An opportunistic survey of aquatic invertebrates in the Goldfields region of Western Australia

KIRSTY QUINLAN [1*], ADRIAN PINDER [1], REBECCA COPPEN [1] AND JENNIFER JACKSON [2]

[1] Science and Conservation Division, Department of Parks and Wildlife, Kensington, WA 6151, Australia

[2] Goldfields Region, Department of Parks and Wildlife, Kalgoorlie, WA 6430, Australia

[*] Corresponding author: kirsty.quinlan@dpaw.wa.gov.au

ABSTRACT

Significant summer rainfall across the arid zone of Western Australia in early 2014 provided an opportunity to improve our knowledge of wetland biodiversity in the Goldfields region. Fourteen wetlands spanning the Coolgardie, Murchison and Gascoyne bioregions were surveyed for aquatic invertebrates and associated habitat variables. Thirteen sites were fresh (<3 g L^{-1}) and one was subsaline (4.1 g L^{-1}). A total of 221 aquatic invertebrate taxa were recorded during the survey, including a new species of calanoid copepod, and potentially new ostracods and a new water mite. Significant range extensions were documented for species of *Branchinella* fairy shrimp and *Mytilocypris* ostracods. The fauna was dominated by insects (46% of species) and crustaceans (28%). Invertebrate communities recorded from highly turbid claypans, rockholes (including a creek pool), 'Possum Swamp' and Mt Forrest spring differed in composition from the remaining fresh and subsaline lakes and swamps. An analysis of multiple arid zone survey datasets suggested that the wetlands sampled in this survey support different species assemblages to WA arid zone wetlands sampled previously. Survey limitations meant that some wetland types were not sampled or were represented by only one or two sites, which are gaps that could be addressed in future survey work. This survey has significantly improved our understanding of biodiversity patterning of aquatic fauna in the Goldfields region and the WA arid zone more generally, particularly in relation to wetlands situated on the conservation estate and Indigenous Protected Areas.

Keywords: arid zone, biodiversity, Goldfields, summer rainfall, wetlands

INTRODUCTION

In Western Australia (WA) several large-scale biodiversity surveys have provided regional-scale information of biodiversity patterning in the state, including for aquatic ecosystems. These include surveys of the Pilbara (George et al. 2010), the agricultural zone in the Wheatbelt (Keighery et al. 2004), and the southern Carnarvon Basin (Burbidge et al. 2000). While wetland survey has been extensive in some regions of WA, information from other regions, including the Goldfields and Western Deserts, remains more limited.

Much of the work carried out to date in the Goldfields region has focused on salt lakes, the dominant wetland type in the region, driven by the mining industry's use of these areas for mining and dewatering discharge purposes. A detailed investigation of 43 inland salt lakes by Gregory (2007) and Gregory et al. (2009) was undertaken to better understand the ecological value of the lakes, develop a classification system and investigate the impacts of mining activities on these wetlands. Other studies of individual wetlands in the region, such as Lake Carey (Timms et al. 2006), Rowles Lagoon (Department of Environment and Conservation 2009) and Arrow Lake near Kalgoorlie (Chapman & Timms 2004), as well as taxa-specific work (e.g. Halse & McRae 2004; Timms et al. 2009) have also contributed to a better understanding of the diversity and distribution of aquatic fauna in the region. Elscot et al. (2009) also included some Goldfields sites in their surveys to support Directory of Important Wetlands of Australia (DIWA) nominations. There has also been some research into the faunas inhabiting granite outcrop pools in the Goldfields (e.g. Timms 2012). Other recent arid zone work includes a wetland biodiversity survey of Katjarra (Carnarvon Range; Pinder & Quinlan 2013) in the Little Sandy Desert, undertaken as part of a larger biological survey of the Birriliburu Indigenous Protected Area (IPA) from 2012 to 2014. These studies have revealed many aquatic invertebrate species that

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appear to be restricted to the arid areas of Western Australia, but sampling has been too patchy to determine their distributions and habitat associations for use in conservation planning.

The difficulty in collecting information on aquatic biota or water chemistry in arid regions lies in the infrequent filling of most wetlands and the short periods they hold water. Information collected to date has often been after a fill event associated with cyclonic activity in summer, and the work presented here followed such an event. In early 2014, the Goldfields region experienced significant rainfall which led to the filling of many lakes and wetland areas. The last comparable rainfall event around Kalgoorlie occurred in January 2000 (Australian Bureau of Meteorology 2015a). Given filling events of this magnitude are relatively uncommon, a collaborative effort between the Department of Parks and Wildlife's Science and Conservation Division and Goldfields Region was undertaken to sample aquatic invertebrates in a range of wetlands. In this paper we aim to document the distribution of aquatic invertebrate diversity across 14 wetlands in two areas of the Goldfields region following a significant summer rainfall event, and to make comparisons with previous survey work within the region and wider WA arid zone.

METHODS

Study area

The sites sampled for this project span the northern edge of the Coolgardie bioregion north to the eastern extent of the Gascoyne bioregion (Australian Government 2012), part of what is colloquially referred to as the Goldfields region (Fig. 1). The survey focused on 14 wetlands, with some additional ad-hoc collecting in one of these wetlands and eight other sites. The 14 comprehensively surveyed sites were all sampled between mid-March and mid-April 2014, and the ad-hoc collections were made between February and April 2014 (Table 1).

The majority of the survey sites were situated on Parks and Wildlife tenure, or lands jointly managed by the Department and traditional owners. The southern sites were situated on Credo Station, Bulga Downs and the individual pastoral leases of Mt Burges, Jeedamya and Cowarna Downs Stations. The northern sites were situated across the Matuwa (formerly Lorna Glen Station) and Kurrara-Kurrara (formerly Earaheedy Station) IPA (Fig. 1; Table 1). The IPA is jointly managed by Martu (Tarlka Matuwa Piarku Aboriginal Corporation) and the Department of Parks and Wildlife to keep *Jukurrpa* (dreaming) alive and strong via the protection and management of natural values that support cultural, educational and economic activities.

Several types of waterbodies were surveyed (Table 1), including freshwater and subsaline lakes and swamps, claypans, rockholes (one of which was a rockhole in a creek pool) and a spring (Davis et al. 2013). The swamps referred to in this study were all much smaller in size than the lakes surveyed and were predominantly flat vegetated areas that had been inundated. Photos illustrating some of these wetland types are shown in Fig. 2. Many of the salt lakes that dominate the region were already dry when visited in March, but two of the additional ad-hoc collections (at sites ADS28 and ADS29) were made from salt lakes in the southern part of the study area prior to them drying out.

Climate

The Goldfields region has a semi-arid to arid climate, characterised by hot dry summers and mild to cool winters. Maximum daily temperatures are highest in January (Kalgoorlie mean 33.7 °C) and lowest in July (Kalgoorlie mean 16.7 °C; Australian Bureau of Meteorology 2015a). Total annual rainfall varies across the region and is typically erratic, with many rainfall events associated with the tail end of tropical cyclones. In early January 2014 ex-Tropical Cyclone 'Christine' brought significant rainfall to central WA and later in the same month (16–23 January) an intense tropical low brought further heavy rainfall to northern, central and south-eastern WA. The total monthly rainfall for Kalgoorlie in January was 177.4 mm and during this time several locations in the Gascoyne, Goldfields and Eucla exceeded their highest daily rainfall on record (Australian Bureau of Meteorology 2015b). The previous comparable rainfall event (recorded at Kalgoorlie–Boulder Airport meteorological station) occurred in January 2000 when 169 mm of rainfall resulted from Tropical Cyclone 'John' (Australian Bureau of Meteorology 2015a). Further north, rainfall data for Wiluna suggests that historically the area is likely to have been subject to more lows and tropical cyclones in the summer months (December–February) than Kalgoorlie, with a slightly higher average monthly rainfall (Fig. 3).

Wetland sampling

At each of the 14 main survey sites, turbidity (NTU), electrical conductivity (μS cm^{-1}), salinity (g L^{-1}), water temperature (°C) and pH were measured in-situ using hand held calibrated meters (TPS WP-81 and WP-88). The probes of the meters were suspended in the water column approximately mid-way between the water surface and the sediment. A water sample (approximately 750 ml) was collected at each site approximately 15 cm below the water surface (less for shallow wetlands such as sites 9 and 13) for use in water chemistry analyses. Water samples were analysed by the Chemistry Centre of Western Australia for total nitrogen and phosphorus and total filterable nitrogen and phosphorus, the latter samples having first been passed through a 0.45 μm pore size filter in the field and frozen. Chlorophyll and phaeophytin were also measured in the laboratory using phytoplankton that

