

THE SPREAD OF THE AUSTRALIAN REDCLAW CRAYFISH (*Cherax quadricarinatus* von Martens, 1868) IN MALAYSIA

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Abstract: The introduction of alien crayfish species has resulted in changes of native species communities throughout the world. The Australian redclaw crayfish *Cherax quadricarinatus* were introduced in Malaysia for aquarium and aquaculture industry since 1980s. The current paper presents the distribution of the species in Malaysia through sampling trips, market surveys and focused interviews. Multiple size specimen in populations obtained from Sungai Benut (Johor) and Suai (Sarawak) confirms the establishment of the species in both west (Malaysian Peninsular) and east Malaysia (Borneo). There are no reports yet of any native species displacement or other ecological impacts in Malaysia caused by the redclaw introduction, although the potential cannot be dismissed totally. The growing redclaw culture industry could facilitate the spread of *C. quadricarinatus* faster and further in the near future.

Keywords: Alien species, *C. quadricarinatus*, biological invasion, decapoda.

Introduction

Introduced species can be defined as species that were translocated outside its natural or historical range, either accidentally or on purpose, by various means (Khairul Adha *et al.*, 2013). In their new environment, these species can be classified as non-native or alien species. In Malaysia, the introduction of alien species and issues related to it in the freshwater ecosystem are undervalued, resulting in the low number of research and scarcity of information related to the invaders (Othman & Hashim, 2003; Khairul Adha, 2013).

The redclaw crayfish (*Cherax quadricarinatus* von Martens, 1868) is a species native to river catchments in northern Australia and south-eastern Papua New Guinea (Lawrence & Jones, 2002). It is a non-burrowing and physically robust species that grows relatively quickly in a wide range of environments (Wingfield, 2002; Souty-Grosset *et al.*, 2006; Jones & Ruscoe, 2001). The broad tolerance to environmental factors and attractive colours makes the species ideal for both aquaculture and aquarium industry and translocated to various locations within

Australia and Oceania region (Doupé *et al.*, 2004; Coughran & Leckie, 2007; Rubino *et al.*, 1990), Southern Europe (D'Agaro *et al.*, 1999; Koutrakis *et al.*, 2007; Gozlan 2010), Eastern and Southern Africa (Nakayama *et al.*, 2010; de Moor, 2002), the Americas (Medley *et al.*, 1994; Wickins & Lee, 2002; Vazquez & López Greco, 2007; Romero, 1997; Volonterio, 2009), the Caribbean (Medley *et al.*, 1994; Vazquez, 2008), the Middle east (Karplus *et al.*, 1998), Eastern and South East Asia (Medley *et al.*, 1994; Xiaoxuan & Edgerton, 2001; He *et al.*, 2012; Chang, 2001; Alimon *et al.*, 2003; Edgerton, 2005).

In Malaysia, the redclaw is locally known as freshwater lobster due to its lobster-like appearance and habitat. The exact year of the redclaw introduction into Malaysia are unknown but commercial scale culturing activity of this species was recorded since 2003 in the southern part of Malaysian peninsula (Alimon, 2003). The culture of redclaw crayfish has become an interest for the local population and viewed as a way to gain extra income. Culture are usually for food with target size of 6 to 8 inch length but high demand on

the juveniles prompt more focus on breeding rather than grow out activities.

Consequently, wild population of the redclaw were recorded in the southern Malaysian peninsula and east of Malaysia by Johan *et al.* (2012). The existence of the crayfish has caught the attention of fishermen as they suffer losses due to the damage caused by the crayfish to their catch and fishing nets. The current paper presents the further spread of *C. quadricarinatus* in Malaysia.

Material and Methods

We conducted an initial survey by providing colour images of the redclaw via social media, especially on web pages related freshwater fisheries and freshwater angling. From that survey, we managed to obtain rough information on the locations inhabited by the redclaw, location of redclaw farming establishment, related personnel contacts such as owners of redclaw farms, local fishermen and recreational anglers. To obtain first hand information, we travelled to the locations that were inhabited by the redclaw crayfish based on our finding from the initial survey and approached the locals with colour image of the redclaw and a set of standard questions.

