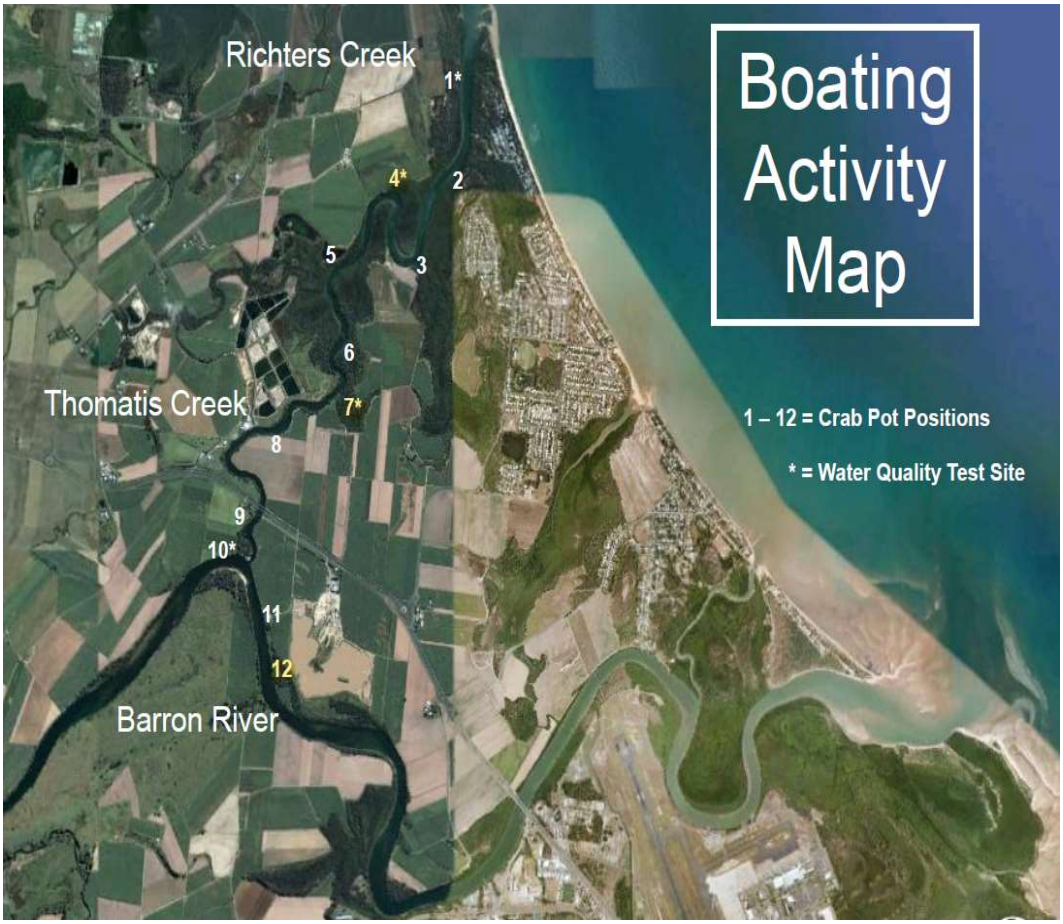
Holloways Beach Environmental Education Centre

Field Study- Boating

1. Site orientation and crab survey
2. Bird survey
3. Survey analysis including Simpson's Diversity Index
4. Water testing and site evaluation



Boating and Crab pot map

The numbers on the map indicate where HBEEC have been surveying crab data for over two decades.

Water Quality results are taken at sites 4, 7 and 12.

Historical data on crabs, birds and water quality is available from HBEEC to compare to your data.

Your Crab catch

M/F	Pot no.	Size (mm)	Tide

Thomatis/Richters Creek

History: Indigenous occupation of the Cairns area dates back at least 5,100 years from primary evidence and over 40,000 years according to secondary evidence. The lower coast area between Cairns and Port Douglas in which the Thomatis/Richters Creek is situated, are the traditional lands of the Yirrganydji people. Their country extends to the islands and reefs off Trinity Inlet including Green and Double islands. The Cairns area attracted European settlement in the late 1870s after gold was discovered further north. Both Thomatis and Richters creeks were named after European settlers in the area. Whilst initially separate creeks, over time they have changed course and merged. The merge point can be seen near crab pot 5 on the map above.

