You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.
- A reproduction of material that is protected by copyright may be a copyright infringement.
- A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
Evoluion, Systematics & Geographic Parthenogenesis of *Ilyodromus* (Crustacea, Ostracoda)

by

Rylan James Shearn, BSc Hons

A thesis submitted to Edith Cowan University in accordance with requirements for the degree of Doctor of Philosophy

Submitted 27th February 2015
ON THE AFFINITY OF ISOCYPRIDINAE AND HERPETOCYPRIDINAE, WITH REDESCRIPTIONS OF FOUR SPECIES OF *Ilyodromus* Sars, 1894 (CRUSTACEA, OSTRACODA)

Adapted from:
4.1 Abstract

In previous studies, the high degree of similarity of some species of *Ilyodromus* Sars, 1894 (Herpetocypridinae) to species of another subfamily (Isocypridinae) was noted, calling for a revision of their systematic placement. Here, the systematics of *Ilyodromus* Sars, 1894 are revised within the context of Herpetocypridinae and Isocypridinae, by redescribing four species from material deposited at Museum Victoria (*I. amplicolis* De Deckker, 1981, *I. dikrus* De Deckker, 1981, *I. candonites* De Deckker, 1981, and *I. williamsi* (McKenzie, 1966)), and recollected topotypes, and comparing them to descriptions of other species in the genus, and to those of other genera of Herpetocypridinae and Isocypridinae. The study found that most genera within Isocypridinae share morphological characters that are diagnostic to the subfamily Herpetocypridinae. On these grounds, the transfer of Isocypridinae to the rank of Tribe Isocypridini Rome, 1965 of subfamily Herpetocypridinae Kaufmann, 1900 is proposed here to account for the present understanding of morphological divergence.

4.2 Key Words

taxonomy, systematics, diversity, morphology, SEM
4.3 Introduction

Most non-marine Ostracoda species belong to the family Cyprididae Baird, 1845 (Martens et al., 2008). Herpetocypridinae is one of 23 subfamilies in Cyprididae, and contains three tribes and 11 genera (Martens, 2001). Of these tribes, Herpetocypridini Kaufmann, 1900 is characterised by several diagnostic features, including the spatulate shape of the distal maxillula palp segment, the laterally flattened carapace, the lengths of the d1 and d2 setae on the sixth limb, and the presence of a posterior seta on the Caudal Ramus. However, a review of Herpetocypridinae noted the affinity of some species from the genus *Ilyodromus* Sars, 1894 from the western region of Australia with some representatives of another subfamily, Isocypridinae Rome, 1965 (Martens, 2001). Indeed, at least one species (*Ilyodromus williamsi* McKenzie, 1966) has been transferred between these ranks (De Deckker, 1981) due to the unclear boundary between them. These events highlighted the need for a morphological revision of *Ilyodromus* with the purpose of resolving the systematic relationship between Herpetocypridinae and Isocypridinae.

*Ilyodromus* Sars, 1894 has, at present, 18 nominal species distributed throughout Australasia (Brady, 1886; De Deckker, 1981, 1982a,b; King, 1855; McKenzie, 1966; Sars, 1894, 1896; Smith et al., 2011; Victor and Fernando, 1981), the sub-Antarctic (Müller, 1906; Smith and Sayers, 1971), North America (Sharpe, 1908) and Europe (Fox, 1965; Ghetti and McKenzie, 1981; Ghetti, 1973; Petkovski and Meisch, 1995). In Shearn et al. (2014), six species were revised in high detail, including the type species (*I. stanleyanus* King, 1855)), enabling confirmation of what characters are considered as truly representative of the genus. With this information, we are now in the position of being able to investigate the placement of the species in this genus, and the placement of the genus within a higher systematic context. However, the Western Australian species of *Ilyodromus* Sars, 1894 in question were not described to the same level of detail as the type species in Shearn et al. (2014), and redescriptions of *Ilyodromus* species from the western region of Australia are needed to compare key features that are definitive of the genus.

This study aimed to revise the systematics of *Ilyodromus* Sars, 1894 within the context of Herpetocypridinae and Isocypridinae by:


2. Comparing these, and other recent detailed descriptions (Shearn et al.,
2014; Smith et al., 2011) to the morphology of genera in Isocypridinae, and other tribes of Herpetocypridinae;

3. determining whether these species of *Ilyodromus* Sars, 1894 share enough characters to be considered as belonging to this genus, or;

4. whether they indeed belong to Isocypridinae, or;

5. whether changes in the placement of higher taxonomic ranks are needed to explain the affinity between *Ilyodromus* Sars, 1894 and representatives of Isocypridinae

The study redescribed *I. amplicolis* De Deckker, 1981, *I. dikrus* De Deckker, 1981, *I. candonites* De Deckker, 1981, and *I. williamsi* (McKenzie, 1966) in high detail with scanning electron microscopy and illustrations of all appendages. A high degree of morphological similarity was found between several genera of Isocypridinae to those of the *Ilyodromus* redescribed here, in Shearn et al. (2014) and described in Smith et al. (2011). Furthermore, many diagnostic features of Isocypridinae, including the size and thickness of the posterior seta on the Caudal Ramus, the distal segment of the maxilulla palp being spatulate, the h2 claw of the sixth limb being long in some species, and the Caudal Ramus attachment having a single basal branch, were found to be shared diagnostic characters for *Ilyodromus* Sars, 1894 and other genera (De Deckker, 1981; González Mozo et al., 1996) of the tribe Herpetocypridini, family Herpetocypridinae. Thus, since there were only a small number of characters found that distinguish Isocypridinae from the tribe Herpetocypridini of Herpetocypriinae, a change for Isocypridinae to be ranked as tribe Isocypridini of Herpetocypridinae is proposed here.

### 4.4 Methods

#### 4.4.1 Species descriptions

The morphology of *I. amplicolis* De Deckker, 1981, *I. dikrus* De Deckker, 1981, *I. candonites* De Deckker, 1981, and *I. williamsi* (McKenzie, 1966) was examined, illustrated and redescribed using type material originating from Western Australia and the Northern Territory (Figure 4.1) that is deposited in Museum Victoria (Australia). For two of these species (*I. amplicolis* De Deckker, 1981 and *I. candonites* De Deckker, 1981), type material was found to have some appendages damaged, and not suitable for species redescriptions.
Figure 4.1: Distribution of *Ilyodromus* redescribed in the present study, showing the locality of each species represented by a corresponding symbol.

For these species, topotypes were resampled from the type locality, and illustrated alongside type material for appendages where damage was detected in type specimens. Topotypes were sampled using a 250\( \mu \)m sweep net. Contents of the net were put in a tray with water, and ostracods were picked using 1 ml disposable pipettes. Specimens were preserved at 4°C in 100 % ethanol.

For up to three females and three males of recollected *I. amplicolis* De Deckker, 1981 and *I. candonites* De Deckker, 1981, valves were removed while the specimen remained in ethanol using 1 \( \mu \)m diameter tip tungsten needles. Valves were stored dry on micropalaeontological slides, while soft parts were moved to a drop of glycerine on a glass slide and appendages dissected using 1 \( \mu \)m diameter tip tungsten needles.

All appendages were drawn with the aid of an Olympus BX51 compound light microscope and a *camera lucida*. In the drawings, setae and claws were sometimes shifted, but always anchored at the correct place, to avoid features overlapping and thus being obscured in the final illustrations. The length, width and structure of these features, were always illustrated as they appeared on the slide. Valves from type specimens were imaged with a Philips XL30 scanning electron microscope, aside from *I. williamsi* (McKenzie, 1966) which was imaged with a light microscope due to museum loan restrictions.

---

4.4. METHODS

---

131
Post processing of all images was performed using a combination of GIMP (GNU Image Manipulation Program) v2.8 and Inkscape v0.48.

For appendage illustrations, intraspecific variability and specimen damage was detected by comparing the illustrations to appendages from additional dissected specimens. Diagnostic characters were determined for each species by comparison to existing *Ilyodromus* species descriptions (Baird, 1862; Brady, 1886; Daday, 1905; Danielopol and McKenzie, 1977; De Deckker, 1981, 1982b; King, 1855; McKenzie, 1966; Müller, 1906, 1912; Petkovski and Meisch, 1995; Sars, 1889, 1894, 1896; Sharpe, 1908; Shearn et al., 2014; Smith et al., 2011; Victor and Fernando, 1981).

All original material is deposited in Museum Victoria (numbers: J1171 to J1182, J1184 to J1186, J1188 to J1191, J17 and J18). Additional topotypes collected in this study are deposited in the Western Australian Museum, and specimen information can be found in the supplementary material (Appendix D, Table D.1, numbers: RS711 to RS718, RS724 to RS732, RTJ25 to RTJ26, and RTJ21).

### 4.4.2 Terminology in descriptions and figures

Antennule—A1; antenna—A2; Rome organ—RO; mandible—Md; maxillula—Mx; fifth limb—L5; sixth limb—L6; seventh limb—L7; caudal ramus—CR; anterior seta—Sa; anterior claw—Ga; posterior claw—Gp; posterior seta—Sp; medial shield of hemipenis—ms; lateral shield of hemipenis—ls; left valve internal view—LVi; right valve internal view—RVi; left valve external view—LVe; right valve external view—RVe; carapace right lateral view—CpRL; carapace dorsal view—CpD; carapace ventral view—CpV; Calcified Inner Lamella—CIL; ethanol—EtOH; female—♀; females—♀s; male—♂; males—♂s. All features were described with terminology following that of Broodbakker and Danielopol (1982), Martens (1987) and Meisch (2000). For the A1, the first two fused segments are considered together as the first segment, making a total of seven segments on the A1. Synonymy lists are written in abbreviated form according to Richter (1948).

