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HABITAT FEATURES OF LOACH *ABORICHTHYS KEMPI* (CHAUDHURI, 1913) FROM RONO HILLS, ARUNACHAL PRADESH, INDIA

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ABSTRACT
An investigation was attempted on the habitat features of *Aborichthys kempi* from a hill stream known as Rono stream in Rono Hills, a tributary of Dikrong River during April' 2015 to March' 2016 . The sampling of fish species and water sampled was carried out at monthly intervals. The study revealed that the water temperature was ranged from 14.67^{0}C (January) to 26.67^{o}C (August); air temperature from 18.67^{o}C (January) to 31.67^{o}C (August); pH ranged from 6.77 (June) to 7.60 (December); salinity ranged from 0.03 (Oct-Nov) to 0.37 (June); electrical Conductivity ranged from 57.00 (December) to 522.0 µ mhos cm-$^{2)}$ (June). Dissolved solids ranged from 30.87 (December) to 511 mg/l (June); dissolved oxygen ranged from 7.51 (August) to 9.05 mg/l (January); alkalinity ranged from 36.47 (July) to 61.87 (January); Hardness ranged from 6.80 (March) to 17.57 mg/l (October); Free carbon dioxide from 4.05 (December) to 6.19 (July). All the parameters were found within permissible limits for optimal survival of fishes. An assessment of stream substrates indicated the dominance of pebbles and cobbles with a rich riparian in its habitat as the choice of the loach species towards their natural abundances.

KEYWORDS: Rono Hillls, Physico-chemical parameters, *Aborichthys kempi*.

INTRODUCTION

Arunachal Pradesh is regarded as the largest state in geographical as well as in river drainage area in North east India. It is engorged with a huge number of rivers and rivulets harbouring a myriad piscatorial fauna. The Rono hills of Papumpare district, Arunachal Pradesh have various small streams which are glowing habitat for many fresh water stream fishes. This particular stream has been identified as a significant habitat for *Aborichthys kempi*, an important indigenous ornamental fish (IOF). It is to worth mention here that small river streams are gradually declining due to various developmental activities and anthropogenic activities in the state (Tiwari, 2004).

As freshwater fishes are highly sensitive to the quantitative and qualitative variation of aquatic environment, characterization of stream habitat seems to be important for most of the threatened taxonomic groups (Darwall *et al*., 2005). Practically, Stream habitat contributes largely to river 'health' (Maddock, 1999) and can be used to assess the overall ecological integrity of a major river system (Muhar and Jungwirth, 1998). Further, habitat parameters are very important to explore biological processes and population structure of any dwelling species. The physical and chemical characters are crucial factors for the assessment of water quality. Any changes in physico-chemical profile of the water can directly influence the flora and fauna subsist therein (Bagra *et al*., 2014).

Riparian vegetation refers to the vegetation on the land surface in the catchment area of the stream or river influencing bank stability, sedimentation reduction, temperature regulation and accumulation of large woody debris at some extent (James and Craig, 2000). A substrate is a complex variable of the physical environment and consists of everything on the bottom or sides of streams or projecting out into the stream, including an array of human artefact and debris, on which organisms live in (Minshall, 1984). The heterogeneous substrate consisting of sands, gravels, cobbles, boulders, rocks, bedrocks etc have great influence on habitat formation of a particular species.

So far, no work has been done on this aspect from the Rono hills and such investigation on the habitat features of hill stream is also very limited in the state. Kachari *et al.* (2014) studied the habitat preference of an endangered hill stream catfish *Olyra longicaudata* from Arunachal Pradesh. The study of physical and chemical parameters of water, riparian vegetation and substrate composition of stream may be of immense help to the conservationist in designing the necessary conservation or management plan. With this milieu, the present research aims to study the habitat parameters

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of Rono stream at Rono Hills an inhabitant of *Aborichthys kempi* in the context of dwindling stream habitats in Arunachal Pradesh, India.

