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ORIGINAL ARTICLE

Diversity, endemism and conservation of the freshwater crabs of China (Brachyura: Potamidae and Gecarcinucidae)

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Abstract

China lies at the heart of the global center of freshwater crab diversity in tropical Asia, where the 2 most diverse families occur: Potamidae (505 species, 95 genera) and Gecarcinucidae (344 species, 59 genera). China stands out as the country with the highest species richness of freshwater crabs globally. Its fauna comprises 243 species in 37 genera and in 2 families, and species discovery is still progressing at a rapid pace. The vast majority of the species are distributed in southwest, south central and eastern China in the Oriental zoogeographical region. China also stands out as having a highly endemic freshwater crab fauna at the species level (96%) and at the genus level (78%). Although the recent International Union for the Conservation of Nature (IUCN) red list conservation assessment found only 6 out of 228 species (2%) to be threatened (5 potamids and 1 gecarcinucid), the majority (more than 75%) of Chinese species are regarded as data deficient, so the number of threatened species is likely to be a serious underestimate. Threats from increasing habitat destruction and pollution are a major concern due to the rapidly growing economy and massive developments taking place in China. There is therefore an urgent need for increased species exploration and for the development of a conservation strategy for China's threatened (and potentially threatened) endemic freshwater crab species.

Key words: China, conservation, distribution, endemism, Potamoidea.

INTRODUCTION

The past 40 years have seen an upsurge of interest in the biology of China's freshwater crabs that has resulted in a steep increase in the known diversity of this understudied country (see Bott 1967, 1970; Dai 1990, 1995,

1999; Ng *et al.* 2008; Yeo *et al.* 2008; Cumberlidge *et al.* 2009). The first 2 species of Chinese freshwater crabs were described in 1853, and only 2 more species were added during the rest of the 19th century. Species exploration continued to be relatively slow in the early 20th century and only 23 more species had been described from China by 1950 (Wu 1934). The recent upsurge of interest in the freshwater crabs of China took place since the 1970s, and the total number of known species rose dramatically more than eightfold to 228 species by the end of the century, making China currently the most species-rich country in the world (see Ng & Dudgeon 1992; Dai 1999; Yeo & Nguyen 1999). This interest has continued into the 21st

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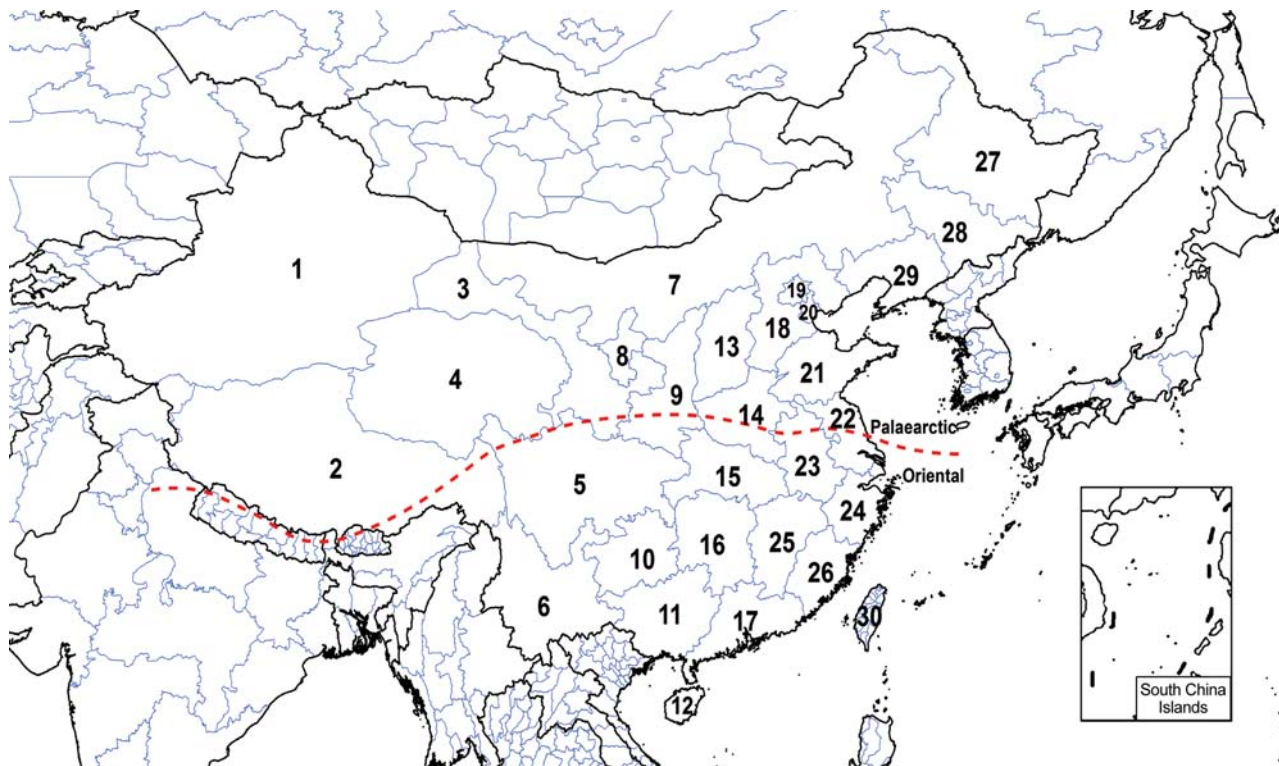


