

# Culture-based fishery of giant freshwater prawn: Experiences from Thailand

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**Abstract:** Releasing of giant freshwater prawn (*Macrobrachium rosenbergii*) for the purposes of stock enhancement and to create a fishery has been conducted in Thailand since the 1980s. In each year, over a hundred million post larvae (30 day old post larvae of -1 cm) of *M. rosenbergii* have been released into inland waters nationwide. The stocking density is, generally, about 2,500 prawn larvae/ha. Average age at harvest is around 6 to 8 months, with an average total length of 20 cm. The individual weights can range between 100 and 200 g after a year of release. Common fishing gears are gillnet, long-lines and traps, the latter designed exclusively for *M. rosenbergii*. Overall, the success of stocking *M. rosenbergii* is poor since the recapture rate is generally less than 5%. However, the economic return is high. Average market price of *M. rosenbergii* is 150 Thai Baht/kg, which is about 3 times more than the average price of marketed freshwater fish. The profit is reported to be as high as 800%. Moreover, the high market price of *M. rosenbergii* benefits traders at various levels, job creation and income for all related sectors. Although the economic profit is very high, the low rate of recapture of stocked *M. rosenbergii* makes this culture-based practice not entirely satisfactory. The major problem is that there are no guidelines in regard to the optimum size of seed for release as well as appropriate time and location to be stocked, that could enhance the rate of return and economic returns.

**Key words:** *Macrobrachium rosenbergii*, culture-based fishery, Thailand, stocking practices, rate of recapture.

## Introduction

Culture-based fisheries of inland water-bodies in Thailand have been operated since the 1950s, by the Department of Fisheries (DoF), but the regular stocking program commenced in 1978 under “the nation-wide fish stocking program” for communal ponds, lakes and reservoirs (Virapat, 1993; Jutagate and Rattanachai 2010). This activity is currently conducted under the strategy issue 1 of DoF “Fish Production Enhancement”, which aims to improve potential fish production in natural waters by at least two percent per year (DoF 2012). The commonly stocked species were the exotic Chinese carps, Indian major carps and tilapia (Bhukaswan 1989). However, because these species, except for tilapias, cannot form sufficiently large populations that could be exploited commercially, the major species stocked have shifted to indigenous species since the 1980s. In each year, about 2,000 million fish seed are stocked into inland water bodies countrywide, of which about 55 to 65% are indigenous species (Jutagate and Rattanachai 2010). The giant freshwater prawn, *Macrobrachium rosenbergii*, is the only shellfish that has been stocked regularly for fishery purposes, of which about 350 million seed have been released annually (Jutagate and Rattanachai 2010). Other than in Thailand, culture-based freshwater prawn fisheries have been conducted in India and Sri Lanka as well as trialed in other Asian countries (New and Kutty

2010). This is one of the relatively uncommon examples of a culture-based fishery with a non-fish species in inland waters (De Silva and Funge-Smith 2005).

*M. rosenbergii* is the largest freshwater prawn in Asia and in Thailand it occurs naturally in large rivers that are connected to the coastal area countrywide, from the Moei River in the north to the Pattani River in the south as well as large swamps (e.g. Bueng Boraped) and lakes (e.g. Songkhla Lake) that are connected to these rivers (Amarttayakul and Bhukaswan 1974). The yield of *M. rosenbergii* from capture fisheries had continuously decreased from 3,000 to 500 tonnes per year from 1974 to 1994 (Fishery Economic Division 1996). This is mainly due to fishing pressure because this prawn is among the most targeted species of the inland fishery and has the highest economic value. *M. rosenbergii* is priced about 150 Thai Baht per kg (1 US \$= 30 Thai Baht), whereas other freshwater fishes and shellfishes are priced around 50 Thai Baht per kg (Figure 1). However, production of *M. rosenbergii* from capture fisheries recently increased to around 1,000 tonnes per year and this increase was mostly attributed to the success of the stocking program (Fishery Economic Division 2013).