### 4.5 Results

#### 4.5.1 Taxonomic descriptions

Class Ostracoda Latreille, 1802

Subclass Podocopa G.O. Sars, 1866
4.5.1.1  Subfamily Herpetocypridinae Kaufmann, 1900

**4.5.1.1.1 Diagnosis (modified after Martens, 2001)**

Large (1.0-3.5mm), mostly elongated and laterally compressed Cp; marginal valve structures mostly well developed; branched pore canals and marginal septa present in some genera. Most genera with conical inclusions in the valves, visible with transmitted light as small extra pores. Anterior calcified lamella wider than posterior one; pore-canals mostly branched along ventral margin, simple and straight along anterior and posterior margins; false pore canals present (remnants of fused selvage); selvage present or absent.

A1 in some genera with large Rome organs. A2 in males with claw GM developed into a comb-like structure, with one row of strong teeth. CR well developed, symmetrical or asymmetrical; CR attachment with a triangular basal reinforcement (in some genera only weakly developed, with a single short branch). Hemipenis with large and sclerotized bladder-like part ‘c’ of the labyrinth, post-labyrinthinal internal spermiduct with up to 6 additional whorls.

4.5.1.2  Tribe Isocypridini Rome, 1965 (new rank)

**4.5.1.2.1 Synonymy**

Isocypridinae Rome, 1965
Amphibolocypridinae Hartmann and Puri, 1974
Platycypridinae Hartmann and Puri, 1974
Isocypridinae Hartmann and Puri, 1974 — (in Martens and Savatenalinton, 2011)

**4.5.1.2.2 Diagnosis (modified after Jocque et al., 2010; Meisch, 2000)**

Medium-sized ostracods, with laterally flattened and elongated valves, often with posterior margin bearing two long setae and with septae at anterior and anteroventral marginal zones, posterior calcified inner lamella either narrow or completely absent. Mx with distal palp segment spatulate, L6 large with
long setae and claws, and elongated segments; these limbs mostly sticking out of the carapace.

4.5.1.2.3 Remarks

Comparisons of *Isocypris* Rome, 1965 and *Platycypris* Herbst, 1957 to *Ilyodromus* Sars, 1894 after redescriptions in Shearn et al. (2014) and this study, reveals remarkable similarity among these genera, more so than to other recognised genera in other tribes of the Herpetocypridinae. Specifically, the size and thickness of the Sp seta on the CR, the distal segment of the Mx palp being spatulate, the h2 claw of the L6 being long in some species, and the CR attachment having a single basal branch were diagnostic characters of Isocypridinae (Meisch, 2000; Rome, 1965). However, since these characters are typical of species in Herpetocypridinae (examples in De Deckker, 1981; González Mozo et al., 1996), and are diagnostic for this subfamily (Martens, 2001), there are only a small number of characters available that distinguish Isocypridinae from the tribe Herpetocypridini in the Herpetocypridinae (see diagnosis). On these grounds, a change for Isocypridinae to be ranked as tribe Isocypridini of Herpetocypridinae is proposed here. Isocypridini has three genera; *Isocypris*, *Platycypris* and *Amphibolocypris*. Of the four tribes in Herpetocypridinae, Isocypridini is closest to Herpetocypridini, but can be differentiated by a combination of different characters: absence of the posterior calcified inner lamella, presence of visible septae along the anterior and anteroventral valve margin for *Isocypris* and *Platycypris*; or for *Amphibolocypris*, the long and robust claw h3 of the L6, and the absence of an Sp on the CR. The placement of *Amphibolocypris* alongside *Isocypris* and *Platycypris* is in need of review, as some species of this genus do not exhibit the degree of similarity to the other genera that one would expect at the tribe level. See for example, the more rectangular distal segment of the Mx palp, and the missing Sp seta on the CR in *Amphibolocypris* (Jocque et al., 2010). A review of all species within *Amphibolocypris* will be of great benefit to decide whether this genus belongs in Isocypridini, or another tribe of Herpetocypridinae.

4.5.1.3 Tribe Herpetocypridini Kaufmann, 1900

4.5.1.4 Genus *Ilyodromus* Sars, 1894

4.5.1.4.1 Type Species

*Ilyodromus stanleyanus* (King, 1855)
4.5.1.4.2 Remarks

This genus is placed alongside two other genera (*Candonocypris* Sars, 1896 and *Herpetocypris* Brady and Norman, 1889) within the tribe *Herpetocypridini* Kaufmann, 1900. *Ilyodromus* can be distinguished from *Herpetocypris* by the often claw-like Sp on the CR, the reduced basal branch on the CR attachment (triangular in *Herpetocypris*), and the absence of an additional branch on the CR attachment (present in *Herpetocypris*). From *Candonocypris*, it can be differentiated by having only a single lateral seta on the penultimate segment of the seventh limb (two lateral setae in *Candonocypris*).

4.5.1.4.3 Diagnosis (modified after Shearn et al., 2014)

Carapace of females larger than males but otherwise the same, often with longitudinal striations of varying complexity, in lateral view sub-rectangular and usually straight along dorsal hinge with LV slightly overlapping RV, in dorsal view often elongated and compressed. Internal view of both valves with calcified inner lamella usually broad anteriorly and posteriorly, with or without inner lists in the LV, and most species without prominent selvage in the RV, calcified inner lamella of LV with anteroventral peg (remnants of an inner list) in most species and in some species another posteroventrally, the pegs of varying size and structure. A1 second segment with two segmented sensory Rome organ having distal flagella of varying length that can appear as another segment under low magnification, and with a long dorso-distal seta. A2 with natatory setae highly variable in length. Md palp with $\alpha$ seta short and spine-like distally, but with broad base, the $\beta$ seta stout, covered with long setules, and almost of the same length as the $\alpha$ seta, the $\gamma$ seta elongate and with short setules covering the distal half. Mx with seven setae on first palp segment and a spatulate second palp segment with three claws and three setae. Claw-like Sp of the CR hirsute and jointed at the base in all species, but can be thin, and more bristle-like. Male Mx prehensile palps with hook shaped distal segment, hemipenis with lobes ls and ms highly variable in shape.

4.5.1.5 *Ilyodromus amplicolis* De Deckker, 1981

Figures 4.2 to 4.5

---

*1981* *Ilyodromus amplicolis* n. sp. — De Deckker: 54-56, Figs 8, 9 l-r h.

*nov. comb.* 2011 *Isocypris amplicolis* (De Deckker) — Martens & Savatalinton: 50.
4.5.1.5.1 Remarks

*Ilyodromus amplicolis* was described in 1981 from a granite rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western Australia, Australia (De Deckker, 1981). In these descriptions, several features of the valves and appendages were not clearly visible in illustrations and were not described. Here, type, and topotype material for this species is used in a redescription that includes these features.

4.5.1.5.2 Distribution and habitat

This species mainly occurs in temporary rock pools (Bayly, 1982; De Deckker, 1981), but has also been found in pit gnammas (Timms, 2014), roadside ditches (De Deckker, 1981) and lakes (Cale et al., 2004) in Western Australia. At the type locality, this species was not observed swimming in open water, but instead rapidly ‘running’ across the sediment surface. The reduced natatory setae on the A1 and A2 (Figure 4.3) support this notion of the species being a true benthic form, as was observed for many other *Ilyodromus* species by Sars (1894).

4.5.1.5.3 Type Locality

Granite rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western Australia, Australia (De Deckker, 1981). Approximate coordinates: S 32° 28’ 14.92”, E 116° 53’ 10.29” (Figure 4.1).

4.5.1.5.4 Material investigated

4.5.1.5.4.1 Original type material

Holotype female with soft parts dissected on a sealed slide (J1171a) and valves stored dry in a micropalaeontological slide (J1171b); one male paratype with soft parts dissected on a sealed slide (J1172a) and valves stored dry in a micropalaeontological slide (J1172b); two female paratypes with carapaces stored dry on micropalaeontological slides (J1173a, J1174a).

4.5.1.5.4.2 Topotypes

One female topotype recollected from type locality with soft parts dissected on a sealed slide and valves stored dry in a micropalaeontological slide (RS711); one male topotype recollected from type locality with soft parts dissected on a sealed slide and valves stored dry in a micropalaeontological slide (RS712). Three female topotypes recollected from type locality with carapaces stored dry in micropalaeontological slides.
(RS713 to RS715), three male topotypes recollected from type locality with
carapaces stored dry in micropalaeontological slides (RS716 to RS718).

Many in toto topotype specimens in EtOH recollected from type locality
by RS on the 24th September 2013 stored in two vials (RTJ25, RTJ26 - granite
rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western
Australia, Australia).

4.5.1.5.5 Measurements (in µm)

♀ RV: L = 1875–2027 (n = 4), H = 914–975 (n = 4). LV: L = 1711–2057 (n = 5), H =
848–989 (n = 4). Cp: L = 2290 (n = 1), W = 1048 (n = 1).

♂ RV: L = 1373–1558 (n = 2), H = 615–714 (n = 2). LV: L = 1368–1537 (n = 2), H =
552 (n = 1).

4.5.1.5.6 Diagnosis (modified after De Deckker, 1981)

Adults large, up to 2000 µm in length, valve surfaces with deep, broad stria-
tions and finer striations nested within them. Calcified inner lamella of both
valves broad anteriorly and posteriorly, extending inwardly by approximately
1/4 of valve length, and with a blunt anteroventral peg (remnants of reduced
inner list) in LV. A1 third segment with dorsal seta shorter than ventral seta,
and Rome Organ 0.3 times length of second segment of A1. A2 with longest
natatory setae 0.7 times length of second endopodal segment. Males with L5
Rpp and Lpp almost symmetrical, Hp with ls broad and rectangular with al-
most straight distal margin, proximally with lateral rounded protrusion; ms
with rounded edge, reaching almost as far as ls.

4.5.1.5.7 Differential diagnosis (Table A.1, Page 319)

4.5.1.5.8 Description (modified after De Deckker, 1981)

Carapaces dark green to dark blue in colour. Female carapace elongate (Fig-
ure 4.2A & B), with anterior and posterior edges pointed in dorsal and ven-
tral view, but with anterior one more elongated than posterior one. Great-
est width situated at mid-length. In lateral view (Figure 4.2A), dorsal margin
almost straight along dorsal hinge for about half its length, sloping in cau-
dal direction, and with slight concavity in front of anterodorsal hinge. Ven-
tral margin slightly sinuous at mid length (Figure 4.2A & B). Anterior mar-
gin slightly more broad than posterior, with apex of both anterior and poste-
rior margins below mid-height. LV only slightly overlapping RV around entire
margin. Greatest height situated at approximately 1/4 from anterior. All external valve surfaces with deep, broad striations (Figure 4.2A & B), with finer striations nested within them (Figure 4.2I).

In inner view, RV and LV with similar shape, mainly differing in size with LV being slightly larger (Figure 4.2C & D). Both valves with calcified inner lamella broad, and extending around entire valve, aside from dorsal hinge area; calcified inner lamella extending inward, by approximately 1/4 of valve length anteriorly, and by approximately 1/5 of valve length posteriorly, much narrower ventrally at mid-length. LV calcified inner lamella with a blunt anteroventral peg (remnants of reduced inner list) (Figure 4.2G–H). Central muscle scar consisting of a central group of five scars with two other large scars set apart anterodorsally from central group.

A1 (Figure 4.3B & C) seven segmented (with first two fused segments counted as only one segment). Length of first segment approximately twice the width, with one short dorsal seta and two long ventral setae. Length to width ratio of second segment approximately 1:1, this segment with a long medio-dorsal seta and a Rome organ of approximately half the length of the segment; this Rome organ (Figure 4.3D) two segmented, with distal flagella rarely visible. Third A1 segment elongate, with length approximately twice the width, additionally with one ventral seta, approximately 1.5 times the length of the segment, and a longer dorsal seta with length over twice that of the segment. Fourth segment with length to width ratio approximately 1:1, carrying two ventral setae, the ventral-most one approximately 0.75 times the length of the other, and two dorsal natatory setae, both of these much longer than the ventral setae. Fifth segment (Figure 4.3C) with length approximately twice its width, with two dorsal natatory setae, and two shorter ventral setae, the latter less than half the length of the dorsal natatory setae, the ventral-most being the shortest and broadest. Sixth segment with length approximately twice its width, with an apical group of three reduced setae, dorsal to this group one very short seta, and ventral to this group one seta of approximately half the length of the three reduced setae. Seventh segment with length approximately twice its width, distally carrying one long seta, one short seta, a broader ventral claw-like seta and a dorsal aesthetasc Ya with length shorter than any of the other setae.

A2 (Figure 4.3A) first protopodal segment with two latero-distal setae, as typical of Cypridoidea. Second protopodal segment (fused with first) with one distal seta on inner side of the segment. Exopod a small rudimentary plate, with three setae, the anterior-most of similar length to the segment, the middle seta approximately 1/3 this length, and the posterior-most very

4.5. RESULTS
short. First endopodal segment with aesthetasc Y elongate and 2 segmented, with distal segment approximately half the length of the proximal one; distally this segment (Figure 4.3E) with 4 very reduced and one short natatory setae, flanked by another short adjacent seta, the four reduced setae being less than 0.2 times the length of the anterior-most seta, and less than 0.1 times the length of the second endopodal segment; ventro-distally this segment with a large bristled seta, of similar length as the segment. Second endopodal segment with four medio-ventral t-setae, two medio-dorsal setae on the opposite segment margin, three subapical z-setae and three distal claws (G1–G3), the latter all of similar length, approximately twice the length of the second endopodal segment, and a short aesthetasc (y2). Terminal segment approximately twice as long as its basal width, distally with two claws, the larger one (GM) reaching as far as G1–G3, and about 1.8 times the length of the shorter claw on this segment (Gm); one solitary g seta and one seta fused at the base with aesthetasc y3, all being approximately 1.8 times the length of claw Gm.

Md coxa (Figure 4.3G) distally with teeth accompanied by few setae, and more proximally from largest tooth an elongate seta covered in stiff setules, as typical of Cypridoidea.

Md palp (Figure 4.3F) with length ratios of four palp segments 4:1:2:1. First palp segment the largest, with length approximately 1.6 times the width; this segment with a group of four setae; the most proximal seta long and smooth, followed by an S1 seta of similar length, an α seta, then most distally a broader S2 seta, both S setae of similar length and carrying rows of long setules, the more proximal S1 straight, the distal S2 bent; α seta short and spine-like distally, but with a broad base; total length of α seta approximately 0.4 times the length of the S setae. Second palp segment stout, its width about twice its length, and with six setae posteriorly; β seta short and stout, covered with long setules, and almost of the same length as the α seta; four subsequent setae all of similar length as the S setae; last seta in this group originating more distally, about half the length of the S setae, and covered with rows of long setules; this segment also with a group of three antero-dorsal setae, two of which smooth, with similar length to the S setae, and the most distal one shorter, with long setules over the distal half of its length. Third palp segment elongate with length approximately 1.5 times its width, antero-distally with four smooth setae, the three most distal ones of similar length as the first palp segment, the most proximal one slightly shorter; distal margin of third palp segment with γ seta anteriorly (missing in illustrated holotype, Figure 4.3F), and a row of three additional setae, γ seta elongate and with short setules covering the distal half, three neighbouring setae of similar length (two missing
in illustrated holotype); ventral margin of third segment with two subapical setae, one very short, the other long, approximately the same length as the S setae. Terminal palp segment short, with length approximately 1.5 times its width; distally with a group of three claws, one longer than the other two, and four setae of similar length to the shorter claws.

Rake-like organ (not illustrated) with elongate proximal arm, broadening abruptly to a 7–9 toothed rake structure.

Mx (Figure 4.4A) endopodite two segmented. First segment with six setae on the dorso-apical margin, three of these setae smooth and of similar length, two slightly longer and hirsute, the most proximal one slightly longer; a seventh seta being the shortest, based more medially than the others, and pointed posteriorly. Second endopodal segment spatulate, distally with three claws and three setae. Third endite distally with two strongly developed but smooth claws positioned between seven setae dorsally (one not visible in illustrated holotype), and one seta ventrally, all setae on the distal margin of similar length, apart from one seta based slightly more proximal, this seta stout, bent, covered with long stiff setules, and approximately one third of the length of the other setae. Chaetotaxy of endites II and III not elaborated. Respiratory plate with approximately 26 rays, six of these reflexed.

L5 (Figure 4.4B) protopod with two a-setae of similar length, based proximally on the anterior margin, one long and hirsute b-seta on ventral margin, and a long, hirsute d-seta based anteriorly. Endite with 14 setae lining the antero-distal margin of varying length and shape. Endopodite with three hirsute distal setae, one longer than the other two. Exopodite a respiratory plate with 6 rays.

L6 (Figure 4.4C) a walking limb, with first two segments bearing d1 and d2 setae antero-distally, with d2 being approximately 1.5 x longer than d1. Endopod four-segmented. First endopodal segment with e seta (damaged and missing in illustrated holotype); posterior margin hirsute and arranged into four groupings. Second endopodal segment with f seta antero-distally and approximately the same length as the third endopodal segment. Third endopodal segment with g seta antero-distally, plus one shorter seta, approximately half the length of the g seta, and less than half the length of the third endopodal segment. Terminal segment with h2 developed into a long serrated claw, about 2.6 times the length of the third endopodal segment, seta h3 0.7 times the length of h1, h3 approximately twice the length of the terminal segment. Length ratios of first to fourth endopodal segments approximately 8:6:5:2.

L7 (Figure 4.4E) a cleaning limb, basal segment with setae d1 and d2 on
Figure 4.3: Ilyodromus amplicolis. ♀ (Holotype NMV J1171b) from granite rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western Australia, Australia A–G. A. Antenna. B. Antennule, first four segments. C. Antennule, segments five to seven. D. Antennule, detail of Rome organ. E. Antenna, detail of natatory setae. F. Mandibular palp. G. Mandibular coxa. Scales: A–C = 200 µm, D = 30 µm, E = 15 µm, F–G = 150 µm
anterior margin, and seta dp posterodistally; seta dp slightly longer than and d1 and d2. First endopodal segment the longest, and bearing a bristled antero-distal e seta with length approximately the same as d2 seta. Second and third endopodal segments fused, with a bristled f seta approximately in the middle of this fused segment, this seta approximately half the length of the e seta. Third endopodal segment without g seta. Terminal segment fused with third endopodal segment to form a pincer organ, and bearing three setae: seta h1 forming a comb-like seta, h2 short, approximately half the length of the f seta, a reflexed seta h3 slightly longer than the f seta.

CR (Figure 4.4F) symmetrical and elongated, each with three serrated claws and apical Sa seta. Claw Ga nearly half the length of the ramus. Length ratios of claws Sa, Ga, Gp and Sp to ramus 0.1, 0.5, 0.5 and 0.2 respectively. Attachment of CR (Figure 4.4D) with slightly bent main stem, bearing an obvious branch at proximal end, and a distal bifurcation.

Male Cp smaller than females and with calcified inner lamella of both valves extending inward far less than in females (Figure 4.2E & F, the latter deformed because of decalcification), but otherwise of similar appearance.

Male L5 prehensile palps (Figure 4.5B & C) with first segment approximately twice its central width; subapically with two sensory organs of similar length; second segment narrow and hook shaped with distal sensory organ; Rpp second segment broader than Lpp second segment, but otherwise left and right prehensile palps symmetrical.

Male Hp (Figure 4.5A) is broad and rectangular, with nearly straight distal margin, protruding slightly further than ms, proximally with lateral globular protrusion; ms with broad base narrowing to rounded distal margin, 0.8 times the width of ls at mid-length, with additional proximal lobe over ls.
Figure 4.4: Ilyodromus amplicolis. ♀s from granite rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western Australia, Australia A–F. A. Maxillula palp and endites, without detail on first and second endites (Holotype NMV J1171b). B. Fifth limb (Holotype NMV J1171b). C. Sixth limb (Holotype NMV J1171b). D. Caudal ramus attachment, broken in two pieces (RS711). E. Seventh limb (Holotype NMV J1171b). F. Caudal ramus (Holotype NMV J1171b). Scales: A–F = 150 µm

144  CHAPTER 4.  ILYODROMUS, ISOCYPRIDINAE AND HERPETOCYPRIDINAE
Figure 4.5: *Ilyodromus amplicolis*. ♀ (Paratype NMV J1172b) from granite rock pool on top of Boyagin Rock, between Brookton and Pingelly, Western Australia, Australia. A–C. A. Hemipenis. B. Prehensile palp of left fifth limb. C. Prehensile palp of right fifth limb. Scales: A–C = 77 µm

4.5.1.6 *Ilyodromus dikrus* De Deckker, 1981

Figures 4.6 to 4.9

*Ilyodromus dikrus* n. sp. — De Deckker: 61-63, Figs 11 & 12.

2011 *Isocypris dikrus* (De Deckker) — Martens & Savatenalinton: 50.

4.5.1.6.1 Remarks

*Ilyodromus dikrus* was described in 1981 from a dam at Wasley Well, near Nallan, 21 km NNE of Cue, Western Australia, Australia (De Deckker, 1981). In these descriptions, several important taxonomic features of the valves and appendages for this genus, discovered in Shearn et al. (2014), were not visible in existing illustrations and were not described. Here, type material for this species is used in a redescription that includes these features.

4.5. RESULTS
4.5.1.6.2 Distribution and habitat

To date, there appear to be only two records of the species, and thus it has a limited known distribution within inland Western Australia. This species was described from a dam, in fresh turbid water (De Deckker, 1981), but has also been recorded at least once from a temporary rock pool (Pinder et al., 2000) in Western Australia. Given that the natatory setae of the A1 and A2 aren’t heavily reduced, it may be that this species does not completely lack swimming power, and may have the ability to swim through the water column as well as traversing the sediment surface.

4.5.1.6.3 Type Locality

Dam at Wasley Well, near Nallan, 21 km NNE of Cue, Western Australia, Australia (De Deckker, 1981). Approximate coordinates: S 27° 16’ 54”, E 118° 09’ 06” (Figure 4.1).

4.5.1.6.4 Material investigated

Holotype male with soft parts dissected on a sealed slide (J1182a) and valves stored dry in a micropalaeontological slide (J1182b); two female paratypes with soft parts dissected on a sealed slide (J1184a, J1185a) and valves stored dry in a micropalaeontological slide (J1184b, J1185b); Three female paratypes with carapaces stored dry on micropalaeontological slides (J1189a, J1190a, J1191a). Two male paratypes with carapaces stored dry on micropalaeontological slides (J1186a, J1188a).

4.5.1.6.5 Measurements (in \(\mu m\))

♀ RV: \(L = 1422–1470\) \((n = 2)\), \(H = 647–653\) \((n = 2)\). LV: \(L = 1425–1477\) \((n = 2)\), \(H = 657–660\) \((n = 2)\). Cp: \(L = 1228–1505\) \((n = 4)\), \(H = 547–718\) \((n = 3)\), \(W = 447\) \((n = 1)\).

♂ RV: \(L = 1373–1558\) \((n = 2)\), \(H = 615–714\) \((n = 2)\). LV: \(L = 1368–1537\) \((n = 2)\), \(H = 552\) \((n = 1)\). Cp: \(L = 1258–1338\) \((n = 2)\), \(H = 562–598\) \((n = 2)\).

4.5.1.6.6 Diagnosis (modified after De Deckker, 1981)

Adults up to 1500 \(\mu m\) in length and appear as an inclined parallelogram in lateral view, valve surfaces with deep, broad striations and finer striations nested within them. Calcified inner lamella of both valves broad anteriorly and posteriorly, extending inward by approximately 1/4 of valve length, and with a
blunt anteroventral peg (remnants of reduced inner list). A1 second segment stout, with length to width ratio approximately 1:2. A1 third segment with dorsal seta longer than ventral seta, and Rome Organ 0.4 times length of second segment of A1. A2 second endopodal segment short, longest natatory seta 3.9 times length of second endopodal segment. Males with L5 Rpp and Lpp asymmetrical, Rpp with second segment subtriangular whereas Lpp with second segment hook shaped. Male Hp ls protruding further than ms, narrow with parallel margins and rounded distal margin; Hp ms broad proximally, narrowing distally to flattened distal margin.

4.5.1.6.7 Differential diagnosis (Table A.1, Page 319)

4.5.1.6.8 Description (modified after De Deckker, 1981)

Female carapace elongate (Figure 4.6A & B), pointed in ventral view at both ends (Figure 4.6K). Greatest width at mid-length. In lateral view, dorsal margin straight along dorsal hinge, with pronounced concavity in front of the hinge anterodorsally (Figure 4.6A & B). Ventral margin slightly sinuous at mid length (Figure 4.6A & B). Curve of anterior margin less elongate than posterior (Figure 4.6A & B), apex of anterior margin well above mid-height and posterior margin well below mid-height (Figure 4.6A & B). No obvious overlapping of either valve over the other around entire margin (Figure 4.6A–D). Greatest height situated at approximately 1/3 from anterior (Figure 4.6A & B).

RV and LV with similar size and shape (Figure 4.6E & F). Both valves with calcified inner lamella broad, and extending around entire valve, aside from dorsal hinge area (Figure 4.6E & F); calcified inner lamella extending inward, by approximately 1/4 of valve length anteriorly, and by approximately 1/5 of valve length posteriorly (Figure 4.6E & F), much narrower ventrally at mid-length (Figure 4.6E & F). Selvage at periphery around entire margin (Figure 4.6E, F; I). Ventral margin straight, with only slight sinuation at mid-length (Figure 4.6E & F). LV calcified inner lamella with a blunt anteroventral peg (remnants of reduced inner list) (Figure 4.6I). All external valve surfaces with deep, broad striations (Figure 4.2A–D), with finer striations nested within them (Figure 4.6J).

A1 (Figure 4.7B) seven segmented (with first two fused segments counted only as one segment). The first segment length approximately two times the width, with one dorsal seta and two ventral setae. Second segment stout, with length to width ratio approximately 1:2, with long medio-dorsal seta and Rome organ (Figure 4.7A) with approximately half the length as the segment; Rome organ (Figure 4.7A) two segmented, with distal flagella not vis-
Figure 4.6: *Ilyodromus dikrus* from dam at Wasley Well, near Nallan, 21 km NNE of Cue, Western Australia, Australia A–J. **A.** CpRL ♀ (J1189a). **B.** CpLJ ♀ (J1190a). **C.** CpRL ♂ (J1188a). **D.** CpLJ ♂ (J1186a). **E.** LVI ♀ (J1184a). **F.** RVi ♀ (J1184a). **G.** LVI ♂ (J1182a). **H.** RVi ♂ (J1182a). **I.** LVI ♀, detail of peg (J1185a). **J.** CpRL ♀, detail of A (J1189a). **K.** CpV ♀ (J1191a). Scales: A–H, K = 500 µm, I = 300 µm, J = 50 µm
ible. Third A1 segment elongate, with length approximately two times the width, and with one ventral seta, approximately twice the length of the segment, and one long dorsal seta, well over twice the segment length. Fourth segment with length to width ratio approximately 1:1, with two ventral setae, the ventral-most being half the length of the other, and two dorsal natatory setae, both of these much longer than the ventral setae. Fifth segment with length to width ratio approximately 1:1, with two dorsal natatory setae, and two shorter ventral setae, these about 1/3 the length of the dorsal natatory setae, the ventral-most being the shortest. Sixth segment (Figure 4.7C) with length approximately 1.5 times its width, with a group of four natatory setae, dorsal to this group one very short seta. Seventh segment with length approximately twice its width, two long setae, a broader ventral claw-like seta and a dorsal aesthetasc Ya.

A2 (Figure 4.7C) first protopodal segment with two distal setae, as typical of Cypridoidea. Second protopodal segment (fused with first) with one distal seta on inner side of the segment. Exopod a small rudimentary plate, with three setae, the anterior-most short and half the length of the segment, the middle seta approximately 1/3 this length, and the posterior-most very short. First endopodal segment with aesthetasc Y elongate and 2 segmented, with distal segment approximately 1.5 times the length of the proximal one; distally with group of five natatory setae, with another short adjacent seta, the five posterior natatory setae 4 times the length of the second endopodal segment; postero-distally with large bristled seta, approximately the same length as the segment. Second endopodal segment with four medio-ventral t-setae, two medio-dorsal setae on the opposite segment margin, three subapical z-setae and three distal claws (G1–G3), the latter all of similar length, approximately 1.5 times the length of the second endopodal segment, and a short aesthetasc (y2). Terminal segment approximately twice as long as its basal width, distally with two claws, the larger one (GM) reaching as far as G1–G3, and about 1.5 times the length of the shorter claw on this segment (Gm) and one seta fused at the base with aesthetasc y3.

Md coxa (Figure 4.7D) distally with teeth accompanied by setae, and more proximally from largest tooth an elongate seta covered in stiff setules, as typical of Cypridoidea.

