

Three Freshwater and Coastal Crabs (Crustacea: Decapoda: Brachyura) New to Penghu, Taiwan, with Notes on Their Biogeographical Implications

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Abstract. Three species of crabs new to Penghu County, Taiwan are reported. *Nanhaipotamon formosanum* (Parisi, 1916) was found on the bank of a river in Husi Village and is the first report of a true freshwater crab from Penghu. In the same locality, *Eriocheir japonica* De Haan, 1835 lives in a river which implies Penghu may have played a role as a "stepping stone" for this species during the dispersal between Taiwan and China. Specimens of *Uca coarctata* (H. Milne Edwards, 1852) were also collected on mudflats of Magong City and Citou, and this finding shows the *Uca* fauna of Penghu and the main island of Taiwan are the same.

Keywords: Brachyura, *Nanhaipotamon formosanum*, *Eriocheir japonica*, *Uca coarctata*, biogeography, Penghu.

INTRODUCTION

The Penghu Islands (the Pescadores) are situated in the middle of the Taiwan Strait between Taiwan and China. Compared to the abundant studies of crabs of Taiwan (see Ng et al., 2001), the crab fauna of Penghu was only recently well studied (Hung, 2000; Shen and Jeng, 2005). Shen and Jeng (2005) reported 148 species of crabs from Penghu, among which 12 were new to Taiwan and 85 were new to Penghu.

Because most of the mountains of Penghu are < 50 m high and few rivers exist, it is not expected that there are suitable habitats for land-locked true freshwater crabs or catadromous crabs, except that *Varuna litterata* was recorded from a harbor and downstream section of a river (Hung, 2000; Shen and Jeng, 2005).

The fiddler crab genus, *Uca*, has probably

garnered more attention than any other crabs in Penghu. There are five reports of *Uca* species in Penghu (Hung, 1997, 2000; Shen, 1997; Yeh and Chen, 2000; Shen and Jeng, 2005). Compared with the 10 species of *Uca* recorded from the main island of Taiwan (Shih, 1994), there are only 9 species of *Uca*, with no records of *U. coarctata*, in Penghu in the extensive surveys from the above authors.

In our study, a true freshwater crab, *Nanhaipotamon formosanum* (Parisi, 1916), a catadromous crab, *Eriocheir japonica* De Haan, 1835, and a rare fiddler crab, *Uca coarctata* (H. Milne Edwards, 1852), were collected from Penghu. Although they are not new to Taiwan, their occurrences in Penghu have important biogeographical significance. Specimens of *N. formosanum* and *U. coarctata* were collected by digging or with the hands, and traps with fish meat submerged in the river were used to collect specimens of *E. japonica*. Specimens were sexed, the carapace width (CW) was measured, then

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crabs were preserved in 80%~90% ethanol and deposited in the Zoological Collections of the Department of Life Science, National Chung Hsing University, Taichung, Taiwan (NCH-UZOO) and the Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, Keelung, Taiwan (NTOU).

TAXONOMY

Family Potamidae

Nanhaipotamon formosanum (Parisi, 1916)

(Fig. 1A, B)

Material examined: 3 males, CW 23.6~24.0 mm, NCHUZOO 13233, Husi Village, Penghu, Taiwan, coll. Jung-Hsiang Lee, 8 Oct. 2008; 1 male, 1 female CW 26.7, 26.2 mm, NCHUZOO 13232, Husi Village, Penghu, Taiwan, coll. Yu-Hsi Wang, Yuan-Chieh Hsu, Kuo-Chih Wu, and Hsi-Te Shih, 17 Oct. 2008; 1 female, CW 23.9 mm, NTOU F10701, Husi Village, Penghu, Taiwan, coll. Zhi-Wei Lai, Jheng-Sian Jhou, Jia-He Lin, Jheng-Fong Lian, and Li-Cheng Wang, 19 Oct., 2008; 1 male, CW 13.1 mm, NTOU F10702, Husi Village, Penghu, Taiwan, coll. Jhy-Yun Shy, 20 Oct., 2008; 1 male, 1 female, CW 25.2, 24.1 mm, NTOU F10703, Husi Village, Penghu, Taiwan, coll. J.-Y. Shy and Bor-Wen Lin, 21 Oct., 2008.

Ecological notes: The genus *Nanhaipotamon* is a true freshwater crab, but shows more-terrestrial habits. It is distributed in lowlands and digs deep burrows on river banks or muddy habitats near a water source (Shy and Yu, 1999; Shih et al., 2005). In Penghu, small- to medium-sized specimens of *N. formosanum* were collected from burrows of about 50 cm deep on the mud bank of a small creek (Fig. 1C). It lived sympatrically with *Macrobrachium nipponense* (De Haan, 1849) and *Neocaridina denticulata* (De Haan, 1849) in the shallow creek.

Distribution: This species is endemic to Taiwan, distributed in western Taiwan, from Nantou to Tainan Counties (Shy and Yu, 1999; Shih et al., 2005). This study is the first report of this species outside of the main island of Taiwan and is also the first report of a true freshwater crab in Penghu.

Remarks: The morphological characters of the specimens from Penghu (Fig. 1A, B) agree well with those of *N. formosanum* from Taiwan (Shy et al., 1996; Dai, 1999; Shy and Yu, 1999).

Family Varunidae

Eriocheir japonica De Haan, 1835

(Fig. 1D, E)

Material examined: 1 female, CW 43.0 mm, NCHUZOO 13237, Husi Village, Penghu, Taiwan, coll. Y.-H. Wang, 17 Oct. 2008; 2 males, CW 34.7 and 38.5 mm, 3 females, CW 39.9~45.2 mm, NCHUZOO 13235-13236, Husi Village, Penghu, Taiwan, coll. Y.-H. Wang and Y.-C. Hsu, 18 Oct. 2008.

Ecological notes: Its habitat in Penghu is a small creek with artificial banks, and the distance to the estuary is about 600 m. Individuals were seen on the bottom in shallow water (about 50 cm deep), but hid themselves within crevices near the bank (Fig. 1F). They are sympatric with other large crustaceans, including *Varuna litterata* (Fabricius, 1798), *Macrobrachium nipponense*, and *M. lar* (Fabricius, 1798).

Distribution: Widely distributed in mainland Japan, the Ryukyus, western Taiwan, and southeastern China. This is the first report of this species from Penghu, Taiwan.

Remarks: Based on the weak anterolateral teeth of these specimens, they were easily identified as *E. japonica* (Fig. 1D, E), instead of *E. sinensis* (Dai and Yang, 1991).

Family Ocypodidae

Uca coarctata (H. Milne Edwards, 1852)

(Fig. 1G, H)

Material examined: 1 male, CW 21.3 mm, NTOU M20077, Magong City, Penghu, Taiwan, coll. J.-Y. Shy and Kari Lee, 22 Aug. 1999; 1 female, CW 21.0 mm, NCHUZOO 13231, Citou, Baisha Village, Penghu, Taiwan, coll. H.-T. Shih and Y.-H. Wang, 19 May 2007.

Coloration: Coloration of female specimen variable: a large round reddish-orange area on carapace posteriorly, with light yellow anteriorly; a narrow horizontal light-yellow stripe in orbital region; other parts of dorsal surface brown; side of carapace and merus of legs bluish-white; other part of legs gray (Fig. 1G).

Ecological notes: In Citou, a female individual burrowed beside the artificial bank of a middle-high intertidal mudflat inside a semi-enclosed bay, and were sympatric with *U. crassipes*, *U. dussumieri*, and *U. borealis*.

Distribution: Widely distributed in the West Pacific, including East and Southeast Asia,



Fig. 1. Coloration of *Nanhaiopotamon formosanum* (Parisi, 1916), *Eriocheir japonica* De Haan, 1835, and *Uca coarctata* (H. Milne Edwards, 1852) from Penghu County, Taiwan. A, B. Dorsal and frontal views of *N. formosanum*, respectively; C. the riverbank habitat of *N. formosanum*; D, E. dorsal and frontal views of *E. japonica*, respectively; F. the habitat of *E. japonica* in crevices of the bank; G, H. dorsal view and the floor of the orbit with a short row of tubercles (red arrow) of a female *U. coarctata* specimen, respectively.

Australia, and the South Pacific. This species is not common on the main island of Taiwan (Shih, 1994), and this is the first report in Penghu.

Remarks: *Uca coarctata* is similar to *U. dussumieri* (H. Milne Edwards, 1852), but the former's orbit floor has a short row of tubercles (Fig. 1H), which is a useful character for both males and females.

