

Short Communication

First record of the invasive Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853 (Crustacea: Brachyura: Varunidae) from Singapore

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Abstract

The introduced Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853, considered amongst '100 of the world's most invasive alien species', has been well-documented in Europe and North America. Most recently, it was recorded in subtropical western Asia (northern Iran). Here, we report *E. sinensis* from Singapore; the first record of this species in the wild from the tropics. While the likelihood of establishment of this temperate species in the tropics is low, potentially high and sustained propagule pressure could still allow it to pose a potential threat to native ecosystems and biota, a scenario with precedence in Singapore. Efforts by regulatory agencies are urgently needed to monitor and prevent the introduction of this potential invasive alien species.

Key words: Crustacea; Brachyura; Chinese mitten crab; *Eriocheir sinensis*; invasive alien species; tropics; Singapore

Introduction

The Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853, is an invasive catadromous species (Peters 1933; Veldhuizen 2001; Herborg et al. 2005; Bentley 2011) originating from the low-lying coastal regions of northern China and the western Korean Peninsula (Panning 1938; Wang et al. 2008; Naser et al. 2012; Xu and Chu 2012). The species has established in Europe and North America, most likely introduced via ballast water or hull fouling of transoceanic vessels as well as live imports for seafood trade and aquaculture (Panning 1938; Herborg et al. 2003, 2005; Bentley 2011; Gollasch 2011). Its well-documented ecological and economic impacts have led it to being named amongst '100 of the world's most invasive alien species' (Lowe et al. 2000).

When mitten crab populations reach sufficiently high magnitudes, they cause economic and ecological impacts, including the damaging and weakening of riverbanks and levees by burrowing activities (Rudnick et al.

2005), interference with commercial fishing (Veldhuizen 2001), predation on native species (Gollasch 2011), and competition with native species for food and space (Clark et al. 1998).

Eriocheir sinensis introductions and impacts have so far been restricted to temperate (or even subtropical) regions in parts of central and northern Europe as well as North America (Naser et al. 2012). Until now, the species has not been reported from tropical regions. Here we report the sighting of *E. sinensis* in Singapore, and briefly discuss the implications of this discovery.

Results and discussion

A single specimen of *Eriocheir* was sighted and photographed by the first author at Sembawang Beach, Singapore (1°27'42.47"N, 103°50'25.94"E) (Figure 1), on 22nd October 2010 (~1600 hrs) on a tidally exposed sandbar east of the northern end of Sembawang Road (Figure 2). The unsexed specimen (estimated carapace width >70 mm) was found hidden beneath a piece of discarded

