Overview and challenges of blood cockle culture in Malaysia

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Abstract. The blood cockle (Tegillarca granosa) is an important aquaculture species in Southeast Asia and plays a major role on economic importance in Malaysia since 1948. In comparing food value among other bivalves, cockles showed a cheap source of protein among Malaysians. Malaysia used to have a coastline which was suitable for breeding cockles, particularly, Selangor was enriched with a large number of cockles spat naturally developed from mudflats. Unfortunately, production of cockles spat in farming and marketing started to decline in 2000 and stopped production in year 2005 where there are only two main peaks for spawning season which are in March and November. Based on statistics from Department of Fisheries, unstable production of adult cockles occurred since 2011 and drastically declined in 2015, where the total yield for year 2015 was only 16,866.22 tonnes compared to 57,544.40 tonnes in 2011. With the decreased of cockle production, cockles are no longer considered as a cheap seafood resources but a delicacy marketed to the locals and tourists. There are several factors leading to the mortality of seed and adult cockles such as environmental issue, smuggling and overharvesting and low food availability in culture areas. The overview of the cockle status in Malaysia over 28 years, the challenges and the potential of aquaculture of cockles will be presented in this paper.

Keywords: cockle culture; grow out; hatchery; spat.

1. Introduction

Seafood. The blood cockles, Tegillarca granosa, is a family of Arcidae due to the red haemoglobin liquid inside the soft tissues. The blood cockle used to be known as Tegillarca granosa is an important aquaculture species in Southeast Asia and plays a major role on economic importance in Malaysia since 1948. In Malaysia, they are commercially important bivalves exploited for human consumption through farming and marketing because they are the cheapest source of protein compared to other bivalves [1]. This species contributed more than 50% to the national aquaculture production where Malaysia was ranked fifth in Asia Pacific [2]. According to Department of Fisheries Malaysia (2011), most of the cockles are exported to Thailand. Cockle farming areas in Malaysia covered 10,000 acres which approximately involving more than 1,000 farmers [3]. The cultivated areas for blood cockles with mudflats are located at Kedah, Pulau Pinang, Perak, Selangor, Johor, and Sarawak while Selangor and Perak play are sites where spat and adult cockles were produced naturally throughout the years [4].
Figure 1. Established states for production of cockles in Malaysia for year 2017. (Source: Department of Fisheries Statistics Report).

Normally, cockle farming areas are located in open areas such as estuaries and coastal zones where these areas were exposed to many pollutants from point and non-point sources [5]. However, the production of adult cockle and spat showed unstable production based on statistic from Department of Fisheries from 1990 until 2017. Based on the statistics from Department of Fisheries, the production of cockles spat in farming and marketing started to decline in 2000 and stopped production in year 2005 where there were only two main peaks for spawning season which are in March and November [6]. In addition, unstable production of adult cockles occurred since 2011 and drastically declined in 2015. Based on this issue, our study was designed to define the status and challenges and potentials through aquaculture technique for production of cockles in Malaysia.

2. Production statistic of cockles in Malaysia

Malaysia has dominated 93% of the total production shellfish production and one of the major producers of adult cockles in Asia [7]. In this study, nineteen years of statistics on production of spat and adult cockles were analysed from the source of Department of Fisheries Statistic Report from 1990 until 2017. The data showed unstable production of cockles in farming throughout the years (Figure 2).

The highest production of cockle occurred in 1995 with a total yield 100,275.76 tonnes and the lowest production in 2016 with a total yield 9,596.76 tonnes based on the statistics within nineteen years. Between 2002 until 2017, the production of spat was not recorded while unstable production of adult cockles occurred since 2011 and drastically declined in 2015, where the total yield for year 2015 was only 16,866.22 tonnes compared to 57,544.40 tonnes in 2011 (Figure 2). The highest production of adult cockles was in 2010 around 78,024.70 tonnes (Figure 3).
3. Challenges of Cockle culture in Malaysia

3.1. Environmental issue
Culture areas for blood cockles are usually situated in open areas and are areas of major recipient of pollutants that come from variety of sources [4]. Cockles can survive in polluted environment by accumulating pollutants inside their body tissue [9-12]. Previous studies had proved that environmental issues had lead to unstable production of cockles in Malaysia. A study has reported that (Kampung Bagan, Selangor) exhibited high concentration of ammonia in the water had and caused
mortality of cockles in farming areas of which ammonia concentration were in range from 0.3 mg/L up to 4 mg/L, (exceeded the cockles’ tolerance of 0.08 mg/L) [13]. The production of cockle was between 300 to 400 tonnes in low concentration of ammonia and decreased to 270 tonnes when high concentration of ammonia was present in water bodies at entire areas. A study reported that mortalities of cockle area in Penang and Perak occurred due to poor water quality that contain high level of ammonia at upstream ranging from 0.09 mg/L to 0.32 mg/L with dissolved oxygen levels ranging from 4.6 mg/L to 7.8 mg/L at Perak, while in Penang the concentration of ammonia ranged from 0.30 mg/L to 0.81 mg/L with lower dissolved oxygen of 2.0 mg/L to 4.3 mg/L [14].