In west Malaysia, specimens were obtained primarily from local fishermen and in Suai (Sarawak), specimens were caught using the combination of two baited folding crab traps and a three layer net (4 cm x 14 cm x 4 cm) for a trapping session. The traps were baited with punctured cans of sardine, inside a sock before tied to the inner chamber of the traps. The traps and net were set for 24 hours for each trapping session. We managed to conduct 18 trapping session from September 2014 to May 2015. All of the *C. quadricarinatus* specimens were measured for Total Length (TL) in millimeters (mm), and sorted according to their gender. Specimens were identified following identification keys from Holdich (2002) and Ahyong and Yeo (2007).

Results and Discussion

Distribution of Cherax quadricarinatus

We were able to record wild populations of the *Cherax quadricarinatus* namely in Machap dam and Benut river (Johor), Ayer Keroh lake and Timun river (Melaka), Puchong Perdana Lake in Selangor and streams in Suai, Sarawak (Figure 1).

Our interview with the local anglers, fishermen and fishery officer suggests that

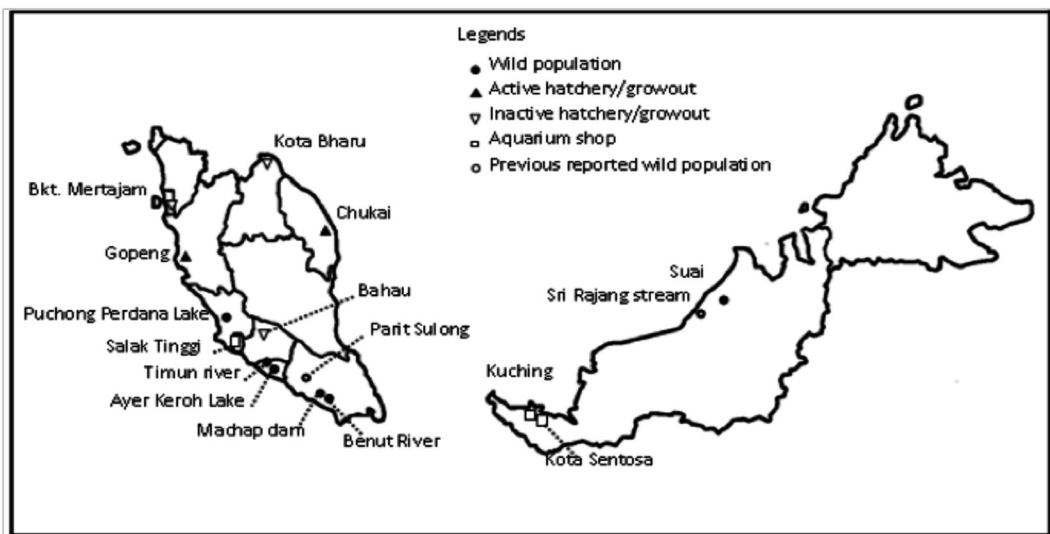


Figure 1: Marked locations associated with wild redclaw population, redclaw breeding, culture and trading

the species were available around Johor including Benut river since the 1980s but enter Machap dam after a flood in 2006 (Table 1). In Melaka, anglers that were interviewed at Ayer Keroh lake suggest that they noticed the presence of *C. quadricarinatus* since the end of 1990s. Results of our interview with anglers of Puchong Perdana lake suggest that *C. quadricarinatus* was already in the lake in the 1990s but become abundant in 2008. In Suai, Sarawak, the interview with local chief, villagers, and staffs in the oil palm plantation suggests that the redclaw were available since 2011 but noticed the increasing number in 2014 and 2015. We managed to obtain 25, 2 and 10 *C. quadricarinatus* individuals from local anglers and fishermen at Benut river, Ayer Keroh lake and Puchong Perdana lake respectively, although the ones from Puchong Perdana have already been graded, resulting in small and uniform-sized samples (Table 1).

Hatcheries and small scale culture facilities of the redclaw were recorded in Kelantan, Terengganu, Perak, Pulau Pinang and Negeri Sembilan. According to the owners, the broodstock were obtained from Australia and Indonesia (international translocation) or from Johor (domestic). While most of the owners suffered from high maintenance and overhead resulting inactive or closed hatcheries, the ones in Perak and Terengganu remains active.

Redclaw sold as aquarium pets were recorded in Kota Samarahan, Kuching (Sarawak), and Salak Tinggi (Selangor) (Figure 1). We also found four other crayfish species that were sold in the aquarium industry which are *Cherax albidus*, *Cherax destructor*, *Procambarus clarkii* and *Procambarus alleni*.

Following the timeline on the discovery of the wild *Cherax quadricarinatus* population, our study suggests that the redclaw crayfish were first translocated into Malaysia in the 1980s in Johor, where the species then spread to the north along the west coast of Malaysian Peninsula. In Sarawak, the specific time of the redclaw introduction is unknown, but the population seems to start in the region between Bintulu and Miri following reports by Johan *et al.* (2012). Currently, there are no records of wild *C. quadricarinatus* population in the states other than Johor, Melaka and Sarawak but the spread of *C. quadricarinatus* may expand together with the increasing number of redclaw culture facilities. Second-hand information suggests that there are more hatcheries or culture facilities in Malaysia which could speed up and facilitate the establishment of the species further.

The spread of the redclaw are probably due to escapes from aquaculture and aquarium industries, similar to previous reports in Israel, Mexico, Puerto Rico and Singapore (Karplus

Table 1: Interview findings and size range of specimens obtained

Location	No. of Respondent	Year of Discovery	No. of Specimen	Size range (TL in mm)
Machap dam	4	2006	-	-
Benut river	3	1980s	25	68-156
Timun river	2	2004-2006	-	-
Ayer Keroh lake	7	1997-2000	2	86-144
Puchong Perdana lake	9	1990s	10	73-97
Streams in Suai	5	2011	136	60-184

et al., 1998; Williams, *et al.*, 2001; Ahyong & Yeo 2007; Bortolini *et al.*, 2007 and Belle *et al.*, 2011). The Malaysian equatorial climate are very suitable for tropical freshwater crayfishes including the redclaw crayfish. With average temperature of 27 °C, growth and reproduction of the redclaw crayfish are maximize (Karplus *et al.*, 1998 & Reynolds, 2002). Although there are other crayfish species such as the highly invasive *Cherax destructor* and *Procambarus clarkii* in the Malaysian aquarium industry, *C. quadricarinatus* is the only freshwater crayfish species that were reported to establish their population in Malaysian freshwater habitats. This probably has to do with the superior traits of *C. quadricarinatus* in growth, reproduction and size compared to the other two species mentioned above (Belle *et al.*, 2011). Following the fact that *C. quadricarinatus* have traits that are appealing for aquaculture industry, it is possible that the species have been translocated to Malaysia in large numbers for broodstocks. Indeed, alien species are likely to become established when they are introduced in large numbers of individuals or introduced repeatedly (Alpert, 2006). Furthermore, aquaculture has always be the main pathway of alien fish introduction in Malaysia and contributes to 64% of alien fish species introduction (Khairul Adha *et al.*, 2013).

Potential Negative Impacts

Invasive species are the second major contributor of biodiversity loss (Chandra & Gerhardt, 2008) as they disrupt the balance of the receiving environment via competition for shelter and resources, spread various diseases, direct predation on native species and fish eggs, and alter habitat by burrowing activity and grazing on macrophytes (Holdich, 1988; Light *et al.*, 1995; Laurent, 1997; Lodge *et al.*, 2000; Geiger *et al.*, 2005 and Rodríguez *et al.*, 2005). The redclaw crayfish exhibits the general characteristic of successful crayfish invaders with wide dietary requirements and high reproductive potential (Kats & Ferrer, 2003). The fact that there are currently no

