The Pharma Innovation Journal 2023; 12(5): 3091-3095

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 3091-3095

www.thepharmajournal.com
Received: 01-02-2023
Accepted: 04-03-2023

Maheen Altaf
Research Scholar, Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K Rangil, Ganderbal, Jammu & Kashmir, India

Dr. Farooz Ahmad Bhat
Dean, Faculty of Fisheries, Professor and Head,
Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, Rangil, Ganderbal, Jammu & Kashmir, India

Dr. Tasaduq Hussain Shah
Associate Professor, Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K Rangil, Ganderbal, Jammu & Kashmir, India

Dr. Adnan Abubakr
Professor and Head, Division of Aquatic Environmental Management (AEM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, Rangil, Ganderbal, Jammu & Kashmir, India

Dr. Bilal Ahmad Bhat
Professor and Head, Division of Social Sciences, Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K Rangil, Ganderbal, Jammu & Kashmir, India

Dr. Tariq Hussain Bhat
Associate Professor and Head, Division of Post Harvest Technology Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, Rangil, Ganderbal, Jammu & Kashmir, India

Zaib Hafiz
Research Scholar, Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, Rangil, Ganderbal, Jammu & Kashmir, India

Asim Iqbal Bazaz
Research Scholar, Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, Rangil, Ganderbal, Jammu & Kashmir, India

Corresponding Author:
Maheen Altaf
Research Scholar, Division of Fisheries Resource Management (FRM), Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K Rangil, Ganderbal, Jammu & Kashmir, India

Study on gut morphometric parameters of an endemic schizothoracine fish *Schizopyge niger* (Heckel, 1838) in Kashmir Himalaya

Maheen Altaf, Dr. Farooz Ahmad Bhat, Dr. Tasaduq Hussain Shah, Dr. Adnan Abubakr, Dr. Bilal Ahmad Bhat, Dr. Tariq Hussain Bhat, Zaib Hafiz and Asim Iqbal Bazaz

Abstract
Gut morphometric parameters viz. Gut length, Gut weight, Relative Gut Mass (RGM), Relative Length of Gut (RLG), Zihler's Index (ZI), and Gut Vacuity Index (GVI) of *Schizopyge niger* were studied to investigate its feeding characteristics. According to the results, total length and total weight of fish ranged from 110.69 mm to 297.90 mm and 62.00 to 311.89 g, respectively and the gut length and gut mass of fish varied from 258.35 mm to 906.91 mm and 1.52g to 17.02 g, respectively. The overall RGM and RLG values ranged from 0.01 to 0.13 with a mean value of 0.04±0.02 and 1.26 to 4.59 with a mean value of 2.14±0.21, respectively thereby exhibiting that *S. niger* has herbivorous nature. The results revealed the ZI values to be in the range of 6.04 to 18.16 and GVI values ranged from 0 to 23.33 exhibiting the gluttonous nature of this species. This type of study is beneficial for aquaculture as well as assessing the ecological role of *Schizopyge niger* along with its position in the food chain of fresh waters of Kashmir valley.

Keywords: *Schizopyge niger*, relative gut mass, relative length of gut, Zihler's index, and gut vacuity index

1. Introduction
Snow trouts (*Schizothorax* spp.) are included in subfamily Schizothoracinae and family Cyprinidae. This genus is important to fisheries and is indigenous in Himalayan and sub Himalayan regions of Indian subcontinent, Central Asia, Afghanistan, Myanmar, Kazakhstan and China. Snow trouts inhabit cold waters and prefer rivers, streams and lakes of temperature between 8 and 22 °C [1].

