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Costacosa, a new genus of wolf spider (Araneae, Lycosidae) from coastal north-west Western Australia

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ABSTRACT – A new genus of wolf spider (family Lycosidae Sundevall, 1833), *Costacosa* gen. nov. is described from north-west Western Australia to include *C. torbjorni* sp. nov. (type species) and *C. dondalei* sp. nov. The genus belongs to the subfamily Lycosinae Sundevall, 1833 and differs from all other Australian genera in this subfamily with similar somatic morphology, in particular *Venator* Hogg, 1900 and *Knoelle* Framenau, 2006, mainly in genitalic characters. The tegular apophysis of the male pedipalp has a pronounced ventral spur, a distinct ventral edge of species-specific shape and serrations along its apical edge. The female epigyne has an elongated triangular atrium and the medium septum is longer than the posterior transverse part. *Costacosa* are medium-sized wolf spiders of overall brown colouration and with broad light median and sublateral bands on the carapace and a black patch in the frontal two-thirds of the venter. *Costacosa torbjorni* is the most commonly recorded wolf spider on Barrow Island, from where currently seven species of Lycosidae are known.

KEYWORDS: taxonomy, Lycosinae, new species, Pilbara

INTRODUCTION

In a taxonomic treatment of Western Australian wolf spiders (Lycosidae Sundevall, 1833), McKay (1979b) reviewed *Lycosa meracula* Simon, 1909, which was originally described based on material from Denham and Albany, Western Australia (Simon 1909). McKay (1979b) based his interpretation of the species on the examination of two immature syntypes collected at Denham; however, the syntype from Albany, not examined by McKay (1979b), is a mature male and consequently, Framenau et al. (2006) designated this specimen as the lectotype of *Lycosa meracula*. As this male is conspecific with *Tetralycosa oraria* (L. Koch, 1877), *Lycosa meracula* was placed into synonymy with *T. oraria* (Framenau et al. 2006). *Tetralycosa oraria*, a member of the subfamily Artoriinae Framenau 2007, is not conspecific with the specimens from coastal northern Western Australia that McKay (1979b) illustrated as *Lycosa meracula* which are, based on genital morphology, members of the subfamily Lycosinae.

The Lycosinae are characterised by the structure of the male pedipalp, which has a transverse tegular apophysis with a ventrally directed spur and a sinuous channel on the dorsal surface (Dondale 1986). This subfamily is the most species-rich in Australia in addition to the Artoriinae, the Venoniinae Lehtinen and Hippa, 1979 and the Zoicinae Lehtinen and Hippa, 1979 (Framenau 2007; McKay 1979a; Yoo and Framenau 2006). The Australian Lycosinae are represented by two distinct lineages, a Gondwanan lineage with biogeographic links to the Neotropics and a second lineage that presumably invaded Australia much later through South-East Asia (Murphy et al. 2006). Australian genera of the Gondwanan lineage that were recently revised include *Dingosa* Roewer, 1955 and *Hoggicosa* Roewer, 1960, and the monotypic *Knoelle* Framenau, 2006, *Mainosa* Framenau, 2006 and *Tapetosa* Framenau et al. 2009 (Framenau 2006a, b; Framenau and Baehr 2007; Framenau et al. 2009; Langlands and Framenau 2010). The South-East Asian lineage is currently represented by *Venatrix* Roewer, 1960 and *Tuberculosa* Framenau

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and Yoo, 2006 (Framenau 2006d; Framenau and Vink 2001; Framenau and Yoo 2006). Other largely Northern Hemisphere lycosine genera currently reported from Australia, such as *Alopecosa* Simon, 1885, *Geolycosa* Montgomery, 1904, *Lycosa* Latreille, 1804 and *Trochosa* C. L. Koch, 1847, represent historical taxonomic artefacts as early European arachnologists generally placed Australian species in taxa they were familiar with. Ongoing taxonomic and systematic work will place these species into a framework of generally endemic new Australian genera (VWF, unpublished data).

The material that McKay (1979b) listed in his review of *L. meracula* includes two species from coastal north-western Western Australia which are here described in a new genus of wolf spiders. One of these is the most common wolf spider species collected on Barrow Island but also occurs on other islands off the coast of north-western Western Australia and the coastal mainland. The currently known wolf spider fauna of Barrow Island is summarised as a contribution to this special volume on the Barrow Island fauna.

MATERIAL AND METHODS

This study is based on an examination of more than 20,000 records of wolf spiders in all Australian museums and many historic European institutions as part of an extensive revision of the Australian Lycosidae by the senior author.

Descriptions are based on spiders stored in 70% ethanol (EtOH). For examination and illustration of female internal genitalia, epigynes were placed in lactic acid overnight to clear soft tissue. Digital images were taken using a Leica DFC 295 digital camera attached to a Leica M205C stereo microscope. To increase depth of field, multiple images were merged using the software package Leica Application Suite 3.7.0.

All measurements are in millimetres (mm). Morphological nomenclature follows Framenau and Baehr (2007) and Langlands and Framenau (2010).

ABBREVIATIONS

Morphology

AL, AW – abdomen length and width; CL, CW – carapace length and width; TL – total length

ALE, AME, PLE, PME – anterior/posterior lateral/median eyes

Collections

BMNH – Natural History Museum, London

QM – Queensland Museum, Brisbane

WAM – Western Australian Museum, Perth

RESULTS AND DISCUSSION

BIOGEOGRAPHY

The new genus *Costacosa* includes two morphologically very similar species with distribution ranges that abut each other; currently mixed populations of both species are not known (Figure 4). Their distribution does not follow a latitudinal or climatic gradient, but at latitudes where both occur, *C. torbjorni* is known from offshore islands, including Barrow Island, whereas *C. dondalei* is found on the mainland only. This distribution is consistent with the geological history of the region as the Barrow Island, Lowendal and Montebello archipelagos represent a natural geological extension to Cape Range in the south and were connected to the mainland until some 8,000 years ago (Humphreys 1993). Although *C. torbjorni* has so far not been reported from Cape Range, its distribution ranges as far south as Shark Bay. The current distribution of both species appears to reflect the geological history of the region rather than dispersal events despite the ability of many wolf spider species to 'balloon' on gossamer thread (Bell et al. 2005; Pearce et al. 2005).

