Searching for Nature Stories 2010

Do you like your new home at Tung Chung River, Acrossocheilus beijiangensis?

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Investigation topic:

Do you like your new home at Tung Chung River, Acrossocheilus beijiangensis?

Abstract

Acrossocheilus beijiangensis (A. beijiangensis) was officially published by Wu Hsien Wen in his book 《中國鯉科魚類志》1977. It is mainly distributed in Guangdong and Guangxi, the Pearl River tributary of the Xijiang River and the North River in the Mainland China. A. beijiangensis is not native in Hong Kong, it is a re-introduced species. It was carried to Hong Kong by Dong Jiang water from China and was added to the Tung Chung River by Water Supplies Department for balancing reservoir ecosystem.

In this study, larger size and more A. beijiangensis can be found at the upper course, fewer in the middle course, and none in the lower course of the Tung Chung River. Its favorable habitat is the pool zone with slow running water after a rapid riffle, where has high dissolved oxygen concentration. It usually hides under large stones.

A. beijiangensis can be used as the biological indicator of clean water. The amount of dissolved oxygen is higher but the conductivity is lower at the upper course of the Tung Chung River. While at the middle course and the upper part of the lower course, the amount of dissolved oxygen and pH are similar but the conductivity increases a lot. The abundance of A. beijangensis at the upper course indicates that the water quality is better. The water in the middle course may be affected by the residents nearby. The lower course is close to the concreted catchment and the natural habitats are destroyed. The higher conductivity and lower amount of dissolved oxygen may account for the diminishing number of A. beijangensis along the river.

A. beijangensis has once been reported at the middle course and upper part of the lower course. However it cannot be observed in the lower course in this study. Stringent measures should be practiced to keep the natural habitat of Tung Chung River away from pollution so that A. beijangensis can still have an ideal habitat to live.

Reasons of the investigation

A. beijangensis is a special fish. According to the internal assessment of the Agriculture, Fisheries and Conservation Department of HKSAR, A. beijangensis is classified as 'Rare' fish species that can only be found in Lantau Island and a few rivers in Hong Kong Island. It is not a wild species in Hong Kong. In fact it was carried to Hong Kong by Dong Jiang water from China and was added to the Tung Chung River by Water Supplies Department for balancing reservoir ecosystem. So far it seems naturalize to live at the streams at Shek Pik and Tai Tam reservoir and tends to expand further.

At late 2003, a 330-metre section of the middle course of Tung Chung River was damaged by illegal excavation work by a sub-contractor supplying boulders to Disneyland. The ecosystem there was greatly disturbed and the living organisms at stream were severely affected. After months of intense restoration effort the stream was back to life and A. beijangensis reappeared even at lower course in 2004.

In 2006, the site inspection by WWF near Shek Mun Kap at the midstream section of the Tung Chung River revealed significant sediment runoff from upstream water. Only a small number of aquatic insect larvae and no fish were found in the stream. Species observed in the same section in 2005, including the rare fish A. beijiangensis had disappeared. It was suspected that the impacts may extend more than two kilometres along the stream. However in 2008-2009, the river monitoring team formed by students and teachers from

five secondary schools [‘Come from Rivers’, Green Power] collected data on water quality and ecology at water quality monitoring sites along the upper, middle and lower courses and estuary of Tung Chung River. It was reported that the rare fish species, A. beijiangensis and other freshwater organisms can be found at the lower course, the restored natural river channel.

Tung Chung River has been identified as one of Hong Kong’s most ecologically important streams that supports more than 20 indigenous species of freshwater fish as well as many species of conservation importance. So we are interested to know the latest status of Tung Chung River and also would like to grasp the opportunity to have a close look at the precious rare fish species, A. beijiangensis.

Objectives of the study

1. Investigating the distribution of A. beijiangensis in the river
2. Investigating the habitat of A. beijiangensis
3. Investigating the current situation of the Tung Chung River

Ways to study

1. Literature study on Acrossocheilus beijiangensis

- **Classification**

Taxonomic Hierarchy

Kingdom Animalia -- Animal, animals, animaux
Phylum Chordata -- chordates, cordado, cordés
Subphylim Vertebrata -- vertebrado, vertebrates, vertébrés
Superclass Osteichthyes -- bony fishes, osteíceto, peixe ósseo, poissons osseux
Class Actinopterygii -- poisson épineux, poissons à nageoires rayonnées, ray-finned fishes, spiny rayed fishes
Subclass Neopterygii -- neopterygians
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes -- cyprins, meuniers, minnows, suckers
Superfamily Cyprinoidea
Family Cyprinidae -- carpas, carpas y carpitas, carpes, carpes et ménés, carpitas, carps, carps and minnows, ménés, minnows
Genus Acrossocheilus Oshima, 1919

Species Acrossocheilus beijiangensis Wu and Lin in Wu, Lin, Chen, Chen and He, 1977 (Taxonomic Serial No.: 688373)

- **Characteristics**

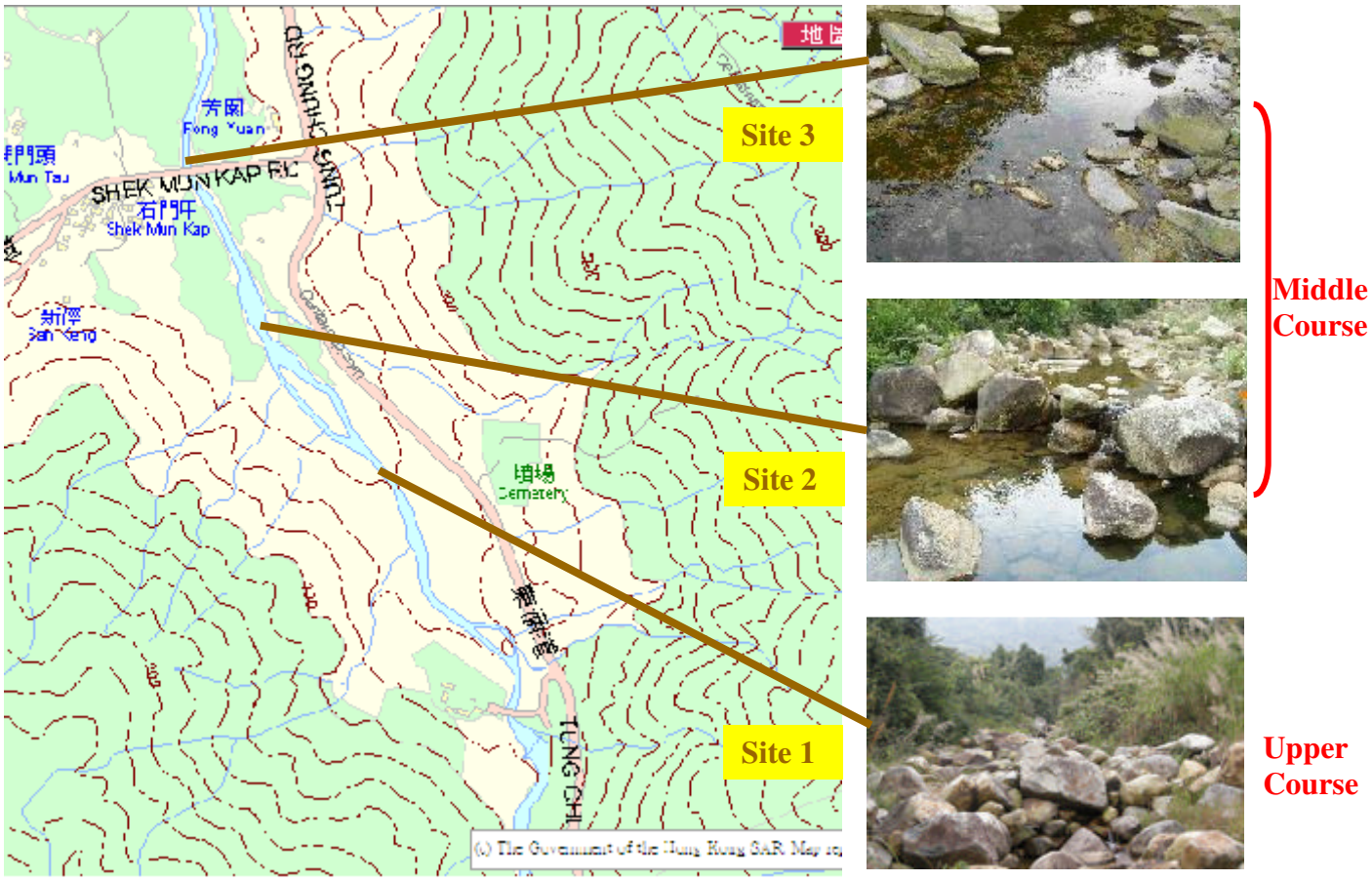
A. beijiangensis is a small freshwater fish and lives in groups. It is active at day time. It is omnivorous and likes to eat small invertebrates, algae and water plants. It is distinguishable by having 5 symmetrical strips on the two lateral sides of the body. Female fish has thinner body than male and their eggs are poisonous. It is very sensitive and hides under stones when frightened.