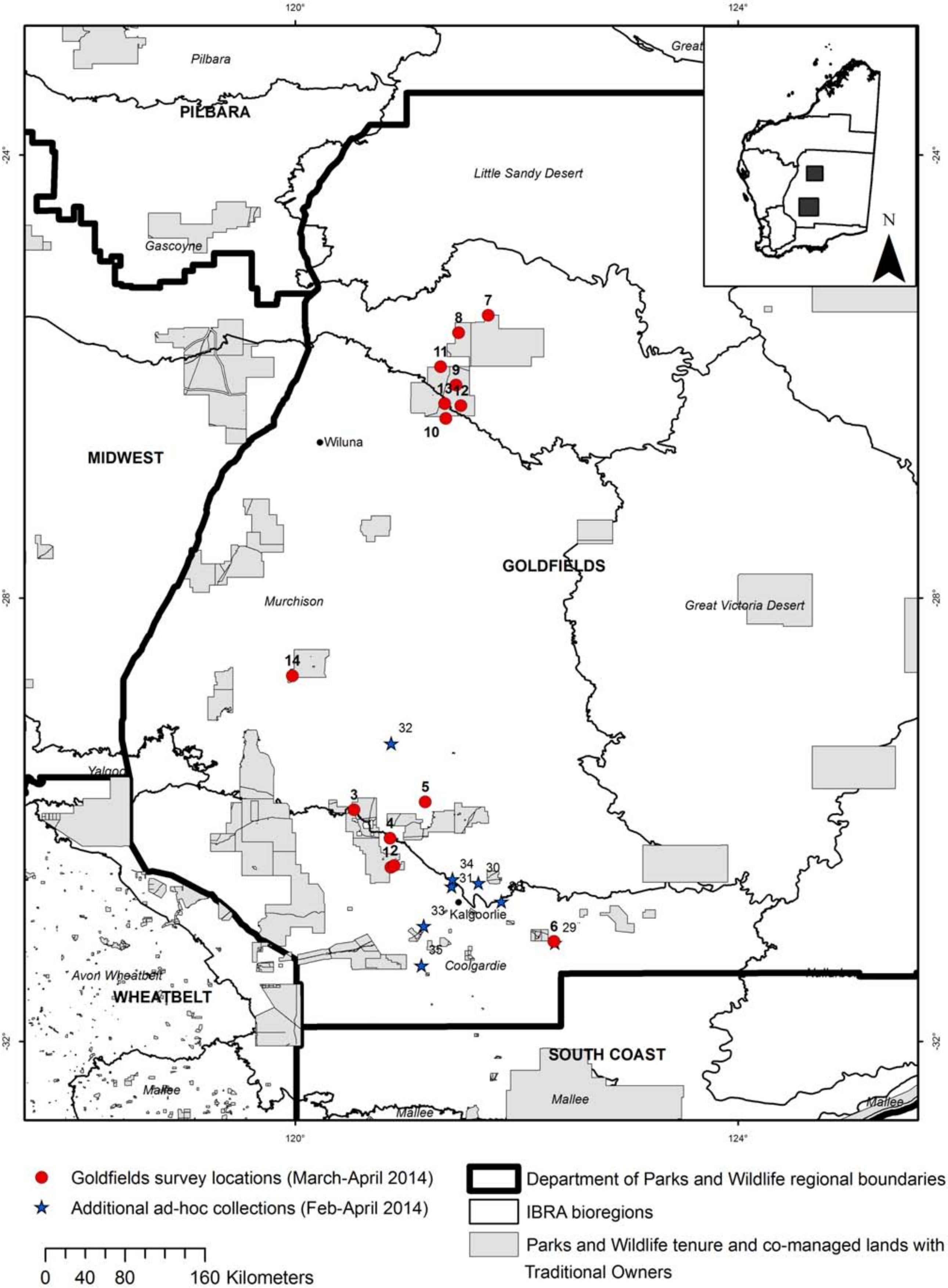

Figure 1. Map showing the location of the fourteen wetland survey sites (1–14) and additional ad-hoc collection sites (28–35) in the Goldfields region, sampled between February and April 2014. Parks and Wildlife tenure and co-managed land with Traditional Owners, Department regional boundaries and bioregions (IBRA7 http://www.environment.gov.au/land/nrs/science/ibra#ibra) are also illustrated.

Table 1

Fourteen Goldfields survey sites and additional ad-hoc collection sites (2014). GPS co-ordinates measured using datum WGS84. IPA = Indigenous Protected Area.

Site code	Date	Site name	GPS co-ordinates Latitude (S)	Longitude (E)	Wetland type	Land Tenure	Management Purpose
GOL01	10/03/2014	Rowles Lagoon	-30° 25' 38"	120° 51' 50"	turbid lake	UCL	Former leasehold, managed as Credo
GOL02	10/03/2014	Canegrass Lagoon	-30° 24' 37"	120° 53' 34"	turbid lake	UCL	Former leasehold, managed as Credo
GOL03	11/03/2014	Ularring Wetland	-29° 54' 23"	120° 31' 49"	swamp	UCL	Former leasehold, managed as Credo
GOL04	11/03/2014	Wangine Lake	-30° 09' 55"	120° 51' 21"	lake	Pastoral lease	Mt Burges Station
GOL05	12/03/2014	Lake Moriaty	-29° 50' 10"	121° 10' 29"	subsaline lake	Pastoral lease	Jeedamya Station
GOL06	13/03/2014	Swan Lake	-31° 05' 46"	122° 20' 16"	lake	Pastoral lease	Cowarna Downs Station
GOL07	15/03/2014	Imbin Rockhole	-25° 26' 49"	121° 44' 37"	rockhole	UCL	IPA - jointly managed as Kurrara-Kurrara
GOL08	15/03/2014	'Cattle Pool'	-25° 36' 13"	121° 28' 30"	swamp	UCL	IPA - jointly managed as Kurrara-Kurrara
GOL09	16/03/2014	'Pink Lake'	-26° 04' 31"	121° 27' 06"	highly turbid claypan	UCL	IPA - jointly managed as Matuwa
GOL10	16/03/2014	'Turtle Pool'	-26° 22' 37"	121° 21' 42"	rockhole (within a creek)	UCL	IPA - jointly managed as Matuwa
GOL11	17/03/2014	'City Beach'	-25° 54' 41"	121° 18' 47"	highly turbid claypan	UCL	IPA - jointly managed as Matuwa
GOL12	18/03/2014	Lindsay Gordon Lagoon	-26° 15' 45"	121° 29' 51"	lake	UCL	IPA - jointly managed as Matuwa
GOL13	18/03/2014	'Possum Swamp'	-26° 14' 42"	121° 21' 04"	swamp	UCL	IPA - jointly managed as Matuwa
GOL14	11/04/2014	Mt Forrest Spring	-28° 41' 55"	119° 58' 26"	spring	UCL	Former leasehold, managed as Bulga Downs
Additional ad-hoc collection sites (approximate locations only)							
GOL01	13/02/2014	Rowles Lagoon	-30° 25' 38"	120° 51' 50"			
ADS28	04/2014	Lake Yindarlgooda	-30° 44' 17"	121° 51' 45"			
ADS29	26/02/2014	Salt Lake (Cowarna Downs)	-31° 06' 36"	122° 20' 41"			
ADS30	19/02/2014	Yarri road nr Carmelia Road	-30° 34' 11"	121° 39' 14"			
ADS31	19/02/2014	Gidji lake N of Kalgoorlie	-30° 36' 01"	121° 24' 48"			
ADS32	04/2014	N Lake Ballard (Jeedamya Station)	-29° 18' 31"	120° 51' 59"			
ADS33	16/02/2014	Coolgardie-Gnarbine Road	-30° 57' 28"	121° 09' 37"			
ADS34	13/02/2014	Arrow Lake, N of Kalgoorlie	-30° 32' 06"	121° 25' 12"			
ADS35	02/2014	South of Coolgardie	-31° 18' 48"	121° 08' 21"			

Figure 2. Photos of Goldfields survey sites showing some of the types of waterbodies sampled: (a) 'Possum swamp' (site 13), (b) Wangine lake (site 4), (c) Lake Moriaty (site 5), (d) Imbin rockhole (site 7), (e) 'City Beach' claypan (site 11) and (f) Mt Forrest spring (site 14).

had been retained on glass-fibre filter paper through a water filtration tower. Concentrations of total filterable nitrogen and phosphorus, chlorophyll and phaeophytin were missing for the two claypan sites (9 and 11) because the samples were too turbid to filter. Habitat information was recorded, including an estimate of the percentage cover of emergent and submerged aquatic plants in the area sampled for invertebrates as well as a substrate description based on an estimate of the percentage cover of silt/clay, sand/gravel, cobble/pebble, boulder and bedrock. The selection of substrate size classes was largely based on the grade scale of sediment particle sizes, as detailed in Brakensiek et al. (1979) and is the same method used in recent wetland survey work by the Parks and Wildlife staff (e.g. Pinder & Quinlan 2013).