Schizothoracines are believed to have originally migrated from turbulent streams of Central Asia to westwards towards Kashmir [2]. The fish biodiversity of Kashmir valley is different from rest of India and is mainly represented by this genus (Schizothoracines). Therefore, the valley remains in the minds of ichthyologists as the "Snow Trout place" or the "Snow Barbel place". About 40 species of fishes have been reported from Kashmir valley but presently the number of valid fish species is believed to be not more than 23. The major fish fauna of Kashmir water bodies comprise of exotic carp *(Cyprinus carpio)* and indigenous *Schizothorax* species. Common carp (*Cyprinus carpio)* is represented by two phenotypes, *Cyprinus carpio* var. *communis* and *Cyrpinus carpio* var. *specularis.* The *Schizothorax* species found in water bodies of Kashmir are; *Schizothorax esocinus* (Churru), *Schizothorax curvifrons* (Satter gad), *Schizothorax niger* (Ale gaad), *Schizothorax plagiostomus* (Khont), *Schizothorax labiatus* (Chosh) [3, 4, 5, 6, 7, 8, 9].

Schizopyge niger is locally called as "Ale gad" in Kashmir valley. It is known to inhabit both lentic and lotic water bodies of valley. However, it is found chiefly in lentic habitats. It differs from all other *Schizothorax* species of Kashmir predominantly due to presence of thick but not otherwise expanded lower lip folds. Other diagnostic features include presence of short snout and few gill rackers than others. Mouth is horse-shoe shaped and lips marginally sharp. Generally, *S. niger* appears to be darker (drak brown on back, lighter on flanks, belly yellowish and fins brownish) and has thick fleshly lips in addition to longer barbels. Remarkably, it is the only *Schizothorax* species with exclusively six dorsal fin rays while others usually have seven to eight [6, 10]. The overall populations of local Schizothoracines have been experiencing a continuous decline largely due to rise in pollution levels, encroachments,

earth filling, illegal constructions and transforming water channels into roads [5, 7, 8, 9].

Gut morphometric parameters are widely used in order to determine the feeding habits such as herbivorous, carnivorous, omnivorous, herbi-omnivorous or carni-omnivorous of fish. There is little information regarding certain gut morphometric parameters and somatic indices such as relative gut mass, relative gut length, Zihler's index and gut vacuity index of *S. niger*. This information is necessary to determine its feeding habit as the population of these fishes seems to be declining in Kashmir region. In view of its commercial importance it is of great necessity to know the feeding habit of this fish which can help to raise them in captivity. Thus, the present study will add the knowledge of feeding biology of economically important fish viz. *S. niger*.

2. Material and Methods

The research work on *S. niger* was conducted in Fisheries Resource Management (FRM) laboratory, Faculty of Fisheries, SKUAST-K, Rangil, Ganderbal. The study involved the following steps for meeting the various objectives of the work.

2.1 Collection of fish samples

30 fish samples of *S. niger* of different size groups were collected monthly for a period of one year from Dal lake landing centre, Srinagar. Samples were transported to FRM laboratory (FoFy) in insulated boxes containing ice packs. The fish samples were then cleaned under running tap water and dried with a clean cotton cloth. After cleaning, total weight and total length of each sample was measured using electronic weighing balance up to the nearest 0.5 gram and digital vernier caliper to the nearest 0.01 millimeter respectively.

2.2 Gut morphometric and somatic indices analysis

For gut morphometric analysis, each specimen of fish was measured to its total length to the nearest of millimeter and weighed to the nearest of gram. Each sample was then discreetly dissected by making incision at anus and extending it anteriorly along the fish belly towards the head and their guts were removed out carefully.

Gut morphometric parameters and somatic indices were then recorded with the help of digital vernier caliper and digital weighing balance. Total gut length was measured with the help of digital vernier caliper by carefully stretching out the whole gut and then removing the attaching tissues like adhering fat and viscera cautiously with the help of forceps. Length of gut was recorded from the anterior end to the cloacal aperture. The gut was then weighed carefully on a digital weighing balance to the nearest milligrams. Following parameters were calculated:

1. Gut length (GL)
2. Gut mass (GM)
3. Relative gut mass (RGM)

It was calculated using formula:

$$\text{RGM} = \frac{\text{Total Gut mass(g)}}{\text{Total body mass (g)}}$$

Relative length of gut (RLG) or Intestinal Quotient (IQ)
Its value was calculated using following formula [11]:

$$\text{RLG} = \frac{\text{Total gut length}}{\text{Total length of fish}}$$

Zihler's Index (ZI)
It was calculated by the following formula [12]:

$$\text{ZI} = \frac{\text{Total gut length(mm)}}{10\ x\ (\text{body mass})^{1/3}}$$