2. Field Trip

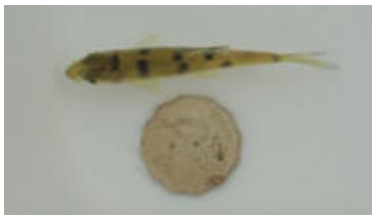
Basic Principle: **No damage of the habitat**
The least disturbance to the ecosystem
No samples be removed and taken back for the lab work.

Preliminary study - Site visit

Date: 28/02/2010
Time: 1000-1530
Weather: Cloudy
Aim: 1/ Study the topography of Tung Chung River
2/ Search for A. beijiangensis at Tung Chung River
3/ Observe the presence of other living organisms
4/ Determine the sites for further studies



Observation:

SITE 1	
SPECIES	**NUMBER**
A. beijiangensis 	~10
Spider	1
Butterfly	3

SITE 2	
SPECIES	**NUMBER**
A. beijiangensis	5-7
Butterfly	2

Mayfly larvae		3
Canton Bee Shrimp		1

SITE 3: (AT THE BRIDGE)	
SPECIES	**NUMBER**
A. beijiangensis	2-3
Japanese Mitten Crab	1

- Site 1 is the upper course with many large boulders and relatively dry. Sites 2 and 3 are near the Shek Mun Kap bridge, the middle course where many pool zones with slow running water are found. Large and small pebbles are seen at the bottom of the shallow water.

- The water at the upper and middle course are very clear.

- Many A. beijiangensis can be observed at the upper course. At Shek Mun Kap, the middle course, only two small A. beijiangensis can be found.

- A. beijiangensis is very sensitive and alert to the environment. When they are frightened, they swim swiftly and hide under stones.

- Different types of living organisms, like prawns, insect larvae (mayfly) and small fishes are found in the upper and middle course.

Quadrat study:

A quadrat study of size 0.5m x 0.5m was performed at the middle course. Stones are removed and fish nets were used to collect small living organisms and fish. In addition, algae were scraped from the stone surfaces and then put on a tray for observation and identification.

- Some mayfly larvae could be identified under careful observation.

Difficulties encountered:

- It is difficult to catch the fish by fish nets as they swim very fast, especially A. beijiangensis.

- Fish tend to swim away from the quadrat once the water is disturbed.

Suggestion for improvement:

- A bigger net with smaller holes should be used in order to catch the fish for observation and identification.

Investigation Area – Biological knowledge

A. Physical Factor

1. Temperature

- The temperature of river water is affected by the weather conditions and environmental variations, e.g. the shading of trees.
- Temperature at around 18-24°C suits aquatic life the best.

2. Conductivity

- The rising conductivity reading shows increasing impurities or generally increasing concentration of chemicals in a stream.
- The higher the conductivity represents more mobile ions in water. Lower conductivity represents the more the naturalness of the river water.
- High conductivity of the river water may be resulted due to backflow of sea water. Therefore, measuring the conductivity of water indirectly indicates the total amount of dissolved solids (TDS).
- Each stream tends to have a relatively constant range of conductivity. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream.
- Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25°C and generally ranges from 50-1500 µs/cm.

3. **Salinity**
   - Salinity is the saltiness or dissolved salt content of a body of water. It describes the levels of different salts such as sodium chloride, magnesium and calcium sulfates, and bicarbonates.
   - Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. A freshwater stream is a flowing water body with salinity less than 0.05%.

4. **Dissolved oxygen concentration**
   - In aquatic environments, oxygen saturation is a relative measure of the amount of oxygen (O_2) dissolved in the water.
   - Oxygen is typically a limiting factor in aquatic ecosystems.
   - Dissolved oxygen (DO) concentrations are expressed as milligrams of oxygen per liter of water (mg/L).
   - Many species of fish and macro-invertebrates are sensitive to low DO levels.
   - DO also regulate the availability of certain nutrients in the water.
   - The physical factors that influence DO are temperature, altitude, salinity, and stream structure.
   - Temperature inversely controls the solubility of oxygen in water; as temperature increases, oxygen is less soluble.
   - Atmospheric oxygen becomes mixed into a stream at turbulent, shallow riffles, resulting in increased DO levels.
   - DO concentrations often decrease between surface and bottom measurements.
   - DO must be measured directly in the stream, since concentrations change quickly once a sample is collected.

5. **pH Value**
   - In chemistry, pH is a measure of the acidity or alkalinity of a solution.
   - The pH of water determines the solubility and biological availability of chemical constituents such as nutrients (e.g. phosphorus, nitrogen, and carbon) and heavy metals (eg: lead, cadmium, copper).
   - The greatest natural cause for change in pH in a stream is the seasonal and daily variation in photosynthesis.
   - Although pH may be constantly changing, the amount of change remains fairly small.
   - Natural waters are complex, containing many chemical “shock absorbers” that prevent major changes in pH. The pH of natural waters hover between 6.5 and 8.5.

6. **Flow Rate**
   - Volumetric flow rate, also called discharge, volume flow rate, and rate of water flow, is the volume of water which passes through a given cross-section of the river channel per unit time. It is typically measured in cubic meters per second.
   - The water is well oxygenated in fast-flowing stream due to the good mix of air and water. Organisms living there must have developed adaptive features to prevent them from being washed away.

