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Declining Production of Cockles in Relation to Ammonia Concentrations in Sungai Buloh River, Selangor

Mohd Fadzil Shuhaimi Ramli*, Faizal Riza Abu Hasan, Mohd Nasir Saadon
Faculty of Science and Biotechnology, Universiti Selangor, Bestari Jaya, Selangor
*Email:drfadzil@unisel.edu.my

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Abstract
This research was conducted in Kampung Bagan, Sungai Buloh, one of the major areas for cockles farming in Selangor. Based on the Fisheries Annual Statistic Report 2000, issued by the Department of Fisheries Malaysia, the total production of cockle landings in Selangor was 6,922 mt utilizing 654 ha farming area with a production rate of 11 mt/ha. Meanwhile, in the 2011 report, the total production of cockle landings had increased remarkably to 26,505 mt with further expansion of 5,593 ha of cockle farming area. It shows an increasing number of productions and area of cockle's farming. However, the production rates for 2011 had declined to 4.7 mt/ha. The declining of cockle's production rate was due to several factors. One of the factors is high ammonia concentration in the water. To test this hypothesis, several water samples were collected from the site to test the ammonia concentration in the water by using the colorimeter base on Salicylate method. From these tests, the readings for ammonia concentration in the farm area ranged from 0.3 mg/L up to 4 mg/L. This indicates that ammonia concentration had exceeded the cockle maximum tolerance level towards ammonia. Thus, high ammonia concentration is one of the factors that cause cockles mortality resulting in declining of cockle production in Selangor.
Keywords: Cockles, Ammonia concentration, production rate

Introduction

In Malaysia, cockles (*Anadara granosa*) are the main species being cultured in the coastal areas (Broom, 1985 & Vakily, 1992). The species are easily found in muddy area especially along the mangrove areas (Brown, 1985). Cockles can be found naturally in Malaysia, especially on the west coast of Peninsular Malaysia and some areas in Sabah (Shabdin & Rosniza, 2010). Malaysia is the largest exporter of adult cockles in Southeast Asia. The major importer of Malaysia's cockles is Thailand (DOF, 2011). One of the major cockles producing in Malaysia is Kampung Bagan, Sungai Buloh, Selangor (DOF 2011). Between 2001 and 2007, the cockles production in Selangor was less than 10,000 mt, however began to show an increasing trend beginning 2008 until 2010 where it dropped to 26,505 mt in 2011 The highest production was in 2010 at about 40,000 mt(see Figure 1)

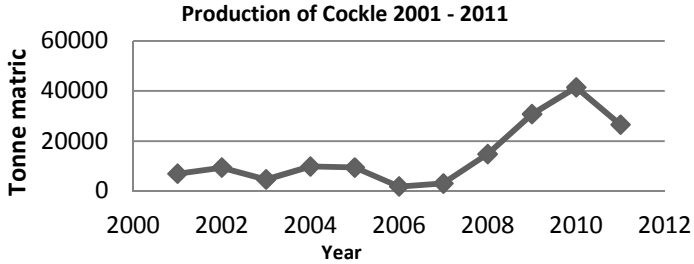

Figure 1: Cockles production from 2001 to 2011 in Selangor.
(Source: Fisheries Statistics Annual Report 2001 to 2011)

In term of farming areas, there was a remarkable increase from 654 ha in 2001 to 5,593 ha in 2011 (see Figure 2). This explains increasing trend of production in tandem with the expansion of the farming areas. However, when the rate of production is taken into account, it reveals the decreasing trend. For example, in 2001, the production was 11 mt/ha compared to only 4.7 mt/ha in 2011 (see Figure 3)

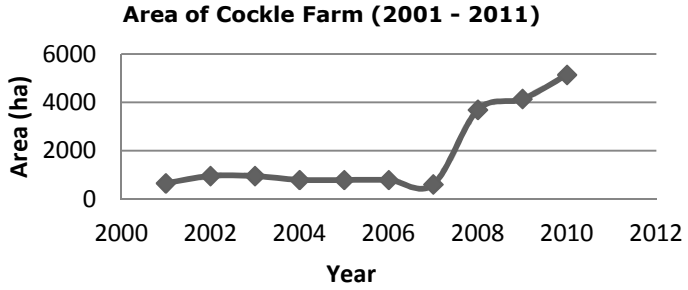

Figure 2: Total Area of Cockle Farming from 2001 to 2011.
(Source: Fisheries Statistics Annual Report 2001 to 2011)

