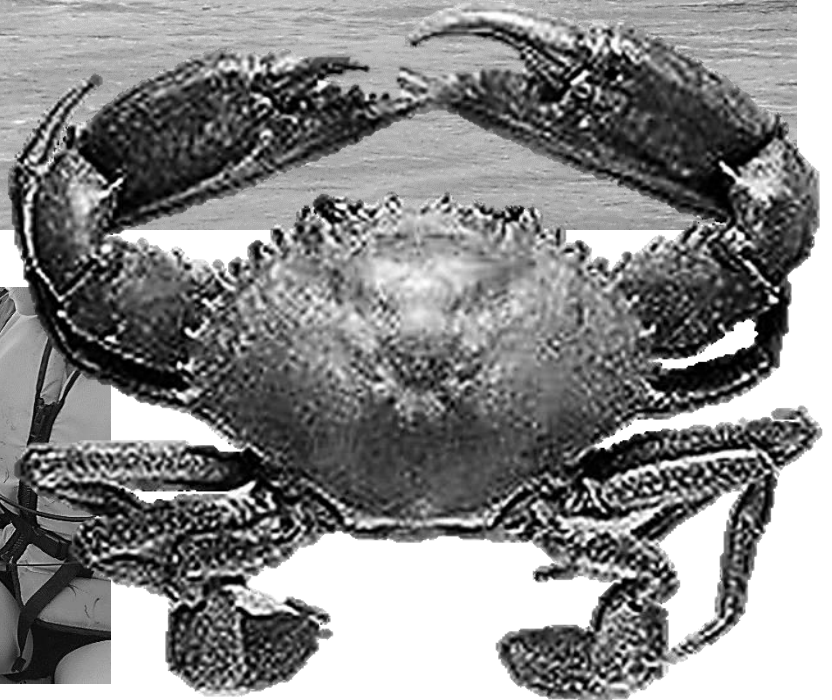


*Holloways
Beach***Environmental
Education Centre**

- Data contributed by: Holloways Beach Environmental Education Centre (HBEEC)
- Water Quality Parameters with thanks to Richard Hunt from Terrain NRM
- Laboratory water testing done with the support of Cairns Regional Council and Dr. Lynne Powell. For live water quality data and learning resources visit: <https://www.cairns.qld.gov.au/water-waste-roads/water/smartcatchments/live-data-saltwater-creek2>

marineeducation.com.au



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Published by Marine Education 2020
ABN: 48765406873
Gail Riches
PO Box 394
Bli Bli Qld 4560
Email: info@marineeducation.com.au
www.marineeducation.com.au

Data provided by Holloways Beach Environmental Education Centre
46 Poinsettia Street
Holloways Beach, Cairns, Qld. 4878
Phone 4055 9300
www.hollowaysbeacheec.eq.edu.au/

Water Quality Parameters with thanks to Richard Hunt from Terrain NRM at www.terrain.org.au

Laboratory water testing conducted with the support of Cairns Regional Council and Dr. Lynne Powell

Interested persons are invited to contact the author for information or to indicate errors and omissions.

The purpose of this booklet is to *make observations* using data kindly donated by Holloways Beach Environmental Education Centre (HBEEC). The data consists of: (1) Mud Crab data and, (2) Water Quality data.