BARROW ISLAND WOLF SPIDERS

A total of seven species of wolf spiders have so far been recorded from Barrow Island and *C. torbjorni* is the most commonly collected of these (Table 1). All Barrow Island wolf spider species belong to the subfamily Lycosinae, consistent with the notion that representatives of the three other subfamilies present in Australia, Artoriinae, Zoicinae and Venoniinae, generally represented by small to medium-sized vagrant and web-building spiders, are mostly found in the Torresian and Bassian regions (Framenau 2002, 2005, 2006c, 2007; Yoo and Framenau 2006). In contrast, the generally larger and burrowing Lycosinae dominate the Eyrean region (Framenau 2006a, b; Framenau and Baehr 2007; Langlands and Framenau 2010). These spiders are generally active at night and hide in their burrows from the heat of the day (VWF unpublished data).

Most species of wolf spiders found on Barrow Island are known to be widespread on the Australian mainland, although the distribution of two undescribed species in the genus *Hogna* is unknown (Table 1). In comparison, *C. torbjorni* is a Western Australian endemic and, together with its congener *C. dondalei*, only found along the north-western coastline and offshore islands (Figure 4). Wolf spiders are known to disperse on gossamer silk and therefore the wide distributions of many species are not surprising. However, many species have very specific habitat preferences which limit an establishment of populations after dispersal.

It is unknown if juvenile *Costacosa* disperse via ballooning, but even if so, their distribution is apparently restricted by the preference for sandy, high-salinity habitats and a subtropical climate. Similarly, *T. oraria* is only found in coastal sandy habitats, but favours more temperate conditions around the southern coast of Australia (Framenau et al. 2006).

HALOTOLERANT AUSTRALIAN WOLF SPIDERS

As genus with general coastal distribution, *Costacosa* appears to have some halophile tendencies or is at least halotolerant. Similarly, *Lycosa corallina* McKay, 1974 is restricted to offshore islands of the Western Australian coast and is currently known from coral shingle fields on the Abrolhos and Dampier archipelagos only (McKay 1974; VWF unpublished data). *Lycosa salifodina* McKay, 1976 is found on the surface of inland salt lakes in Western Australia and South Australia, where they survive the extreme temperatures in self-excavated burrows (McKay 1976). Somatic and genital morphology of the halotolerant *L. corallina* and *L. salifodina* is very different to that of *Costacosa*; both are apparently closely related lycosine species with affinities to *Hogna* Simon, 1885. The artoriine *T. oraria* occupies coastal beaches and beach dunes in the southern half of Australia, including Tasmania, and belongs to a genus in which most species are halotolerant or halophile, and all except *T. oraria* live on or near the surface of ephemerally flooded salt lakes (Framenau et al. 2006; Hudson and Adams 1996). Consequently, tolerance to salty environments has evolved at least three times in wolf spiders in Australia in two different subfamilies, Lycosinae and Artoriinae. In *Costacosa*, this evolutionary pathway appears to have originated near marine environments and in *Tetralycosa* at inland salt lakes based on the number of species preferring each environment in both genera. However, only detailed phylogenetic analyses of halophile and related wolf spider genera will be able to shed light on the evolution of halotolerance in wolf spiders of Australia.

TAXOMONY

Family Lycosidae Sundevall, 1833

Subfamily Lycosinae Sundevall, 1833

Costacosa gen. nov.

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TYPE SPECIES

Costacosa torbjorni sp. nov.

INCLUDED SPECIES

Costacosa torbjorni sp. nov. (type species), *C. dondalei* sp. nov.

DIAGNOSIS

Paraphyly and polyphyly are rife within the subfamily Lycosinae. Current taxonomy at the genus level does not reflect phylogenetic relationships, in particular with respect to the fauna of Gondwanan origin (i.e. Murphy et al. 2006, Alvares 2007). This unsatisfactory situation is mainly a legacy of Roewer's (1959, 1960) revisionary work that focused on the African fauna and that was purely based on selected somatic characters which are now recognised as having poor phylogenetic signal. Consequently, many lycosine genera, in particular those of Gondwanan origin, are poorly defined and it is not possible to define synapomorphies that undoubtedly identify *Costacosa* against world-wide Lycosinae. We therefore diagnose the new genus within a local Australian context pending a genus-level review of world-wide, but in particular Gondwanan, Lycosinae.

Within the Australian lycosine fauna, *Costacosa* most closely resembles *Venator* and *Knoelle* in somatic morphology. However, it differs from *Venator* by the lack of a retrolateral incision in the tegular apophysis of the male pedipalp and the lack of sharp lateral edges of the epigyne atrium in females (VWF unpublished data). It differs from *Knoelle* by the lack of a large patch of apical setae on the male pedipalp cymbium (Framenau 2006a). *Costacosa* differs from *Tasmanicosa* and *Dingosa* considerably in somatic colouration, in particular it lacks the Union-Jack-pattern on the carapace (Framenau and Baehr 2007, unpublished data). In addition, *Costacosa* do not build turrets around their burrows as typical in *Dingosa*. *Costacosa* differs from *Hoggicosa* by the shape of the epigyne, as the distance between the anterior pockets is smaller than the width of the posterior transverse part (Langlands and Framenau 2010). In addition, males of *Hoggicosa* have a patch of dorsally bent setae on the tip of the cymbium, which are lacking in *Costacosa*. *Costacosa* distinctly differs from the monotypic *Tapetosa*, as the spiders are not dorso-ventrally flattened and the legs are not laterigrade (Framenau et al. 2009). The new genus differs from *Mainosa* by a very different body colouration, i.e. the abdomen is not black with transverse light bars on the abdomen and the lack of turret-building behaviour around its burrow entrance (Framenau 2006b). *Costacosa* differs from *Hogna* by the shape of the male and female genitalia as *Hogna* have a very simple, triangular tegular apophysis in the male pedipalp and a simple, inverted T-shaped median

septum of the female epigyne (Framenau et al. 2006; Fuhn and Niculescu-Burlacu 1971). *Costacosa* differs from *Venatrix* and *Tuberculosa* by the lack of an apical cymbial hook in males (Framenau and Vink 2001; Framenau and Yoo 2006).

A number of other lycosinae genera are currently listed as part of the Australian fauna, but *Costacosa* is not diagnosed against these here. Two of these, *Cynosa* Caporiacco 1933 and *Orinocosa* Chamberlin 1916, are themselves poorly diagnosed based on modern taxonomic standards for the Lycosidae and a morphological assessment of these remains difficult based on their original descriptions; however, they were described from very different biogeographical regions, North Africa and South America respectively. *Orthocosa* Roewer 1960 is considered a junior unpublished synonym of *Tasmanicosa* (V.W. Framenau and B.C. Baehr unpublished data). *Agalenocosa* Mello-Leitão, 1944 is considered a member of the Venoniinae (Alvares 2007). *Alopecosa*, *Geolycosa*, *Lycosa* and *Trochosa* are largely Northern Hemisphere Lycosinae and reasonably well diagnosed (e.g. Lugetti and Tongiorgi 1969; Dondale and Redner 1979; Dondale and Redner 1990; Zyuzin and Logunov 2000; Kovblyuk et al. 2012; Planas et al. 2013). Based on these reviews, Australian representatives of these genera are taxonomically misplaced and therefore *Costacosa* is not diagnosed against these here.