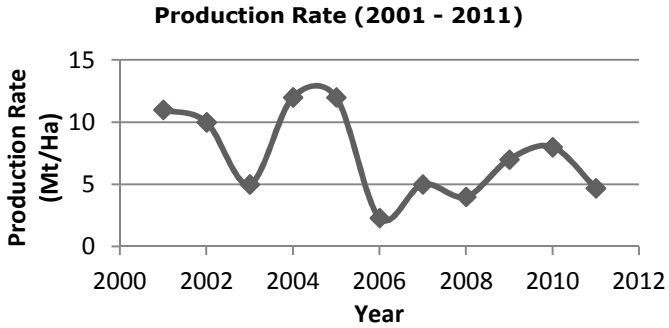

Figure 3: Cockle production rate from the year 2001 until year 2011.
(Source: Fisheries Statistics Annual Report 2001 until 2011)

Ammonia is a compound of nitrogen and hydrogen with the formula NH_3. It is a colorless gas with pungent odor character. Ammonia exists in many forms, including ammonia-nitrogen, ammonia-nitrate and other, and ammonia is a compound that is insoluble in water (McCormick *et al.*, 1984). The concentration of ammonia toxicity increases as the rate of dissolved oxygen in water decreases; which can cause toxicity to aquatic life, especially bivalves with high sensitivity (Wajsbrot *et al*., 2003). Studies conducted on *Perna viridis* had shown that high rates of ammonia can cause death since ammonia toxicity can cause damages to the gills, intestines or adductor muscles (Becker and Thatcher, 1975). In the presence of high pH resulting from the presence of NH_3 may lead to cellular damage (Reddy and Menon, 1979). The increase in ammonia content in the water is caused by changes in temperature, pH and dissolved oxygen which increase the toxicity of ammonia in water. This was proven in a study conducted by Lim *et al.,* (2006), where an increase in temperature of between 10 - 20^0C resulted in increase of 1.3 - 1.6 times the non-ionized ammonia. This can disrupt the aquatic ecosystem as aquatic life is sensitive to the increase of ammonia in the water.

Cockles production can be affected by pollution (Pushpa and Manisha, 2013), heavy metals concentration (Mubiana et al., 2007 and Suwanjarat *et al.,* 2009), predation and lack of farm management practices (Lokman, 1992). One of the major pollutants is ammonia which may be naturally formed or introduced by human. It has been found that ammonia can be lethal at 5.0 mg/L for marine culture (Reddy and Menon, 1979). A study by Department of Environment, Malaysia in Sg Buluh showed that the level of ammonia is damaging to the marine lives (DOE, 2009). This study investigates the ammonia concentrations near the Sg Buluh river mouth that may affect the cockles' production in the nearby areas.

Material and Method

Figure 4 shows the study area and sampling stations. The samples were collected once a month between months of January and June in 2013.There were three station denoted as Station 1 (river), Station 2 (estuary) and Station 3 (farm area). At each station, four replicates of 500 ml water were taken and analyzed in laboratory using the Salicylate method and the ammonia readings using Hach DR890 colorimeter (Mazlin Mokhtar *et al.,* 2001).

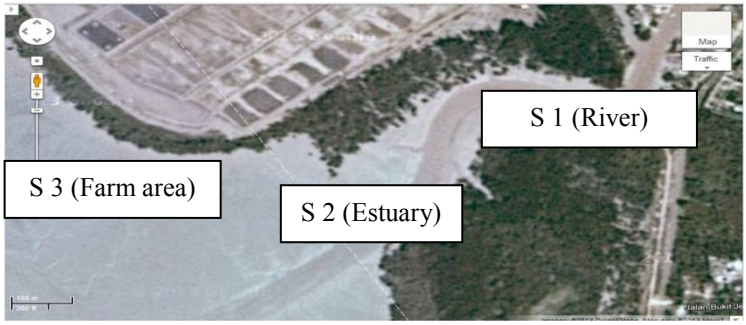

Figure 4: Sampling area and stations

Results and Discussion

During the months of January, February and March, the average level of ammonia concentrations were between 0.5 mg/l to 1.6 mg/l in river, 0.5 mg/l to 1.7 mg/l in estuary and 0.3 mg/l to 1.4 mg/l in farm area. However, the ammonia concentrations for the next three months (April, May and June) were extremely high, that is, 28 mg/l to 15 mg/l in river, 18 mg/l to 12 mg/l in estuary and 1.3 mg/l to 4 mg/l in farm area (sea) (see Figure 5). The lower ammonia concentrations during the first three months was due to rainy season that helped diluting the river and sea in contrast to dry season in the months of April through June. During the low ammonia concentrations, the cockles production was between 300 mt to 400 mt but decreasing from 400 mt to 270 mt during the higher concentrations (see Figure 6).