MATERIALS AND METHODS

Study site:

The present study site, Rono stream (Fig. 1) is originated from the peak of Rono hills and finally drains into the Dikrong River at Doimukh in Papum Pare District of Arunachal Pradesh, encompassing an area of 1.5km approximately. It is located approximately between $27^0$09'12.7''N latitude and $93^0$45'54.9''E longitude. The stream was selected based (Fig. 2) on the preliminary survey revealed that high distribution of the endemic fish *Aborichthys kempi* along with some other indigenous ornamental fish. It is located in the vicinity of the Rajiv Gandhi University, Rono Hills Doimukh, of Arunachal Pradesh.

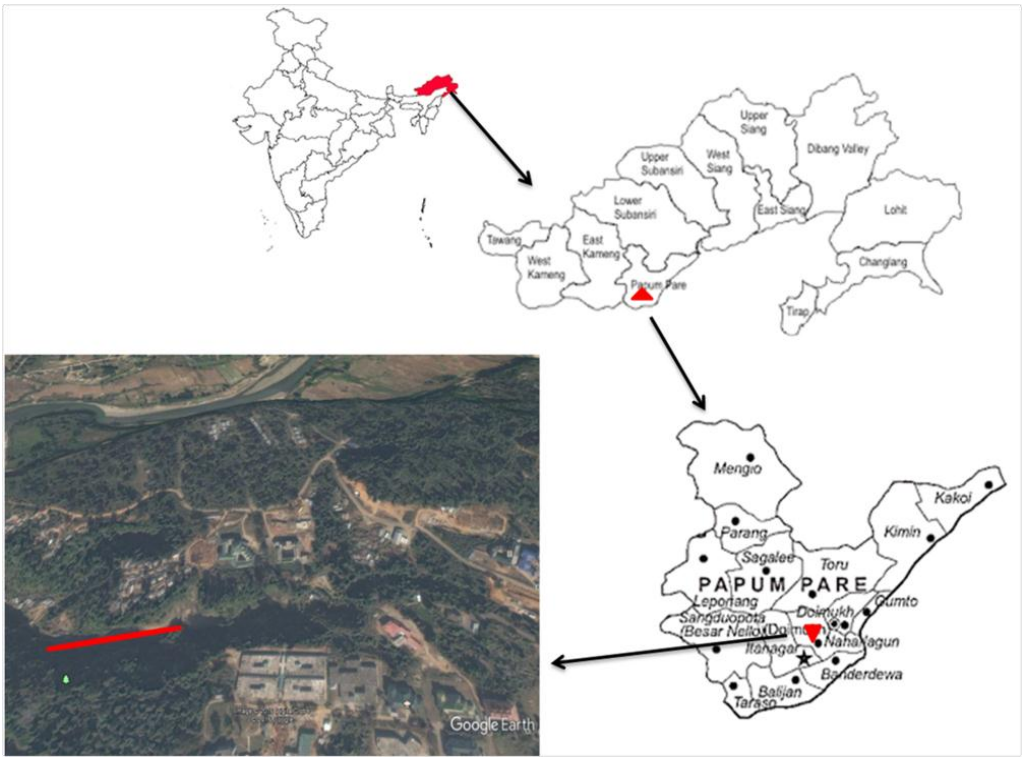

Figure 1: Political map and aerial view of sampling site at Rono stream (in Rono hills)

Physico-Chemical parameters and sample collection:

The geographical co-ordinates and altitudinal variations of study sites were recorded with the help of global positioning system (GPS, Garmin eTrex Legend). The water samples were taken between 6.00 am to 12.00 noon for every month. The collection of samples and analysis of the water parameters of the stream was done according to respective standard protocols. Both atmospheric and water temperature was measured using Mercury thermometer graduated upto 100^oC. The pH was measured with pH meter (µ pH system 361). The dissolved oxygen (DO), total alkalinity (TA), free carbon dioxide (FCO_2) and total hardness (TH) of samples was estimated following titration methodology (APHA, 2005). Total dissolved solids (TDS), electrical conductivity (EC), salinity was recorded using systronic water analyzer 361. The fish samples was collected from the Rono stream by using electroshocker (Hailibao 2800AV) and were transported to the laboratory either by using oxygenated plastic bags or by bucket fitted with battery operated aerator and kept in aquarium for identification and rearing. In case the caught fishes were dead while transporting to the aquarium then the fishes were immediately preserved in 5% formalin. The identification of the fishes was done with the help of standard keys of Vishwanath *et al*. (2007). The enumeration of fish species was done either freshly after collection or after fishes was fixed in 5% formalin.

