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Original Research Article

Sex ratio of *Noemacheilus montanus* (*Mcclelland*) from Pithoragarh district, Uttarakhand, India

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Noemacheilus montanus, Sex –ratio, Spring fed water, Pithoragarh, India

A B S T R A C T

The present paper deals with the sex ratio of *Noemacheilus montanus* (Mc.Cl.) from Pithoragarh district, Uttarakhand, India. The *Noemacheilus montanus* is a beautiful loach in this region. The sex population of *Noemacheilus montanus*, found a significant sex ratio in 1male:1.22 female. On the basis of observations it is concluded that the sex population of *Noemacheilus montanus (Mc.Cl.)* from almost all the localities female fishes are dominated. During the overall investigation on the *Noemacheilus montanus (Mc.Cl.)*, the sex population was observed non-significant i.e. 1 male: 1.22 female. The chi-square value also showed 3.84 which are non-significant at 5% level.

Introduction

A prior knowledge of sex population estimation in fishes is essential for the management practices of fishery science. It is important to ensuring a proportional fishing of two sexes. Sex population estimation is defined the abundance of any sex at a particular time or the population is in natural condition abnormal condition. It is generally found that in a healthy population, the sex ratio should be 1:1.There are several other factors like temperature, water velocity, vulnerability of females to their predators, migratory phase and other ecological hazards, which possibly change the sex composition in streams or rivers (Jameela Beevi and Ramachandran, 2005). Sex population estimation is defining the abundance of any sex at a particular time or whether the population is in natural condition or abnormal condition. It is generally found that in a healthy population the sex ratio should be 1:1. According to Jameela Beevi and Ramachandran (2005), there are several other factors like a temperature, water velocity, vulnerability of females to their predators, migratory phase and other ecological hazards, which possibly change the sex composition in streams or rivers. For commercial utilization of any fish species, it is highly essential to have a prior knowledge of its spawning behavior, which includes the month, frequency, sex ratio and ecology of spawning (Verma, 2013 a).

Many ichthyologists have worked on the fishes breeding biology, sex ratio and other aspects of different fishes biology (Sobhana and Nair, 1976; Pathani, 2000; Johal and Negi, 2000; Dobriyal et al., 2004; Kumar et.al, 2006; Pawar and Mani, 2006; Bahuguna et.al, 2007; Shendge and Mani, 2009 and Bahuguna et.al, 2009, 2010a, b, c; Bahuguna and Kumar, 2011; Bahuguna et.al., 2011, Krishan et.al., 2012, Verma, 2013 b). The present study is in continuation with earlier studies and is dealing with population sex ratio status of *Noemacheilus montanus.* This is for the first time this species is being studied from Pithoragarh district, Uttarakhand, India.

Materials and Methods

The present sampling site area study was conducted on the hill stream Rai in latitude 29º36´ N - 80º12´ E at an elevation of about 730 to 750 meters. The Rai spring fed stream is the tributary of river Kali in the upland of Kumaun Himalayan (Map-1), as Central and Kumaun Himalaya is a region of an exceedingly diversified climate and natural aqua-resources (Verma, 2014). The fishes were collected from Rai stream for a period of two year during October 2011 to September 2013. These fish were caught by means of traditional fishing gear hand picking and scoop.

After taking morphometric measurements, the fish was preserved in 5% formalin for further study. The total length and weight of fish was recorded in fresh condition. However, the other parameters were measured within a fortnight of collection. A total of 231 specimens were collected (104 males and 127 females). Sex-ratio was calculated for entire period of study and its significance was tested by Chi-square test (χ^2).

$$\chi^2 = (O - E)^2 / E.$$

Where-

χ^2 = chi-square,

O = observed value,

E = expected value.

