Biodiversity and Conservation Science

Aquatic invertebrate survey of Kurriji Pa Yajula Nature Reserve and adjacent soaks on Karajarri Indigenous Protected Area, Great Sandy Desert

September 2022

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Ecosystem Science Program, DBCA

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GOVERNMENT OF WESTERN AUSTRALIA

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This document is available in alternative formats on request.

Cover image. Dragon Tree Soak. Photograph by Matt Macdonald

Contents

1 Background

Kurrji Pa Yajula (formerly Dragon Tree Soak) Nature Reserve comprises an isolated desert spring complex, listed as a Threatened Ecological Community (Endangered), in the Great Sandy Desert approximately 250km SSE of Broome. It is fed by discharge from Canning Basin groundwater but the hydrological processes supporting the springs are poorly understood. Knowledge of biological values are limited due to its isolation and has rarely been visited by scientists and in recent times, even by traditional owners.

In September 2018, staff from the Department of Biodiversity, Conservation and Attractions (DBCA) West Kimberley District and Karajarri traditional owners and Indigenous Protected Area (IPA) rangers undertook an aquatic invertebrate survey of three wetlands in the area (Pinder *et al.* 2020). Prior to this study the only other comprehensive biological study was by Graham-Taylor and Bamford (1996), who reported on a varies biological aspects of the reserve and the springs but did not sample aquatic invertebrates. They did report some water chemistry values for Dragon Tree Soak and Elizabeth Soak and some other wetlands.

To increase knowledge of the area, further survey work for aquatic invertebrates and flora was undertaken in September 2022 by DBCA staff and Karajarri IPA rangers. The aim of the invertebrate survey was to re-sample the sites previously sampled in 2018 (Figure 1). However, water levels in 2022 were too low in Elizabeth Soak (small puddle approximately 1 m in diameter) and Slimy Soak (dry) to sample. Depth in Dragon Tree Soak was lower than in 2018 but the wetland was deep enough to sample (Figure 2). Sampling of another wetland on Karajarri IPA, informally called Mini Soak herein, (Figure 3), was undertaken on the same day as Dragon Tree Soak.