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Figure 2: (A) and (B) upstream and (C) & (D) downstream views of Rono Stream

Physical organization of the Rono stream:

A bench mark survey was conducted visually throughout stream length from its point of origin upto the main river Dikrong. It is observed that stream is a low gradient having shallow depth and distinct scarp without any other tributaries. So, it is a small first-order stream of the Rono Hills. The water is transparent and flow moderately forming indefinite thalweg and a slight surface agitation. The water becomes turbid only in the rainy season. The substrates are mainly boulder, cobble, pebble, gravel, sand, silt and clay. The substrate composition of the stream bed was assessed by line quadrate method of Stevenson and Bain (1999). Standard data sheets were prepared based on standard protocols of Mills and Stevension (1999) and habitat inventory manual NBFGR (2000) for studying the riparian vegetation in and around the stream. The parameters recorded were vegetation type and stages of vegetations, dominant land use pattern and types of the bank shapes of the stream bank.

RESULTS

Physical and Chemical characteristics of stream water:

Monthly variations in physico-chemical parameters of water such as the stream temperature, pH, salinity, conductivity; total dissolve solute, dissolved oxygen, alkalinity, hardness and free carbon dioxide of the study area were recorded (Table 1). It reveals that the minimum (14.67^{o}C ±1.15) water temperature was recorded in the month of January and the maximum (26.67^{o}C ±0.58) in August. The lowest (18.67^{o}C ±0.58) air temperature was recorded in January and the highest (31.67^{o}C ±0.58) in August. The water temperature was recorded as it varies with the atmospheric temperature of the site and there was no significant variation between surface and bottom water temperature. The lowest value (6.77 ±0.06) of pH was recorded in June and the highest value (7.6±0.06) in December. The minimum salinity (0.03 mg/l ±0.01) was found in October and November and that of highest (0.37 mg/l ±0.05) in June. The highest (522µS cm-1 ±13.23) electronic conductivity (EC) was recorded in June while the lowest (57.07 µS cm-1 ±10.99) in December. The minimum (30.87 mg/l ±7.40) and maximum (511 mg/l ±57.17) of total dissolved solids (TDS) was found in December and June respectively. The highest (9.05 mg/l ±0.74) DO was recorded in January and its lowest (7.51 mg/l ±0.35) in August. The alkalinity level determines the buffering capacity or ability to neutralize acid. In the present study, the lowest (36.47 mg/l ±0.64) alkalinity was observed in July and its highest (61.87 mg/l ±4.56) in January. The lowest (6.80 mg/l ±0.69) hardness was recorded in March while its highest (17.57 mg/l ±0.40) in October. The minimum (4.05 mg/l ±0.42) FCO_2 was recorded in February and its maximum (6.91 mg/l ±0.31) in July.

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Table 1: Monthly average physico-chemical parameter of water of the Rono stream at Rono Hills (Mean±SD & n= number of sampling)