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Because *M. rosenbergii* is catadromous, their production from communal ponds and reservoirs as well as rivers that are not connected directly to the sea, e.g. the tributaries of Mekong River, are totally based on regular stocking to sustain the fisheries, i.e. culture-based fisheries. These fisheries bring direct benefits to the community through increased availability of fish (De Silva, 2003), high income, and thus improving livelihoods. In this paper, the experiences of the culture-based *M. rosenbergii* fishery in Thailand are synthesised and future research needs are examined with a view to improving the current practices of this fishery.

## Stocking practices

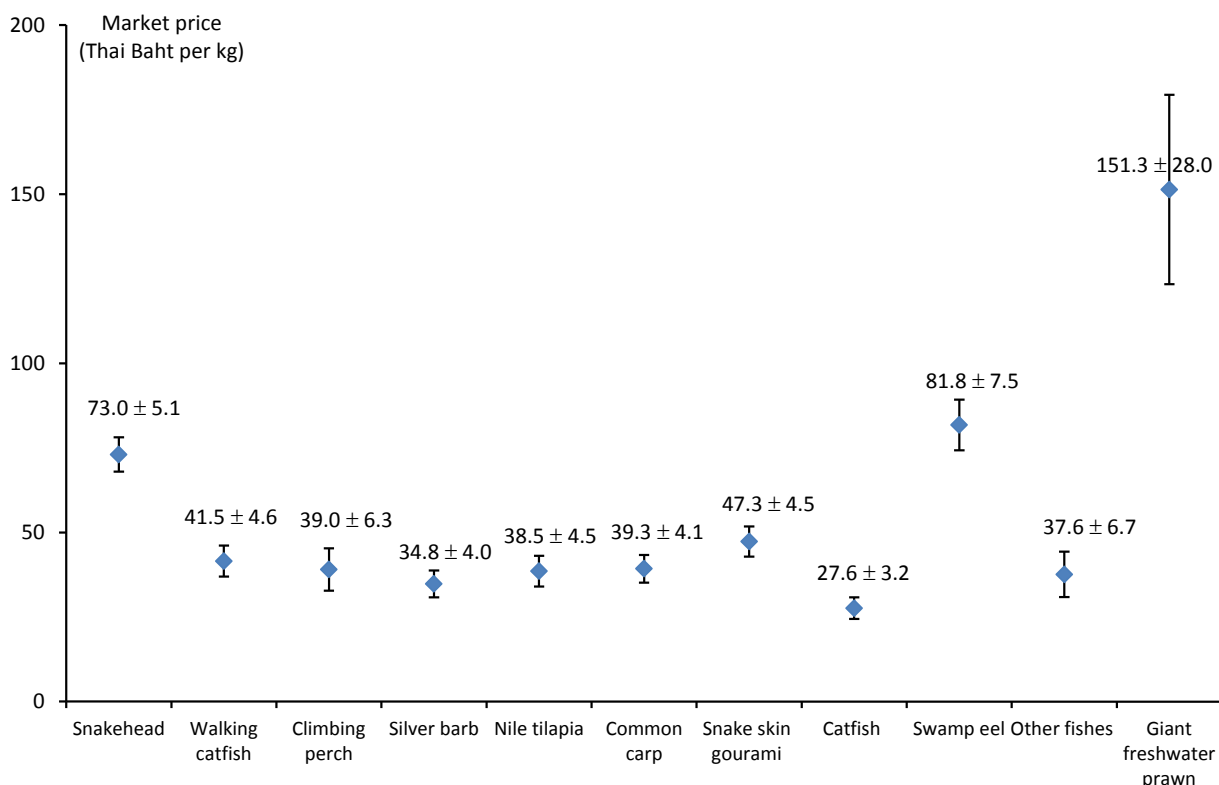
*M. rosenbergii* is normally released as 30 day old post larvae (PL), i.e. stage PL<sub>30</sub> (Sripatprasite and Lin 2003). At this stage, the seed size ranges from about 0.8 to 1 cm, and weigh about 0.01 g. This is also the commonly released size for culture-based prawn fisheries in other Asian countries (New et al. 2000). The exceptions were found in Sri Lanka, where 45 day post larvae i.e. stage PL<sub>45</sub> are stocked (Pushpalatha and Chandrasoma 2010), and PL<sub>60</sub> and PL<sub>90</sub> were released in Tonle Sap, Cambodia (Thuok et al. 2011). Stocking of larger PL<sub>60</sub>, i.e. about 1.5 cm, has also been trialed in Ubolratana Reservoir in 1981 (DoF 1986). The commonly practised