Two aquatic invertebrate sweeps were taken at each of the 14 main survey sites (both sweeps covering the

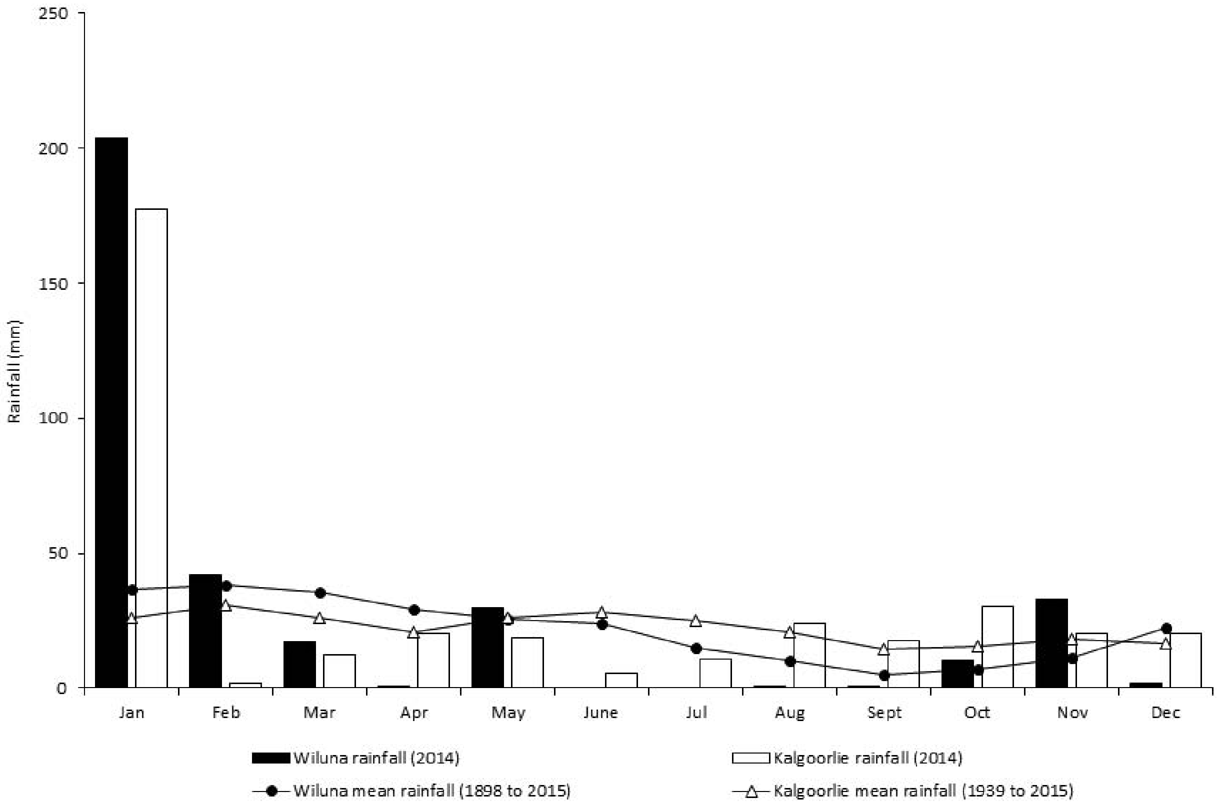

Figure 3. Monthly mean rainfall and 2014 rainfall values from Wiluna (northern Goldfields region) and Kalgoorlie (southern Goldfields region) meteorological stations.

same area of the wetland). A plankton sample, using a 50 µm mesh net to sample the water column, and a benthic sample, using a 250 µm mesh net to sample the sediment and major habitat types within wadeable depth (e.g. open water, submerged vegetation, sticks/logs/leaf litter). These two sweeps were designed to sample different habitat types within the wetland, ensuring that a more complete diversity of aquatic invertebrates was being captured. At all but two sites, each of the plankton and benthic sweeps involved sampling 50 m of wetland (usually not contiguous). However, in the two rockholes (sites 7 and 10) the sweep lengths were 17 and 20 metres respectively, due to the small size of the habitat, and to ensure that at least half the wetland remained undisturbed. A maximum water depth was recorded in the sampling area where the invertebrate sweeps were collected. Coarse inorganic sediment and coarse organic matter were removed prior to sample preservation by washing debris and elutriating in buckets before passing the water back through the net. Samples were then preserved in 100% ethanol.

At the eight additional ad-hoc locations (sites ADS28–ADS35), some larger animals that were visible from the shoreline were hand-collected and preserved in 100% ethanol, but full aquatic invertebrate sweeps and environmental data (as per the methods described above) were not collected. Data from these ad-hoc collections contributed to the final species list but are not used in the multivariate analyses.

Sample processing and aquatic invertebrate identification

Plankton samples were washed and sieved through 250 µm, 90 µm and 50 µm sieve sizes and the benthic samples through 2 mm, 500 µm and 250 µm sieve sizes. Each sieve fraction was examined and representatives of each discernible species were picked out under a dissecting microscope and preserved in 100% ethanol. All taxa were identified to the lowest taxonomic level possible using keys and voucher specimens and undescribed taxa were assigned morphospecies names based on previous survey work by the Parks and Wildlife. A survey specific voucher collection was prepared and lodged with the Western Australian Museum.

A DNA barcoding technique was used to provide improved taxonomic resolution of *Berosus* beetles (Coleoptera: Hydrophilidae). Morphologically identified adults were sequenced and then successfully matched to unidentified sequenced larvae, enabling all *Berosus* data to be included in the community analyses, rather than, as is usual, excluding records of larvae from analyses because they cannot be identified morphologically (see Quinlan & Ottewell 2016).

Data analysis

Non-metric multi-dimensional ordinations were performed on Sørenson dissimilarity matrices of aquatic invertebrate data using the 'meta-MDS' function in the vegan package 2.2–0 (Oksanen et al. 2014) for R 3.1.2 (R Core Team, 2015). Ordinations of the data were performed on presence/absence data edited to improve taxonomic consistency between samples (e.g. removal of most identifications above family level, and specimens unable to be identified morphologically due to gender or life-stage constraints). In order to examine aquatic invertebrate biodiversity patterning more broadly across the state's arid zone and to place our current data in context, we performed an ordination using aquatic invertebrate data from this survey plus four previously published studies of arid zone invertebrates. These datasets were edited to minimise inconsistencies in the data due to differences in expertise and taxonomic understanding at the time the samples were identified, including the lumping of some species to genus level. These other studies were surveys of Lake Gregory on the edge of the Great Sandy Desert by Halse et al. (1998), Katjarra (Carnarvon Range) in the southern extent of the Little Sandy Desert by Pinder and Quinlan (2013), Mandora Marsh in the Great Sandy Desert by Storey et al. (2011) and survey work undertaken to improve representation of arid zone wetlands in the Directory of Important Wetlands of Australia by Elscot et al. (2009).

No statistical analyses were possible between the environmental variables (water chemistry and habitat data) and aquatic fauna community composition due to the strongly skewed data or the limited ranges of some variables (Table 2).

RESULTS

Environmental variables

Thirteen sites were fresh (<3 g L^{-1}) with salinity ranging from 0.01 g L^{-1} (site 13) to 1.46 g L^{-1} (site 8; Table 2). The subsaline Lake Moriaty (site 5) was the exception with a salinity value of 4.1 g L^{-1}. This lake is located just south-east of Menzies, and is one in a series of satellite lakes associated with the southern end of a much larger salt lake, Lake Marmion. Thirteen of the 14 sites were alkaline with pH between 7.47 (site 1) and 9.93 (site 8), the exception being site 7 with a pH of 6.12. Turbidity was generally low, with the exception of the two claypans (sites 9 and 11) with 1150 and 319 NTU respectively, and Rowles Lagoon (site 1) with a value of 323 NTU. Nutrient concentrations were highest in the claypans (sites 9 and 11) and site 14 (Table 2), but nitrogen was also high at site 3. Site 14 was re-analysed by the Chemistry Centre of WA but the initial values were determined to be accurate. Water depth where the invertebrate sample was taken ranged from 0.1 to 1 m. Submerged macrophytes occurred at most sites, with exceptions being the highly turbid sites 1, 9 and 11 and the highly coloured Imbin Rockhole (site 7), probably a consequence of low light penetration. Sand, silt or clay (or a combination of these) was the dominant substrate at all sites (Table 2), with bedrock an additional distinguishing character at sites 7 and 10. Only Imbin Rockhole (site 7) had substantial 'litter' covering 20–40% of the bed.

Aquatic invertebrates

A total of 221 aquatic invertebrate taxa were collected from the survey (including the ad-hoc collections; see Appendix 1) with the dominant groups being insects (46% of the total fauna) and crustaceans (28%). Among insects, fly larvae and beetles were the most species rich, constituting 40% and 29% of insects respectively, whilst among the crustaceans, ostracods (34%) and cladocerans (31%) were the richest groups. Rotifers were the richest of the remaining groups, totalling 15% of the fauna, followed by water mites (4.6%), protists (3.7%), aquatic earthworms (1.4%) and 0.5% each for flatworms, nematodes and snails. However, some of the higher order taxa may represent multiple species so the total number of taxa may be higher. Larger cladocerans in some of the plankton samples were not sufficiently well preserved to identify so diversity of these may have been underestimated.

Species richness at sites ranged from 16 (site 9) to 57 (site 6) taxa, with an average of 42 ± 13 (SD). The two highly turbid claypans (sites 9 & 11) had lowest total richness with 16 and 20 taxa respectively and were dominated by microinvertebrates. Microinvertebrate richness (protozoans, rotifers, copepods, cladocerans and ostracods) ranged from 4 (site 7) to 25 (site 13), with an average of 14 taxa per site. Macroinvertebrate richness (all other taxa) ranged from 5 (site 9) to 44 (site 14), with an average of 28 taxa per site. In terms of species occurrence, 45% of taxa collected occurred in one site only, and only 8.7% occurred in seven or more of the sites. The most common species collected during the survey (occurring in at least 70% of sites) included the copepod *Mesocyclops brooksi*, beetle *Allodessus bistrigatus*, chironomid *Procladius paludicola*, dragonfly *Hemicordulia tau*, and hemipterans *Agraptocorixa parvipunctata* and *Micronecta gracilis*, all of which have broad distributions in Australia.