parameter	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Water temperature (^{0}c) n=3	14.67±1.15	18.67±0.58	19.67±0.58	23.03±0.06	23.07±0.12	23.90±0.85	25.00±0.00	26.67±0.58	25.00±0.00	23.00±0.00	20.33±0.58	17.33±1.53
Air temperature (^{0}c) n=3	18.67±0.58	20.00±0.00	21.00±0.00	24.23±0.51	24.33±0.00	26.33±2.08	30.67±0.58	31.67±0.58	27.00±0.00	24.00±0.00	23.33±0.58	19.67±1.50
pH n=3	7.57 ±0.12	7.33 ±0.23	7.17 ±0.23	7.43 ±0.12	7.27 ±0.32	6.77 ±0.06	6.90 ±0.17	7.57 ±0.35	7.53 ±0.12	7.13 ±0.12	7.40 ±0.17	7.60 ±0.06
Salinity (ppt) n=3	0.04 ±0.0	0.04 ±0.0	0.12 ±0.01	0.18 ±0.07	0.34 ±0.03	0.37 ±0.05	0.36 ±0.07	0.21 ±0.09	0.05 ±0.0	0.03 ±0.01	0.03 ±0.01	0.04 ±0.0
EC (µ mhos cm$^{-2)}$ n=3	70.07 ±0.42	58.73 ±3.55	192.67 ±19.73	198.0 ±91.0	404.67 ±93.6	522.0 ±13.23	455.0 ±119.53	420.33 ±189.1	97.27 ±0.99	57.07 ±1.00	64.57 ±4.95	57.0 ±10.99
TDS (ppt) n=3	40.67 ±0.65	32.27 ±1.35	81.97 ±31.97	134.17 ±79.73	461.33 ±70.73	511.0 ±57.17	427.00 ±15.0	348.33 ±259.69	46.07 ±1.16	28.47 ±1.12	40.87 ±1.15	30.87 ±7.40
DO (mg/l) n=3	9.05 ±0.74	8.08 ±0.77	8.38 ±0.43	7.78 ±0.12	7.76 ±0.49	7.72 ±0.17	7.99 ±0.33	7.51 ±0.35	7.55 ±0.30	7.70 ±0.33	8.80 ±0.32	9.01 ±0.49
Alkalinity (mg/l) n=3	61.87 ±4.56	55.83 ±2.73	38.70 ±6.87	44.60 ±6.6	43.93 ±4.35	47.33 ±6.11	36.47 ±0.64	58.20 ±6.09	45.9 ±4.29	43.53 ±1.72	52.83 ±6.63	54.73 ±1.67
Total Hardn –ess (mg/l) n=3	11.87 ±4.16	14.00 ±2.36	6.80 ±0.69	9.03 ±2.02	13.70 ±1.99	12.30 ±0.26	6.88 ±0.35	9.73 ±1.62	15.53 ±0.42	17.57 ±0.40	15.30 ±0.66	15.50 ±3.38
FreeCO_2 (mg/l) n=3	4.71 ±0.98	9.78 ±0.53	4.98 ±0.80	5.15 ±0.03	5.51 ±0.58	4.58 ±0.94	6.19 ±0.31	5.76 ±0.36	4.58 ±0.87	5.65 ±0.50	4.91 ±0.46	4.05 ±0.42

During the reporting period, a total of 9 fish species belonging to 5 families under 8 genera have been recorded from the study site (Table 2). Of the recorded ornamental fish species, *Aborichthys kempi* was most dominant and frequently caught during each sampling along with some other endemic ornamental fish species.

Table 2: List of ornamental fish species found in the study area.

Sl.no.	Family	Genus	Species
1	Nemacheilidae	*Aborichthys*	*A. kempi*
2	Cyprinidae	*Devario*	*D. aequipinnatus*
3	Cyprinidae	*Garra*	*Garra sp.*
4	Cyprinidae	*Lepidocephalichthys*	*L. guntea*
5	Cyprinidae	*Physoschistura*	*Physoschistura sp.*
6	Bagridae	*Olyra*	*O. longicaudata*
7	Bagridae	*Olyra*	*O. praestigiosa*
8	Amblycipitidae	*Amblyceps*	*A. apangi*
9	Channidae	*Channa*	*C. Punctata*

Substrate composition of the stream:

The main substrates of the Rono stream were pebble, coble, gravel, sand, boulder, and silt and clay. Substrate percentage reveals that pebble was found to be dominant in all site followed by cobble, gravel, sand, bolder and silt & clay (Table 3). The stream sites were dominated by pebble with 33% of the total substrate followed by cobble with 29%, gravel with 20%, sand with 9%, boulder with 8% and silt and clay with 1% each (Fig. 3).