Md palp (Figure 4.7F) with length ratios of four palp segments 6:1:3:1. First palp segment largest, with length approximately 1.6 times the width. First segment with a group of four setae. The most proximal seta long and smooth. This followed by an S1 seta of similar length, an α seta, then most distally a broader S2 seta. Both S setae carrying rows of long setules, the more proxi-
mal S1 longer and straight, the distal S2 shorter and bent. $\alpha$ seta short and spine-like distally, but with broad base; total length of $\alpha$ seta approximately 0.4 times the length of the S setae. Second palp segment stout, its width over twice its length, and with six setae posteriorly; $\beta$ seta stout, covered with long setules, and almost of the same length as $\alpha$ seta; four subsequent setae all of similar length as the S setae; last seta in this group originating more distally, about half the length of the S setae, and covered with rows of long setules; this segment also with a group of three antero-dorsal setae, two smooth, with similar length to the S setae, and the most distal one shorter, with long setules over the distal half of its length. Third palp segment elongate with length approximately 1.5 times its width, antero-distally with four smooth setae, all of similar length; distal margin of third palp segment with $\gamma$ seta anteriorly, and a row of three additional setae, $\gamma$ seta elongate and with short setules covering the distal half, three neighboring setae 1.3 times the length of the $\gamma$; posterior margin of third segment with two setae, one very short, the other long, almost the same length as the S setae. Terminal palp segment short, with length approximately 1.5 times its width; distally with a group of three claws, one much longer than the other two, and two setae with length half that of the shorter claws.

Rake-like organ (Figure 4.7E) with elongate proximal arm, broadening abruptly to a 7–9 toothed rake structure.

Mx (Figure 4.8A) endopodite two segmented. First segment with six setae on the antero-distal margin, three of these setae smooth and of similar length, two shorter and hirsute, the most proximally based one slightly longer, and a seventh seta being the shortest, based more medially than the others, and pointed posteriorly. Second endopodal segment spatulate, distally bearing three claws and three setae. Third endite distally with small seta on the posterior margin, and at the distal margin, two strongly developed but smooth claws positioned between six setae anteriorly, and two seta posteriorly, all setae on the distal margin of similar length, apart from one seta based slightly more proximal, this seta stout, bent, covered with long stiff setules, and approximately half the length of the other setae. Chaetotaxy of endites II and III not elaborated.

L5 (Figure 4.8B) protopod with two a-setae of similar length, based proximally on the anterior margin, one long and hirsute b-seta on ventral margin, and a long, hirsute d-seta based anteriorly. Endite with 14 setae lining the antero-distal margin of varying length and shape. Endopodite with three hirsute distal setae, one longer than the other two.

L6 (Figure 4.8E) a walking limb, with first two segments bearing d1 and d2
Figure 4.7: *Ilyodromus dikrus* ♀ (Paratype NMV J1184b) from dam at Wesley Well, near Nal-Ian, 21 km NNE of Cue, Western Australia, Australia A–F. A. Antennule, detail of Rome organ. B. Antennule. C. Antenna. D. Rake-like organ. E. Mandibular coxa. F. Mandibular palp. Scales: A = 30 µm, B = 150 µm, C = 153 µm, D = 60 µm, E–D = 102 µm

4.5. RESULTS
setae antero-distally, with d2 being approximately 2 x longer than d1. Endo-
pod four-segmented. First endopodal segment with e seta; posterior margin
hirsute and arranged into five groupings. Second endopodal segment with
f seta antero-distally and slightly shorter than the third endopodal segment.
Third endopodal segment with g setae antero-distally, both less than half the
length of the third endopodal segment. Terminal segment with h2 developed
into a long serrated claw, with length about 2.8 times the length of the third
endopodal segment, seta h1 0.3 times the length of h3, h3 approximately six
times the length of the terminal segment. Length ratios of first to fourth en-
dopodal segments approximately 8:6:5:2.

L7 (Figure 4.8F) a cleaning limb, basal segment with d1 and d2 on anterior
margin, and dp posterodistally, all of similar length. First endopodal segment
the longest, and bearing a bristled antero-distal e seta with length approx-
imately the same as d2 seta. Second and third endopodal segments fused,
with a bristled f seta approximately in the middle of this fused segment, of
approximately 1/3 the length of the e seta. Third endopodal segment without
g seta. Terminal segment fused with third endopodal segment to form a pin-
cer organ, and bearing three setae: seta h1 forming a comb-like seta, h2 short,
approximately half the length of the f seta, seta h3 nearly twice the length of
the f seta.

CR (Figure 4.8C) symmetrical and elongated, each with two serrated
claws, an apical Sa seta, and a claw-like Sp. Claw Ga half the length of the
ramus. Length ratios of claws Sa, Ga, Gp and Sp to ramus 0.2, 0.5, 0.3 and 0.3
respectively. Attachment of CR (Figure 4.8D) bearing an obvious branch at
proximal end, and a distal bifurcation.

Male Cp (Figure 4.6B & C) and valves (Figure 4.6G & H) smaller than fe-
males, but otherwise of similar appearance.

Male L5 Lpp (Figure 4.9B) with first segment length approximately twice
its central width; subapically with two sensory organs of similar length; sec-
ond segment narrow and hook shaped with distal sensory organ; Rpp (Fig-
ure 4.9C) with first segment length over 2.5 times its width, second segment
broader than Lpp second segment and subtriangular in shape with long distal
sensory organ.

Male Hp (Figure 4.9A) elongated; ls narrow with parallel margins and
rounded distally, protruding notably further than ms; ms with broad base
narrowing to a flattened distal margin.
Figure 4.8: *Ilyodromus dikrus* ♀ (Paratype NMV J1184b) from dam at Wasley Well, near Nal- lan, 21 km NNE of Cue, Western Australia, Australia A–F. A. Maxillula palp and endites, without detail on first and second endites. B. Fifth limb. C. Uropodal Ramus. D. Caudal ramus attachment. E. Sixth limb. F. Seventh limb. Scales: A, C = 77 µm, B, F = 102 µm, D, E = 150 µm

4.5. RESULTS
Figure 4.9: *Ilyodromus dikrus* ♂ (Holotype NMV J1182b) from dam at Wasley Well, near Nallan, 21 km NNE of Cue, Western Australia, Australia A–C. A. Hemipenis. B. Prehensile palp of left fifth limb. C. Prehensile palp of right fifth limb. Scales: A = 68 µm, B–C = 108 µm
4.5.1.7  *Ilyodromus candonites* De Deckker, 1981

Figures 4.10 to 4.14

*Ilyodromus candonites* n. sp. — De Deckker: 56-61, Figs 9f-j & 10.

4.5.1.7.1 Remarks

*Ilyodromus candonites* was described in 1981 from a small granite rock pool at the summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia (De Deckker, 1981). In these descriptions, several important taxonomic features of the valves and appendages for this genus (later discovered for other species in Shearn et al. (2014)) were not visible in illustrations and were not described. Unfortunately, the condition of type material was poor, and many slides had dried with appendages damaged and having missing segments and setae. It was thus necessary to re-sample *Ilyodromus candonites* at the type locality and designate topotypes to be used alongside the damaged holotype and paratypes to redescribe the species with the additional taxonomic characters.

4.5.1.7.2 Distribution and habitat

This species is adapted to temporary rock pools of Western Australia. The species was described from a small granite rock pool at the summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia, but was also recorded nearby at Muirillup Rock (De Deckker, 1981) and quite some distance away in a pool at Pintha Rock (Pinder et al., 2000), in the mid west of Western Australia. Like many other species in the genus, the natatory setae of the A1 and A2 are very reduced, suggesting this species lacks swimming power and is a benthic form, as was observed in *Ilyodromus amplicolis* (Section 4.5.1.5, Page 135), and many other species by Sars (1894).

4.5.1.7.3 Type Locality

Small granite rock pool at the summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia (De Deckker, 1981). Approximate coordinates: S 34° 45' 51.3", E 116° 05' 13.24" (Figure 4.1).

4.5.1.7.4 Material investigated

Holotype male with soft parts dissected on a sealed slide (J1175a) and valves stored dry in a micropalaeontological slide (J1175b); two female paratypes
with soft parts dissected on a sealed slide (J1176a, J1177a) and valves stored dry in a micropalaeontological slide (J1176b, J1177b); two female paratypes with carapaces stored dry in micropalaeontological slides (J1180a, J1181a). Two male paratypes with carapaces stored dry in micropalaeontological slides (J1178a, J1179a).

Two female topotypes recollected from type locality with soft parts dissected on a sealed slide and valves stored dry in a micropalaeontological slide (RS724, RS726); one male topotype recollected from type locality with soft parts dissected on a sealed slide and valves stored dry in a micropalaeontological slide (RS725). Three female topotypes recollected from type locality with carapaces stored dry in micropalaeontological slides (RS727, RS728, RS729). Three male topotypes recollected from type locality with carapaces stored dry in micropalaeontological slides (RS730, RS731, RS732).

Many in toto specimens in EtOH recollected from type locality (RTJ21 - Small granite rock pool at the summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia).

4.5.1.7.5 Measurements (in $\mu$m)


♂ RV: $L = 1093–1144$ ($n = 3$), $H = 568$ ($n = 1$). LV: $L = 1099–1150$ ($n = 3$), $H = 568–592$ ($n = 3$). Cp: $L = 1149$ ($n = 1$), $H = 562$ ($n = 1$).

4.5.1.7.6 Diagnosis (modified after De Deckker, 1981)

Adults up to approximately 1400 $\mu$m in length, in lateral view subrectangular, anterior margin appearing more elongated than posterior, apex of anterior and posterior margins very low; valve surfaces with deep, broad striations and finer striations nested within them. Valves with calcified inner lamella broad anteriorly but narrow posteriorly, extending inward by approximately 1/5 of valve length anteriorly but only 1/10 of valve length posteriorly, LV with one pointed anteroventral and one pointed posteroventral peg (remnants of reduced inner list) and faint inner list along posterior margin extending anteriorly and terminating near the apex of the anterior margin. RV with selvage broad posteriorly. A1 third segment with dorsal seta longer than ventral seta, and Rome Organ 0.3 times length of second segment of A1. A2 second endopodal segment with natatory setae reduced. A1 terminal segment without broad claw-like ventral seta, as seen in other species. Md palp with S2 seta
longer than S1. L6 with d1 longer than d2. CR with length ratios of claws Sa, Ga, Gp and Sp to ramus 0.1, 0.4, 0.4 and 0.2 respectively.