Community patterning

An initial ordination based on invertebrate composition of all 14 sites resulted in a plot with two distinct groups. The turbid claypans (sites 9 and 11) separated out from the remaining group of 12 sites, which were tightly clustered, and were subsequently excluded from further analysis. An ordination of the remaining 12 sites (Fig. 4) showed a separation of sites 7 (isolated rockhole), 10 (rockhole within a creek), 13 (freshwater swamp) and 14 (spring), from the remaining cluster of wetlands (most of which were lakes). These four sites not only have aquatic invertebrate faunas that are distinct from

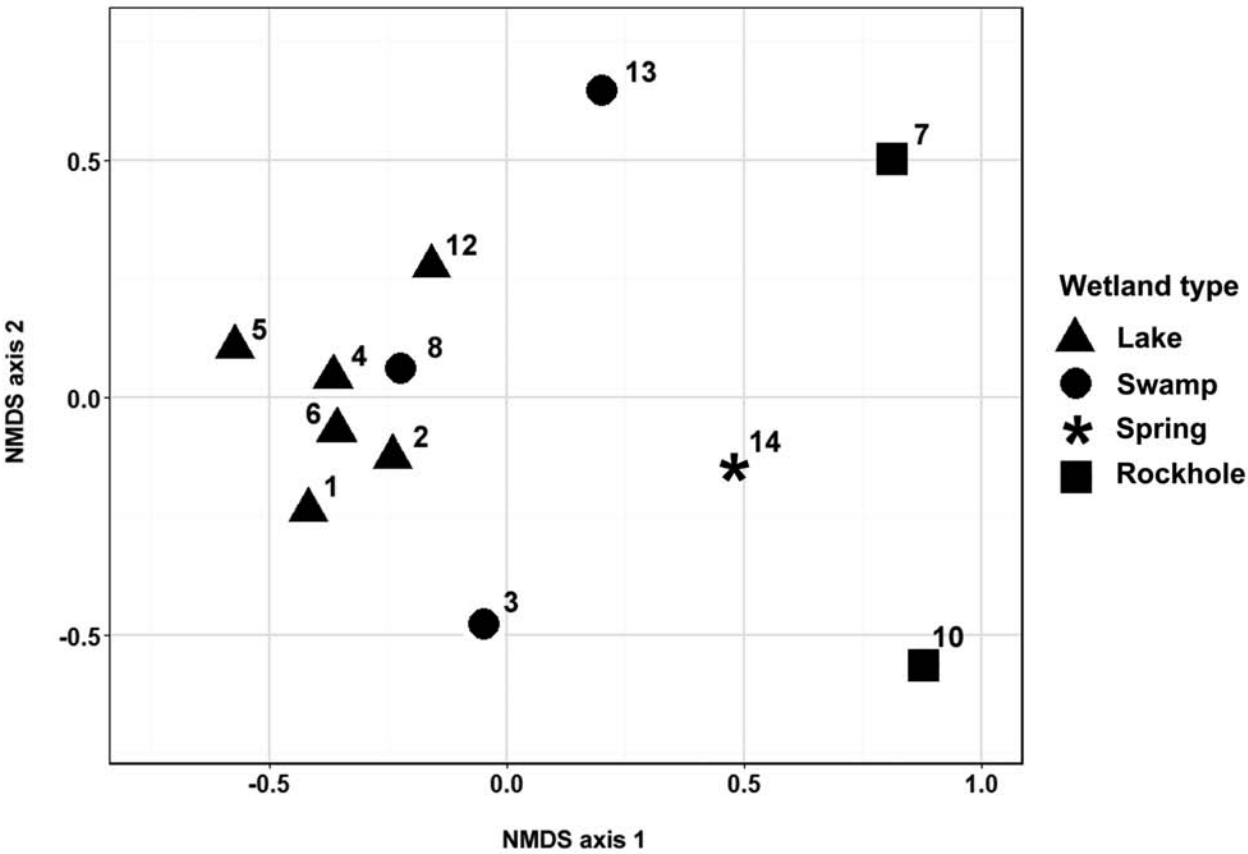

Figure 4. Non-metric multi-dimensional ordination of 12 wetland survey sites from the Goldfields based on Sørenson dissimilarity matrices of aquatic invertebrate fauna (two dimensions, stress = 0.11). Sites are displayed as belonging to one of four main wetland types. Claypans (sites 9 and 11) were excluded from the ordination.

those of the main cluster of sites, they each have faunas that are distinct from one another. These four sites had very few species in common, with only four of the 118 known taxa from these sites common to them all. These are the waterboatman *Agraptocorixa parvipunctata*, dragonfly *Hemicordulia tau*, copepod *Mesocyclops brooksi* and *Culex* mosquitoes.

Another ordination of aquatic invertebrate data from this survey and from four other published works on WA arid zone invertebrates (see methods) suggests there is significant variation in aquatic fauna community composition across the WA arid zone, with three of the four surveys (Lake Gregory, Mandora Marsh and Katjarra) clearly separating out from each other in ordination space (Fig. 5). The DIWA sites were more widely distributed within the ordination plot, with some overlap between these and the Katjarra sites. The ordination also suggests that invertebrate community composition of the Goldfields sites were similar to some sites from the DIWA, Katjarra and Lake Gregory surveys. The two claypans (9 and 11), which were excluded from the ordination analysis represented in Fig. 4, are the two furthest Goldfields points towards the right hand side of Fig. 5. There is a high stress value for this ordination (0.18) which indicates that a significant amount of the variation in composition between the sites could not be represented in two dimensions, perhaps reflecting the high diversity of sites compared to the number of wetlands sampled and the large geographical area of the study. Nonetheless, the ordination still provides an insight into likely patterning of aquatic invertebrates across the state's arid zone.

DISCUSSION

Adequacy of sampling

The current survey of wetlands was an opportunity to take advantage of significant summer rainfall in a part of the state's arid zone where little previous survey work has been undertaken. While not an exhaustive survey, this work helps to fill a knowledge gap by sampling numerous freshwater lentic wetlands in two areas of the Goldfields. A number of wetland types were not sampled (e.g. granite outcrop gnammas and salt lakes) or were represented by only one or two sites, including springs, rockholes and creek pools. When opportunities arise, sampling more of these types of wetlands (and perhaps in different seasons) will further build up a picture of aquatic invertebrate diversity and patterning in inland WA.

Table 2

Water chemistry and habitat data for 14 Goldfields wetlands surveyed in 2014. See Table 1 for sampling dates. For the substrate variables, % cover was recorded using the categories: 0 = none noted; 1 = 0–20%, 2 = 21–40%; 3 = 41–60%; 4 = 61–80%; and 5 = >80% cover. Shading indicates the dominant descriptor/s at each site.

Site Code/Name	GOL01 Rowles Lagoon	GOL02 Canegrass Lagoon	GOL03 Ularring Wetland	GOL04 Wangine Lake	GOL05 Lake Moriaty	GOL06 Swan Lake	GOL07 Imbin Rockhole	GOL08 Cattle Pool	GOL09 Pink Lake	GOL10 Turtle Pool	GOL11 City Beach	GOL12 Lindsay Gordon Lagoon	GOL13 Possum Swamp	GOL14 Mt Forrest Spring
Water Chemistry														
Surface temperature (°C)	23	25.4	26	27.1	23.7	24.1	25.4	35	23.2	28.7	28.6	24.3	30.7	18.3
Conductivity (µS/cm^{-1})	133.3	148.1	609	827	8270	1667	136.6	3110	869	46.8	203.9	2046	20.5	239
Salinity (gL^{-1})	0.55	0.06	0.27	0.37	4.10	0.77	0.05	1.46	0.40	0.02	0.09	0.94	0.01	1.11
pH	7.47	8.88	9.16	8.55	8.67	8.61	6.12	9.93	7.88	8.3	7.76	7.93	7.71	7.76
Total Filterable Nitrogen (µgL^{-1})	540	510	1700	910	310	340	790	710	-	310	-	490	510	9450
Total Filterable Phosphorus (µgL^{-1})	41	26	55	24	5	14	89	13	-	23	-	11	23	5
Total Nitrogen (µgL^{-1})	620	570	1800	930	310	360	940	730	3100	320	4400	520	540	9900
Total Phosphorus (µgL^{-1})	41	36	65	25	5	14	130	21	920	34	4400	16	31	23
Turbidity (NTU)	323	72.2	52.5	30.7	4.7	3.2	6.7	0	1150	1.6	319	48.7	7.3	0.6
Chlorophyll-a (µgL^{-1})	0.5	2	7	0.5	0.5	0.5	3	0.5	-	3	-	0.5	0.5	0.5
Chlorophyll-b (µgL^{-1})	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	0.5	-	0.5	0.5	0.5
Chlorophyll-c (µgL^{-1})	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	0.5	-	0.5	0.5	0.5
Phaeophytin-a (µgL^{-1})	0.5	0.5	2	0.5	0.5	0.5	2	0.5	-	0.5	-	0.5	0.5	0.5
Habitat														
Depth of invertebrate sample (cm)	100	100	50	70	100	80	100	30	12	100	40	50	20	35
Submerged macrophyte cover (%)	0	70	25	10	2	70	0	90	0	2	0	20	10	2
Emergent macrophyte cover (%)	30	50	2	5	5	5	0	5	20	0	0	1	70	20
Substrate														
Silt + Clay	1	**4**	**4**	**4**	0	**4**	0	**5**	**4**	0	**5**	1	**4**	0
Sand + Gravel	**4**	1	1	2	**5**	2	**4**	0	2	**5**	1	**5**	1	**5**
Pebble + Cobble	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Boulder	0	0	0	0	0	0	1	1	0	0	0	0	0	1
Bedrock	0	0	1	0	1	0	5	0	0	5	0	0	0	0
Organic Soil	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Benthic Mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate organic matter	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Litter (leaves and sticks)	1	1	0	1	0	1	2	0	1	0	0	0	0	0
Logs	1	1	0	1	0	0	0	0	0	0	0	0	0	1

