Porongurup Bioblitz Wetlands Survey:

Nunarrup Lagoon and Kaimerndyip Lake

Report prepared for Green Skills Inc, Denmark WA.

By Geraldine and Steve Janicke

Waterways Assessment & Environmental Investigations

May 2018

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Porongurup Bioblitz Wetlands Survey

INTRODUCTION

Australia's biodiversity is of profound scientific value but, tucked away in a tiny pocket of southwest WA is an ancient place that is especially profound – the Porongurup 'Life-Raft'
Porongurup Bioblitz Poster

The Porongurup Range has been described as a refuge (life-raft) for Gondwanan relictual species. Similarly, wetlands are a refuge for a range of plants and animals. Wetlands can be fresh or saline, seasonal or permanent but all are influenced by the activities occurring within their catchments. They contain an amazing range of invertebrates which are largely unseen but play an important role in the wetland ecosystems.

The two wetlands chosen for this survey were Nunarrup Lagoon and Kaimerndyip Lake. They are at the opposite ends of the scale in terms of salinity and have very different hydrology. They are both to the north of the Porongurup Range (see Figure 1).

Nunarrup Lagoon is situated within farmland and has been fenced to keep stock out. The lower end, bound by the farm road, has been dammed which maintains a relatively constant water level (see Figure 2). The wetland has an area of about 3.3 Hectares of mostly open water within 12 Hectares of fenced bushland. There are two reasonably well vegetated watercourses feeding into the wetland with a combined length of about 5 kilometres and a catchment area of 437 Hectares. The wetland overflows into Stoney Creek which ultimately enters the Kalgan River. At the time of sampling the stream was gently overflowing at less than 1L/s.

Kaimerndyip Lake catchment is four times larger at about 1817 Hectares and has two main streams entering, with a combined length of 9.5 kilometres (see Figure 3). It is situated within crown land and when full has an area of 110 Hectares of open water surrounded by a narrow-vegetated area of about 100 Hectares. The farmland surrounding the lake has only small areas with remnant or planted vegetation.

Figure 1: Porongurup Bioblitz wetland survey sampling sites: Nunarrup lagoon and Kaimerndyip Lake.

Figure 2: Nunarrup Lagoon showing sampling sites (blue icons).

Figure 3: Kaimerndyip Lake showing sampling site on the southern edge (blue icon).

Steve & Geraldine Janicke.

METHOD

The wetlands were sampled on 28th April 2018 for macroinvertebrate composition and water quality.

The waters from the two wetlands were tested for Salinity, pH, temperature and turbidity. A Hydrolab multiparameter WQ sonde, Salinometer and turbidity tube were used to obtain water quality measurements.

Aquatic macroinvertebrates were sampled using a 250 µm mesh net to sweep an area approximately 8 metres by 30 metres along the foreshore. Citizen Science volunteers assisted in the sampling of the foreshore in the shallows at both lakes. All samples were placed in white trays and macroinvertebrates were live picked and placed in containers with the help of keen naturalists and Citizen Science volunteers. Estimates of animal numbers were also made while examining the trays. All picked animals were placed into sample containers with 70% ethanol and returned to the laboratory where all specimens were identified to the lowest taxonomic level possible.

Two sites were sampled at Nunarrup Lagoon, site one was around the overhanging sedges along the dam wall near the overflow and the other was in the shallows under the Swamp Paperbark (*Melaleuca rhaphiophylla*) trees (see Figure 2). This represents two different types of habitat. Kaimerndyip Lake was sampled at only one location (see Figure 3).

RESULTS AND DISCUSSION

Past rainfall

High rainfall in January 2016 resulted in localised flooding in the region and the filling of all wetlands including Lake Kaimerndyip (see Figure 4). That year was also a high rainfall year (192 mm above average) with higher than average rainfall in August and September keeping the wetland levels high. Last year (2017) was a much drier year on average (50 mm below average) with wetland water levels decreasing.

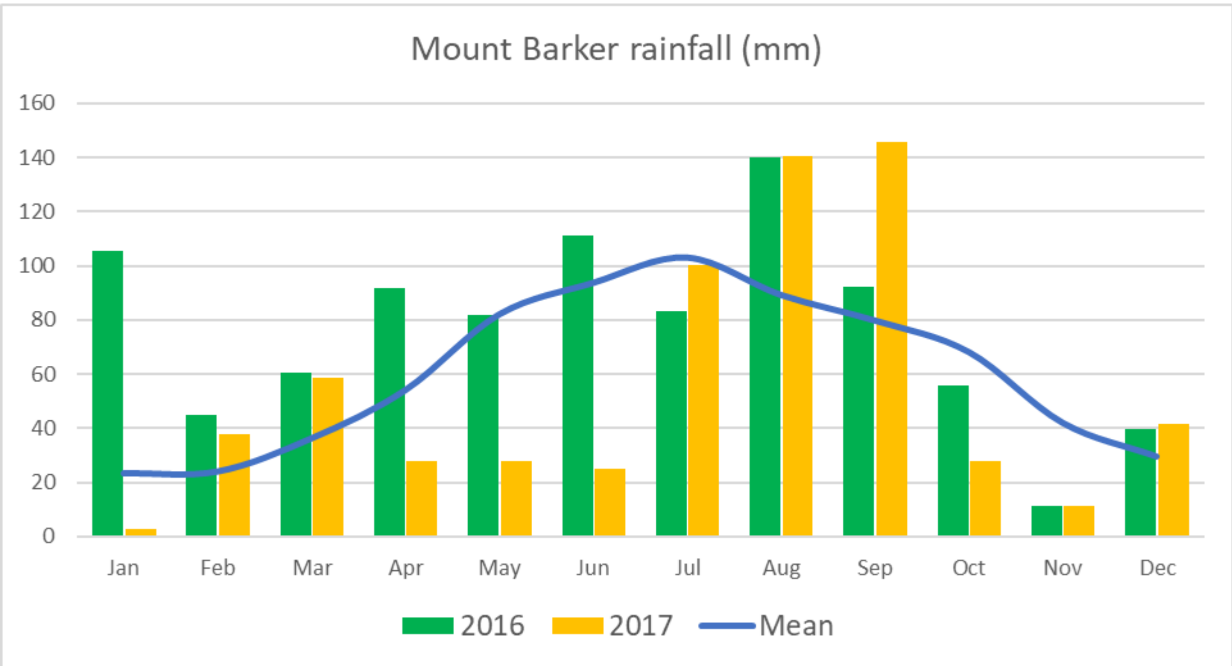

Figure 4: Mount Barker rainfall (Data: http://www.bom.gov.au/jsp/ncc/cdio/cvg/av)

