Bob's Lake Ecological Investigation

What makes Bob's Lake so special for birds?

Report prepared for Green Skills Inc, Denmark WA.

by Steve & Geraldine Janicke

March 2017

This project is supported by funding from the Western Australian Government's State Natural Resource Management Program, supported by Royalties for Regions. It has also been supported by the Great Southern Science Council Regional Science Engagement Project through Great Southern Development Commission and Inspiring Australia. The event is part of Green Skills' wetland conservation activities and has also been supported through South Coast NRM with funding from the Australian Government's National Landcare Program.

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Cover photos: Banded Stilts at Bob's lake (photo by A. Bondin) and Cranbrook Primary Students learning about water quality from Steve Janicke (photo by G. Janicke.)

Acknowledgements

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INTRODUCTION

Bob's Lake is one of the smaller lakes within of a suite of lakes to the northwest of the Stirling Range in Western Australia. It covers an area of about 16 hectares and is within the Lehmann family farm property "Westholm" north of Cranbrook (See map in Figure 1). the Lehmann family have made the lake accessible for birdwatchers and recently a bird hide has been installed on the edge of the lake. A Citizen Science Bird Survey managed by Dr Nic Dunlop has found that Bob's Lake is visited by many different waterbirds. The question then arose as to what were these birds feeding on. A Citizen Science wetland investigation event was developed for 22 February 2017.