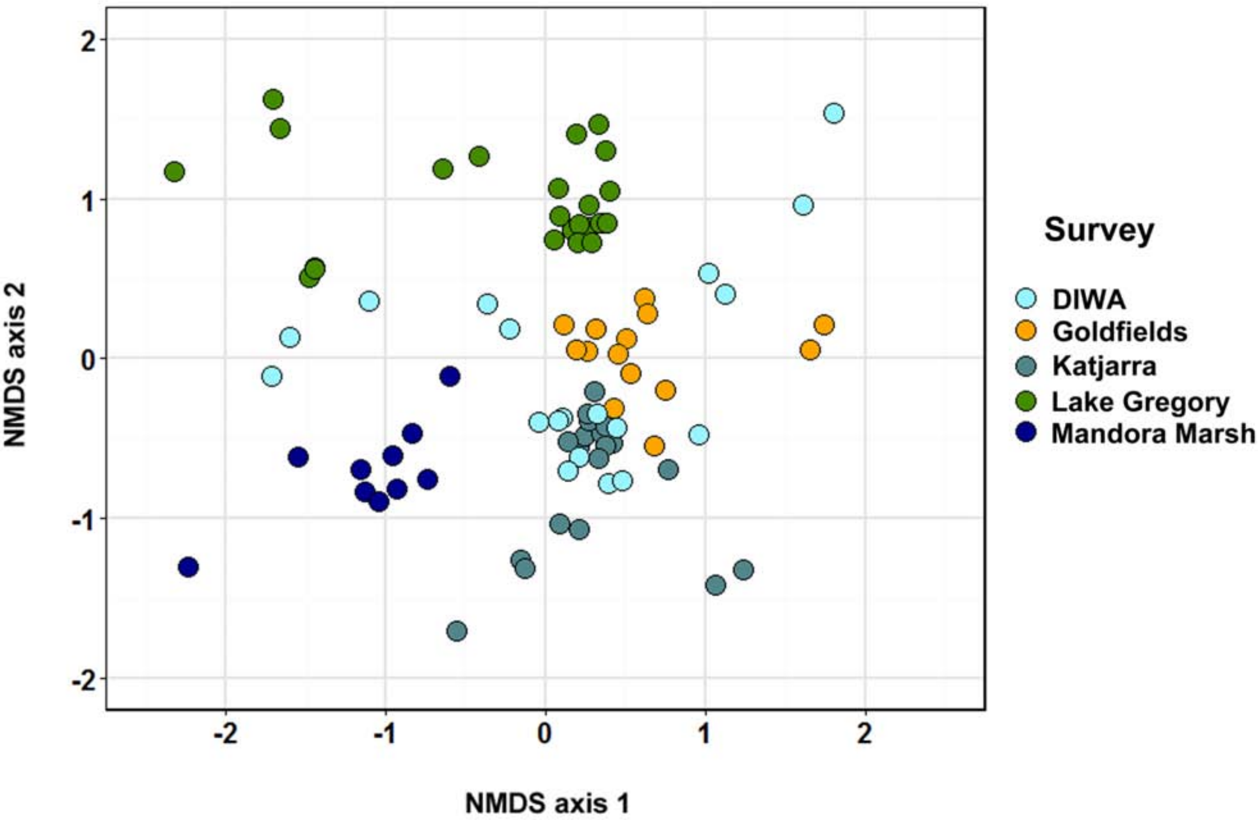

Figure 5. Non-metric multi-dimensional ordination of sites from five wetland surveys, including the Goldfields, based on Sørenson dissimilarity matrices of aquatic invertebrate fauna (two dimensions, stress = 0.18). Other surveys listed include a survey to inform listing of wetlands in the Directory of Important Wetlands of Australia (DIWA), Katjarra, Lake Gregory and Mandora Marsh.

Faunal composition and patterning

The total of 221 aquatic invertebrate taxa collected from this survey is similar to other arid zone wetland surveys of a similar scale, such as the 154 taxa collected from Katjarra (15 sites; Pinder & Quinlan 2013), 174 from Lake Gregory (12 sites; Halse et al. 1998), 138 from Mandora Marsh (10 sites; Storey et al. 2011) and 230 from the DIWA survey (22 sites; Elscot et al. 2009). The combined total from these surveys is at least 400 taxa from 90 samples and, individually, each survey accounts for more than a third of this combined total. While this suggests that there is overlap in composition between these arid zone areas, the ordination involving multiple datasets (Fig. 5) suggests that there is, nonetheless, some regional patterning occurring. The average species richness per sample for the current Goldfields survey is 42, somewhat higher than the average of 36 taxa per sample for Katjarra, 25 for Lake Gregory, 26 for Mandora Marsh, and 26 for the DIWA survey. In the Pilbara region of north-west WA average richness was much higher at 94 taxa per sample for the 100 wetlands surveyed (Pinder et al. 2010), with average richness of temporary lentic waters being 69. This higher richness was attributed to the large numbers of permanent river pools and springs in that region that provide refuges from drought and lead to a high regional species pool available to colonise temporary waters. The Pilbara also has higher annual rainfall (average 370 mm year^{-1}) so temporary wetlands are flooded more frequently, which would support richer propagule banks in temporary waters.

While strongly dispersing insects such as beetles and dragonflies dominated the fauna in the current survey, insects made up a smaller proportion of the total fauna (46%) than in some studies of more isolated wetlands, such as the wetlands at Katjarra (Little Sandy Desert) and central Australian ranges, where insects comprised 75% and 65% of the faunas respectively (Davis 1997; Davis et al. 1993; Brim-Box et al. 2008; Pinder & Quinlan 2013). This may reflect the more isolated nature of the Katjarra and central Australian wetlands compared with those in the Goldfields, so that they are less likely to be colonised by poor dispersers such as snails, worms and crustaceans. Additionally, wetlands sampled in these other areas were primarily permanent to semi-permanent springs, rockholes and gorge pools whereas many arid zone crustaceans (which are generally the next most speciose group after insects) are adapted to the kinds of temporary waters sampled in the Goldfields. Crustaceans made up 28% of the Goldfields fauna compared to only 14% at Katjarra and 18% in central Australia (although some crustaceans were not identified beyond genus in the latter study).

In particular, the Katjarra and central Australian studies had far fewer species of the crustacean groups such as fairy shrimps (*Branchinella* and *Parartemia*), clam shrimps (Conchostraca), and ostracods that are adapted to ephemerality but are not active dispersers.

Rowles Lagoon (site 1) is the only site from the current survey that had been sampled on a previous occasion, in 2008, as part of the Inland Aquatic Integrity Resource Condition Monitoring project (Department of Environment and Conservation 2009). Twenty macroinvertebrate species from 11 families were collected in 2008, compared with 32 species from 16 families in 2014. The combined species richness from both years was 37, so the 2008 sampling found very few species not also recorded in 2014. This comparison between years excluded the microinvertebrate fauna (rotifers, ostracods, cladocerans and copepods) and chironomids, as these groups were not identified in 2008. No water mites or representatives from several insect families (including mayflies) were collected in 2008, whereas in 2014 a hydrachnid water mite and a baetid mayfly were collected. The larger crustaceans were more diverse in 2014, with representatives from additional families including the Limnadiidae, Lynceidae and Triopsidae being collected. Following the identification of *Branchinella occidentalis* and *B. halsei* from the 2014 sample, the 2008 specimen of *Branchinella* was re-examined and determined to be *B. halsei* and not *B. simplex* as documented in the 2009 report. In 2008 the lagoon was slightly more alkaline (pH 8.31) and fresher (TDS 0.31 g L^{-1}) compared to 2014 (pH 7.47 and TDS 0.55 g L^{-1}) but the differences in species composition and richness may have arisen from sampling at different times in the hydroperiod.

The ordination of Goldfields invertebrate samples suggested that there are some compositional differences in invertebrate faunas between sites which led to the claypans (sites 9 and 11), rockholes (sites 7 and 10), 'Possum Swamp' (site 13) and Mt Forrest spring (site 14) to separate out from the main cluster of survey sites (Fig. 4). This dissimilarity between sites is largely reflective of the types of wetlands that were sampled.