Current use: The system is used for recreational fishing, crabbing and boating and flow is affected by rainfall, groundwater and human use such as the dams from the Barron Gorge Hydroelectric Power Station. Adjacent land use ranges from suburban housing to farming, roadways, a dump (inland from pot number 11) and boat ramps. HBEEC use the lower system for educational boat tours and environmental research.

1. Bird Survey

Methodology

This study was completed with Holloways Beach Environmental Centre staff on Thomatis/Richters Creek. Birds were sighted from 4.3m boats travelling through the system and identified using HBEEC booklets.

- Data was taken in_____ (season) on ____/____/___ (date).
- Tally start time _____ end time_____ duration____ hours and _____minutes
- Tide_____ Moon phase_____ Recent rainfall: high/ medium/ low/ none

Species	Tally (n)	n(n-1)	Species	Tally (n)	N(n-1)
Aust. White Ibis			Osprey		
Azure kingfisher			Pelican		
Beach Thick Knee			Rainbow Bee-eater		
Black Butcherbird			Sacred Kingfisher		
Black kite			Silver Gull		
Brahminy Kite			Torres Strait Pigeon		
Darter			Welcome Swallow		
Eastern Curlew			Whimbrel		
Forest Kingfisher			Whistling Kite		
Great Egret			White-bellied Sea Eagle		
Great-billed Heron			White-breasted Woodswallow		
Gull-billed Tern			White-faced Heron		
Indian Myna			Willy Wagtail		
Laughing Kookaburra					
Mangrove Heron					
Mangrove Kingfisher					
Masked Lapwing					
Orange-footed Scrub fowl					
TOTAL	N=	**Σ n(n-1) =**			

Which species was/were most prevalent?

What type of birds (waders/ raptors/ small tree-dwelling/ other) were the most abundant? Why do you think this might be the case?

List 2 biotic and abiotic factors that may affect the species diversity		
Factor	**Affect if high levels/numbers**	**Affect if low levels/numbers**
Biotic 1.		
Biotic 2.		
Abiotic 1.		
Abiotic 2.		

Evaluating biodiversity, species richness, and evenness, using Simpson's Diversity Index

Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present (richness), as well as the abundance of each species (evenness).

$$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)}\right)$$ Where:

- n is the total number of individuals of a particular species
- N is the total number of organisms of all species

∑ n (n-1) is the sum of all species calculations of n(n-1)

SDI ranges between 0 and 1:

The closer the SDI is to 1, the more diverse the community. This means that there are many different species without overly dominant species.

The closer to zero, the less diverse; predominantly or entirely one species

Calculate SDI for your data:

$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)}\right)$	

What is the Simpson's Diversity Index derived from the survey?_____

What does this suggest about the diversity of birds within the Richters/Thomatis Creek ecosystem?

Richness?

Evenness?

Diversity?

If you were to complete the same survey once a month throughout the year, do you think that the SDI would fluctuate significantly? Why/ why not?

Bird survey methodology.

Use the chart below to determine the type of survey conducted by HBEEC.

