

## A new species of *Mictyris* (Crustacea: Decapoda: Brachyura: Mictyridae) recorded from northern Australia-Kimberley region to Cape York

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### Abstract

*Mictyris darwinensis* is a new species of soldier crab recorded from the Kimberley region of Western Australia to Albany Passage, Cape York in Queensland. Diagnostic features include: its relatively small eyes; smooth carapace; prominent non-recurving antero-lateral spines with microscopically granular ridges to branchial and sub-hepatic regions; chelipeds with long carpus and slender palm; two parallel spines on the ventro-distal margins of the cheliped merus; narrow front; rectangular and downward-projecting shape of the carapace posterior border; short pointed spine at distal end of dorsal ridge on carpus of walking leg; and long straight dactyl on the 4<sup>th</sup> walking leg. The new species has morphological affinities with *M. longicarpus* Latreille 1806, and to a lesser extent with *M. occidentalis* Unno 2008. *M. darwinensis* is endemic to the northern Australian coastal sector from Western Australia to Queensland. A key to the described species of *Mictyris* is provided.

**Keywords:** Mictyridae, *Mictyris darwinensis*, soldier crab, taxonomy, endemic, Western Australia.

### Introduction

*Mictyris darwinensis*, a new species from the monotypic Family Mictyridae Dana 1851, is described from the northern Australian coastal region, recorded from Shirley Island in the Kimberley region of Western Australia to Cape York in Queensland (Fig. 1).

The taxonomic history of *Mictyris* in regard to the description of its various species, the misapplication and misspelling of names, and the problems of holotypes was discussed by Unno (2008). McNeill (1926) identified the Western Australian and Northern Territory species of *Mictyris* as morphologically distinct variants of *M. longicarpus*. Davie (1982, 1985, 2002) suggested that *Mictyris* in Australia is a “complex” of species. This complex includes: three species described from eastern Australia (*M. longicarpus* Latreille 1806, *M. platycheles* H Milne Edwards 1852, and *M. livingstonei* McNeill 1926), one from Western Australia described as *M. occidentalis* Unno 2008, and a fifth from the Northern Australian region, which is the subject of this paper.

This present study supports full species status for the *Mictyris* that is endemic to coastal areas of the Kimberley region in Western Australia and the Northern Territory. The new species is morphologically and biometrically compared with *M. longicarpus* to which it is most morphologically similar and which is its biogeographical congener to the east, and *M. occidentalis*, its biogeographical congener to the west. The paper also provides a key to help differentiate between the species of *Mictyris* described to date.

### Terms and abbreviations, sampling sites, material examined and methods

The terms used here follow McNeill (1926), particularly for the cheliped where the wrist = carpus, palm = manus, immoveable finger = pollex, and moveable finger = dactyl.

#### Abbreviations:

♂ = male, ♀ = female, J = juvenile (unsexed), ovig. = ovigerous, AM = Australian Museum, NTM = Northern Territory Museum, WAM = Western Australian Museum, VCSRG = V & C Semeniuk Research Group, max = maximum. Other abbreviations employed in this paper are shown in Table 1.

#### Sampling sites:

Specimens for this paper derive from 11 sites in various locations in Western Australia and the Northern Territory (this study), and 6 sites whose specimens are housed in the Australian Museum, Northern Territory Museum and the Western Australian Museum (Fig.1 and Table 2; all co-ordinates in WGS84 system).

#### Material examined for description, comparisons and biometric study:

Morphological descriptions and comparisons in this study were based on: 1. *Mictyris* specimens from AM and WAM collections and 2. our collections now lodged with WAM and NTM. For *Mictyris darwinensis* sp. nov. and *Mictyris darwinensis* sp. nov. (formerly *Mictyris longicarpus*) material examined see Taxonomy section

Table 1

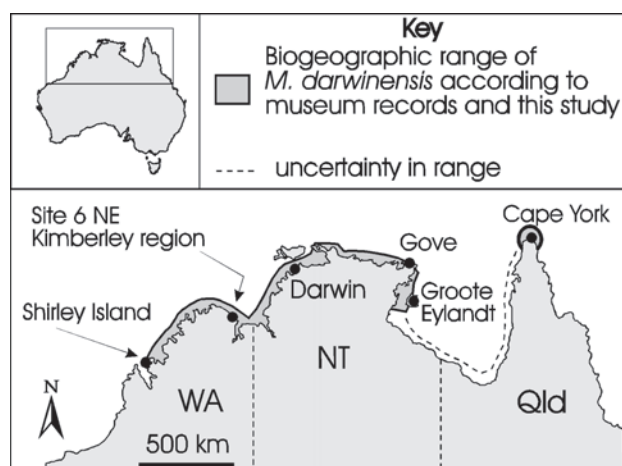
Diagnostic characters and other abbreviations used in this paper

| Character  | Description   | Abbreviation |
|--|---|--------------|
| Abdominal segment 1                              | straight line length of 1 <sup>st</sup> abdominal segment measured along the mid-line             | AS1L         |
| Abdominal segment 6                              | length of 6 <sup>th</sup> abdominal segment measured along the mid-line                           | AS6L         |
| Abdominal segment 7 (=telson)                    | length of 7 <sup>th</sup> abdominal segment measured along the mid-line                           | AS7L         |
| Antero-lateral spines interspace                 | distance between inner bases of antero-lateral spines   | ALSI         |
| Body Height                                      | vertical distance between top of carapace and lowest point on abdomen                             | BH           |
| Carapace anterior to posterior                   | length between front and edge of posterior border of carapace (not including setae)               | CL           |
| Carapace lateral dimensions                      | distance between widest point of branchial regions  | CW           |
| Cheliped carpus anterior to posterior            | straight line distance between top of wrist to distal end, along outer edge                       | CHCL         |
| Cheliped carpus distal edge                      | length of distal edge of wrist  | CHCW         |
| Cheliped dactyl                                  | length of moveable finger   | CHDL         |
| Cheliped palm lower margin                       | length of palm on lower margin  | CHPLm        |
| Cheliped palm upper margin                       | length of palm on upper margin  | CHPLum       |
| Cheliped pollex                                  | length of immovable finger  | CHPOL        |
| Cheliped palm                                    | depth of palm   | CHPW         |
| Cornea   | distance from top of eye to start of peduncle   | COL          |
| Cornea plus peduncle                             | distance from tip of cornea to base of peduncle   | COL+PED      |
| Eye interspace                                   | distance between outer extremities of eyes  | EI           |
| Front lateral dimensions                         | horizontal distance across top of frontal lobe  | FW           |
| Front vertical dimensions                        | distance from the median point of the front, level with the eyes, to the point of the median lobe | FL           |
| Gonopods   | first gonopods  | G1           |
| Gastric region lateral dimensions                | width of gastric region   | GW           |
| Median carapace dimensions                       | width of middle part of carapace (mid-branchial region)   | MCW          |
| Posterior border caudal margin                   | width of rear carapace border from corner to corner   | PBW          |
| 3 <sup>rd</sup> maxilliped                       | total length of 3 <sup>rd</sup> maxilliped from top of merus to bottom of ischium                 | 3MTL         |
| 3 <sup>rd</sup> maxilliped merus                 | central length of merus   | 3MML         |
| 3 <sup>rd</sup> maxilliped ischium naked surface | central length of bare ischium surface  | 3MILns       |
| 3 <sup>rd</sup> walking leg merus                | length of part measured centrally   | 3WLML        |
| 4 <sup>th</sup> walking leg dactyl               | length of part measured centrally   | 4WLDL        |
| 4 <sup>th</sup> walking leg propodus             | length of part measured centrally   | 4WLPL        |
| 4 <sup>th</sup> walking leg merus                | length of part measured centrally   | 4WLML        |