Figure 1 Map of China showing provinces. 1, Xinjiang; 2, Tibet (Xizang); 3, Gansu; 4, Qinghai; 5, Sichuan; 6, Yunnan; 7, Inner Mongolia; 8, Ningxia; 9, Shaanxi; 10, Guizhou; 11, Guangxi; 12, Hainan; 13, Shanxi; 14, Henan; 15, Hubei; 16, Hunan; 17, Guangdong; 18, Hebei; 19, Beijing; 20, Hanjin; 21, Shangdong; 22, Jiangsu; 23, Anhui; 24, Zhejiang; 25, Jiangxi; 26, Fujian; 27, Heilongjiang; 28, Jilin; 29, Liaoning; 30, Taiwan. We did not include Taiwan province in this study of Chinese continental freshwater crabs.

century where almost 20 new species and subspecies have been recognized (see Li & Cheng 2000; Ng & Yeo 2001; Cheng *et al.* 2003; Yeo & Ng 2004, 2007; Shih *et al.* 2007; Cheng *et al.* 2008; Naruse *et al.* 2008; Zhou *et al.* 2008; Zou *et al.* 2008; Cheng *et al.* 2009; Shih *et al.* 2009; Zou *et al.* 2010). Exploration is still continuing rapidly and the species count will continue to rise as taxonomic discrimination improves and exploration continues. Dozens of new species remain undescribed (D. Yeo, T. Naruse, H.T. Shih, X.M. Zhou, unpublished data). Interest in the freshwater crabs of China has also focused on their phylogeny (e.g., Shih *et al.* 2007, 2009; Klaus *et al.* 2009), their medical importance as second intermediate hosts of the human lung fluke, *Paragonimus* (Tai & Sung 1975; Liu *et al.* 2008), and their embryological development (Wu *et al.* 2010; Xue *et al.* 2010).

China straddles 2 major zoogeographical zones, the species-poor Palaeartic zone in northern China and the

species-rich Oriental zone in southwest, south central and eastern China (Fig. 1). The Chinese freshwater crabs belong to 2 Old World families, the Potamidae Ortmann, 1896, which is found throughout the Oriental zone and the warmer parts of the Palaeartic zone (Fig. 2), and the Gecarcinucidae Rathbun, 1904, which is found in the Oriental and Australasian zones (Fig. 3) (Bott 1970; Ng *et al.* 2008; Yeo *et al.* 2008; Cumberlidge *et al.* 2009). The most recent accounts of freshwater crab diversity list the Potamidae as comprising 90 genera and 505 species (40% of the world's freshwater crab diversity) and the Gecarcinucidae as comprising 57 genera and 345 species (27% of the world's diversity) (Ng *et al.* 2008; Yeo *et al.* 2008; Cumberlidge *et al.* 2009). The objectives of the present study are to describe and update our knowledge of Chinese freshwater crab diversity, to describe the patterns of distribution and endemism and to identify the species most vulnerable to extinction.