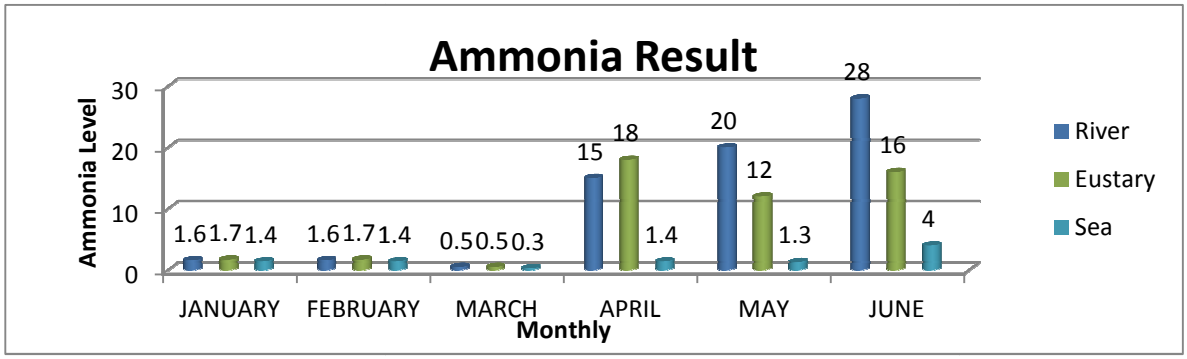

Figure 5: Result on ammonia analysis

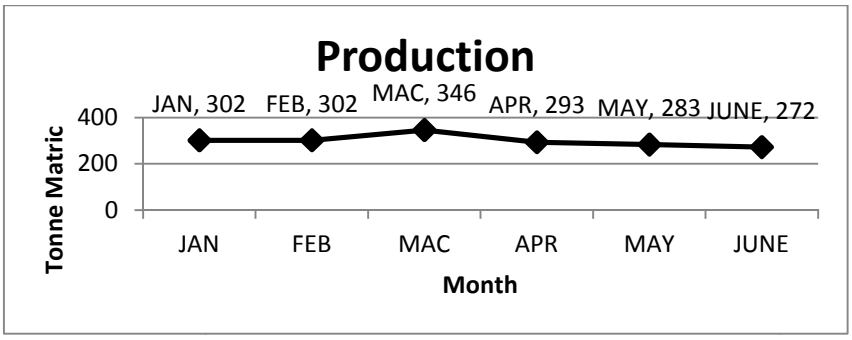

Figure 6: Cockle Production in Kampung Bagan from January to June 2013

Apparently the water quality of Sg Buluh river is in extremely bad condition. According to river classification as suggested by the Department of Environment (see Table 1 and 2), Sg Buluh river may fall under the Class IV that is not suitable for aquatic species of economic value but in the farm area, and during rainy season, the whole of the study areas can be classified as Class III river. The latter is suitable for aquaculture and agriculture use but requiring extensive water treatment. Although the ammonia concentrations had passed over the tolerance limit of 0.5 mg/L of most bivalves (Reddy and Menon, 1979), the survival of some cockles was amazing as shown by this study. There was no mass mortality observed and cockles seemed to endure the high ammonia level.

Table 1: Nutrient values found in river water quality classification system

Parameters	unit	Water quality class				
		I	IIA	IIB	III	IV
Ammonia	mg/L	<0.1	0.1 – 0.3	0.1 – 0.3	0.3 – 0.9	>2.7
Nitrate	mg/L	Natural Value	<7.0	<7.0	-	<5.0
Phosphate	mg/L	Natural Value	<0.2	<0.2	<0.1	-

Source: Department of Environment, Malaysia -River Water (Surface water) quality monitoring Programme, 2005