Result and Discussion

The monthly variations in the population sex-ratio of *Noemacheilus montanus* is showed in the table 1. The minimum length is 3.8mm and maximum length 9.2mm of the fish respectively. Month wise sex ratio was observed and maximum values were found in the month of June (1male:2.08female) and minimum ratio was found in the month of August (1male:1female). The seasonal and pooled data indicated variations in the sex ratio of *Noemacheilus montanus* are presented in the table 2. The sex population observed season wise, varied from a maximum in summer season (1♂:1.66♀) and minimum in winter season (1.05♂:1.00♀). The total pooled data showed average sex population status 1male:1.22 female *Noemacheilus montanus* during the course of study. The estimation of sex population both in male and female showed non significantly at 5% level of significance in the months, season and in the pooled data. In the month of June there were significant differences in the ratio of male and female fish (1male:2.08female).

Chacko and Ganapati (1949) suggested that the studies on the sex composition status estimation have their own significance are helpful in detecting differential fishing, if any, in different periods of the year in the various size-groups and thus we can get informality about the abundance of the sex at a particular time or throughout the year. Holcik et.al, (1988) stated theoretically, the expected composition of males to females is

1:1. The present study showed 1male:1.22 female sex status in *Noemacheilus montanus* (Mc.Cl.) from the Kalapani spring fed stream which is non-significant.

Nautiyal (1984) observed 1: 7 sex- ratio of *Tor putitora* in Alaknanda and Nayar rivers during the spawning season only. Sobhana and Nair (1976), during the course of their study on *Puntius sarana subnasutus* calculated the sex composition was 1:2. The sex-composition of *Labeo cylindricus* was found female dominated at 1male:1.63 females in the Lake of Chicamba, a hydroelectric dam in central Mozambique, South Africa. (Wely and Booth, 1999). Dobriyal et. al, (2000) indicated the sex ratio of *Tor chilinoides,* in which male and female differ significantly with ratio of 1: 3.1. Johal et.al, (2000) reported male and female ratio 1:4.9 from Gobindsagar population. The 1 male: 4.64 female sex ratio in *Tor putitora* from the pong reservoir observed by Johal and Negi (2003) and suggested abnormal sex ratio.

Sobhana and Nair (1976), during the course of their study on *Puntius sarana subnasutus* calculated the sex composition was 1:2. The sex-composition of *Labeo cylindricus* was found female dominated at 1male:1.63females in the Lake of Chicamba, a hydroelectric dam in central Mozambique, South Africa (Wely and Booth, 1999). The sex composition of ninu *Labeo victorianus* from Kagera and Sio River, Uganda. Sex ratios in the months of February (2Male:1.00 Female), May (1.84 Male: 1.00 Female) and August (2.67 Male:1.00 Female) samples from the Kagera River were male dominated, and rest of the year did not deviate significantly. In the Sio River population, there were no male or female biased sex ratios. The significantly higher male sex ratio in February and August in Kagera River suggests that a sex specific upstream migration of males ahead of females prior to spawning occurred. No difference in sex ratio (1.15 Male:1.00 Female) was observed in Sio River population, which might imply no sex specific upstream migration (Rutaisire, 2003). The sex ratio of *Puntius vittatus was* 1male: 2 female reported by Jameela Beevi and Ramachandran (2005) from Ernakulam district (Kerala). The male: female ratio was 1.1.15 in *Cirrihina reba* calculated by Shendge and Mani (2009).

The seasonal change in different physico-chemical parameters is in the all major river system of Kumaun Himalaya (Verma, 2013 c). These changes affect fish biology by various ways. Rutaisire (2003) studied the sex composition of ninu *Labeo victorianus* from Kagera and Sio River, Uganda. Sex ratios in the months of February (2 Male:1.00Female), May (1.84Male: 1.00 Female) and August (2.67 Male:1.00 Female) samples from the Kagera River were male dominated, and rest of the year did not deviate significantly. In the Sio River population, there were no male or female biased sex ratios. The significantly higher male sex ratio in February and August in Kagera River suggests that a sex specific upstream migration of males ahead of females prior to spawning occurred. No difference in sex ratio (1.15 Male:1.00 Female) was observed in Sio River population, which might imply no sex specific upstream migration.