DESCRIPTION

Medium-sized wolf spiders (TL ca. 10.0 – 21.0 mm); males slightly smaller than females. Carapace longer than wide (Figures 1A, 3A, 5A, 7A), in lateral view dorsal profile highest just posterior of PLE and continuously sloping towards posterior end (Figure 1D). Head flanks comparatively steep in males (Figure 1C). Carapace brown with darker radial pattern and with distinct lighter median and submarginal bands; median and submarginal bands irregular; white setae in median and submarginal bands and in eye region (Figures 1A, 3A, 5A, 7A). Diameter of AME less than twice the diameter of ALE, row of anterior eyes narrower than row of posterior median eyes; row of anterior eyes slightly procurved (Figure 1C). Chelicerae with three promarginal and three retromarginal teeth. Labium wider than long. Abdomen light or yellow-brown and mottled with darker and lighter spots, heart mark irregular and indistinct (Figures 1A, 3A, 5A, 7A). Venter with a large black patch covering about three quarters of venter from epigastric furrow (Figures 1B, 3B, 5B, 7B). Leg formula IV>I>II>III. Spination of legs: Femur: 3 dorsal, 2 apicoprolateral, 3 retrolateral; patella: 1 prolateral, 1 retrolateral (male only); tibia: 1 dorsal (male only), 3 ventral pairs, 2 prolateral, 2 retrolateral (male only); metatarsus: 3 ventral pairs, 2 prolateral, 2 retrolateral (male only), 1 apicoprolateral, 1 apicoretrolateral, 1 apicoventral. Cymbium tip with ca. 2–5 macrosetae (Figures 2A, B, 6A, B). Tegulum undivided, large retrolateral tegular lobe; tegular apophysis with distinct, ventral spur, distinct ventral edge and apical serrations (Figures 2C, 6C). Embolus originating prolaterally on palea and curving ventrally around it, long and slender. Terminal apophysis and pars pendula sickle-shaped (Figures 2D, 6D). Epigyne with inverted T-shaped median septum, longer than wide, atrium elongated triangular (Figure 3C, 7C); spermathecal heads slightly wider than spermathecal stalks, spermathecal stalks S-curved (Figures 3D, 7D).

ETYMOLOGY

From Latin *costa*, "a rib, a side", which developed a sense in Medieval Latin of the shore as the "side" of the land; and *–cosa*, a generic ending for Lycosidae genera. It refers to the typical coastal distribution of the known members of the genus.

***Costacosa torbjorni* sp. nov.**

Figures 1–4

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Lycosa clara L. Koch: Hogg (1914): 333 (misidentification).

Lycosa meracula Simon: McKay (1979b): 264–267 (ad part), Figures 9c–g, i–k (misidentification).

MATERIAL EXAMINED

Holotype

Australia: ***Western Australia***: ♂, Barrow Island, John Wayne Country, 20°45′08″S., 115°22′05″E., 16–17 December 1993, K. Aplin (WAM T118024).

Paratype

Australia: **Western Australia**: 1 ♀, Barrow Island, 29°47′18″S., 115°27′46″E., 19 November 2003, spotlighting, *Acacia coriacea*/*Triodia* on pinkish brown sand, RTBI-100, R. Teale, G. Harold (WAM T57673).

Other material

Australia: Western Australia: 4 ♂, 1 juvenile, Airlie Island, 21°20′S., 115°10′E. (WAM T51233); 2 ♀, Barrow Island, 20°47′S., 115°24′E. (WAM 69/366B–7B); 5 ♀, same locality (WAM 71/1807–11); 1 ♀, same locality (WAM 74/1473); 17 ♂, 5 ♀, 2 juveniles, same locality (WAM T57690); 3 ♂, 1 ♀, same locality (WAM T53501); 16 ♂, 1 ♀, 1 juvenile, same locality (WAM T57691); 3 ♂, same locality (WAM T57689);

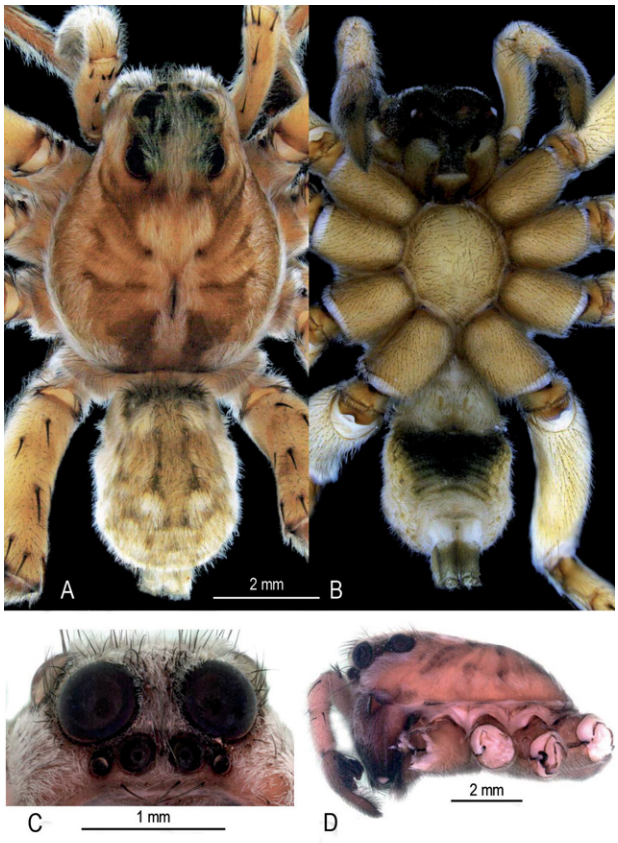

FIGURE 1 *Costacosa torbjorni* sp. nov.: A, holotype male (WAM T118024) from Barrow Island, dorsal view; B, same specimen, ventral view; C, male (WAM T57674) from Barrow island, eye arrangement, frontal view; D, same specimen, carapace profile, lateral view.