B. Biotic factor

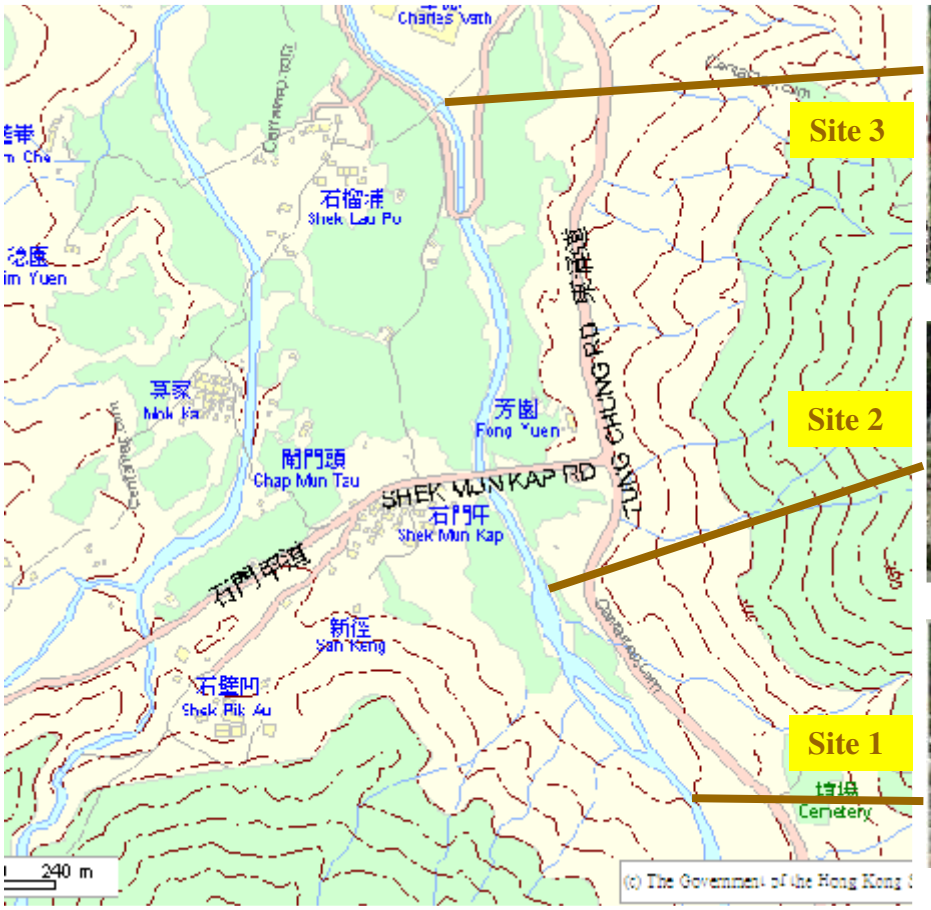
- Biological indicators are useful to assess the health of aquatic environments as a whole, as they can reflect impacts on both water quality and stream habitat.

- Many macro-invertebrates are highly sensitive to environmental changes because they generally have a short breeding cycle and spend most of their lives in the one geographical location, e.g. mayfly nymphs are very sensitive to water bourne pollutants, their presence indicates water quality is good. If only freshwater snails, water boatmen and worms are present, this indicates poor water quality at the time of sampling. The results of macro-invertebrate monitoring provide a snapshot of current conditions.

- The abundance and diversity of native fish can indicate the condition of a waterway not just where they are found during sampling because fish do not tend to stay in one small localised area where they were born, but move within a waterway. They also have a longer life cycle, one that tends to span more than one season. The presence or absence of certain species of fish at a site indicates something about conditions in the waterway over the lifespan of that species.

Field Study

Date: 14th March, 2010
Study period: 0900-1700
Weather: Sunny
Aim:
1. Measure the physical factors at upper, middle and lower course of Tung Chung River
2. Estimate the population size of A. beijiangensis
3. Study the current situation at different regions of Tung Chung River



Lower Course

Middle Course

Upper Course

Apparatus and equipments:

Apparatus:	Quantity:
Data Logger	2
pH Sensor	2
DO Sensor	2
Temperature Sensor	2
Conductivity Sensor	2
Flow Rate Sensor	1
Computer	2
Refractometer	2
Quadrat	3
Deionised Water	500mL
Wash Bottle	2
Brush	4
Tray	2
Net	4
Dropper	4







Procedure:

1. **River profile**
   (1) fix a measuring tape across the river, i.e. from the left to the right side of the river
   (2) use another measuring tape to measure the depth of water in every 20-cm interval
   (3) take the readings at eye-level and record the data

2. **Physical factor**
   - take measurements at one quarter from each side of the river bank along the measuring tape across the river, i.e. two measurements were made at each site

   (1) Refractometer
   i. add a drop of distilled water on the glass of the refractometer for calibration
   ii. look through the eyepiece and set the salinity level as '0'
   iii. use a dropper to add a drop of sample river water to the glass
   iv. take the readings by looking through the eyepiece and record the data

(2) pH meter

i. use buffer solution to calibrate the pH meter before measurement
ii. shake the probe as to make the bubbles goes up if there are any bubble inside
iii. use deionised water to wash the probe as to prevent contamination
iv. turn on the pH meter by turning the switch to pH
v. immerse the probe into water, take the reading and record the data

(3) Data logger and sensors

i. prepare and connect the temperature sensor, conductivity sensor, dissolved oxygen sensor, flow rate sensor to the data logger.
ii. set the computer to the remote mode and disconnect the logger from the computer
iii. put all the sensors into the river at the same time and start logging
iv. take the measurement for about 20 seconds
v. connect the data logger to the computer and save the data in the computer

3. Biotic factor

(1) Fish

i. use 8 iron sticks and a mosquito net to make a big cubical trap to catch fish
ii. put the net near the stones where A. beijiangensis frequently appears

