K'GARI SURVEY OF FRESHWATER LAKES AND STREAMS

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INTRODUCTION

K'gari (also known as Fraser Island) is the largest sand island in the world. In 1992 it was inscribed on the World Heritage List in recognition of its outstanding natural universal values. The island has formed over the past two million years as sand has been swept up from the Australian continental shelf to the south by currents, waves and wind (Moss 2016). The sand has formed dunes which have become vegetated with a range of ecosystem types including rainforest. Over 100 lakes have formed in depressions between the dunes and many freshwater streams flow off the slopes of the dunes to the sea. The lakes are 'perched' high above sea level on a substrate of pure silica sand which influences their water chemistry (Timms 1986). Although sandy substrates are typical of marine environments, it is relatively unusual to find so many freshwater habitats which have substrates entirely of sand. There have been previous studies of lakes on K'gari (e.g. Arthington et al. 1986, Arthington and Hadwen 2003, Moss 2016) but I know of no previous published studies of streams.

A pilot survey of four streams and two lake ecosystems on K'gari was undertaken in November 2019. The survey's main objectives were to undertake an assessment of the water quality of the wetlands with respect to basic physico-chemical parameters, invertebrate fauna and flora and to introduce the Butchulla Land and Sea Rangers to basic freshwater survey techniques.

METHODS

SURVEY LOCATION

A survey of four K'gari streams and two lakes was undertaken on 6-8 November 2019. The location of the island is shown in Figure 1 and the sampling sites are depicted in Figures 2-7.

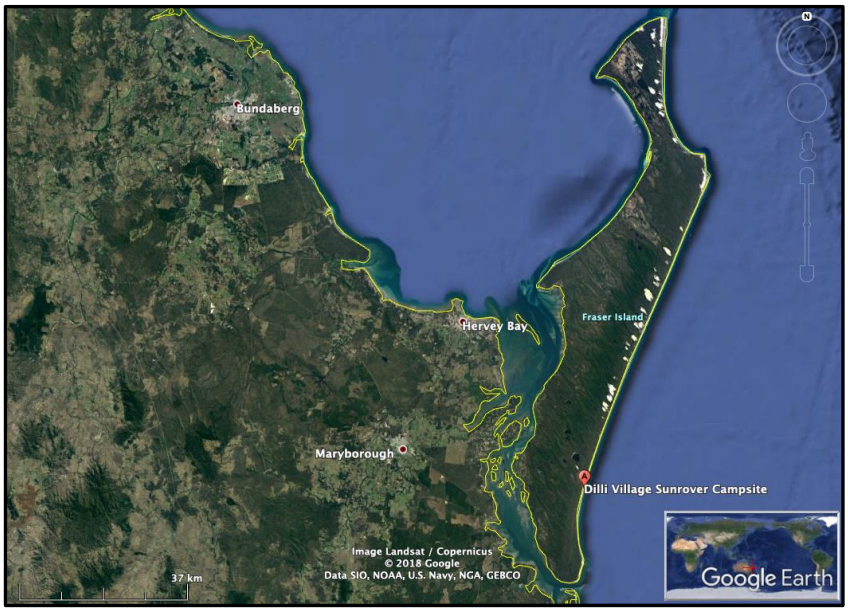

Figure 1. Location of K'gari.

SAMPLING METHODS

Water samples were collected and field observations were made at six sites (Figures 2-7) which were accessed by car. We measured water temperature, conductivity, pH, salinity and dissolved oxygen at each site using a hand held probe (Figure 7). Total dissolved solids were measured at four sites. We identified the dominant riparian vegetation and noted substrate types, leaf litter cover, canopy cover and aquatic vegetation.

A rapid survey of the aquatic invertebrates was made using a dip net. Fauna were identified in the field as far as possible and some samples were taken back to the lab at USC for identification using a dissecting microscope (10-40X magnification). Freshwater invertebrates exhibit a range of tolerance to pollution and other habitat degradation and so the presence or absence of taxa typically reflects the health of the aquatic environment.