records on environmental damage caused by the redclaw in Malaysia could probably due to the underestimation on bioinvasion risks issues and lag phase in detectable impacts and establishment of the species (Othman & Hashim, 2003; Sakai *et al.*, 2001; Lodge *et al.*, 2006 & Yeo, 2010). Crayfish species can also threaten human health if they are consumed without proper cooking and handling. Crayfish species are known to be intermediate hosts for parasitic digean flatworms such as the lung flukes *Paragonimus* species and rickettsia-like parasites which can be transmitted to vertebrates and linked to various diseases in humans (Edgerton & Prior, 1999; Lane *et al.*, 2009 and Romero & Jimenez, 2002). They can also act as disease vectors for harmful microbes such including *Vibrio cholerae*, *Vibrio mimicus*, enterococci, and *Escherichia coli* (Wong *et al.*, 1995; Eaves & Ketterer, 1994 and Edgerton *et al.*, 2002).

Conclusion

Wild populations of the invasive *Cherax quadricarinatus* can be found in lakes, small rivers and waterways of several locations in Malaysia. With the increasing of facilities for redclaw culture both in aquaculture and aquarium industry, the spread of the species may be expanded further and faster.

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Appendices

Appendix A

Questions for fishermen/anglers:

1. The first time when the respondents saw/ caught the species.
2. Trends in their catch. What species usually caught. Increase/decrease in the redclaw population. Increase/decrease of the variety of their catch.
3. The commercial value of the redclaw crayfish (self consume or sell). Sell to whom and what price?

Questions for farm owners:

1. When they started the facility. What activities conducted in the premises. Where do they get their initial stocks from.
2. When and why their business closed

Appendix B

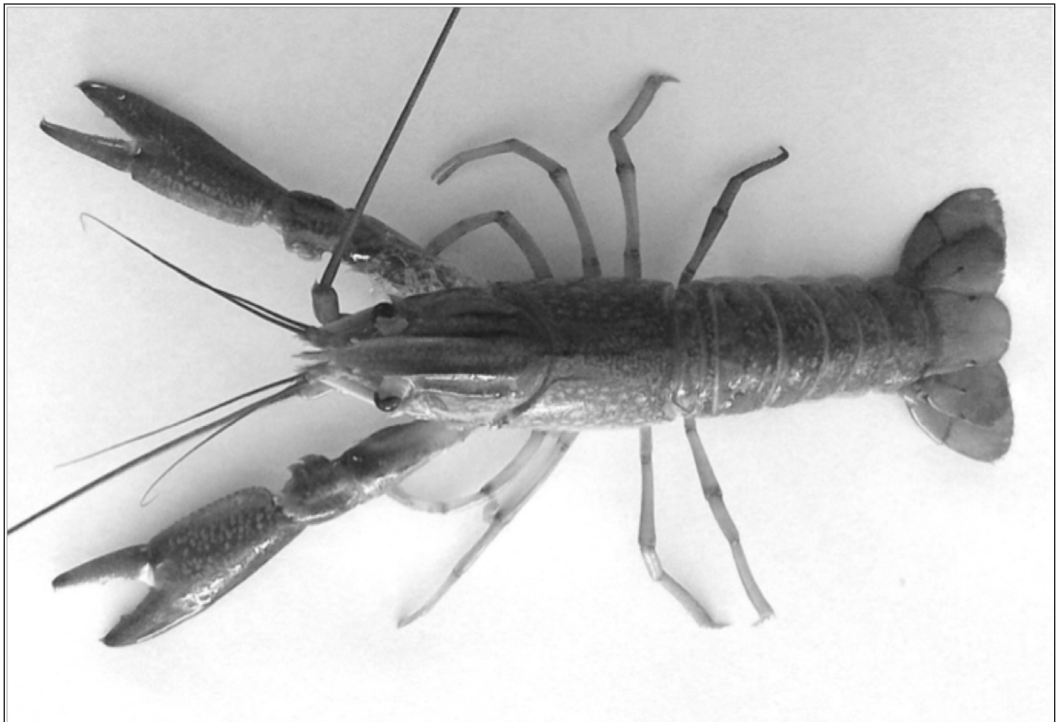


Figure 2: A redclaw crayfish (*Cherax quadricarinatus* von Martens, 1868)