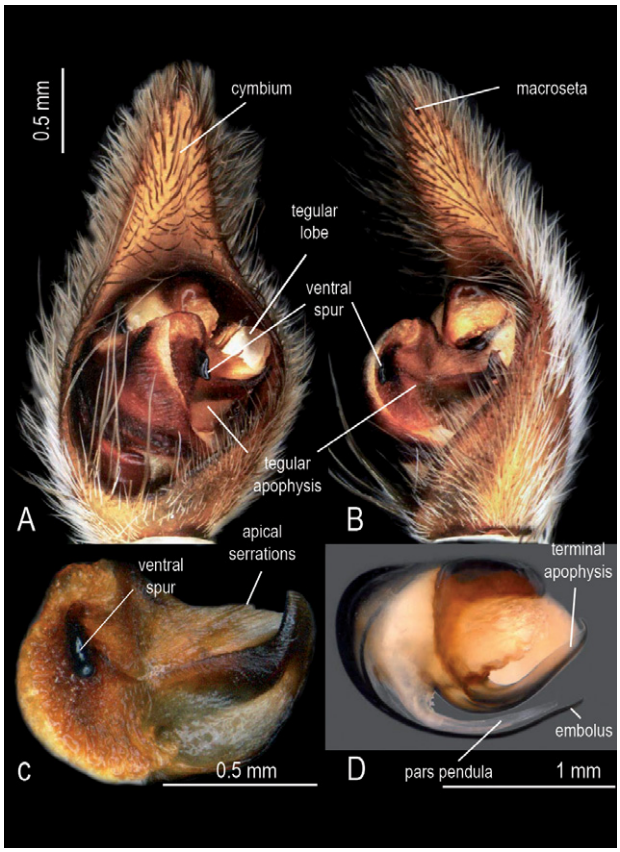

FIGURE 2 *Costacosa torbjorni* sp. nov. A, holotype male (WAM T118024) from Barrow Island, male pedipalp, ventral view; B, same specimen, male pedipalp, retrolateral view; C, same specimen, male pedipalp, tegular apophysis, ventral view; D, male from Barrow Island (WAM T126917), palea, ventral view.

1 ♂, same locality (WAM T126917); 3 ♂, Barrow Island, 20°47′18″S., 115°27′46″E. (WAM T57679–81); 6 ♀, same locality (WAM T57674–8); 1 ♂, Barrow Island, 20°48′26″S., 115°27′03″E. (WAM T57683); 4 ♀, same locality (WAM T57684–7); 1 ♀, Barrow Island, 20°48′23″S., 115°27′09″E. (WAM T57688); 2 ♂, 2 ♀, Barrow Island, Bandicoot Bay, 20°52′S., 115°19′E. (WAM T73510); 1 ♂, Barrow Island, east coast, 20°46′S., 115°24′E. (WAM 74/1472); 1 ♀, 3 juveniles, same locality (WAM 74/1479–82); 5 ♂, 1 juvenile, Barrow Island, John Wayne Country, 20°45′08″S., 115°22′05″E. (WAM T57813); 2 ♂, same locality (WAM T57815); 1 ♂, same locality (WAM T57818); 1 ♀, Barrow Island, John Wayne Country, 20°45′14″S., 115°21′53″E. (WAM T57819); 3 ♂, Barrow Island, John Wayne Country, 20°45′S., 115°22′E. (WAM T73511); Barrow Island, "near camp" (possibly WAPET Camp), 20°49′S., 115°27′E. (WAM T75883); 1 ♂, 1 ♀, 2 juveniles, Barrow Island, WAPET Camp, 20°49′43″S., 115°26′40″E. (WAM T57814); 2 ♂, same locality (WAM T57820–1); 1 ♂, Bush Bay, 25°07′31″S., 113°49′22″E. (WAM T68895); 4 ♂, Bush Bay, 25°06′49″S., 113°43′52″E. (WAM T68893); 3 ♂, 1 ♀, 2 juveniles, ca. 4 km W. of Carnarvon, 24°53′01″S., 113°38′20″E. (WAM T56410); 2 ♂, 1 ♀, 5 juveniles, Central Peron Peninsula, 26°05′30″S., 113°36′45″E. (WAM T62335); 1 ♀, same locality (WAM T62316); 1 ♀, 6 juveniles, Coral Bay, 23°08′S., 113°46′E. (WAM T55318); 1 ♀, same locality (WAM T99903); 2 ♀, 2 juveniles, same locality (WAM T55315); 1 ♀, Edel Land, 26°14′13″S., 113°16′E. (WAM T62317); 1 ♂, 1 ♀, 1 juvenile, Heirisson Pump, 26°03′S., 113°23′E. (WAM T68894); 1 ♀, 9 juveniles, Hermite and Montebello Islands, 20°26′S., 115°31′E. (BMNH 1924.3.1.1018–27); 1 ♀, Hermite Island, Montebello Islands, 20°25′22″S., 115°31′54″E. (WAM T95800); 4 ♂, Lake Macleod, 24°21′16″S., 113°30′35″E. (WAM T108982–3, T108992–3); 1 ♂, 1 ♀, Lowendal Islands, Island 'B', 20°38′S., 115°34′E. (WAM T70346); 2 ♀, Mauds Landing, 23°07′S., 113°46′E. (WAM69/64–5);

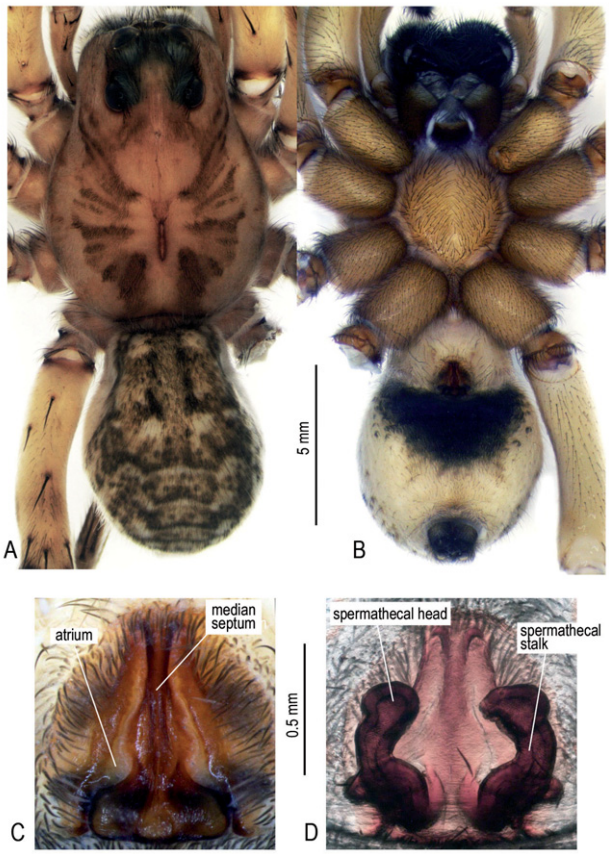

FIGURE 3 *Costacosa torbjorni* sp. nov., paratype female (WAM T57673) from Barrow Island. A, dorsal view; B, ventral view; C, epigyne, ventral view; D, epigyne, dorsal view.