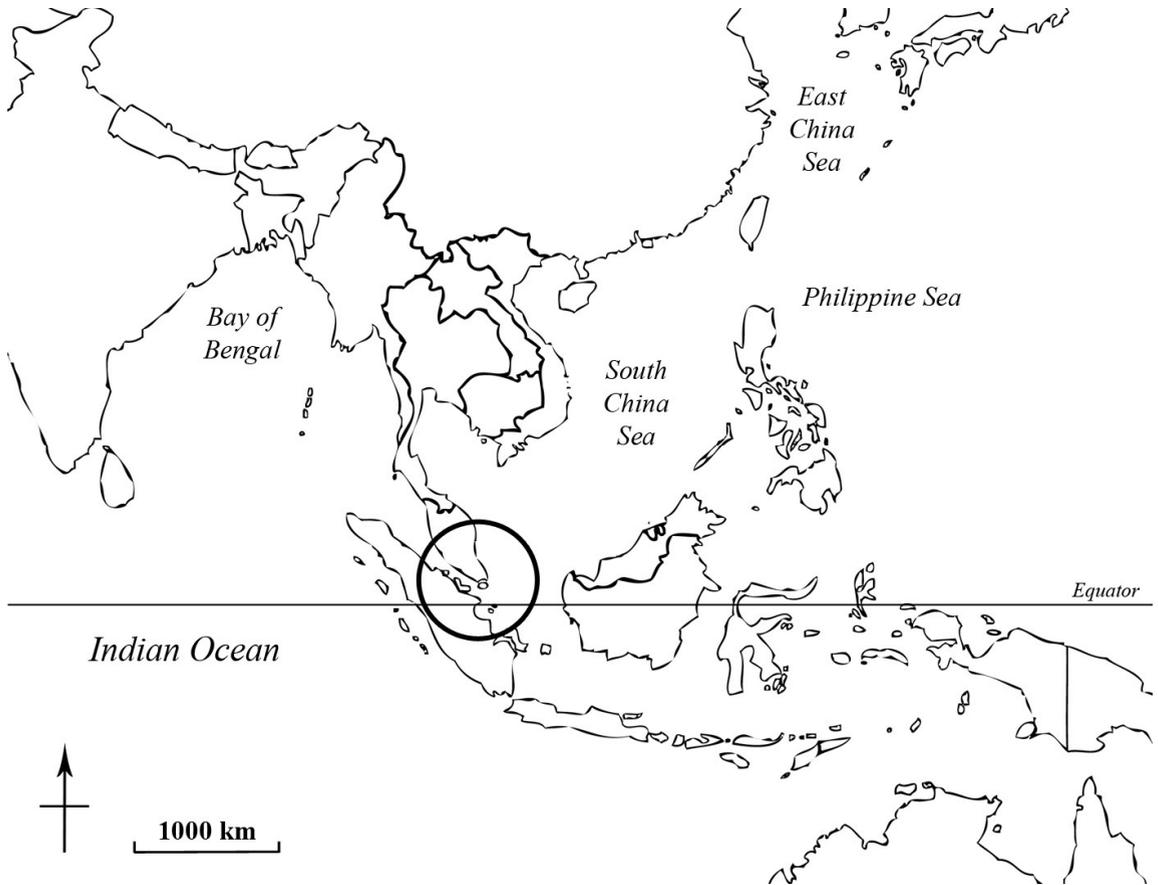


Figure 1. Map showing Singapore's tropical location (circled) at the southern tip of the Malay Peninsula.

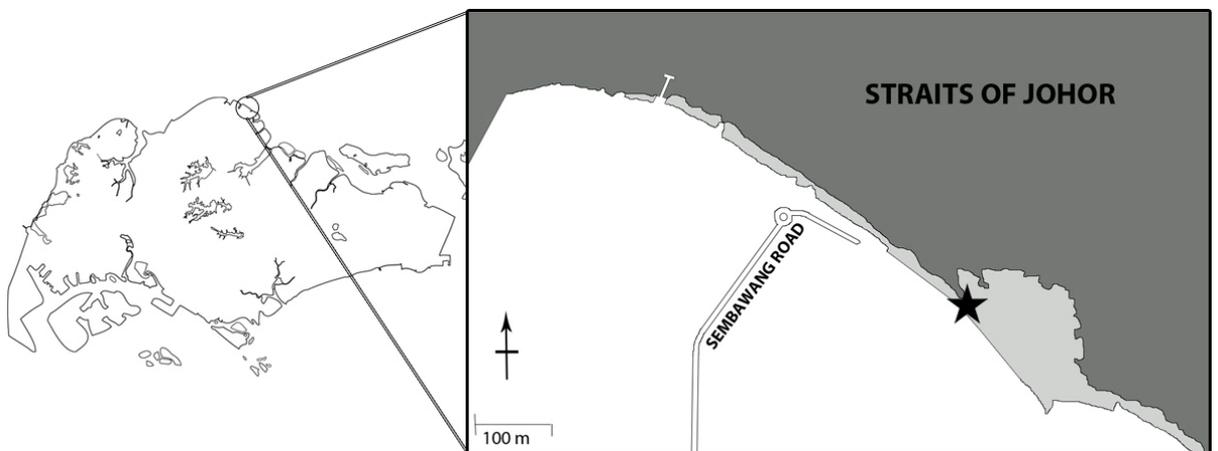


Figure 2. Map showing Sembawang Beach on the northern coast of Singapore. Light shading denotes tidally-exposed shoreline. Star demarcates where the *Eriocheir sinensis* specimen was sighted ($1^{\circ}27'42.47''\text{N}$, $103^{\circ}50'25.94''\text{E}$).

Table 1. Characters distinguishing *Eriocheir sinensis* from *E. hepuensis*, *E. japonica* and *E. ogasawaraensis* (from Guo et al. 1997; Komai et al. 2006; Naser et al. 2012). Character states of *E. sinensis* clearly discernible in the photographs of the presently reported specimen in Figure 3 are marked with asterisks.

Characters/Species	<i>E. sinensis</i>	<i>E. hepuensis</i>	<i>E. japonica</i>	<i>E. ogasawaraensis</i>
Teeth on frontal margin	Sharp, acutely triangular*	Blunt, broadly triangular	Rounded median teeth	Rounded median teeth
Median cleft on frontal margin	Narrow, deep V-shaped	Wide, moderately deep V-shaped	Shallow	Shallow
Hind legs	Slender, long*	Broad, stout	Broad, stout	Slender, moderately long
Carapace physiognomy	Strongly domed*	Slightly convex	Relatively flat	Relatively flat
Epigastric cristae	High*	Low	Low	Moderately high
Protogastric cristae	High	Low	Low	Low

cardboard. It appeared healthy and active and displayed a defensive posture when disturbed. The specimen was not collected, but was later identified through photographic evidence (Figure 3).

