ISSN 2250-3153

Feeding habits and diet composition of Brown trout (*Salmo-trutta fario*) in the upper streams of Kashmir Valley

Nusrat Rasool*, Ulfat Jan*, G. Mustafa Shah*

* Department of Zoology, University of Kashmir, Pin-190006, India

Abstract- The feeding habits and diet composition of the stream dwelling resident brown trout *Salmo trutta fario* in the upper streams of the Kashmir valley were investigated by examining the stomach contents of 108 specimens collected from January 2004 to December 2005. Analysis of monthly variations of stomach fullness indicated that feeding intensity was higher between March and July than that for the spawning season that covered the period from October to December. A total of 4464 individual preys were counted representing trichoptera, ephemeroptera, diptera, plecoptera, coleoptera, odonata, amphipoda, hirudinea, megaloptera; trout egg, plant seeds and terrestrial ants were also identified in the diet. The index of relative importance (IRI%) revealed that four food items together constituted more than 90% of the diet, with the most important being *Brachycentridae* (51.55%), *Blepharocera* (14.06%), *Baetis species* (10.48%) and *Ephemerella species* (5%).

Index Terms- Brown trout, diet composition, *Salmo trutta fario*, streams of Kashmir valley.

I. Introduction

Salmo trutta fario is one of the most important fish species due to its aquaculture potential, economic value and wide consumer demand and *Salmo trutta fario* forms resident populations in the upper streams of rivers and occurs in North Africa, Europe, West Asia and Anatolia (Lehane et al., 2001; Bachmann, 1984) and it is an important species for recreational fishery.

Quality and quantity of food received from their environment is a result of the relationship between the environment and fish. In order to understand this relationship, analysis of the contents of the digestive system needs to be done. Analysis of diet in fish provides us with indirect information about how it feeds, its possible interaction with other species (Smith et al., 1993).

Several studies have been performed in relation with the diet of wild trout populations in different locations (Bridcut and Giller, 1993, 1995; Friberg et al., 1994; Fochetti et al., 2003; Ruginis, 2008). In the previous studies, it was stated that feeding was accomplished by visual foraging in salmonids and three potential groups of brown trout food can be distinguished: substrate associated prey, suspended drift and surface drift prey (Ruginis, 2008).

Scarce information is available on feeding activity of *Salmo trutta* populations in Kashmir valley. In addition natural food organisms used as feed by the brown trout have received little attention. The present study was carried out in Sindh stream, Ferozpur stream and Lidder stream situated in three different districts of Kashmir valley at an average altitude of 2100m, 2400m and 1900m above sea level respectively. During the present investigations, three sites were selected for collection of fish: middle, uphill and downhill parts of the stream. In this paper, we describe diet composition of native resident brown trout in the upper streams of Kashmir valley by analysis of stomach contents.

II. Materials and methods

A total of 108 individuals of the brown trout were caught monthly at the three selected sampling sites, between January 2004 to December 2005 by angling. All the captured fish specimens were immediately kept in an ice box for later analysis. For each fish, total weight (grams), total length (mm) and sex were recorded. For each fish, following the removal of digestive tract, stomach was opened; its content was flushed into a petridish. The weight of the full gut and the weight of the empty gut were recorded in order to get the weight of the food content contained within it. Stomach content flooded with distilled water was examined under a stereoscopic microscope. Contents were sorted and prey items were identified to the lowest feasible taxonomic units using the identification keys of Edmondson (Edmondson, 1959) and Geldiay and Balik (Geldiay and Balik, 1988).

Food items were damp dried on blotting paper and the number of individuals and total weight of each prey category were recorded. Tract contents having no food items were also recorded as empty stomachs.