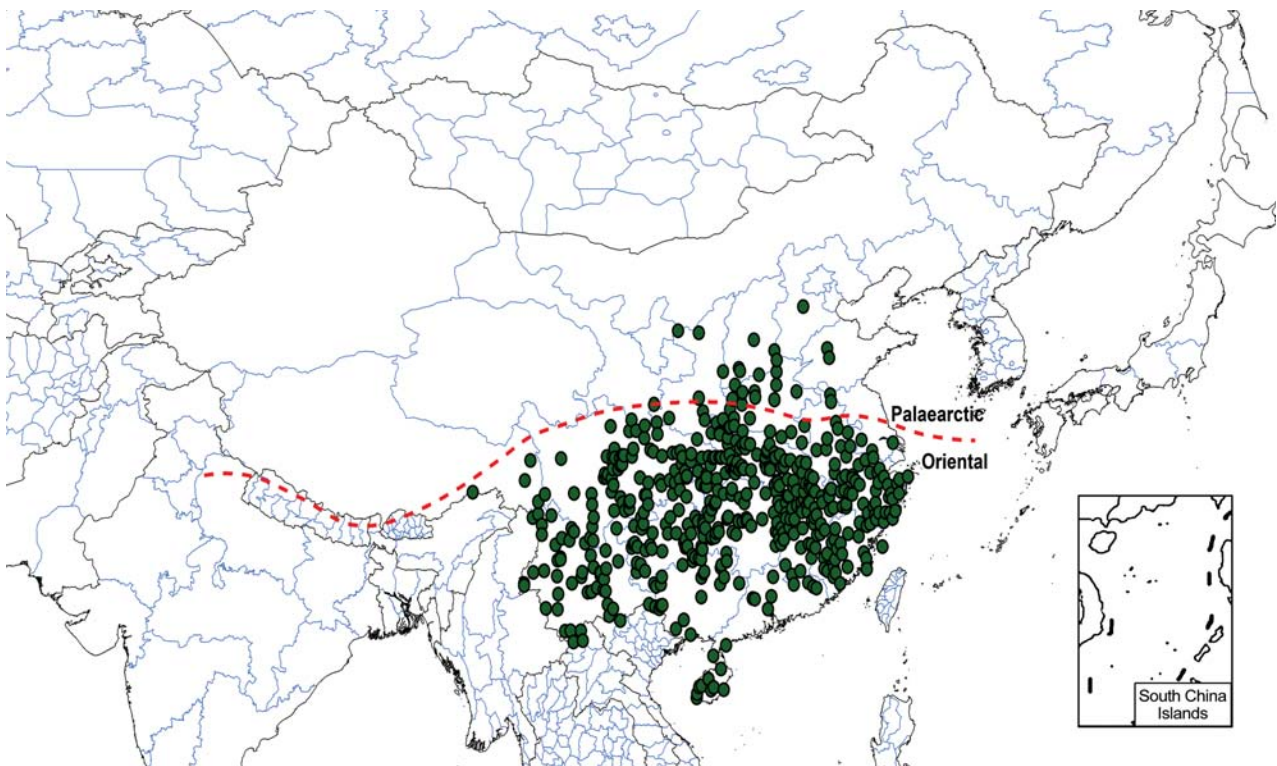


Figure 2 Distribution of Potamidae in China showing point localities.

METHODS

Data on the distribution and the abundance of freshwater crabs in China have been compiled mainly from the published literature, in particular the major monograph by Dai (1999). Distribution maps are based on specimen-level databases compiled for all species from material collected over a period of more than 150 years (from 1853 to 2010) and include information from over 900 localities (Figs 2 and 3). Although many of the Chinese species are quite well studied, the majority are known only from the type locality or from just a few localities, and, in these cases further collection is necessary to ascertain their actual distribution. The conservation status of China's freshwater crab fauna was assessed by Cumberlidge *et al.* (2009) using the International Union for the Conservation of Nature (IUCN) red list categories and criteria at the global scale (IUCN 2003), and individual species assessments can be found at the IUCN red list website (www.iucn.redlist.org). Freshwater crabs were assessed for inclusion in a red list categories based on a combination of

data on geographic range and/or population levels and related trends (Cumberlidge *et al.* 2009). The available data were sufficient to make valid assessments of the conservation status of only 57 out of the 228 species found in continental or mainland China. Assessments were not possible for the remaining 171 species, which were treated as being data deficient due to a lack of specimens, and of locality and population data (Cumberlidge *et al.* 2009). Threats were inferred if a species was potentially subject to anthropogenic impacts such as habitat destruction or pollution, especially if it was either not found in a protected area or if it was found in a protected area for only part of its range.

RESULTS

Freshwater crab diversity

The total number of species listed by Cumberlidge *et al.* (2009) for continental China, including Hong Kong, is 228. This number has been updated here to include spe-