Water Quality

Table 1: Water quality parameters measured during the survey on 28th April 2018

Wetland	Nunarrup Lagoon	Kaimerndyip Lake
WQ meter	Hydrolab	Hydrolab, salinometer
Conductivity (mS/cm)	3.28	>100
Sal (ppt)	1.78	70.74
pH	7.25	7.87
Turbidity (ntu)	<10	50
Temperature (°C)	19.6	18.7
Dissolved Oxygen (mg/L)	8.3	9.2
Visual appearance	clear	cloudy, phytoplankton

Nunarrup Lagoon

Nunarrup Lagoon had clear fresh water and was slightly alkaline. Situated close to the base of the Porongurup Range, it would receive surface runoff from the range as well as sub-surface flow which would be fresh. The Lagoon overflows into Stoney Creek enabling it to be 'flushed' with fresh water during high rainfall events.

Kaimerndyip Lake

Kaimerndyip Lake was hyper-saline at twice seawater (see inset). The lake was also highly turbid reflecting the phytoplankton bloom that made the water cloudy in appearance. The lake also had a slightly higher dissolved oxygen content that would be due to the products of phytoplankton photosynthesis.

Wetland salinity categories (Pinder et al, 2004)[1].

- <6mS/cm (3ppt), freshwater
- 6 to 20mS/cm (3-12ppt), sub-saline, brackish
- 20 to 52mS/cm (12-35ppt), saline
- >52mS/cm (35 ppt), hyper-saline.

Note: seawater is usually 52mS/cm (35 ppt).

Kaimerndyip Lake is the endpoint of it's catchment with no obvious overflow. Like many salt lakes and river pools in the lower southwest, may be flooded by episodic storm events (usually in summer/autumn) which thus 'resets' the aquatic environment. Evaporation steadily increases the salt concentration over subsequent years.

Historically this was part of a natural cycle and not a problem provided no extra salt found its way into the wetland. Once the salt input increased, chiefly through increasing groundwater discharge, there was no mechanism (overflow) for removing the salt build-up and the wetlands become secondarily highly salinised.

During a conversation with Mr Thomas senior (Warren Thomas's father) he mentioned that the lake had dried out in earlier years, to the extent that they used to have motorbike races on the dry lake bed.

The role of nutrients in the phytoplankton bloom is not known. Nutrient sampling and analysis would be required to determine if there are any elevated nutrients in the system. Since the lake is the endpoint of it's catchment, any mobile nutrients would end up in the lake. Nitrogen fixing benthic algae are common in saline wetlands and Nitrogen is elevated naturally. Phosphorus tends to accumulate in the sediments. Fencing and revegetating the incoming watercourses and increasing the width of surrounding vegetation could assist in reducing nutrient inputs.

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[1] Pinder, Adrian M., S.A. Halse, J.M. McRae and R.J. Shiel (2004) "Aquatic invertebrate assemblages of wetlands and rivers in the wheatbelt region of Western Australia" *Records of the Western Australian Museum* Supplement No. 67: 7–37 (2004).

Plants

Nunarrup Lagoon

The dominant vegetation surrounding Nunarrup Lagoon is *Melaleuca rhaphiophylla* and various sedges.

Also noted was budding club-rush, *Isolepis prolifera*, a weed from South Africa. This plant has the potential to invade native sedges around the edges of the waterway. It propagates through water borne seed and produces suckering buds at the leaf tips. Club-rush will spread out over a still waterway slowly trapping sediment and infilling shallows. It is a pest of drains. However, it also provides habitat and protection for some invertebrates from larger predators like fish.

A freshwater algae of the order Charales was also present on the lagoon base. As a group, they are usually regarded as indicators of healthy, clear-water ecosystems (Coops 2002[2]). They take up nutrients from the water and promote a clear water state. Charophytes can occupy deeper parts of clear water lakes that other plants. They are also pioneer plants in recently inundated edges of wetlands (Casanova and Brock, 1999[3]). They are important as a refuge habitat for zooplankton and are a food source for macroinvertebrates, dabbling and diving ducks and grazing waterfowl including swans, shelducks and wood ducks.

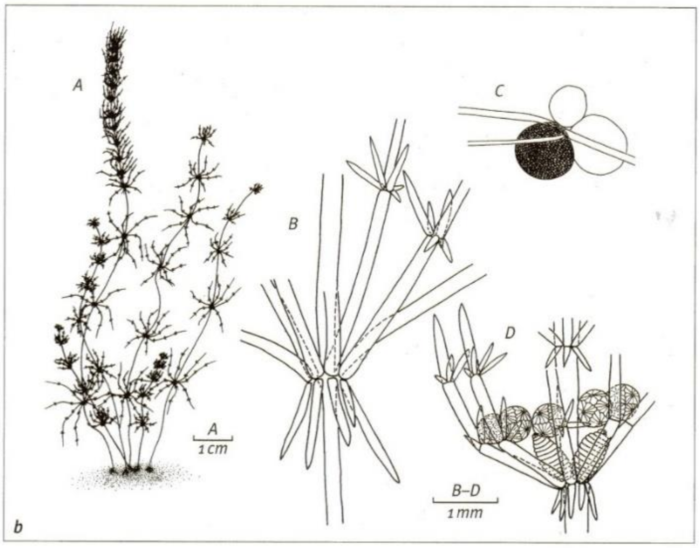
Kaimerndyip Lake

The dominant vegetation surrounding the lake is *Melaleuca cuticularis* and Samphire. The after effects of episodic flooding on saline lakes can be observed in the distinctive concentric vegetation bands of the riparian zone. Bands of *Melaleuca cuticularis* had germinated in Kaimerndyip Lake from a high rainfall event (probably before the 2005 high autumn rainfall event). Subsequent drier years would have seen the lake levels lower than the newly germinated *M. cuticularis* allowing the plants to grow. *M. cuticularis* can tolerate a wide range of salinity but cannot tolerate extended periods of flooding. A flooding event and subsequent higher than average rainfall would have seen the *M. cuticularis* trees flooded resulting in their deaths. This is a normal cycle on inland lakes subject to episodic summer/autumn flooding events.