Males with L5 Rpp and Lpp similar but not symmetrical, both with second segment hook shaped but angular, the shape resembling a drawer handle. Male Hp ls protruding further than ms, narrow, curved and widest distally; Hp with ms embracing ls proximally. Hp with an additional lobe embracing the proximal 1/2 of the ms.

4.5.1.7.7 Differential diagnosis (Table A.1, Page 319)

4.5.1.7.8 Description (modified after De Deckker, 1981)

Carapaces dark green to dark blue in colour. Female sub-rectangular (Figure 4.10A & B), pointed in ventral view at both ends. Greatest width at mid-length. Ventral margin sinuous at mid length (Figure 4.10A & B). Curve of anterior margin more elongate than posterior (Figure 4.10A & B), apex of anterior margin low, below mid-height and posterior margin very low below mid-height (Figure 4.10A & B). Strong overlap of LV over RV around entire margin, including dorsal hinge area (Figure 4.10A & B). Greatest height spanning middle 1/2 of carapace (Figure 4.10A & B).

RV and LV with similar shape, but LV larger (Figure 4.10E & F). Both valves with calcified inner lamella broad anteriorly but not posteriorly, and extending around entire valve, aside from dorsal hinge area (Figure 4.10E & F); calcified inner lamella extending inward, by approximately 1/4 of valve length anteriorly, and by approximately 1/10 of valve length posteriorly (Figure 4.10E & F), much narrower ventrally at mid-length (Figure 4.10E & F). Selvage at periphery around entire margin (Figure 4.10E–F, I–J) aside from posterior of RV where it is much broader (Figure 4.10F). Ventral margin sinuous at mid-length in both valves (Figure 4.10E & F). LV calcified inner lamella with two pointed anterodorsal pegs (remnants of reduced inner list) (Figure 4.10l) and with a weakly developed inner list obvious posteriorly, continuing around the ventral margin and terminating near the apex of anterior margin (Figure 4.10E). All external valve surfaces with deep, broad striations (Figure 4.10A–B), with finer striations nested within them (Figure 4.10D).

A1 (Figure 4.11A) seven segmented (with first two fused segments counted as only one segment). The first segment length approximately 1.5 times the width, with one dorsal seta and two ventral setae. Second segment stout, with length to width ratio approximately 1:1, with short medio-dorsal seta and short Rome organ (Figure 4.7B); the Rome organ approximately 1/3 the length of the segment, two segmented, with distal flagella not visible. Third A1 seg-
ment elongate, with length nearly three times the width, and with one ventral seta, approximately 1.5 times the length of the segment, and one long dorsal seta, over twice the segment length. Fourth segment with length to width ratio approximately 1:1, with two ventral setae, the ventral-most being half the length of the other, and two dorsal natatory setae, both of these much longer than the ventral setae. Fifth segment with length approximately 1.5 times the width, with two dorsal natatory setae, and two shorter ventral setae, these about 1/3 the length of the dorsal natatory setae, the ventral-most being the shortest, broad and claw-like. Sixth segment with length approximately 1.5 times its width, with a group of four natatory setae. Seventh segment with length approximately twice its width, two long setae, a shorter ventral seta and a dorsal aesthetasc Ya.

A2 (Figure 4.11C–E) first protopodal segment with two distal setae, as typical of Cypridoidea (missing in damaged illustrated paratype (Figure 4.11C), but clearly visible in topotype (Figure 4.11D)). Second protopodal segment (fused with first) with one distal seta on inner side of the segment (again missing in damaged illustrated paratype (Figure 4.11C), but clearly visible in topotype (Figure 4.11D)). Exopod a small rudimentary plate, with three setae of variable length, the anterior-most between 1/2 to 2/3 the length of the segment, the middle seta approximately 1/2 this length, and the posterior-most very short. First endopodal segment with aesthetasc Y elongate and 2 segmented, with proximal segment approximately 1.5 times the length of the distal one; distally with group of 5 reduced natatory setae (Figure 4.11E), with another longer adjacent seta, the five posterior natatory setae 0.2 times the length of the second endopodal segment; postero-distally with large bristled seta, approximately 0.8 times the length of the segment. Second endopodal segment with four medio-ventral t-setae, two medio-dorsal setae on the opposite segment margin, three subapical z-setae and three distal claws (G1–G3), with G3 shorter than G1 and G2, and a short aesthetasc (y2). Terminal segment approximately twice as long as its basal width, distally with GM a claw and reaching as far as G1 and G2, Gm a seta alongside two other setae, one fused at the base with aesthetasc y3.

Md coxa (Figure 4.12A) distally with teeth accompanied by setae, and more proximally from largest tooth an elongate seta covered in stiff setules, as typical of Cypridoidea.

Md palp (Figure 4.12B) with length ratios of last three palp segments approximately 1:3:1. First palp segment largest. First segment with a group of four setae, the most proximal seta long and smooth, this followed by an S1 seta of similar length, an α seta, then most distally a broader S2 seta. S2 seta
Figure 4.11: *Ilyodromus candonites* ♀s from small granite rock pool at summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia A–E. A. Antennule (Paratype NMV J1176b). B. Antennule, detail of Rome organ (Paratype NMV J1176b). C. Antenna, damaged with a number of missing and broken setae (Paratype NMV J1176b). D. Antenna, showing all setae (Topotype RS724). E. Antenna, detail of natatory setae (Topotype RS724). Scales: A = 150 µm, B = 30 µm, C–D = 118 µm, E = 40 µm
longer than S1, both carrying rows of long setules. α seta short and spine-like distally, but with broad base; total length of α seta approximately 0.3 times the length of the S setae. Second palp segment stout, its width over twice its length, and with six setae posteriorly; β seta stout, covered with long setules, and almost of the same length as α seta; four subsequent setae all of similar length as S1; last seta in this group originating more distally, under half the length of S1, and covered with rows of setules; this segment also with a group of three antero-dorsal setae, two smooth, with similar length to S1, and the most distal one half the length of the others, with long setules over most of its length. Third palp segment elongate with length approximately 1.5 times its width, antero-distally with four smooth setae, the most distal one shorter than the others; distal margin of third palp segment with γ seta anteriorly, and a row of three additional setae, γ seta elongate and with short setules covering the distal half, three neighboring setae 1.2 times the length of the γ; posterior margin of third segment with two setae, one very short, the other long, almost the same length as S1. Terminal palp segment short, with length approximately 1.2 times its width; distally with a group of three claws of variable length, and one seta of similar length to the claws.

Rake-like organ with elongate proximal arm, broadening abruptly to a 7–9 toothed rake structure.

Mx (Figure 4.12C) endopodite two segmented. First segment with six setae on the antero-distal margin, three of these setae smooth and of similar length, two shorter and hirsute, the most proximally based one slightly longer, and a seventh seta being the shortest, based more medially than the others, and pointed posteriorly. Second endopodal segment spatulate, distally bearing three claws and three setae. Third endite distally with small seta on the posterior margin, and at the distal margin two strongly developed but smooth claws positioned between seven setae anteriorly, and one seta posteriorly, all setae on the distal margin of similar length, apart from one seta based slightly more proximal, this seta stout, bent, covered with long stiff setules, and under half the length of the other setae. Chaetotaxy of endites II and III not elaborated. Respiratory plate with approximately 26 rays, six of these reflexed.

L5 (Figure 4.12D) protopod with two a-setae of similar length, based proximally on the anterior margin, one long and hirsute b-seta on ventral margin, and a long, hirsute d-seta based anteriorly. Endite with 14 setae lining the antero-distal margin of varying length and shape. Endopodite with three hirsute distal setae, one longer than the other two.

L6 (Figure 4.13A) a walking limb, with first two segments bearing d1 and d2 setae antero-distally, with d1 being approximately 1.5 times longer than
Figure 4.12: *Ilyodromus candonites* ♀ (Paratype NMV J1176b) from small granite rock pool at summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia A–D. A. Mandibular coxa. B. Mandibular palp. C. Fifth limb D. Maxillular palp and endites, without detail of second and third endites. Scales: A–D = 102 µm
d2. Endopod four-segmented. First endopodal segment with e seta reaching to approximately mid-length of third segment; posterior margin hirsute and arranged into four groupings. Second endopodal segment with f seta antero-distally and slightly shorter than the third endopodal segment. Third endopodal segment with g setae antero-distally, one slightly longer than the other, and both less than half the length of the third endopodal segment. Terminal segment with h2 developed into a long serrated claw, with length approximately 2.5 times the length of the endopodal segment, seta h1 0.7 times the length of h3, and approximately twice the length of the terminal segment. Length ratios of first to fourth endopodal segments approximately 9:6:5:2.

L7 (Figure 4.13B & C) a cleaning limb, basal segment with d1 and d2 on anterior margin, and dp posterodistally, all of similar length. First endopodal segment the longest, and bearing a bristled antero-distal e seta, slightly longer than d2 seta. Second and third endopodal segments fused, with a bristled f seta approximately in the middle of this fused segment, of approximately 1/2 the length of the e seta. Third endopodal segment without g seta. Terminal segment fused with third endopodal segment to form a pincer organ, and bearing three setae: seta h1 forming a comb-like seta, h2 short, approximately 1/3 the length of the f seta, seta h3 1.5 times the length of the f seta.

CR (Figure 4.13E) symmetrical and elongated and narrow distally, each with two serrated claws, an apical Sa seta, and a claw-like Sp. Length ratios of claws Sa, Ga, Gp and Sp to ramus 0.1, 0.4, 0.4 and 0.2 respectively. Attachment of CR (Figure 4.13D) bearing an obvious branch at proximal end, and a distal bifurcation.