Dobriyal et. al, (2004) found the sex ratio of 1male : 1.028 female during their study on *Crossocheilus latius latius* from the river Mandakini that the population ratio is very close to natural. The sex ratio of *Puntius vittatus was* 1male: 2 female reported by Jameela Beevi and Ramachandran (2005) from Ernakulam district (Kerala).

Table.1 Monthly variations in the sex ratio of Rai- stream *Noemacheilus montanus* (Mc.Cl.)

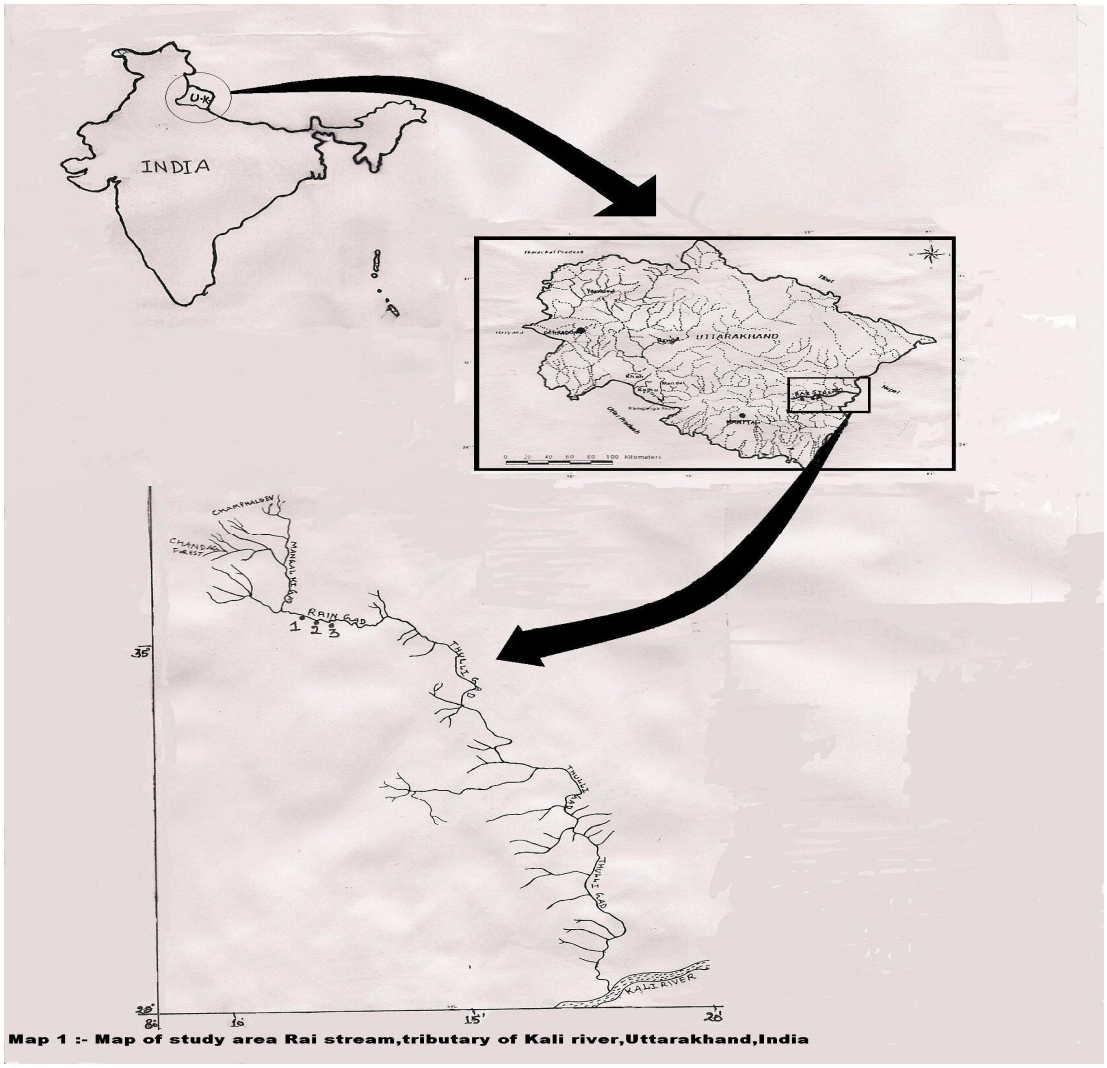
Month	Total	Male	Female	Male%	Female%	Retio		χ^2	Remarks
						Male	Female		
October	17	08	09	47.00	52.94	1.00	1.12	0.058	NS
November	25	13	12	52.00	48.00	1.08	1.00	0.040	NS
December	16	10	06	62.50	37.50	1.66	1.00	1.000	NS
January	11	07	04	63.63	36.36	1.75	1.00	0.818	NS
February	14	04	10	28.57	71.42	1.00	2.50	2.571	NS
March	10	06	04	60.00	40.00	1.50	1.00	0.400	NS
April	22	12	10	54.54	45.45	1.20	1.00	0.181	NS
May	19	09	10	47.36	52.63	1.00	1.11	0.052	NS
June	37	12	25	32.43	67.37	1.00	2.08	4.567	S
July	34	12	22	35.29	64.70	1.00	1.83	2.941	NS
August	10	05	05	50.00	50.00	1.00	1.00	0.000	NS
September	16	6	10	37.5	62.5	1.00	1.66	1.000	NS