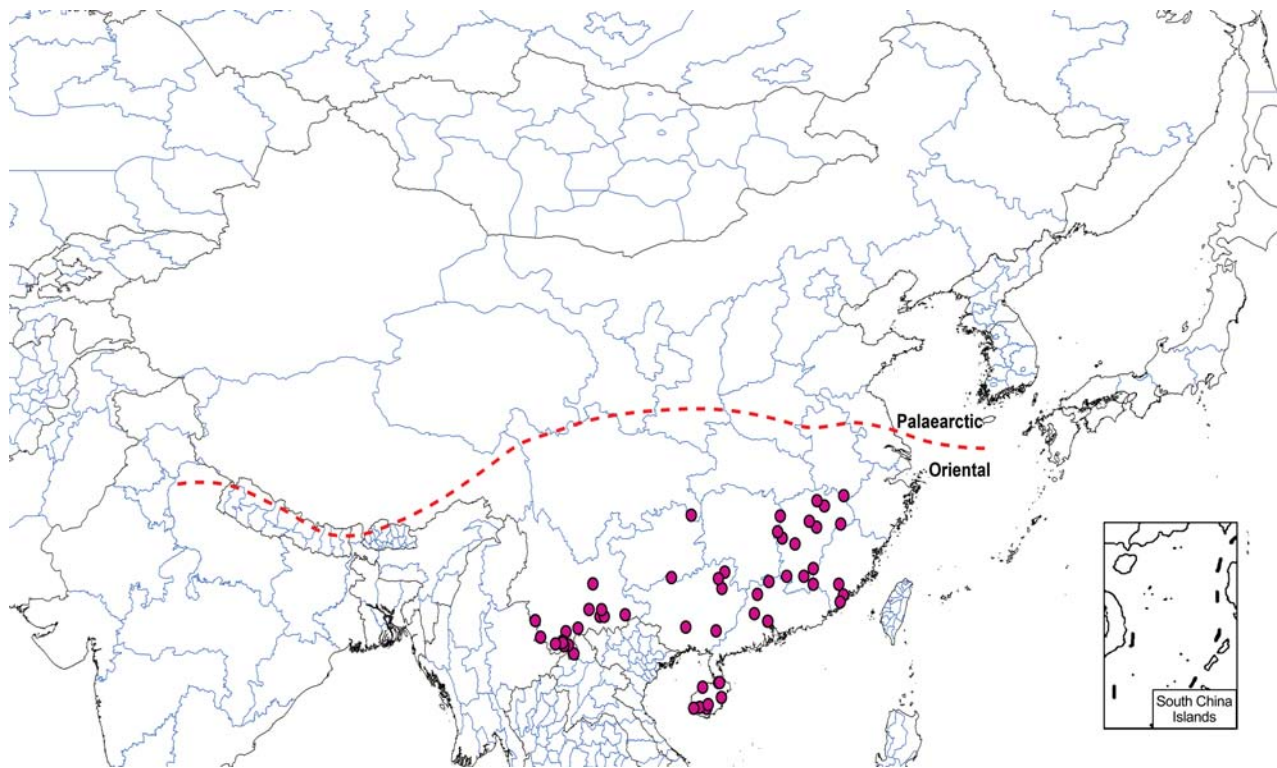


Figure 3 Distribution of Gecarcinucidae in China showing point localities.

cies described since that study was published (H.T. Shih, pers. comm.). China's range of freshwater crab fauna (37 genera, 243 species, 2 families) is the most diverse of any country in the world, is greater in number than that in the entire Afrotropical region (18 genera, 133 species, 2 families) and is only slightly less diverse than in the Neotropical region (50 genera, 298 species, 2 families) (Cumberlidge *et al.* 2009). China has its own distinctly recognizable freshwater crab fauna, with only 8 species also occurring in parts of Southeast Asia (mainly Indochina). The Chinese freshwater crab fauna today is dominated by potamids (36 genera and 218 species), while its gecarcinucids consist of 25 species in a single genus. The Chinese potamids are the most widely distributed of the 2 families (in 19 out of the 22 provinces and 5 autonomous regions; Taiwan province was not included in the present study and information on distribution there is not included in our data), whereas the gecarcinucids are only found in 7 provinces, with both families distributed mostly in the southwest, south central, and eastern provinces (Table 1).

Southwestern China stands out as the most diverse and

the most species-rich part of the country (with 204 species, 30 genera and 2 families) (Tables 1 and 2). The greatest abundance of species occurs in Yunnan (16 genera and 47 species), Guizhou (15 genera and 27 species), Guangxi (13 genera and 21 species) and Sichuan (12 genera and 43 species) provinces, where the high mountains, deep valleys and vast subtropical to tropical monsoon rainforests extend into Myanmar, Laos, Cambodia, Vietnam and Thailand. Perhaps not surprisingly for a group found in primarily tropical to subtropical freshwater habitats worldwide, these crabs are completely absent from the arid northern provinces of China that include the Gobi Desert. For example, there are no freshwater crabs in the high plateaus and deserts of the Palaeartic provinces in the northeast (Heilongjiang, Jilin and Liaoning) and the northwest (Gansu, Anhui, Qinghai and Shanxi), with the exception of a few species found along the Changjiang (Yangtze) River basin in Hebei and Shandong provinces. Provinces with more than 20 species of potamids include Yunnan, Sichuan, Guizhou, Guangxi (southwest), Hubei, Hunan (south central), and Jiangxi and Fujian (east). The Chinese gecarcinucids are found only in the warm Orien-