The fullness index (FI) was assessed as per Windell (1971) to investigate the variations in feeding intensity, using the equation:

$$FI = \frac{(\text{Weight of the food})}{(\text{Total weight of fish})} \times 100$$

Gastrosomatic Index (GSI): The feeding intensity was measured for each fish species by calculating gastrosomatic index and the amount of food contained in the gut. GSI was calculated by using the formula:

$$GSI = \frac{(\text{Total weight of full gut})}{(\text{Total weight of fish})} \times 100$$

Dietary importance of food categories was determined using the modified index of relative importance:

$$IRI = (N\% + W\%) \times FO\% \text{ (Pinkas et al.., 1971)}$$

where FO% is percentage frequency occurrence of stomachs in which a food item occurred relative to the total number of stomachs containing food items; N% is the numeric percentage of individuals of a food item relative to the total number of food items in the stomach and W% is the percentage weight of the food item relative to the weight of the total stomach contents. Percentage of weight (W %) was used instead of volumetric percentage (Pita et al., 2002).

The values of the compiled growth exponent were used for the calculation of condition factor (CF) or Ponderal Index i.e.

$$K = \frac{(W \times 10^5)}{L^3}$$

where W is total weight of fish in (grams), L is total length of fish in (mm) and 10^5 was introduced to bring the value of Ponderal index near unity.

III. Results

A. Diet composition

A total of 26 preys were identified in the diets of the fish and they are presented in Table 1. Trichoptera were present in 71 (65.74%), ephemeroptera in 65 (60.19%), diptera in 61 (56.48%) stomachs, while plecoptera in 32 (29.63%), coleoptera in 36 (33.33%) and amphipoda in 15 (13.89%) stomachs. In addition odonata, hirudinea, megaloptera, terrestrial ants, trout eggs, plant seeds and stones were rarely present in the stomach contents (Table 1).

Table 1: Food items and their relative importance index in the diet composition of Brown trout *(Salmo trutta fario)*.

Prey	N	%N	W	%W	FO	%FO	IRI	%IRI
I. TRICHOPTERA	**1420**	**31.8**	**37.144**	**43.172**	**71**	**65.74**		
(i) Brachycentridae	1269	28.4	33.133	38.510	63	58.33	3902.86	51.55
(ii) Hydropsychidae	133	2.97	3.523	4.095	21	19.44	137.34	1.81
(iii) Chimarra	18	0.4	0.4878	0.567	4	3.70	3.578	0.047
II. EPHEMEROPTERA	**1353**	**30.3**	**21.333**	**24.795**	**65**	**60.19**		
(i) Ephemerella spp.	231	5.17	6.0706	7.056	33	30.55	373.50	4.93
(ii) Caenis spp.	171	3.83	1.3851	1.610	47	43.52	236.75	3.13
(iii) Heptagenia spp.	23	0.52	0.4659	0.541	17	15.74	16.70	0.22
(iv) Ephemera spp.	240	5.37	10.288	11.958	12	11.11	192.51	2.54
(v) Baetis spp.	688	15.41	3.1235	3.630	45	41.66	793.21	10.48
III. DIPTERA	**1326**	**29.7**	**14.163**	**16.462**	**61**	**56.48**		
(i) Chironomida	392	8.78	2.536	2.948	22	20.37	238.90	3.16
(ii) Antocha	108	2.41	0.135	0.157	15	13.88	35.63	0.47
(iii) Tipula	26	0.58	0.39	0.453	5	4.63	4.78	0.063
(iv) Chrysops	34	0.76	0.544	0.632	8	7.41	10.31	0.136
(v) Simulium	23	0.52	0.253	0.294	4	3.70	3.01	0.040
(vi) Atherix	11	0.24	0.275	0.320	2	1.85	1.04	0.014
(vii) Blepharocera	732	16.39	10.03	11.658	41	37.96	1064.70	14.06
IV. PLECOPTERA	**115**	**2.5**	**2.7111**	**3.151**	**32**	**29.63**		