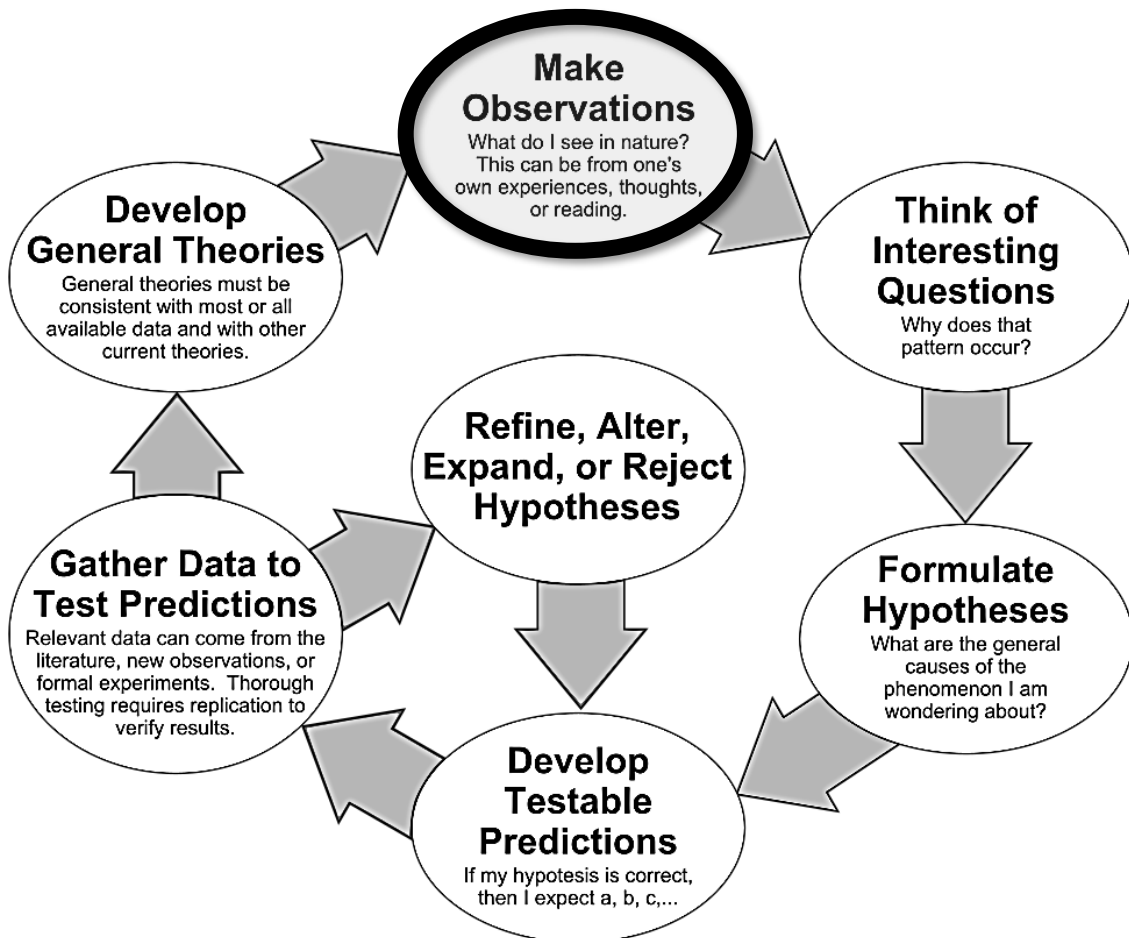


Figure 1: The Scientific Method as an ongoing process ^[1].

You can access the original data files at www.marineeducation.com.au
 Updated HBEEC water quality and further resources available at HBEEC biology overview at:
<https://hollowaysbeacheec.eq.edu.au/supportandresources/formsanddocuments/documents/biology%20at%20hbeec.pdf>

Q. What is the purpose of this booklet? Ans.

^[1] ArchonMagnus (2015). *The scientific method as an ongoing process*. Wikimedia Commons. Accessed 26.01.2020 from: https://commons.wikimedia.org/wiki/File:The_Scientific_Method_as_an_Ongoing_Process.svg

Make Observations

Study Sites

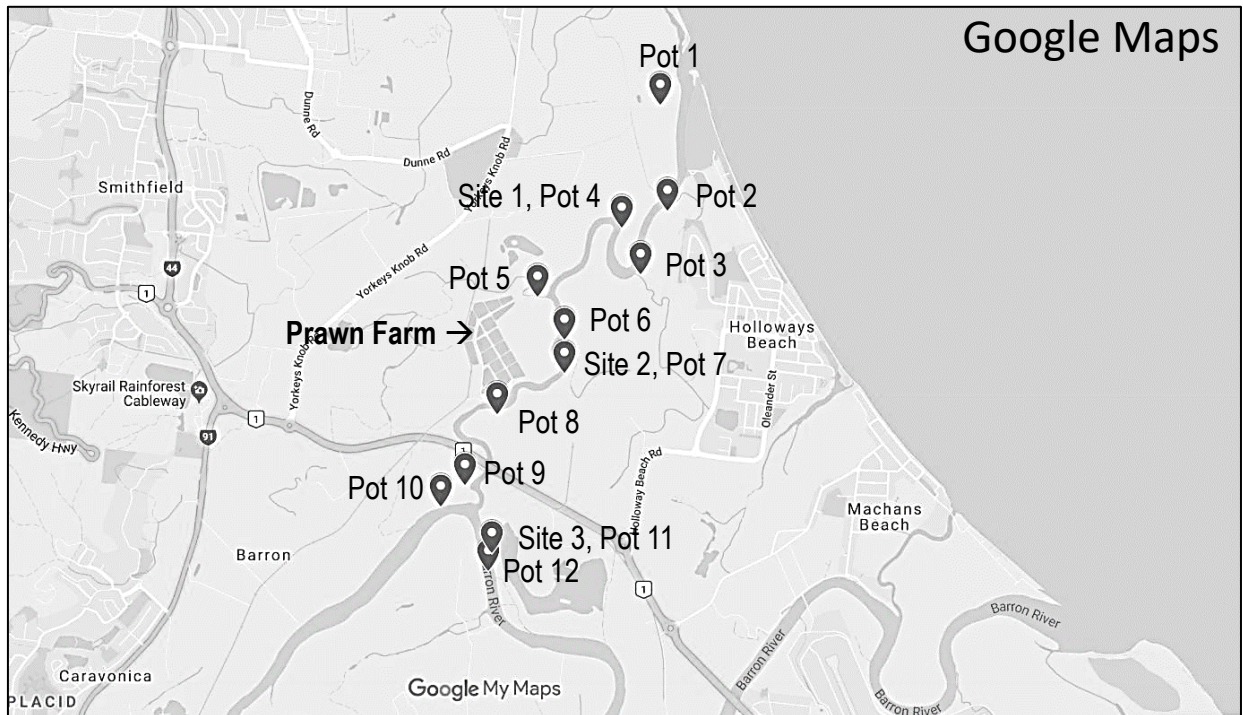
Name:

Date:

Activity: Familiarise yourself with the study sites at Holloways Beach Environmental Education Centre. *Hint: copy/paste the latitude and longitude coordinates into google maps (satellite view)*

Location: Barron River (Richters Creek and Thomatis Creek)

- Site 1 (Water Quality Data) and Pot 4 (Crab data): **S16° 50'03.72", E145° 43'39.27"**
Lush Riparian Mangroves and muddy banks. Slow-moderate flow. Depth approximately 6m.
- Site 2 (Water Quality Data) and Pot 7 (Crab data): **S16° 50'42.12", E145° 43'23.41"**
Slightly downstream from *All Panderosa Prawn Farm*. Moderate riparian vegetation bordered by agriculture. Moderate flow. Depth approximately 3m.
- Site 3 (Water Quality Data) and Pot 11 (Crab data): **S16° 51'29.88", E145° 43'03.30"**
Limited riparian area bordered by agriculture, bamboo thicket and Northern Sands Waste Management site. Moderate flow. Depth approximately 3m.
- Pots 1, 2, 3, 5, 6, 8, 9, 10, 12 (Crab data only): see crab pot map below