Table 1 Distribution of Potamidae and Gecarcinucidae in Chinese provinces (Taiwan province not included). Numbers indicate the number of genera, species, and localities of Chinese Potamidae; similar data for the Gecarcinucidae are given in parentheses

Province	Region	Number of genera	Number of species	Number of locations
Yunnan	Southwest	16 (1)	45 (2)	82 (21)
Guizhou	Southwest	15 (1)	27 (2)	52 (2)
Guangxi	Southwest	13 (1)	21 (7)	37 (9)
Sichuan	Southwest	12 (0)	43	130
Fujian	East	8 (1)	21 (3)	35 (4)
Guangdong	South Central	5 (1)	11 (3)	13 (5)
Hunan	South Central	5 (0)	21	52
Shaanxi	Northwest	5 (0)	12	17
Jiangxi	East	4 (1)	26 (2)	103 (6)
Hubei	South Central	4 (0)	31	131
Hainan	South Central	3 (1)	6 (3)	11 (9)
Henan	South Central	2 (0)	7	16
Zhejiang	East	2 (0)	6	50
Anhui	East	1 (0)	7	24
Jiangsu	East	1 (0)	2	3
Gansu	Northwest	1 (0)	2	2
Shanxi	North	1 (0)	2	2
Shandong	East	1 (0)	1	1
Hebei	North	1 (0)	1	1
Heilongjiang	Northeast	0 (0)	0	0
Jilin	Northeast	0 (0)	0	0
Liaoning	Northeast	0 (0)	0	0
Qinghai	Northwest	0 (0)	0	0

tal zone in Yunnan, Guizhou, Guangxi (southwest), Hainan, Guangdong (south central), Fujian and Jiangxi (east).

Some 17 out of 37 Chinese freshwater crab genera have a wide distribution that includes more than 1 province of China (Table 3). Notably, *Sinopotamon* is found in 19 provinces mostly associated with the Changjiang (Yangtze) River, but is found essentially wherever freshwater crabs occur. Despite its wide distribution throughout China, *Sinopotamon* is endemic to this country. Other genera with a wide distribution are *Somanniathelphusa* (7 provinces), *Aparapotamon* (6 provinces), *Bottapotamon* (5 provinces), *Neilopotamon* (4 provinces) and *Tenuilipotamon* (4 provinces). Distribution patterns considered at the genus level indicate that the taxonomic diversity of Chinese freshwater crabs is by far the highest in the 4 provinces of southwestern China: Yunnan (17 genera), Guizhou (16 genera) Guangxi (14 genera) and Sichuan (12 genera). It is lower in eastern China, in Fujian

(9 genera), Jiangxi (5 genera), Zhejiang (2 genera) and Anhui (1 genus), and in south central China, in Guangdong (6 genera), Hunan (5 genera), Hubei (4 genera), Hainan (4 genera) and Henan (2 genera) (Tables 1 and 2).

Freshwater crab distribution patterns

The composition of the freshwater crab fauna in China is not uniformly distributed: it is predominantly Oriental in character and its species and genus composition changes from province to province (Table 1, Figs 1 and 2). The pattern of no freshwater crab species in the Palearctic region and of species-rich areas in the Oriental region is best explained by freshwater crabs requiring warm freshwater habitats and by their aversion to frost (Yeo *et al.* 2008). Freshwater crabs are found in all major habitat types in southern and eastern China in rivers, rapids, swamps, lakes and mountain streams (Thieme *et al.* 2005; Abell *et al.* 2008). Freshwater crabs are particularly abundant in

Table 2 Species of Chinese freshwater crabs described since Cumberlidge *et al.* (2009)

Genus	Species	Authority
<i>Sinopotamon</i>	<i>mindongense</i>	Cheng, Li & Xu, 1998
<i>Nanhaipotamon</i>	<i>wupingensis</i>	Cheng, Yang, Zhong & Li, 2003
<i>Bottapotamon</i>	<i>nanan</i>	Zhou, Zhu & Naruse, 2008
<i>Latopotamon</i>	<i>qujingense</i>	Naruse, Yeo & Zhou, 2008
<i>Latopotamon</i>	<i>xuanweiense</i>	Naruse, Yeo & Zhou, 2008
<i>Sinopotamon</i>	<i>gaocuense</i>	Naruse, Yeo & Zhou, 2008
<i>Sinopotamon</i>	<i>mayangense</i>	Naruse, Yeo & Zhou, 2008
<i>Sinopotamon</i>	<i>zixiense</i>	Zou, Naruse & Zhou, 2008
<i>Trichopotamon</i>	<i>xiangyunense</i>	Naruse, Yeo & Zhou, 2008
<i>Huananpotamon</i>	<i>lini</i>	Cheng, Li, Lin, Li, Fang, Jiang, Huang, Zhou & Zhang, 2008
<i>Huananpotamon</i>	<i>sheni</i>	Cheng, Li, Lin, Li, Fang, Jiang, Huang, Zhou & Zhang, 2008
<i>Nanhaipotamon</i>	<i>xiapuense</i>	Cheng, Li & Zhang, 2009
<i>Sinolapotamon</i>	<i>auriculatum</i>	Zou, Naruse & Zhou, 2010
<i>Sinolapotamon</i>	<i>palmatum</i>	Zou, Naruse & Zhou, 2010