1 ♀, 4 juveniles, same locality (WAM 74/1474–8); 1 ♀, 5 juveniles, same locality (WAM 71/1820–5); 1 ♀, 20 miles S. of Mauds Landing, , 23°24′S., 113°46′E. (WAM69/796); 1 ♀, 1 juvenile, Point Quobba, South, 24°33′14″S., 113°28′30″E. (WAM T53492); 4 ♂, 1 ♀, Thevenard Island, 21°28′S., 114°59′E. (WAM T53792); 1 ♂, Warroora Station, 23°29′S., 113°48′E. (WAM 70/238); 2 ♂, 54 juveniles, same locality (WAM 70/370–420); 1 ♀, same locality (WAM 70/211); 1 ♀, 1 juvenile, same locality (WAM T53679).

DIAGNOSIS

Male *C. torbjorni* sp. nov. differ from *C. dondalei* by the narrow tip of the terminal apophysis and the tip of the tegular apophysis which points apicad in relation to the cymbium. The medium septum is generally widened centrally or towards the posterior transverse part and this widening is absent in *C. dondalei*. The widening of the median septum of the female epigyne is sometimes very subtle (e.g. McKay 1979b, Figure 9j) and therefore some females of the species can be confused with *C. dondalei*.

DESCRIPTION

Male (based on holotype)

Carapace (Figures 1A, C, D). Brown; distinct dark radial pattern; irregular light brown median band; irregular light brown submarginal bands (Figure 1A); brown setae, but white setae in median and submarginal bands and in eye region; dark brown macrosetae scattered around eyes; one long bristle between AME, six bristles below ALE in irregular order. *Eyes* (Figure 1C). Row of anterior eyes slightly procurved and narrower than row of PME. *Sternum* (Figure 1B). Yellow-brown; brown setae, especially centrally, and brown macrosetae, which are denser and longer towards margins. *Labium*. Brown; front end truncated and white. *Chelicerae*. Dark reddish-brown; covered with white setae and silvery macrosetae basally; three promarginal teeth, the median largest and the apical very small and close to the median; three retromarginal teeth with the basally smallest. *Pedipalp* (Figures 2A–D). Cymbium with ca. 5 macrosetae; tegular apophysis with keel-shaped ventral spur (Figure 2C); embolus slender, terminal apophysis and pars pendula sickle-shaped and with small denticles at its base (Figure 2D). *Abdomen*. Light brown, mottled with darker olive-grey and lighter whitish spots and lines; olive-green heart mark in anterior half border by irregular dark lines and patches (Figure 1A); setal colouration corresponds to abdomen colour. Venter yellow-brown with large black patch covering ca. three quarter behind epigastric furrow (Figure 2B). Spinnerets grey. *Legs*. Leg formula IV>I>II>III; light brown, with the distal segments darker; dense scopulate setae ventrally on tarsi and metatarsi of leg I and II. Spination of leg I: femur: 3 dorsal, 3 retrolateral, 2 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 1 dorsal, 3 ventral pairs, 2 prolateral, 2 retrolateral; metatarsus: 3 ventral pairs, 2 prolateral, 2 retrolateral, 1 apicoprolateral, 1 apicoretrolateral, 1 apicoventral.

Female (based on paratype)

Carapace (Figure 3A). As male but slightly darker; four bristles below ALE. *Labium, sternum, chelicerae*. As male. *Abdomen*. As male, mottled pattern darker and heart mark less distinct. Venter and spinnerets as male (Figure 3B). *Epigyne*. Atrium elongated triangular, median septum inverted T-shaped, centrally depressed into a cavity of the atrium (Figure 3C); spermathecal heads marginally wider than spermathecal stalks, spermathecal stalks S-shaped (Figure 3D). *Legs*. Leg formula IV>I>II>III; colouration as male but slightly darker; dense scopulate setae on tarsi and metatarsi of all legs and apical half of tibiae I. Spination of leg I: Femur: 3 dorsal, 3 retrolateral, 2 apicoprolateral; patella: 1 prolateral; tibia: 3 ventral pairs, 2 prolateral; metatarsus: 3 ventral pairs, 2 prolateral, 1 apicoprolateral, 1 apicoventral.

Measurements

Male holotype (female paratype): TL 12.40 (16.64), CL 7.38 (9.11), CW 5.64 (6.81). Eyes: AME 0.35 (0.46), ALE 0.19 (0.28), PME 0.87 (1.13), PLE 0.70 (1.03). Row of eyes: ALE 1.53 (1.85), PME 2.11 (2.62), PLE 2.52 (3.11). Sternum (length/width) 3.12/2.74 (3.77/3.14). Labium (length/width) 0.95/0.98 (1.08/1.33). AL 5.20 (8.00), AW 3.33 (6.07). Legs: Lengths of segments (femur + patella/tibia +metatarsus + tarsus = total length): Pedipalp 3.31 + 3.07 + – + 2.88 = 9.26, I 5.54 + 7.62 +5.35 + 3.27 = 21.78, II 6.20 + 7.44 + 4.94 + 3.10 = 21.68, III 5.89 + 6.81 + 5.28 + 3.02 = 21.00, IV 6.82 + 8.23 + 6.79 + 3.31 = 25.15 (Pedipalp 3.70 + 3.43 + – + 2.46 = 9.59, I 6.85 + 7.41 + 5.16 + 3.10 = 22.52, II 6.64 + 7.27 + 4.93 + 3.08 = 21.92, III 6.31 + 6.42 + 4.78 + 3.12 = 20.63, IV 7.28 + 9.21 + 6.86 + 3.59 = 26.94).

Variation

Males (females) TL 12.12–15.13; CL 6. 59–8.40; CW 5.18–6.41; n = 5 (TL 15.45–19.90; CL 7.98–9.49; CW 6.31–7.33; n = 5).

REMARKS

McKay's (1979b) review of *L. meracula* included material of both *C. torbjorni* and *C. dondalei* and those illustrations that depicted *C. torbjorni* are given in the list of synonyms above. Some of the specimens he examined represent juveniles and these are not identified to species level here.

