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MORPHOLOGICAL AND MERISTIC STUDIES OF RAINBOW TROUT (*Oncorhynchus mykiss*) AND SNOW TROUT (*Schizothorax richardsonii*)

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ABSTRACT

The morphometric and meristic studies of Rainbow trout and Snow trout were carried out. The morphometric and meristic data were analyzed. The regression equation for (Y = a + bX) was calculated for both of the fishes i.e. Y = 0.2415 + 0.3184 X and Y = 1.0489 + 0.3399 X for Rainbow trout and Snow trout respectively. The pelvic fin rays and anal fin rays are negatively correlated with total length in Rainbow Trout. In Snow trout dorsal fin rays, pectoral fin rays, anal fin rays and caudal fin rays were don't have any correlation with the total length.
Keywords: Morphometrics, Meristic, Rainbow trout, Snow trout

INTRODUCTION

In general, morphological characters that are seen externally are the ones used in the identification of fishes. The countable characters of a fish are collectively called as meristic and the measurable characters are called morphometrics. These characters are more superficial as well as more variable and hence they should be employed with caution. Morphological characters have been commonly used in fisheries biology to measure discreteness and relationships among various taxonomic categories. There are many well documented morphometric studies which provide evidence for stock discreteness (**Avsar, 1994, Corti et. al., 1988, Villaluz et. al., 1988)**.

Morphometric stock identifications have reflected the historical development of morphometric analysis, which has emerged as a complex discipline with applications in many biological fields of study. In fact, many benchmark case studies in morphometrics have involved finfish and crustaceans. However, some recent morphometric advances have had only limited application to identification of fish stocks. Understanding the historical development of morphometric techniques and their biological basis lends guidance for interpretations of morphometric patterns (**Blackith and Reyment, 1971**).

MATERIALS AND METHODS

Sample collection for the Experiment

The Snow trout (*Schizothorax richardsonii)* were collected from the Gaudi River, Champawat. The fish were caught with the help of cast net. The live fish were brought from the river and kept in the pond (area = 300 m^2, depth = 1 m) at the Experimental Fish Farm, Champawat (DCFR). Sampling was done in the month of October, 2010. The Rainbow trout (*Oncorhynchus mykiss)* were used from the cultured stock at the center for the experimental purpose. The whole work of the experiment was carried out during the period of October, 2010 to June, 2011.

Morphometric Characters

The terms used for the study of morphometric characters which are describsed below (**Practical Manual on Fish Biology, CIFE**):

1. **Total Length**: It is a measurement of body length from snout to the longest part of the caudal fin.
2. **Standard Length**: It is a length from snout to the origin of caudal fin.
3. **Forked Length**: It is a length from snout to the point of bifurcation of caudal fin.
4. **Head Length**: It is a length from snout to the posterior most part of operculum.
5. **Snout Length/Pre-orbital Length**: It is a length from snout to the anterior most margin of the eye orbit.
6. **Post-orbital Length:** It is a length from posterior margin of the eye orbit to the posterior most part of operculum.
7. **Eye Diameter**: It is a maximum length of eye orbit from one margin to other.
8. **Inter-orbital Length**: It is a distance between two dorsal most orbits of the eyes.

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9. **Pre Dorsal Length**: It is a length from the snout to the origin of the dorsal fin.
10. **Pre Pectoral Length**: It is a length from the snout to the origin of the pectoral fin.
11. **Pre Pelvic Length**: It is a length from the snout to the origin of the pelvic fin.
12. **Pre Anal Length**: It is a length from the snout to the origin of the anal fin.
13. **Dorsal fin Length**: It is a length from the base of origin of the dorsal fin to the tip of the largest dorsal fin ray.
14. **Pectoral fin Length**: It is a length from the base of origin of the pectoral fin to the tip of the largest pectoral fin ray.
15. **Pelvic fin Length**: It is a length from the base of origin of the pelvic fin to the tip of the largest pelvic fin ray.
16. **Anal fin Length**: It is a length from the base of origin of the dorsal fin to the tip of the largest anal fin ray.
17. **Caudal fin Length**: It is a length from the origin of the caudal fin to the tip of the longest part of the caudal fin i. e. total length – standard length.
18. **Body Depth**: It is a maximum vertical length of the body i.e. the deepest part of the body.
19. **Caudal Depth**: It is a minimum vertical length of the body i.e. minimum depth on caudal peduncle.
20. **Dorsal fin Base**: It is a length of whole base of the dorsal fin.
21. **Anal fin Base**: It is a length of whole base of the anal fin.

Meristic Characters

1. **Dorsal fin rays**: The total number of rays present on dorsal fin.
2. **Pectoral fin rays**: The total number of rays present on pectoral fin.
3. **Pelvic fin rays**: The total number of rays present on pelvic fin.
4. **Anal fin rays**: The total number of rays present on anal fin.
5. **Caudal fin rays**: The total number of rays present on caudal fin.