(i) Nemoura spp.	88	1.97	1.5312	1.780	27	25	93.75	1.24
(ii) Perla spp.	27	0.60	1.1799	1.371	31	28.70	56.57	0.75
V. COLEOPTERA	**108**	**2.42**	**6.328**	**7.355**	**36**	**33.33**		
(i) Elmidae	108	2.42	6.328	7.355	36	33.33	325.8	4.30
VI. ODONATA	**20**	**0.45**	**0.76**	**0.883**	**7**	**6.48**		
(i) Coenagrionidae	20	0.45	0.76	0.883	7	6.48	8.64	0.114
VII. AMPHIPODA	**76**	**1.70**	**1.5777**	**1.834**	**15**	**13.89**		
(i) Gammarus spp.	76	1.70	1.5777	1.834	15	13.89	49.09	0.65
VIII. HIRUDINEA	**9**	**0.20**	**0.18**	**0.209**	**4**	**3.70**		
(i) Erpobdella spp.	9	0.20	0.18	0.209	4	3.70	1.513	0.02
IX. MEGALOPTERA	**12**	**0.26**	**0.5004**	**0.582**	**6**	**5.55**		
(i) Corydalidae	12	0.26	0.5004	0.582	6	5.55	4.67	0.062
X. OTHERS	**35**	**0.7**	**1.34**	**1.557**	**13**	**12.04**		
(i) Terrestrial ants	10	0.22	0.025	0.029	6	5.55	1.38	0.018
(ii) Trout egg	4	0.09	0.280	0.325	3	2.78	1.15	0.015
(iii) Plant seed	14	0.31	0.369	0.429	12	11.11	8.21	0.108
(iv) Stone	7	0.16	0.666	0.794	7	6.48	6.05	0.080
TOTAL	**4464**	**100.00**	**86.037**	**100.00**			**7571.64**	**100.00**

where **N =** Number, W = Weight, FO = Frequency occurrence, IRI = Index of Relative Importance

A total of 4464 individual preys were counted from 108 brown trouts examined and their total weight was 86.037g. The most representative prey were *Brachycentridae* (28.4%), a dipteran species, *Blepharocera* (16.39%), *Baetidae* (15.41%), *Chironomidae* (8.78%) and *Ephemera species* (5.37%). By weight, *Brachycentridae* (38.51%) represented the largest portion of the diet followed by *Ephemera species* (11.958%), *Blepharocera* (11.658%), *Elmidae* (7.355%) and *Ephemerella species* (7.056%). The most frequent prey in the stomachs were *Brachycentridae* (58.33%), *Caenis species* (43.52%), *Baetis species* (41.66%), *Blepharocera* (37.96%), *Elmidae* (33.33%) and *Ephemerella species* (30.55%).

According to IRI %, four food items represented more than 90% of the diet, with the most important being *Brachycentridae* (51.55%), *Blepharocera* (14.06%), *Baetis species* (10.48%) and *Ephemerella species* (5%) (Table 1). Further, the presence of the terrestrial ants in the gut contents revealed that the brown trout had a greater tendency to eat large prey from wherever available.

B. Feeding Intensity

This was judged by the degree of the distention of stomach or by the quantity of food that was contained in it through GSI and FI which was calculated monthly and in various length groups for estimating feeding intensity.

Gastrosomatic Index (GSI)

The GSI in *Salmo trutta fario* fluctuated from 3.6 to 6.4 with a mean value of 5 (Table 2). The gastrosomatic index was maximum in the smallest length group (201-250mm) and decreased with increase in the length of the fish (Figure 1). The GSI decreased during the spawning season of brown trout (October to December). There was a slight increase in the GSI in the months of January and February but the GSI values were still low because of less availability of food in winter. However, there was a sharp rise in GSI from March onwards touching high during the summer months (Table 3 and Figure 2).

Table 2: Gastrosomatic index and fullness index in various length groups of Brown trout *(Salmo trutta fario).*

Length Groups	**201-250**	**251-300**	**301-350**	**351-400**	**401-450**	**Average**
Total length (mm)	234.1	276	328.6	364.6	429.3	326.5
Body weight (gm)	157.7	244.2	382.2	526.2	977.5	457.6
Ponderal Index (K)	1.2	1.14	1.10	1.07	0.99	1.1

Gut length (mm)	204.1	246	296.6	332.6	394.3	294.7
Weight of full gut (gm)	8.5	14.6	19.1	19.4	29.4	18.2
Weight of gut contents (gm)	3.9	6.5	7.9	6.6	8.0	6.6
Gastrosomatic Index (GSI)	6.4	5.9	5.12	4.0	3.6	5.0
Fullness Index (FI)	3.01	2.7	2.1	1.5	0.8	2.02

Table 3: Fluctuations in the monthly mean values of feeding indices of Brown trout *(Salmo trutta fario)*

Month	**Gastrosomatic Index (GSI)**	**Fullness Index (FI)**
January	4.11	1.38
February	4.54	1.67
March	7.80	3.93
April	7.56	3.36
May	7.03	3.45
June	6.23	2.69
July	6.80	2.91
August	4.61	1.85
September	4.41	1.53
October	3.40	1.03
November	3.43	1.032
December	2.97	0.913

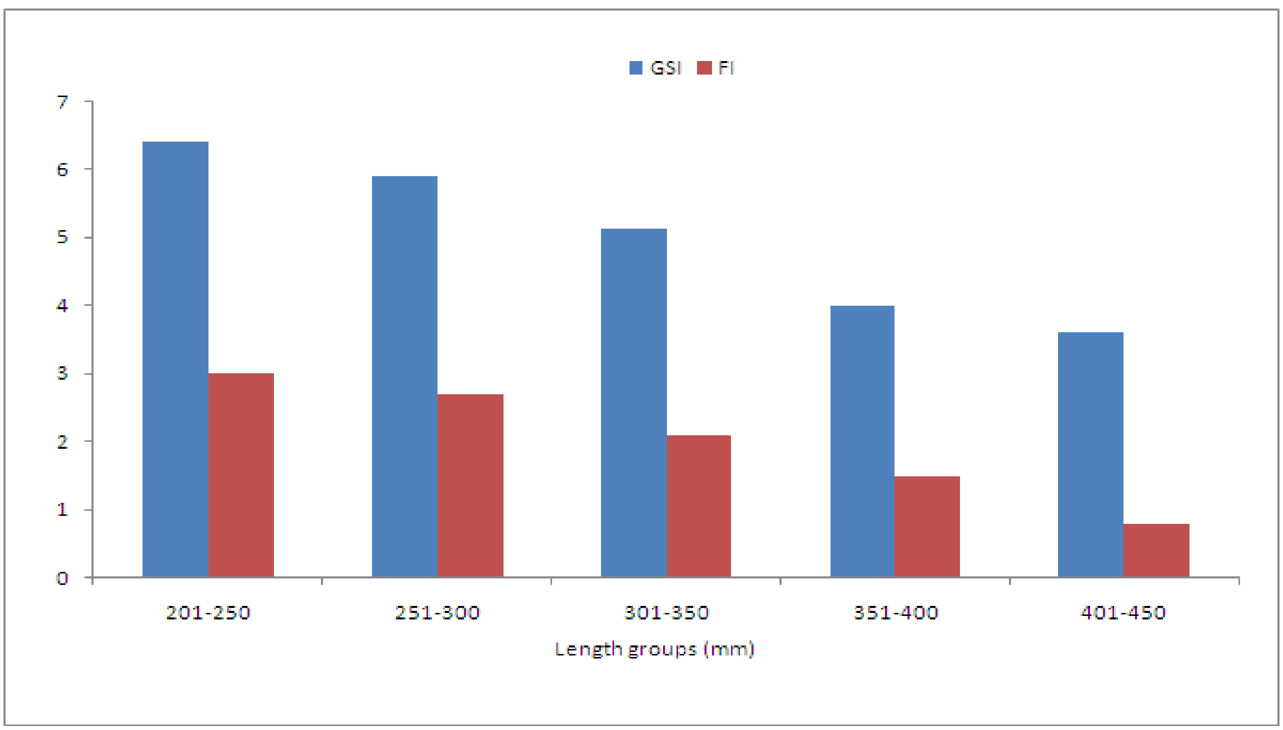

Figure 1: Variations in Gastrosomatic Index (GSI) and Fullness Index (FI) of Brown trout in different length groups.

