

## NEW OBSERVATIONS OF THE EXOTIC AUSTRALIAN RED-CLAW CRAYFISH, *CHERAX QUADRICARINATUS* (VON MARTENS, 1868) (CRUSTACEA: DECAPODA: PARASTACTIDAE) IN SINGAPORE

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### INTRODUCTION

The tropical Australian red-claw crayfish *Cherax quadricarinatus* (von Martens, 1868) has been translocated worldwide as economically important aquaculture and ornamental trade species (Lawrence & Jones, 2002). A member of the southern hemispheric freshwater crayfish family Parastacidae, the native range of *Cherax quadricarinatus* comprises river catchments in northern Australia, and south-eastern Papua New Guinea, where it inhabits warm, hard and slightly alkaline waters (pH 7.0–8.5) (Jones, 1990; Lawrence & Jones, 2002). *Cherax quadricarinatus* displays a considerable degree of phenotypic variability throughout its native range and has the ability to survive and reproduce under various biotic and abiotic conditions from tropical to temperate zones (Jones, 1995; Karplus et al., 1998). The growth rate is usually high and individuals might reach a size of 250 mm total body length or up to a wet weight of 600 g in nine months (Lawrence & Jones, 2002). In Singapore, this crayfish is commonly sold as an ornamental aquarium species for its bright and conspicuous colouration and is also popular because of its hardiness. Mature males possess a characteristic decalcified red patch on the outer surface of the major chelae, hence the common name Australian red-claw crayfish, or just red-claw (Figs. 1, 2), and both sexes display bright red to maroon lateral and caudal highlights on a blue to blue-green body. Animals are readily available in wet markets and aquarium shops, and in 2009, the price ranged from S\$1.50 for juveniles to S\$5.00 for adult individuals (our observations).



Fig. 1. *Cherax quadricarinatus*, dorsal view of male, Upper Peirce Reservoir, Singapore. Total body length = 176.4 mm; cephalo-thorax length = 65 mm. (Photograph by: Tan Heok Hui).



Fig. 2. *Cherax quadricarinatus*, lateral view of male, Upper Peirce Reservoir, Singapore. Total body length = 176.4 mm; cephalothorax length = 65 mm. (Photograph by: Tan Heok Hui).

*Cherax quadricarinatus* is widely recognised as an invasive tropical crayfish species, which has already established naturalised populations in several tropical and subtropical countries, e.g., South Africa, Mexico, and Puerto Rico (Williams et al., 2001; de Moor, 2002; Bortolini et al., 2007). Feral *Cherax quadricarinatus* in Singapore were reported for the first time in 2007 in three Singapore reservoirs (Ahyong & Yeo, 2007), but, to date, there have been no published records from the numerous small, isolated water bodies in Singapore such as park and golf course ponds. This article presents the first record of a feral *Cherax quadricarinatus* population in a pond: “Little Guilin Lake” in Bukit Batok Town Park, Singapore.

#### SITE DESCRIPTION

Bukit Batok Town Park, which includes Little Guilin Lake, was constructed in 1984 by landscaping and flooding a disused granite quarry (NParks, 2009). As a town park, it is located in the middle of an urban residential area and therefore is easily accessible to the public. The park itself comprises 42 ha of land and resembles a famous scenic area in China. Little Guilin Lake, with an approximate surface area of 4.5 ha, represents one of many such park ponds in Singapore, characterised by steep granite walls, artificial rock bunds, open grassy patches and secondary rain forest vegetation or exotic and native shrubs at its edges. The lake shore in the surveyed area consists of patchily-distributed submerged granite boulders of varying sizes, which have numerous crevices and cavities below and in between that provide ideal shelter and habitat for *Cherax quadricarinatus*. Where granite boulders are absent, the shore consists of grassy patches with silty or sandy benthic substrate, sometimes also including roots of riparian trees. Macrophytes are absent, and the water depth in the surveyed area varies between 0.3–0.6 m.