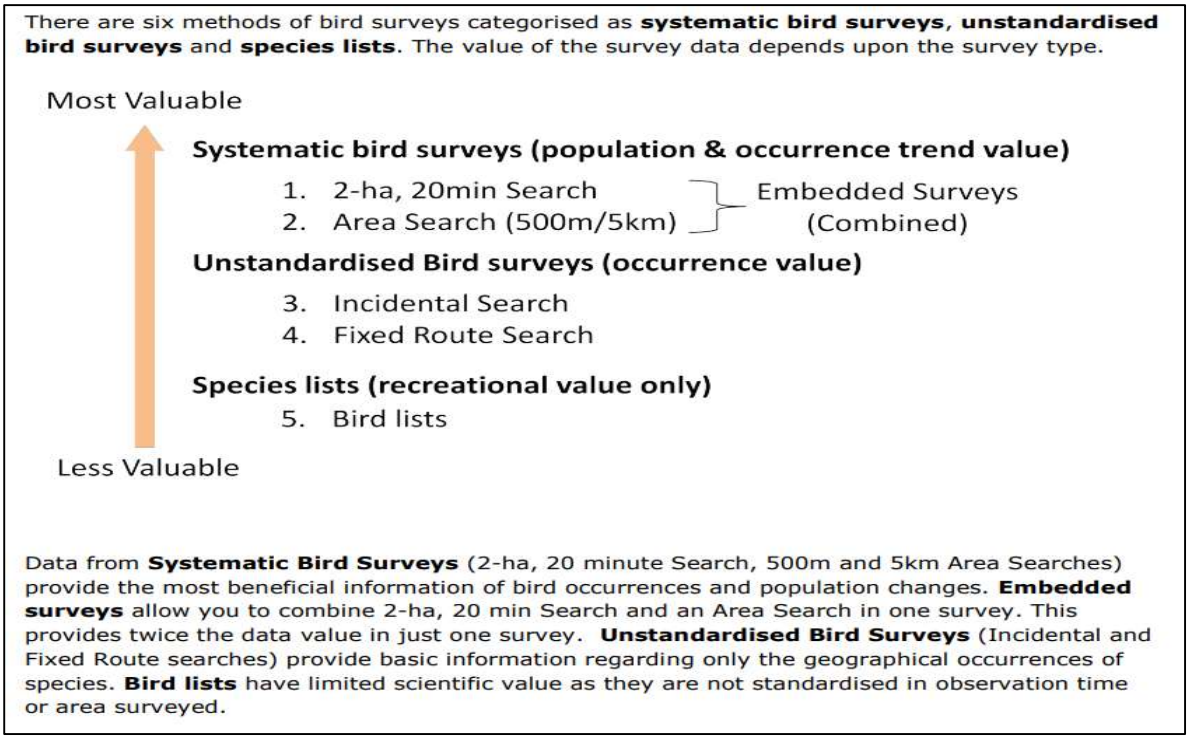


Figure 1: Types and Validity of Surveys. Sourced from Table sourced from: https://birdata.birdlife.org.au/wp-content/uploads/2015/04/Survey-Techniques-Guide.pdf

According to the chart, what type of survey does the HBEEC Centre survey methodology constitute?

How accurate do you think that the HBEEC methodology is? Excellent/good/fair/slightly inaccurate/unreliable

What are the advantages/disadvantages of using this methodology?

Advantages	Disadvantages

Name 3 or more issues with the data reliability and offer a way to improve.

Data issue/Limitation	How it might affect data (potential error)	Suggestions for improvement (modification) (reduce error or improve validity of results)

4. Water Testing and Site Evaluation

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Thomatis Creek Water Quality Testing

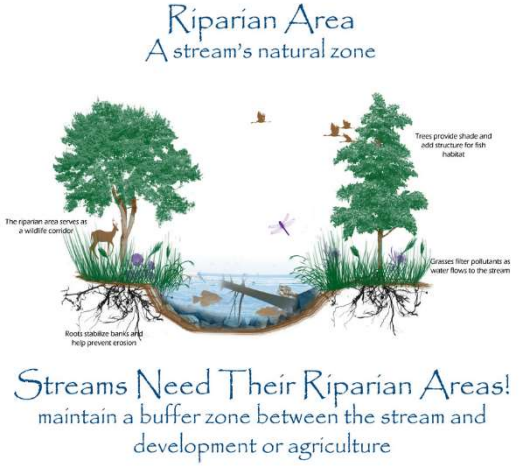
- **Date:** **Vessel:**
- **Weather Observations:**
- **Samples taken by:**