stocking density, by the Department of Fisheries, ranged between 400 – 500 prawns per rai<sup>1</sup> or 2,500 – 3,000 prawns per ha (i.e. 0.25 – 0.3 seeds/m<sup>2</sup>; Jaiyen 2003). The seed are normally packed in 15 L plastic bags containing 2,000 prawns, in which the ratio between oxygen and water is 3:1, and transported from hatcheries to the releasing sites in a cool container maintained at 18°C by trucks or vans (Jaiyen 2003; Sripatprasite and Lin 2003). The stocking program in each year is conducted during two major events viz., firstly, during the Songkran Festival, between 12 and 15 April and, secondly, on 21 September, the National Fishery Day. The first event is the transitional period to the rainy season and the latter is the end of the rainy season. Stocking during the rainy season is to guarantee an abundance of natural food and shelter for the stocked seed, especially in flooded forests of the respective water bodies (Jutagate and Rattanachai 2010).

There are a number of cases where arbitrary stocking densities have been used. However, a more important concern is the number of releasing events. Examples of these cases are from the stockings by the Provincial Office and the Sub-district Administrative Organisations for communal ponds or by private companies for

<sup>1</sup>. Rai is the Thai measurement for unit of area. A rai is equal 1,600 square metres.

**Figure 1. Average prices (Thai Baht per kg) of common freshwater fishes and giant freshwater prawn in Thailand.**



performing their corporate social responsibilities. There is also the case of stocking for conservation purposes; for example, 84 million *M. rosenbergii* post-larvae were released into the Chao Phraya River in 2014 as a part of the celebrations of Her Majesty Queen Sirikit's 84th birthday (DoF 2014a).