the rivers and streams that flow through the tropical monsoon and seasonal rainforests (confined to Yunnan and Hainan Island) and the subtropical evergreen broadleaf forests in south central and east China, especially in highland areas (Cumberlidge *et al.* 2009). Species diversity appears to depend on vegetation cover and the availability of water, with the fewest species occurring in the more arid ecosystems with cold winters.

For the whole of China, the dominance of Potamidae (90%) no doubt reflects the extensive land border with potamid-rich Indochina (Bott 1970; Yeo & Naiyanetr 1999; Yeo & Nguyen 1999; Yeo 2004; Yeo & Naruse 2007; Yeo & Ng 2007). However, it is harder to explain the relative paucity of gecarcinucids in China (one genus, 25 species, only 10% of the fauna) because the species richness is highest in Guangxi, Jiangxi, Guangdong and Fujian Provinces, some distance from Indochina where gecarcinucids are abundant and diverse (Yeo & Ng 1999). In Southeast Asia, Thailand is the second most species-rich country after China (with 101 species and a rate of endemism of 86%) and Malaysia is the third most species-rich country (with 92 species and a rate of endemism of 95%) (Cumberlidge *et al.* 2009). The abundance of crabs in southwest China and neighboring Indochina (Vietnam, Myanmar, Laos, Thailand and Cambodia) coincides with a freshwater habitat species diversity hotspot defined by overlapping distributions of stenotopic species based on combined data from vertebrates and invertebrates (Collen *et al.* 2008). These Indochinese countries, together with

southwest China, are still in a phase of exploration and steep rises in species numbers are expected once more surveys have been completed (Yeo & Ng 1999).

Freshwater crab endemism

The distributional data indicate that China has a rich, highly diverse and distinctly recognizable freshwater crab fauna, and that nearly all species (96%) are endemic to this country (Cumberlidge *et al.* 2009). The high degree of endemism in China's freshwater crab fauna at the species level (235 of 243 species, 96%) is also seen to a lesser extent at the genus level (29 of 37 genera, 78%), but not at the family level (neither of the 2 families are exclusively found in China). Many of the Chinese endemics are found in the isolated mountain streams and in the middle stretches of rivers associated with the rainforests in the mountains of southwestern and south central China (Dai 1999).

Conservation status

The 228 freshwater crab species known to occur in China up to 2009 were evaluated against the IUCN (2003) red list criteria (version 3.1) to assess their risk of extinction and the results published by Cumberlidge *et al.* (2009). Species described since that work (Table 2) have not been assessed for conservation status and are not included in the results presented here. The vast majority of Chinese freshwater crabs (171 species) were too poorly known to submit to the assessment protocols and were treated as

Table 3 Distribution and endemism of freshwater crab genera in the Chinese mainland provinces. Modified from http://web.nchu.edu.tw/~htshih/crab_fw/fwcb_China.htm by Shih (2010)