Male Cp (Figure 4.10C) and valves (Figure 4.10G & H) smaller than females, but otherwise of similar appearance.

Male L5 Lpp (Figure 4.14B) first segment stout, with length approximately 1.5 times its central width; apically with two sensory organs, one double the length of the other; second segment hook shaped but angular, the shape resembling a drawer handle, with distal sensory organ; Rpp (Figure 4.14C) with first segment length over twice its width and with only one apical sensory organ, second segment with similar shape to Lpp second segment but broader distally, and with pronounced outward bend proximally.

Male Hp (Figure 4.9A) ls narrow, curved, protruding notably further than ms, with parallel margins aside from distal 1/4, where it is broadest and terminating with a flat distal margin; ms with broad base narrowing to a rounded distal margin, with two lobes embracing ls proximally, and with a rounded lateral protrusion; an additional lobe embracing the proximal 1/2 of the ms.
Figure 4.13: *Ilyodromus candonites* ♀ from small granite rock pool at summit of Mt. Chu-dalup, near Northcliffe, Western Australia, Australia A–E. A. Sixth limb (Paratype NMV J1176b). B. Seventh limb, with missing seta on second segment (Paratype NMV J1176b). C. Fifth limb, showing all setae (RS726) D. Caudal ramus attachment (Paratype NMV J1176b). E. Caudal ramus (Paratype NMV J1176b). Scales: A–C, E = 102 µm, D = 200 µm
Figure 4.14: *Ilyodromus candonites* ♂ (Holotype NMV J1175b) from small granite rock pool at summit of Mt. Chudalup, near Northcliffe, Western Australia, Australia A–C. A. Hemipenis. B. Prehensile palp of left fifth limb. C. Prehensile palp of right fifth limb. Scales: A–C = 54 µm

4.5. RESULTS
4.5.1.8 *Ilyodromus williamsi* (McKenzie, 1966)

Figures 4.15 to 4.17


4.5.1.8.1 Remarks

*Isocypris williamsi* was described in 1966 from 10 miles west of Inverway, Northern Territory, Australia (McKenzie, 1966). In this description, several appendages were partly illustrated with only the left valve. Later, De Deckker (1981) designated the species to the genus *Ilyodromus* based on the presence of the A1 Rome organ, the similar morphology of the $\alpha$, $\beta$, and $\gamma$ setae of the Md palp, the spatulate distal segment of the Mx palp, the thick and pectinate Sp seta of the CR, and the CR attachment bearing an obvious single branch at the proximal end. These genus level characters were still considered valid after revision of a number of species, including above and in Shearn et al. (2014), so the transfer of this species to *Ilyodromus* appears to have been justified. However, the illustration of these characters was limited in McKenzie (1966) and no illustrations were provided in De Deckker (1981). Detailed illustrations of all appendages will enable confirmation of the transfer of this species to *Ilyodromus*, and will provide a larger set of taxonomic characters with which to diagnose this species from others in the genus. Here, the only existing type specimen is used to illustrate all appendages and redescribe the species. Unfortunately due to restrictions in the way type material is able to be examined, SEM micrographs of the valves could not be taken. Instead, light microscope micrographs were taken of the left valve (internal view), and right valve (external view). This has highlighted some major differences of internal valve structure to some other species in the genus. However, to determine character states such as the inner pegs of the left valve that have been documented in other species, SEM micrographs are essential. Thus although the redescription here provides a much larger set of taxonomic characters, the collection of topotypes to have valves imaged using scanning electron microscopy would be of great benefit. Additionally, inspection of the holotype appendages in the glass slide revealed that this specimen had been stained, most likely with methylene blue (perhaps to make it easier to pick from a sample). For this reason it is likely that the pigment of the valves has also been altered, so it was not possible to know for sure what the original pigment was.
4.5.1.8.2 Distribution and habitat

This species was documented from creek side pools, waterholes and temporary pools in north Western Australia and the Northern Territory at the time of its description (sample details from McKenzie (1966) listed below), but has not been documented since. The detailed redescriptions here reveal long natatory setae on the A1 and A2, suggesting this species is adapted to more nektobenthic habitats than many other species in the genus that exhibit a more burrowing lifestyle (Sars, 1894).

Samples investigated in McKenzie (1966):

1. Sample No. 583, 3 adults, 7 juveniles, May 1965; a shallow pool, creek about 10 miles west of Inverway, N.T.

2. Sample No. 584, 1 juvenile, May 1965. Small artificial dam, about 200 yd from 583, Northern Territory; May 1965.

3. Sample No. 590, 1 juvenile, June 1965; Large shallow waterhole, near junction of Broome-Derby-Fitzroy Crossing roads, Western Australia; June 1965.

4. Sample No. 593, 1 juvenile, June 1965; Waterhole, Leopold Ranges, 25-30 miles west of Mt. House on Derby-Mt. House road, Western Australia; June 1965.

4.5.1.8.3 Type Locality

About 10 miles west of Inverway, Northern Territory, Australia (De Deckker, 1981). Approximate coordinates: S 17° 50’ 15”, E 129° 29’ 10” (Figure 4.1).

In McKenzie (1966), the type locality is given as above. However, the appendix lists more accurately that the Holotype originated from sample “583, a shallow pool, creek about 10 miles west of Inverway, N.T.; May 1965.”

4.5.1.8.4 Material investigated

Holotype female with soft parts dissected on a sealed slide (Museum Victoria: J18) and valves stored dry in a micropalaeontological slide (Museum Victoria: J17).

4.5.1.8.5 Measurements from McKenzie (1966) (in µm)

♀ Cp: L = 1080 \( (n = 1) \), H = 540 \( (n = 1) \), W = 430 \( (n = 1) \).
4.5.1.8.6 Diagnosis (modified after De Deckker, 1981; McKenzie, 1966)

Adults up to approximately 1000 µm in length, subreniform in lateral view. LV with calcified inner lamella broad anteriorly but narrow posteriorly, and a pronounced inner list around entire margin. A1 second segment with large Rome organ, third segment with dorsal and ventral setae subequal in length, fourth segment also stout, fifth segment with two ventral claw-like setae. A2 with natatory setae 3.7 times the length of the second protopodal segment. L6 with h2 2.5 times the length of the third endopodal segment, and h1 0.7 times the length of h3. L7 with first endopodal segment only marginally longer than the others. CR with Ga short, only 0.4 times the length of the ramus.

4.5.1.8.7 Differential diagnosis (Table A.1, Page 319)

4.5.1.8.8 Description (modified after De Deckker (1981) and McKenzie (1966))

Female carapace in lateral view subreniform (Figure 4.15A & B), dorsal margin rounded, ventral margin sinuous at mid length (Figure 4.15A & B), curve of anterior margin more elongate than posterior (Figure 4.15A & B), apex of anterior margin below mid-height and apex of posterior margin at mid-height (Figure 4.15A & B), greatest height at mid length (Figure 4.6A & B); in dorsal view pointed anteriorly but rounded posteriorly, greatest width at mid-length.

RV and LV with similar size and shape (Figure 4.15A & B). LV with calcified inner lamella broad anteriorly, narrow posteriorly and ventrally, and extending around entire valve, aside from dorsal hinge area (Figure 4.15A); calcified inner lamella extending inward, by approximately 1/5 of valve length anteriorly, under 1/10 of valve length posteriorly (Figure 4.15A), and much narrower ventrally at mid-length (Figure 4.15A). Ventral sinuous at mid-length (Figure 4.15A). LV calcified inner lamella with a pronounced inner list (Figure 4.15A) beginning at postero-dorsal margin near the hinge boundary, extending around ventral and anterior margins, and terminating anterodorsally near the hinge boundary. External valve surfaces of some individuals with fine striations. Central muscle scar with of five scars, one of these smaller than the others, and two larger scars positioned anteroventral to the main group.

A1 (Figure 4.16B) seven segmented (with first two fused segments counted as only one segment). The first segment length approximately twice the width, with one dorsal seta and two ventral setae. Second segment stout, with length to width ratio approximately 1:2, with long medio-dorsal seta.
and Rome organ (Figure 4.7A) with approximately length approximately 0.7 times the segment length; Rome organ (Figure 4.7A) two segmented, with distal flagella. Third A1 segment elongate, with length approximately two times the width, and with one ventral seta and one dorsal seta, both approximately twice the length of the segment. Fourth segment stout, with length approximately 0.8 times the width, with two ventral setae, the ventral-most being 2/3 the length of the other, and two dorsal natatory setae, both of these longer than the ventral setae. Fifth segment with length to width ratio approximately 1:1, with two dorsal natatory setae, and two shorter and claw-like ventral setae, these under half the length of the dorsal natatory setae, the ventral-most being the shortest. Sixth segment (Figure 4.7C) with length to width ratio approximately 1:1, with a group of four long natatory setae, dorsal to this group one very short seta. Seventh segment with length approximately 1.5 times its width, two long setae, a broader ventral claw-like seta and a dorsal aesthetasc Ya.

A2 (Figure 4.16C) first protopodal segment with distal setae not visible in illustrated holotype. Second protopodal segment (fused with first) with one distal seta on inner side of the segment. Exopod a small rudimentary plate, with three setae, the anterior-most of similar length as the segment, the middle seta approximately 1/3 this length, and the posterior-most very short. First endopodal segment with aesthetasc Y elongate and 2 segmented, with both segments equal in length; distally with group of five long natatory setae, with another short adjacent seta, the five posterior natatory setae 3.7 times the length of the second endopodal segment; postero-distally with large bristled seta, approximately the same length as the segment. Second endopodal segment with four medio-ventral t-setae, two medio-dorsal setae on the opposite segment margin, three subapical z-setae, a short aesthetasc (y2) and three distal claws (G1–G3); G1 & G2 approximately 1.7 times the length of the
second endopodal segment, G3 slightly shorter. Terminal segment approximately 1.5 times as long as its basal width, distally with one seta fused at the base with aesthetasc y3, GM a claw reaching as far as G1–G3, and Gm reduced as a seta.