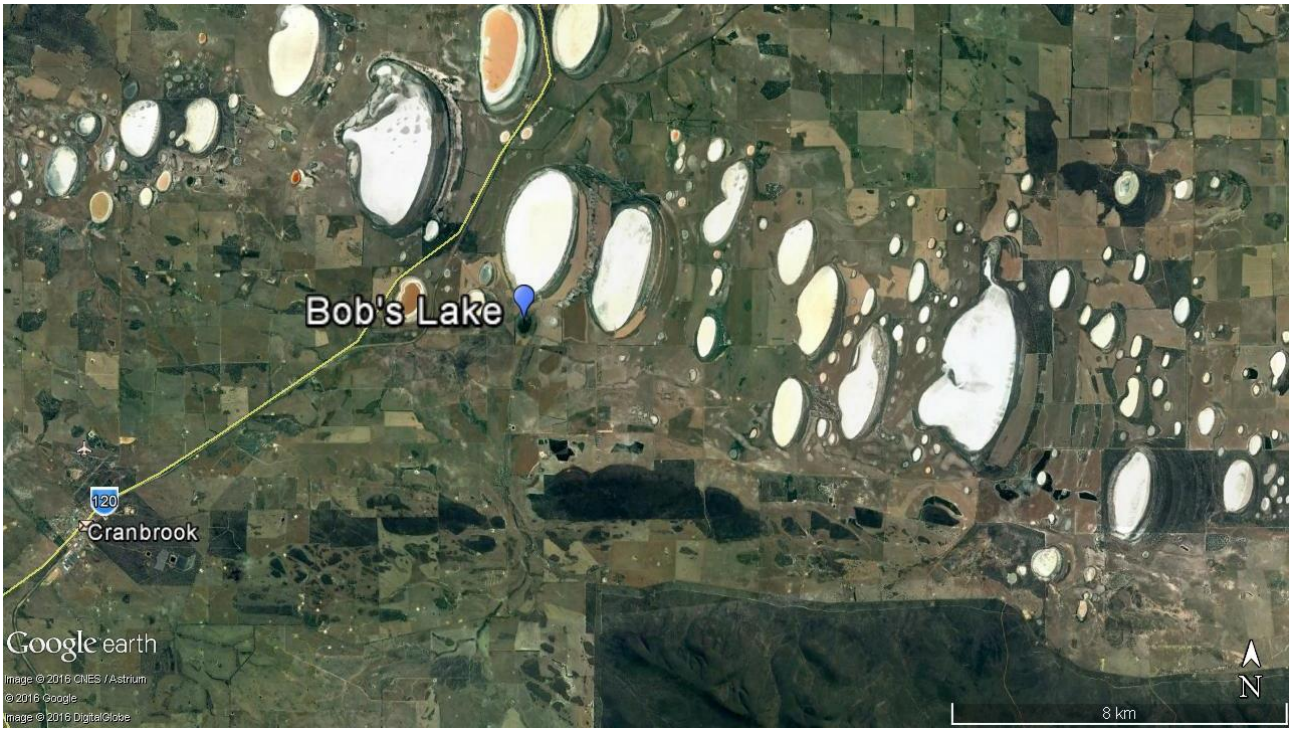

Figure 1: Bob's Lake within the suite of lakes northwest of the Stirling Range.

LAKE BATHYMETRY AND WATER QUALITY

The lake was visited on 16th February 2017 with canoes to measure the depth profile of the lake. The water level at the depth board datum was 0.25 metres and the maximum depth at the time of sampling was 0.7m equating to 0.45m relative to the datum.

Figure 2: Bob's Lake bed elevation relative to the depth board datum.

The salinity of Bob's Lake as measured by Salinometer on 16th February 2017 near the middle of the lake was 15 parts per thousand (ppt) and on 22 February 2017 at the edge of the lake was 20ppt. The differences between the two readings are likely to reflect the error bounds of the Salinometer as well as increased evapo-concentration in the shallows. The lake water was alkaline with a pH of 8.8.

Wetland salinity categories (Pinder et al, 2005).

- <3 ppt, freshwater
- 3 to 12 ppt, sub-saline or brackish
- 12 to 35 ppt, saline
- >35 ppt, hyper-saline.

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

The present day aquatic conditions in Bob's Lake are a relatively new development. A surface water catchment extends for some 12 kilometres from the agricultural area at the north-western end of the Stirling Range National Park (See Figure 3). The channel originally bypassed the lake on the eastern side of the wind formed ridge of high ground bordering the shallow basin, but has been diverted into the lake (Sam Lehmann pers. comm.). The creation of the diversion channel has increased the input of storm rainfall runoff. Storm runoff is generally less saline than seawater and certainly less than the highly saline waters in many of the neighbouring lakes.

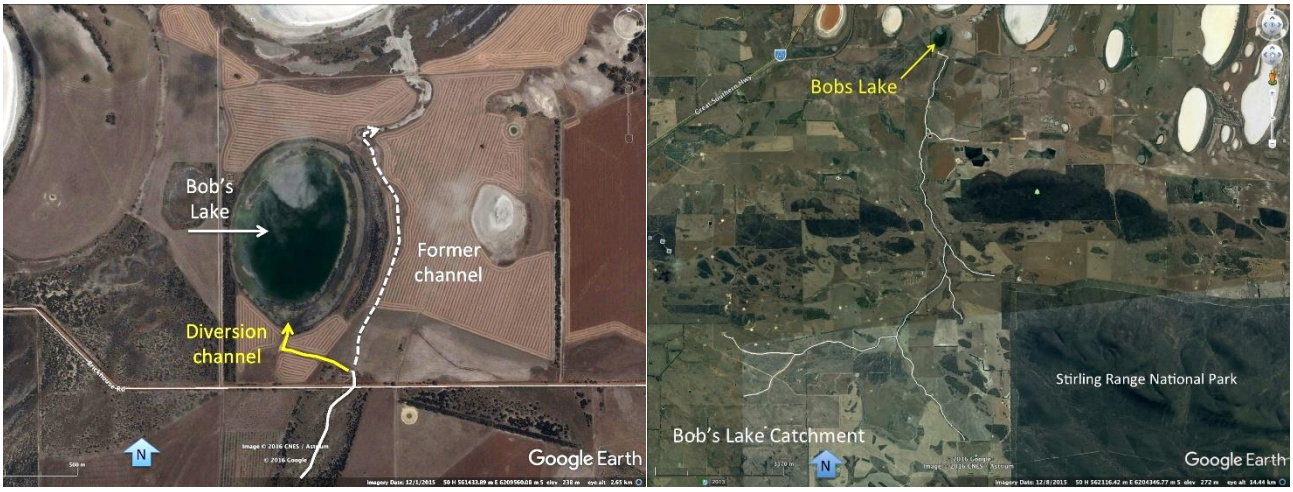

Figure 3: Bob's Lake diversion channel and extended surface water catchment.