Fullness Index (FI)

Fullness index (degree of satiation) also recorded the highest value in the smallest length group (201-250mm) and decreased with increase in the length of the fish. The FI fluctuated from 0.8-3.01 with a mean value of 2.02 (Table 3 and Figure 1). FI also fluctuated throughout year. Maximum FI was observed from March to July, while the index showed a decline from August to December and the value of FI remained low in January and February (Table 3 and Figure 2).

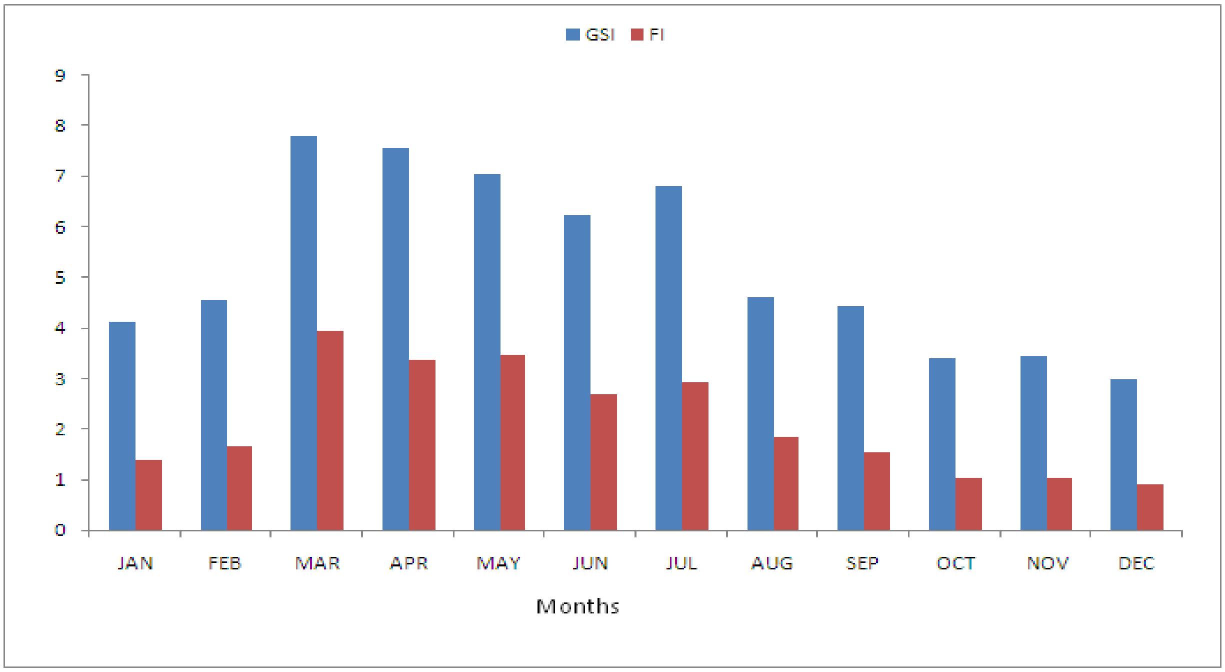

Figure 2: Monthly variations in gastrosomatic index (GSI) and Fullness Index (FI) of Brown trout.

C. Seasonal fluctuations in feeding

During July to October 80% of the food consisted of caddisfly larvae which thrived on stony bed, fast current and clear water and was the favourite food of the fish.