RESULTS AND DISCUSSION

A total about 57 specimens of Snow trout (*Schizothorax richardsonii*) caught by cast net from the Gaudi River Champawat and 20 specimens of Rainbow trout (*Onchorynchus mykiss*) collected from the Experimental Fish Farm, Champawat (DCFR) were used for the study.

To examine the differences between Rainbow trout (*Onchorynchus mykiss*) and Snow trout (*Schizothorax richardsonii*) about 21 morphometric measurements like total length, standard length, forked length, snout length, head length, eye diameter, inter-orbital length, post-orbital length, dorsal fin length, pectoral fin length, pelvic fin length, anal fin length, caudal fin length, pre-dorsal fin length, pre-pectoral fin length, pre-pelvic fin length, pre-anal fin length, dorsal fin base, anal fin base body depth, caudal depth etc. were recorded from each of the specimen used for the study (**Table 1**).

The statistical analysis of morphometric and meristic data was carried out using software **SPSS 16.0 version.** All the morphometric measurements and meristic counts were correlated with total length in case of both the fishes i.e. Rainbow trout (*Onchorynchus mykiss*) and Snow trout (*Schizothorax richardsonii*).

In case of Rainbow trout (*Onchorynchus mykiss*), the Pearson Correlation between total length and all other morphometric measurement and meristic count showed that weight of fish, forked length, standard length, inter-orbital length, head length, pre dorsal fin length, pre adipose dorsal fin length, pre pectoral length, pre pelvic length, pre anal length, anal fin length, body depth, caudal depth and dorsal fin base were highly correlated with total length (r=0.900 or more) (at 0.01level of significance). Pectoral fin length, dorsal fin rays and pectoral fin rays were found correlated with total length at 0.05 level of significance. The pelvic fin rays and anal fin rays are negatively correlated.

The results of Snow trout (*Schizothorax richardsonii*) showed that weight of fish, forked length , standard length, pre dorsal fin length, pre pectoral fin length, pre pelvic fin length, pre anal fin length, pectoral fin length, anal fin length and caudal depth are highly correlated ($r_{=}$ 0.900 or more) with total length (at 0.01 level of significance). Pelvic fin rays were correlated with total length at 0.05 level of significance. Dorsal fin rays, pectoral fin rays, anal fin rays and caudal fin rays were don't have any correlation with the total length. The regression equation for (Y = a + bX) is find out for both of these fishes i.e. Y = 0.2415 + 0.3184 X and Y = 1.0489 + 0.3399 X for Rainbow trout and Snow trout respectively.

While all the morphometric measurements of Rainbow trout (*Onchorynchus mykiss*) and Snow trout (*Schizothorax richardsonii*) were compared with percentage of total length **(*Md. Y. Hossain et al., 2009*)**. Rainbow trout have total length ranges from 98 mm to 150 mm while Snow trout has 91 mm to 165 mm. The comparison showed that the snout length (3.95%) and caudal fin length (20.77%) has less percentage of total length of Rainbow

Trout to that of snout length (5.46%) and caudal fin length (24.11%) of Snow Trout. The eye diameter (7.78%), post-orbital length (10.28%), head length (21.69%), body depth (21.23%), dorsal fin base (11.65%) and anal fin base (7.66%) has more percentage of total length of Rainbow Trout to that of eye diameter (4.71%), post-orbital length (7.02%), head length (17.05%), body depth (14.69%), dorsal fin base (9.74%) and anal fin base (5.17%) of Snow Trout (**Table 2**).

Rainbow trout have more dorsal fin rays (14-15) and anal fin rays (12-14) than the Snow trout Snow trout i.e. dorsal fin ray (9-10) and anal fin rays (6-7). The Rainbow trout has 20 caudal fin rays while Snow trout has ranging from 18-20. Rainbow trout have 13-15 pectoral fin rays and 10-11 pelvic fin rays while Snow trout have 12-16 pectoral fin rays and 8 -10 pelvic fin rays (**Table 3).**

Rainbow trout has large eye diameter, body depth, depth at caudal peduncle, dorsal and anal fin base compared to that of the percentage of total length than Snow trout. Snow trout showed the more slender body form and more length of caudal fin and snout length (pre orbital length) compared with percentage of total length.

Table 1. Morphometric measurements of Rainbow Trout (*Onchorynchus mykiss*) from the Experimental Fish Farm, Champawat (DCFR).