(2) Small living organisms

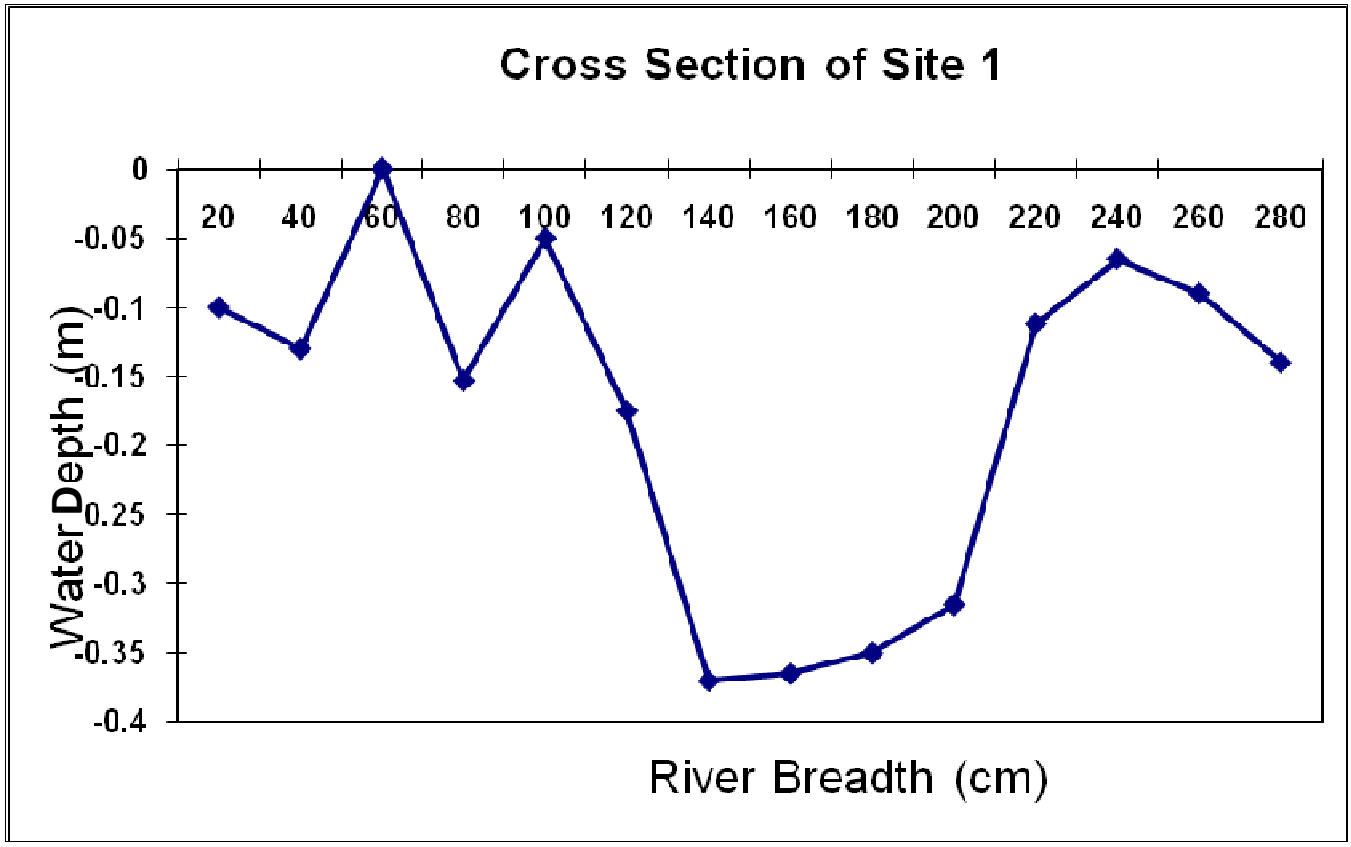
i. lift up the stones along the measuring tape set for river profile measurement
ii. use brushes to remove the small living things obtained to the tray for observation
iii. refer to the key for identification