Table 3: Substrate percentage (%) in different sites of the study area.

Study area	Bolder	Cobble	Pebble	Gravel	sand	Silt & Clay
Site I	7	51	24	10	6	2
Site II	5	27	38	19	9	2
Site III	20	27	29	21	3	0
Site IV	9	21	38	22	10	0
Site V	3	31	38	17	11	0
Site VI	6	19	32	29	14	0

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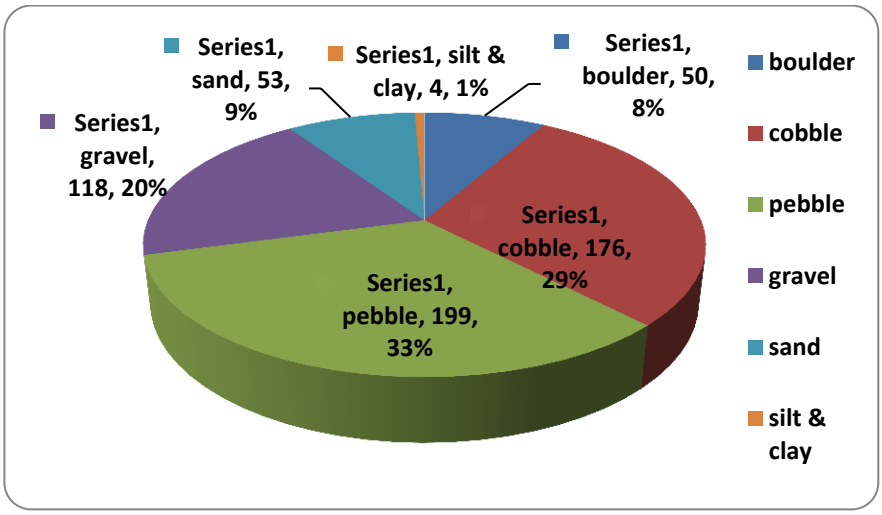

Figure 3: Substrate composition (%) of the study site.

Riparian vegetation in and around the stream:

The present study was also focused on the vegetation type, vegetation stages, dominant land use and the bank shaped of the each study site. The dominant riparian vegetation was recorded (Fig. 4) and the results divulge that in type vegetation the subtype shrub was dominant constituting (8.25%) of the total parameters observed. The vegetation stage was dominated by shrub stage (10.75%) of the total parameters observed. The dominant land used was under forest with (18%) and the dominant bank shape was found to be S-shape (10.25%) of the total parameters observed.