One female and nine juveniles of *C. torbjorni* from the Hermite and Montebello Islands (BMNH 1924.3.1.1018–27) were reported as *K. clara* (sub

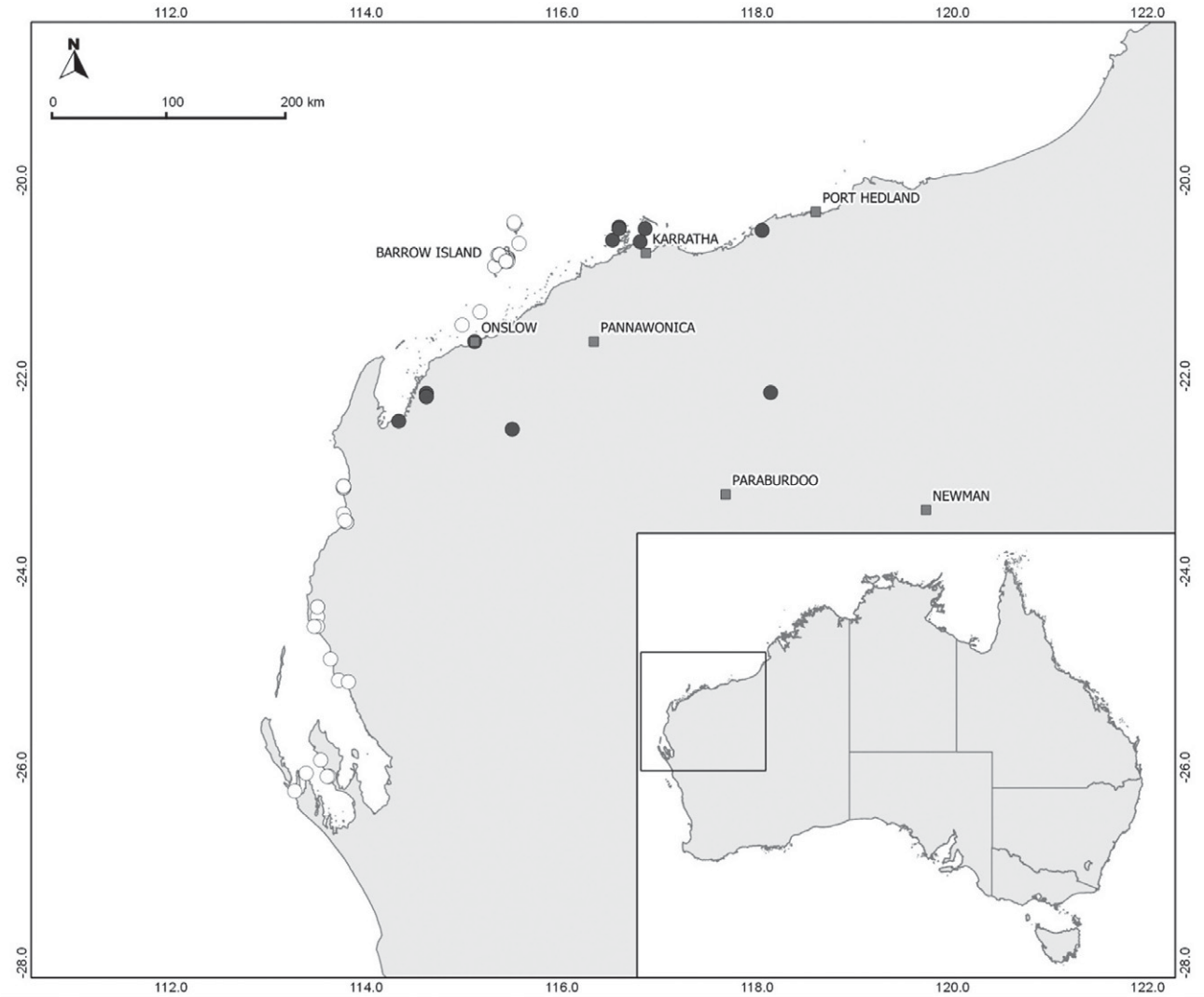

FIGURE 4 Records of *Costacosa torbjorni* sp. nov. (full circles) and *C. dondalei* sp. nov. (open circles) in Western Australia.

Lycosa) by Hogg (1914). However, it cannot be excluded that *K. clara* occurs on the Hermite and Montebello Islands, as the species is also known from Barrow Island (Table 1).

LIFE CYCLE AND HABITAT PREFERENCES

Highest numbers of mature males and females have been collected in October and November, i.e. at the beginning of the wet season; however, low numbers of each sex can be found throughout the year. Mature males have so far not been recorded in May, June and September, and mature females not in September and December. Two females carrying an eggsac are in collections, collected in October and March. This is consistent with McKay's (1979b) assessment that was based on a much smaller sample of specimens and states that mature females were collected from April to October and males in August. However, a life history assessment should consider that McKay's (1979b) review also included some *C. dondalei*.

Habitat descriptions found with specimens read: sandy site, sand dunes, sand dunes near beach, beach dunes, on beach, *Acacia coriacea* shrubs/heath on white sand dune and *Acacia coriacea/Triodia* on white coastal sand, but also leaf litter on dry banks and claypan. This largely agrees with McKay's (1979b) assessment who reports the species from coastal sandy soils, in particular in open areas on wind protected slopes of coastal sand dunes down to the wet sand of the beach.

Costacosa torbjorni construct open burrows to a depth of 65 to 130 mm, but wandering females can be found well away from the burrow (McKay 1979b).

DISTRIBUTION

Costacosa torbjorni was found along the north-western Western Australian coast, including offshore islands, between 20°45'S and 26°15'S of latitude; it appears that the species only occurs on islands at latitudes where *C. dondalei* is found on the mainland (Figure 4).

ETYMOLOGY

The specific epithet is a patronym in honour of Torbjørn Kronestedt for his extra-ordinary contributions to wolf spider systematics and ecology.

TABLE 1 Wolf spiders recorded from Barrow Island, Western Australia.

Species	No. of records from Barrow Island in WAM	Distribution	Reference
Costacosa torbjorni sp. nov.	35	north-western coastal WA[2] (Figure 4)	this study
Hoggicosa snelli (McKay, 1975)	4	northern WA[2]	Langlands and Framenau (2010)
Hogna crispipes (L. Koch, 1877)	1	Indian Ocean Islands (Christmas Island) to Pacific islands (incl. New Zealand and Hawaii)	Framenau et al. (2006) and VWF (unpublished data)
Hogna sp. 1	5	unknown, genus taxonomically poorly known in Australia	
Hogna sp. 2	1	unknown, genus taxonomically poorly known in Australia	
Knoelle clara (L. Koch, 1877)	1	northern Australia (NSW, NT, Qld, SA, WA[2])	Framenau (2006a)
Lycosa[1] *laeta* L. Koch, 1877	4	Australia (NSW, NT, Qld, SA, Vic, WA[2])	VWF (unpublished data)

1 Generic placement in *Lycosa* Latreille, 1804 is historical. The species belongs to a yet undescribed new genus of Australian wolf spiders (VWF unpublished data).