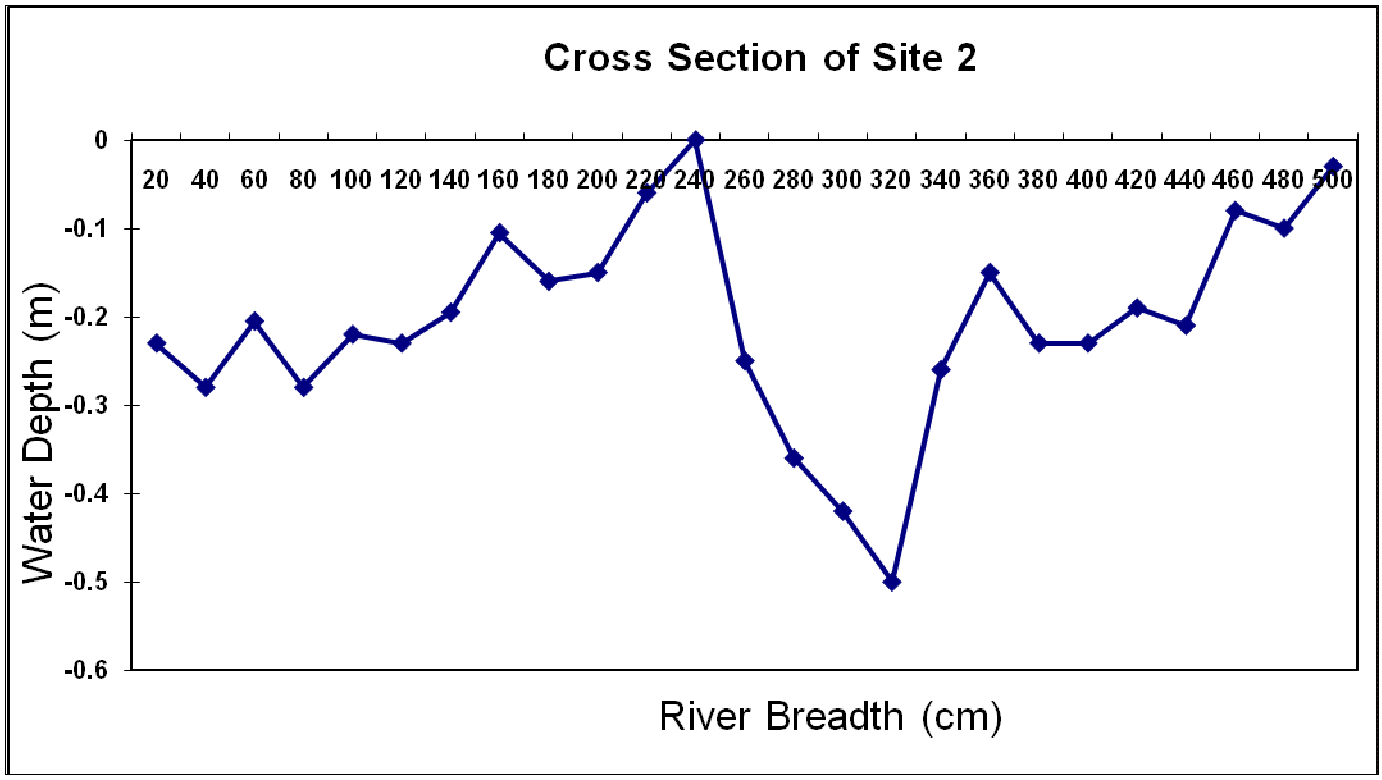
(3) Macro-organisms

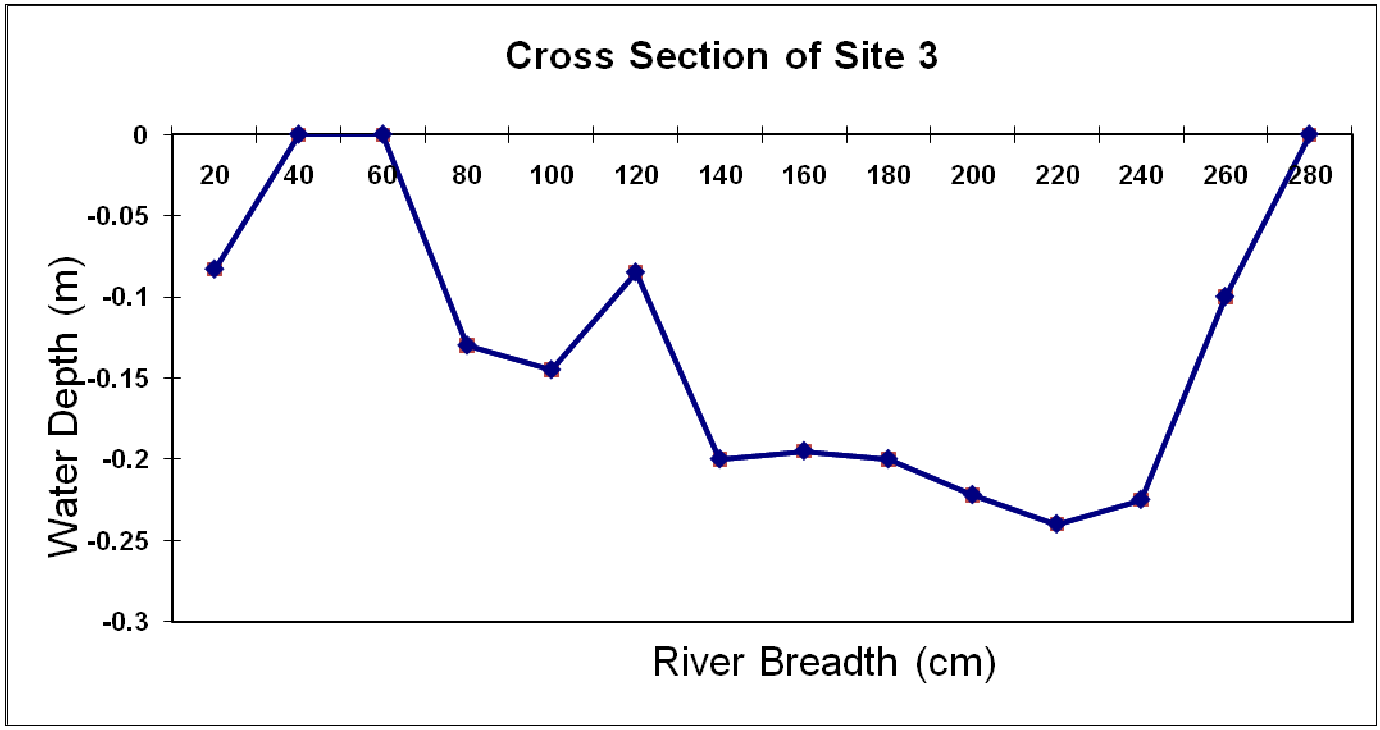
- observe directly and take photos as record

Results:

A. River profile

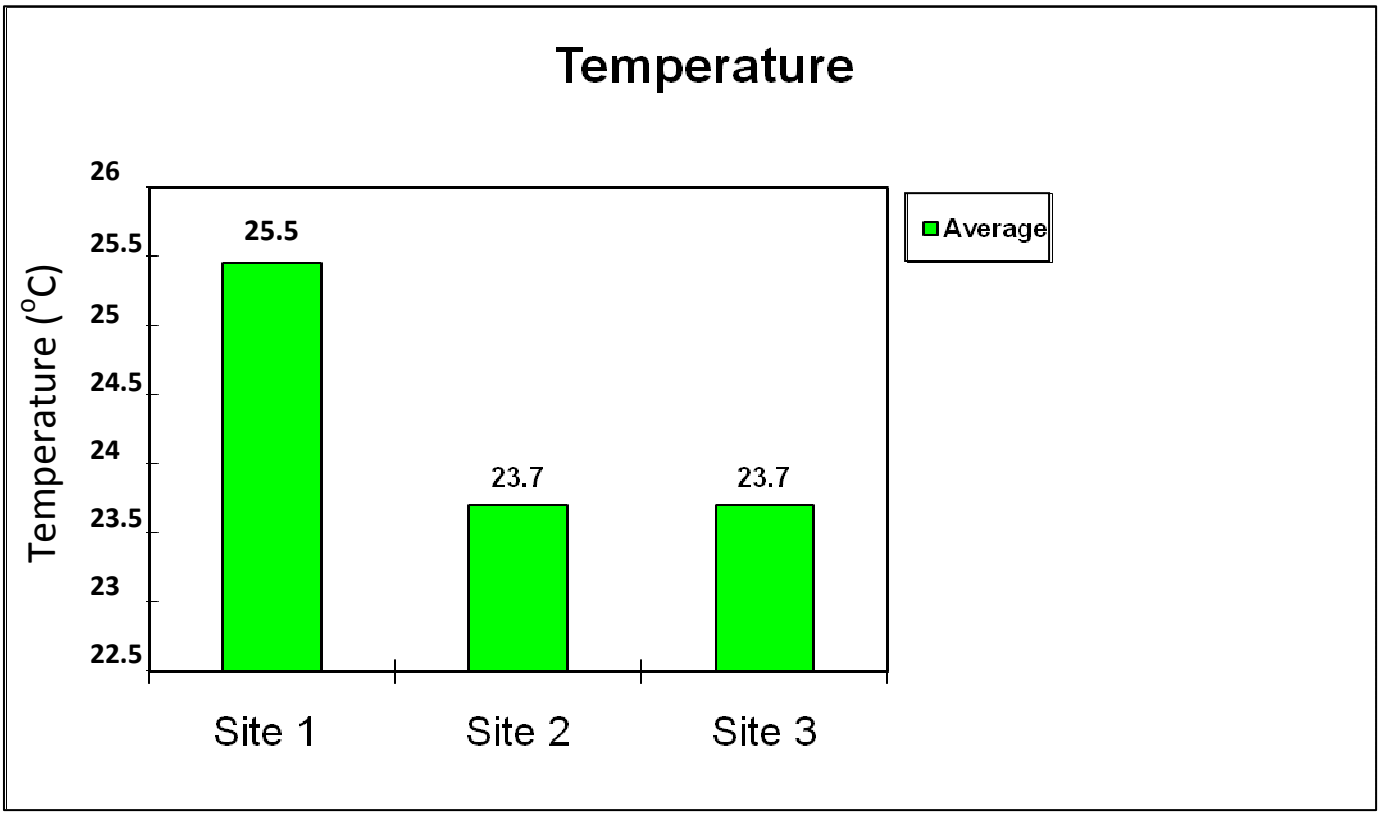


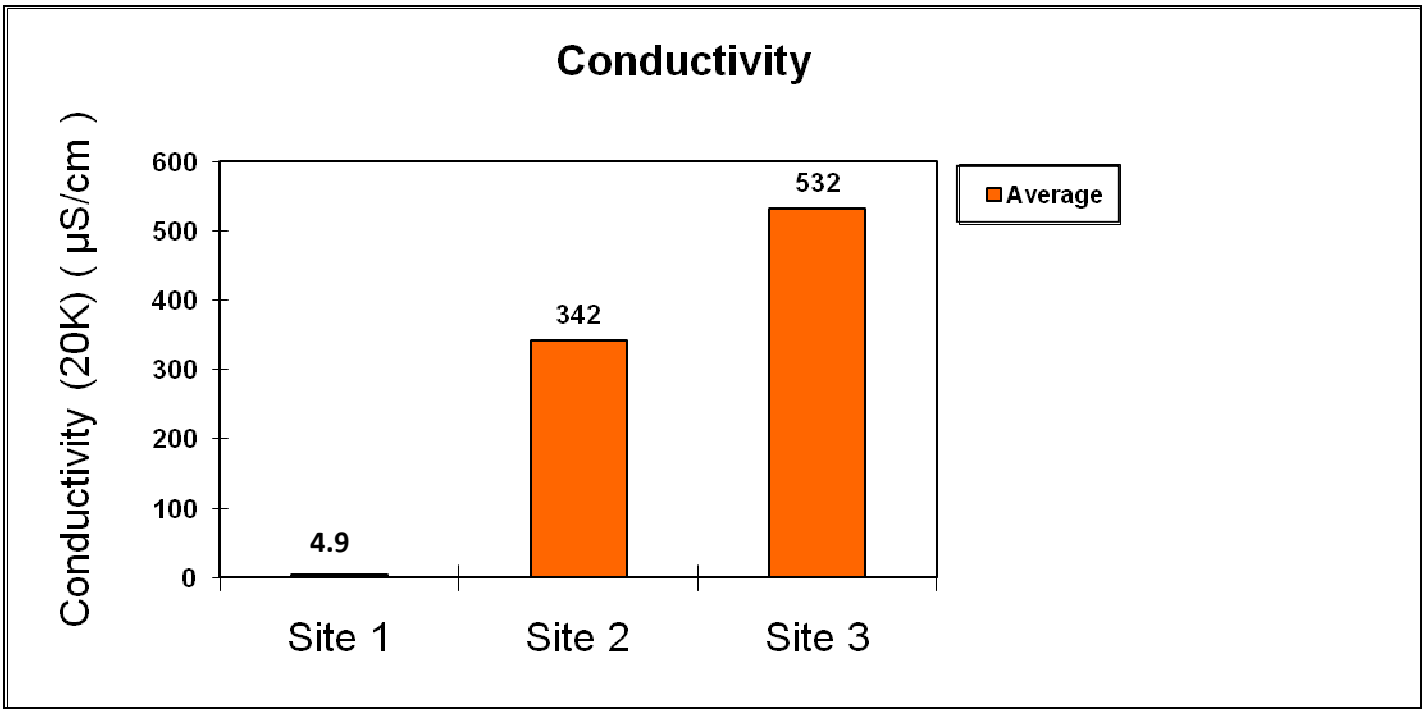


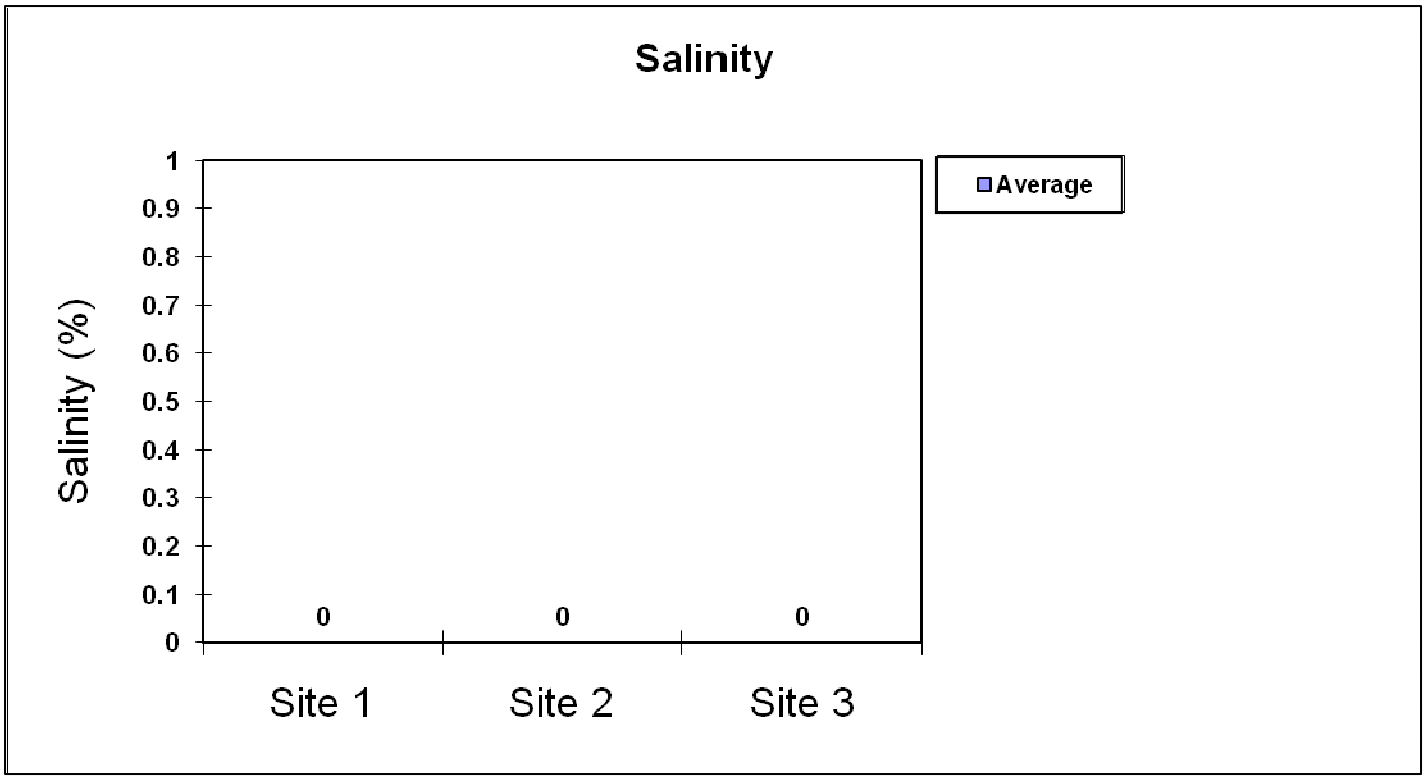


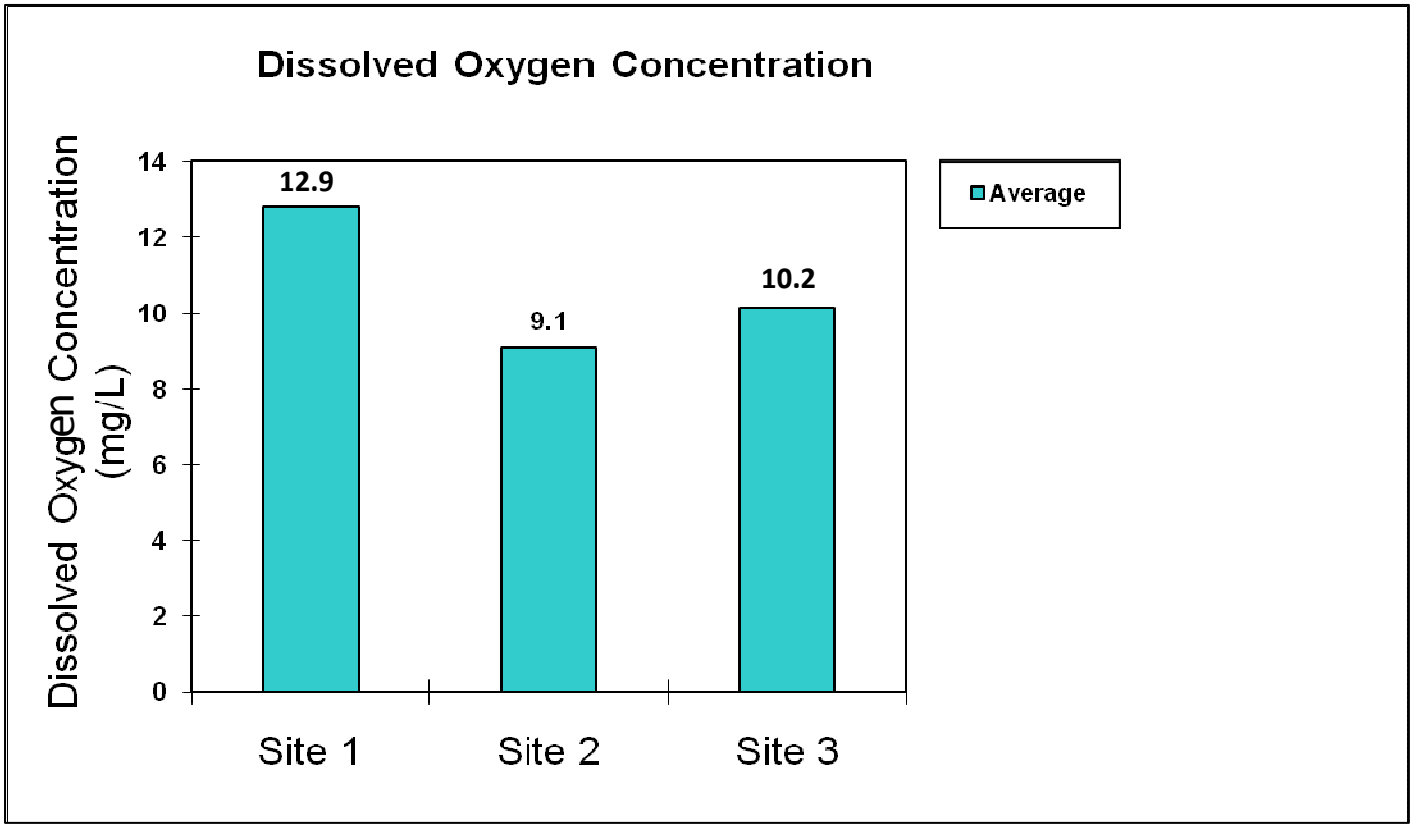
B. Physical factor

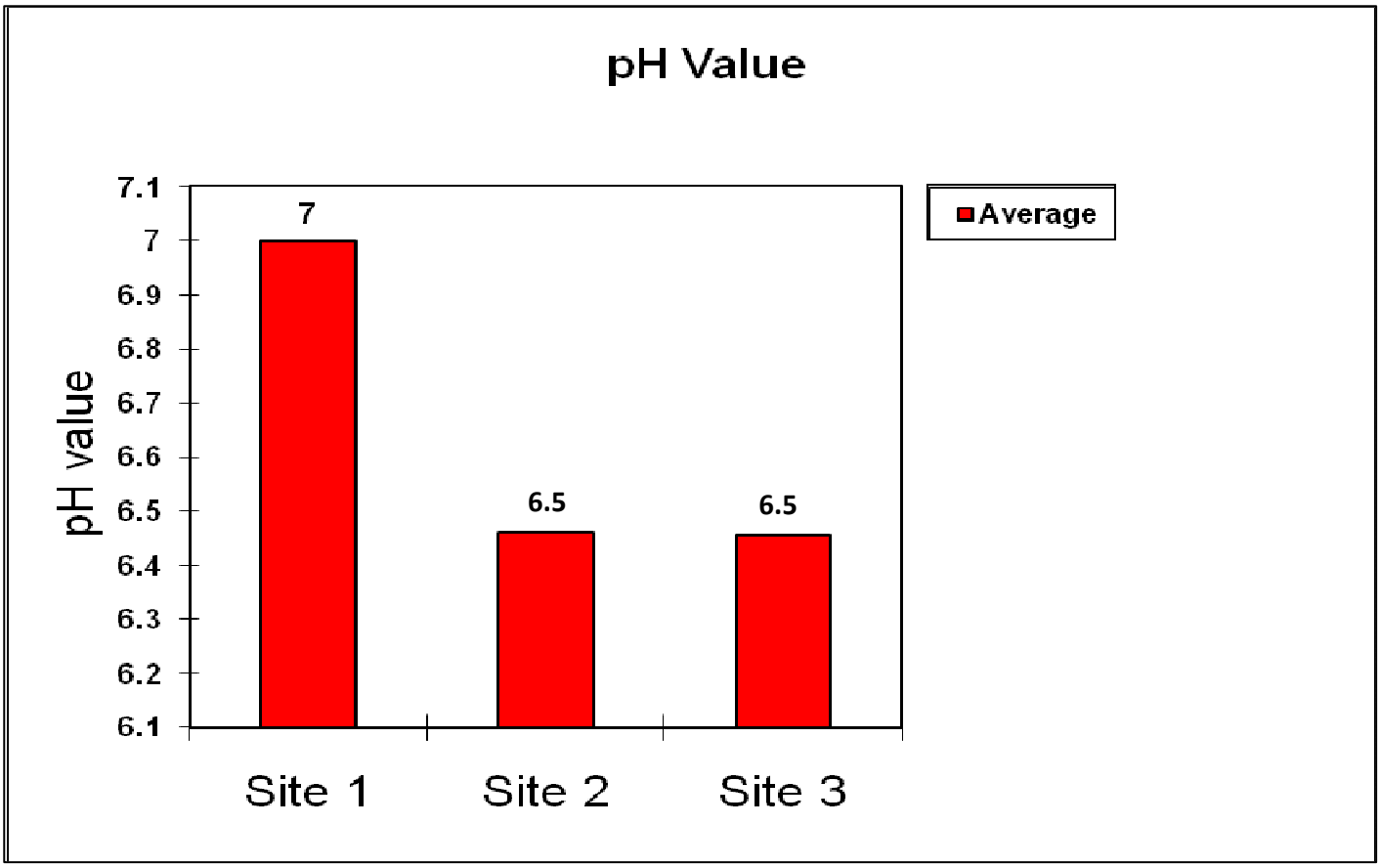
Site		Temperature (°C)	Conductivity (20K) (µS/cm)	Salinity (%)	Dissolved Oxygen Concentration (mg/L)	pH Value	Flow Rate (m/s)
1 Upper Course	Left Side	26.6	9.8	0	12.9	7.1	0.03
	Right Side	24.3	0	0	12.8	6.9	0
	Average	25.5	4.9	0	12.8	7	0.015
2 Middle Course	Left Side	24	293	0	9.7	6.4	0
	Right Side	23.4	391	0	8.5	6.5	0
	Average	23.7	342	0	9.1	6.5	0
3 Lower Course	Left Side	23.9	527	0	9.9	6.4	0
	Right Side	23.5	537	0	10.5	6.5	0.02
	Average	23.7	532	0	10.2	6.5	0.01