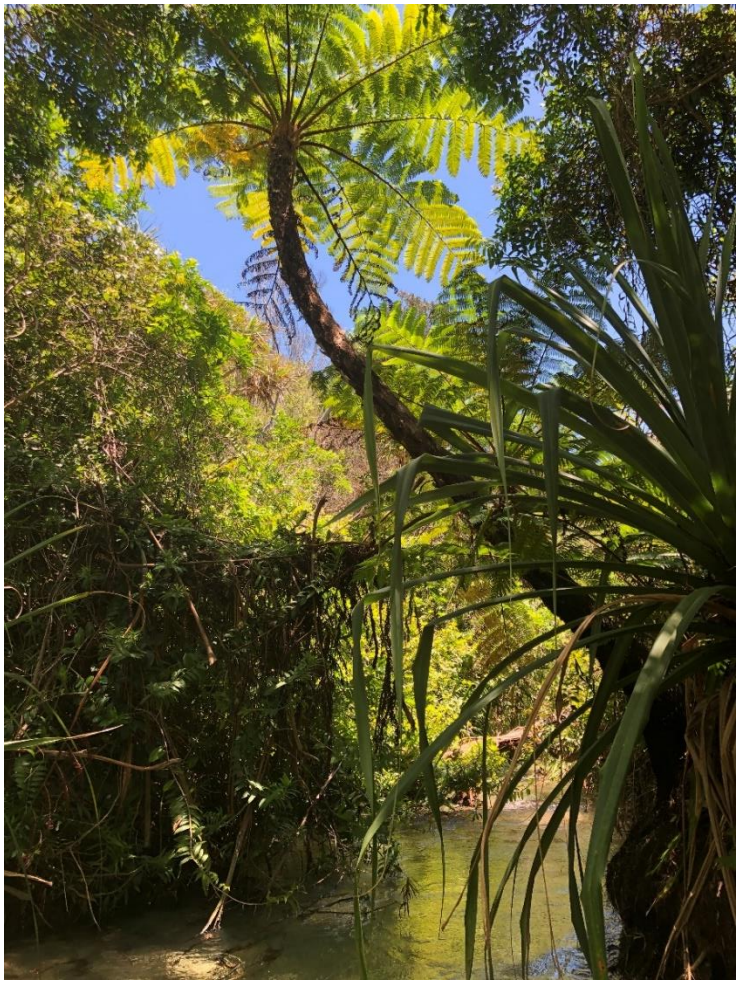

Figure 2. Eli Creek

Figure 3. Gerroweea Creek

Figure 4. Wanggoolba Creek

Figure 5. Lake Garawongera

Figure 6. Lake Boorangoora/McKenzie

Figure 7. Taking water chemistry measurements in Lake Boorangoora/McKenzie

RESULTS

Results of the survey are given in Tables 1 and 2. All the sites were slightly acidic (pH 4.8-5.88) in line with previous studies. They were all high in oxygen and very low in salinity, indicating that even the coastal streams were not affected by marine intrusion at the point and time of sampling. All sites had substrates entirely of sand. Some had a covering of leaf litter and detritus. Eli Creek showed signs of erosion downstream of the bridge due to the activities of tourists floating downstream on the current. Lake McKenzie was another site with a great number of tourists. Wanggoolba Creek also had heavy tourist traffic, but the tourists appeared to remain on the boardwalks and at the time of sampling they were not observed to enter the water. Wanggoolba Creek is a site of cultural significance for the Butchulla people because it used to be the site of a womans' birthing area. As such men are not meant to visit Wanggoolba Creek.

All sites had a surprisingly depauperate aquatic fauna, possibly due to the unstable, sandy substrate. All the insects found had flying adults – some of these adults are aquatic such as the Coleoptera and Hemiptera (beetles and bugs), but others are terrestrial – living in the water as juveniles, but then emerging to fly away as adults to mate and lay eggs (e.g. dragonflies – Odonata and mayflies – Ephemeroptera).

The most diverse fauna was observed at Wanggoolba Creek, Central Station. This was the only site where leaf shredding invertebrates were observed (leptocerid caddisfly larvae). The diverse riparian vegetation with tall trees provided both shade and a source of food (leaves), which would be broken down by shredding invertebrates and the nutrients made available to other stream inhabitants such as mayfly nymphs and shrimps.

The presence of Cyanophyta (blue-green algae) which was observed in the two lakes, can be an indication of nutrient enrichment.