A considerable part of the insect food consisted of flying insects which fell into the water from the air or the shores such as grasshoppers, crickets, mantis, mayflies, midges, dragonflies, butterflies and adult caddisflies. This aerial terrestrial insect food formed the highest part of the diet from May till September. However, the occurrence of these insects fall rapidly from October onwards and in January and February they were not recorded in diet which remained coldest months in Kashmir. However, mayflies and stoneflies formed an important part of the diet during the winter months (November to April) (Table 4).

Table 4: Percentage occurrences of various prey in the summer and winter diet of Brown trout.

Prey	Brown Trout	
	Summer (n=66)	**Winter (n=42)**
Caddis Larvae	104	43
Mayfly Nymphs	32	107
Stonefly Nymphs	4	34
Terrestrial Insects	28	2
Other Foods	28	2

D. Ponderal Index or condition factor

The condition factor (K) was calculated in various length groups. The value of 'K' in *Salmo trutta fario* decreased with increase in fish length, varying in different length groups from 1.2 to 0.99 with an average value of 1.1 (Table 2). The gradual fall in the ponderal index in the older size groups is related to increased metabolic strain of spawning.

IV. Disscussion

During the course of study it was found that the gut contents of the brown trout showed the major contribution of trichopteran larvae, followed by ephemeropteran larvae and dipteran larvae, which is in consonance with the findings of Merz (2002). Dedual and Collier (1995) found the proportion of Diptera in the diet of small trout specimens to be higher than in large specimens and reverse was observed for the proportion of trichoptera. Further, Allan (1981) examined the composition (by numbers) of brook trout diet at different times of the year and predicted that relative abundance and then body size seemed to explain the food choice of the fish.

The percent index of relative importance (% IRI) also depicted that the most preferred and important food item for the brown trout was the order trichoptera followed by ephemeroptera and *diptera*. Resident brown trout in the present study fed on a variety of prey items, and the diet changed with season. Most of the preys were found to be benthic organisms. A majority of the researchers suggest that brown trout feed chiefly on drifting invertebrates (Hayes and Jowett, 1994; Rader, 1997), although stream-dwelling salmonids can adjust their feeding behavior in response to changes in the abundance of prey (Fausch et al., 1997 and Mc Laughlin et al., 1999) and can also use benthic prey (Forrester et al., 1994 and Lagarrigue et al., 2002). Lehane et al. (2001) reported that trichopteran species (30.4%) represented the largest proportion of the diet of brown trout, followed by *ephemeroptera* (26%), *plecoptera* (13.9%), *coleoptera* (7.3%), *gammarus species* (6.9%), *mollusca* (4%), *diptera* (3.9%) and others (8%). Ecdyonurus species, *hydropsychid species*, *baetis species*, *protonemura species* and *gammarus species* were the most important individual prey species and represented the most dependable food sources for trout (Lehane et al., 2001). The most frequent prey items of the brown trout during the present study were reported to be Trichoptera (31.8%). Ephemeroptera (30.3%) followed by Diptera larvae (29.7%). Thus trichoptera was found to be the dominant food item in the examined fishes and thus the results are in accordance with those of Lehane et al. (2001). Intensive exploitation of trichoptera by salmonids has also been reported previously (Egglishaw, 1967; Bisson, 1978; Peddley and Jones, 1978; Neveu, 1981) and prey size may again be a factor explaining this.

The presence of the terrestrial ants in the gut contents revealed that the brown trout had a greater tendency to eat larger prey from wherever available. Merz (2002) in another study found bird feathers, mammalian hair and terrestrial ants in the stomachs of steel head trout. These findings indicate that the brown trout like steel head trout eats everything that is smaller than the trout itself and looks alive. In the present study, good quantity of sand was also found in the gut of the fish thereby indicating the benthophagic feeding habits of the fish. The study also revealed that the benthic macro-invertebrates are the most important food of brown trout. The study gains further support from the findings of Richardson (1993) who also opined that the production of salmonids is limited by the benthic production.