Isolated lakes low in the landscape may be ground water fed and this is usually saline and the salt accumulates at the surface through evaporation. The lack of an outlet for many lakes means that salt remains in the basin. For example, the salinity of nearby Jebajup Lake was measured at more than 250 ppt at the time of the survey, compared with Bob's Lake which was between 15 to 20 ppt. Sea water, by way of comparison, is approximately 35 ppt.

Re-vegetation has also been undertaken on the western side of the lake. In many ways, Bob's Lake has elements of an 'artificial wetland' with favourable ecological outcomes in an otherwise harsh environment.

AQUATIC PLANTS AND MACROINVERTEBRATES

Method

Bob's Lake was sampled on the 16th February 2017 for plankton and on 22 February 2017 for macroinvertebrate composition. Plankton was sampled using a 70µm mesh net pulled alongside a canoe for about 30 metres in the centre of the lake. Whilst canoeing the lake to collect the plankton sample, aquatic plants were also collected from the lake bed.

Aquatic macroinvertebrates were sampled using a 250µm mesh net to sweep around the flats to the north and south of the bird hide and the foreshore adjacent to the bird hide. A number of children from the Cranbrook Primary School also sampled the foreshore adjacent to the bird hide using a variety of scoop nets. All samples were passed through appropriate sized sieves to aid examination and placed in white trays. Macroinvertebrates were live picked and placed in containers with the help of participants in the "Citizen Science Wetland Monitoring Survey" event. 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.

Results

Aquatic plants

The lake bed had a fairly even covering of the green algae *Lamprothamnium papulosum* (Charales), commonly called foxtail stonewort. This is a cosmopolitan species that is common in saline lakes and river pools worldwide. The green plant like algae 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). It can grow in dense swards to about 0.4m high however was about 0.15m high throughout Bob's Lake (See Figure 4). This implies a more recent germination event. Mature *Lamprothamnium* produces starch bulbils which are also a food source for birds (Delroy, 1974).

Figure 4: *Lamprothamnium papulosum* from Bob's Lake and illustration from Womersley, 1984[1])

Macroinvertebrates

At the 22 February sampling of Bob's Lake, there were thirteen species of macroinvertebrates collected with three groups with very high numbers of individuals. See Table 1: Macroinvertebrate composition of Bob's Lake.

The flats to the south of the bird hide were about 0.2 to 0.3m deep and appeared to have more abundant invertebrates than the flats to the north of the bird hide which was 0.1 to 0.15m deep. However different people did the sampling and the northern flats may have been more difficult to sample evenly with more remnant samphire plants in the water. One participant conducted a macroinvertebrate sweep around the overhanging shrubs to the north of the bird hide however this sample did not produce anything different to the other sweeps.

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

The Amphipod, *Austrochiltonia subtenuis* produced the highest macroinvertebrate biomass in Bob's Lake followed by the various species of midge larvae. *Austrochiltonia subtenuis* is 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 in the burrowed in the damp soil until the next wetland infilling. Juvenile forms can also 'hitch' a ride from one wetland to another in the feathers of a waterbird.

Midge larvae (Chironomidae) are a diverse group of insects that are found in the sediments of most wetlands. The greatest abundance of midge larvae are usually observed in nutrient enriched fresh and saline wetlands. They mostly feed on detritus and micro-algae although *Procladius paludicola* is predatory, feeding on other midge larvae, nematodes and small invertebrates.

When the lake was visited on 16th February, there was a dense band of midge pupal exuviae being blown by the wind along the water's edge. The pupae were mostly from the species *Chironomus occidentalis* which generally does not tolerate salinities above 10ppt. The other three species of midge larvae all tolerate high levels of salinity. This would indicate a succession of species with changing salinity levels; *Chironomus occidentalis* dominating the biomass during the first fresh flush in the lake. As the lake water becomes more saline, the saline tolerant species would begin to dominate the biomass. The presence of Daphniid (water flea) eggs would also indicate the lake water had been fresher at some time in the recent past.

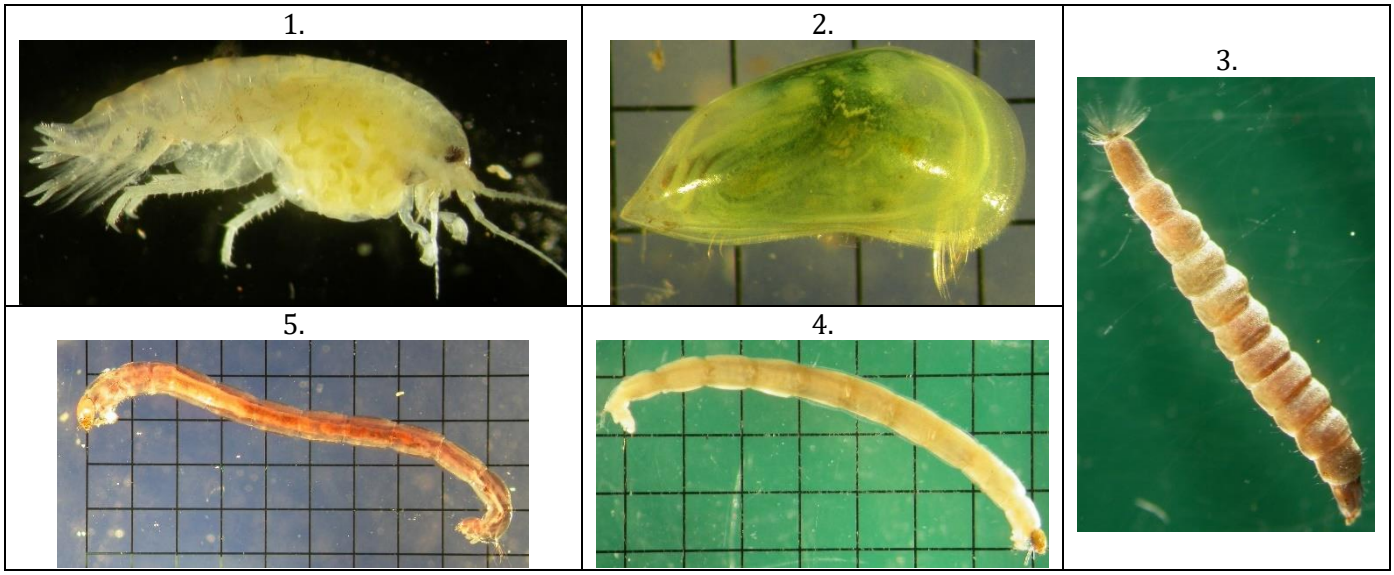

Figure 5: Macroinvertebrates common to Bob's Lake: 1. Austrochiltonia subtenuis with an egg mass under her thorax, 2. Mytilocypris tasmanica, 3. Stratiomyid larvae, 4. Cladopelma curtivalva and 5. Chironomus occidentalis. Note: the grids are in 1mm squares (images by G. Janicke).

The seed shrimp *Mytilocypris tasmanica* belong to the 'giant' ostracods being 3mm long. They are filter feeders that feed on plankton and can be found throughout the whole water column. They are highly salt tolerant. They produce drought resistant eggs but juveniles can also 'hitch' a ride on the feathers of waterbirds.

Stratiomyid larvae hatch into Soldier Flies which are usually metallic green or black with a wasplike appearance. The last abdominal segment of the larvae has a tuft of hairs which are used to break the surface tension of the water and draw air into the breathing tube. They can be seen hanging from the surface feeding on plankton and a tolerant of very high salinities. During the 16th February visit to the lake, several Eurasian Coots (*Fulica atra*) were observed swimming around and pecking at the surface.

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 were recorded from Bob's Lake and also are a food source for waterbirds.