Table 2

Sample sites &amp; museum collections – Shirley Island, WA to Cape York, Qld

| Locality/Site   | Latitude & Longitude        |
|---|-----------------------------|
| Shirley Island, NW Kimberley (WAM)  | 16° 16.589'S, 123° 26.502'E |
| Unwins Island, NW Kimberley (WAM)   | 15° 16.000'S, 124° 49.000'E |
| NE Kimberley Site 1, King George River (this study)   | 13° 56.142'S, 127° 16.531'E |
| NE Kimberley Site 2, King George River (this study)   | 13° 57.231'S, 127° 20.008'E |
| NE Kimberley Site 3, 5 km south of Berkley River, on mainland opposite Reverley Island (this study) | 14° 23.199'S, 127° 47.755'E |
| NE Kimberley Site 4, bay West side of Buckle Head (this study)                                      | 14° 26.605'S, 127° 49.296'E |
| NE Kimberley Site 5, ~6 km SE of Buckle Head (this study)   | 14° 30.175'S, 127° 54.144'E |
| NE Kimberley Site 6, ~10 km SE of Buckle Head (this study)  | 14° 30.313'S, 127° 54.984'E |
| NE Kimberley Site 7, Cape Dussejour (this study)  | 14° 44.500'S, 128° 13.206'E |
| Buffalo Creek, Darwin, NT (this study)  | 12° 20.069'S, 130° 54.382'E |
| Lee Point, Darwin, NT (this study)  | 12° 19.827'S, 130° 53.648'E |
| Rapid Creek, Darwin, NT (this study)  | 12° 22.176'S, 130° 51.619'E |
| Mindil Beach, Darwin, NT (this study)   | 12° 26.850'S, 130° 49.678'E |
| Gove, NT (WAM)  | 12° 11.000'S, 136° 46.900'E |
| Groote Eylandt, NT (AM)   | 13° 56.000'S, 136° 36.000'E |
| north of Albany Passage, Cape York Qld (AM)   | 10° 44.000'S, 142° 36.000'E |
| Fly Point, Albany Passage, Cape York Qld (AM)   | 10° 45.000'S, 142° 37.000'E |



**Figure 1.** Map of northern Australia encompassing Western Australia, Northern Territory and Queensland, showing the distribution of *Mictyris darwinensis* and some of the sampling sites mentioned in the text.

below. Other *Mictyris* species material examined included:

*Mictyris occidentalis*: WAM C39420: ♂ holotype (CL 12.46 mm, CW 10.32 mm), King Bay, Dampier Archipelago, WA 2003; WAM C39422: 4 ♂♂ (CL 12.90–12.73 mm), King Bay, Dampier Archipelago, WA, 2004; WAM C39423: 5 ♂♂ (CL 14.96–13.36 mm), Broome, WA, 2004; WAM C39424: 5 ♂♂ (CL 12.95–10.52 mm) Monkey Mia, Shark Bay, WA, 2004.

*Mictyris longicarpus*: WAM C13323: 7 ♂♂ (CL 19.58–11.23), 3 ♀♀ (CL 15.15–13.12) Cape Ferguson, Townsville, Queensland, Australia, 1982; WAM C39392: 1 ♀ (CL 13.27 mm) 1 J, Sandfly Creek, MacKay, QLD, 1983; WAM C8039: 1 ♂ Townsville, QLD 1961; WAM C13327: 1 ovig ♀ Townsville, QLD, 1982; WAM C13348: 1 ♂, Townsville, QLD, 1982.

## Methods

Ten adult male *M. darwinensis* from Buffalo Creek in Darwin were compared with ten *M. longicarpus* and ten *M. occidentalis* adult male specimens obtained from WAM. *M. darwinensis* adult males from four sites (Shirley Island, Site 6 NE Kimberley and Gove, Fig. 1), were also measured. Thirty characters, considered diagnostic, were used for the biometric study for species determination (Table 1), and were measured to the nearest 0.01 mm with a digital vernier caliper (DSE Model Q1382). Figure 2 of Unno (2008) shows the anatomical features used in biometrics in this paper. Measurements of features (*e.g.*, leg, eye) were obtained on the right side of the crab unless the feature was missing, in which case the left side was used. Averages were taken of the measurements for each group of crabs and these were used to determine ratios for the comparisons. Ratios of morphological features follows McNeill (1926) and Unno (2008), particularly for CW:CL, all 3<sup>rd</sup> maxilliped ratios, ALSI:PBW, CHPW:CHPLm, and FW:FL (Table 3).