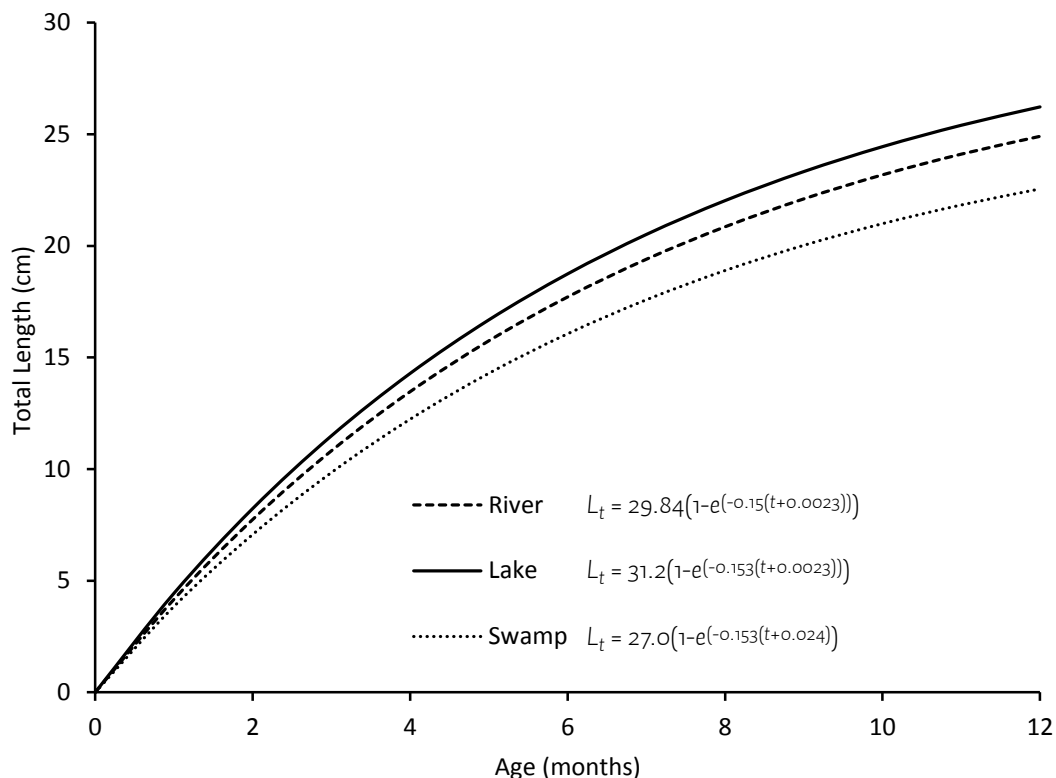
## Growth performance

The life span of *M. rosenbergii* can be as long as two years (Vogt 2012). The males can reach a total length (from tip of rostrum to tip of telson) of 320 mm, and females 250 mm (Brown et al. 2010). However, the largest male (350 mm TL) and female (280 mm TL) have been reported from Songkhla Lake about 45 years ago (Pongsuwan et al. 1967). For the stocked populations, their growth varied according to habitat type. Although *M. rosenbergii* exhibits a "leapfrog" growth pattern (Ra'anan and Cohen 1985), its growth curve conforms to a von Bertalanffy equation (Figure 2), which indicates the growth rate is high during the first month after stocking and decreases later (New and Valenti 2000). The asymptotic length (i.e. average length of the oldest group) of the stocked *M. rosenbergii* in Thai waters ranged between 270 to 310 mm TL, and the highest value was observed in a population in a brackish water system, i.e. Songkhla Lake. Meanwhile, *M. rosenbergii* can reach a size of 230 cm TL within 6 months after stocking in intensive culture

in earthen pond at a stocking density of 0.3 seeds/m<sup>2</sup>, i.e. a similar stocking density to the culture-based fishery (Sampio and Valenti 1996).

It takes about 6 to 8 months for the prawns to approach a harvestable size, of individual weight between 60 and 100 g (i.e. size around 200 mm TL), and could be up to 150 to 200 g, one year after stocking (Jaiyen 2003). Sripatrprasite and Lin (2003) reported that the stocked *M. rosenbergii* in "run-of-the river" Pak Mun Reservoir could grow to 110.6 g within 8 months, with an average growth rate of 28.6 g per month. In large reservoirs (e.g. Rajjaprabha Reservoir) an average weight of 107 ± 5 g were observed one year after stocking (Jindapun and Sungkapaitoon 2006). By stocking larger sized PL, however, prawns can reach a size of 200 g within one year (DoF 1986). Similar results have been obtained from Tonle Sap (Thuok et al. 2011). Moreover, *M. rosenbergii* could grow as large as 350 mm and weight of 450 g 15 months after stocking in this reservoir (Pawaputanon and Boonpew 1983). Similar results of a one year size was also reported in a medium-sized swamp in the northeast, where the stocked prawn had an average size of 235 ± 0.25 mm and 170.6 ± 6.5 g (Supsooksamran et al. 2001). A size around 250 cm and weight 350 g of one year old *M. rosenbergii* was also reported from the Chi River (Chaiyapoom Inland Fisheries Station 2009).

**Figure 2. Total length at age (cm) of the giant freshwater prawn from different habitats in Thailand.**



## Fishing gears

Adult *M. rosenbergii* are active at night while during the day they remain in shaded areas (Brown et al. 2010), thus most of the fishing gears are operated during night time. The common fishing gears are traps, long-lines, gillnets, cast-net and spear (Pawaputanon and Boonpew, 1983; DoF 1986; Potaros, 1993; Jaiyen 2003), and the prawns are occasionally caught by the bug lift net. Cast-net and spear are the most selective gear for large sized prawns, i.e. larger than 20 cm TL, whereas other gear will catch a wide size range (Potaros 1993; Sripatprasite and Lin 2003). A survey conducted by the Pak Mun Fisheries Research Station between May and August 2004 (Kwangkhang, unpublished data) revealed that ranges of the catches by common fishing gears ranged between 5 and 30 cm TL. The number of catches by the “Jann” trap (Figure 3), the gear that is designed exclusively for catching *M. rosenbergii*, was about double that of other common gears used, and also the larger sized prawns were most often caught by this gear (Figure 4). There is no clear trend on the fishing season but catches were observed to be higher from February to July, when the water is relatively clear, and decrease afterwards (DoF 1986; Potaros 1993).