Figure 5: Keen naturalists and citizen scientists listening to Steve Janicke among the dead *Melaleuca cuticularis* trees, Kaimerndyip Lake.

[2] Coops, Hugo (2002) "*Editorial: Ecology of charophytes: an introduction*". Aquatic Botany 72 (2002) 205–208

[3] Casanova, MT and Brock, M. (1999) "*Life Histories of Charophytes from Permanent and Temporary Wetlands in Eastern Australia*" Aust. J. Bot., 1999, 47, 383-397



Stonewort, *Lamprothamnium papulosum* was observed as seed spores and degraded plant material in the sweep net at Kaimerndyip Lake. Stonewort requires low salinities for spore germination to occur but grows well in salinities up to 60ppt although it has been recorded in salinities as high as 104 ppts (3 times more saline than seawater). They need light penetration to grow and the high turbidity from phytoplankton may have resulted in the decline of Stonewort. Mature Stonewort produces starch bulbils which are also a food source for birds (Delroy, 1974[4]).

Figure 6: *Lamprothamnium papulosum* illustration from Womersley, 1984[5].

Birds

Bird observations were made around Nunarrup Lagoon as a separate part of the Porongurup Bioblitz weekend. The waterbirds observed are listed in Table 2 along with their feeding strategies (guild). Waterbirds are one of the most conspicuous groups of animals that use wetlands. Different species of waterbirds feed and breed in different parts and types of wetlands. They are a useful ‘indicator’ group for the condition of wetlands, as different species utilise different parts of a wetland for feeding and breeding. A diverse wetland supports birds with a range of feeding strategies (guilds).

There were 10 species of waterbird observed at Nunarrup Lagoon before the sampling for macroinvertebrates. They belonged to six different feeding guilds indicating the diversity of habitats and food sources available for them. There were no bird observations made at Kaimerndyip Lake and no birds were observed during this survey.

There are considerable differences in waterbird communities among lakes, depending on whether a lake is saline or freshwater (Halse et al. 1993[6]). Moreover, individual lakes change in their suitability with changes in salinity as the lake dries. Hypersaline lakes are seldom utilised by waterbirds except Hooded Plovers (Weston 2007[7]), with abundance and diversity falling once salinity increases beyond the tolerances of aquatic organisms. However, the episodic cycle of saline lakes filling with freshwater during a flood event and then gradually increasing in salinity through evapo-concentration, often supports a succession of abundant aquatic plants that in turn, supports an abundance of macroinvertebrates and birds.

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[4] Delroy, L.B. (1974). *The food of waterfowl (Anatidae) in the southern Coorong saltwater*

[5] Womersley, H.B.S. (31 May, 1984) *The Marine Benthic Flora of Southern Australia Part* I

[6] Halse, S. A. , Williams, M. R. , Jaensch, R. P. , and Lane, J. A. K. (1993). “Wetland characteristics and waterbird use of wetlands in south-western Australia”. Wildlife Research 20, 103–126.

[7] Weston, MA (2007) “The foraging and diet of non-breeding Hooded Plovers *Thinornis rubricollis* in relation to habitat type.” Journal of the Royal Society of Western Australia, 90: 89-95, 2007

Table 2: Waterbird feeding guilds and species observed on salt lakes of the region

Feeding Guild	Bird species observed on Nunarrup Lagoon
Ducks –dabbling (upend for food) in the shallow water and littoral zone. Food includes: Aquatic plants and animals and invertebrates, as well as gastropods and crustaceans.	Pacific Black Duck, Grey Teal
Diving waterbirds in deep or shallow water. Dives for bottom dwelling animals, invertebrates, plant material, crustaceans and small fish.	Little Pied Cormorant
Specialist - feed almost entirely on vegetable matter, supplemented with only a few insects, worms and fish.	Eurasian Coot
Grazing – The Black Swan is a vegetarian. Grazing ducks eat algae, insects and molluscs or by grazing on grasslands.	Black Swan
Waders, foraging in littoral zone & mudflats. Waders feed on insects, especially chironomids, crustaceans, molluscs, vegetation, seeds and roots.	Yellow-billed Spoonbill
Other birds, generalist feeders - frogs, insects, small fish and crustaceans found in shallow wetlands or in open grassy areas.	White-Faced Heron, Purple Swamphen, Dusky Moorhen, Crakes (heard, species not identified)

Macroinvertebrates

Sampling for aquatic macroinvertebrate biodiversity is usually done during spring when many insects especially midges and other invertebrates are hatching, and the larvae are growing. In autumn, the diversity of aquatic macroinvertebrates is usually lower as many seasonal species have already pupated. There were 50 different species/taxa of macroinvertebrates collected in the pond net sweeps in the two lakes (See Table 3 for full list of taxa). About a quarter of these could not be identified below Family name (taxa).

Endemism within the south-western Australian terrestrial plants and animals has long been recognised, but endemism within the region's aquatic invertebrate fauna has gone unrecognised until relatively recently. In this survey there were 21 species that are known to be endemic to Australia of which three are endemic to the southwest of Western Australia. Since the Zooplankton were not identified to species level, their endemic status could not be determined. However, Pinder *et al* (2004) [8] in their wheatbelt survey found a high level of endemism in the micro-crustaceans of saline lakes.