Site	GPS Location	Time	Site Evaluation Score		Observations: Eg. Human impacts and dominant species	Temp (°C)	Flow rate	pH	D.O.		Sal (ppt)	Turb (JTU)
			Vegetation Score	Erosion Score					mg/l	% sat		
Site 1(pot 4) surface (20cm)	S16°50'03", E145°43'39"											
>1m												
Site 2(pot 7) surface (20cm)	S16°50'42", E145°43'23"											
>1m												
Site 3(pot 12) surface (20cm)	S16°51'29", E145°43'03"											
>1m												

Excellent	Good	Fair	Poor	Very Poor
Bank vegetation				
(5) Mainly undisturbed native vegetation extending at least 5m back from water's edge. No signs of site alteration.	(4) Mainly native vegetation extending several meters back from water's edge. Little disturbance or no signs of recent site disturbance.	(3) Medium cover, mixed native/ introduced. Or one side cleared, the other undisturbed or less than 2m of healthy riparian area.	(2) Introduced ground cover, reduced native tree cover, predominantly introduced vegetation.	(1) Introduced ground cover with lots of bare ground, occasional tree. Also includes sites with concrete-lined channels.
Bank erosion and stability				
(5) Stable; no erosion/ sedimentation evident. No undercutting of banks, usually gentle bank slopes. Lower banks covered with root mat grasses, reeds or shrubs.	(4) Only spot erosion occurring. Little undercutting of bank, good vegetation cover, usually gentle bank slopes, no significant damage to bank structure.	(3) Localised erosion evident. A relatively good vegetation cover. No continuous damage to bank structure or vegetation.	(2) Significant active erosion evident especially during high flows. Unstable, extensive areas of bare banks, little vegetation cover.	(1) Extensive or almost continuous erosion. Over 50% of banks have some form of erosion; very unstable with little vegetation cover.

A riparian zone/area is the interface between land and a river or stream. This is typically where mangroves grow. Their health is affected by numerous factors such as adjacent land use, wash from boats, invasive species, pollution and dieback due to factors such as poor water quality.

Mangroves protect our shores from erosion and tidal surge and protect our water by filtering out nutrients and other pollutants like our kidneys filter our blood. Mangroves also provide homes and food sources for innumerable terrestrial and aquatic species and are a key contributing factor in the health of coastal reef systems.



Water Testing- what, how and why

Test	Measurement units	What does it measure?	How is it measured? (all probes are calibrated at HBEEC)	Influencing factors	Impact on ecosystem	Water Quality objective
Temperature	Degrees Celsius (◦C)	The heat of a substance	Via probe at 20cm and 1+m depth	Flow, rainfall, salinity, surface cover, turbidity, atmospheric temperature, shade groundwater etc.	Organisms rely on specific temperature windows for survival. Too hot or too cold and organisms fail to thrive or die.	Seasonal variance ≈16-28◦ C
pH (potential of hydrogen/ power of hydrogen)	1-14 Lower=acidic 7 = neutral Upper = alkaline	The number of loose hydrogen (hydroxyl, H+) ions in a solution. More H+ = more acidic.	Via probe which detects H+ by using a buffer solution inside a glass membrane and measuring the potential between the internal buffer and the external solution.	Flow, rainfall, bank composition, pollution, fertiliser run off etc.	If water is too acidic or too alkaline it can severely inhibit growth, reproduction or survival of species.	6.4 (fresh water) to 8.4 (salt sinks) Seawater ≈ 8 Fresh≈ 6.5-7.5
Dissolved oxygen (DO)	mg/L or ppm or % saturation	The amount of oxygen accessible for aquatic organisms for essential life processes such as respiration (breathing).	DO probes measure the oxygen that diffuses across a membrane. This induces a chemical reaction and an electrical signal. The signal is read by the DO probe and is displayed on a meter.	Water temp, atmospheric availability (molecular oxygen), photosynthesis, flow etc.	Too little- mass die offs of single or multiple species. 0-2 mg/L: not enough oxygen to support life 2-4 mg/L: only a few fish and aquatic animals can survive 4-7 mg/L: good for many aquatic animals 7-11 mg/L: very good for aquatic life	>4ppm/ mg/L or 80-105% saturation
Salinity	Ppt/ppm	The amount of salt in a liquid.	The probe measures the conductivity of the water, salt dissolved in water increases conductivity. The more salt, the more conductive the water.	Tide, flow, distance from ocean etc.	Organisms rely on specific salinity windows for survival. Some organisms are tolerant of different levels, but generally, too much variation will see organisms fail to thrive or die.	0-35ppk (ocean≈35ppk)
Turbidity	NTU Nephelometric Turbidity Units (Jackson units)	The clarity/cloudiness of a liquid. A measurement of the amount of light that is scattered by material (suspended solids) in the water when a light is shined through the water sample.	1. Via Secchi disc or turbidity tube reading on site. 2. Via a water sample tested in the lab.	Rainfall, soil types, stormwater runoff, pollution, tidal flow etc.	Suspended solids can quickly cause water quality deterioration through increasing temp, lowering DO and preventing light from reaching aquatic plants.	<10 NTU