## Evaluation

The recapture rate of stocked fish is generally high with an average of over 10 %, and could be as high as 50 % in communal ponds and swamps, whereas the recapture rate of the *M. rosenbergii* is generally poor and less than 5

**Figure 3. “jaan” trap, which is used exclusively for fishing giant freshwater prawn.**



% (Jutagate and Rattanachai 2010). The highest recapture rate of about 10 % for *M. rosenbergii* was experienced in the natural lake, Beung Borapet, which had been stocked in 1995 with 3 million PL (Rithcharung and Srichareondham 1998). In Ubolratana Reservoir, where 536,000 PL were stocked in 1983, 11,455 prawns (2 %) were returned. Moreover, the overall recapture rate of the whole project, i.e. between 1981 and 1986, was also about 2 % (i.e. 5,081,000 releases and 98,859 returns) (Chumnongsittsthum 1987). A similar rate of recapture was also observed in Bangphra Reservoir (Renunual and Silapachai 2005). In an attempt to create a new fishery in Pak Mun Reservoir, Jaiyen (2003) showed that the recapture rate of *M. rosenbergii* was very low (<1 %), and most of the catches were small-sized prawns, with individuals weighing <100 g. It was assumed that some stocked prawns moved downstream through spillways and turbines (New and Kutty 2010). However, there is also evidence suggesting that higher stocking levels could yield greater recaptures in the Pak Mun Reservoir. Stocking of 5 million prawns, during 1995 – 1998, resulted in 1 % recapture, meanwhile stocking of 40 million prawns, between 2003 and 2007, returned 2.5 % (Kwangkhang, unpublished data).

In terms of production, the experience from the Pak Mun Dam was that stocking of 2 million *M. rosenbergii* PL resulted in a production of 3 kg/ha/yr (Sripatprasite and Lin 2003), and by stocking 40 million PLs, the production was as high as 11.5 kg/ha/yr (Jaiyen 2003). Rithcharung and Srichareondham (1998) reported that, by stocking 3 million PL to Bung Boraped, the catch per unit effort increased from month-5 to month-11 after stocking. Meanwhile, of about 5 million PL that had been continuously stocked into Ubolratana Reservoir between 1981 and 1986, a return of about 24.5 tonnes of the *M. rosenbergii* was obtained (Chumnongsittsthum 1987).

The economic benefit from *M. rosenbergii* is higher than for any other stocked fish species. Sripatprasite and Lin (2003) reported that catches of prawn contributed 53.8 % to the total fish catch by weight, but 97 % to the economic value of the landings in the Pak Mun Reservoir. A five year monitoring program undertaken by Chumnongsittsthum (1987) revealed that the economic profit of stocked *M. rosenbergii* in Ubolratana Reservoir was 382 %. Renunual and Silapachai (2005) found that only with a low recapture rate of 1.8 % of stocked *M. rosenbergii* in Bangphra Reservoir, economic profit was 722 %.

The high economic return reflects the high market demand of *M. rosenbergii* and large difference between the cost of production of seed and market price. The cost of the *M. rosenbergii* PL is about 0.15 Thai Baht<sup>2</sup>, whereas those for the fingerlings of Chinese carps

2. 1 US dollar = approximately 30 Thai Bah t.

and Thai indigenous fishes, are about 0.3 and 1.0 Thai Baht, respectively (DoF 2014b). The market prices of the stocked Chinese carps and Thai indigenous fishes average 20 and 50 Thai Baht/kg, whereas the market price of the *M. rosenbergii* is ranges from about 150 Thai Baht/kg from the fishers to as high as 600 Thai Baht/kg to the consumers. Stocked *M. rosenbergii*, therefore, benefits traders at various levels of the market chain(s), and provides employment opportunities and income for all related sectors (Jaiyen 2005).