#### OBSERVATIONS

On 22 Nov. 2009 between 1700–1900 hours, eight individuals of *Cherax quadricarinatus* were captured at Little Guilin Lake along a 15–20 m stretch of shore (1°21'24.26"N 103°45'13.60"E to 1°21'25.61"N 103°45'14.41"E) at the public fishing area opposite the main granite wall. At that time, the crayfish were emerging from their shelters between the submerged granite boulders to forage. The animals were caught by recreational fishermen using a short fishing rod and raw pig skin as bait. If an individual was observed to be emerging, it was presented with the bait and if it approached the bait and started feeding, the crayfish was gently lifted with the fishing rod and captured with a scoop net. Using that method, eight mature individuals (one female and seven males) ranging in size from 45–65 mm cephalothorax length were obtained. Both sexes were conspicuously coloured with lateral red and maroon highlights on a blue-green to brown abdomen, and males possessing the distinctive bright red patch on the outer surface of the first pair of chelae (Fig



Fig. 3. *Cherax quadricarinatus* from Little Guilin lake, Bukit Batok town park, Singapore (in cooler box). A captured mature male is feeding on raw pig skin used as bait. (Photograph by: Christina Belle).

1, 2). Besides the distinct colouration, the female individual was also identified as *Cherax quadricarinatus* based on the following diagnostic morphological features: (1) the presence of four long and distinct carinae (ridges) on the dorsal surface of the cephalon (hence *quadricarinatus*); (2) three to five pairs of marginal spines on the rostrum; (3) three distinct lateral cervical spines situated laterally along the cervical groove; (4) two caudolateral spines on the telson, and (5) dense ventral patches of setae on the merus and carpus of the major chelipeds (Jones & Morgan, 1994). No voucher specimens were obtained at this time because the captured animals were kept by the fishermen as ornamentals; however, photographic evidence is available (Fig. 3).

## DISCUSSION

High individual densities of naturalised *Cherax quadricarinatus* originating from aquaculture are usually described in heavily impacted or artificially constructed water bodies such as park ponds and reservoirs (Bortolini et al., 2007; Vazquez, 2008). For this observation, the catch per unit effort (CPUE), excluding 10 other observed individuals which were not targeted as they were outside the transect area, was four crayfish per hour. This is the highest *Cherax quadricarinatus* CPUE observed in Singapore so far, as in the reservoirs the average was much lower [max 0.7 crayfish per hour (Belle et al., in prep.)]. The relatively higher density of *Cherax quadricarinatus* in Little Guilin Lake, in comparison to the reservoirs, suggests that it has found a highly suitable habitat to persist, even if reproductive females are yet to be captured. In addition, as human release of aquarium trade specimens has been implicated as the major source of introduction for this exotic species in Singapore (Ahyong & Yeo, 2007; Belle et al., in prep.), the higher density may also be a reflection of higher propagule pressure faced by Little Gulin Lake, being an urban park pond that is smaller and more easily accessible to the public than the reservoirs.

Invasive species are defined as species that establish themselves in natural or semi-natural ecosystems and negatively affect the habitats in the invaded area, either economically, environmentally, or in terms of human health (Lodge et al., 2006). Hardly anything is known about the potential impacts of *Cherax quadricarinatus* on the native freshwater benthic community in Singapore, but any environmental effect that the population in Little Guilin Lake might have is likely to be localised, as, unlike Singapore's reservoirs, it is an isolated water body without connections to natural freshwater habitats. Potential human health threats presented by the crayfish in Little Guilin Lake could result from the crayfish not being properly handled or if they are consumed without being properly cooked. Like other crayfish, *Cherax quadricarinatus* is a potential disease vector for lethal microbes including *Vibrio cholerae*, enterococci, and *Escherichia coli* (Edgerton et al., 2002). In North America and East Asia, crayfish are also known to be intermediate hosts of parasitic digean flatworms that can be transmitted to vertebrates including humans, e.g., the lung flukes *Paragonimus* species (Lane et al., 2009). Depending on water quality, certain crayfish tissues like the hepatopancreas and the intestines may also accumulate high levels of cyanotoxin (Saker & Eaglesham, 1999).

## CONCLUSIONS

This first report of feral *Cherax quadricarinatus* from an urban pond illustrates its increasing spread in Singapore. The fact that the pond is isolated from any of the reservoir systems that the species has been reported from (see Ah Yong & Yeo, 2007; Belle et al., in prep.), also supports the suggestion by Ah Yong & Yeo (2007) that multiple independent introductions of *Cherax quadricarinatus* have probably occurred, showing this to be an important factor behind the spread of the species in Singapore.

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