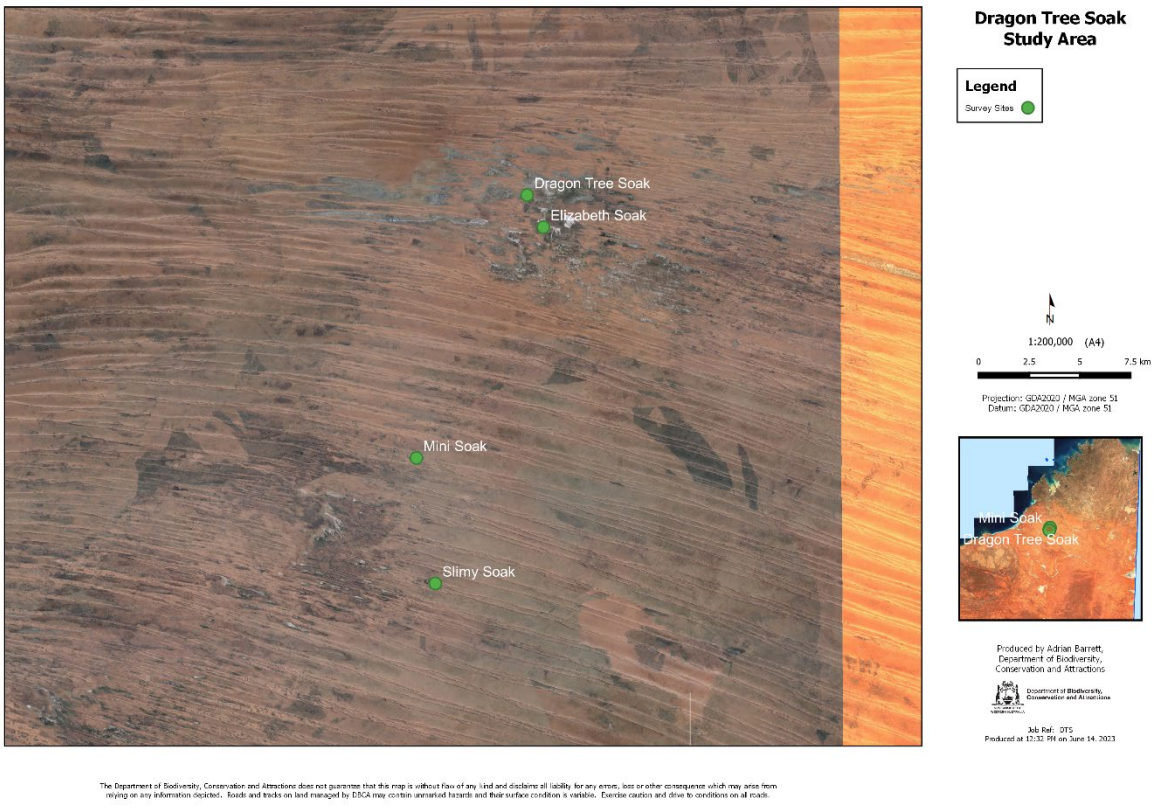

Figure 1. Aquatic invertebrate sampling sites, 2018 and 2022

Figure 2. Dragon Tree Soak, 2018 (left) (photo Nicole Godfrey) and 2022 (right) (photo Matt Macdonald)

Figure 3. Mini Soak (photo Matt Macdonald)

2 Methods

All field work was undertaken by Biodiversity Conservation Science staff Adrian Barrett and West Kimberley District staff Nathan Hunter.

Dragon Tree Soak and Mini Soak were sampled for water chemistry and aquatic invertebrates on 10th September 2022 (Table 1). Dragon Tree Soak is a permanent spring, with emergent and fringing *Typha* (*Typha domingensis*) and scattered Dragon Trees (*Sesbania formosa*) surrounded by mixed grasses. It had a fine black silty clay substrate with much organic matter (Figure 4). Mini Soak is likely an ephemeral soak and was situated in a swale between sand dunes. It was generally devoid of emergent or fringing vegetation except for a small patch of *Typha* on the south-eastern end. There was a barren margin around the wetland which abruptly met adjacent shrubland (Figure 5). It had a shallow layer of silt and clay over a sandy substrate and had little organic matter.

Table 1. Sample sites

Site name	Site code	Latitude	Longitude
Dragon Tree Soak	DTS001	19.669126°S	123.363116°E
Mini Soak	DTS004	19.786550°S	123.310685°E

Figure 4. Dragon Tree Soak (photo Adrian Barrett)

Figure 5. Mini Soak (photo Adrian Barrett)

2.1 Water chemistry

At each site, in-situ sampling for pH and conductivity were undertaken using a YSI handheld meter. Unfiltered water samples were collected for analysis of conductivity, total nutrients, ionic composition, turbidity, alkalinity, heavy metals and total dissolved solids (TDS: gravimetric). Water was filtered in the field through glass fibre filter paper in situ to capture Chlorophyll-a for laboratory analysis (100ml for Dragon Tree Soak and 190 ml for Mini Soak). The filtered water was then further filtered through 0.45 µm paper for nitrate-N, nitrite-N, NOx-N, ammonia-N and filterable nutrients in the laboratory.

2.2 Invertebrates

Two samples were collected at each site, these were a 'plankton' sample using a net with 50 µm mesh and a 'benthic' sample using a 250 µm mesh net. The plankton sample collected invertebrates from the water column and submerged plants without touching the sediment. The benthic sample involved stirring up the wetland bed and submerged and emergent vegetation and sweeping through the stirred-up material. Each sample (plankton and benthic) incorporates a number of "sweeps" depending on the size of the site. The standard for DBCA sampling is 50 x 1 metre sweeps but lower where the wetland is small and taking 50 sweeps would create too much disturbance. In Dragon Tree Soak 35 sweeps of plankton and benthic were taken, and in Mini Soak 50 sweeps were taken. Samples were preserved in 100% ethanol and returned to the Ecosystem Science Program lab for identification to the lowest taxonomic level. Protozoa and Rotifera were not identified from samples for the 2022 survey and have been excluded from results for comparison purposes.

3 Results and discussion

3.1 Water chemistry

Water chemistry data from 2018 and 2022 are presented in Table 2 and original laboratory results in Appendices 1 and 2. Laboratory measurement of pH at Dragon Tree Soak was 7.9 compared to 7.6 measured in situ. Both results were lower than field measured pH from 2018 (8.35). In Mini Soak, the water was alkaline with a pH of 9.6 from both laboratory analysis and in-situ measurement. Alkalinity was much higher in Mini Soak (1700 mg/L) than in Dragon Tree Soak. In this respect Mini Soak is similar to Slimy Soak which had pH 10.45 and alkalinity 1660 mg/L in 2018.

