

A NEW LOCALITY OF THE SINGAPORE FRESHWATER CRAB *JOHORA SINGAPORENSIS* (CRUSTACEA: BRACHYURA: POTAMIDAE) IN THE BUKIT TIMAH NATURE RESERVE

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ABSTRACT. — A population of the Singapore freshwater crab, *Johora singaporensis*, was discovered at a newly located hill-stream site in the eastern part of the Bukit Timah Nature Reserve. This discovery highlights the value of hill-stream habitats and their important role in the protection of endemic and endangered aquatic fauna in Singapore.

KEY WORDS. — *Johora singaporensis*, decapod, Potamidae, endemic, hill streams, Bukit Timah Nature Reserve

INTRODUCTION

The critically endangered Singapore freshwater crab, *Johora singaporensis* (Ng, 1986), is endemic to Singapore (Yeo et al., 2008; Tan et al., 2010) and has very stringent habitat requirements. To date, it has only been found in three hill-stream drainages in Bukit Batok, Bukit Gombak, and Bukit Timah (Ng, 1986; 1990; Yeo et al., 2008; Ng et al., 2014, Ng et al., 2015).

Within the Bukit Timah Nature Reserve (BTNR), *Johora singaporensis* was previously recorded only from two hill streams in the south-west of the hill, including the type locality—Jungle Fall Valley. However, the crab has not been sighted in Jungle Fall Valley since the late 1990s and is believed to be extirpated most probably due to the acidification of the stream water to which the causes of acidification are still in the process of investigation (Ng et al., 2014). Here, we present a new locality of the crab in the eastern side of the nature reserve, situated within a hill valley with steep slopes. This site has not been surveyed thoroughly before owing to its poor accessibility, though it has similar characteristics to the three hill stream drainages mentioned above.

OBSERVATIONS

During a biodiversity survey of freshwater streams in the Bukit Timah Nature Reserve on 9 Feb.2015 (ca. 1400 hours), several individuals of *Johora singaporensis* were observed at a hill stream on the eastern side of the BTNR. One adult female with carapace length of 19.43 mm (Fig. 1) was seen crawling among the leaf litter at the edge of the stream. Two juvenile crabs with carapace lengths 9.82 mm and 9.50 mm, respectively, were also observed. The larger juvenile was hiding under a rock while the smaller crab was collected in a hand net. During the stream survey, hand nets were used to sweep against the stream bank to dislodge fauna residing in the aquatic vegetation and substrate.

A follow-up survey on 23 Feb.2015 (ca. 1000 hours) sampled four sites along the stream. Site 1 was near the headwater, site 2 at the middle of the upper stream, site 3 at the end of the upper stream just before it goes underground, and site 4 at a swampy area after the stream re-emerges. The survey area was approximately 139 m long and the total length of the stream was estimated to be 420 m. The shallow hill stream is located at the bottom of a patch of forest deep inside Bukit Timah Nature Reserve at an elevation of approximately 90 m above sea level. The forest has a steep gradient, forming valleys leading to the stream. The stream width was measured to be between 50–80 cm with a maximum depth of 7 cm. The stream flow was observed to be moderate ($\sim 0.1 \text{ m s}^{-1}$) with high levels of dissolved oxygen (7.74–8.77 ppm) and lower pH (~ 5.5) as compared to the other hill streams outside the BTNR. The substrate was observed to be mostly sand covered by dense leaf litter and interspersed with small rocks. The habitat surrounding the stream is a narrow valley dominated by secondary forest with abundant spiny palms (*Eleiodoxa conferta*), *Byttneria maingayi*, and dense canopy cover. While sites 1 to 3 were noted to have similar stream conditions, Site 4 was slightly different. Site 4 is between the upper and lower streams and includes a swampy area 1.76 m wide. Compared to the other three sites, the pH was measured to be slightly higher (5.91) while the dissolved oxygen level was lower (5.24 ppm) (Table. 1). Some parts of the stream had no visible water, possibly due to the recent dry weather, and most stretches were observed to be covered with fallen logs, decaying wood, as well as a dense network of plant roots.



Fig. 1. Dorsal view of a Singapore freshwater crab (*Johora singaporensis*; female, carapace length 19.43 mm) in the new locality at Bukit Timah Nature Reserve. (Photograph by: Cai Yixiong).

Table 1. Water parameters at sites 1 to 4 during a sampling event on 23 Feb.2015. Abbreviations: Temp. = temperature; ORP = oxidation-reduction potential; EC = electrical conductivity; TDS = total dissolved solids; Sal. = salinity; D.O. = dissolved oxygen.

Site	Temp. (°C)	pH	ORP (mV)	EC ($\mu\text{S cm}^{-1}$)	TDS (ppm)	Sal. (psu)	D.O. (%)	D.O. (ppm)	Turbidity
1	25.81	5.18	267.3	77	39	3.50E-02	108.2	8.77	3.0
2	25.64	5.45	155.6	54	27	2.38E-02	99.6	8.11	15.7
3	25.50	5.88	126.0	45	23	1.98E-02	94.8	7.74	2.7
4	25.31	5.91	92.0	66	33	2.97E-02	64.0	5.24	4.4

Eleven *Johora singaporensis* individuals were observed in the follow-up study with a mixture of adults and juveniles, males and females. More crabs were observed at sites 2 and 3 and none were found at site 4. The nationally endangered Johnson's freshwater crab (*Irmengardia johnsoni*) and *Geosesarma peraccae* were also found at these sites. Other fauna observed in the same stream included tadpoles of the nationally endangered Malayan horned frog (*Megophrys nasuta*), spiny terrapin (*Heosemys spinosa*), freshwater shrimp (*Macrobrachium malayanum*), Malayan forest betta (*Betta pugnax*) and the very rare yellow-banded caecilian *Ichthyophis paucisulcus*.

DISCUSSION

The discovery of this new population of *Johora singaporensis* in a previously less known part of the BTNR further affirms the rich biodiversity harboured by the nature reserve, as it now contains two out of five localities of the critically endangered Singapore freshwater crab (*Johora singaporensis*). The number of individuals and the population density at the sites surveyed indicate that a healthy population of the crab exists in this stream. The additional discovery of the Malayan horned frog in the same stream is also of significance as this endangered frog is confined to the Bukit Timah and Central Catchment nature reserves (Selveindran, 2014). It was previously recorded only from a small area in Bukit Timah and the Nee Soon Swamp Forest within the Central Catchment Nature Reserve. The location of this hill stream away from roads and visitor paths warrants protection from anthropogenic disturbance, creating an important refuge and breeding ground of this species. This highlights the vitally important role that nature reserves and protected areas play in conserving rare and threatened native biodiversity in Singapore.



Fig. 2. Photographs of Sites 1 to 4 at the new locality of *Johora singaporensis* in the Bukit Timah Nature Reserve. (Photographs by: Lim Weihao).

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