	Family	Genus	Distribution in the Chinese mainland	Number of provinces	E = Endemic to the Chinese mainland
1	Potamidae	<i>Sinopotamon</i>	Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, Zhejiang	19	E
2	Gecarcinucidae	<i>Somanniathelphusa</i>	Yunnan, Guangxi, Guangdong, Hainan, Fujian, Jiangxi, Zhejiang	7	Taiwan (China) Indochina
3	Potamidae	<i>Aparapotamon</i>	Yunnan, Sichuan, Guizhou, Hunan, Hubei, Henan	6	E
4	Potamidae	<i>Bottapotamon</i>	Fujian, Zhejiang, Jiangxi, Guangxi, Guangdong	5	E
5	Potamidae	<i>Neilupotamon</i>	Hunan, Guizhou, Guangxi, Yunnan	4	E
6	Potamidae	<i>Tenuilapotamon</i>	Sichuan, Guizhou, Hubei, Hunan	4	E
7	Potamidae	<i>Chinapotamon</i>	Guangdong, Guangxi, Guizhou	3	E
8	Potamidae	<i>Huananpotamon</i>	Fujian, Jiangxi, Zhejiang	3	E
9	Potamidae	<i>Mediapotamon</i>	Guangxi, Guizhou, Yunnan	3	E
10	Potamidae	<i>Nanhaipotamon</i>	Guangdong, Fujian, Zhejiang	3	Taiwan (China)
11	Potamidae	<i>Parapotamon</i>	Yunnan, Guizhou, Guangxi	3	E
12	Potamidae	<i>Potamiscus</i>	Yunnan, Sichuan, Xizang	3	Indochina
13	Potamidae	<i>Acartiapotamon</i>	Guizhou, Hubei	2	E
14	Potamidae	<i>Hainanpotamon</i>	Hainan, Fujian	2	Indochina
15	Potamidae	<i>Indochinamon</i>	Yunnan, Guangxi	2	Indochina
16	Potamidae	<i>Parapotamonoides</i>	Yunnan, Guangxi	2	E
17	Potamidae	<i>Yarepotamon</i>	Guangdong, Guangxi	2	E
18	Potamidae	<i>Apotamonautes</i>	Hainan	1	E
19	Potamidae	<i>Artopotamon</i>	Yunnan	1	E
20	Potamidae	<i>Candidiopotamon</i>	Guangdong	1	Japan, Taiwan (China)
21	Potamidae	<i>Cryptopotamon</i>	Hong Kong	1	E
22	Potamidae	<i>Daipotamon</i>	Guizhou	1	E
23	Potamidae	<i>Eosamon</i>	Yunnan	1	Indochina
24	Potamidae	<i>Heterochelamon</i>	Guangxi	1	E
25	Potamidae	<i>Lacunipotamon</i>	Yunnan	1	E
26	Potamidae	<i>Latopotamon</i>	Guizhou	1	E
27	Potamidae	<i>Lophopotamon</i>	Sichuan	1	E
28	Potamidae	<i>Minpotamon</i>	Fujian	1	E
29	Potamidae	<i>Neotiwariopotamon</i>	Hainan	1	E
30	Potamidae	<i>Pararanguna</i>	Yunnan	1	E
31	Potamidae	<i>Parvuspotamon</i>	Yunnan	1	E
32	Potamidae	<i>Qiangpotamon</i>	Guizhou	1	E
33	Potamidae	<i>Sinolapotamon</i>	Guangxi	1	E
34	Potamidae	<i>Tenuipotamon</i>	Yunnan	1	E
35	Potamidae	<i>Tiwariopotamon</i>	Guangxi	1	Vietnam
36	Potamidae	<i>Trichopotamon</i>	Yunnan	1	E
37	Potamidae	<i>Vadosapotamon</i>	Sichuan	1	E

Table 4 Red list assessments of freshwater crabs in the Chinese mainland. LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered, DD = data deficient

Family	Number of Species	LC	NT	VU	EN	CR	DD
Potamidae	204	48	0	3	1	0	151
Gecarcinucidae	24	3	0	0	1	0	20
Total	228	51	0	3	2	0	171

data deficient (Table 3). Of the remaining 56 species that could be assessed (belonging to 12 genera and 2 families), the majority (51 species) were found to be of least concern in terms of conservation status, with most of these species living in rivers, marshy lowlands or in mountain streams in the forested parts of China (Cumberlidge *et al.* 2009). For the Potamidae, 53 out of 204 species were assessed (151 species were data deficient), and of these, 48 species were of least concern in terms of conservation status, one species (*Hainanpotamon orientale*) was endangered and 4 species (*Sinopotamon ebianense*, *S. hanyangense*, *Parapotamon spinescens* and *Cryptopotamon anacoluthon*) were vulnerable (Tables 4 and 5). For the Gecarcinucidae, 4 out of 24 species of *Somanniathelphusa* were assessed (data was deficient for 20 species) and of these, 3 species were of least concern in terms of conservation status and 1 species (*Somanniathelphusa zanklon*) was endangered (Tables 3 and 4). Combining the families, 6 of the 57 assessed species of Chinese freshwater crabs (11%) were listed in one of 2 threatened categories, either as endangered (2 species) or vulnerable (4 species) (Tables 4 and 5). No species were assessed as critically endangered or near threatened, and no species of Chinese freshwater crabs could be confirmed extinct or extinct in the wild. However, it should be noted that a species cannot be formally assessed as extinct until exhaustive surveys

probing its disappearance have been carried out. Because conservation status could not be assigned to large numbers of Chinese species for which data is deficient (171), the proportion of threatened species in Cumberlidge *et al.* (2009) is almost certainly an underestimation. This means that the proportion of species in a threatened category could well prove to be an underestimate if any of the species for which data are deficient are later found to be threatened (Cumberlidge *et al.* 2009). Despite the large numbers of specimens included, very little information is available on population levels and trends, except for a qualitative estimate (e.g. whether common or rare) based on the number of sites at which a species is present and its relative abundance at each site (Tables 1 and 2).