Claypans are characteristically shallow, ephemeral, lack submerged macrophytes and are frequently very turbid due to suspended clay particles. While these wetlands often have lower diversity than many other wetlands, they are often associated with distinctive communities particularly characterised by crustaceans such as branchiopods and ostracods (Timms & Boulton 2001; Timms 2002). The two claypans (sites 9 and 11) sampled on this occasion also exhibited the characteristics described above, but were also high in nutrients. This may be due to the adsorption of nutrients to suspended clay particles or due to the inflow of nutrients from stock and feral animals, washed in after flooding rains. However, despite low diversity, these claypans also had quite distinctive invertebrate communities and grouped separately from the remaining wetland sites. Several species were recorded exclusively from these claypans, including the copepods *Calamoecia baylyi* and *Calamoecia halsei*, which have predominantly been recorded from turbid claypans across the Carnarvon and Pilbara bioregions. The ostracod *Mytilocypris coolcalalaya*, collected at both claypans, is uncommon, having previously been collected from just a few turbid claypans in the Carnarvon IBRA bioregion (Halse & McRae 2004; Pinder et al. 2010). Several new crustaceans were collected from these pans and may be regional endemics, including the calanoid *Boeckella* n.sp, and potentially new ostracods (*Ilyocypris*, *Paralimnocythere*, *Cypricercus* and *Potamocypris*). Further survey effort is required to determine the ranges of these species, but it is likely that they are associated with such turbid pans.

Rockholes and springs are frequently semi-permanent to permanent sources of freshwater for aquatic invertebrates and are important refuge areas, particularly in the arid zone (Bunn et al. 2006; Davis et al. 2013; Pinder et al. 2010). Mosquito larvae (*Anopheles* and *Culex*) occurred in sites 7 (Imbin Rockhole), 10 ('Turtle Pool'), 13 ('Possum swamp') and 14 (Mt Forrest Spring) but were absent from all remaining sites. Typically, these genera tend to be associated with more permanent and still water bodies (Liehne 1991). The dytiscid beetle *Necterosoma wollastoni* was the only species exclusive to sites 7, 10 and 14. *Necterosoma wollastoni* has a primarily arid-zone distribution and has been recorded further north as part of the DIWA (Elscot et al. 2009) and Katjarra (Pinder & Quinlan 2013) surveys, and has been collected as far south as the periphery of the Wheatbelt (Keighery et al. 2004). Imbin Rockhole (site 7) shared both habitat characteristics (abundant leaf litter with a sand/silt substrate set in amongst bedrock) and species in common with the suite of rockholes sampled during the Katjarra survey (Pinder & Quinlan 2013). The chironomid *Paraborniella tonnoiri* is typically found in rockholes and tolerant to partial desiccation and was found in both Imbin Rockhole and some Katjarra sites.

A number of species were collected exclusively from Mt Forrest spring (site 14). The mayfly *Tasmanocoenis tillyardi* has predominantly been collected from rivers and streams in the south-west of WA, although it is also known from springs (i.e. Nangcarrong Springs and Durba springs) in the Yalgoo and Little Sandy Desert bioregions (Elscot et al. 2009). The gomphid dragonfly *Austroepigomphus (Xerogomphus) gordoni* is quite widespread in the arid zone, but is also largely restricted to springs and river pools (Elscot et al. 2009; Halse et al. 2000; Pinder et al. 2010). The fauna of this site did not include any species known to be associated with groundwater. Also placed away from the main cluster of sites in Fig. 4 was 'Possum Swamp' (site 13), which was the freshest site in the survey (salinity 0.008 gL^{-1}) and had a much higher cover of emergent vegetation than other sites. The hemipteran *Limnogonus fossarum gilguy* was collected from this site and Mt Forrest spring (site 14) during the survey, and is known to occur in a range of habitat types from streams to temporary waterholes, although it is most commonly collected from vegetated water bodies like this one that are still and unshaded (Andersen & Weir 1997). A *Bennelongia* ostracod from the *australis* lineage was collected only from this spring and from site 8 during the survey. This ostracod is part of a poorly resolved species complex and is otherwise known only from a swamp on Thundelarra station in the Yalgoo bioregion (S Halse, pers. comm.). Given the ephemerality of many of the wetlands in this arid region, permanent sources of freshwater such as Mt Forrest spring become important refuge areas for particular taxa.

Several groups of aquatic invertebrates occurred in the main cluster of survey sites in Fig. 4 but were noticeably absent from the four sites discussed above (7, 10, 13 and 14). This included all large branchiopods, of which there were four species of anostracans, five conchostracans and one notostracan. These large branchiopods are specifically adapted to freshwater ephemeral wetlands and many of the species commonly occur in turbid waters (Hancock & Timms 2002), so it is not surprising that this entire group is absent from the rockholes and the spring. The fairy shrimp *Branchinella simplex* is known to be a halobiont and to tolerate salinities of up to 62 g L^{-1} (Timms et al. 2006), so its presence only in the subsaline Lake Moriaty, during this survey, is not surprising. Damselflies from the genus *Austrolestes* and the dragonfly *Diplacodes bipunctata* also occurred in the majority of sites within the main cluster in Fig. 4, but were absent from the four sites above, as are some of the chironomids (*Ablabesmyia notabilis, Tanytarsus* sp. C [*bispinosus*] and *Cryptochironomus griseidorsum*). The odonate *Diplacodes bipunctata* is known from a wide range of habitat types including lakes, swamps, springs, claypans and creek pools throughout the Pilbara and WA arid zone, so although not recorded from the more northern sites on this occasion, it is likely that with additional sampling it would also occur in these wetland types.

Overall, the composition of the aquatic invertebrate fauna revealed in this study, particularly the dominance of crustaceans, reflects the ephemeral nature of the region's wetlands. Many of these aquatic invertebrate groups possess life-history strategies (drought resistant propagules, short-life cycles and bet hedging) or mechanisms of dispersal (wind-blown eggs, phoresy on waterbirds) that enable them to persist in a landscape dominated by ephemerality and unpredictability (Hairston & Cáceres 1996; Brock et al. 2003; Green et al. 2008). Those that are unable to actively disperse, such as crustaceans, persist by producing long-lived diapausing eggs or cysts which remain dormant in the sediment until they receive an appropriate cue to emerge. These dormant propagules remain viable in sediments for years, decades, and for some, over a century (Hairston & Cáceres 1996; Cáceres 1997; Brendonck & De Meester 2003; Brock et al. 2003). Other groups like molluscs exhibit physiological and behavioural adaptations (e.g. burrowing into sediment) for surviving dry conditions (Ponder & Slatyer 2007). Large rainfall events, such as that experienced in January 2014, are quite rare in the Goldfields, but they are likely to be important in maintaining populations of aquatic invertebrates through the renewal of these dormant egg banks, and allowing dispersal across the landscape via floodwaters or movement of waterbirds (Jenkins & Boulton 2003; Green et al. 2008). The frequency and magnitude of these flood events will have shaped aquatic invertebrate composition of Goldfields wetlands via these processes (Boulton & Lloyd 1992; Timms 1996; Jenkins & Boulton 2007).

Novel species and range extensions

The majority of species in the current survey have been collected previously and many have a wide distribution within the state and some Australia-wide. Notable exceptions to this include several aquatic invertebrates that are thought to be new to science. A new species of *Boeckella* copepod was collected from the 'City Beach' claypan (site 11) located on Matuwa. The last new species of *Boeckella* recorded in the Australasian region was *Boeckella timmsi* 17 years ago, collected from a shallow turbid claypan in Queensland (Bayly 1998). This newly discovered species from Matuwa was also collected from a shallow turbid claypan, and, once formally described, would bring the total number of *Boeckella* species known from Australasia to 22.

Five potentially new ostracods were also collected during the survey. These include species of *Ilyocypris*, *Paralimnocythere* and *Cypricercus* from site 9, a species of *Potamocypris* from site 11 and another *Ilyocypris* from site 12. An unusual form of what may be *Repandocypris austinensis* (otherwise known from Lake Austin and also the Lake Carey catchment) was collected from site 5. Other significant ostracod records include an undescribed species of *Strandesia* from site 8, otherwise known only from a rockhole at Katjarra, and *Mytilocypris* n.sp. 'moojari' from Lindsay Gordon Lagoon (site 12), otherwise known only from the Fortescue Marsh in the Pilbara and one other saline wetland south of Newman (Pinder et al. 2010). Other significant records are the ostracod from the *Bennelongia australis* lineage (sites 8 and 13) that is discussed above, the *Reticypris* (sp. 544) ostracod from site 5 (otherwise known from Lake Austin and Lake Lefroy), and a *Heterocypris* ostracod from site 5 that is part of a species complex within the *Heterocypris* sp. 548 lineage (S Halse, pers. comm.). Another important record was the rotifer *Keratella* sp. nov. (aff. *australis*) from 'City Beach' claypan (site 11). This species is currently undescribed, rarely collected, and is currently only known from a few claypans in the Carnarvon Basin and Pilbara. A *Unionicola* water mite collected from site 10 is potentially new.

Branchinella pinderi was discovered during the Pilbara Biological Survey (Pinder et al. 2010) and described by Timms (2008). It was originally collected from a turbid claypan on Minderoo Station just south of Onslow in the Carnarvon bioregion but has now also been recorded from 'Pink Lake' (site 9) and 'City Beach' (site 11), both turbid claypans located on Matuwa, some

1800 km to the south-east. This is a significant extension to its previously known range, and it is possible that it may be present in other similar turbid claypan habitats in the WA arid zone. Similarly, the ostracod *Mytilocypris coolcalalaya* (also collected at sites 9 and 11) was also previously known only from the same claypan on Minderoo Station and two other claypans in the Carnarvon bioregion (Halse et al. 2000).