Test	Measurement units	What does it measure?	How is it measured? (all probes are calibrated at HBEEC)	Influencing factors	Impact on ecosystem	Water Quality objective
Dissolved Inorganic Nitrogen (DIN)	mg/L	DIN = ammonia + nitrate + nitrite which is derived from inorganic sources both natural and manmade e.g. fertilisers, chemicals.	Water sample taken and tested in a lab.	Rainfall, adjacent land use, stormwater runoff, pollution, tidal flow etc.	DIN, TN, DIP and TP are all forms of nutrients. Excess nutrient flow may result in algal outbreaks and subsequent outbreak of algal eaters such as Crown of Thorns sea stars. It may also result in the eutrophication of lakes and estuaries which can mean high water temperatures, acidification, low oxygen (hypoxia) and death of organisms. Even a modest increase in phosphorus or nitrogen can set off a whole chain of undesirable events in a waterway.	<0.03 mg/L
Total Nitrogen (TN)	mg/L	Ammonia, nitrate and nitrates derived from both organic and non-organic substances. Dissolved and suspended.	Water sample taken and tested in a lab.	Soil types, rainfall, adjacent land use, stormwater runoff, pollution, tidal flow etc.		<0.250 mg/L
Dissolved Inorganic Phosphorus (DIP) AKA orthophosphate or soluble reactive phosphorus	mg/L	Dissolved phosphorus derived from non-living sources or bacterial decomposition of organic matter. Inorganic phosphorus is the form required by plants.	Water sample taken and tested in a lab.	Rainfall, flow, adjacent land use, decomposing matter, salinity etc.		<0.005 mg/L
Total Phosphorus (TP)	mg/L	All forms of phosphorus in the sample organic, inorganic, dissolved and suspended. Animals can use either organic or inorganic phosphate.	Water sample taken and tested in a lab.	Rainfall, flow, adjacent land use, decomposing matter, salinity etc.		<0.02 mg/L
Chlorophyll a (Chl a)	µg/L	Green pigment found in plants which absorbs sunlight and converts it to sugar during photosynthesis.	Water sample taken and tested in a lab.	Rainfall, flow, tides, nutrients, water and atmospheric temp, sunlight etc.	Concentrations are an indicator of algal abundance. Higher concentrations indicate poor water quality due to stagnant water, high temps or excess nutrients.	Less than 3µg/L
Intestinal Enterococci	CFU/100 mL colony forming units	Enterococci are bacteria that live in the intestinal tracts of warm-blooded animals, including humans.	Water sample taken and tested in a lab.	Animal effluent, sewerage leakage etc.	Indicate possible contamination of streams and rivers by fecal waste. May cause severe illness.	

Estuaries are biologically productive transition zones between land and sea that play a vital role in transforming, recycling, and sequestering nutrients and organic matter, thus influencing nutrient loading to coastal and marine systems.