Sr. No.	Measurements (mm)	Minimum	Maximum	Mean	% of Total Length
1	Total Length	98	150	120.1	
2	Fork Length	92	135	111.3	92.67
3	Standard Length	78	118	95.15	79.22
4	Snout Length	3	6	4.75	3.95
5	Eye Diameter	7	12	9.35	7.78
6	Post- Orbital Length	10	16	12.35	10.28
7	Inter-orbital Length	5	9	7.25	6.03
8	Head Length	21	32	26.05	21.69
9	Pre-Dorsal Length	40	62	50.35	41.92
10	Pre-Adipose Dorsal Length	62	102	81.3	67.69
11	Pre-Pectoral Length	19	28	22.7	18.90
12	Pre-Pelvic Length	44	66	53.55	44.58
13	Pre-Anal Length	60	96	75.55	62.90
14	Dorsal Fin Length	17	26	20.05	17.01
15	Pectoral Fin Length	14	22	16.9	14.07
16	Pelvic Fin Length	11	18	14	11.65
17	Anal Fin Length	12	18	14.9	12.40
18	Caudal Fin Length	20	32	24.95	20.77
19	Body Depth	20	33	25.5	21.23
20	Caudal Depth	8	13	9.65	8.03
21	Dorsal Fin Base	11	18	14	11.65
22	Anal Fin Base	7	12	9.2	7.66

Table 2. Morphometric measurements of Snow trout (*Schizothorax richardsonii*) from the Gaudi River, Champawat.

Sr. No.	Measurements (mm)	Minimum	Maximum	Mean	% of Total Length
1	Total Length	91	165	120.01	
2	Fork Length	81	146	107.10	89.24
3	Standard Length	70	126	91.08	75.89
4	Snout Length	4	10	6.56	5.46
5	Eye Diameter	4	8	5.66	4.71
6	Post- Orbital Length	6	14	8.43	7.02
7	Inter-orbital Length	6	14	7.96	6.63
8	Head Length	16	27	20.47	17.05
9	Pre-Dorsal Length	36	70	50.47	42.05
10	Pre-Pectoral Length	16	29	20.61	17.17
11	Pre-Pelvic Length	40	70	51.49	42.90
12	Pre-Anal Length	57	100	74.49	62.06
13	Dorsal Fin Length	11	28	18.92	15.76
14	Pectoral Fin Length	13	24	17.35	14.45
15	Pelvic Fin Length	11	25	16.07	13.39
16	Anal Fin Length	13	25	16.94	14.11
17	Caudal Fin Length	21	40	28.94	24.11
18	Body Depth	13	27	17.63	14.69
19	Caudal Depth	7	13	8.87	7.39
20	Dorsal Fin Base	8	18	11.70	9.74
21	Anal Fin Base	4	9	6.21	5.17

Table 3: Meristic Counts of cultured Rainbow Trout (*Onchorynchus mykiss*) and wild Snow trout (*Schizothorax richardsonii*)

Sr. No.	Meristic Data	Rainbow Trout	Snow trout
1	Dorsal fin rays	14-15	9-10
2	Pectoral fin rays	13-15	12-16
3	Pelvic fin rays	10-11	8-10
4	Anal fin rays	12-14	6-7
5	Caudal fin rays	20	18-20

One of the important considerations in the management of a fishery resource is the identification of discrete populations or stock units which are generally defined as self maintaining groups, temporarily or spatially isolated from one another and considered genetically distinct. Failure to recognize or to account for stock complexity in management units has led to an erosion of spawning components, resulting into a loss of genetic diversity and other unknown ecological consequences **(Begg et. al.1999)**.

The present investigation, morphometric and meristic variation between cultured Rainbow trout (*Onchorynchus mykiss*) and wild Snow trout (*Schizothorax richardsonii*) were recorded and all the morphometric measurements were compared with the percentage of total length. Also the correlation coefficient (r) was calculated for all the morphometric measurements for each other. Rainbow trout has shorter snout length than the Snow trout. The eye diameter, body depth, depth at caudal peduncle, dorsal fin base and anal fin base observed to be larger in Rainbow trout to that of Snow trout. Besides these measurements all of the other morphometric measurements are found to be nearly same.

Morphometric variation in adult male and female salmon, including coho salmon, *Oncorhynchus kisutch*, has been described in several studies **(Beacham 1985, Beacham & Murray 1985, Beacham & Withler 1985, Beacham et al. 1988, Lund et al. 1989, Kinnison et al. 1998)**. Most of these have analyzed conventional body measurements. These studies indicate that morphometry (1) can be highly variable among and within conspecific populations, (2) is often correlated with geographic and habitat variation and (3) often appears to have a genetic component, based on differences among groups in a common environment.

Negi R. K. and Negi T. (2010) also obtained the same results in case of Snow trout (*Schizothorax richardsonii*). It was investigated that all the morphometric characters show high degree of correlation coefficient ($r<0.90$) and correlation coefficient was significant at $p<0.01$ except anal fin depth which significant at $p<0.05$.

Collection of Snow trout at Gaudi River, Champawat, Uttarakhand, INDIA

Experimental fish farm Champawat (DCFR), Uttarakhand, INDIA

Rainbow trout at Experimental fish farm Champawat (DCFR), Uttarakhand, INDIA

Snow trout collected from Gaudi River, Champawat, Uttarakhand, INDIA

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