In 2022 Dragon Tree Soak was the fresher of the two sites, with conductivity 2800 uS/cm and total dissolved solids 1600 mg/L, similar to when it was sampled in 2018 (2900 uS/cm). Mini Soak had conductivity 7600 uS/cm and total dissolved solids 4200 mg/L. In 2022, salinity in Dragon Tree Soak was dominated by sodium (74.4% of cation millequivalence[1]) and chloride (70.6% of anion millequivalence). Sodium was also the dominated cation in Mini Soak (72%) but carbonate dominated anion composition (54.8%), as was the case for Slimy Soak in 2018. Mini Soak had very little calcium and magnesium compared to Dragon Tree Soak. While the pH and alkalinity align, the ionic composition should be used with caution as the laboratory analyses of cations and anions do not balance[2].

[1] Milliequivalence is a way of expressing ionic concentration that accounts for molar weight and valency charge and allows the concentrations of different ions to be compared in a way that reflects solute chemistry.

[2] In all natural water samples anions (-ve charge) and cations (+ve charge) should balance each other out (when ionic concentration is converted to milliequivalence). Where this is not the case there are likely problems with

Mini Soak and Slimy Soak are located to the south of Dragon Tree Soak and Elizabeth Soak and water chemistry suggests they are fed by a different hydrological system.

Table 2. Water quality data for four sites sampled in 2018 and/or 2022.

	Limits of Reporting 2018	Limits of Reporting 2022	Units	Dragon Tree Soak DTS001 7/9/2018	Dragon Tree Soak DTS001 9/10/2022	Slimy Soak DTS002 8/9/2018	Elizabeth Soak DTS003 8/9/2018	Mini Spring DTS004 9/10/2022
Field measurements								
pH				8.35	7.6	10.45	7.64	9.6
Temperature			°C	-	23.8	22.3	19.9	26.9
Conductivity			µS/cm	2900	2620	5190	1994	7532
Turbidity			NTU		25.9			13.05
Maximum depth			cm	40	30	60	60	60
Maximum invertebrate sampling depth			cm	30	30	40	30	60
Laboratory analyses								
Colour	1	5	TCU	160	290	2800	190	47
Turbidity	0.5	0.1	NTU	10	6.2	98	3	7.7
Gravimetric total dissolved solids	10	5	mg/L	1700	1600	3200	1100	4200
Total suspended solids		5	mg/L		43			18
Conductivity		10	µS/cm		2800			7600
Total organic carbon		1	mg/L		31			94
pH		0.1			7.9			9.6
Ionic composiion								
Alkalinity	1	5	mg/L	275	260	1660	182	1700
Hardness	1	5	mg/L	220	170	37	160	11
Carbonate	1	5	mg/L	<1	<5	691	<1	1200
Calcium	0.1	0.5	mg/L	40.2	33	12.9	32.1	3.9
Chloride	1	5	mg/L	722	610	798	457	1200
Bicarbonate	1	5	mg/L	335	260	614	222	520
Sodium	0.1	0.5	mg/L	538	440	1010	340	1500
Sulphate	1	1	mg/L	270	200	<1	140	400
Hydroxide		5	mg/L		<5			<5
Potassium	0.1	0.5	mg/L	72.3	59	295	43.9	290
Magnesium	0.1	0.5	mg/L	29.9	25	1.1	18.8	1.4
Nutrients								
Nitrogen - total	0.01	0.2	mg/L	3.7	3.8	79	2.9	5
Nitrogen - total (filtered)		0.2	mg/L		1.5			3.1
Ammonia-N		0.02	mg/L		<0.02			<0.02
Nitrate-N		0.01	mg/L		<0.01			<0.01
Nitrite-N		0.01	mg/L		<0.01			<0.01
NOx-N		0.01	mg/L		<0.01			<0.01
Total Kjeldahl-N		0.2	mg/L		3.8			5
Chlorophyll-a		0.001	mg/L		0.17			0.064
Phosphorus - total	0.005	0.01	mg/L	0.37	0.66	4.3	0.18	0.66
Phosphorus - total (filtered)		0.01	mg/L		0.45			0.61
Filterable reactive phosphorus		0.01	mg/L		0.1			0.28
% Milliequivalent ionic concentrations								
Sodium			%	78.7	74.4	84.1	77.6	72
Calcium			%	6.7	6.4	1.2	8.4	0.2
Magnesium			%	8.3	8	0.2	8.1	0.1
Potassium			%	6.2	5.9	14.5	5.9	8.2
Chloride			%	64.7	70.6	40.5	66.3	46.4
Sulphate			%	17.8	17.1	0.0	15.0	11.4
Bicarbonate			%	17.5	17.5	18.1	18.7	11.7
Carbonate			%	0.0	0.3	41.4	0.0	54.8
Ionic balance			%	-2.9	-2.7	-3.1	-1	-10.8
Heavy metals								
Arsenic (filtered)		0.001	mg/L		< 0.001			0.12
Cadmium (filtered)		0.0001	mg/L		< 0.0001			< 0.0001
Chromium (filtered)		0.001	mg/L		< 0.001			< 0.001
Copper (filtered)		0.001	mg/L		0.004			0.002
Lead (filtered)		0.001	mg/L		< 0.001			< 0.001
Magnesium		0.5	mg/L		25			1.4
Mercury (filtered)		0.0001	mg/L		< 0.0001			< 0.0001
Nickel (filtered)		0.001	mg/L		< 0.001			< 0.001
Zinc (filtered)		0.005	mg/L		0.022			0.006