Gut Vacuity Index (GVI)
It was calculated using the following equation [13]:

$$\text{GVI} = \frac{\text{Number of empty guts(EG)}}{\text{Number of surveyed guts (TG)}} * 100$$

3. Results and Discussion

In the present study, 30 fish samples of *S. niger* of different size groups were collected for a period of 12 months and gut morphometric parameters such as gut length (GL), gut weight (GW), relative gut mass (RGM), relative length of gut (RLG) or intestinal quotient (IQ), Zihler's index (ZI) and Gut vacuity index (GVI) were then recorded (Table 1).

Table 1: Descriptive statistical summary of gut morphometric parameters of *S. niger*

	Minimum	Maximum	Mean± SD
Total Length (mm)	110.69	297.9	222.13±39.50
Total Weight (g)	62	311.89	128.11±43.18
Gut Length (mm)	258.35	906.91	487.46±123.44
Gut Weight (g)	1.52	17.02	5.56±2.96
RGM	0.01	0.13	0.04±0.02
RLG	1.26	4.59	2.14±0.21
ZI	6.04	18.16	9.82±2.37
GVI (%)	0	23.33	6.11±7.63

The gut of the *S. niger* was found to be quite lengthy and extensively coiled with the length range of 258.35 mm to 906 .91 mm (25.83 cm to 90.69 cm) and weighed from minimum of 1.52g to a maximum of 17.02g. It is reported that one of the most widely recognized anatomical features of vertebrates is that herbivores exhibit longer digestive tracts than do carnivores, and this pattern appears to be consistent among mammals [14, 15], birds [16], reptiles and amphibians [15] and fishes [17, 18, 19, 20]. Zihler [12] also stated that piscivorous, paedophagous and crustacean eating species have short intestines with little or no coiling where as herbivorous, planktivorous and detritivorous forms have complicated and much coiled intestines. It is stated that one of the effective ways of increasing digestive efficiency is total intestinal length as longer guts would allow food to spend more time in the digestive tract and, therefore, allow more nutrients to be absorbed [21, 22]. Gharaei [23] also recorded that the gut of snow trout *Schizothorax zarudnyi* species is elongate and coiled ranging from 24-64 cm.

In the present analysis, the average relative gut mass (RGM) in *S.niger* was measured as 0.04 and RGM values ranged from 0.01 to 0.13. Relative gut mass was obtained to estimate the information determining the relative quantity of tissue allocated to the digestive tract in *S.niger*. Hani *et al* [24] recorded the RGM values of three spine stickleback (*Gasterosteus aculeatus*) ranged from 0.034 to 0.052. They further reported that RGM values were higher in small sticklebacks than in large ones, suggesting that small

sticklebacks tend to increase their gut mass to maximize extraction of nutrients and energy from their diet and ensure growth. German and Horn [25] stated that RGM might provide a useful measure for comparing total gut size in herbivores and carnivores when used together with gut length and reported that RGM is characteristically utilized to evaluate the tissue quantity. However, comparisons of RGM between herbivorous and carnivorous fishes appear to be lacking in the literature.

In the present analysis, the average relative gut length (RLG) in *S.niger* was measured as 2.14 and the RLG values ranged from 1.26 to 4.59. Das and Moitra [26] reported herbivorous fishes usually have long digestive tracts with relative length of gut (RLG) values as high as 12 and in carnivorous fish RLG values less than 1 were reported to be common feature. Al-Hussaini [11] stated that if RLG of fish species is measured to be more than 1, then it tends to be herbivore. Yousuf *et al.* [27] while studying the food and feeding habits of *Glyptosternon reticulatum* reported the average RLG of fish as 0.93 and termed the fish as carnivore. Johari *et al.* [28] reported that RLG is used to indicate the type of food eaten and if RLG is >> 1, then the fish is a herbivore, if RLG = 1, then the fish is an omnivore, and if RLG is << 1, then the fish is a carnivore. Gharaei [23] reported the average relative length of gut in *S. zarudnyi* as 1.71. Becker *et al.* [29] found the intestinal quotient for grass carp to be 2.78 and stated it to be in the range of herbivorous species. They also recorded the intestinal quotient of silver catfish as 0.65 and stated it to be in the range of carnivorous species. The RLG value of grass carp reported by Buddington *et al.* [30] is 1.90 and the RLG value of large herbivore specimens of *Brycon guatemalensis* was also reported to be 2.3 by Drewe *et al.* [31]. Therefore, based on this *S.niger* can be categorized as an herbivore fish.

In the present analysis, the average Zihler's index (ZI) in *S.niger* was measured as 9.82 and the ZI values ranged from 6.04 to 18.16. Relative gut length is the index likely used most commonly in comparisons among fishes with different diets [17, 31], but this index ignores differences in body mass. However, ZI [12] relates gut length to body mass which therefore offers a potential powerful perspective as it takes into account differences in body mass. Zihler [12] reported an enormous increase in the intestinal weight length (ZI) combined with more complicated intestinal coiling. Karachle and Stergiou [32] while studying the intestinal morphometrics of fishes reported the mean ZI values as 20.31, 3.75, 5.3 and 4.3 of herbivores, omnivores with preference to animal material, carnivores with preference to decapodes and fish and carnivores with preference to fish and cephalopods respectively. Kramer and Bryant [20] classified fishes according to their ZI as carnivores (ZI = 2.3–3.2), omnivores (ZI = 2.4–5.8) or as herbivores (ZI = 11.6–55.0). Therefore, based on this classification *S.niger* tends to be classified as an herbivore fish.

The mean Gut Vacuity Index (GVI) in *S.niger* during the present study was measured as 6.11 and the GVI values ranged from 0 to 23.33, which revealed that *S.niger* is gluttonous species. GVI is used to work out the appetite of the species, following Euzen [13] where numbers of empty guts are surveyed. Johari *et al.* [28] reported the gut vacuity index (GVI) in *Capoeta fusca*, a cyprinid fish was 20 to 40 (mean = 30.95±5.90) in all months of the year which shows that this fish is relatively gluttonous species. They further stated that if GVI<20, then the species is considered gluttonous. If GVI<40, then the species is considered relatively gluttonous. If GVI<60, then the species has a medium nutrition. If GVI<80, then the species has a relatively low nutrition and if GVI<100, then the species has low nutrition.

Pearson's correlation of the gut morphometric parameters of the *S.niger* revealed that total length showed positive correlation with fish weight, gut length, gut weight and Zihler's index where as it showed negative correlation with relative gut mass and relative gut length. Karachle and Stergiou [32] also reported a strong relationship between gut length (GL) and total length (TL) while studying the intestinal indices i.e. gut length and Zihler's index of various fishes from the North Aegean. Fish body weight showed positive Pearson's correlation with total length, gut length, gut weight and relative gut length whereas it showed negative correlation with RGM and ZI. Gut length and gut weight showed positive correlation with all variables under study. RGM showed positive correlation with GL, GW, RLG and ZI and negative correlation with TL and TW. RLG showed positive correlation with TW, GL, GW, RGM and ZI and negative correlation with TL. ZI showed strong positive correlation with GL. ZI also showed positive correlation with TL, GW, RGM and RLG and negative correlation with TW (Table 2.). Riaz and Naeem [33] also reported positive Pearson's correlation of fish weight with total length, gut weight and negative correlation of fish weight with RGM and ZI. They also reported positive correlation of TL with GW and GL and positive correlation of Gut weight with RGM, RGL and ZI. Further they found positive correlation of Gut length with RGM and ZI.

Table 2: Pearson's correlation of the traits under study of the *S.niger*.

	TL	TW	GL	GW	RGM	RLG	ZI
TL	1	.344**	.345**	.208**	-.068	-.489**	.188**
TW	.344**	1	.234**	.244**	-.285**	.038	-.159*
GL	.345**	.234**	1	.535**	.350**	.621**	.913**
GW	.208**	.244**	.535**	1	.809**	.309**	.425**
RGM	-.068	-.285**	.350**	.809**	1	.317**	.476**
RLG	-.489**	.038	.621**	.309**	.317**	1	.630**
ZI	.188**	-.159*	.913**	.425**	.476**	.630**	1

**. Correlation is significant at the 0.01 level (2 -tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. Conclusion

The present analysis on gut morphometric parameters viz. Gut length, Gut weight, Relative Gut Mass (RGM), Relative Length of Gut (RLG) and Zihler's Index (ZI) of *S. niger* revealed that this species is primarily herbivorous. The Gut Vacuity Index indicated *S. niger* to be a gluttonous species

having voracious appetite. The present study therefore provides the insights on the feeding habit of the fish. Further comprehensive information on the food and feeding habits and patterns of this fish will be required in properly understanding its digestion strategy.

5. References

1. Sharma BP. Status of Schizothorax sp. in the Indian-Chinese sub-continent. FAO Fisheries Report. No. 405 (Suppl.), Rome; c1989. p. 90-94.
2. Sehgal KL. The Ecology and Fisheries of Mountain Streams of N.W. Himalayas. Thesis for the award of D.Sc. Degree, Meerut University; c1988.
3. Heckel JJ. Fische aus Cashmir. Carl Freiherrn V. Hugel, Wien; c1838. p. 1-86, 1-12.
4. Heckel JJ. Fische Kaschmir‟s nebst einem Anhang von drei neuen Aeten aus Indien, gesammelt von Freiherrn Carl V. Hugel. In: Hugel, C. v., Kaschmir und das Reich der; c1844.
5. Yousuf AR. Fishery resource of Kashmir. In: A. H. Khan and A. K. Pandit (eds.) Ecology, Environment and Energy. University of Kashmir; c1996. p. 75-120.
6. Kullander SO, Fang F, Delling B, Ahlander E. The Fishes of the Kashmir Valley. River Jhelum, Kashmir Valley: Impact on the Aquatic Environment. Department of Vertebrate Zoology, Seweden Museum of Natural History, POB 50007, SE-104 05 Stockholm, Sewden; c1999.
7. Balkhi MH. Fish Diversity in Jammu and Kashmir and Conservation Measures. Kashmir Speaks; *c*2007. p. 104-115.
8. Bhat FA, Balkhi MH, Yousuf AR. Fish Diversity in the Kashmir Himalaya. In: Biodiversity, Development and Poverty Elevation; International Day for Biological Biodiversity. Department of Botany, University of Kashmir; c2010. p. 24- 27.
9. Bhat FA, Yousuf AR, Balkhi MH. Biodiversity of Fishes in Jammu and Kashmir. In: Biodiversity of the Himalaya: Jammu and Kashmir State (Gh. Hassan Dar and Anzar A. Khuroo, Eds.). Springer Nature Singapore, Private Limited; c2020. p. 859-887.
10. Jhingran VG. Fish and Fisheries of India. Third edition. Hindustan publishing corporation (India), New Delhi, 1991, 160.
11. Al-Hussaini AH. On the Functional Morphology of the Alimentary Tract of Some Fish in Relation to Difference in their Feeding Habits: Anatomy and Histology. Q. J. Microsc. Sci. 1949;90:109-139.
12. Zihler F. Gross morphology and configuration of digestive tracts of Cichlidae (Teleostei: Perciformes): phylogenetic and functional significance. Neth. J Zool. 1982;32(4):544-571.
13. Euzen O. Food Habits and Diet Composition of Some Fish of Kuwait. Kuwai. B. Mar. Sci. 1987;9:65-85.
14. Korn H. Intestine lengths of Southern African savanna rodents and insectivores: intra- and interspecific comparisons. Journal of Zoology.1992;228(3):455-460. doi:10.1111/j.1469-7998.1992.tb04448.x