BIOGEOGRAPHICAL IMPLICATIONS

In our study, the three crab species reported from Penghu have biogeographical importance. The genus *Nanhaipotamon* is distributed in China (Zhejiang, Fujian, and Guangdong Provinces, and Hong Kong), western Taiwan, and the Dongying Island (in the northern Taiwan Strait) (Dai, 1999; Shy and Yu, 1999; Shih et al., 2005). Because of the land-locked habit of true freshwater crabs, the finding of *Nanhaipotamon* from Penghu in the central Taiwan Strait, implies that Taiwanese *N. formosanum* might have come from China during previous glaciations, and Penghu might have been more like a mountainous area when the sea level was low at that time. Thus the Penghu population might be a glacial relict isolated after the end of glaciation. However, the population was also possibly colonized from Taiwan during recent glaciation or even dispersed by rafting from Taiwan in the past few centuries. Further studies on the genetic structures of populations in Penghu and on the main island of Taiwan may reveal their relationships.

In Taiwan, *E. japonica* can be found in Ilan County, northeastern Taiwan where it is sympatric with another Taiwanese mitten crab, *Platyeriocheir formosa* (Chan, Hung and Yu, 1995), which is endemic to eastern Taiwan (Chan et al., 1995). In western Taiwan, *E. japonica* is distributed from Taipei County to its southern limit at the Dadu River (Jeng et al., 2001), and it is not seen south of the Dadu R. However, old references recorded this species in Chiayi (Yu, 1764), Changhua (Yuanlin), Tainan (Gueiren) (Maki and Tsuchiya, 1923), and Kaohsiung (Sakai, 1939), demonstrating it was formerly distributed in the southern part of western Taiwan. The disappearance of this species in southwestern Taiwan may have been due to impacts from mass development, dam building, and pollution from upstream areas of rivers being carried to the estuary. *Eriocheir japonica* is also distributed in

southeastern China (e.g., Fujian and Guangdong Provinces). Larvae of *E. japonica* may be transported by currents from China to Taiwan, or vice versa, and Penghu may have played a role as a "stepping stone" during the dispersal in the 150-km-wide Taiwan Strait. However, more studies on the genetic structures of populations among China (Fujian), Penghu, and the main island of Taiwan are needed to reveal the degree of differentiation.

In studies of Penghu's *Uca*, Shen (1997) reported eight species: *U. arcuata*, *U. borealis*, *U. crassipes*, *U. dussumieri*, *U. formosensis*, *U. lactea*, *U. perplexa*, and *U. tetragonon*. Hung (1997) added a new record, *U. triangularis*, from Magong City, Penghu. The last species, *U. coarctata*, collected from Magong City and Citou, Baisha Village in our study, makes the *Uca* fauna between Penghu and the main island of Taiwan (Shih, 1994) identical. However the species composition greatly differs between the two areas. While *U. crassipes* and *U. borealis* are dominant in Penghu (Hung, 1997; Shih, 1997), *U. arcuata* and *U. lactea* are most common along the west coast of Taiwan (Shih, 1994). The different species structures might be due to the different compositions of grain sizes in the sediments (HTS, unpublished data). *Uca coarctata*, *U. triangularis*, and *U. formosensis* are very rare in Penghu, and some conservation action may be necessary to protect them. The endemic *U. formosensis* seems have been disappeared from the habitat at Cingluo of Husi due to the artificial planting of mangroves, *Lumnitzera racemosa*, at the end of 2007 (Shih, 2008).

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台灣澎湖新增加之淡水和沿岸蟹類(甲殼類:十足類:短尾類), 與其生物地理之註解

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報導三種台灣澎湖新增加之蟹類。*Nanhaipotamon formosanum* (Parisi, 1916) (台灣南海溪蟹) 於湖西鄉溪流堤岸處發現, 這是澎湖首次有真正淡水蟹的報導。同個地點, *Eriocheir japonica* De Haan, 1835 (日本絨螯蟹) 則棲息於溪流中, 暗示著此種在台灣與中國之間的擴散過程中, 澎湖可能扮演“踏腳石”的角色。在馬公市與岐頭的泥灘地也採集到 *Uca coarctata* (H. Milne Edwards, 1852) (窄招潮) 標本, 此發現顯示澎湖與台灣的招潮蟹相是一樣的。

關鍵詞: 短尾類, 台灣南海溪蟹, 日本絨螯蟹, 窄招潮, 生物地理學, 澎湖。