Both sites had clear water. Field measured turbidity for Dragon Tree Soak and Mini Soak was 25.9 and 13 NTU respectively, somewhat higher than measured in the lab (6.2 and 7.7 NTU respectively). These are similar values to turbidity at Dragon Tree Soak (10 NTU) and Elizabeth Soak (3 NTU) in 2018. By contrast, Slimy Soak was moderately turbid (98 NTU) in 2018. Water in Dragon Tree Soak was markedly more coloured compared to Mini Soak (290

the analysis or in storage of the water samples prior to analysis. In the case of Mini Soak there was 10% greater +ve charge in the results.

and 47 PCU[3] respectively) and darker than in 2018 (160) but much lower than recorded for Slimy Soak in 2018 (2800). Chlorophyll-a in Dragon Tree Soak was also higher than in Mini Soak (0.17 and 0.064 mg/L respectively). Chlorophyll-a could not be compared between years because it was not collected in 2018.

The two sites sampled in 2022 had similar nutrient concentrations. Both had the same total phosphorus (0.66 mg/L) but filterable reactive phosphorus was nearly three times higher in Mini Soak than in Dragon Tree Soak (0.28 and 0.1 mg/L respectively). This suggests more of the Dragon Tree Soak phosphorus was bound to suspended particulates and algae, which aligns with the higher chlorophyll-a for Dragon Tree Soak. Total nitrogen was lower in Dragon Tree Soak than in Mini Soak (3.8 and 5.0 mg/L respectively). With all detectable nitrogen being Kjeldahl[4] and ammonia being below the detectable limit, nitrogen in both sites was presumably mostly organic, much of it unfilterable in both sites indicating nitrogen in particulates and/or algae. Nutrient concentrations are not considered high for 'tropical Australia (ANZECC and ARMCANZ 2000), noting that arid zone data were not used to derive guideline values. Total nitrogen within Dragon Tree Soak was similar in 2018 and 2022 (3.7 and 3.8 mg/L respectively), while total phosphorus was lower in Dragon Tree Soak in 2018 than in 2022 (0.37 and 0.66 mg/L respectively).

Heavy metals in both sites in 2022 were generally non-detectable, with the exception of arsenic and zinc. Arsenic was non-detectable in Dragon Tree Soak (<0.001 mg/L) but was 0.12 mg/L in Mini Soak. Zinc was minimal in Mini Soak but was 0.022 mg/L in Dragon Tree Soak. Arsenic in Mini Soak and Zinc in Dragon Tree Soak were above concentrations estimated to cause acute toxicity to 10% of aquatic species (ANZECC and ARMCANZ 2000) but given the isolation of the site the concentrations are undoubtedly natural and derived from hydrogeological sources. Heavy metals were not analyzed in 2018.

3.2 Invertebrates

Species data from 2018 and 2022 surveys are presented in Appendix 3. Fifty taxa were recorded across the two sites in 2022, of which 80% (40) were identified to species level. This brings the total number of taxa recorded across all five sites from 2018 and 2022 to 102, with 74% (75) identified to species. In 2022, Dragon Tree Soak with 43 taxa was far more diverse than Mini Soak with 16 taxa. Fly larvae (Diptera) and water bugs (Hemiptera) were the most speciose groups with 13 taxa each and beetles (Coleoptera) had 10. The two sites had eight taxa in common (15%) which were generally widespread and adaptable species such as the damselfly *Xanthagrion erythroneurum,* dragonfly *Orthetrum caledonicum*, and chironomids *Kiefferulus intertinctus* and *Procladius paludicola.* Dragon Tree Soak had a rich diversity (eight species) of predatory diving beetles (Dytiscidae) while Mini Soak had one species (Appendix 3). No water bug (Hemiptera) species were common to both sites. Earthworms (Oligochaeta), seed shrimps (Ostracoda) and caddisflies (Trichoptera) were found in Dragon Tree Soak but were absent from Mini Soak.