Table 1. K'gari field data

SITE	Eli Creek	Wyuna Ck	Gerroweea Ck	Central Station Wanggoolba Ck	Lake Garawongera	Lake McKenzie
Temperature - Air			23.5	22		28
- Water	21.35	21.9	22.6		26.7	26.8
Size - Depth		0.9 m	0.5 m	0.24 m	5.5 m (maximum)	9 m (maximum)
Width		0.4 m	3 m	6 m	1.6 km x 400 m	1.2 km x 1 km
Flow Rate		0.1 m/sec	0.1- 0.3 m/sec	0.25 m/sec	-	
pH	5.23	5.33	5.32	5.03	5.88	4.80
Conductivity µs/cm	232	275	276	187	210	186
Salinity PSU (= ‰)	0.07	0.09	0.11	0.06	0.07	0.06
Total Dissolved Solids (mg/L)				119	137	119
Oxygen ppm (%)	92.3	74.6	71.8	82.60%	111	106.90
Substrate % composition Bedrock, boulders cobbles, gravel, sand	Sand	Sand	Sand	Sand	Sand	Sand
Leaf litter cover %	0%	0%	0%	20%	10%	80% on edges, 0 deeper
Canopy cover %	90%	5%	0%	80%	0%	0%
Aquatic Vegetation	Green aquatic plant	*Spirogyra* (green algae)	*Lepironia articulata* (sedge), *Nymphaea* (water lily), red algae, *Cycnogeton* (water ribbons)	None observed. Biofilm	Blue green algae, Sedge, branched red cyanophyta	Lepironia, blue green algae, filamentous algae
Riparian Vegetation	Tree ferns, other ferns, Pandanus	Coastal dune heathlands: *Casuarina, Pandanus, Banksia* , Creeping wheat grass	Coastal dune heathlands: *Casuarina, Pandanus, Banksia* , Creeping wheat grass, pigface, *Melaleuca quinquenervia, Acacia*	Rainforest: satinay (*Syncarpia hillii*), brush box (*Lophostemon confertus*), blue quandong, red gums, scribbly gums, piccabeen palms, tree ferns (*Angiopteris*),	*Melaleuca quinquenervia*	*Melaleuca quinquenervia*
Fauna observed	Mayflies, shrimp	Jungle perch, shrimp, mayflies, dipteran larvae, pyralid larva	Longfin eel (Anguilla reinhardti), Firetail gudgeon, shrimp, yabbies,	Caddisflies, mayflies, shrimp, fish	Freshwater turtles, mites, dragonflies	Mayflies, purple spotted gudgeon, red chironomids, mites, shrimp, freshwater turtles

Table 2. K'gari freshwater fauna and flora

Phylum	Class	Order	Suborder	Family	Subfamily	Genus	Common Name	Eli Creek	Wyuna Ck	Gerroweea Ck	Wanggoolba Ck	Lake Garawongera	Lake McKenzie
Rotifera	Monogonota						Rotifer	x	x	x			
Ciliophora							Ciliated protozoa	x	x	x			
Tardigrada							Tardigrade/water bear			x			
Arthropoda	Crustacea	Ostracoda					Seed shrimp			x			
		Copepoda				*Calamoecia tasmanica*	Copepod						xxx
		Cladocera					Water flea			x			
		Decapoda	Caridea	Palaemonidae		*Macrobrachium*	Shrimp						xx
			Caridea	Atyidae		*Caridina*	Shrimp	xxx	xx	xx	xxx		
			Caridea	Parastacidae		*Cherax*	Yabby			x	xx		
Arthropoda	Insecta	Odonata		Libellulidae			Dragonfly				x	x	x
		Hemiptera		Veliidae			Velvet water bug						x
				Gerridae			Water strider				xx		
		Coleoptera		Gyrinidae			Whirligig beetle (adults)			x			
				Elmidae			Beetle larva				xx		
		Diptera		Chironomidae	Chironominae	*Chironomus*	Midge Larva		x				
					Chironominae	spp.	Midge Larva		x		xx		xx
					Tanypodinae		Midge Larva						
				Simuliidae			Blackfly larva		x				
		Trichoptera		Leptoceridae			Caddisfly larva				xx		
		Lepidoptera		Acentropinae		*Eophyla* sp?	Moth larva (caterpillar)		x				
		Ephemeroptera		Baetidae			Mayfly nymph	xxx	xxx				xxx
				Leptophlebiidae			Mayfly nymph				xx		
Arthropoda	Arachnida/ Subclass Acari	Trombidiformes					Water Mite	x	x	x	x	xx	
	Arachnida			Aranae			Spider		x				
Algae													
Chlorophyta						*Spirogyra*	Green filamentous algae		x				xx
Ochrophyta	Bacillariophyceae						Diatoms				x		
Cyanobacteria							Blue green algae					xxx	xxx
Flowering Plants						*Nymphaea*	Water lily			xx			
						Lepironia articulata	Sedge			xx		xx	xxx
						Cycnogeton	Water ribbons			xx			
						Utricularia	Bladderwort						