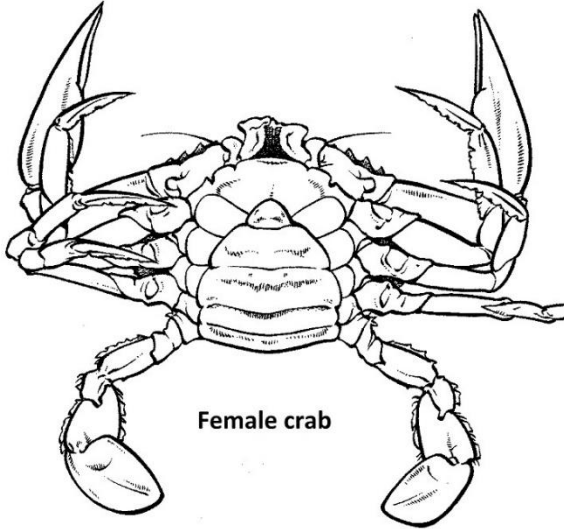
Make Observations

Mud Crab

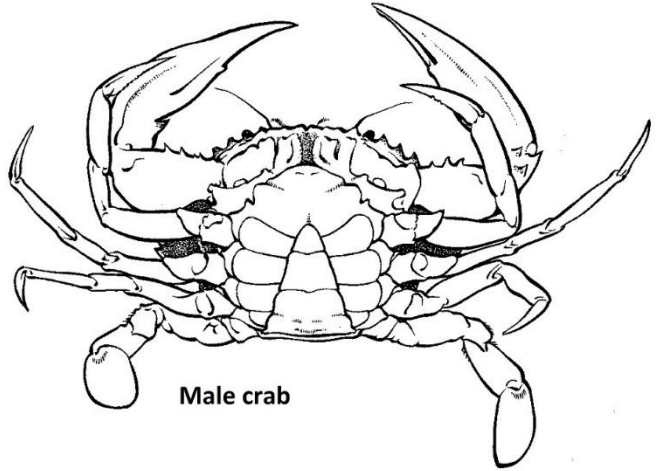
Name:

Date:

Activity: Familiarise yourself with the magnificent 'muddy' *Scylla serrata*



Female crab



Male crab

Image: <https://www.daf.qld.gov.au/fish-identification-information/fish-species-guide/fish-species-id-info/profile?fish-id=mud-crab>

Q. How can you identify the difference between a female and male crab? Ans.

Q. What is the minimum size limit for a mud crab? Ans.

Q. Can you keep a female mud crab (any size)? Ans.

Activity: Research the biology of the *muddy* and record your findings in the space below

Make Observations

Mud Crab Data

2017

Name:

Date:

Activity: Make an observation by studying the following Mud Crab data collected from HBEEC during 2017, 2018 and 2019

* N = neap (1m range); A= average (1-2.5m); S = spring (>2.5m);

* L = Low tide; I = incoming tide; H = high tide; O = outgoing tide

** e.g. Nipper L1 missing, R1 damaged; Pub = capture by public

*** Effort: 1.0 = 12 pots for 3 hours



Pot No.	Date (2017)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
2	3-Feb	N/I	M	154	1.00		
2	3-Feb	N/I	M	158			
8	3-Feb	N/I	M	121		W14166	
8	3-Feb	N/I	M	117		W14165	
8	3-Feb	N/I	M	112			
8	3-Feb	N/I	F	101			Missing L1, R1
	3-Mar	N/H			1.00		No crabs
1	7-Mar	A/O	M	87	1.00		
2	7-Mar	A/O	M	134		W14181	Missing R1,L1,L3
6	7-Mar	A/O	F	147			
6	7-Mar	A/O	M	135			
6	7-Mar	A/O	F	152			
1	9-Mar	S/O	F	94	1.00		
4	14-Mar	A/O	F	163	1.00		
8	14-Mar	A/O	M	155			
9	14-Mar	A/O	F	188			
9	14-Mar	A/O	M	93			
7	16-Mar	A/O	M	143	1.00		Lost R5 in pot
	17-Mar	N/H			1.00		No crabs
1	21-Mar	N/L	M	123	1.00		
8	21-Mar	N/L	F	112			
11	21-Mar	N/L	M	131			Missing L2, L1 deformed
	23-Mar	A/O			1.00		No crabs
	28-Mar	S/O			1.00		No crabs
1	20-Apr	N/L	F	134	1.00		Missing R1
4	20-Apr	N/L	F	115			
12	20-Apr	N/L	M	150			Missing L1
	27-Apr	S/O			1.00		No crabs
	9-May	A/O			1.00		No crabs
1	11-May	A/O	F	not measured	1.00		
5	11-May	A/O	M	121			
6	11-May	A/O	M	167			
	16-May	N/O			1.00		No crabs
	17-May	N/I			1.00		No crabs
2	25-May	A/O	M	121	1.00		Missing L5
7	25-May	A/O	F	148			

Make Observations

Mud Crab Data

2017

Name:

Date:

Pot No.	Date (2017)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
1	30-May	N/H	F	116	1.00		
2	30-May	N/H	F	114			
2	30-May	N/H	M	120			
3	30-May	N/H	M	128			Missing L1
4	30-May	N/H	M	145			
6	30-May	N/H	F	138			
11	30-May	N/H	M	152			
1	1-Jun	N/I	F	137	1.00		
5	1-Jun	N/I	M	126			Missing R1, L5
5	1-Jun	N/I	M	122			
2	7-Jun	A/O	M	99	1.00		Missing R2, R3
2	7-Jun	A/O	F	15?			
4	7-Jun	A/O	F	87			Missing R3, R4
5	7-Jun	A/O	M	142			Missing R1, L3
4	13-Jun	N/O	F	109	1.00		Missing L2, R1
6	13-Jun	N/O	F	154			
6	13-Jun	N/O	F	154			Missing R5
8	13-Jun	N/O	M	118			Missing 4 legs
4	20-Jun	A/L	F	109	1.00		Missing L2, R1
9	20-Jun	A/L	F	158			Small R1
10	20-Jun	A/L	M	129			
1	22-Jun	A/O	F	145	1.00		
12	22-Jun	A/O	M	140			Missing top of L1
4	13-Jul	N/O	M	130	1.00		
4	13-Jul	N/O	F	98			
4	13-Jul	N/O	F	158			
5	13-Jul	N/O	M	134			
5	13-Jul	N/O	M	134			
6	13-Jul	N/O	F	158			
6	13-Jul	N/O	F	154			
8	13-Jul	N/O	F	130			
8	13-Jul	N/O	M	118			
12	13-Jul	N/O	M	140			Missing R1, top of L1
?	19-Jul	A/L	F	164	1.00		Missing R3, L1, L2
?	19-Jul	A/L	M	110			
3	19-Jul	A/L	M	124			
4	19-Jul	A/L	M	125			
6	19-Jul	A/L	F	154			
6	19-Jul	A/L	F	155			
7	19-Jul	A/L	M	98			Missing L3
1	25-Jul	S/O	M	145	1.00		Top of R1 damaged
3	25-Jul	S/O	M	118			Missing L1
4	25-Jul	S/O	F	149			
2	02-Aug	N/L	F	102	1.00		
5	02-Aug	N/L	F	105	1.00		
6	02-Aug	N/L	F	157	1.00		Missing L1,R1
10	02-Aug	N/L	M	128	1.00		Top of R1 damaged
1	03-Aug	N/O	F	172	0.67		Missing R2
2	03-Aug	N/O	F	103			
2	03-Aug	N/O	M	125			
4	03-Aug	N/O	F	138			
5	03-Aug	N/O	F	105			
11	03-Aug	N/O	F	139			Missing R5
1	4-Aug	A/O	F	138	1.00		

Make Observations

Mud Crab Data 2017

Name:

Date:

Pot No.	Date (2017)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
1	4-Aug	A/O	F	138			
3	4-Aug	A/O	M	123			Missing R5
3	4-Aug	A/O	M	109			Missing R4
5	8-Aug	A/O	M	105	0.67		
8	8-Aug	A/O	F	130			Missing R3
3	14-Aug	N/I	M	106	1.00		
12	14-Aug	N/I	M	105			
1	15-Aug	A/I	F	129	1.00		Parasite in abdomen
2	15-Aug	A/I	M	123			
2	16-Aug	A/I	M	125	1.00		Missing L5
8	16-Aug	A/I	F	126			Missing R3
8	16-Aug	A/I	M	134			
5	17-Aug	A/L	F	105	1.00		
5	17-Aug	A/L	M	110			Missing L3,4 R2,4 Missing R1,4, parasite present
1	22-Aug	S/O	F	127	0.67		
7	22-Aug	S/O	M	94			Missing L3
1	24-Aug	A/O	F	127	0.67		Parasite present
4	24-Aug	A/O	M	95			Missing R4,5
6	24-Aug	A/O	F	153			Missing L5 bottom part
7	24-Aug	A/O	F	138			
1	29-Aug	N/I	M	113	0.67		
2	29-Aug	N/I	M	146			Missing L5, R3,5
2	29-Aug	N/I	F	151			Missing L4
2	29-Aug	N/I	M	125			
3	29-Aug	N/I	M	101			
7	31-Aug	A/L	F	109	1.00		Missing R4
7	31-Aug	A/L	F	101			
7	31-Aug	A/L	F	150			
1	5-Sep	A/O	M	109	1.00		
8	5-Sep	A/O	F	131			Missing R3
11	5-Sep	A/O	M	125			
1	7-Sep	A/O	F	138	1.00		Missing L1
3	7-Sep	A/O	F	158			
3	7-Sep	A/O	M	122			
4	7-Sep	A/O	M	165			Missing L5
4	7-Sep	A/O	M	147			
6	7-Sep	A/O	M	142			Missing L1
10	7-Sep	A/O	M	148			Missing L5, R2,4
2	12-Sep	N/I	M	114	1.00		Missing L5, R2,4
3	13-Sep	N/I	M	121	1.00		
7	13-Sep	A/I	F	156			
10	13-Sep	A/I	F	127			
2	14-Sep	A/I	F	122	1.00		
4	5-Oct	A/O	F	139	1.00		
2	10-Oct	A/H	F	121	0.67		
3	10-Oct	A/H	F	133			
5	12-Oct	A/I	M	164	1.00		R1,L1,L2 missing
	19-Oct	A/O			1.00		No crabs
4	26-Oct	N/O	M	158	1.00		
5	26-Oct	N/O	M	143			L3,L5 missing
10	26-Oct	N/O	M	152			L3 missing
1	30-Nov	A/O	F	167	1.00		
1	30-Nov	A/O	F	142			
3	30-Nov	A/O	M	136			



Make Observations

Mud Crab Data 2018

Name:

Date:

Pot No.	Date (2018)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
7	12-Mar	A/O	M	161	0.66		Perfect condition
1	12-Mar	A/O	M	151	0.66		Brown and rusty
2	12-Mar	A/O	F	72	0.66		
	13-Mar	S/L			1.00		No crabs
2	14-Mar	A/L	M	123	1.00		
	15-Mar	S/L			1.00		No crabs
	16-Mar	S/L			1.00		No crabs
	22-Mar	A/O			1.00		No crabs
7	19-Apr	A/O	M	132	1.00		L2/L4 missing, R3 is missing getting ready to molt
	26-Apr	S/I			1.00		No crabs
	27-Apr	S/I			1.00		No crabs
9	1-May	S/O	M	130	1.00		Left claw missing
6	1-May	S/O	F	99	1.00		Perfect condition
	3-May	A/O			1.00		No crabs
	10-May	A/I			1.00		No crabs
6	15-May	S/O		130	1.00		
	18-May	A/O			1.00		No crabs
1	22-May	A/I	M	132	1.00		L5 missing + R3 and R5 missing
1	22-May	A/I	M	136	1.00		Good condition, part of carapace missing
2	22-May	A/I	F	153	1.00		
2	22-May	A/I	F	145	1.00		Perfect condition
12	22-May	A/I	M	146.5	1.00		
1	24-May	A/I	M	143	1.00		
1	24-May	A/I	F	107	1.00		
2	24-May	A/I	F	135	1.00		
	29-May	A/L			1.00		No crabs
6	6-Jun	A/I	F	167	0.66		Lost L1
6	6-Jun	A/I	F	150	0.66		Perfect
	8-Jun	A/I			1.00		No crabs
9	12-Jun	S/L	M	140	1.00		
5	12-Jun	S/L	F	138	1.00		
12	14-Jun	S/L	M	125	1.00		
11	14-Jun	S/L	M	138	1.00		
11	14-Jun	S/.L	F	154	1.00		R4 Missing
2	14-Jun	S/L	F	152	1.00		Perfect
2	14-Jun	S/L	F		1.00		
2	14-Jun	S/L	M	130	1.00		
	19-Jun	A/H			1.00		No crabs
	21-Jun	A/I			0.66		No crabs
10	28-Jun	A/O	F	152	1.00		Perfect condition
1	23-Jul	S/I	M	120	0.66		Missing L1 and L2
	24-Jul	S/I			1.00		No crabs
6	26-Jul	S/L	F	151	1.00		Intact
2	26-Jul	S/L	F	151	1.00		Missing swimmer L5, R1
2	26-Jul	S/L	F	150	1.00		Missing L4
1	26-Jul	S/L	M	136	1.00		
1	26-Jul	S/L	F	142	1.00		L1 L3 R2 are missing
1	26-Jul	S/L	M	142	1.00		Perfect



Make Observations

Mud Crab Data 2018

Name:

Date:

Pot No.	Date (2018)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
1	26-Jul	S/L	F	147	1.00		Perfect
8	31-Jul	A/O	F	126	1.00		Missing 3
12	2-Aug	A/O	M	145	1.00		Perfect
5	2-Aug	A/O	F	146	1.00		Perfect
1	2-Aug	A/O	F	133	1.00		Missing R1, L1, L3 and nip
9	7-Aug	S/I	M	120	1.00		Perfect
1	7-Aug	S/I	F	134	1.00		L1 missing
7	9-Aug	S/O	M	134	1.00		Perfect condition
4	14-Aug	S/O	M	147	1.00		L5 L4 missing
11	14-Aug	S/O	M	140	1.00		Missing tips of nippers
11	14-Aug	S/O	M	123	1.00		Perfect
9	14-Aug	S/O	F	105	1.00		Perfect condition
1	16-Aug	A/I	F	142	1.00		Perfect condition
10	21-Aug	S/O	M	83	0.66		Perfect condition
4	23-Aug	S/I	M	79	1.00		Perfect condition
3	23-Aug	S/I	M	148	1.00		Perfect
	28-Aug	A/O			1.00		No crabs
10	30-Aug	A/O	M	121	1.00		Perfect condition
7	30-Aug	A/O	M	140	1.00		5 missing legs
1	30-Aug	A/O	M	156	1.00		Sand crab perfect condition
6	30-Aug	A/O	M	145	1.00		R1 smaller than L1
17	4-Sep	A/I	M	116	1.00		Perfect
12	6-Sep	S/O	M	135	1.00		Good condition
2	6-Sep	S/I	M	123	1.00		
7	6-Sep	S/I	F	145	1.00		Missing R1
7	6-Sep	S/I	M	132	1.00		Perfect
1	6-Sep	S/I	F	100	1.00		Perfect
2	6-Sep	S/L	F	135	1.00		Perfect
11	6-Sep	S/L	F	144	1.00		
2	6-Sep	S/I	F	159	1.00		
2	10-Sep	S/O	F	162	1.00		Perfect
2	10-Sep	S/O	F	159	1.00		Perfect
9	11-Sep	S/L	M	149	1.00		
2	11-Sep	S/O	F	153	1.00		
8	18-Sep	A/I	F	153	1.00		
2	18-Sep	A/I	F	178	1.00		Missing R3 and L3
9	18-Sep	A/I	F	157	1.00		R2 Missing
0	18-Sep	A/I	M	112	1.00		Juvenile
1	20-Sep	S/I	F	143	0.66		Missing R1 and R5
1	11-Oct	A/O	M	116	1.00		Perfect
8	11-Oct	A/O	M	136	1.00		Missing L1, R1, R2 and R5
10	16-Oct	A/I	M	124	1.00		Missing L1 and R1
12	18-Oct	A/I	M	126	1.00		Perfect
9	25-Oct	S/O	M	114	1.00		M.S.S
1	30-Oct	A/I	F	152	1.00		Perfect
	8-Nov	S/O			0.66		No crabs
	20-Nov	A/I			1.00		No crabs

Make Observations

Mud Crab Data

2019

Name:

Date:

Pot No.	Date (2019)	Tide* NAS/LIHO	M/F	Carapace (mm)	Effort ***	Tag No.	Comments **
	5-Mar				1.00		No Crabs
	12-Mar				1.00		No Crabs
	13-Mar				1.00		No Crabs
	14-Mar				1.00		No Crabs
3	15-Mar	A/I	F	154	1.00	-	
	18-Mar				0.25		No Crabs
	26-Mar	A/I			0.25		No Crabs
	28-Mar	A/O			1.00		No Crabs
4	2-Apr	S/O	F	119	1.00		Perfect
4	2-Apr	S/O	M	114	1.00		R5 Missing
1	2-Apr	S/L	M	121	1.00		Perfect
	24-Apr				0.33		No Crabs
	2-May	A/L			1.00		No crabs
	9-May	N/O			0.33		No crabs
1	14-May	S/I	M	130	1.00		
1	14-May	S/I	M	132	1.00		
1	14-May	S/I	F	114	1.00		
3	16-May	S/L	M	119	1.00		R5 missing
3	16-May	S/L	F	101	1.00		
3	16-May	S/L	F	89	1.00		
6	16-May	S/O	F	143	1.00		
5	16-May	S/L	M	144	1.00		
5	16-May	S/L	F	162	1.00		
2	16-May	S/L	M	109	1.00		
5	21-May	A/O	M	143	1.00		Perfect
5	21-May	A/O	M	145	1.00		Perfect
8	21-May	A/O	M	140	1.00		
	28-May	A/I			0.66		No crabs
10	30-May	S/L	F	147	1.00		Perfect
10	30-May	S/L	M	142	1.00		Perfect
10	30-May	S/L	F	168	1.00		Perfect
8	5-Jun	S/O	M	134	0.66		R3, R4 missing
1	5-Jun	S/O	F	144	1.00		
1	5-Jun	S/O	M	131	1.00		
	11-Jun	A/I					No crabs
7	17-Jun	S/L	F	107	1.00		
	18-Jun	A/O			0.66		No crabs
3	20-Jun	A/O	F	98	1.00		Perfect
5	25-Jun	N/O	F	85	1.00		
	27-Jun	A/I					No crabs
11	17-Jul	A/L	F	141	1.00		
2	25-Jul	N/I	F	146	1.00		
8	30-Jul	A/L	M	112	1.00		R5 missing
5	30-Jul	A/L	F	84	1.00		R5 missing
5	30-Jul	A/L	M	116	1.00		L4 missing
7	30-Jul	A/I	M	142	1.00		R5 missing

Make Observations

Mud Crab Data

Name:

Date:

Q. What observations did you make from the Mud Crab data at HBEEC? Ans.
(*hint: think about gender, tide, times of year etc.*)

Make Observations

Water Quality

Name:

Date:

Activity: Familiarise yourself with the water quality *parameters* below

Temperature

Temperature controls the rate of fundamental biochemical processes in organisms. Organisms that can only live within a narrow temperature range are called **stenothermal**. Whereas, organisms that can live within a wide temperature range are called **eurythermal**. Water temperature is affected by air temperature, stormwater runoff, groundwater inflow, turbidity and exposure to sunlight.

A rise in temperature reduces the concentration of dissolved oxygen (DO) in the water.

Likewise, a drop in temperature increases the concentration of dissolved oxygen (DO) in the water.

A **thermocline** is when there is an abrupt change in temperature with depth, forming a barrier between the warm water (usually above the thermocline) and the cold water (usually below the thermocline).

pH

pH is used to measure the acidity or alkalinity of a solution. Changing levels of pH in a creek or river can be an indicator of increasing pollution or some other environmental factor. A pH value is a number from 1-14, with 7 as the middle (neutral) point. The optimum pH levels for fish is between 6.5 and 8.4

Dissolved Oxygen (DO)

Aquatic animals rely on oxygen that is dissolved in the water to survive. Levels of Dissolved Oxygen (DO) vary depending on factors including water temperature, **time of day**, season, depth, altitude, rate of flow, and levels of pollution. If DO levels drop too low, there is not enough oxygen for the animals to 'breathe' and it can lead to 'fish kill events' where large numbers of fish die within a short period.

DO is measured in milligram per litre (mg/L) or parts per million (ppm). Exposure to less than 2 mg/L oxygen for one to four days may kill most of the biota in a system, leaving behind only the low-DO-tolerant fish, air-breathing insects and anaerobic (not requiring oxygen) bacteria and fungi (microflora). Lethal DO concentrations for fish are generally between 1 and 3 mg/L. DO can also be measured as % saturation, whereby DO should be somewhere between 80-105%. DO <61% or >108% is poor quality.

Salinity

Salinity is a measure of salt content. Salinity is usually measured in parts per thousand (ppt). The salinity of freshwater in rivers and creeks averages 0.5ppt or less. The salinity of seawater averages 35ppt. The mixture of seawater and freshwater in estuaries is called **brackish** water and its salinity can range from 0.5ppt to 35ppt. Organisms that can only live within a narrow salinity range are called **stenohaline**. Whereas, organisms that can live within a wide salinity range are called **euryhaline**.

Turbidity (NTU)

Estuary Indicator Scores

Good/Very Good: ≤10

Moderate: 11-13

Poor: 14-16

Very Poor: >16

Turbidity is the cloudiness or haziness of the water caused by suspended solids. Turbidity does not identify individual substances; it just indicates that something is there.

Make Observations

Water Quality

Name:

Date:

Activity: Familiarise yourself with the water quality *parameters* below

Depth and Flow

The overall size, depth and flow of a waterway can affect its water quality. For example, contaminants entering deep and fast-moving rivers will have less effect on the river than the same amount of contaminants entering a slow moving, shallow creek. How deep a creek is can also affect other 'parameters' of water quality, such as temperature and light which both decrease with depth. Measuring flow allows us to observe any change in the load of contaminants and sediment that may be in the water. Load is a measurement of concentration x flow. Flow is a measurement of the amount of water (volume) x the speed of the water (velocity). Depth and flow are influenced by tides, weather, the landscape and obstructions such as rocks, fallen trees and bends in the waterway.