**Table 3**

Ratios of morphological characters used in this paper

**Ratios following McNeill (1926):**

ALSI:PBW; CHPW:CHPLm; CHDL:CHCL; CHPOL:CHCL; CHPW:CHPLm; CHPW:CHPOL; CL:CW; COL:COL + PED; EI:PBW; EI:MCW; FW:FL; 3MML:3MILns; 3MTL:ALSI; 3MTL:CHPLm + CHDL

**Ratios following Unno (2008):**

CHCL:CHCW; CHCL:ALSI; CHPOL:CHPLm; 4WLML:4WLDL

**Additional ratio for this paper:**

CHCL:3MTL

## Taxonomy

MICTYRIDAE Dana, 1851

*Mictyris* Latrielle, 1806

Type species: *Mictyris longicarpus* Latreille 1806

*Mictyris darwinensis*, sp. nov. (Figure 2)

*Mictyris longicarpus* Latreille 1806

*Mictyris longicarpus* (*pro parte*). -McNeill 1926: page 109 (general locality “Northern Territory”)

Material examined

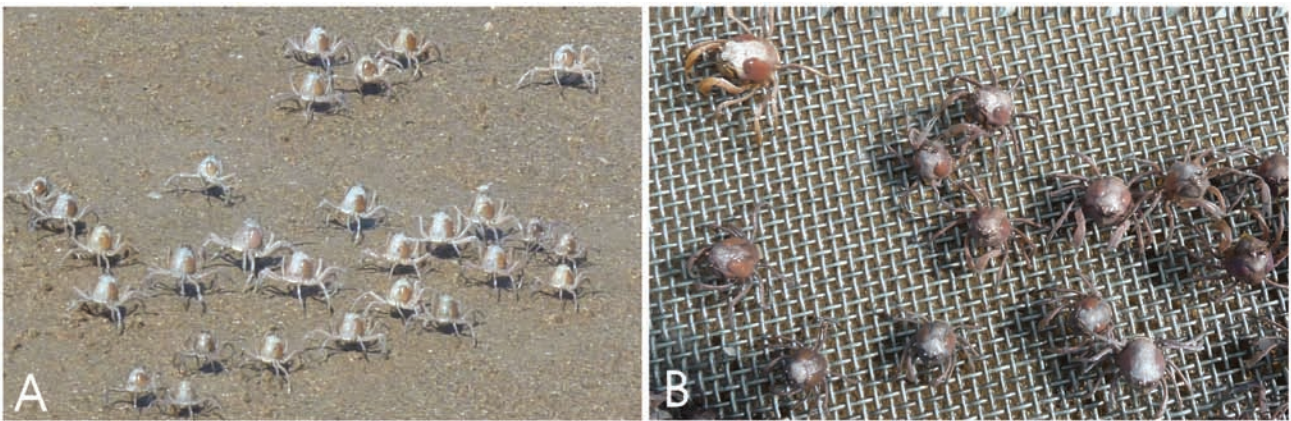
**Holotype**: NTM Cr016966: ♂ (CL 15.40, CW 12.71 mm) Buffalo Creek, Darwin, Northern Territory, Lat. 12° 20.069'S, Long. 130° 54.382'E (WGS84), coll. V. Semeniuk, Dec. 2009.

**Allotype**: NTM Cr016967: (CL 11.94, CW 9.77 mm) Buffalo Creek, Darwin, Northern Territory, Lat. 12° 20.069'S, Long. 130° 54.382'E (WGS84), coll. V. Semeniuk, Dec. 2009.

**Paratypes**:

NTM Cr016968: 10 ♂♂ (CL 15.13–13.01 mm), 1 ♀ (CL 11.38 mm) Buffalo Creek, Darwin, Northern Territory, Dec. 2009; NTM Cr016969: 5 ♂♂ (CL 12.79–11.85 mm), 5 ♀♀ (CL 11.28–9.76 mm) Lee Point, Darwin, NT Dec 2009; NTM Cr016970: 5 ♂♂ (CL 11.28–9.66 mm), 3 ♀♀ (CL 8.75–8.25 mm) Rapid Creek, Darwin, NT Dec 2009; NTM Cr016971: 8 ♂♂ (CL 12.57–7.58 mm), 2 ♀♀ (CL 19.29, 8.35 mm) Mindil Beach, Darwin, NT Dec 2009; WAM 47065: 1 ♂ (CL 10.24 mm), 2 ♀♀ (CL 9.27, 9.23 mm), 1 J (CL 6.76 mm), Site 1 King George River, NE Kimberley, 13° 56.142'S 127° 16.531'E; WAM 47066: 2 ♂♂ (CL 12.23, 10.57 mm) Site 2 King George River, NE Kimberley, 13° 57.231'S 127° 20.008'E; WAM 47067: 1 ♂ (CL 7.01 mm), 5 J (CL 6.32–4.52 mm) Site 3 NE Kimberley, 5 km S of Berkley Rv on mainland, opp. Reverley Is., 14° 23.199'S 127° 47.755'E; WAM 47068: 9 J (CL 5.60–4.00 mm) Site 4 NE Kimberley, bay W side of Buckle Head, 14° 26.605'S 127° 49.296'E; WAM 47069: 1 ♂ (9.20 mm), 2 J (CL 5.22, 4.83 mm) Site 5 NE Kimberley, ~ 6 km SE of Buckle Head 14° 30.175'S 127° 54.144'E; WAM 47070: 10 ♂♂ (CL 14.13–12.48 mm), 3 ♀♀ (CL 11.70, 9.95, 9.86 mm), Site 6 NE Kimberley, ~ 10 km SE of Buckle Head, 14° 30.313'S 127° 54.984'E; WAM 47071: 4 ♀♀ (CL 8.77–7.14 mm), 2 J (CL 5.55, 4.63 mm), Site 7 Cape Dussejour, NE Kimberley, 14° 44.500'S 128° 13.206'E.





**Figure 2.** A. Field photograph showing swarm of *M. darwinensis*, with their distinctive colouration of very pale blue (nearly white) carapace and reddy brown branchial regions (Site 6, ~10 km SE of Buckle Head, north-eastern Kimberley Coast). The distinctive white posterior border is evident. B. Soldier crabs retrieved on 3 mm mesh sieve to show the range of colouration of the species, from very pale blue (nearly white) carapace and reddy brown branchial regions to steel blue carapace and reddy brown branchial regions to dark carapace (Buffalo Creek, NT).

*Mictyris darwinensis* sp. nov. (formerly *Mictyris longicarpus*) AM P8422: 2 ♂♂ (CL 15.41, 14.00 mm) east side of Groote Eylandt NT 1921; AM P45643: 53 ♂♂ (CL 15.50–12.11 mm), 18 ♀♀ & 1 ovig. (12.90–9.91 mm) mainland north of Albany Passage QLD 1928; AM P45382 1 ♂ (CL 13.61 mm), 1 ♀ (CL 12.37 mm) Fly Point Albany Passage QLD 1928; WAM C19115: 3 ♂♂ (CL 14.42–10.57 mm), 3 ♀♀ (12.65–11.83 mm) Shirley Island WA 1988; WAM C19116: 4 ♂♂ (CL 15.38–12.01 mm), 2 ♀♀ (CL 11.54–11.05), NW of Unwins Island, north Kimberley, WA, 1988; WAM C39395: 6 ♂♂ (CL 18.18–10.26 mm), 5 ♀♀ (12.27–10.51), 1 ovig. (10.31 mm) West Woody Island Creek Gove, NT, 1982.