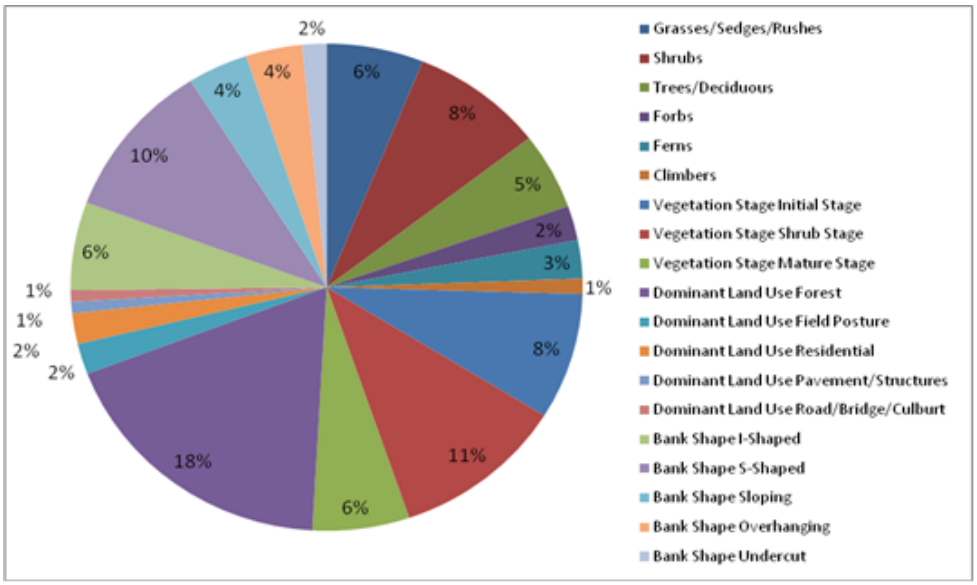

Figure 4: Riparian composition (%) of the study site.

DISCUSSION

The water temperature and atmospheric temperature of the site was found to be closely related to each other. The water temperature was recorded maximum in the months of June, July, August and September where the atmospheric temperature was also recorded to be the highest. The highest temperature (water and atmospheric) were recorded in August and the lowest water and atmospheric temperature were recorded in January. Both temperature drops down from December upto March and again started increasing from January onwards. A huge difference (12^{o}C) between the highest and the lowest water temperature was recorded as it indicates that *Aborichthys kempi* can stand a wide range of

temperature variation in waterbody and it signifies a potentiality to be an aquarium fish. Temperature is one of the crucial parameter that is used to assess various physiological activities of aquatic biota and most important factor controlling the survival activities of fishes (Fry, 1971). Fishes are very sensitive to temperature changes in the river or stream water and each species of fish has an optimum or preferred water temperature.

The pH of water is usually influenced by the pH of the river bed or soil from where it flows and in hilly regions pH generally remains acidic in nature (Bagra *et al.*, 2014). It was observed that recorded pH from the study site was nearly neutral to slightly alkaline and to be considered desirable for growth and reproduction of fishes. Here, the variation in pH value might be due to draining of rain water, decay organic matter and deposition of inorganic matter during monsoon season. Salinity is the total of all non-carbonate salts dissolved in water, usually expressed in parts per thousand (ppt). Salinity is a major driving factor that affects the growth and density of aquatic organism's population (Jamabo, 2008). The salinity measured was under suitable range (0.03-0.37 ppt) supporting the ideal quality of freshwater stream. The EC and TDS were also recorded were within the acceptable range.

The dissolved oxygen (DO) is probably the most important analyzed chemical parameter in water quality which affects the growth, survival, distribution, behaviour and physiology of fishes and other aquatic organisms (Solis, 1988). In the present study, the DO recorded in the Rono stream was consistently high indicating the high-quality habitat for a hill stream fishes. Increased water temperature will decrease DO concentration in water because the saturation level for oxygen in water decreases as water temperature increases (Bagra and Das, 2010). Alkalinity refers to the quantity and kinds of compounds which collectively shifts the pH into the alkaline range (Allan, 1995). It is the ability of water to resist changes in pH and it determines the buffering capacity to neutralize acid. In the current study, alkalinity and total hardness was within tolerable range as suggested by Boyd and Lichtkoppler (1979). Free carbon dioxide (FCO_2) in water exists naturally in varying amounts. The FCO_2 recorded in the present study was within tolerable limit and the average range was constant throughout the sampling period.

In the present study, the assessment of substrate resulted pebble and cobble as dominant with presence of negligible amount of silt and clay supporting the habitat preference for stream loaches. Riparian vegetation is very important for the health of many lotic habitats and formation of many habitat components. The result of riparian vegetation showed the vegetation stage as shrub stage with shrubs as the main vegetation type. The study also showed dominance of forest in dominant land use which reflects rich vegetation organizations. In the present study, an attempt has been made to give an account of the natural habitat of hill stream loaches with *Aborichthys kempi* as the main representative candidate species. From the above investigation, it appears that this loach prefer moderate flow, shallow depth, distinct scarp and undisturbed areas with lower substratum dominated by pebble and cobble. The water quality of the Rono stream representing high oxygenated, colourless and contains relatively little in the form of suspended matter except during monsoon periods.

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