## Conclusion

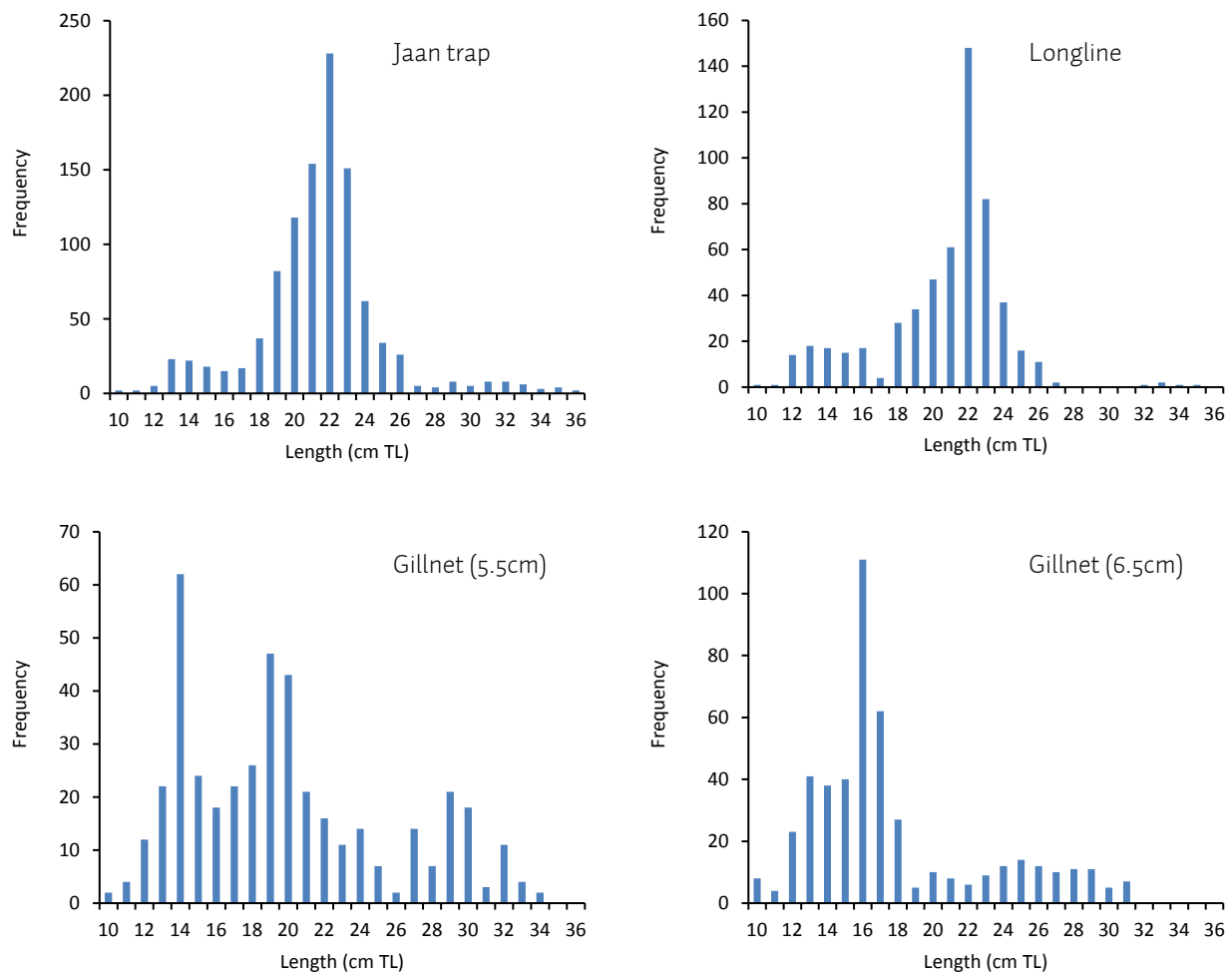
The information available on *M. rosenbergii* culture-based fisheries in Thailand suggests that the fishery has achieved considerable success, especially in terms of economic benefits, even though the recapture rate is low compared to stocked fish species. Stocked prawns are generally harvested after 6-8 month at a size and weight around 20 cm TL and 80 g, respectively. Despite considerable success in CBF development based on *M. rosenbergii*, there is a lack of information on appropriate

stocking strategy (ies), ecological impacts of stocked populations. Guidelines with regard to the optimum size of released seed as well as appropriate time and location to be stocked are required to optimise CBF yields of *M. rosenbergii*.

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**Figure 4. Size variations of catches of giant freshwater prawn from four different fishing gears used in Thailand.**





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