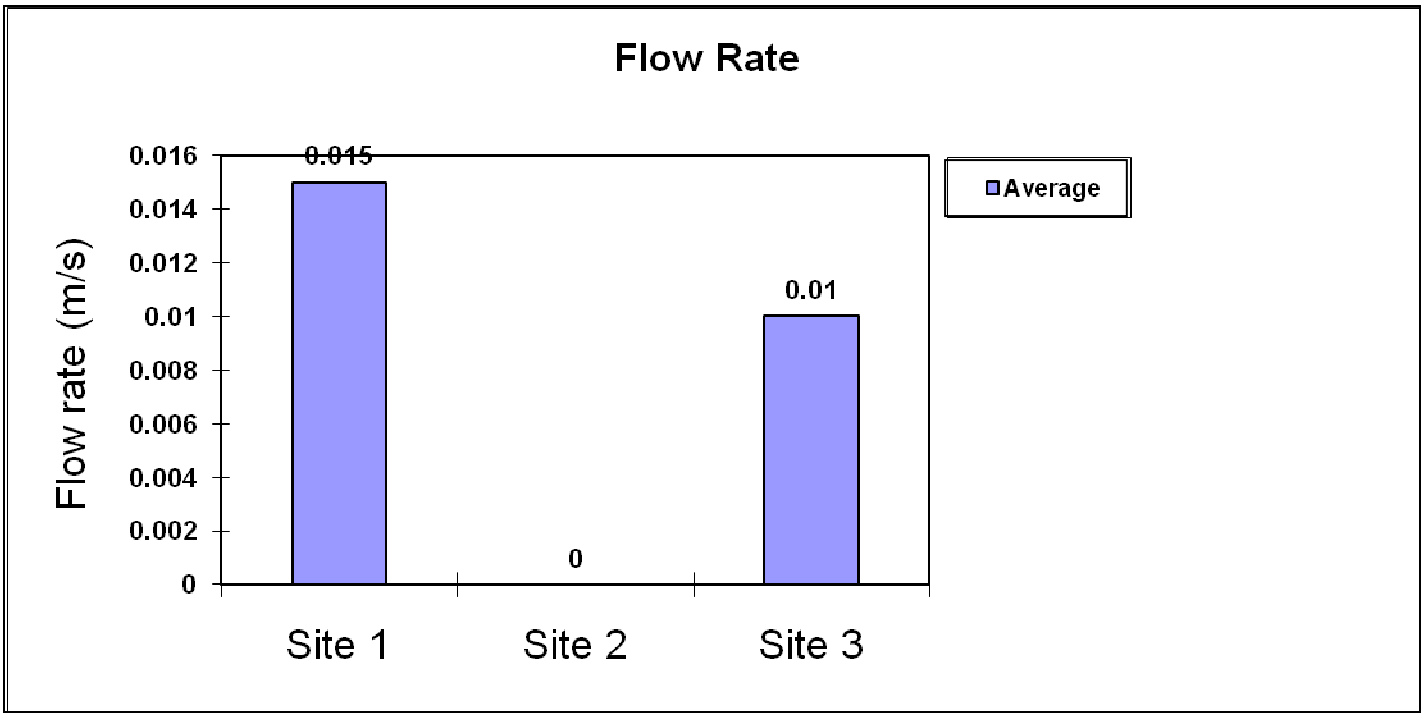

Temperature
Temperature (°C)
26
25.5
25
24.5
24
23.5
23
22.5
25.5
23.7
23.7
Average
Site 1
Site 2
Site 3


Conductivity
Conductivity (20K) (µS/cm)
600
500
400
300
200
100
0
4.9
342
532
Average
Site 1
Site 2
Site 3


Salinity
Salinity (%)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0
0
Site 1
Site 2
Site 3
Average


Dissolved Oxygen Concentration
Dissolved Oxygen Concentration (mg/L)
14
12
10
8
6
4
2
0
12.9
9.1
10.2
Site 1
Site 2
Site 3
Average


pH Value
pH value
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
7
6.5
6.5
Site 1
Site 2
Site 3
Average


Flow Rate
Flow rate (m/s)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0.015
0
0.01
Site 1
Site 2
Site 3
Average

C. Biotic factor

SITE 1: Upper Course		
SPECIES:	**Number:**	**Remarks:**
A. beijiangensis 	~20	- The A. beijiangensis are about 5-7 cm long.
Spider	1	
Mayfly larvae 	1	
Damselfly larvae 	1	
Dragonfly 	1	
Butterfly	5	
Canton Bee Shrimp 	1	

SITE 2: Middle Course		
SPECIES:	**Number:**	**Remarks:**
A. beijiangensis 	10	- 4 of the A. beijiangensis are about 2 cm in length, 3 of them are about 1 cm and 3 of them are about 6 – 7 cm.
Butterfly	5	
Spider	2	
Freshwater Clam	1	

Damselfly 	1	
Canton Bee Shrimp	1	

SITE 3: Lower Course		
SPECIES:	**Number:**	**Remarks:**
Tadpole 	more than 50	- The water at a small branch at Site 3 is stagnant and some patches of different colours of fungi are grown. 
Caterpillar	1	
Ladybird	1	
Grasshopper	1	
Butterfly	1	

Interpretation:

- The river profiles taken were the sites where A. beijiangensis appeared. At site 1 (upper course), about 20 A. beijiangensis were found at a quadrat size 0.5m x 0.5m. Their relative length was three times longer than those at site 2 (middle course).

- At site 1, the conductivity was extremely low while the amount of dissolved oxygen (DO) was comparatively high. The lower conductivity represents the more the naturalness of the river water and higher DO favours the survival of living organisms. The good water quality accounts for the abundance of A. beijiangensis and the presence of various kinds of insect larvae.

- It seems strange that the DO was high at site 1 even though the flow rate of water was low. In fact A. beijiangensis is usually found gathering at slow running water after a rapid riffle where water is well oxygenated. They like to hide under big stones.

- The temperature difference at the three sites was little. It was less than $2^{o}C$. The temperature variation might be due to the shading of trees or clouds.

- The pH of water at site 1 on average was neutral (7.06) while those at sites 2 and 3 were slightly acidic (6.4). The amount of green algae present at sites 2 and 3 was more than that at site 1. The carbon dioxide produced by photosynthesis of algae might cause the slight decrease in pH.

- The three sites studied were far from the sea. The salinity of the stream water was zero.

Limitation

1. A. beijiangensis is very sensitive and swims away rapidly even under small disturbance of water. It is difficult to collect it by normal fish nets. It also did not enter the big net specially designed for it. So its population size can only be estimated by direct observation. This may affect the accuracy of the results.

2. Tung Chung River is at Lantau Island and transportation is not convenient. It takes about 3 hours for traveling to and leaving the sites. Setting data loggers and loading the data to the computer takes time. The time constraint does not allow us to study and visit more sites on the same day to make fair comparison.

3. Since on-site study and measurement are expected, the four group members had to carry a lot of apparatus, equipment and also computer. In addition, walking up and down the stones and pebbles along the river bank require great energy demand.

Further studies

To improve the reliability of the results

- field studies should be repeated in different seasons as living organisms may have different behavior and are at different stages of growth and development.

- for each measurement, more trials of data taking should be done.

- in an ecosystem, the interaction between physical environment and living organisms, and the relationship between living organisms are complicated. More field studies should be conducted to make valid conclusion.

Conclusion

- Many A. beijiangensis is found at the upper course and some at the middle course. It is absent at the lower course.

- The length of A. beijiangensis decreases from the upper course to middle course.

- A. beijiangensis loves to hide under big stones. It usually appears at slow running water after a rapid riffle, where the amount of dissolved oxygen is still high.

- In this field study, some garbage was found left along the river bank and in water from the middle course to the lower course. Some visitors went there for barbecue. Tyres and old shoes were thrown into the river. The natural environment has been disturbed. This will affect the living organisms and upset the ecological balance of the Tung Chung River. The survival of the rare species, A. beijiangensis and other living organisms is threatened.

- Environmental conservation is indeed as important as the economic development of land. So far Tung Chung River is still one of the rivers in Hong Kong that can maintain good water quality. It is everybody's role to conserve it.

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