The results show clearly that caddisfly larvae and mayfly nymphs were the main prey of brown trout in the study streams. Terrestrial insects increased in importance in summer and stonefly nymphs in winter. Remarkably similar diets have been reported for river-dwelling trout in New Zealand (Burnett, 1969; Fenemore, 1976), in France (Elliott, 1973), and in Wales (Thomas, 1962).

During the course of study feeding index was also calculated. Fullness index recorded highest value in the smallest length group in the brown trout and then increased gradually with increase in the length of fish. Menzel (1960) reported that feeding efficiency and growth rate of *Epinephelus guttatus* decreases with increase in size. This is explained by the faster feeding rates of small individuals and the greater efficiency with which they utilize protein for growth.

Under natural conditions, fullness index was maximum in the months of March to July for brown trout, thus reached a peak during spring and summer and decreased during autumn and winter, which is also the spawning season. Several authors have linked such seasonal variations in salmonid feeding activity to prey availability (Frost and Brown, 1967; Bridcut and Giller, 1993; Alanara and Branas, 1997).

The Gastrosomatic index (GSI) was also maximum in the smallest length group (201-250 mm) and decreased with increase in the length of the fish. A similar phenomenon was reported in *Rhinomugil corsula* (Hamilton) by Sugunan and Vinci (1981). Maximum gastrosomatic index (GSI) was in the month of March (7.80) for brown trout. The higher GSI in the months of March and April was another evidence of heavy intake of food after spawning and emphasized that weight of ingested food increased with the seasonal rise in temperature (Elliott, 1973).

Ponderal index or condition factor (K) is widely used in fisheries as a measure to provide information about fitness of the fish with respect to its environment, and also about the attainment of maturity, spawning behaviour, feeding and growth (Bhatt, 1968). .

V. Conclusion

In this study, the results suggest that the stream dwelling resident brown trout, *Salmo trutta fario*, feed on a variety of prey items and the diet and feeding behaviour changes by season, habitat and fish size, while does not differ by sex.

REFERENCES

[1] Alanara, A. and Brannas, E. (1997). Diurnal and nocturnal feeding activity in Arctic char *(Salvelinus alpinus)* and rainbow trout *(Oncorhynchus mykiss). Can. J. Fish. Aquat. Sci.*, 54: 2894-2900.

[2] Allan, J. D. (1981). Determinants of diet of brook trout *(Salvelinus fontinalis)* in a mountain stream. *Canadian Journal of Fisheries and Aquatic Sciences*, 38: 184-192.

[3] Bachmann, R.A. (1984). Foraging behaviour of free ranging wild and hatchery brown trout in a stream. *Trans. Am. Fisher. Soc*., 113: 1-32.

[4] Bhatt V.S. 1968. Studies on the biology of some freshwater fishes. Part VII. *Heteropneustes fossilis* (Bloch). *Indian Journal of Fisheries* 15 (1 and 2): 99 – 115.

[5] Bisson, P. A. (1978). Diel food selection by two sizes of rainbow trout *(Salmo gairdneri)* in an experimental stream. *Canadian Journal of Fisheries and Aquatic Sciences*, 35: 971-975.

[6] Bridcut, E. E. and Giller, P. S. (1993). Diet variability in relation to season and habitat utilization in brown trout *(Salmo trutta* L.*)* in a southern Irish stream. In: Gibson, R. J., Cutting, R. E. (Eds.), Production of juvenile Atlantic salmon Salmo salar in natural waters. *Can. Spec. Publ. Fish. Aquat. Sci.*, 118: 17-24.

[7] Bridcut, E. E. and Giller, P. S. (1995). Diet variability and foraging strategies in brown trout *(Salmo trutta)*: An analysis from sub populations to individuals. *Can. J. Fish. Aquat. Sci.*, 52: 2543-2552.

[8] Burnett, A. M. R. (1969). A study of the inter-relation between eels and trout, the invertebrate fauna and the feeding habits of the fish. New Zealand Marine Department Fisheries Technical Report, 36: 12p.