Two studies had proved that the high ammonia levels in water bodies could lead to high mortality in cockle areas [13, 14]. Uncontrolled agriculture activities in using pesticide and unsystematic techniques of discharging agriculture waste had caused the ammonia levels to increase in water bodies leading to negative impact on aquatic environment. Toxicity of ammonia is affected by pH where ionized ammonia would lead to toxicity in water if pH is high [15]. A retardation of growing blood cockle happened when exposed to industrial discharge in which high concentration of toxic materials would affect the physiology of the animals [16]. Cockles placed near the industrial discharge located in Kuala Juru, Penang for eight weeks and the growth rate started to decline at week two and started to die at week 6. The death was caused by increasing in temperature, total suspended solid, biological oxygen demand and heavy metals (Cd, Cu, Ni and Zn) at the discharge point. This is a reflection of the effect of environmental stresses on the physiology of cockles.

3.2. Smuggling and Overharvesting
Smuggling of cockle spat has been an on-going activity for export to Thailand across the border. Smugglers has been reported to smuggle 100 kg of cockles spat into Thailand with value of USD 11,941 [17]. There were 35 cases of smuggling happened in 2014 and 33 cases in 2015 reported by CNA news [18]. The Anti-smuggling agencies of Malaysia had arrested a truck carrying 191 gunny sacks (six tonnes) that contained cockle spat with the price at USD 91235 into Thailand [19]. The smuggling of cockle spat across boarder is still happening because the price of spat is five times higher compared to selling in Malaysia.

Overharvesting of cockle had caused to the shortage of production because the farmers did not have a proper management during harvesting. Based on Malaysia Fisheries Act (1985), the average cockle size for harvesting is no less than 31.8 mm and spat size ranged from 6 to 10 mm to reduce mortality during collection and transportation to culture sites. However, cockles have been harvested for the culture areas, as the size as small as 15 mm. The farmers and fishermen had reduced the mesh size of their net or scoop despite the Malaysia Fisheries Act (1985). The enforcement agency (Department of Fisheries Malaysia) has tried to rectify the law but did not manage to implement the law. Harvesting of cockles at smaller size than 31.8 mm had led to the reduction of spawners in the breeding grounds of cockles. Therefore, overharvesting of adult cockles and harvesting cockles at the unpermitted size had done much damage to the production of spat and adult cockles over the years.

3.3. Low food availability
Cockles are bottom filter feeder that feed on organic detritus and microalgae [20]. They usually found in mudflats [21] and they depend on detritus that naturally produced from dead plants of mangroves species. In decomposition process, the nutrients such as nitrogen, phosphorus and phosphate had been released to enhance a suitable condition for algae to growth. Unfortunately, years by years, the soil at culture bed became unfertile regarding to environmental issue that lead to mortality of cockles causes low in food availability. Therefore, feeding quantity and quality are important in cockle culture in order to maintain a production and quality of cockles [22]. The sudden changes in environment of culture site led to changes of nutrient present in water bodies that disturb the physiology of cockles. A mass mortality event of blood cockle occurred due to low food availability during flooding in which impact of freshwater flooding from river to culture site [23]. From their observation on the digestive tube no food present and the epithelial tissue was flattened. Flooding can cause drastically decrease in salinity level in which cockles were very sensitive during spawning season and sudden changes led to mortality [24].
4. Solution and Opportunities

The statistics from Department of Fisheries mentioned the nature spat production had stopped in 2002, therefore, there is a need to breed the cockle in the hatchery for production of adult and spat cockle in order to support marketing and farming demand. Spawning induction had been conducted in this study by using physical shocked on salinity and temperature. A diet *Chaetoceros calcitrans* was given every day to ensure the adult cockles achieve optimum growth and maturity before spawning. A study used a thermal shock in water at 16-18 °C to 30-32 °C to induce spawning of the cockles within 2 hours [25]. The purpose using induced spawning was to reduce the mortality of spat that very sensitive towards environmental changes especially in poor water quality and low food availability in which will disturb their physiological changes. Besides, this technique can be synchronized in continuous reproduction of cockle that is needed by farmers in culture areas. In other hand, overharvesting of cockle can be reduced in which the legal size to marketed need to be strictly enforced. The government and non-government agencies in Malaysia should play an important role in controlling smuggling activities across the border and creating a continuous awareness programmes to educate our communities on the effects of uncontrolled human activities especially in discharged of unwanted waste that give a negative impact towards our aquatic ecosystem and lead to unstable production of cockle. Furthermore, the farmers should be monitoring on the water quality and condition of culture beds to ensure the development of cockle and spat in optimum condition.

5. Conclusion

Blood cockle in Malaysia is facing a lot of challenges that had led to huge drop in production of spat and adult cockles. Uncontrolled human activities problem and habitat degradation of cultural areas. Possible ways to overcome this problem is played a significant role towards this by improving aquaculture techniques and through awareness programmers towards our communities. Therefore, the production of adult cockle and spat can be improved from years to years to fulfill the demand for human consumption.

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