DISCUSSION

The water in the lakes and streams of K'gari was slightly acidic with a pH of 4.8 to 5.88. This is probably due to humic acids leaching from the dead vegetation either along the banks or washing in from the catchments. The water at all sites was high in oxygen indicating that they are a good habitat for aquatic organisms which acquire oxygen from the water such as fish, dragonfly and mayfly nymphs, chironomid larvae etc. Some aquatic invertebrates and vertebrates such as water beetles and turtles obtain oxygen from the air and so can cope with low oxygen levels. When lakes and streams have high inputs of nutrients (e.g. from sewerage or fertilizers) algae can bloom, forming thick mats which may then die as the top algae layers shade the algae beneath. As the algae decompose they then cause a decrease in oxygen levels which can kill the fauna, particularly fish. This could happen in K'gari streams if water levels are very low and the streams form pools. The presence of Cyanophyta (blue-green algae) can be an indication of nutrient enrichment. Some species of Cyanophyta are toxic to humans and other animals. The electrical conductivity at all sites was low (below 300 µS), indicating that the water was not polluted.

Despite the good quality of the water, the freshwater fauna of the streams and lakes appeared to be quite depauperate – low in abundance and diversity. This is likely to be due to:

1. Low nutrients in the sandy substrate
2. Instability of the sandy substrate:
    a. Sand is not a good habitat for many species which require rocks or other stable surfaces
    b. Unvegetated or poorly vegetated sand dunes can move causing the lakes and streams to be modified or even obliterated
3. K'gari is a relatively young offshore island

Many freshwater faunal groups were not observed and are likely to be absent from the island. These include molluscs – possibly due to low calcium levels in the water and Plecoptera (stoneflies) – possibly due to the sandy substrates, fairly high temperatures and distance from source populations (stoneflies are poor fliers). Other insect orders such as the Odonata (dragonflies), Coleoptera (beetles), Ephemeroptera (mayflies) and Trichoptera (caddisflies) were represented by only a few taxa.

K'GARI LAKES AND STREAMS: CONSERVATION VALUE

The lakes and streams of K'gari are clearly of High Conservation Value with respect to provision of vital ecosystem services:

- Biodiversity of flora and fauna
- Habitat for rare or endangered species (e.g. Fraser Island Short-necked Turtle *Emydura macquarii nigra* McCord et al., 2003)
- Source of water for terrestrial fauna
- Climate regulation through influence the on water cycle and carbon sequestration in soils and biomass of vegetation
- Recreation
- Natural and aesthetic values

K'GARI LAKES AND STREAMS: THREATS

The lakes and streams are under threat particularly from:

- Tourism/recreation activities e.g. A total of around 111,000 vehicles were recorded visiting Lake McKenzie in 2015 (Moss 2016). The banks of Eli Creek were eroded where tourists had access
- Fire
- Sea level rise due to climate change – this will particularly impact the coastal streams and swamps
- Introduced exotic species such as cane toads and weeds
- Litter – especially plastics - from tourists and brought in to streams by the ocean

MITIGATION OF THREATS

- Restriction of tourist access
- Rehabilitation of eroded banks of streams through replanting with native species
- Removal of introduced species such as cane-toads and weeds
- Maintenance of healthy coastal ecosystems will help to mitigate the impact of sea-level rise. This is particularly true for the carbon-sequestering and sediment accreting habitats such as mangroves and Melaleuca swamps
- Banning use of sunscreens and other skin care chemicals or promoting the use of ecosystem-friendly products (where they exist) for swimmers in lakes and streams
- Banning swimming in culturally significant lakes and streams
- Waste prevention, waste minimization, clearing of rubbish

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