With only 6 out of 228 species of Chinese freshwater crabs assessed as threatened with global extinction, the region's largely endemic freshwater crab fauna does not appear at first sight to be in immediate trouble compared with other aquatic groups found in the same freshwater habitats (e.g. fish, mollusks, and dragonflies). The 47 species of Chinese freshwater crabs judged to be of least concern in terms of conservation status (3 species of gecarcinucids, *Somanniathelphusa brevipodum*, *Somanniathelphusa gaoyunensis* and *Somanniathelphusa grayi*) and 44 species of potamids (*Aparapotamon grahami*, *Bottapotamon fukienense*, *Chinapotamon depressum*, *Daipotamon minos*,

Table 5 Threatened species of freshwater crabs in the Chinese mainland. For explanation of red list categories see IUCN (2003)

Family	Taxon	Authority	IUCN Red List Category	Distribution
POTAMIDAE	<i>Sinopotamon ebianense</i>	Huang, Luo & Liu, 1986	VU D2	China: Sichuan
POTAMIDAE	<i>Sinopotamon hanyangense</i>	Dai, 1995	VU D2	China: Hubei
POTAMIDAE	<i>Parapotamon spinescens</i>	Calman, 1905	VU B1ab(v)	China: Yunnan
POTAMIDAE	<i>Cryptopotamon anacoluthon</i>	Kemp, 1918	VU D2	China: Hong Kong
POTAMIDAE	<i>Hainanpotamon orientale</i>	Parisi, 1916	EN B1ab(i,ii,iii,iv,v)+ 2ab(i,ii,iii,iv,v)	China: Hainan
GEARCINUCIDAE	<i>Somanniathelphusa zanklon</i>	Ng & Dudgeon, 1992	EN B1ab(iii)	China: Hong Kong

Mediapotamon leishanense, *Nanhaipotamon dongyinense*, *Nanhaipotamon hongkongense*, *Neilopotamon physalisum*, *Potamiscus elaphrius*, *Potamiscus tumidulum*, *Sinolapotamon patelifera* and *Tenuilapotamon latilum*, plus 32 species of *Sinopotamon*) have a wide distribution in rivers, lakes and lowland wetlands, and appear to be tolerant of changes in land use that affect aquatic ecosystems.

Threats to Chinese freshwater crabs include habitat destruction driven by increasing agriculture, the demands of increasing industrial development and the alteration of fast flowing rivers for the creation of hydroelectric power (Cumberlidge *et al.* 2009). Even species assessed here as being of least concern could suffer a catastrophic decline should there be abrupt changes in land development, hydrology or pesticide-use regimes. Species with a narrow distribution are vulnerable to extreme population fragmentation and could suffer a rapid decline and even extinction in a relatively short time should dramatic changes in land-use affect their habitat. There could also be threats for invasive freshwater crab species inadvertently introduced (see Shih *et al.* 2011). The 171 species of Chinese freshwater crabs judged to be deficient in terms of data are mostly rare species, and their conservation status needs to be re-evaluated once more information comes to light. It is hoped that prioritizing species for conservation action through the red list assessment process will lead to the development of conservation recovery plans for threatened species in the future.

CONCLUSIONS

This study confirms China's status as the most diverse country in the world for freshwater crabs, and represents a first step toward the identification of threatened species within this region and toward the development of a conservation strategy for the threatened freshwater crabs endemic to China. Another major finding is that 75% of all freshwater crab species in China are poorly known and further research is required; this percentage is much higher than that for the freshwater crabs as a whole (49%) (Cumberlidge *et al.* 2009). Although some Chinese species are quite well studied, the majority are known only from either the type locality or from just a few localities and, in these cases, further collections are necessary to ascertain their actual distributions. The restricted range of many species from China, together with the ongoing human-induced loss of habitat in many parts of the region are a cause for concern for the long-term security of elements of this fauna. Therefore, conservation activities should be aimed primarily at preserving the integrity of sites and habitats while at the same time closely monitor-

ing key populations. Significant areas of China still remain insufficiently explored, and the focus of fresh efforts should be on new species discovery through increased collection in remote areas, and the refinement of taxonomic skills. These efforts should also focus on conserving threatened species, and on seeking out data deficient species. Gathering current data on the distribution, the natural history, the population trends, the threats and the endemism of China's highly diverse freshwater crabs will enable the updating of the IUCN red lists, and the development of conservation strategies for this understudied, diverse and potentially threatened fauna.

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