The Hemipteran insects (*Micronecta* sp., *Agraptocorixa* sp. and *Anisops* sp.) generally only tolerate lower salinities (< 15 ppt) and the presence of a few individuals in the sweeps again is indicative that the lake is slowly increasing in salinity as the water levels decrease through evaporation.

What was also striking were the species NOT found in the lake. At the lower salinity levels recorded and with the abundance of macroinvertebrates present, I would have expected to find several aquatic beetles and damsel fly larvae in the lake. I have no explanation for their absence.

Table 1: Macroinvertebrate composition of Bob's Lake on 22 February 2017

				Northern Flats	Adjacent Hide	Southern Flats
	CLASSIFICATION	Taxon	Common name	Numbers present in 30m sweep (*estimated)		
Crustacean	Amphipoda Chiltoniidae	*Austrochiltonia subtenuis*	Scuds	1000 *	abundant	7000 *
	Ostracoda Cyprididae	*Mytilocypris tasmanica*	seed shrimp	abundant	abundant	210 *
	Ostracoda Cyprididae	*Diacypris spinosa*	seed shrimp	10		1 some
	Cladocera Daphniidae	Eggs unknown species	water fleas		many	
Insects	Diptera Chironomidae	*Cladopelma curtivalva*	Midge larvae	30	many	1260 *
	Diptera Chironomidae	*Tanytarsus barbitarsus*				
	Diptera Chironomidae	*Procladius paludicola*				
	Diptera Chironomidae	*Chironomus occidentalis*				
	Diptera Stratiomyidae	Undetermined larvae	Soldier flies		3	
	Diptera Dolichipodidae	Undetermined larvae			1	
	Hemiptera Notonectidae	*Anisops* sp. juvenile	backswimmer		1	
	Hemiptera Corixidae	*Agraptocorixa* sp.	water boatman		1	
	Hemiptera Corixidae	*Micronecta robusta*		1		
	Mollusc, Gastropoda Pomatiopsidae	*Coxiella* sp.	salt-lake snails	20	some	34

Plankton

The colour of Bob's Lake was yellow-green indicating the presence of a microalgae however, these were not collected in the plankton net. The plankton net used had a 70µm mesh (0.07mm) while microalgae are usually smaller.

Table 2: Plankton sweep composition

CLASSIFICATION	Comments
Copepoda	full sized animals and naupili (juvenile forms) – most abundant content of the net.
Rotifers	Not identified – also abundant.
Detritus	Empty shells (moultings) of crustaceans and insects.

Copepods are microcrustaceans and occurred in very high numbers in Bob's Lake. They can produce drought resistant eggs which will lie dormant in the sediment until the lake refills. Both copepods and rotifers form an essential part of the food chain, feeding on detritus, bacteria and microalgae and becoming the food source for larger invertebrates. They also form part of the diet for the filter feeding ducks.

BIRDS FEEDING GUILDS

Waterbirds can be placed into guilds based on their foraging behaviour and principle food sources. Table 3: Waterbird feeding guilds and species observed on salt lakes of the region is based on feeding guilds determined by Ecological Associates (2010). The swans were observed feeding with their heads right down in the water. They would have been feeding on the green algae *Lamprothamnium papulosum.* Three coots were observed moving back and forth in the middle of the lake, picking material from the surface. They would have been feeding on amphipods and seed shrimp and the occasional Stratiomyid larvae.

Table 3: Waterbird feeding guilds and species observed on salt lakes of the region