χ^2= Values are not significant at either level (d.f.1.on p= 0.05 in 3.84); M=Male, F=Female, S=Significant, NS= Non significant

Table.2 Season and pooled data wise variations in the sex ratio of Rai- stream Noemacheilus montanus (Mc.Cl.)

Season	Total	Male	Female	Male%	Female%	Ratio		χ^2	Remarks
						Male	Female		
Winter (Dec-Feb)	41	21	20	51.21	48.78	1.05	1.0	0.024	NS
Spring (March)	32	18	14	56.25	43.75	1.28	1.0	0.125	NS
Summer (May-June)	46	21	35	45.65	76.08	1.0	1.66	0.347	NS
Monsoon (July-Aug)	44	17	27	38.63	61.36	1.0	1.58	2.272	NS
Autumn (Sep-Nov)	58	27	31	46.55	53.44	1.0	1.148	0.275	NS
Pooled Data	231	104	127	45.02	54.97	1.00	1.22	2.290	NS

χ^2= Values are not significant at either level (d.f.1.on p= 0.05 in 3.84); M=Male, F=Female, S=Significant, NS= Non significant



Map 1 :- Map of study area Rai stream,tributary of Kali river,Uttarakhand,India

The sex–ratio was near about natural in *Puntius conchonius,* 1 male: 1.17 female from Mandal river estimated by Bahuguna et.al (2007). The male: female ratio was 1.1.15 in *Cirrihina reba* calculated by Shendge and Mani (2009). Bahuguna et. al. (2009) reported the sex ratio of 1.29 Male: 1Female during their study in *Barilius vagra* from river of Mandal. Montchowui et.al., (2010) reported in the fish *Labeo senegalensis* the sex ratio (1:0.96) was not significantly different from unity.

The sex population estimation presented in the paper is on the basis of month, season and pooled data, which were found significant. Variation in the male and female fishes is also dependent on its locality and fishing gear, therefore, it is very difficult to give any comment on this condition at this moment. From the present work and on the basis of earlier observation it is concluded that the sex population of the Gadara, *Noemacheilus montanus (Mc.Cl.),* from almost all the localities female fishes are dominated. During the overall investigation on the *Noemacheilus montanus (Mc.Cl.),* the sex population was observed non-significant i.e. 1 male: 1.22 female. The chi-square value also showed 3.84 which are non-

significant at 5% level. Nikolsky (1956, 80) suggested that the optimum sex ratio may vary drastically by numerous factors and it may also depend on different populations inhabiting in different regions.

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