Kaimerndyip Lake had 14 taxa (see Table 4) which is representative for naturally saline and secondarily salinised lakes. Although the species richness (number of species) in Nunarrup Lagoon was high, it was less than expected (71 average species richness for freshwater wetlands in the southern wheatbelt). The expected species richness should be viewed with caution. The species collected in this survey represent only a subset of those utilising the wetland at other seasons and the wheatbelt survey by Pinder *et al* (2004) included rotifers, micro-invertebrates well represented in freshwater wetlands but not sampled for in this survey.

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[8] Pinder, Adrian M., S.A. Halse, J.M. McRae and R.J. Shiel (2004) "Aquatic invertebrate assemblages of wetlands and rivers in the wheatbelt region of Western Australia" *Records of the Western Australian Museum* Supplement No. 67: 7–37 (2004).

Table 3: Macroinvertebrate composition of the two wetlands surveyed 28 April 2018.

Taxon	Common name	Endemic	Kaimerndyip Lake	Nunarrup Lagoon 1	Nunarrup Lagoon 2
Oligochaeta unidentified sp.	aquatic worm			1	1
Acarina Hydrachnidae unidentified sp.	mite			1	
Acarina Hydrodromidae *Hydrodroma* sp.	mite			1	1
Acarina Orbatida unidentified sp.	mite		1	1	1
Acarina Unionicolidae unidentified sp.	mite				1
Spider Unknown Terrestrial spiders	spider			1	
Amphipoda Ceinidae *Austrochiltonia subtenuis*	scud			2	2
Cladocera Chydoridae unidentified sp.	water flea			3	2
Cladocera Daphniidae *Ceriodaphnia* sp.	water flea			2	
Cladocera Daphniidae *Simocephalus* sp.	water flea				2
Cladocera Sididae unidentified sp.	water flea			3	2
Copepoda Calanoida unidentified sp.	Copepod		2	4	3
Copepoda Cyclopoidea unidentified sp.	Copepod		2	2	
Decapoda Parasticidae *Cherax quinquecarinatus*	gilgie	SW Aust		1	
Ostracoda Cyprididae *Australocypris insularis*	giant seed shrimp	SW Aust	3		
Ostracoda Cyprididae *Bennelongia australis*	giant seed shrimp	Aust			1
Ostracoda Cyprididae *Cypretta* sp.	seed shrimp			2	2
Ostracoda Cyprididae *Cypridopsis funebris*	seed shrimp	Aust		2	2
Ostracoda Cyprididae *Mytilocypris mytiloides*	giant seed shrimp	Aust	3		
Ostracoda Cyprididae *Reticypris* sp.	seed shrimp	Aust	1		
Ostracoda Cyprididae *Sarcipridopsis* sp.	seed shrimp			3	1
Ostracoda Notodromadidae *Kennethia* sp.	seed shrimp	Aust		3	3
Coleoptera Dytiscidae *Megaporus howitti*	diving beetle	Aust		1	1
Coleoptera Dytiscidae *Rhantus suturalis*	diving beetle			2	
Coleoptera Hydrophilidae *Enochrus elongatus*	scavenger beetle			1	
Coleoptera Hydrophilidae *Laccobius zietzi*	scavenger beetle	Aust	1		
Coleoptera Hydrophilidae *Limnoxenus zelandicus*	scavenger beetle		1		
Collembola Hypogastruridae unidentified sp.	springtail			2	
Diptera Chironominae *Stempellina* affin pupae	midge (non-biting)			1	
Diptera Chironominae *Tanytarsus barbitarsus*	midge (non-biting)	Aust	1		
Diptera Tanypodinae *Paramerina levidensis*	midge (non-biting)	Aust		1	1
Diptera Culicidae *Culex annulirostris*	mosquito			1	1
Diptera Tipulidae unidentified sp.	crane fly			1	1
Hemiptera Corixidae *Sigara truncatipala*	water boatman			1	1
Hemiptera Nepidae *Ranatra dispar*	Needle bug	Aust		1	
Hemiptera Notonectidae *Anisops* sp. Juvenile	backswimmer			1	
Hemiptera Notonectidae *Notonecta handlirschi*	backswimmer	SW Aust			1
Hemiptera Veliidae *Microvelia oceanica*	water striders		1	2	2
Odonata Coenagrionidae *Austroagrion cyane*	SW Billabong fly	Aust		2	1
Odonata Lestidae *Austrolestes annulosus*	Blue Ringtail damselfly	Aust			2
Odonata Aeshnidae *Adversaeshna brevistyla*	Blue-spotted Hawker	Aust		1	1
Odonata Hemicorduliidae *Hemicordulia tau*	Tau Emerald dragonfly	Aust		1	1
Odonata Libellulidae *Diplacodes bipunctata*	Wandering Percher				1
Trichoptera Hydroptilidae unidentified sp.	caddisfly			1	
Trichoptera Leptoceridae *Notalina spira*	caddisfly	Aust		1	1
Trichoptera Leptoceridae *Symphitoneuria wheeleri*	caddisfly	Aust	1		
Gastropoda Planorbidae *Glyptophysa (Glyptophysa) georgiana*	snail	SW Aust		2	1
Gastropoda Pomatiopsidae *Coxiella* sp.	salt-lake snail	Aust	2		
Nematoda unidentified sp.	nematode		2	1	1
Turbellaria Dugesiidae unidentified sp.	planarian worm			1	

Table 4: Species diversity in the two lakes sampled.

	No. of invertebrate species/taxa	Expected No. of taxa (Pinder *et al* 2004[9])
Kaimerndyip Lake	14	13-18 (WG 11, 12)
Nunarrup Lagoon site 1	36	
Nunarrup Lagoon site 2	30	
Nunarrup combined	42	71 (WG 9)

The species differed significantly between the wetlands although several taxa were found at both wetlands including the water strider, *Microvelia oceanica* which is a surface feeder. The other taxa, nematodes, Orbatid mites and copepods are likely to be various species. Orbatid mites are not parasitic and feed on detritus.