For comparison of diversity across the 2018 and 2022 sampling, rotifers and protozoans are excluded since these were not identified in 2022. Dragon Tree Soak had slightly more taxa in 2022 compared to 2018 (Pinder *et al*. 2020; 43 and 39 respectively). In 2022, greater diversity was recorded in predatory diving beetles (Dytiscidae; eight in 2022 and four in 2018), earthworms (Oligochaeta; five in 2022 and two in 2018) and non-biting midges (Chironomidae:

[3] PCU is the same as TCU used in Pinder et al. (2020).

[4] Kjeldahl nitrogen measures nitrogen in organic forms and ammonia.

eight in 2022 and four in 2018), while diversity in scavenging beetles (Hydrophilidae) decreased (one in 2022 and five in 2018). Sixteen taxa recorded at Dragon Tree Soak in 2018 were rerecorded in 2022 (counting *Tanytarsus fuscithorax/semibarbitarsus* and *T. semibarbitarsus* as one species but excluding one genus and one family not identified to species level) equating to 39% overlap in composition.

Of the four sites now sampled, Mini Soak and Slimy Soak had lowest species richness (16 and 19 respectively), reflecting their brackish, highly alkaline, and, in the case of Slimy Soak, more turbid, water. The more benign water chemistry in Dragon Tree Soak and Elizabeth Soak accommodates fringing vegetation, including semi-aquatic species, taller shrubs and grasses and the substrate contains organic material, all of which provides habitat for a broader suite of aquatic fauna: Dragon Tree Soak with 39 and 43 species in 2018 and 2022 and Elizabeth Soak with 46 species in 2018.

As noted by Pinder *et al.* (2020) the fauna of these desert springs has strong affinities with northern Australian aquatic faunas and with faunas of Pilbara springs and river pools in particular, but also includes many species with very widespread distributions which is also typical of desert wetlands. Pinder *et al.* (2020) also noted that some groups with weak dispersal abilities were depauperate or absent in these springs. These include caddisflies (*Oecetis* at one site in 2018, none in 2022), molluscs (absent entirely) and cladocerans (one species in 2018, none in 2022). Oligochaetes (aquatic earthworms) were also noted to be depauperate in 2018 (two species) but four additional species were recorded from Dragon Tree Soak in 2022.

Of the 53 taxa recorded in 2022, notable species were *Tanypus* sp. K1 recorded in Dragon Tree Soak and *Tanytarsus* sp. G recorded in Mini Soak. *Tanypus* sp. K1 is associated with Kimberley mound springs, but also Lake Eda in the south-west Kimberley, and further strengthens the connection between isolated springs in northwestern Australia. *Tanypus* is not well studied in Australia but there are sparse records of the genus from across northern Australia. *Tanytarsus* sp. G is closely associated with springs in the Pilbara region but also inhabits river pools (most if not all groundwater fed) and occurs further south including springs in the northern Wheatbelt and a single wetland in the central Wheatbelt whose hydrology is uncertain.

4 References

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. ANZECC and ARMCANZ, Canberra.

Graham-Taylor C. and Bamford M.J. eds (1996). *The Discovery Project 1996.*

Pinder A, Lewis L, Shiel, R. 2020. *Aquatic invertebrates of three wetlands in the Great Sandy Desert sampled in September 2018*, Department of Biodiversity, Conservation and Attractions, Perth.