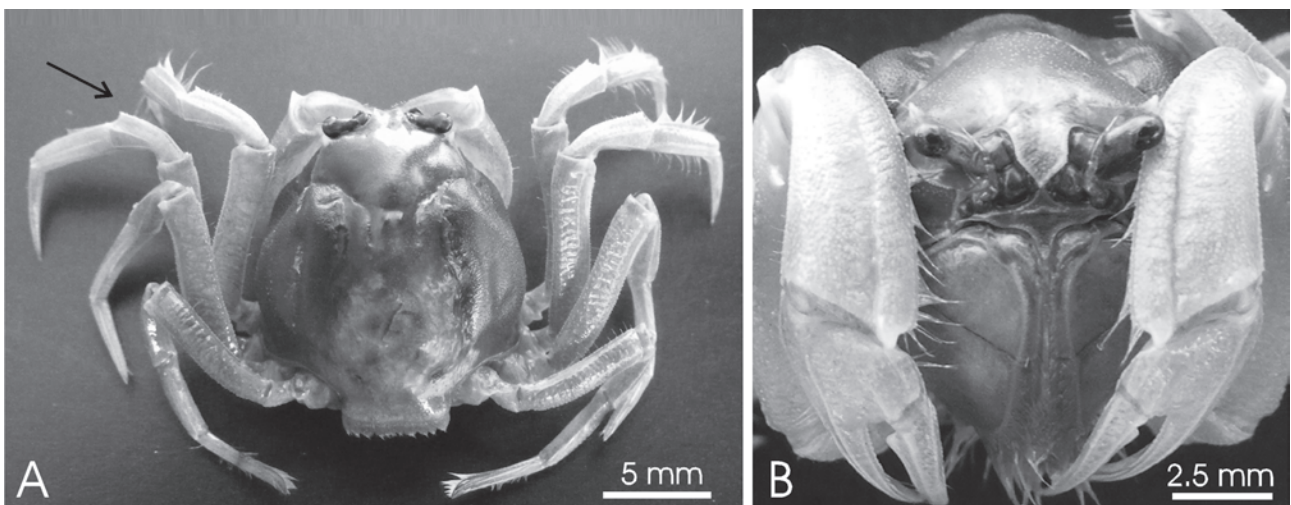
**Diagnosis**

Visibly smooth sub-globular carapace with prominent, straight, antero-lateral spines and microscopically granular associated ridges, and a truncated, slightly downward projecting posterior border. Eyes relatively small, and front relatively narrow (eyes smaller than the large globular eyes of the type species, and front similar

to the type species). Two parallel spines present on the distal end of the cheliped merus ventral surface. Cheliped smooth, relatively slender, long in the carpus, with a small palm and long fingers. Moveable finger with broad, triangular tooth. Distal end of the dorsal ridge on walking leg carpus spinated and terminated with sharp projecting spine and dactyl of the fourth walking leg is straight with a curved apex. Abdominal flap relatively broad (broader than type species). *In vivo* carapace colouration: brown branchial regions, light blue elsewhere including 3<sup>rd</sup> maxillipeds, white posterior border (Fig. 2). Legs pale and uniform in colour.

**Description of male holotype**

**Body:** Sub-globular (Fig. 3A), 1.2 times longer than wide. Branchial regions slightly inflated but not overlapping bases of ambulatory limbs. Posterior border of carapace truncated, straight and conspicuously produced beyond curve of abdomen, projecting downwards rather than outwards; posterior border width equals the interspace between the antero-lateral



**Figure 3.** A. Dorsal view of the holotype showing the medium-sized eyes, smooth carapace, the conspicuously projecting posterior border, the small spine on the end of a walking leg carpus (one is arrowed), and the straight dactyl of the 4<sup>th</sup> walking leg. B. Front of the holotype showing microscopically granulated anterior part of carapace, the narrow front, and the straight antero-lateral spines.

spines; and length of sides are one fifth the width of border.

**Carapace:** Visibly non-granular, and smooth to touch (Fig. 3A). Gastric and branchial regional grooves well-defined. Branchial regions microscopically evenly granular. Sub-hepatic regions visible from above and sparsely granular; sub orbital border granulated; antero-lateral spines prominent (Figs 3A and 3B), orientated upwards (not recurved), microscopically granular at bases; a microscopically granular ridge extends posteriorly from base of each antero-lateral spine to branchial regions and another very short, microscopically granular ridge extends downwards towards the sub-hepatic regions; interspace between antero-lateral spines is less than the distance between the outside of the eyes, equal to the width of the posterior border and less than the width of the space between the mid branchial regions. Front deflexed and narrow (as for type species), although slightly narrower with length slightly longer (1.4 times) than the width (Fig. 3B).

**Eyes:** Globose, medium-sized (smaller than in the type species); the space between the outside of the eyes (Fig. 3B) slightly greater (1.2 times) than the width of the posterior border and equal to the mid carapace width; cornea tipped with several long setae; cornea length is *circa* one third of total length of cornea plus peduncle.

**Epistome:** Width is one third the length, as in type species.

**Third maxillipeds:** large, length of merus is less than half the length of the naked surface of the ischium as in the type species.

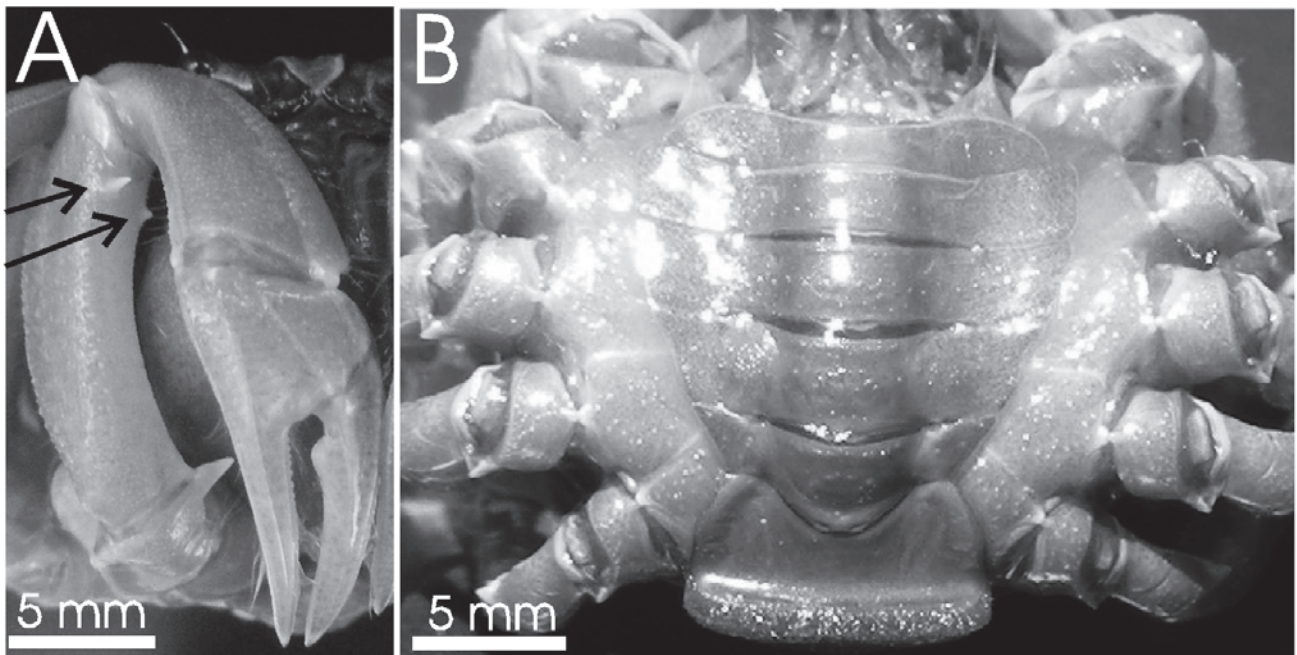
**Thoracic sternite:** Anterior edge of thoracic sternite under 3<sup>rd</sup> maxillipeds with two broad flat spines.

**Cheliped** (Fig. 4A): Slender with moderately large spine on each ischium directed forwards and inwards.

Ventro-distal margin of merus armed with two spines; outer spine larger, inwardly curving with several spinules at the base; inner smaller spine is slightly lower (more proximal), straight, apically blunt, with one or two spinules at the base. As in the type species, cheliped surfaces are smooth and microscopically granular, with scarcely granular ridges and sparsely setose grooves. Carpus long and slender (1.5 times the length of the antero-lateral spine interspace). Palm more slender than typical form- width (depth) is half the length of the immovable finger and is almost equal to length of the lower margin; dorsal margin of palm is 0.15 times the length of the palm lower margin plus immovable finger. Immoveable finger inner cutting edge armed by at least 10 irregular to rounded small teeth proximal to the palm. Immoveable finger length is twice length of the lower border of palm. Moveable finger equipped with broad, conical, flat tooth; moveable finger slightly shorter than wrist but 1.11 times longer than immovable finger; moveable finger more curved than immovable finger and fingers meet as in typical form, slightly below tips.

**Abdomen** (Fig. 4B): Abdominal flap relatively broad (broader than type species; ratio of 5<sup>th</sup> somite width: 3<sup>rd</sup>-6<sup>th</sup> somite length = 1.4:1, compared with 1.2:1 in *M. longicarpus*). First segment long and flat with a short steep lip at the articulation with the posterior border; successive segments increase in width to the 5<sup>th</sup> segment then decrease in width; the 6<sup>th</sup> segment is 4/5<sup>th</sup> length of the telson.

**Ambulatory limbs:** Long and slender; moderately setose; minutely granular along ridges and some transverse minutely granular rugae on meri; distinctive sharp small spine terminating distal end of carpus dorsal ridge, best developed on 2<sup>nd</sup> and 3<sup>rd</sup> walking legs where the carpus dorsal ridge is spinated towards distal end (Fig. 3A); merus of 3<sup>rd</sup> walking leg 1.10 times longer than



**Figure 4.** Key features of *M. darwinensis*. A. Right cheliped with two non-parallel spines (arrowed), one large, one small, on distal margin of the merus ventral surface. B. Abdomen with broad 5<sup>th</sup> segment and long, flat 1<sup>st</sup> segment.



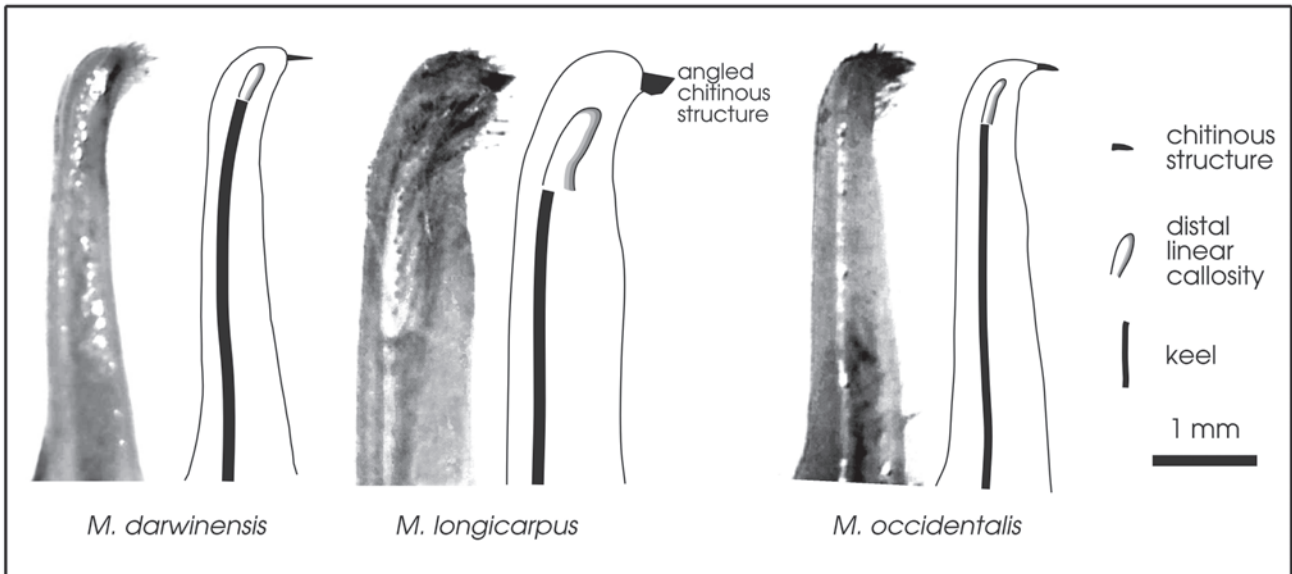


Figure 5. Gonopods of *M. darwinensis*, *M. longicarpus*, and *M. occidentalis* showing ventral (sternal) side views.

1<sup>st</sup>-6<sup>th</sup> abdominal segments; 4<sup>th</sup> walking leg dactyl long and curved at tip.

**Gonopod G1** (Fig. 5): Shaft stout, torsioned tip with very long, dense setae on ventral callosity; shorter dense setae asymmetrically line the interior of the laterally-facing, well-developed spatuloid cavity beneath the slightly overturned crest; a horizontally orientated, unguis, blunt chitinous structure projects from the centre of the crest. G1 length extends from 3<sup>rd</sup> to 6<sup>th</sup> abdominal segments.

**Colour:** When alive, body is coloured very light blue dorsally and on the third maxillipeds, with reddish-brown branchial regions, and a distinctive white posterior border. All limbs, including chelipeds are uniformly pale coloured, with no red bands on the joints.

#### Habitat

Sheltered, low to medium wave energy environments with fine to medium, sandy to slightly muddy sand substrates. Gently sloping intertidal shore zones including low gradient beaches, mid tidal shoals, tidal creek banks, and tidal creek shoals (*cf.*, Unno & Semeniuk 2009).

#### Behaviour

A benthic, cryptic species, generally inhabiting the substrate to a depth of 10–15 cm (at low tide). Females are more cryptic than males, rarely appearing on the surface. Subterranean feeding and emergence or re-entry activities by crabs at low tide produces pustules, tunnels, and rosettes of worked substrate on the tidal-flat surface, and exit holes (Unno & Semeniuk 2008). Large numbers of crabs (predominately adult males) may emerge at low tide to commence surface feeding.

#### Distribution

Tropical northern Australia (Fig. 1). Recorded along the coast of Western Australia, Northern Territory and Queensland, from Shirley Island 12° 20.069'S, 130° 54.382'E (WAM C8038) to Albany Passage Cape York 10°

45.000'S, 142° 37.000'E (AM P45382). McNeill (1926) mentions male *Mictyris* specimens from Groote Eylandt having twin spines on the lower margin of the merus of the cheliped, distinctive of *M. darwinensis*. It was confirmed that *M. darwinensis* occurs at Groote Eylandt by examining the AM P8422 collection. While *M. darwinensis* appears to be the only soldier crab species in the Kimberley and Northern Territory regions, there were other soldier crab species present in the AM P45643 collection from Cape York, Queensland.

#### Etymology

The species name is derived from the City of Darwin (named after Charles Robert Darwin), Northern Territory, which appears to be the centre of its biogeographic distribution, and the designated type location of the new species.

#### Variation

There is some variation in the development and number of spines on the inner cheliped merus where less mature males may have two parallel spines on one cheliped and only one on the other, or one outer spine and an inner small-to-microscopic spinule may be present. Also, in younger males the cheliped tooth is less developed. Carapace colouring shows some variation, with very pale blue adult specimens observed in the NE Kimberley region and specimens from Gove, NT appearing darker blue.

#### Remarks

Examination of the allotype shows that sexual dimorphism occurs with the following characteristics: females smaller than males of the same age; often darker colour than males; granules on antero-lateral spine ridges, subhepatic region and 3<sup>rd</sup> maxillipeds with short setae; no tooth on cheliped moveable finger; two spines on cheliped merus reduced to spinules; 3<sup>rd</sup> maxilliped thoracic sternite unarmed; terminal spine on walking leg carpus much reduced; gonopore with prominent simple spine.

### Morphological and biometric comparison of *M. darwinensis*, *M. longicarpus* and *M. occidentalis*

In describing *M. darwinensis*, emphasis was placed on distinguishing the new species from two other described *Mictyris* species: one that appears superficially similar, *i.e.*, the type form, *M. longicarpus*, and the other, the allopatric species to the west, *M. occidentalis*. *M. darwinensis* exhibits some characters which appear similar to those of *M. longicarpus* and to *M. occidentalis*, however, close examination shows distinct differences.

For example, both *M. longicarpus* and *M. darwinensis* have projecting carapace posterior borders when viewed dorsally, but are morphologically different when viewed ventrally (the 1<sup>st</sup> abdominal segment is flatter in *M. darwinensis*), or laterally (profile of *M. darwinensis* is less rounded). Biometric ratios were useful in separating the new species from congeners (Table 4). Features of gonopods and gonopores are described below and compared in Tables 5 & 6, respectively, and Figure 5. The major morphological features of the three *Mictyris* species are systematically compared in Table 7.

Table 4

Comparisons of major biometric ratios

| Biometric ratios   | <i>M. darwinensis</i> | <i>M. longicarpus</i> | <i>M. occidentalis</i> | Explanation of ratios  |
|--------------------|-----------------------|-----------------------|------------------------|--|
| CL: CW             | 1.20:1                | 1.23: 1               | 1.21: 1                | branchial regions of <i>M. darwinensis</i> and <i>M. occidentalis</i> slightly more inflated than those of <i>M. longicarpus</i>   |
| ALSI:PBW           | 1.02: 1               | 1.24: 1               | 1.22: 1                | the antero-lateral spines interspace equals the length of the posterior border in <i>M. darwinensis</i> and is slightly greater in <i>M. longicarpus</i> and <i>M. occidentalis</i>          |
| COL:COL + PED      | 0.35:1                | 0.52                  | 0.33:1                 | <i>M. darwinensis</i> and <i>M. occidentalis</i> have smaller eyes than <i>M. longicarpus</i>  |
| EI:PBW             | 1.20:1                | 1.24:1                | 1.14:1                 | <i>M. darwinensis</i> carapace ratios same as in <i>M. longicarpus</i>   |
| EI:MCW             | 1.08:1                | 1.03                  | 0.91                   | <i>M. darwinensis</i> carapace ratios same as in <i>M. longicarpus</i>   |
| FW:FL              | 0.70:1                | 1:1                   | 0.80:1                 | <i>M. darwinensis</i> front narrower than <i>M. longicarpus</i> or <i>M. occidentalis</i>  |
| CHCL:ALSI          | 1.50: 1               | 1.51: 1               | 1.30: 1                | wrist length is 1 1/2 times antero-lateral spine interspace in <i>M. darwinensis</i> and <i>M. longicarpus</i> but 1 1/3 times in <i>M. occidentalis</i>                                     |
| CHCL:3MTL          | 0.88:1                | 0.75:1                | –                      | length of <i>M. darwinensis</i> cheliped wrist slightly longer than <i>M. longicarpus</i> ; <i>M. occidentalis</i> is not compared since the 3 <sup>rd</sup> maxilliped ratios are different |
| CHCL:CHCW:         | 2.30: 1               | 2.07: 1               | 2.49:1                 | wrist length is 2 1/3 times wrist width in <i>M. darwinensis</i> , 2 times in <i>M. longicarpus</i> and ~ 2 1/2 times in <i>M. occidentalis</i>  |
| CHPW:CHPOL         | 0.53: 1               | 0.66: 1               | 0.64: 1                | palm width 1/2 length of immoveable finger in <i>M. darwinensis</i> but 2/3 in <i>M. longicarpus</i> and <i>M. occidentalis</i>  |
| CHPW:CHPLm         | 0.94: 1               | 0.90:1                | 0.80:1                 | the width of the palm equal to the length of the lower palm border in both <i>M. darwinensis</i> and <i>M. longicarpus</i>   |
| CHDL:CHCL          | 0.90: 1               | 0.90: 1               | 0.82: 1                | moveable finger slightly shorter than wrist in <i>M. darwinensis</i> and <i>M. longicarpus</i> but distinctly shorter in <i>M. occidentalis</i>  |
| CHPOL:CHCL         | 0.83: 1               | 0.75: 1               | 0.71: 1                | immoveable finger is 4/5 length of wrist in <i>M. darwinensis</i> but 3/4 wrist length in <i>M. longicarpus</i> & <i>M. occidentalis</i>   |
| 3MML:3MILns        | 0.41:1                | 0.44:1                | 0.56:1                 | <i>M. darwinensis</i> third maxillipeds are same as type species, <i>M. occidentalis</i> differs from type species   |
| 3MTL:ALSI          | 1.52:1                | 1.49:1                | 1.56:1                 | as above   |
| 3MTL:CHPLum + CHDL | 1.07                  | 0.94                  | 1.18:1                 | as above   |
| 4WLML:4WLDL        | 1.21                  | 1.27                  | 1.54                   | <i>M. darwinensis</i> & <i>M. longicarpus</i> have a longer dactyl than <i>M. occidentalis</i>   |

Table 5

Comparison of gonopod morphology

| Gonopod feature   | <i>M. darwinensis</i>   | <i>M. longicarpus</i>   | <i>M. occidentalis</i>   |
|---|---|---|--|
| shaft   | relatively stout  | stout   | relatively stout   |
| torsion of shaft  | begins just before curve of tip   | begins just before curve of tip   | begins at midpoint of shaft  |
| curvature of the tip of the shaft                               | curved with moderate hooked tip   | curved with short hooked tip  | curved with extended tip   |
| shape of the chitinous structure                                | bluntly unguial   | bluntly unguial   | long and triangular  |
| location of the chitinous structure                             | below the apex of the curvature of the tip  | below the apex of the apical curvature of the tip   | in line with the apex of curvature of the tip  |
| orientation of the chitinous structure, viewed sterno-laterally | horizontal  | slightly angled with lower end towards sternal (ventral) side of gonopod                            | markedly angled with higher end towards sternal (ventral) side of gonopod (opposite direction to <i>M. longicarpus</i> ) |
| concavity of the apical spatuloid shape                         | well developed  | moderately developed  | well developed   |
| keels   | prominent   | prominent   | prominent  |
| furrows   | shallow   | well developed  | well developed   |
| setae   | along shaft and very long on inner callosity  | along shaft and well developed at tip   | along shaft and well developed at tip  |
| length  | from 3 <sup>rd</sup> abdominal segment to just above 6 <sup>th</sup> abdominal segment (not always visible) | from 3 <sup>rd</sup> abdominal segment to below top of 6 <sup>th</sup> segment (not always visible) | from 3 <sup>rd</sup> abdominal segment to just above 6 <sup>th</sup> segment (visible)                                   |

Table 6

Comparison of gonopore morphology

| Gonopore feature | <i>M. darwinensis</i>      | <i>M. longicarpus</i>            | <i>M. occidentalis</i>     |
|------------------|----------------------------|----------------------------------|----------------------------|
| size of spur     | large                      | large                            | small                      |
| shape of spur    | simple, dentoid, blunt tip | multifurcate, dentoid, blunt tip | simple, dentoid, blunt tip |
| setae            | sparse fringe              | dense short fringe at end        | sparse fringe              |

**Gonopods:** The key features that help to distinguish between the three species are: beginning point of torsion on shaft (viewed on the anterior surface); extent of curvature of the tip of the shaft; shape, location and orientation (viewed sterno-laterally) of the apical chitinous structure; development of the concavity of the apical spatuloid shape; development of the keel; and development of the longitudinal furrow. The gonopods of the three *Mictyris* species examined in this study show some discernible differences (Fig. 5) particularly in the shape and orientation of the chitinous structure and the development of the apical spatuloid cavity. The gonopod of *M. darwinensis* exhibits the greatest development of the concavity in the apical spatuloid shape. Viewed ventrally, the gonopod apex of *M. darwinensis* has greater similarity with *M. occidentalis* than with *M. longicarpus* in

that the apex of the distal curve is longer, but has more affinity to *M. longicarpus* with its prominent keels and furrows. A comparison of the gonopods of the three species is provided in Table 5.

**Gonopores:** Gonopores of the three species share the same feature common to the genus of being a cavity overhung on the mesial side with a projection or spur formed from the end of the 3<sup>rd</sup> sternal segment. *M. darwinensis* gonopores have greater similarity with those of *M. longicarpus* than those of *M. occidentalis*. (Table 6).

A summary of the major morphological similarities and differences of the three *Mictyris* species considered in this study is presented in Table 7 below.



Table 7

Summary of major differences between the three *Mictyris* species in this study

| Species character                       | <i>M. darwinensis</i>   | <i>M. longicarpus</i>   | <i>M. occidentalis</i>   |
|---|---|---|--|
| average ♂ size in this study (CL in mm) | 13.5  | 25  | 12   |
| carapace                                | appears smooth, microscopically granular, smooth to touch   | appears smooth, microscopically granular, smooth to touch   | macroscopically granular, not smooth to touch  |
| branchial regions                       | slightly inflated, not overlapping base of walking legs; microscopically granular   | slightly inflated, not overlapping base of walking legs; microscopically granular   | moderately inflated, slightly overlapping base of walking legs; macroscopically granular with single granules  |
| posterior border                        | projecting; sloping downwards in profile; length straight-edged   | projecting; convex in profile; length slightly sinusoidal   | distinctly projecting outwards in profile; length convex   |
| antero-lateral spines and ridges        | prominent, straight, not recurved smooth except for sparse granules at base; microscopically granular ridges running backwards to branchial regions and downwards to sub-hepatic region   | prominent, recurved, oriented outwards more than upwards, smooth except for sparse granules at base; ill-defined ridge running backwards to branchial regions and another short, microscopically granular ridge downwards to sub-hepatic region | broad and granular, recurved, oriented outwards more than upwards; prominent granular ridge running backwards to branchial region and another short, strongly granular ridge downwards to sub-hepatic region |
| front                                   | narrow, straight laterally  | narrow, straight laterally  | broad, convexly curving laterally  |
| eyes                                    | medium, globular; slender peduncle  | large and globulose; stout peduncle   | medium, globular; slender peduncle   |
| third maxillipeds                       | microscopically granulated; length of merus less than half that of naked surface of ischium   | microscopically granulated; length of merus less than half that of naked surface of ischium   | lower part of merus and all of ischium heavily granulated; length of merus slightly more than half that of naked surface of ischium  |
| abdomen                                 | broad; 7 <sup>th</sup> segment longer than 6 <sup>th</sup> ; 1 <sup>st</sup> segment markedly long and flat   | 7 <sup>th</sup> segment longer than 6 <sup>th</sup> ; 1 <sup>st</sup> segment slightly concave  | 7 <sup>th</sup> segment equal to 6 <sup>th</sup> ; 1 <sup>st</sup> segment markedly sloping  |
| chelipeds                               | slender, smooth, wrist long, palm small; large conical tooth on moveable finger   | wrist and outer surface of palm smooth; palm sturdy; fingers long and robust; large conical tooth on moveable finger  | wrist and palm visibly granulated; slightly asymmetrical domed tooth on moveable finger  |
| walking legs                            | slender; dorsal ridge of carpus distally terminated with small projecting spine on 1 <sup>st</sup> -3 <sup>rd</sup> legs; merus of 3 <sup>rd</sup> pair as long as 1 <sup>st</sup> to 6 <sup>th</sup> abdominal segments; dactyl of 4 <sup>th</sup> walking leg long and slightly curved at tip | merus of 3 <sup>rd</sup> pair as long as 1 <sup>st</sup> to 6 <sup>th</sup> abdominal segments; dactyl of 4 <sup>th</sup> walking leg long and slightly curved at tip   | merus of 3 <sup>rd</sup> pair as long as 1 <sup>st</sup> to 5 <sup>th</sup> abdominal segments; dactyl of 4 <sup>th</sup> walking leg short, setose and distinctly curved over distal third                  |
| gonopods                                | relatively stout shaft, well-developed spatuloid cavity at tip with moderate apical curve, prominent, horizontally orientated chitinous tip;  | stout shaft, tip with short distal curve, prominent, slightly angled chitinous tip  | relatively stout shaft, slender tip, with long distal curve, prominent, strongly angled chitinous tip  |
| gonopores                               | large, simple spur  | large, setose, multifurcate spur  | small, simple spur   |

### Key to species of *Mictyris* Latreille 1806

A key to distinguish the adult males of the five described species of *Mictyris* Latreille 1806 is presented below. The key is designed to identify species without reliance on colour(s) present in living specimens, *i.e.*, it enables identification of samples that may have been bleached while stored in preserving liquids.

- |  |                                 |   |
|--|---------------------------------|---|
| 1a. eyes large   | <i>M. longicarpus</i>           |   |
| 1b. eyes not large   |                                 | 2 |
| 2a. posterior border of carapace produced  |                                 | 3 |
| 2b. posterior border of carapace not produced  |                                 | 4 |
| 3a. carapace smooth  | <i>M. darwinensis</i>           |   |
| 3b. carapace not smooth, with macroscopic granules or tubercles                                |                                 | 5 |
| 4a. eyes very small  | <i>M. livingstonei</i>          |   |
| 4b. eyes not very small  |                                 | 6 |
| 5a. 4 <sup>th</sup> walking leg dactyl markedly curved, prominent antero-lateral spines        | <i>M. occidentalis</i>          |   |
| 5b. 4 <sup>th</sup> walking leg dactyl not markedly curved, no prominent antero-lateral spines | <i>M. platycheles</i>           |   |
| 6a. chitinous structure on gonopod oriented horizontally                                       | <i>M. brevidactylus</i>         |   |
| 6b. chitinous structure on gonopod oriented slightly upwards                                   | <i>M. guinotae</i> <sup>1</sup> |   |

### Discussion and conclusions

Qualitative and biometric data point to *Mictyris* in northern Australian from the Kimberley to Cape York region as a new species. *M. darwinensis* has morphologically distinct characters, and can be readily distinguished from *M. longicarpus*, to which it is morphologically most similar, by its smaller size, smaller eyes, pale blue to white carapace and reddy brown to brown coloured branchial regions when alive, two spines on the inner cheliped merus, and uniformly coloured walking legs with distinctive terminating spine on carpal dorsal ridge. *M. longicarpus*, in contrast, is larger in size, with very large globular eyes, has medium blue carapace and pale blue to white branchial regions when alive, one large spine on the inner cheliped merus, red coloured bands on the bases of the legs and the merus-carpus junction (knees) of the chelipeds and walking legs, and no terminating spine on the carpal dorsal ridge of the walking legs. Thus *M. darwinensis* is most similar to *M. longicarpus* in the shape and micro-granularity of the carapace, chelipeds, 3<sup>rd</sup> maxillipeds and walking legs (except for the carpal dorsal ridge spines), particularly in the 4<sup>th</sup> walking leg dactyl. We consider it to be a close relative of *M. longicarpus*.

Apart from those features common to the genus, *M. darwinensis* shares very few characteristics with

*M. occidentalis*, its biogeographic nearest neighbour. *M. darwinensis*, with its smooth, not visibly granular, pale blue to white carapace, reddy brown to brown-coloured branchial regions, straight antero-lateral spines, two spines on the inner cheliped merus, straight dactyl of the 4<sup>th</sup> walking leg, and downward projecting posterior border shows little similarity to *M. occidentalis*, which has a macroscopically granular dark blue carapace, pinkish-blue branchial regions, recurved antero-lateral spines, one spine on the inner cheliped merus, curved 4<sup>th</sup> dactyl of the walking leg, no terminating spine on the carpal dorsal ridge of the walking legs, and outwardly projecting posterior border (Unno 2008). The two characters that *M. darwinensis* shares with *M. occidentalis* are that both have smaller eyes and have smaller adult male average sizes than *M. longicarpus*.

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<sup>1</sup> Recently, Davie *et al.* (2010) subdivided the Asian species *M. brevidactylus* Stimpson 1858, into *M. guinotae* in the southern Japan Ryuku Islands and *M. brevidactylus* on the coasts of Taiwan, mainland China and northern Vietnam, assigning a neotype for the latter species. The distinction between the two species was based on absence/presence of red band colouration at base of walking legs (a feature largely not present in bleached Museum-stored specimens), the orientation of the chitinous structure of the gonopod, and DNA information. However, without the presence of colour, examination of gonopod morphology by microscopy, and DNA data, the two species actually appear to be macroscopically indistinguishable.