Both wetlands were dominated by insects and crustaceans however when their abundance was considered, crustaceans were the most abundant macroinvertebrate group for both wetlands (see Figure 7 and Figure 15).

Nunarrup Lagoon

The high diversity within Nunarrup Lagoon is a good example of natural freshwater wetlands. Although there were more Insect taxa collected (24 taxa), the most abundant group were the crustaceans consisting of water fleas, copepods and seed shrimps (collectively called zooplankton). These macroinvertebrates thrive in wetlands were there is a diversity of habitat including Charales algae and overhanging sedges.

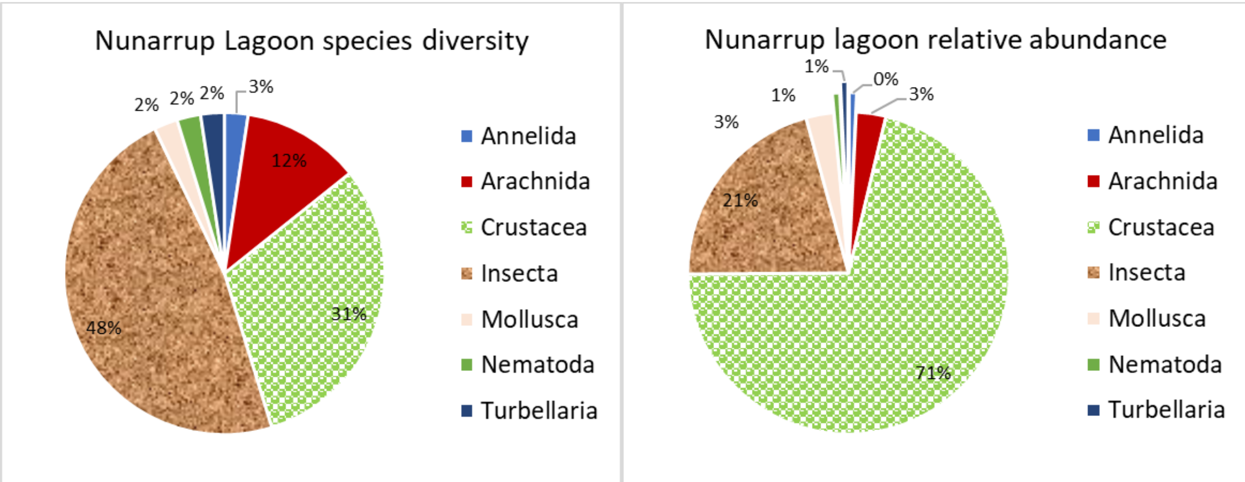
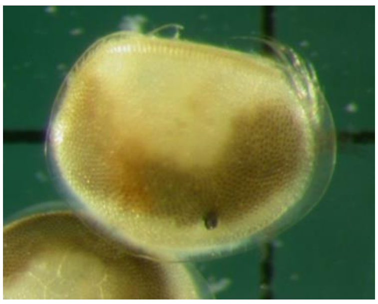


Figure 7: Macroinvertebrate species diversity (number of different taxa) relative abundance within macroinvertebrate groups for Nunarrup Lagoon.



The small seed shrimp of the genus *Kennethia* were abundant in the lagoon and is an Australian endemic. They are unusual in that they have a flat underneath and swim upside down against the water surface (Figure 8). Also abundant in the Lagoon were the small green seed shrimp, *Sarcipridopsis* sp., a calanoid copepod and several species of water flea. These crustaceans produce drought resistant eggs that can survive in the lake bed when the lakes dry up. They are quick colonisers when water returns. Zooplankton use

[9] Pinder, Adrian M., S.A. Halse, J.M. McRae and R.J. Shiel (2004) "Aquatic invertebrate assemblages of wetlands and rivers in the wheatbelt region of Western Australia" *Records of the Western Australian Museum* Supplement No. 67: 7–37 (2004).

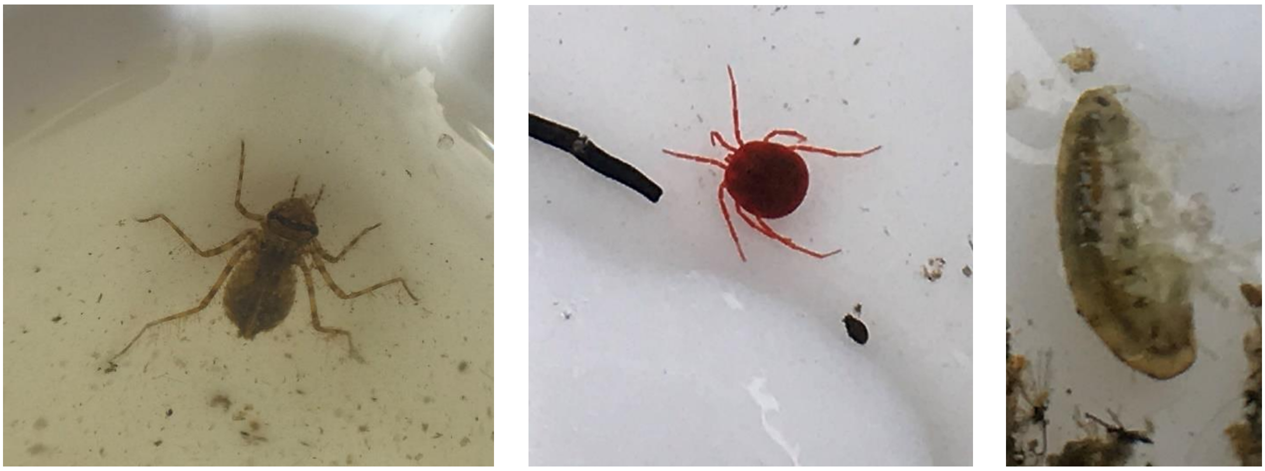
the strategy of dropping down into the freshwater algae (Charales) zone during the day to avoid predation.