5 Appendices

Appendix 1. Water chemistry data from Eurofins ARL 2022.

eurofins | ARL

Certificate of Analysis

Rivers and Estuaries Science
17 Dick Perry Avenue
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Site Number 2370

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Attention: **Adrian Barrett**

Report **924241-W**
Project name DRAGON TREE SOAK
Received Date Sep 15, 2022

Client Sample ID			**Dragon Tree Soak**	**Mini Soak**
Sample Matrix			**Water**	**Water**
Eurofins Sample No.			**L22-Se0037092**	**L22-Se0037093**
Date Sampled			**Sep 10, 2022**	**Sep 10, 2022**
Test/Reference	LOR	Unit		
Alkalinity	5	mg CaCO3/L	260	1700
Ammonia-N	0.02	mg/L	< 0.02	< 0.02
Bicarbonate	5	mg CaCO3/L	260	520
Carbonate	5	mg CaCO3/L	< 5	1200
Chloride	5	mg/L	610	1200
Chlorophyll-a	0.001	mg/L	0.17	0.064
Colour	5	PCU	290	47
Conductivity	10	uS/cm	2800	7600
Filterable Reactive Phosphorus	0.01	mg/L	0.10	0.28
Hydroxide	5	mg CaCO3/L	< 5	< 5
Nitrate-N	0.01	mg/L	< 0.01	< 0.01
Nitrite-N	0.01	mg/L	< 0.01	< 0.01
NOx-N	0.01	mg/L	< 0.01	< 0.01
pH	0.1	pH Units	7.9	9.6
Sulfate	1	mg/L	200	400
Total Dissolved Solids	5	mg/L	1600	4200
Total Kjeldahl Nitrogen	0.2	mg/L	3.8	5.0
Total Nitrogen	0.2	mg/L	3.8	5.0
Total Nitrogen (Filtered)	0.2	mg/L	1.5	3.1
Total Phosphorus	0.01	mg/L	0.66	0.66
Total Phosphorus (filtered)	0.01	mg/L	0.45	0.61
Total Suspended Solids	5	mg/L	43	18
Turbidity	0.1	NTU	6.2	7.7
Hardness mg equivalent CaCO3/L	5	mg/L	170	11
Total Organic Carbon	1	mg/L	31	94
Heavy Metals				
Magnesium	0.5	mg/L	25	1.4
Alkali Metals				
Calcium	0.5	mg/L	33	3.9
Potassium	0.5	mg/L	59	290
Sodium	0.5	mg/L	440	1500
Heavy Metals				
Arsenic (filtered)	0.001	mg/L	< 0.001	0.12
Cadmium (filtered)	0.0001	mg/L	< 0.0001	< 0.0001
Chromium (filtered)	0.001	mg/L	< 0.001	< 0.001
Copper (filtered)	0.001	mg/L	0.004	0.002

eurofins | ARL

Client Sample ID			Dragon Tree Soak	Mini Soak
Sample Matrix			Water	Water
Eurofins Sample No.			L22-Se0037092	L22-Se0037093
Date Sampled			Sep 10, 2022	Sep 10, 2022
Test/Reference	LOR	Unit		
Heavy Metals				
Lead (filtered)	0.001	mg/L	< 0.001	< 0.001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001
Nickel (filtered)	0.001	mg/L	< 0.001	< 0.001
Zinc (filtered)	0.005	mg/L	0.022	0.006

Appendix 2. Water chemistry data from ChemCentre of WA 2018.

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ChemCentre Reference: 18S1657 R0

Dept. of Biodiversity, Conservation & Attractions
Locked Bag 104
Bentley Delivery Centre WA 6983

Attention: Adrian Pinder

Report on: 3 samples received on 24/10/2018

LAB ID	Material	Client ID and Description
18S1657 / 001	water	Site 1. Dragon Tree Soak
18S1657 / 002	water	Site 2. Slimy Tree Soak
18S1657 / 003	water	Site 3. Elizabeth Soak

LAB ID			001	002	003
Client ID			Site 1. Dragon Tree Soak	Site 2. Slimy Tree Soak	Site 3. Elizabeth Soak
Sampled			07/09/2018	08/09/2018	08/09/2018
Analyte	Method	Unit			
Alkalinity as CaCO3	iALK1WATI	mg/L	275	1660	182
Bicarbonate	iALK1WATI	mg/L	335	614	222
Calcium	iMET1WCICP	mg/L	40.2	12.9	32.1
Carbonate	iALK1WATI	mg/L	<1	691	<1
Chloride	iCO1WCDA	mg/L	722	798	457
Colour, TCU	iCOL1WACO	TCU	160	2800	190
Hardness, total	iHTOT2WACA	mg/L	220	37	160
Magnesium	iMET1WCICP	mg/L	29.9	1.1	18.8
Nitrogen, total	iNP1WTFIA	mg/L	3.7	79	2.9
Phosphorus, total	iPP1WTFIA	mg/L	0.37	4.3	0.18
Potassium	iMET1WCICP	mg/L	72.3	295	43.9
Sodium	iMET1WCICP	mg/L	538	1010	340
Sulphate	iCO1WCDA	mg/L	270	<1	140
Total dissolved solids(grav)	iSOL1WDGR	mg/L	1700	3200	1100
Turbidity	iTURB1WCZZ	NTU	10	98	3.0