2 NSW, New South Wales; NT, Northern Territory; Qld, Queensland; SA, South Australia; Vic, Victoria; WA, Western Australia.

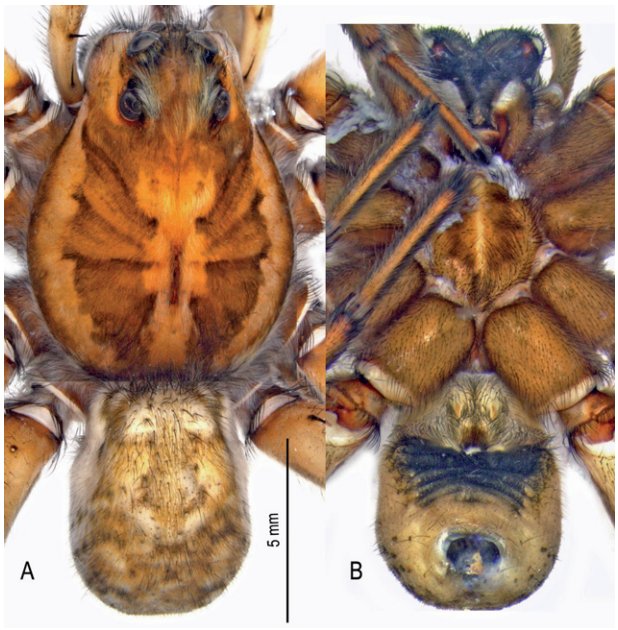

FIGURE 5 *Costacosa dondalei* sp. nov. A, holotype male (WAM T126963) from 100 km E. of Karratha, dorsal view; B, ventral view.

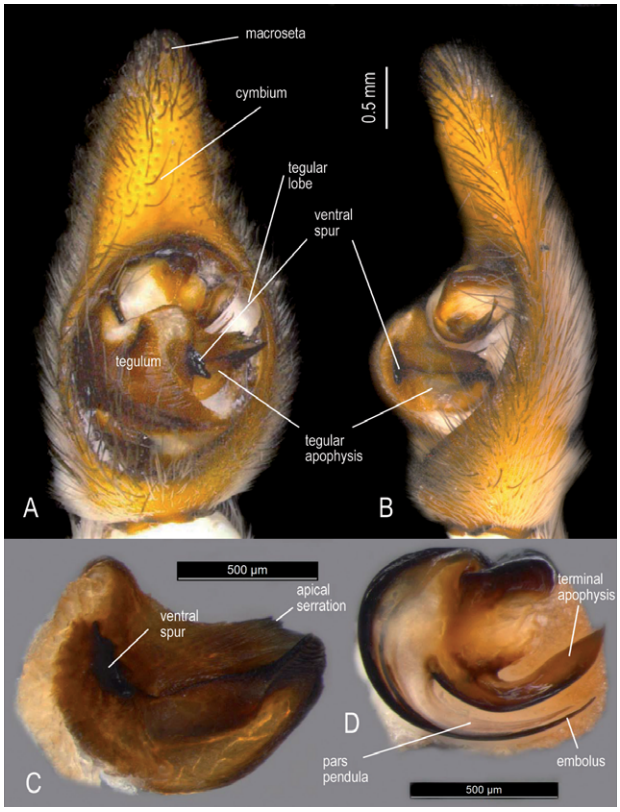

FIGURE 6 *Costacosa dondalei* sp. nov. A, holotype male (WAM T126963) from 100 km E. of Karratha, A, pedipalp, ventral view; B, pedipalp, retrolateral view; C, tegular apophysis, ventral view; D, palea, ventral view.

Costacosa dondalei sp. nov.

Figures 5, 6

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Lycosa meracula Simon: McKay, 1979b: 264–267 (ad part), Figures 9a, b, h (misidentification).

MATERIAL EXAMINED

Holotype

Australia: ***Western Australia***: ♂, 100 km E. of Karratha, 20°40′47.34″S., 117°39′42.47″E., 6 December 2012, dry pitfall trap, Phoenix Environmental Sciences 1016-vert-04_T1_PD, PES 10378, J. Clark (WAM T126963).

Paratype

Australia: **Western Australia**: 1 ♀, same data as holotype (WAM T126964).

Other material

Australia: Western Australia: 4 ♂, 4 ♀, 5 juveniles, Dolphin Island, Dampier Archipelago, 20°29′S., 116°51′E. (WAM T64605); 1 ♂, Enderby Island, 20°36′S., 116°31′E. (WAM T53478); 4 ♂, Exmouth Gulf, Straits Saltfield, 38 km NW. of Yanrey Homestead, 22°10′12″S., 114°37′12″E. (WAM T102354–7); 1 ♀, Giralia Bay, 22°27′S., 114°20′E. (WAM T58495); 4 ♂, 1 ♀, Hearson Cove North, Burrup Peninsula, 20°37′S., 116°48′E. (WAM T53500); 1 ♀, 5 juveniles, Mt King Well, 22°09′30″S., 118°08′15″E. (WAM T53494); 1 ♀, Munda Station, Cowrie Beach, 20°30′S., 118°03′E. (WAM T47611); 8 ♂, 3 ♀, 7 juveniles, Nanutarra, 20 km NNE. of Red Dunes, 22°32′25″S., 115°29′50″E. (WAM T42146); 1 ♀, 1 juvenile, Onslow, 21°41′S., 115°08′E. (QM S48); 1 ♂, 31 km SW. of Onslow, BHP site, no exact locality (WAM T68897); 8 ♂, 8 ♀, 6 juveniles, Rosemary Island, Dampier Archipelago, 20°28′S., 116°35′E. (WAM 72/198–219); 2 ♀, same locality (WAM T53485, T53496).

DIAGNOSIS

Male C. *dondalei* sp. nov. differ from *C. torbjorni* by the wider tip of the terminal apophysis and the tip of the tegular apophysis which points more retrolaterad than apicad in relation to the cymbium. The medium septum is not widened centrally as in *C. torbjorni*.