Figure 8: *Kennethia* sp. showing the flat underside.

Also abundant in the Lagoon were scuds, *Austrochiltonia subtenuis* (Figure 9). Scuds are widespread throughout southern Australia in both freshwater and saline wetlands. They grow up to one centimetre in length and feed on detritus and plankton. In turn, they are a food source for many different species. These crustaceans, unlike the seed shrimps, do not produce drought resistant eggs and must survive by burrowing in the damp soil until the next wetland infilling. Hence, they are more common in permanent waters. Juvenile forms can also 'hitch' a ride from one wetland to another in the feathers of a waterbird.

Figure 9: A female amphipod, also know as scuds, *Austrochiltonia subtenuis* carrying eggs under her thorax.

Redfin Perch (*Perca fluviatilis*) had been introduced into Nunarrup Lagoon some time back (Loxley Fedec per. comms.). They were introduced to Western Australia from Europe in the 1890s and are voracious predators feeding on marron, gilgies, frogs, insects and native fish. They grow to about 450mm and can reach 600mm but will become stunted in size as they deplete the food supply (Fisheries [10]). A variety of aquatic habitats including overhanging sedges are important to provide refuge for the invertebrates and frogs from the Redfin Perch. Redfin spawn in late winter and spring, when they lay several hundred thousand eggs in a gelatinous ribbon amongst aquatic vegetation and take 2-3 years to reach sexual maturity.



Some of the macroinvertebrates photographed at the Lagoon: Left: *Hemicordulia tau*, Centre*: Hydrodroma* sp. mite and Right: *Austrochiltonia subtenuis*

[10] Fisheries "*Aquatic Invaders Identification guide*". www.fish.wa.gov.au/biosecurity.

Figure 10: Site 1 at Nunarrup Lagoon

The two sites sampled in the lagoon had different habitats; site one was among overhanging and flooded sedges and Charales while site two was in the shallows under the paperbark trees. As was expected, there were different species observed at the different sites (see Table 5).

Table 5: Macroinvertebrates found only at one site and not the other at Nunarrup Lagoon

	Nunarrup Lagoon site 1	**Nunarrup Lagoon site 2**
Spider	Terrestrial spiders	
Planarian worm	Dugesiidae sp.	
Mites	Hydrachnidae sp.	*Unionicolidae* sp.
Crustaceans	*Ceriodaphnia* sp.	*Bennelongia australis*
	Cyclopoidea sp.	*Simocephalus* sp.
	Cherax quinquecarinatus	
Springtail	Hypogastruridae sp.	
Hemiptera (Bugs)	*Ranatra dispar*	*Notonecta handlirschi*
	Anisops sp. Juvenile	
Dragonfly/damselfly		*Diplacodes bipunctata*
		Austrolestes annulosus
Beetles	*Enochrus elongatus*	
	Rhantus suturalis	

Site1 – overhanging sedges

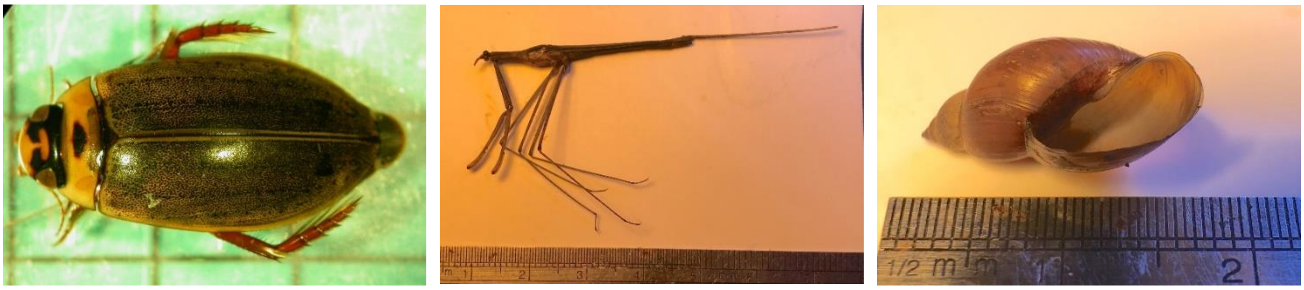


Figure 11: Left: The large diving beetle *Rhantus suturalis,* Centre: *Ranatra dispar*, Needle Bug with a body length of 40mm. Right: A Planorbid snail, of genus *Glyptophysa (Glyptophysa)*

Site 1 was among overhanging sedges (Figure 10) and had more taxa (36 taxa, Table 4) and a higher abundance of zooplankton than site 2. Abundant in site 1 was the diving beetle, *Rhantus suturalis* (Figure 11) which is a predator. The very small springtail (Hypogastruridae sp.) is a surface feeder and common among overhanging vegetation at the edge of wetlands.

Of interest from Site 1 was the Needle Bug, *Ranatra dispar*, which hangs from the water surface by its breathing tube, hiding between vegetation with the fore legs pointing downwards. They are skilled predators catching their prey with their fore legs. The authors have observed Needle Bugs catch small fish and pierce their body with their piercing mouthparts. They are not often seen.

A Planorbid snail was collected from the lagoon with more animals at site 1. The snail belongs to the genus *Glyptophysa (Glyptophysa).* There is only one species recorded from the region, *Glyptophysa (Glyptophysa) georgiana*. This is a species restricted to the southwest of WA (Ponder *et al* 2016 [11]). Identification of this snail to species level is beyond the scope of this project however they are most likely to be this species. They feed on algae and detritus and produce a bean-shaped jelly strip egg mass, containing many small eggs. The mite Unionicolidae sp. found at site 2 is a parasite of molluscs.

Site 2 – under the paperbark trees

Figure 12: Site 2 at Nunarrup Lagoon

Site 2 had fewer taxa (30 taxa, Table 4) than site 1, but there were six species not found in site 1 including one backswimmer (*Notonecta handlirschi*), an endemic to southwestern Australia, the cosmopolitan Wandering Percher (*Diplacodes bipunctata)* and Blue Ringtail damselfly (*Austrolestes annulosis)* an Australian endemic.