Table 2: Classification of rivers

Class	Fuction	The level of water Treatment
I	Water supply for environmental conservation level I Fishery I - very sensitive aquatic species	No Treatment Needed
IIA	Water supply for environmental conservation level II Fishery II - very sensitive aquatic species	Conventional water treatment is required
IIB	For recreational use	Conventional water treatment is required
III	Water supply for environmental conservation level III Fishery III- aquatic species commonly bred and have economic value, as well as to serve as livestock drinking	extensive water treatment is required
IV	Irrigation	-

Source: Department of Environment -River Water (Surface water) quality monitoring Programme, 2005

Conclusions

This study indicates that Sg Buloh river is contaminated with high ammonia concentration beyond the level indicated by the Department of Environment, Malaysia. Although ammonia levels were high, there was no mass mortality observed and this phenomenon leads another interesting future study in water quality. A longer and extensive monitoring study is needed to assess the actual status of the ammonia concentration in the study area in relation to other factors such as dissolved oxygen, pH values, salinity and temperature.

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References

Annual States Fisheries Statistics Report 2001. 2002. Vol. 1. Department of Fisheries, Ministry of Agriculture. Kuala Lumpur, Malaysia.

Annual States Fisheries Statistics Report 2011. 2012. Vol.1. Department of Fisheries, Ministry of Agriculture. Kuala Lumpur, Malaysia.

Broom, M.J. (1985)**.** The biology and culture of marine bivalve molluscs of the genus Anadara *ICLARM Studies and Reviews, 12***:** 37.

Becker, C.D. and Thatcher, T.0. (1973). Toxicity of power plant chemicals to aquatic life. *U.S. Atomic Energy Commission Publ., 1249,* 1-218.

Department of Environment Annual Report 2005 - River Water (Surface water) quality monitoring Programme, 2006. Ministry of Natural Resources and Environment, Malaysia

Department of Environment Annual Report 2009. 2010. Selangor Department of Environment, Ministry of Natural Resources And Environment, Selangor, Malaysia

Lokman, S. (1992). *Akuakultur Pinggir Laut*. Dewan Bahasa dan Pustaka, Kementerian Pendidikan Malaysia, Kuala Lumpur, Malaysia.

Lim, S., H., Abdullah, S. & Mohd Rozali, O. (2006). Indeks kualiti air negara (IKAN) sistem Sungai Labu. *Malaysia Journal of Analytical Sciences*, *10* (1): 7-14.

Mazlin Mokhtar, Ismail Bahari, Yap Chee & Agnes Poon. (2001). Kajian kualiti ait di sekitar kawasan perindustrian Subang Jaya dan Shah Alam, Lembah Kelang. *Malaysia Journal of Analytical Science, 7* (1) *:* 139-149

McCormick, J., H., Broderius, S., J., & Fiandt, J., T. (1984). Toxicity of ammonia to early life stages of the green

sunfish *Lepomis cyanellus. Environmental Pollution Series A, Ecological and Biological, 36* (2): 147-163
Mubiana., V., K. & Blust., R. (2007). Effect of temperature on scope for growth and accumulation of Cd, Co, Cu, Pb by the marine bivalve Mytilus edulis. *Marine Environmental Research 63 :* 219-235.
Pushpa, D., Manisha, & Ahlawat. (2013). *Environmental Science: A New Approach*. Oxford, United Kingdorm : Alpha Science International Ltd.
Reddy, N.A., & Menon, N.R. (1979). Effect of Ammonia and Ammonium on Tolerance and Byssogenesis in *Perna virdis*. *Marine Ecology Progress Series, 1*: 315-321
Shabdin, M.L., & Rosniza, R. (2010). *Kekunci siput dan kerang-kerangan, Perairan Pantai Malaysia timur.* Terengganu : Penerbit UMT.
Suwanjarat, J., Pitusalee, C., & Thongchai, S. (2009). Reproductive cycle of *Anadara granosa* at Pattani Bay and its relationship with metal concentrations in the sediments. *Songklanakarin J. Sci. Technol*., *31* (5): 471-479.
Vakily, J., M. (1992). Determination and Comparison of Bivalve Growth, with Emphasis on Thailand and Other Tropical Areas. *ICLARM Technical Report,* 36: 2.
Wajsbrot, N., Gasith, A., Krom, D.M., & Popper, D.M. (2003). Acute toxicity of ammonia to juvenile gilthead seabream *Sparus aurata* under reduced oxygen levels. *Aquaculture*, *92*: 277-288.