DESCRIPTION

Male (based on holotype)

Carapace (Figure 5A). Light brown; distinct grey radial pattern; irregular yellow-brown median

band; irregular yellow-brown submarginal bands (Figure 5A); brown setae, darker in radial bands, but white setae in median and submarginal bands and in eye region; dark brown macrosetae scattered around eyes; one bristle between AME, four bristles below ALE in irregular order. *Eyes*. Row of anterior eyes very slightly procurved and narrower than row of PME. *Sternum* (Figure 5B). Yellow-brown, dense grey pigmentation except in narrow median band and at margin; brown setae and macrosetae, which are denser and longer towards margins. *Labium*. Brown; front end truncated and white. *Chelicerae*. Dark brown; covered with white setae and silvery macrosetae basally; three promarginal teeth, the median largest and the apical very small and close to the median; three retromarginal teeth with the basally smallest. *Pedipalp* (Figures 6A–D). Cymbium with 2 macrosetae; tegular apophysis with keel-shaped ventral spur (Figure 6C); embolus slender, terminal apophysis and pars pendula sickle-shaped, terminal apophysis widened apically. *Abdomen*. Yellow-brown, mottled with brown, olive-grey and lighter whitish spots and lines; indistinct olive-green heart mark in anterior half (Figure 5A); setal colouration corresponds to abdomen colour. Venter yellow-brown with large black patch covering ca. three quarter behind epigastric furrow (Figure 5B). Spinnerets black. *Legs*. Leg formula IV>I>II>III; yellow-brown, with the distal segments darker; dense scopulate setae ventrally on tarsi and metatarsi of leg I and II; coxae with dark pigmentation ventrally. Spination of leg I: femur: 3 dorsal, 3 retrolateral, 2 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 1 dorsal, 3 ventral pairs, 2 prolateral, 2 retrolateral; metatarsus: 3 ventral pairs, 2 prolateral, 2 retrolateral, 1 apicoprolateral, 1 apicoretrolateral, 1 apicoventral.

Female (based on paratype)

Carapace (Figure 7A). As male; no bristles below ALE. *Labium, sternum, chelicerae, abdomen*. As male (Figure 7A, B). *Epigyne*. Atrium elongated triangular, median septum inverted T-shaped (Figure 7C); spermathecal heads wider than spermathecal stalks, spermathecal stalks S-shaped (Figure 7D). *Legs*. Leg formula IV>I>II>III; colouration as male but slightly darker; dense scopulate setae on tarsi and metatarsi of all legs and apical half of tibiae I. Spination of leg I: Femur: 3 dorsal, 3 retrolateral, 1 prolateral, 2 apicoprolateral; patella: 1 prolateral; tibia: 3 ventral pairs, 2 prolateral; metatarsus: 3 ventral pairs, 2 prolateral, 1 apicoprolateral, 1 apicoventral.

Measurements

Male holotype (female paratype): TL 17.14 (17.55), CL 10.35 (10.49), CW 7.14 (7.92). Eyes: AME 0.54 (0.57), ALE 0.25 (0.30), PME 1.10 (1.18), PLE 0.97 (1.10). Row of eyes: ALE 1.92 (2.13), PME 2.65 (2.95), PLE 3.26 (3.51). Sternum (length/width) 4.43/4.38 (3.38/3.41). Labium (length/width) 1.30/1.38 (1.51/1.70). AL 7.59 (7.78), AW 5.29 (5.72). Legs: Lengths of segments (femur + patella/tibia +metatarsus + tarsus = total length): Pedipalp 3.52 + 3.35 + – + 3.70 = 10.57, I 8.61 + 10.15 +7.03 + 4.16 = 29.95, II 8.15 + 8.76 + 7.20 + 4.05 = 28.16, III 7.76 + 9.00 + 6.34 + 3.91 = 27.01, IV 9.03 + 10.79 + 8.95 + 4.90 = 33.67 (Pedipalp 3.90 + 4.23 + – + 2.50 = 10.63, I 11.03 + 7.71 + 7.08 + 4.09 = 29.91, II 9.99 + 7.44 + 6.79 + 4.05 = 28.27, III 8.91 + 7.74 + 6.70 + 3.85 = 27.20, IV 8.88 + 10.98 + 8.94 + 4.26 = 33.06).

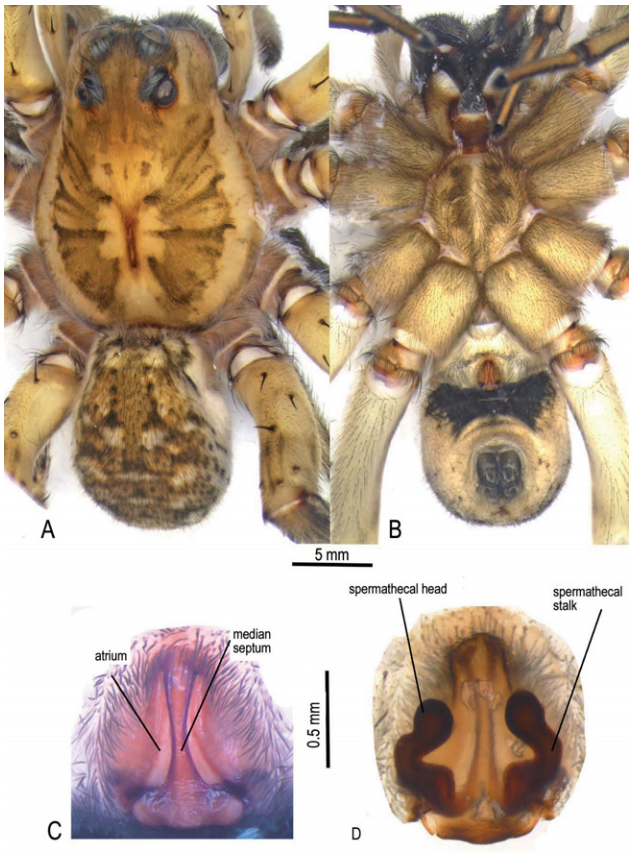

FIGURE 7 *Costacosa dondalei* sp. nov. A, holotype female (WAM T126964) from 100 km E. of Karratha, dorsal view; B, ventral view; C, epigyne, ventral view; D, epigyne, dorsal view.

Variation

Males (females) TL 14.120–18.15; CL 7.82–10.40; CW 6.35–7.420; n = 6 (TL 15.60–20.10; CL 8.15–11.32; CW 6.85–8.10; n = 5).

LIFE CYCLE AND HABITAT PREFERENCES

Mature males and females have been collected in throughout the year, but the low number of specimens in collections does not allow an accurate interpretation of the life cycle of *C. dondalei*.

Habitat descriptions found with specimens read: tussock grass over sand, sparse mulga/*Triodia* on stony red-brown loam, sand dune and sand beaches and red loam near beach.

DISTRIBUTION

Costacosa dondalei was generally found in the Pilbara region along the north-western Western Australian coastline, including offshore islands of the Dampier Archipelago, between ca. 20°25'S and 22°35'S of latitude; two records are from further inland (Figure 4).

ETYMOLOGY

The specific epithet is a patronym in honour of Charles Dondale for his extraordinary contributions to spider systematics and ecology, in particular in relation to wolf spiders, and his contribution to Australian spider taxonomy in general (Dondale 1966).

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