15. Stevens, CE, Hume ID. Comparative Physiology of the Vertebrate Digestive System. 2nd ed. Cambridge; New York: Cambridge University Press, 1995, 400.
16. Battley P, Piersma T. Adaptive interplay between feeding ecology and features of the digestive tract in birds. In: J. M. Starck, & T. Wang (Eds.), Physiological and ecological adaptations to feeding in vertebrates, Science Publishers; c2005. p. 201-228.
17. Al-Hussaini AH. The anatomy and histology of the alimentary tract of the plankton-feeder, Atherina forskali Rüpp. Journal of Morphology. 1947;80(2):251–286.
18. Kapoor BG, Smit H, Verighina A. The alimentary canal and digestion in teleosts. Advances in Marine Biology. 1975;13:109-239.
19. Horn LR. A Natural History of Negation. University of Chicago Press, 1989. ISBN 0226353370
20. Kramer DL, Bryant MJ. Intestine length in the fishes of a tropical stream: 2. Relationships to diet — the long and short of a convoluted issue. Environ Biol Fish. 1995;42:129-141.
21. Wootton RJ. Ecology of Teleost Fishes. 2nd Edition, Kuwer Academic Publishers, Dordrecht; c1998.
22. Pennisi E. What determines species diversity? Science. 2005;309(5731):90.
23. Gharaei A. Morphometric and Meristic Studies of Snow Trout *Schizothorax zarudnyi* (Nikolskii, 1897) as A Threatened Endemic Fish. World Journal of Fish and Marine Sciences. 2012;4(4):426-429.
24. Hani YMI, Marchand A, Turies C, Kerambrun E, Palluel O, Bado-Nilles A *et al*. Digestive Enzymes and Gut Morphometric Parameters of Threespine Stickleback *(Gasterosteus aculeatus*): Influence of Body size and Temperature. PLoS ONE, 2018, 13(4).
25. German DP, and Horn MH. Gut length and Mass in Herbivorous and Carnivorous Prickleback Fishes (Teleostei: Stichaeidae): Ontogenetic, Dietary, and Phylogenetic effects. Marine Biology. 2006;148:1123–1134.
26. Das SM, Moitra SK. Studies on the Food and Feeding Habits of some Freshwater Fishes of India, IV: A Review on the Food and Feeding Habits of 24 Freshwater Fishes with General Conclusions. Ichthyologica. 1963;2:107-115.
27. Yousuf AR, Bhat FA, Mehdi, D, Ali S, Ahangar MA. Food and Feeding Habits of *Glyptosternon reticulatum* McCelland & Griffith in Torrential Streams of Kashmir Himalayas. Journal of Research and Development, 2003, 3.
28. Johari SA, Coad BW, Mazloomi S, Kheyri M, Asghari, S. Biological and Morphometric Characteristics of *Capoeta fusca*, a Cyprinid Fish Living in the Qanats of South Khorasan, Iran. Zoology in the Middle East. 2009;47(1):63-70.
29. Becker AG, Gonçalves JF, Garcia LO, Behr ER, Graça DL, Filho, MK *et al*. Morphometric Parameters Comparisons of the Digestive Tract of Four Teleosts with Different Feeding Habits. Ciência Rural, Santa Maria. 2010;40(4):862-866.
30. Buddington RK, Chen JW, Diamond J. Genetic and phenotypic adaptation of intestinal nutrient transport to diet in fish. The Journal of Physiology. 1987;393(1):261-281.
31. Drewe KE, Horn MH, Dickson KA, Gawlicka A. Insectivore to frugivore: ontogenetic changes in gut morphology and digestive enzyme activity in the characid fish *Brycon guatemalensis* from Costa Rican rain forest streams. Journal of Fish Biology. 2004;64(4):890-902.
32. Karachle PK, Stergiou KI. Gut Length for Several

Marine Fish: Relationships with Body length and Trophic implications. Marine Biodiversity Records. 2010;3:1-10.
33. Riaz P and Naeem M. Digestive Enzymes Activity with Gut Morphometric Parameter of Carnivorous Fish *Wallago attu* (Siluridae, Siluriformes). Sarhad Journal of Agriculture. 2020;36(3):832-839.