Arid zone patterning

The ordination involving datasets from multiple arid zone surveys (Fig. 5) suggested that there is significant patterning associated with geography and wetland type across the WA arid zone, although effects of geography and habitat are difficult to distinguish since wetlands habitats are not evenly distributed. In the ordination plot the DIWA survey sites were distributed across a larger area of ordination space than the other surveys, reflecting a larger variation in species assemblages between the wetlands. This is likely a reflection of the wide variety of wetland types sampled over a very large geographic area (Lake Disappointment to the Nullarbor). By contrast, the Lake Gregory, Katjarra and Mandora Marsh sites were all geographically restricted studies and included a more restricted range of wetlands (a single large wetland in the case of Lake Gregory, springs from Mandora Marsh and mostly rockholes and isolated creek pools from Katjarra). The overlap between some of the DIWA and Katjarra sites can be explained by the partial geographic and site overlap of these two surveys. Most of the wetlands sampled in this survey fell between the DIWA and Katjarra surveys and sites from Lake Gregory (Halse et al. 1998). This analysis was fairly conservative as potential taxonomic inconsistencies were dealt with by lumping to at least genus level across the datasets, so regional differences may be greater than this analysis indicates. Nonetheless, these studies had reasonably consistent taxonomic resolution and scope and used the same taxonomic tools and expertise and, if combined with additional data (e.g. from gnammas) and additional sampling, could form the basis of a provisional analysis of aquatic invertebrate biodiversity patterning in the WA arid zone. From this analysis it appears that the wetlands we sampled in 2014 support different species assemblages to WA arid zone wetlands sampled previously, so this survey has significantly improved our understanding of the patterning of aquatic fauna in the WA arid zone.

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Appendix 1

Aquatic invertebrates collected from the Goldfields survey in 2014 (includes 14 survey sites and additional ad-hoc collections).

Major Group	Order	Lowest Identification	Site																						
			GOL01a	GOL01b	GOL02	GO0L3	GOL04	GOL05	GOL06	GOL07	GOL08	GOL09	GOL10	GOL11	GOL12	GOL13	GOL14	ADS28	ADS29	ADS30	ADS31	ADS32	ADS33	ADS34	ADS35
PROTOZOA	Arcellinida	*Arcella discoides*	1	–	1	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Arcellinida	*Arcella hemisphaerica*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Arcellinida	**Arcella* sp.	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Arcellinida	*Centropyxis aculeata*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Arcellinida	**Centropyxis* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Arcellinida	**Difflugia* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Arcellinida	*Difflugia australis*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Arcellinida	*Difflugia* cf. *globulosa*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Arcellinida	*Lesquereusia spiralis*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Euglyphida	*Euglypha* sp.	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–
	Sessilida	*Epistylis* sp.	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
TURBELLARIA	–	Turbellaria	1	–	–	1	–	–	–	–	1	–	1	1	–	1	–	–	–	–	–	–	–	–	–
NEMATODA	–	Nematoda	–	–	–	1	–	–	–	–	–	–	1	1	–	–	1	–	–	–	–	–	–	–	–
ROTIFERA	Bdelloidea	Bdelloidea	–	–	–	1	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Flosculariacea	*Conochilus dossuarius*	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–
	Flosculariacea	*Filinia pejleri*	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Flosculariacea	*Hexarthra intermedia*	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
	Flosculariacea	*Testudinella patina*	1	–	–	1	1	–	1	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–
	Monogononta	*Enteroplea* cf. *lacustris*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Asplanchna sieboldi*	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Anuraeopsis* sp.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Brachionus angularis*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Brachionus lyratus*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Brachionus quadridentatus*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	**Brachionus* sp.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Keratella procurva*	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Keratella tropica*	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Keratella* cf. *quadrata*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Keratella* sp. nov. (aff. *australis*)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Platyias quadricornis*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Dicranophorus epicharis*	–	–	–	–	1	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Dicranophorus halbachi*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Microcodides* cf. *chlaena*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Euchlanis dilatata*	–	–	–	1	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	**Lecane* sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Lecane bulla*	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Lecane ludwigi*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Lecane luna*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Lecane lunaris*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Lecane papuana*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

	Ploimida	*Lecane quadridentata*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Tripleuchlanis plicata*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Ploimida	*Cephalodella* sp.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Polyarthra dolichoptera*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Trichocerca pusilla*	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Trichocerca similis*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Trichocerca* cf. *rattus*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ploimida	*Trichocerca* cf. *similis grandis*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
GASTROPODA	Basommatophora	*Isidorella* sp.	–	–	–	1	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	1
OLIGOCHAETA	Tubificida	*Nais communis*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Tubificida	*Ainudrilus* sp. nr *nharna* (GOL)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Tubificida	Naidinae (ex Naididae)	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
ACARINA	Acariformes	*Hydrachna australica*	–	–	–	–	–	–	1	1	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Acariformes	**Hydrachna* sp.	1	–	–	–	–	–	–	–	–	–	–	–	1		–	–	–	–	–	–	–	–	–
	Acariformes	*Eylais* sp.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Acariformes	*Neumania* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Acariformes	*Unionicola* sp.'GOL10'	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Acariformes	*Acercella falcipes*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Acariformes	*Piona murleyi*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Acariformes	*Arrenurus balladoniensis*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Acariformes	*Oribatida* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Acariformes	Trombidioidea	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Parasitiformes	Mesostigmata	–	–	–	–	–	–	–	1		–	1	–	–	–	–	–	–	–	–	–	–	–	–
CRUSTACEA	Anostraca	*Parartemia contracta*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
	Anostraca	*Parartemia veronicae*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
	Anostraca	*Branchinella occidentalis*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Anostraca	*Branchinella simplex*	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Anostraca	*Branchinella halsei*	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Anostraca	**Branchinella* sp.	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
	Anostraca	*Branchinella pinderi*	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
	Conchostraca	*Caenestheria* sp.	1	1	1	–	1	1	–	–	–	–	–	–	1	–	–	–	–	1	1	1	–	–	–
	Conchostraca	*Caenestheriella packardi*	1	1	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	1	1	1	–	–
	Conchostraca	*Limnadia* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
	Conchostraca	*Limnadopsis tatei*	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conchostraca	*Limnadopsis pilbarensis*	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Conchostraca	*Lynceus* sp.	1	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conchostraca	*Conchostraca (Unident.)	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	1	–	–	–	–	–
	Notostraca	*Triops australiensis australiensis*	1	1	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–
	Cladocera	*Diaphanosoma unguiculatum*	1	–	1	–	1	1	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
	Cladocera	**Diaphanosoma* sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Cladocera	*Latonopsis brehmi*	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Cladocera	*Alona* sp. a (GOL)	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Cladocera	*Alona* sp. b (GOL)	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Cladocera	*Alona rigidicaudis*	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Cladocera	*Alona cf. guttata*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Cladocera	*Coronatella* sp.	1	–	1	–	1	–	1	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Cladocera	*Ephemeroporus barroisi* s.l.	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–

Cladocera	*Armatalona macrocopa*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Cladocera	*Maraura macracantha*	–	–	1	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cladocera	*Miralona victoriensis*	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–
Cladocera	*Ceriodaphnia* sp.	–	–	–	–	–	–	–	1	–	–	1	1	–	–	1	–	–	–	–	–	–	–	–
Cladocera	**Daphnia* sp.	–	–	–	–	–	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Cladocera	*Daphnia carinata*	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cladocera	*Daphnia cephalata*	1	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cladocera	*Daphnia projecta*	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–
Cladocera	*Ilyocryptus* sp.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cladocera	*Macrothrix breviseta*	–	–	1	–	–	1	1	–	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–
Cladocera	*Macrothrix capensis*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Cladocera	**Macrothrix* sp.	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cladocera	*Moina micrura* s.l.	–	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Paralimnocythere* sp. ‘GOL09’	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	**Ilyocypris* sp.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Ilyocypris* sp.’GOL09’	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Ilyocypris* sp.’GOL12’	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Ostracoda	**Bennelongia* sp.	1	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Bennelongia* sp. ‘triangulata’	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Bennelongia australis* lineage (‘Thundelarra form’)	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Ostracoda	*Cyprinotus cingalensis*	1	–	1	–	1	1	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Cypretta* sp.	–	–	–	1	–	–	–	1	–	1	1	–	–	1	–	–	–	–	–	–	–	–	–
Ostracoda	*Heterocypris* sp. 548 lineage	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Mytilocypris coolcalalaya*	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Mytilocypris* nsp ‘moojari’	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Reticypris* sp. 544	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Ilyodromus* sp.	–	–	1	1	–	–	–	–	–	–	1	–	–	1	1	–	–	–	–	–	–	–	–
Ostracoda	*Cypricercus salinus*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	**Cypricercus* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Ostracoda	*Cypricercus* sp. 415 ‘humped’	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Strandesia* sp. 1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Cypricercus* sp.’GOL09’	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Stenocypris* sp.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Repandocypris austinensis*	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Sarscypridopsis aculeata*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Potamocypris* sp.’GOL11’	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Newnhamia* sp.	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Ostracoda	*Ostracoda (Unident.)	1	–	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–
Copepoda	*Boeckella triarticulata*	1	–	1	1	1	1	1	–	1		1	–	1	–	–	–	–	–	–	–	–	–	–
Copepoda	*Boeckella* n.sp. (Goldfields)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Copepoda	*Calamoecia ampulla*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Copepoda	*Calamoecia halsei*	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Copepoda	*Calamoecia baylyi*	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Copepoda	*Calamoecia ampulla* var P1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Copepoda	*Microcyclops varicans*	1	–	1	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Copepoda	*Metacyclops* sp. 442	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–