Nutrients – Nitrogen and Phosphorus

Nitrogen and phosphorus naturally enter estuarine waters when freshwater runoff passes over geologic formations rich in phosphate or nitrate, or when decomposing organic matter and wildlife waste get flushed into rivers and streams. Man-made sources of nutrients entering estuaries include sewage treatment plants, leaky septic tanks, industrial wastewater, acid rain, and fertilizer runoff from agricultural, residential, and urban areas. Too much nitrogen and phosphorus acts as a water pollutant. This leads to explosive algae blooms that cloud the water and deplete the oxygen. Dissolved Inorganic Nitrogen (also known as Total Oxidised Nitrogen) is often measured in mg/L. Dissolved Inorganic Phosphorus (also known as FRP or Ortho Phosphate) is often measured in mg/L.

Dissolved Inorganic Nitrogen (mg/L)

Estuary Indicator Score

Good/Very Good: ≤ 0.045

Moderate: 0.046-0.095

Poor: 0.096-0.146

Very Poor: >0.146

Dissolved Inorganic Phosphorus (mg/L)

Estuary Indicator Score

Good/Very good: ≤ 0.005

Moderate: 0.0051-0.0066

Poor: 0.0067-0.0082

Very Poor: >0.0082

Chlorophyll a ($\mu\text{g/L}$)

Estuary Indicator Score

Good/Very Good: ≤ 3

Moderate: 3.1-3.6

Poor: 3.7- 4.3

Very Poor: >4.3

Chlorophyll a concentrations are used as an indicator of algae abundance and productivity in aquatic environments. Higher concentrations typically indicate poor water quality, usually when high algal production is maintained due to high nutrient concentrations.

Bacterial Enterococci (CFU: colony forming units)

Enterococci bacteria are found in the faeces of human and warm-blooded animals. The presence of enterococci in water is an indicator of faecal pollution and possible enteric pathogens. The median bacterial content in samples of fresh or marine waters taken over the bathing season should not exceed 35 enterococci CFU/100 mL.

Make Observations

Water Analysis Results

Site 1 (Pot 4) S16°50'03.72", E145°43'39.27"

Name:

Date:

Activity: Study the following Water Analysis Results from HBECC's Site 1:

Site 1 (Pot 4)					In situ testing					Lab Results			
Date	Time	Tide	Weather	Depth	Water Temperature (°C)	pH	D.O. (ppm or % saturation)	Salinity (ppt)	Turbidity (NTU)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorous (mg/L)	Chlorophyll a (ug/L)	Bacterial enterococci (CFU)
15-Mar-18	11:01	O	Sunny, 29.5°C, fairly windy	Surface	25.6	7.04	5.4	9.42	17	0.05	0.01	2.6	88
				1m	25.5	7.05	5.16	9.96					
18-May-18	10:30	H		Surface					5.6	0.14	0.01	4.1	
				1m									
25-Jun-18	11:53	O	Overcast, light breeze, outgoing to low tide	Surface	18.3	5.84	6.7	10.5	8.9	0.05	0.01	1.8	21
				1m	17.8	6.15	6.63	10.42					
31-Oct-18		I	Overcast, 20 knots, some rain after extended dry period	Surface	30.3	7.83	6.06	33.06	6.7	<0.01	0.01	1.7	1
				1m			96.60%						
21-Feb-19	12:30	H/O	Hot- 29°C	Surface	28.8	7.6		7.97%	12	0.04	0.01	1.6	230
				1m	28.4	7.61		8.33					
27-Jun-19		O		Surface	21.1		6.74		7	0.08	0.01	1.2	8
				1m	22.1		5.75						
31-Oct-19	14.40	O	Humid, overcast	Surface	26.6	7.9	79%	25.05		0.03	<0.01		
				1m	26.6	7.9	77.80%	25.02					

Q. What observations did you make about Water Quality at HBECC's Site 1? Ans.

Make Observations

Water Analysis Results

Site 2 (Pot 7) S16°50'42.12", E145°43'23.41"

Name:

Date:

Activity: Study the following Water Analysis Results from HBECC's Site 2:

Site 2 (Pot 7)					In situ testing					Lab Results			
Date	Time	Tide	Weather	Depth	Water Temperature (°C)	pH	D.O. (ppm or % saturation)	Salinity (ppt)	Turbidity (NTU)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorous (mg/L)	Chlorophyll a (ug/L)	Bacterial enterococci (CFU)
15-Mar-18	11:10	O	Sunny, 29.5°C, fairly windy	Surface	12.2	6.25	5.38	9.12	21	0.06	0.01		140
				1m	24.8	6.2	5.35	9.76					
18-May-18		H		Surface	12.2				6	0.06	0.01	4.5	
				1m	22.1								
25-Jun-18		O	Overcast, light breeze, outgoing to low tide	Surface	17.6	6.24	7.13	5.47	8.8	0.04	<0.01	1.3	25
				1m	17.4	6.1	6.89	6.03					
31-Oct-18		I	Overcast, 20 knots, some rain after extended dry period	Surface	30.3	7.78	5.96	29.44	4.4	<0.01	0.01	3.7	1
				1m	22.1		96.8%						
21-Feb-19	11:30	H/O	Hot- 29°C	Surface	28.3	7.72		2.24	20	0.05	0.01	1.8	240
				1m	28.1	7.5		2.33					
27-Jun-19	10:50	O		Surface	20.9		7.33		5.3	0.1	0.01		12
				1m	20.9		7.10						
31-Oct-19	14:06	O	Humid, overcast	Surface	26.4	7.66	75.0%	18.5		0.05	<0.01		
				1m	26.4	7.66	75.0%	18.46					

Q. What observations did you make about Water Quality at HBECC's Site 2? Ans.

Make Observations

Water Analysis Results

Site 3 (Pot 11) S16°51'29.88", E145°43'03.30"

Name:

Date:

Activity: Study the following Water Analysis Results from HBECC's Site 3:

Site 3 (Pot 11)					In situ testing					Lab Results			
Date	Time	Tide	Weather	Depth	Water Temperature (°C)	pH	D.O. (ppm or % saturation)	Salinity (ppt)	Turbidity (NTU)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorous (mg/L)	Chlorophyll a (ug/L)	Bacterial enterococci (CFU)
15-Mar-18		O	Sunny, 29.5°C, fairly windy	Surface	25.9	6.34	5.67	9.01	19	0.12	0.01	<1	170
				1m	24.9	6.23	5.56	9.32					
18-May-18		H		Surface	13.3				4.1	0.1	0.01	3.7	
				1m	22.1								
25-Jun-18		O	Overcast, light breeze, outgoing to low tide	Surface	19.5	6.04	7.33	8.44	6	0.06	<0.01	1.3	35
				1m	19.6	5.89	7.15	8.19					
31-Oct-18		I	Overcast, 20 knots, some rain after extended dry period	Surface	31.3	7.71	6.36	20.72	4.3	0.01	0.01	4.9	6
				1m	22.1		96.80%						
21-Feb-19	13:20	H/O	Hot- 29°C	Surface	28.4	7.98		5.24	28	0.14	0.01	2	330
				1m	28.1	7.45		5.29					
27-Jun-19	11:50	O		Surface	23.3	7.0		9.19	3.5	0.1	0.01	<1	10
				1m	22.1	6.6		5.77					
31-Oct-19	13:30	O	Humid, overcast	Surface	26.8	7.52	77.4%	8.56		0.09	<0.01		
				1m	26.8	7.57	65.5%	17.85					

Q. What observations did you make about Water Quality at HBECC's Site 3? Ans.

Make Observations

Name:

Date:

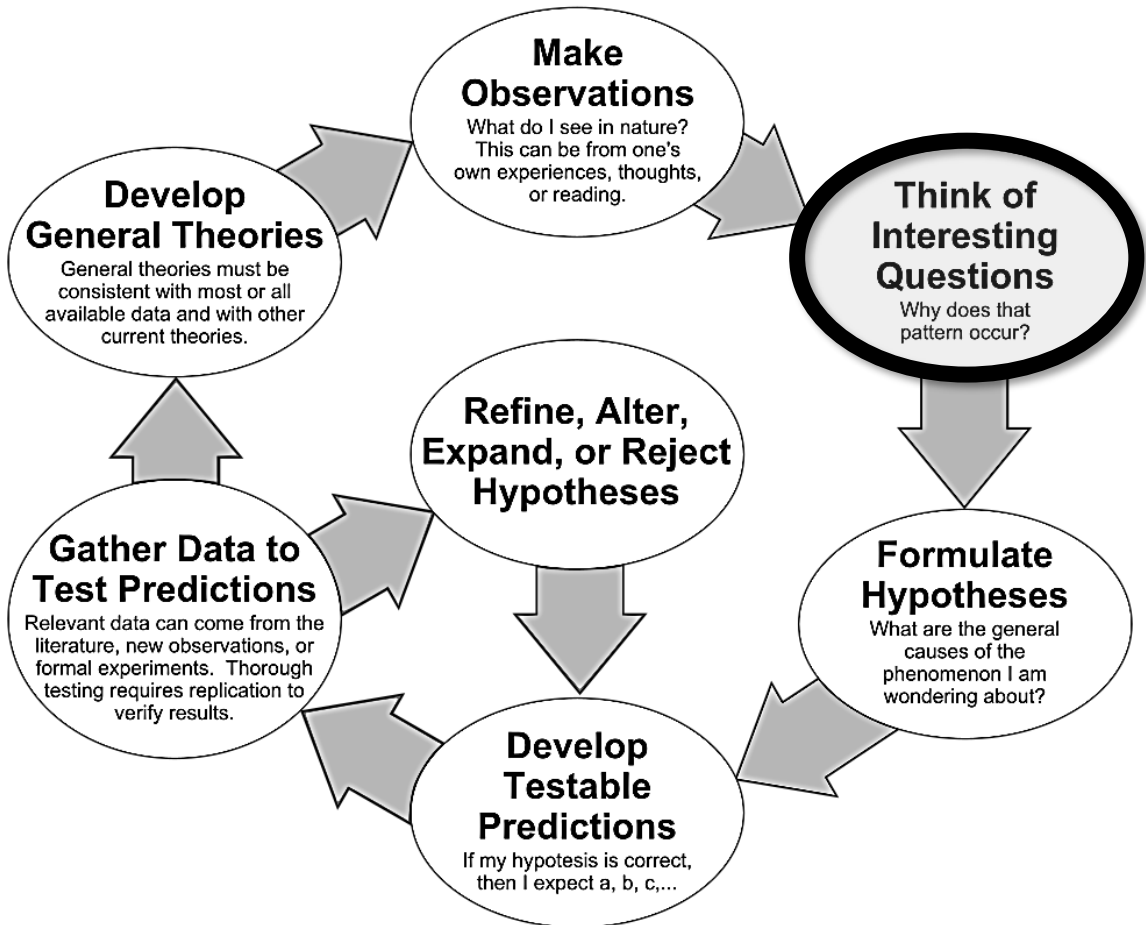
Q. What did you notice *was the same* between Sites 1, 2 and 3? Ans.

(*hint: you may need to investigate beyond the data presented in the spreadsheet*)

Q. What did you notice *was different* between Sites 1, 2 and 3? Ans.

(*hint: you may need to investigate beyond the data presented in the spreadsheet*)

Activity: Continue to the next step of the scientific method ^[1]



Q. What are the following steps to the scientific method? What are you going to do next? Ans.
Hint: Create a list or a mind map of plausible answers to questions generated from your observations!

^[1] ArchonMagnus (2015). *The scientific method as an ongoing process*. Wikimedia Commons. Accessed 26.01.2020 from: https://commons.wikimedia.org/wiki/File:The_Scientific_Method_as_an_Ongoing_Process.svg

My Notes

Name:

Date:

