rezayi, M., Saadati, N., Narimany, L., and Tehrani, G. M. (2013). Distribution and Contamination of Heavy Metal in the Coastal Sediments of Port Klang, Selangor, Malaysia. *Water Air Soil Pollution*. 224, 1476.

Saraee, K. R.E., Abdi, M. R., Naghavi, K., Saion, E., Shafaei, M. A. and Soltani, N. (2011) Distribution of Heavy Metals in Surface Sediments from the South China Sea Ecosystem, Malaysia. Environmental Monitoring Assessment 183:545–554

Selvi, M., Gul, A. and Yilmaz, M. (2003). Investigation of Acute Toxicity of Cadmium chloride (CdCl2 _H2O) Metal Salt and Behavioral Changes it Causes on Water Frog (*Rana ridibunda* Pallas, 1771). *Chemosphere*. 52, 259-263.

Seng, C., Lim, P. and Ang, T. (1987). Heavy Metal Concentrations in Coastal Seawater and Sediments off Prai Industrial Estate, Penang, Malaysia. *Marine Pollution Bulletin*. 18, 611–612.

Shah, M. F. (2014). Johor Building Stadium on Man-made Island. The Star.

Shaibur, M. R. and Kawai, S. (2010). Effect of Arsenic on Nutritional Composition of Japanese Mustard Spinach: An Ill Effect of Arsenic on Nutritional Quality of a Green Leafy Vegetable, Nature and Science. 8(8)

Shan, N. B (2014, March 24). Country Garden, KPRJ Plan Massive Reclamation Development for Luxury Homes. *The Star*. Retrieved March 25, 2004, from http://www.thestar.com.my.

Shazili, N. A. M., Rashid, M. K. A., Husain, M. L., Nordin, A., Ali, S. (1999). Trace metals in the Surface Sediments of the South China Sea, Area I: Gulf of Thailand and the East Coast of Peninsular Malaysia. *Proceedings of the First Technical Seminar on Marine Fishery Resources Survey in the South China Sea Area I: Gulf of Thailand and East Coast of Peninsular Malaysia*. November 24–26 Southeast Asian Fisheries Development Center, Samutprakan, Thailand. 73–85.

Shazili, N. A. M., Yunus, K., Ahmad, A. S., Abdullah, N. and Rashid, M. K. A. (2006). Heavy Metal Pollution Status in the Malaysian Aquatic Environment. *Aquatic Ecosystem Health and Management*. 9, 137–145.

Shawl, A. and Davis, M. (2004). Captive Breeding Behavior of Four Strombidae Conch. *Journal of Shellfish Research*. 23 (1), 157–164.

Shuhaimi-Othman, M., Yakub, N., Ramle, N. A. and Ahmad, A. (2011). Toxicity of Metals to a Freshwater Ostracod: *Stenocypris major*. *Journal of Toxicology*. 1-8.

Shuhaimi-Othman, M., Ramle, N. A. and Yakub, N. (2012). Toxicity of Metals to a Freshwater Snail, Melanoides tuberculate. *The Scientific World Journal*. Retrieved from http://dx.doi.org/10.1100/2012/125785.

Shuhaimi-Othman, M., Yakub, N. and Ramle, N. A. (2013). Sensitivity of Freshwater Organisms to Zinc*. 3rd International Conference on Chemical, Biological and Environment Sciences*. 8-9 January. Kuala Lumpur, Malaysia.

Siddik, J. (2011). *Sebaran Spasial dan Potensi Reproduksi Populasi Siput Gonggong (Strombus turturela) di Teluk Klabat Bangka-Belitung*. Master Thesis, Institut Pertanian Bogor.

Simeonova, P., Papazova, P and Lovchinov, V. (2013). Application of Cluster Analysis in Interpretation of Toxic Metals Accumulation in Biomonitoring Marine Organisms Bulgarian Journal of Physics.40, 269–273.

Silva, A. L. O., Barrocas, P. R. G., Jacob, S. C. and Costa, J. (2005). Dietary Intake and Health Effects of Selected Toxic Elements. Braz. J. Plant Physiol. 17(1): 79-93.

Simon-Hettich, B., Wibbertmann, A., Wagner, D., Tomaska, L. and Malcolm, H., 2001. Zinc. (Environmental Health Criteria; 221).World Health Organization. Geneva.

Simpson, J. M. (2009). Effects of Heavy Metal Contamination on Burial Rates of *Autrovenus stutchburyi*: Implications for Sediment Transport. Master Thesis. Universiti of Waikato, New Zealand

Simon-Hettich, B., Wibbertmann, A., Wagner, D., Tomaska, L. and Malcolm, H. (2001). Zinc. (Environmental Health Criteria; 221). World Health Organization. Geneva.

Singh, R., Gautam, N. and Gupta, R. (2011). Heavy Metals and Living Systems: An Overview. *Indian Journal of Pharmacology*. 43(3), 248-253

Sivaperumal, P., Sankar, T. V. and Nair, P. G. V. (2007). Heavy Metals Concentrations in Fish, Shellfish and Fish Products from Internal Markets of India. *Food Chemistry*. 102, 612-620.

Spade, D.J., Griffitt, R. J., Liu, L., Brown-Peterson, N. J. and Kroll, K. J. (2010). Queen Conch (*Strombus gigas*) Testis Regresses during the Reproductive Season at Nearshore Sites in the Florida Keys. PLoS ONE 5(9): e12737. doi:10.1371/journal.pone.0012737.

Spade, D.J. (2011). The Role of Zinc and Copper Accumulation in Queen Conch, *Strombus gigas*, Reproductive Deficiency at Nearshore Sites in the Florida Keys. Phd Thesis. University of Florida, United States.

Srinivasan, M. and Swain, G, W. (2007). Managing the Use of Copper-Based Antifouling Paints. *Environmental Management*. 39, 423-441.

Stankovic, S., Kalaba, P. and Stankovic, A. R. (2014). Biota as Toxic Metal Indicators. *Environmental Chemical Letters*. 12, 63-84.

Stoner, A. W., Mueller, K. W., Brown-Peterson, N. J., Davis, M. H. and Booker, C. J. (2012). Maturation and Age in Queen Conch (*Strombus gigas*): Urgent Need for Changes in Harvest Criteria. *Fisheries Research*. 131-133, 76-84.

Sudtongkong, C., and Intacharoen, P. (2011).Density Survey of the Dog Conch (*Strombus canarium* Linnaeus, 1758) in Sikao Bay, Southern Thailand: Evaluating the Effectiveness of Community-Based Management. *Current Development in Oceanography*. 2(2), 125-135.

Sunda, W. G. and Hunstman, S. A. (1998). Processes Regulating Cellular Metal Accumulation and Physiological Effects: Phytoplankton as Model Systems. *The Science of the Total Environment*. 219, 165-181.

Tabugo, S. R. M., Pattuinan, J. O., Sespene, N. J. J. and Jamasali, A. J. (2013). Some Economically Important Bivalves and Gastropods found in the Island of Hadji Panglima Tahil, in the province of Sulu, Philippines. *International Research Journal of Biological Sciences*. 2(7), 30-36.

Tan, C. K., Mansor, S., Ibrahim, H. M. and Rashidi, A. (2002). Studies of Sea Surface Temperature and Chlorophyll-a Variations in East Coast of Peninsular Malaysia. *Pertanika Journal Science and Technology*. 10(1), 13-24.

Taylor, A. M. and Maher, W. A. (2010). Establishing Metal Exposure- Dose-Response Relationships in Marine Organisms: Illustrated with Tellina Deltoidalis. In New Oceanography Research Developments. Nova Science Publisher. Pp. 1-57

Thompson, K. C., Wadhia, K. and Loibner, A. P. (2005).*Environmental Toxicity Testing*. Great Britain: Blackwell Publishing Ltd.

Timothy, A. H., Toy, E. L., Westerlund, J. and Coshland, J. L. (2005). Feature Article: The Toxicity of Synthetic Sea Salts and Natural Seawater to the Development of White Sea Urchin *(Lytichinus pictus)* Larvae. *Advance Aquarist's Online Magazine*, 4.

Todd, P. A., Ong, X., Chou, L. M. (2010). Impacts of Pollution on Marine Life in Southeast Asia. *Biodiversity Conservation*. 19, 1063–1082.

Tong, S. L., Yap, S.Y. Ishak, I. and Devi, S. (1999). ASEAN Marine Water Quality Criteria for Copper. Marine Environment Division, Water Quality Management Bureau, Pollution Control Department. ASEAN-Canada CPMS-II.

Tukimat L., Ismail, N., Muzneena, A. M. and Rahim, S. A. (2006). Kandungan Logam Berat dalam Makanan Laut dan Kadar Pengambilannya oleh Penduduk di Tanjung Karang, Selagor. *The Malaysian Journal of Analytical Sciences*. 10(2), 197-204.

Upatham, E. S. (2005). Acute and Subchronic Toxicity of Lead to the Spotted Babylon, Babylonia areolata (neogastropoda, buccinidae). *Journal of Shellfish Research.*

Uy, N. and Shaw, R. (2012). Chapter 3: The Role of Ecosystems in Climate Change Adaptation and Disaster Risk Reduction. In: *Ecosystem-Based Adaptation Community, Environment and Disaster Risk Management*. Emarald Group Publishing Limited.

Varkey, M. J. (1999). Pollution of Coastal Seas. *Resonance*. 4 (1), 36-44.

Valavanidis, A. and Vlachogianni, T. (2010). Metal Pollution in Ecosystems. Ecotoxicology Studies and Risk Assessment in the Marine Environment. Science Advance in Environment, Toxicology & Ecotoxicology Issues. Retrieved from www.chem-tox-ecotox.org.

Vedamanikam, V. J., Shazili, N.A.M. (2008). Comparative Toxicity of Nine Metals to Two Malaysian Aquatic Dipterian Larvae with Reference to Temperature Variation. *Bulletin Environmental Contamination Toxicology*. 80, 516-520.

Volland, J., Lechaire, J., Frebourg, G., Aranda, D. A., Ramdine, G. and Gros, O. (2011). Insight of EDX Analysis and EFTEM: Are Spherocrystals Located in

Strombidae Digestive Gland Implied in Detoxification of Trace Metals. *Miroscopy Research and Technique*. 75, 425-432.

Walker, C. H., Hopkin, S. P., Sibly, R. M. and Peakall, D. B. (2006). *Principles of Ecotoxicology*. 3rd. ed. United States of America; Taylor & Francis Group.

Wan, E. C. K. and Mohamat-Yusuff, F. *Contamination of Trace Elements (Cu, Pb, Cr) in Kong Kong Laut, Johor, Malaysia*. In *From Sources to Solution*. (pp.567-572). Singapore; Springer. 2014.

Wang, W. and Ke, C. (2002). Dominance of Dietary Intake of Cadmium and Zinc by Two Marine Predatory Gastropods. *Aquatic Toxicology*. 56, 153-165.

Wang, W. and Rainbow, P. (2008). Comparative Approaches to Understand Metal Bioaccumulation in Aquatic Animals. *Comporative Biochemistry and Physiology, Part C*. 148, 315-323.

Wang, C. W. (2011). Derivation of Criterion and Standard for Bacteria - A Management Tool for Safety Consumption of Seafood? *International Conference on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystem.* 3-7 December, University of Hong Kong.

Wang, S., Xu, X, Sun, Y., Lie, J. and Li, H. (2013). Heavy Metal Pollution in Coastal Areas of South China: A Review. *Marine Pollution Bulletin*. 76, 7–15.

Wannahari, R., Abdullah, N, A., Nordin M. F. M. and Muhammad, M. (2014). Evaluation of Heavy Metal in Coastal Water at Kelantan. *American Journal of Environmental Science*. 9(6), 505-510.

Watton, A. J. and Hawkes, H. A. (1984). The Acute Toxicity of Ammonia and Copper to the Gastropod Potampyrgus Jenkinsi. *Environmental Pollution (Series A*). 36, 17-29.

Wijesekara, G. A. W and Marambe, B. (2011). Arsenic in the Environment-An Overview on Global and Sri Lankan Context. *Annals of the Sri Lanka Department of Agriculture*. 13: 229-243.

Wolejko, A., Wydro, U., Butarewicz, A. and Loboda, T. (2013). Effects of Sewage Sludge on the Accumulation of Heavy Metals in Soil and in Mixtures of Lawn Grasses. Environment Protection Engineering. 39 (2): 67-76

Wood, A. K. H., Ahmad, Z., Shazili, N. A. M. R. and Carpenter, R. (1997). Geochemistry of Sediments in Johor Strait between Malaysia and Singapore. *Continental Shelf Research*. 17 (10), 1207- 1228.

Wong, N. L. W. S. and Arshad, A. (2011). A Brief Review on Marine Shelled Mollusca (Gastropoda and Bivalvia) Record in Malaysia. *Journal of Fisheries and Aquatic Science*. 6 (7), 669-699.

WorleyParsons (2011). Detailed Environmental Impact Assessment of a Proposed 2 x 1000MW Extension Tanjung Bin Coal-fired Power Planr, Mukim Serkat, Pontian, Johor Darul Takzim.

Williams, J. J., Dutton, J., Chen, C. Y. and Fisher, N. S. (2010). Metal (As, Cd, Hg, and CH_3Hg) Bioaccumulation from Water and Food by the Benthic Amphipod *Leptocheirus plumulosus*. Environmental Toxicology Chemistry. 29(8): 1755–1761.

Yang, J. and Miyazaki, N. (2003). Moisture Content in Dall's Porpoise (*Phocoenoides dalli*) Tissues: A Reference Base for Conversion Factors between Dry and Wet Weight Trace Element Concentrations in Cetaceans. *Environmental Pollution*. 121, 345–347.

Yap, C. K., Ismail, A., Tan, S. G. (2004). Heavy metal (Cd, Cu, Pb and Zn) Concentrations in the Green-lipped Mussel *Perna viridis* (Linnaeus) Collected from Some Wild and Aquacultural Sites in the West Coast of Peninsular Malaysia. *Food Chemistry*. 84, 569–575.

Yap, C.K., Cheng, W.H. and Tan S.G. (2008). Surface Intertidal Sediments Collected from East, South and West Coasts of Peninsular Malaysia. *Asian Journal of Water, Environment and Pollution.* 5 (2), 23-29.

Yap, C. K., and Tan, S.G. (2008). Heavy metal Pollution in the Juru River Basin Receiving Industrial Effluents: The Need for Biochemical and Molecular Studies in the Edible Cockles *Anadara granosa*. *Malaysia Applied Biology*. 37 (2), 63-68.

Yap, C. K. Noorhaidah, A., Azlan, A. Azwadya, A. A. N. Ismail, A. Ismail, A. R., Siraja, S. S. and Tan, S. G. (2009). *Telescopium telescopium* as Potential Biomonitors of Cu, Zn, and Pb for the Tropical Intertidal Area. *Ecotoxicology and Environmental Safety*. 72, 496–506.

Yap, C. K. and Noorhaidah, A. (2011a). Assessment of Bioavailability and Contamination by Cd in the Tropical Intertidal Area, using Difference Soft Tissues of *Telescopim telescopium*: Statistical Multivariate Analyses. *Journal of Sustainability Science and Management*. 6(2), 193-205.

Yap, C. K. and Noorhaidah, A. (2011b). Gill and Digestive Caecum of *Telescopium telescopium* as Biomonitors of Pb Bioavailability and Contamination by Pb in the Tropical Intertidal Area. *Sains Malaysiana.* 40(10), 1075–1085

Yap, C. K. and Wong, C. H. (2011). Assessment Cu, Ni and Zn Pollution in the Surface Sediments in the Southern Peninsular Malaysia using Cluster Analysis, Ratios of Geochemical Nonresistant to Resistant Fractions, and Geochemical Indices. *EnvironmentAsia*. 4(1), 53-61.

Yap, C. K., Chee, M. W., Shamarina, S., Edward, F. B., Chew, W., Tan, S. G. (2011b). Assessment of Surface Water Quality in the Malaysian Coastal Waters by Using Multivariate Analyses (Penilaian Kualiti Air Permukaan di Perairan Pantai Malaysia Menggunakan Analisis Multivariat). Sains Malaysiana 40(10): 1053–1064.

Yap, C. K., Rashiq, M. and Edward, F. B. (2012a). Is a Mussel Processing Site a Point Source of Zn Contamination? Evidence of Zn Remobilization from Boiled Mussel, *Perna viridis.* Pertanika Journal Tropical and Agriculture Science. 35 (2): 199-207.