Feeding Guild	Bird species observed on salt sakes in the region
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 *Anas superciliosa*, Grey Teal *Anas gracilis*, Chestnut Teal *Anas castanea*, Blue-billed Duck *Oxyura australis*,
Ducks – diving in deep or shallow water. Dives for bottom dwelling animals, invertebrates, plant material, small fish.	Musk Duck *Biziura lobate*, Hardhead *Aythya australis* Australasian Grebe *Tachybaptus novaehollandiae* Hoary-Headed Grebe *Poliocephalus poliocephalus*
Filter-feeding duck - using special lamellae (grooves) along the edges of the bill to filter insects, crustaceans and a variety of plants from the water.	Australasian Shoveler *Anas rhynchotis*, Pink-Eared Duck *Malacorhynchus membranaceus*
Specialist - feed almost entirely on vegetable matter, supplemented with only a few insects, worms and fish.	Eurasian Coot *Fulica atra*,
Grazing – The Black Swan is a vegetarian. Grazing ducks eat algae, insects and molluscs or by grazing on grasslands.	Black Swan *Cygnus atratus*, Australian Shelduck *Tadorna tadornoides*, Australian Wood Duck *Chenonetta jubata,*
Waders, foraging in littoral zone & mudflats. Waders feed on insects, especially chironomids, crustaceans, molluscs, vegetation, seeds and roots.	Banded Stilt *Cladorhynchus leucocephalus*, Black-winged Stilt *Himantopus himantopus*, Common Greenshank *Tringa nebularia*, Common Sandpiper *Actitis hypoleucos*, Hooded Plover *Thinornis rubricollis*, Red-Necked Avocet *Recurvirostra novaehollandiae*
Other birds, generalist feeders - frogs, insects, small fish and crustaceans found in shallow wetlands or in open grassy areas.	White-Faced Heron *Ardea pacifica*, Silver Gull *Chroicocephalus novaehollandiae*

Based on Ecological Associates (2010).

Birds observed at Bob's Lake on 22nd February 2017 by Anne Bondin, Carol Trethowan and Liz Tanner were: Musk Duck, Black Swan, Australian Shelduck, Chestnut Teal, Wedge-tailed Eagle (flying above adjacent field), Eurasian Coot, Common Greenshank, Welcome Swallow (feeding above the lake surface) and Tree Martin (feeding above the lake surface).

CONCLUSIONS: WHAT MAKES BOB'S LAKE SO SPECIAL FOR BIRDS

Under the modified catchment conditions and greater input of freshwater, a greater number of salt sensitive aquatic plants and invertebrates have been able to germinate and grow. At the time of sampling, Bob's Lake was transitioning from a brackish or sub-saline condition to a saline lake. With this transition, the more salt tolerant species were the dominant species present.

In saline wetlands, invertebrates diversity is usually low, but with a high abundance of individuals for some of the species. This was evident at Bob's lake with two species of plankton invertebrates present in high numbers and three of the 13 species of macroinvertebrates present in high numbers. These three - scuds (Amphipods), midge larvae (Chironomids) and seed shrimp (large Ostracods) can be food sources for waterbirds from all the feeding guilds except the grazers. The saline tolerant algae (*Lamprothamnium papulosum*) is a food source for the grazing birds including swans.

As the lake water evaporates and salt levels increase, these abundant food sources will continue to thrive and feed the waterbirds. The constraint on food source growth and abundance is the salinity tolerance threshold for each species. For scuds (Amphipods), this is around 70ppt (Pinder *et al*, 2004) which is twice seawater. *Lamprothamnium* produces starch bulbils at high salinities which is also a waterbird food source but does not grow in salinities above 60ppt (Womersley, 1984).

There is possibly an opportunity to develop a citizen science monitoring program for Bob's Lake. This would involve community members measuring the salinity level of the lake and conducting a simple macroinvertebrate sweep to determine the dominant groups of macroinvertebrate present. Monitoring would take a few hours and could be done two or three times a year. The monitoring data, alongside rainfall data and lake water level data, would give an indication of the seasonal variations in the lake ecology and waterbird food sources. Training required for the community members to conduct the aquatic monitoring is relatively simple and would take a few hours.

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APPENDIX: SELECTED PHOTOS

Figure 6: Steve Janicke being watched by swans while measuring lake bed bathymetry (16th February 2017) (images by G. Janicke).

Figure 7: Students of Cranbrook Primary School prepare to collect macroinvertebrates from Bob's Lake. (22th February 2017) (image Jenni Loveland)

Figure 8: Students lining up to view water birds through the telescope with Ann Bondin. Bob's Lake (22th February 2017) (images by G. Janicke).