Backswimmers, *Notonecta handlirschi* and Anisops sp. are so named as they swim upside down on their back. Back swimmers have haemoglobin within cells of their abdomen which store oxygen. This enables them to store less gas and maintain a neutral buoyancy requiring less effort to remain submerged in the water column (Andersen and Weir, 2004[12]). They are predators and will feed on invertebrates that move through the water column such as seed shrimp, water fleas and copepods as well as mosquito larvae. There was one species of water boatman (*Sigara truncatipala*) which unlike the back swimmers need to carry a more air on their body under their wings and hence are strong swimmers. They are generally found close to the bottom clinging to debris and have a varied diet of algae, detritus and animal prey. Water bugs do not have desiccation resistant eggs but are able to fly from drying wetlands to new locations including farm dams.

[11]Ponder, W. F., Hallan, A., Shea, M. and Clark, S. A. 2016. Australian Freshwater Molluscs. http://keys.lucidcentral.org/keys/v3/freshwater_molluscs/

[12] Anderson, NM and Weir, TA (2004) “Australian Water Bugs: Their Biology and Identification” Entomonograph Vol 14. CSIRO Publishing Australia.

The Blue Ringtail damselfly (*Austrolestes annulosus*) was also abundant at site 2. They are a conspicuous damselfly when they emerge from their pupae (Figure 13). The larvae provide a good food source for a variety of birds.

Figure 13: Male (left) and female (right) Blue Ringtail damselflies (*Austrolestes annulosus*) (images Doug McDougie, Western Australian Insects Facebook page).

Kaimerndyip Lake

Figure 14: The sampling site at Kaimerndyip Lake

The sample collected at Kaimerndyip had a species richness of 14 which is normal for secondarily salinised naturally saline wetlands (13-18, Pinder et al, 2004[13]). The species collected represent only a subset of those probably utilising the wetland at other seasons. Insects and crustaceans were the dominant taxa however Crustaceans were the most abundant macroinvertebrate group (Figure 15).

[13] Pinder, Adrian M., S.A. Halse, J.M. McRae and R.J. Shiel (2004) "Aquatic invertebrate assemblages of wetlands and rivers in the wheatbelt region of Western Australia" *Records of the Western Australian Museum* Supplement No. 67: 7–37 (2004).

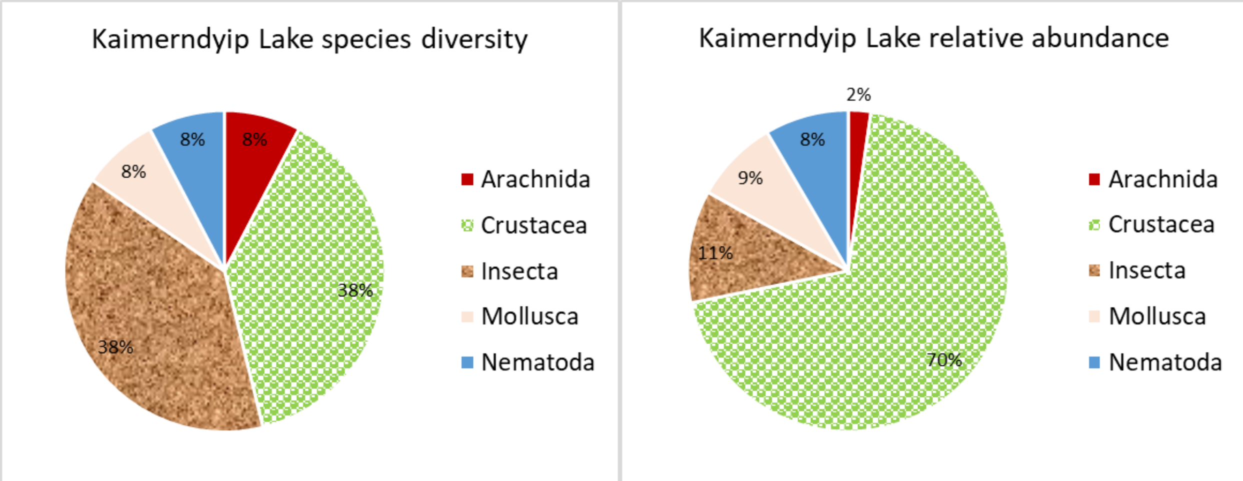


Figure 15: Macroinvertebrate species diversity (number of different taxa) relative abundance within macroinvertebrate groups for Kaimerndyip Lake

Species commonly occurring in freshwater but tolerant of some salinity are referred to as halotolerant, while halophiles are those considered to show a strong preference for saline environments (Pinder *et al* 2004[14]). Crustaceans, such as brine shrimp, seed shrimp (Ostracoda) and copepods, are the most common invertebrate communities of naturally saline wetlands. The south-west of Western Australia is a global hotspot for inland crustacean diversity with diversity of salt loving endemic ostracods a 'result of long history of aridity on the continent' (DeDecker 1983[15])

Unlike Nunarrup Lagoon where the abundant crustacea were a mix of zooplankton, the crustaceans in Kaimerndyip Lake were dominated by the seed shrimp, including two of the 'giant' ostracods *Australocypris insularis* and *Mytilocypris mytiloides* (Figure 16.) Both seed shrimps are halophiles and have been found in wetlands with a salinity of 127ppt (3.5 times seawater).

Kaimerndyip lake was turbid in appearance due to a phytoplankton bloom. This would be a food source for the Calanoid and Cyclopoid copepods collected from the lake. The abundance of the copepods was not as high as expected. This is possibly because of the abundance of *Australocypris insularis* which is a predatory ostracod, feeding on zooplankton and reducing their numbers. It is described by Halse and McRae (2004)[16] as frequently occurring in secondarily salinised wetlands.