Yap, C. K., Cheng, W.H., Tan, S.G. (2012b). Comparative Studies of Concentrations of Cu and Zn in the Surface Intertidal Sediments Selected from East, South and West Coasts of Peninsular Malaysia in Coastal Environments: Focus on Asian Coastal Regions, Capital Publishing Company. pp: 130-143

Yap, C. K., Cheng, W. H. (2013). Distributions of Heavy Metal Concentrations in Different Tissues of the Mangrove Snail *Nerita lineata*. *Sains Malaysiana*. 42(5), 597–603.

Yilmaz, S. and Sadikoglu, M. (2011). Study of heavy metal pollution in seawater of Kepez harbor of Canakkale (Turkey). *Environmental Monitoring Assessment*. 173, 899–904.

Yunus, K., Ahmad, S. W., Chuan, O. M. and Bidai. (2010). Spatial Distribution of Lead and Copper in the Bottom Sediments of Pahang River Estuary, Pahang, Malaysia (Taburan Plumbum dan Kuprum di Sedimen Dasar Muara Sungai Pahang, Pahang, Malaysia). *Sains Malaysiana.* 39(4), 543–547.

Yusof, A.M, Yanta, N.F, Wood, A.K.H. (2003). Bivalves as Bio-indicators of Marine Pollution in the Management of Coastal Area. *2nd Technical seminar on Shoreline Management.* Kota Kinabalu, Sabah.

Yusof, S. (2005). *Distribution and Accumulation of Heavy Metals in Fish in Cage System in Linggi Estuary, Malaysia*. Master Thesis. Universiti Putra Malaysia

Yuzereroglu, T. A., Gok, G., Cogun, H.Y., Firat, O., Aslanyavrusu, S., Maruldah, O. and Kargin, F. (2010). Heavy metals in *Patella caerulea* (Mollusca, Gastropoda) in polluted and non-polluted areas from the Iskenderun Gulf (Mediterranean Turkey). *Environ Monitoring Assessment*. 167,257–264.

Zakaria, M. H., Bujang, J. S. and Razak, F. R. A. (2003). Occurrence and Morphological Description of Seagrasses from Pulau Redang, Terengganu, Malaysia. *Jurnal Teknologi*. 38 (C), 29-39.

Zakaria, N., Sarimin, A. S., Sabuti, A. A. and Mohamed, C. A. A. R. (2013). Assessment Activity of ^{210}Po and ^{210}Pb in the Edible Tissues of Cultured Seabass (*Lates calcarifer*) at Peninsular Malaysia. *EnvironmentAsia*. 6(1), 66-73.

Zaleha, K., Farah Diyana, M. F., Mohd Luthfi, O., Noorul Ain Falah, A., and Ahmad Wafi, A. (2011). Health Status of Recreational Beaches in Iskandar Development Region, Johor, Malaysia. *The Malaysian Journal of Analytical Sciences*. 15 (2), 184-190.

Zhang, Q., Zhong, W., Xing, B. Tang, W. and Chen, Y. (1998). Binding Properties and Stoichiometries of a Palladium (II) Complex to Metallothioneins in Vivo and in Vitro. *Journal of Inorganic Biochemistry*. 72,195-200.

Zhao, L., Yang, F., Wang, Y., Huo, Z. and Yan, X. (2013). Seasonal Variation of Metals in Seawater, Sediment and Manila clam *Ruditapes philippinarum* from China. *Biology Trace Element Research*. 152(3), 358-366.

Zulkifli, S. Z., Ismail, A., Mohamat-Yusuff, F., Arai, T., Miyazaki, N. (2010). Johor Strait as a Hotspot for Trace Elements Contamination in Peninsular Malaysia. *Bulletin Environmental Contamination Toxicology*. 84,568–573.

Zahir, M. S. M., John, B. A., Kamaruzzaman, B, Y., Jalal, K. C. A., Shahbudin, S., Fuad, M. M., Fikriah, F., Aznida, M. A. (2012). The Distribution of Selected Metals in the Surface Sediment of Langkawi Coast, Malaysia. *Oriental Journal of Chemistry*, 28(2), 725-732.