	Copepoda	*Australocyclops australis*	1	–	1	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Copepoda	*Mesocyclops brooksi*	1	–	1	1	1	1	1	1	1	–	1	–	1	1	1	–	–	–	–	–	–	–	–
	Copepoda	**Mesocyclops* sp.	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Copepoda	*Apocyclops dengizicus*	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
INSECTA	Coleoptera	*Haliplus gibbus*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	**Haliplus* sp.	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	Haliplidae	–	–	1	–	–	–	–	–	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–
	Coleoptera	*Laccophilus* sp.	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Coleoptera	*Hyphydrus elegans*	–	–	1	1	1	1	1	1	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–
	Coleoptera	*Hyphydrus lyratus*	–	–	–	–	–	–	–	1	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–
	Coleoptera	**Hyphydrus* sp.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Hydroglyphus trilineatus*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Hydroglyphus* sp.	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Limbodessus* sp.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Allodessus bistrigatus*	1	–	1	1	1	1	1	–	1	1	1	–	1	1	1	–	–	–	–	–	1	–	–
	Coleoptera	*Antiporus gilberti*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	**Antiporus* sp.	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Sternopriscus multimaculatus*	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	**Sternopriscus* sp.	1	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Necterosoma wollastoni*	–	–	–	–	–	–	–	1		–	1	–	–	–	1	–	–	–	–	–	–	–	–
	Coleoptera	*Necterosoma regulare*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Coleoptera	**Necterosoma* sp.	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Megaporus howittii*	–	–	1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Rhantus suturalis*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Eretes australis*	–	–	–	–	–	–	–	–	–	1	–	1	–	–	1	–	–	1	1	–	–	–	–
	Coleoptera	*Rhantaticus congestus*	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Onychohydrus* sp.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Cybister tripunctatus*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
	Coleoptera	*Dineutus australis*	–	–	–	–	–	–	–	–	–	–	1	–	1	1	1	–	–	–	–	–	–	–	–
	Coleoptera	*Berosus approximans*	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Berosus dallasae*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Coleoptera	*Berosus macumbensis*	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Berosus munitipennis*	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
	Coleoptera	*Berosus nutans*	–	–	–	–	1	–	–	–	1	–	–	–	1	1	–	–	–	–	1	–	1	–	1
	Coleoptera	*Enochrus elongatulus*	1	–	1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
	Coleoptera	**Enochrus* sp.	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Hydrophilus brevispina*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Coleoptera	*Sternolophus immarginatus*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Coleoptera	*Hydrophilidae	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Coleoptera	*Hydraena* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Diptera	*Anopheles* (*Cellia*) *annulipes s.l.*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
	Diptera	*Anopheles* (*Cellia*) sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–
	Diptera	*Culex (Culex) crinicauda*	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Diptera	*Culex* sp.	–	–	–	–	–	–	–	1	–	–	1	–	–	1	1	–	–	–	–	–	–	–	–
	Diptera	*Bezzia* sp. 2	1	–	1	–	–	–	–	–	1	–	–	–	–	1	1	–	–	–	–	–	–	–	–
	Diptera	*Bezzia* sp. 1	1	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
	Diptera	*Culicoides* sp.	1	–	1	1	1	1	1	1	1	–	–	–	1	1	1	–	–	–	–	–	–	–	–

Diptera	*Monohelea* sp. 1	–	–	1	–	–	1	1	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Nilobezzia* sp.	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Nilobezzia* sp. 1	–	–	–	–	1	1	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	Dasyheleinae	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	*Psychodinae* sp. 3	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	Tabanidae	–	–	–	–	–	–	–	1	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	Stratiomyidae	1	–	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	*Coelopynia pruinosa*	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Procladius paludicola*	1	–	1	1	1	1	1	1	1	–	–	–	1	–	1	–	–	–	–	–	–	–	–
Diptera	*Procladius villosimanus*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Procladius* DEC sp. P1	–	–	–	–	–	1	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Ablabesmyia notabilis*	1	–	1	–	1	1	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Diptera	*Paramerina levidensis*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	*Larsia albiceps*	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–
Diptera	*Paralimnophyes pullulus (V42)*	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Cricotopus albitarsus*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Orthocladiinae	–	–	–	1	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Tanytarsus fuscithorax*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Tanytarsus sp. C (bispinosus)*	1	–	–	–	1	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Tanytarsus sp. H*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Tanytarsus fuscithorax/semibarbitarsus*	–	–	–	–	–	1	1	–	1	–	–	–	1	1	1	–	–	–	–	–	–	–	–
Diptera	*Chironomus tepperi*	1	–	–	–	1	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Diptera	*Chironomus aff. alternans (V24)*	1	–	1	–	–	–	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Diptera	*Dicrotendipes* 'CA1' Pilbara type 2	–	–	1	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Diptera	*Dicrotendipes* 'CA1' Pilbara type 1	–	–	–	–	1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Kiefferulus intertinctus*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Polypedilum leei*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	*Polypedilum nubifer*	1	–	1	–	1	–	1	–	1	–	–	–	1	–	1	–	–	–	–	–	–	–	–
Diptera	*Polypedilum watsoni*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Diptera	**Polypedilum* sp.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Paraborniella tonnoiri*	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Cryptochironomus griseidorsum*	1	–	–	–	1	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Diptera	*Paracladopelma M3*	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Parachironomus 'K2'*	1	–	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera	*Chironomini genus K2 sp. 1*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Ephemeroptera	*Cloeon* sp.	–	–	1	1	1	–	1	–	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Ephemeroptera	*Baetidae	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ephemeroptera	*Tasmanocoenis tillyardi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Hemiptera	*Microvelia (Pacificovelia) oceanica*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Hemiptera	*Microvelia (Austromicrovelia) peramoena*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Hemiptera	**Microvelia* sp.	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hemiptera	*Veliidae	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Hemiptera	*Limnogonus fossarum gilguy*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–
Hemiptera	*Agraptocorixa parvipunctata*	1	–	1	1	1	–	1	1	1	–	1	–	1	1	1	–	–	–	–	1	–	–	–
Hemiptera	*Micronecta robusta*	1	–	1	–	1	–	1	–	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–
Hemiptera	*Micronecta gracilis*	1	–	1	1	1	1	1	1	1	–	1	–	1	1	–	–	–	–	–	1	–	–	–
Hemiptera	**Micronecta* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–

Hemiptera	*Anisops thienemanni*	–	–	–	1	1	1	1	–	1	–	–	–	1	1	1	–	–	–	–	–	–	–	–
Hemiptera	*Anisops hyperion*	1	–	1	1	1	–	1	–	–	1	1	–	–	–	1	–	–	–	–	–	–	–	–
Hemiptera	*Anisops gratus*	–	–	–	–	1	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Hemiptera	*Anisops hackeri*	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Hemiptera	*Anisops nasutus*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Hemiptera	*Anisops occipitalis*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Hemiptera	*Anisops stali*	–	–	1	1	–	–	1	–	–	–	1	–	1	–	1	–	–	–	–	–	–	–	–
Hemiptera	**Anisops* sp.	–	–	–	–	–	–	–	1	1	1	–	1	1	–	–	–	–	–	1	1	–	–	–
Odonata	*Ischnura* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Odonata	*Xanthagrion erythroneurum*	–	–	–	1	–	–	1	–	1	–	1	–	–	1	1	–	–	–	–	–	–	–	–
Odonata	*Coenagrionidae	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Odonata	*Austrolestes analis*	1	–	–	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Odonata	*Austrolestes annulosus*	1	–	1	1	1	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Odonata	*Austrolestes io*	1	–	1	1	1	1	1	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Odonata	*Hemianax papuensis*	1	–	1	1	–	1	1	–	1	–	–	–	1	1	1	–	–	–	–	–	–	–	–
Odonata	*Austroepigomphus (Xerogomphus) gordoni*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Odonata	*Diplacodes bipunctata*	–	–	1	1	–	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Odonata	*Diplacodes haematodes*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
Odonata	*Orthetrum caledonicum*	–	–	1	–	–	1	1	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Odonata	*Pantala flavescens*	–	–	1	1	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Odonata	*Libellulidae	–	–	–	–	–	–	–	1	–	–	1	–	1	1	–	–	–	–	–	–	–	–	–
Odonata	*Hemicordulia tau*	1	–	1	–	1	1	1	1	1	–	1	–	1	1	1	–	–	–	–	–	–	–	–
Trichoptera	*Ecnomus* sp.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Trichoptera	*Notalina spira*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Trichoptera	*Oecetis* sp.	–	–	–	–	1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Trichoptera	*Triplectides australis*	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Trichoptera	**Triplectides* sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Trichoptera	*Leptoceridae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–

* denotes specimens unable to be identified to lowest taxonomic level due to immaturity or sex. '1' denotes presence at a site and '–' denotes absence.
GOL01a refers to Rowles Lagoon sampled on 10 March 2014 and GOL01b refers to additional ad-hoc collection on 13 February 2014