Method	Method Description
iALK1WATI	Alkalinity (as CaCO3) and constituents by acid titration.
iCO1WCDA	Colourimetric analysis by DA (Discrete Autoanalyser).
iCOL1WACO	Colour by spectrometry.
iHTOT2WACA	Total Hardness as mg/L CaCO3 by calculation from calcium and magnesium.
iMET1WCICP	Total dissolved metals by ICPAES.
iNP1WTFIA	Total Nitrogen by persulphate digestion and analysis by FIA.
iPP1WTFIA	Total Phosphorus by persulphate digestion and FIA.
iSOL1WDGR	Total dissolved solids (TDS) by gravimetry, dried at 178 - 182 C.
iTURB1WCZZ	Turbidity of water by Nephelometer.

Appendix 3. Invertebrate species data from 2018 and 2022.

				Site							
				Dragon Tree Soak			Mini Soak	Elizabeth Soak		Slimy Soak	
				2018		2022	2022	2018		2018	
Group	**Family**	**Species**	**Distribution**	**Benthic**	**Plankton**	**Benthic and plankton**	**Benthic and plankton**	**Benthic**	**Plankton**	**Benthic**	**Plankton**
Flatworms (Turbellaria)		Unidentified							1		
Earthworms (Oligochaeta)	Naididae	*Allonais inaequalis*				1					
		Allonais ranauana	widespread	1	1	1		1	1		
		Dero furcatus				1					
		Dero nivea				1					
		Pristina leidyi	widespread			1					
		Pristina longiseta	widespread	1				1	1		
		Unidentified							1		
Mites (Acarina)	Arrenuridae	*Arrenurus (Micruracarus)* sp. 29	north-west endemic - springs					1			
	Eylaidae	*Eylais* sp.					1	1			
	Hydrachnidae	*Hydrachna* nr *approximata*				1					
	Hydrodromidae	*Hydrodroma* sp.				1					
	Pionidae	Unidentified		1							
	Unionicolidae	*Neumania* sp.		1		1					
		Oribatida sp.							1		
		Unidentified			1						
Water fleas (Cladocera)	Daphniidae	*Ceriodaphnia cornuta*	widespread						1		
Seed shrimps (Ostracoda)	Cyprididae	*Cypretta* sp.			1	1					
		Cyprinotus cingalensis/kimberleyensis	western?		1						
	Darwinulidae	*Penthesilenula brasiliensis*	widespread - groundwater	1							
		Vestalenula marmonieri	widespread - groundwater	1		1					
Copepods (Cyclopoida)	Cyclopidae	*Mesocyclops brooksi*	groundwater - opportunistic	1	1	1	1	1	1		
Copepods (Harpacticoida)		Unidentified			1						
Beetles (Coleoptera)	Dytiscidae	*Eretes australis*	widespread			1					
		Hydroglyphus basalis	widespread			1					
		Hydroglyphus daemeli	northern			1		1			
		Hydroglyphus grammopterus	northern	1		1	1	1	1	1	
		Hydroglyphus leai	northern	1		1		1	1	1	
		Hydroglyphus trifasciatus	northern					1			
		Hyphydrus lyratus	northern			1		1		1	
		Laccophilus clarki	northern	1		1		1			
		Laccophilus sharpi	northern	1		1		1			
		Limbodessus compactus	northern					1			
		Megaporus ruficeps	northern							1	
		Rhantaticus congestus	northern					1			
	Gyrinidae	*Dineutus australis*	northern					1			
	Hydrophilidae	*Berosus australiae*	widespread	1				1			
		Berosus pulchellus	largely northern							1	
		Berosus sp.				1	1				
		Enochrus deserticola	largely northern	1							
		Enochrus elongatulus	widespread	1						1	
		Unidentified					1				
		Paracymus pygmaeus	widespread	1							
		Regimbartia attenuata	northern	1							