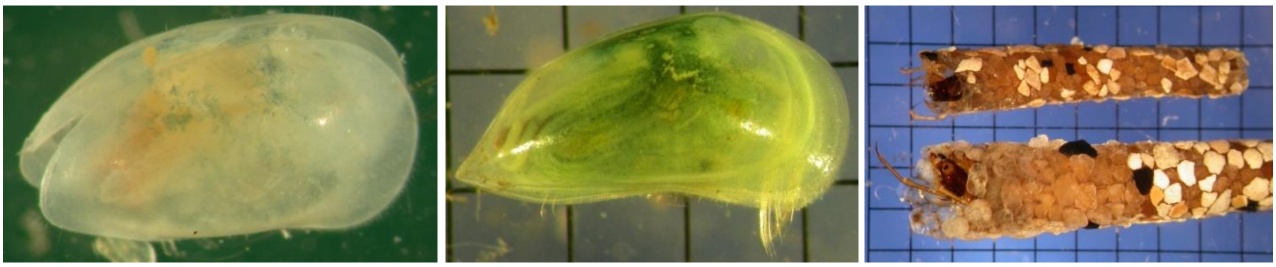


Figure 16: The 'giant' Ostracods: *Australocypris insularis, Mytilocypris mytiloides* and the caddisfly *Symphitoneuria wheeleri*

[14] Pinder, Adrian M., S.A. Halse, J.M. McRae and R.J. Shiel (2004) "Aquatic invertebrate assemblages of wetlands and rivers in the wheatbelt region of Western Australia" *Records of the Western Australian Museum* Supplement No. 67: 7–37 (2004).

[15] De Deckker, Patrick (1983) "Australian salt lakes: their history, chemistry, and biota - a review" *Hydrobiologia* 105, 231-244 (1983).

[16] S.A. Halse & J.M. McRae (2004) New genera and species of 'giant' ostracods (Crustacea: Cyprididae) from Australia in *Hydrobiologia* 524: 1–52, 2004.

The seed shrimp *Mytilocypris mytiloides* are filter feeders that feed on plankton and can be found throughout the whole water column. They produce drought resistant eggs, but juveniles can also 'hitch' a ride to other lakes on the feathers of waterbirds. There has been some confusion with the identification of these seed shrimps and have been also been named *Mytilocypris tasmanica chapmani* complex.

The caddisfly (*Symphitoneuria wheeleri*) found in the lake is endemic to southern Australia preferring saline waters. It makes a case of sand grains or detritus to protect its soft body from predators.

Figure 17: The non-biting midge larvae, *Tanytarsus barbitarsus* with its detritus case and a close up of its head and shells from Gastropod, Coxiella sp. washed up on the eastern shore of Kaimerndyip Lake.

The non-biting midge larvae (*Tanytarsus barbitarsus*) found in the lake, is a salt loving insect although it is capable of living in a very wide range of salinities from fresh to hypersaline (173 ppt, up to 5 times seawater [17]) These non-biting midge larvae live on the surface of submerged sediments within detritus tubes/cases and graze on surface algae. They are also an important food source for waders and fish. Midge larvae can become abundant on salt lake edges and are an important food source for many wading birds.

The salt-lake snail, *Coxiella* sp. is endemic to saline wetlands of Australia. Their shells are thick, often with a tall spire and can be found in huge numbers on the 'beaches' of many saline lakes. They feed on detritus and benthic algae. They can block the opening of the shell with an operculum to avoid desiccation when the lake is too saline or dry. They are a know food source for the Hooded Plover (Weston 2007 [18]).

FROGS

Two types of tadpoles were also collected from the sweep in Nunarrup Lagoon. Tadpoles are difficult to identify with certainty and no tadpoles were taken back to the laboratory for identification. A photo by Kath Gray has been examined by Dr Dale Roberts who gave the following assessment*: 'My guess is the lighter coloured one is Litoria moorei:* (Motorbike Frog) *eyes are on the edge of the head when viewed from above. I think the other one is Limnodynastes dorsalis* (Western Banjo Frog) – *eyes are well inside the edge of the body outline. You can tell them apart by the mouthparts – need a shot from underneath, tadpole on its back! Those guesses are based on the Marion Anstis book on Australian tadpoles [19].*

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[17] DeDeckker, P and Williams, WD (2012) "Australian Chironomidae" in *Limnology in Australia* Springer Science & Business Media

[18] Weston, MA (2007) "The foraging and diet of non-breeding Hooded Plovers *Thinornis rubricollis* in relation to habitat type." Journal of the Royal Society of Western Australia, 90: 89-95, 2007

[19] Anstis, Marion, (2013) TADPOLES AND FROGS OF AUSTRALIA New Holland Publishers, 2013

Figure 18: Two tadpole types collected from Nunarrup Lagoon. (image Kath Gray)

CONCLUSION

At first glance, the South Coast Landscape has a relatively uniform appearance. Sandwiched between the distinctive granite pluton of the Porongurup Range and the angular ridges of the Stirling range, the reality is the opposite. The differences between Nunarrup Lagoon and Kaimerndyip Lake highlight the diversity of habitats and their inhabitants indicating the region hosts unique, subtle and complex ecosystems.

PHOTOS OF THE EVENT

Nunarrup Lagoon photos

Nunarrup lagoon

Keen naturalists and citizen scientists examining the aquatic life with Geraldine Janicke.

Porongurup Bioblitz Wetlands Survey 2018

Steve Janicke starting the event by talking about aspects of safety when sampling in wetlands.

Steve Janicke explaining the details of water quality monitoring.

Geraldine Janicke with keen naturalists and citizen scientists examining the aquatic life.


Examining macroinvertebrates from Nunarrup Lagoon.

Kaimerndyip Lake photos

Geraldine Janicke discussing the macroinvertebrates collected from Kaimerndyip Lake

Steve Janicke discussing the technicalities of monitoring the water quality of saline lakes.

Keen naturalists and citizen scientists looking at the macroinvertebrates collected from Kaimerndyip Lake.

Geraldine Janicke discussing the value of aquatic life in saline lakes.