The crab was identified to genus by the dense patches of setae covering white-tipped chelae, and a quadrate carapace with four anterolateral teeth (Guo et al. 1997; Veldhuizen 2001) and considered to be the Chinese mitten crab *E. sinensis*. There are currently three other recognised species of *Eriocheir* De Haan, 1835, viz., *E. hepuensis* Dai, 1991, *E. japonica* (De Haan, 1835), and *E. ogasawaraensis* Komai, Yamasaki, Kobayashi, Yamamoto and Watanabe, 2006 (for details and illustrations of all four species see Ng et al. 2008; Naser et al. 2012). The morphological differences between *E. sinensis* and its congeners are summarised in Table 1.

This observation from Singapore represents the first record of *Eriocheir sinensis* in the wild from the tropics. Although the species is popular in the live seafood trade in Southeast Asia (Naser et al. 2012), there have hitherto been no reports of the species introduced into the wild from the region.

Following the sighting on 22nd October 2010, two follow-up surveys were carried out at Sembawang Beach in December 2010, both of which yielded no Chinese mitten crabs. There has so far been no further evidence of *E. sinensis* in the wild of Singapore, and it is likely that the sighting was an isolated incident. The individual was probably an escapee or a deliberate release originating from the live seafood trade (Yeo et al. 2011), of which there is considerable volume in Singapore (see later). The appearance of this crab in the wild potentially could also be

attributed to religious animal release practices in order to gain spiritual merit (see Shiu and Stokes 2010).

Despite being a subtropical to temperate species, it is not known whether Chinese mitten crabs could become established in Singapore's tropical waters. While *E. sinensis* has not been observed to reproduce at temperatures above 18–20°C (eggs often aborted when water temperatures exceed 15–20°C) (Cohen and Weinstein 2001) and reported optimum for larval development is 15–18°C (Anger 1991), complete larval development has been induced in the laboratory at up to 25°C (Kim and Hwang 1995). In any case, introduced adult mitten crabs could still persist or pose invasive threats in Singapore waters where average sea surface temperature is 29–30°C (Gin et al. 2006). Juveniles and adult Chinese mitten crabs are in fact able to withstand water temperatures up to 32°C, and 15–30°C has often been cited as optimal for growth (Cohen and Weinstein 2001; Hymanson et al. 1999).

Large numbers of mitten crabs are imported into Singapore for the live seafood trade (Yeo et al. 2011; Naser et al. 2012). An estimated 12.9 tonnes of Chinese mitten crabs were imported in 2009 (Quek 2010). In restaurants, a single crab can fetch up to US\$50 (Wee 2011), though small individuals (~110g) can be purchased off supermarket shelves for as little as US\$5 (Quek 2010) (Figure 4).

The import of so many tonnes of mitten crabs into Singapore together with their popularity, relatively low cost, and easy availability means that the potential for further escapes or deliberate release of mitten crabs in Singapore is extremely high. This is especially true if a female crab spawns (produces eggs) as then it is of little commercial value and could just be discarded.

Figure 3. The *Eriocheir sinensis* specimen sighted and photographed on Sembawang Beach on 22nd October 2010 (~1600 hrs). Photograph by Bi Wei Low.



Figure 4. *Eriocheir sinensis* on sale at a restaurant in Singapore in October 2012. Photograph by Darren C. J. Yeo.



However, this is the first time a mitten crab has been recorded in the wild in Singapore. But given the sustained and even increased vigour of juvenile and adult Chinese mitten crabs in warmer temperatures, this potentially high and persistent propagule pressure (i.e. frequent and sufficiently high number of crabs escaped or released) poses a threat to the surrounding tropical ecosystems and biota. Such as scenario has been observed with other aquatic species imported into Singapore for the live food trade (American bullfrog, *Lithobates catesbaianus*) and ornamental pet trade (red eared terrapin, *Trachemys scripta elegans*), pest species that are not established, but still present in considerable numbers in the wild because of frequent releases (Yeo and Chia 2010; Ng and Lim 2010).

In light of the present discovery of an apparently healthy and vigorous adult mitten crab individual in the wild, efforts should be made by the relevant regulatory agencies, in collaboration with the live seafood industry and the public, to monitor and prevent further introduction of this invasive alien species. The basis of effective prevention of introduction of *E. sinensis* into the wild (through escapes or deliberate releases) should be through education and awareness programmes. In addition, holding, transport, and handling facilities and practices in the live seafood industry should also be reviewed in order to minimise the risk of this species being introduced into the wild in large enough numbers so as to become invasive.

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