				Site							
				Dragon Tree Soak			Mini Soak	Elizabeth Soak		Slimy Soak	
				2018		2022	2022	2018		2018	
Group	**Family**	**Species**	**Distribution**	**Benthic**	**Plankton**	**Benthic and plankton**	**Benthic and plankton**	**Benthic**	**Plankton**	**Benthic**	**Plankton**
Fly larvae (Diptera)	Ceratopogonidae	*Culicoides* sp.		1				1		1	
		Monohelea sp.				1	1				
		Nilobezzia sp.		1			1	1			
	Chironomidae	*Chironomus cf. alternans*	widespread	1		1		1	1	1	
		Chironomus tepperi				1					
		Kiefferulus intertinctus	widespread	1		1	1	1	1		
		Microchironomus "B1"				1					
		Polypedilum nubifer	widespread			1			1	1	
		Procladius paludicola	widespread	1	1	1	1	1	1	1	1
		Tanypus sp. K1				1					
		Tanytarsus fuscithorax/semibarbitarsus	widespread			1					
		Tanytarsus semibarbitarsus	widespread	1				1	1		
		Tanytarsus sp. G					1				
	Culicidae	*Anopheles amictus*	northern						1		
		Anopheles sp.						1			
		Culex sp.						1	1		
	Ephydridae	Unidentified				1					
	Stratiomyidae	Unidentified		1	1	1		1	1	1	1
	Other	Unidentified							1		
Mayflies (Ephemeroptera)	Baetidae	Unidentified		1							
	Unidentified	*Ephemeroptera*							1		
Water bugs (Hemiptera)	Belostomatidae	*Diplonychus eques*	northern			1		1	1		
	Corixidae	*Agraptocorixa eurynome*	widespread	1							1
		Agraptocorixa parvipunctata	widespread			1					
		Agraptocorixa sp.					1				
		Micronecta annae illiese	northern			1					
		Micronecta robusta	widespread				1			1	1
		Micronecta virgata	northern	1		1		1	1		
	Gerridae	*Limnogonus* sp.						1			
	Mesoveliidae	*Mesovelia vittigera*	northern	1		1		1	1	1	
	Notonectidae	*Anisops canaliculatus*	northern		1			1			
		Anisops elstoni	widespread	1							
		Anisops nasutus	northern	1	1	1		1	1	1	1
		Anisops occipitalis	widespread	1					1		
		Anisops semitus	northern				1		1		
		Anisops stali	largely northern			1		1	1		
		Anisops thienemanni	widespread			1					
	Pleidae	*Paraplea* sp.		1							
	Veliidae	*Microvelia oceanica*	northern			1					
Damselflies and dragonflies (Odonata)	Aeshnidae	*Anax papuensis*	widespread				1	1	1		
	Coenagrionidae	*Austroagrion* sp.		1							
		Xanthagrion erythroneurum	widespread	1		1	1	1			
		Unidentified								1	
	Libellulidae	*Diplacodes bipunctata\trivialis*	widespread					1			
		Orthetrum caledonicum	widespread	1		1	1				

*Protozoans and Rotifers were not identified in 2022 survey samples

				Site							
				Dragon Tree Soak			Mini Soak	Elizabeth Soak		Slimy Soak	
				2018		2022	2022	2018		2018	
Group	**Family**	**Species**	**Distribution**	**Benthic**	**Plankton**	**Benthic and plankton**	**Benthic and plankton**	**Benthic**	**Plankton**	**Benthic**	**Plankton**
Caddisflies (Trichoptera)	Leptoceridae	*Oecetis* sp.		1							
		Triplectides australis	widespread			1					
Protozoa	Lobosea	*Arcella hemisphaerica*	widespread						1		
		Netzelia tuberculata	widespread		1						
Rotifers	Asplanchnidae	*Asplanchna* sp.			1						
	Bdelloidea	Unidentified							1		
	Brachionidae	*Brachionus angularis*	widespread		1				1		
		Brachionus cf. bidens	widespread		1						
		Brachionus n. sp.?	new species?								1
		Brachionus quadridentatus	widespread						1		
	Filinidae	*Filinia* sp.			1						
	Floscullariidae	Unidentified							1		
	Hexarthridae	*Hexarthra sp. (?jenkinae)*	widespread								1
	Lecanidae	*Lecane [Monostyla]* sp.							1		
		Lecane bulla	widespread						1		
		Lecane hamata	widespread						1		
		Lecane obtusa	widespread						1		
	Lepadellidae	*Lepadella* sp. A *(cf. oblonga)*	widespread						1		
		Lepadella sp. B *(cf. rhomboides)*	widespread						1		
	Proalidae	*Proalides* sp.			1						
	Trichocercidae	*Trichocerca* sp.			1				1		