Md coxa (Figure 4.16D) distally with teeth accompanied by setae, and more proximally from largest tooth an elongate seta covered in stiff setules, as typical of Cypridoidea.

Md palp (Figure 4.16E & F) with length ratios of four palp segments 8:2:5:2. First palp segment largest, with length approximately 1.3 times the width. First segment with a group of four setae, the most proximal seta long and smooth, this followed by an S1 seta of similar length, an α seta, then most distally a broader S2 seta (broken in illustrated holotype). α seta short and spine-like distally, but with broad base; total length of α seta approximately 0.4 times the length of the S1 seta. Second palp segment stout, its width over twice its length, and with six setae posteriorly; β seta stout, covered with long setules, and almost of the same length as α seta; four subsequent setae all of similar length as the S1 seta; last seta in this group originating more distally, about 3/4 the length of the S1 seta, and covered with rows of long setules; this segment also with a group of three antero-dorsal setae, two with similar length to the S setae, and the most distal one shorter. Third palp segment elongate with length approximately 1.4 times its width, antero-distally with four smooth setae, all of similar length; distal margin of third palp segment with γ seta anteriorly, and a row of three additional setae, γ seta elongate and with short setules covering the distal half, one neighboring seta half the length of the γ, two others positioned posteriorly the same length as γ seta; posterior margin of third segment with two setae missing in illustrated holotype. Terminal palp segment short, with length approximately 1.5 times its width; distally with a group of three claws, one much longer than the other two, one seta of similar length and two setae with length half that of the largest claw.

Mx (Figure 4.17A) endopodite two segmented. First segment with six setae on the antero-distal margin, three of these setae smooth and of similar length, two shorter and hirsute, the most proximally based one slightly longer, and a seventh seta being the shortest, based more medially than the others, and pointed posteriorly. Second endopodal segment spatulate, distally bearing three claws and three setae. Third endite distally with small seta on the posterior margin, and at the distal margin, two strongly developed but smooth claws positioned between seven setae anteriorly, and one seta posteriorly, all setae on the distal margin of similar length, apart from one seta based slightly more proximal, this seta stout, bent, covered with long stiff setules, and ap-
Figure 4.16: *Ilyodromus williamsi* ♀ (Holotype NMV J18) from NT, 10 miles west of Inverway, Northern Territory, Australia A–F. A. Antennule, detail of Rome organ. B. Antennule. C. Antenna. D. Mandibular coxa. E. Mandibular palp, detail of alpha, beta and gamma setae. F. Mandibular palp, detail of setae (note some are missing). Scales: A = 10 µm, B = 135 µm, C = 91 µm, D = 108 µm, E = 68 µm, F = 73 µm

4.5. RESULTS
proximately half the length of the other setae (this seta positioned behind the others on illustrated holotype). Chaetotaxy of endites II and III not elaborated.

L5 not visible in holotype dissection slide.

L6 (Figure 4.17B) a walking limb, with first two segments bearing d1 and d2 setae antero-distally, these setae subequal. Endopod four-segmented. First endopodal segment with e seta; posterior margin hirsute and arranged into five groupings. Second endopodal segment with f seta antero-distally and slightly shorter than the third endopodal segment. Third endopodal segment with g setae antero-distally, both over half the length of the third endopodal segment. Terminal segment with h2 developed into a long claw, about 2.5 times the length of the third endopodal segment, seta h1 0.7 times the length of h3, h3 1.5 times the length of the terminal segment. Length ratios of first to fourth endopodal segments approximately 8:6:5:2.

L7 (Figure 4.17C) a cleaning limb, basal segment with d1 and d2 on anterior margin and dp posterodistally, d1 the shortest, d2 longest, and dp intermediate length. First endopodal segment only marginally longer than the others, and bearing a bristled antero-distal e seta with length approximately the same as d2 seta. Second and third endopodal segments fused, with a bristled f seta approximately in the middle of this fused segment, of approximately half the length of the e seta. Third endopodal segment without g seta. Terminal segment fused with third endopodal segment to form a pincer organ, and bearing three setae: seta h1 forming a comb-like seta, h2 short, approximately half the length of the f seta, seta h3 approximately 1.4 times the length of the f seta.

CR (Figure 4.17E) symmetrical and elongated, each with two serrated claws, an apical Sa seta, and a pectinated claw-like Sp. Claw Ga approximately 0.4 times length of the ramus. Length ratios of claws Sa, Ga, Gp and Sp to ramus 0.1, 0.4, 0.4 and 0.2 respectively. Attachment of CR (Figure 4.17D) bearing an obvious branch at proximal end, and a distal bifurcation.
Figure 4.17: *Ilyodromus williamsi* ♀ (Holotype NMV J18) from NT, 10 miles west of Inverway, Northern Territory, Australia A–E. A. Maxillula palp and endites, without detail on first and second endites. B. Sixth limb. C. Seventh limb. D. Caudal ramus attachment. E. Caudal ramus. Scales: A = 68 µm, B = 108 µm, C = 90 µm, D = 135 µm, E = 84 µm

4.5. RESULTS
4.6 Discussion

4.6.1 The position of *Ilyodromus amplicolis* and *Ilyodromus dikrus*

In a previous study (Martens, 2001), the position of *Ilyodromus amplicolis* and *Ilyodromus dikrus* within the genus *Ilyodromus* was considered invalid due to the visible similarity between these species, and others of another subfamily (Isocypridinae) highlighting the need for systematic revision (Martens, 2001). However, this study has found that *I. amplicolis* and *I. dikrus* do in fact belong to *Ilyodromus*. In particular, several features place these species as closer to the type species than to others in the genus; the broad calcified inner lamella anteriorly and posteriorly, the striation patterning of the valves, the absence of an inner list on the left valve, and the spatulate distal segment of the maxillula palp. Thus *I. amplicolis* and *I. dikrus* appear closely related to the type species (*I. stanleyanus* Sars (1894)) and for now their placement in the genus appears valid.

However, comparison of the shared generic features of *Ilyodromus* shown here, in (Shearn et al., 2014), and in (Smith et al., 2011) reveal a remarkable degree of similarity to other genera of Isocypridinae, more so than to other tribes of Herpetocypridinae. In particular, several diagnostic features of *Isocypris* Rome, 1965 and *Platycypris* Herbst, 1957 are also diagnostic features of Herpetocypridinae (see examples in De Deckker, 1981; González Mozo et al., 1996). Thus, the concern raised in Martens (2001) was well founded, and indicative of changes required in higher taxonomic ranks. Under this current evidence, the placement of Isocypridinae as tribe Isocypridini Rome, 1965 of Herpetocypridinae Kaufmann, 1900 best describes morphological divergence. The only exception being the placement of the genus *Amphibolocypris* Rome, 1965 within Isocypridini, as this genus does not exhibit the same degree of similarity to other genera of Herpetocypridini Kaufmann, 1900, as that seen in *Isocypris* Müller, 1908 and *Platycypris* Herbst, 1957. A review of both species within the genus *Amphibolocypris* Rome, 1965 is required, as it may belong in a separate tribe, or indeed subfamily.

4.6.2 Undescribed diversity within *Ilyodromus*

The redescriptions provided here alongside Shearn et al. (2014), give the best possible account of extant species in Australia. This region has been flagged as having high potential for undescribed ostracod diversity (Martens et al.,
2008), and indeed a large number of undescribed species are being discovered (Karanovic, 2007; Martens et al., 2012, 2013; Shearn et al., 2012). Further taxonomic study of *Ilyodromus* in Australia should target species with a wide recorded distribution, that are also recorded from a diverse range of habitats, as these are likely to yield undescribed species. The redescriptions of existing species given here will ease the identification of new species in these studies.

### 4.6.3 Availability of morphometric data

Many species within *Ilyodromus* were described long before the discovery and widespread use of molecular phylogenetics, and due to the way DNA degrades with heat and time (Lindahl, 1993), the often poor storage, combined with the age of museum specimens mean that it is not possible to extract DNA for use in phylogenetic studies. Furthermore, some species were described from localities that have since been destroyed through urbanisation (King, 1855), making recollection of topotypes impossible. For these cases, an understanding of between species divergence patterns can still be gained through the use of morphological cluster analyses (For examples see Hršak et al., 2011; Venhuis et al., 2007). Such studies rely on the documentation of a large set of morphological characters, and will benefit from the detailed species descriptions given here, and elsewhere (Shearn et al., 2014; Smith et al., 2011).

### 4.7 Author Contributions

RS Planned the project, searched for museum records in an extensive literature review, dissected topotype specimens, drew specimen appendages, processed images, produced figures, and wrote the manuscript

AK assisted with project planning, provided guidance for collection of topotypes, and critiqued the manuscript

IS assisted with project planning and critiqued the manuscript

KM assisted with project planning, provided guidance for decisions to make high level taxonomic changes, and critiqued the manuscript

SH assisted provided guidance on finding museum material and critiqued the manuscript
4.8 Acknowledgements

Claudine Behen (RBINSc, Brussels, Belgium) inked all line drawings. Julien Cilis (RBINSc, Brussels, Belgium) assisted with SEM micrographs, and the identification of taxonomic characters in the valves. Joe Krawiec and Tim Doherty assisted with field collection of topotypes. This research was funded by an ABRS grant (nr RF211-33: ‘Biodiversity and taxonomy of Ostracoda (Crustacea) from temporary water bodies of inland Western Australia’), an Edith Cowan University Industry Collaboration grant, and the Centre for Ecosystem Management, Edith Cowan University, while RS was supported by an Australian Postgraduate Award.

4.9 References


4.9. REFERENCES