Historical water quality data

	DATE	Time	Tide		Water Temp	PH	D.O. Dissolved ox	Salinity (ppt)	Turbidity	DIN Nitrogen (mg/L)	Ammonia (mg/L)	TN Total Nitrogen (mg/L)	DIP osphorous (mg/L)	TP rous (mg/L)	Chlorophyll phyll a (µg/L)	Baterial ent- erococci (CFU)	Readings taken by
SITE 1	15/03/2018	11:01	Outgoing	Surface	25.6	7.04	5.4	9.42	17	0.05	0.05	0.39	0.01	0.04	2.6	88	Woree SHS Yr 11s
				1m	25.5	7.05	5.16	9.96									Woree SHS Yr 11s
	18/05/2018	10:30	High	Surface					5.6	0.14	0.05	0.32	0.01	0.02	4.1	Not tested	Ravenshoe SHS Yr 11/12
				1m													Ravenshoe SHS Yr 11/12
	25/06/2018	11:53	Outgoing	Surface	18.3	5.84	6.7	10.5	8.9	0.05	0.02	0.32	0.01	0.02	1.8	21	Ravenshoe Yr 11s
				1m	17.8	6.15	6.63	10.42									Ravenshoe Yr 11s
	DATE	Time	Tide		Water Temp	PH	D.O. Dissolved ox	Salinity (ppt	Turbidity	Nitrogen (mg/L)	Ammonia (mg/L)	Total Nitrogen (mg/L)	osphorous (mg/L)	rous (mg/L)	phyll a (µg/L)	erococci (CFU)	Readings taken by
SITE 2	15/03/2018	11:10:00 AM	Outgoing	Surface	12.2	6.25	5.38	9.12	21	0.06	0.03	0.4	0.01	0.03	<1	140	Woree SHS Yr 11s
				1m	24.8	6.2	5.35	9.76									Woree SHS Yr 11s
	18/05/2018	11:00	High	Surface	12.2				6	0.06	0.03	0.33	0.01	0.02	4.5	Not tested	Ravenshoe SHS Yr 11/12
				1m	22.1												Ravenshoe SHS Yr 11/12
	25/06/2018	12:07	Outgoing	Surface	17.6	6.24	7.13	5.47	8.8	0.04	0.02	0.34	<0.01	0.02	1.3	25	Ravenshoe Yr 11s
				1m	17.4	6.1	6.89	6.03									Ravenshoe Yr 11s
	DATE	Time	Tide		Water Temp	PH	D.O. Dissolved ox	Salinity (ppt)	Turbidity	Nitrogen (mg/L)	Ammonia (mg/L)	Total Nitrogen (mg/L)	osphorous (mg/L)	rous (mg/L)	phyll a (µg/L)	erococci (CFU)	Readings taken by
SITE 3	15/03/2018	11:56	Outgoing	Surface	25.9	6.34	5.67	9.01	19	0.12	0.03	0.38	0.01	0.03	<1	170	Woree SHS Yr 11s
				1m	24.9	6.23	5.56	9.32									Woree SHS Yr 11s
	18/05/2018	11:20	High	Surface	13.3				4.1	0.1	0.03	0.36	0.01	0.02	3.7	Not tested	Ravenshoe SHS Yr 11/12
				1m	22.1												Ravenshoe SHS Yr 11/12
	25/06/2018	12:30	Outgoing	Surface	19.5	6.04	7.33	8.44	6	0.06	<0.02	0.32	<0.01	0.02	1.3	35	Ravenshoe Yr 11s
				1m	19.6	5.89	7.15	8.19									Ravenshoe Yr 11s

Use the water testing information on the previous pages to answer questions about the historical data above.

1. Which site had the highest turbidity reading? _____ Which date did this occur? _____

2. How might the high turbidity have impacted the other readings on this date? Give examples.

3. Are salinity readings generally higher at the surface or at ≈1m depth? _____ Explain why this trend might occur.

4. On which date were chlorophyll levels highest? _____

a) What could have caused this?

b) How might these high levels have impacted upon the Mangrove ecosystem and the reef?

Article re the loss of seagrass at Waquoit Bay due to excess nutrients: https://www.whoi.edu/press-room/news-release/excess-nutrients-lead-to-dramatic-ecosystem-changes-in-cape-cods-waquoit-bay/

Article on COTS and how nutrient load affects numbers: https://www.aims.gov.au/research-topics/marine-life/crown-thorns-starfish