[9] Dedual, M. and Collier, K.J. (1995). Aspects of juvenile rainbow trout (*Oncorhynchus mykiss*) diet in relation to food supply during summer in the lower Tongariro River, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 29: 381-391.

[10] Edmondson, W. T. (1959). Freshwater Biology. John Wiley, N.Y.

[11] Egglishaw, H.J. (1967). The food, growth and population structure of salmon and trout in two streams of the Scottish Highlands. *Freshwater Salmon Fisheries research*, 38: 1-32.

[12] Elliott, J.M. (1973). The food of brown and rainbow trout *(Salmo trutta and S. gairdneri)* in relation to the abundance of drifting invertebrates in a mountain stream. *Oecologia*, 12: 329-347.

[13] Fausch, K.D.; Nakano, S. and Kitano, S. (1997). Experimentally induced foraging mode shift by sympatric charrs in a Japanese mountain stream. *Behavioural Ecology*, 8: 414-420.

[14] Fenemore, P.G. (1976). Presidential address. The entomology of fly fishing. The New Zealand entomologist, 6*(2)*: 94-100.

[15] Fochetti, R.; Amici, I. and Argano, R. (2003). Seasonal changes and selectivity in the diet of brown trout in the river Nera (Central Italy). *J. Fresh water Ecol.*, 18: 437-444.

[16] Forrester, G.E.; Chace, J.G. and Mc Carthy, W. (1994). Diel and density-related changes in food consumption and prey selection by brook charr in a New Hampshire stream. *Environmental Biology of Fishes*, 39: 301-311.

[17] Friberg, N.; Andersen, T.H.; Hansen, H.O.; Iversen, T.M.; Jacobsen, D.; Krojgaard, L. and Larsen, S.E. (1994). The effect of brown trout (*Salmo trutta* L.) on stream invertebrate drift, with special reference to *Gammarus pulex* L. Hydrobiologia, 294: 105-110.

[18] Frost, W.E. and Brown, M.E. (1967). The trout. Collins, St James Place, London, pp.286.

[19] Geldiay, R.; Balik, S. (1988). Fresh Water Fishes of Turkey. Books Series, No. 97, Ege University, Faculty of Science, New Jersey, 519.

[20] Hayes, J.W. & Jowett, I.G. (1994). Microhabitat models of large drift-feeding brown trout in three New Zealand rivers. *N. Am. J. Fish. Manage.*, 14: 710-725.

[21] Lagarrigue, T.; Cereghino, R.; Lim, P.; Reyes-Marchant, P.; Chappaz, R.; Lavandier, P. and Belard, A. (2002). Diel and seasonal variations in brown trout (*Salmo trutta*) feeding patterns and relationship with invertebrate drift under natural and hydropeaking conditions in a mountain stream. *Aqua. Living Res.*, 15: 129-137.

[22] Lehane, B.M.; Walsh, B.; Giller, P.S. and O' Halloran, J. (2001). The influence of small-scale variation in habitat on winter trout distribution and diet in an afforested catchment. *Aquatic Ecol.*, 61: 61-71.

[23] Mc Laughlin, R.L.; Ferguson, M.M. and Noakes, D.L.G. (1999). Adaptative peaks and alternative foraging tactics in brook charr: evidence of short-term divergent selection for sitting-and-waiting and actively searching. *Behav. Ecol. Sociobiol.*, 45: 386-395.

[24] Menzel, D.W. (1960). Utilization of food by a Bermuda reef fish, *Epinephelus guttatus*. *J. Conseil. Inturnath. Explor., Mer.*, 25*(2)*: 216-222.

[25] Merz, J.E. (2002). Seasonal feeding habits, growth and movement of steelhead trout in the lower Mokelumne River, California. *California Fish and Game*, 88: 95-111.

[26] Neveu, N. (1981). Les rythmes alimentaires en milieu naturel. In: M.Fontaine ed. Nutrition des poisons. Coll. CNERMA 1979, Paris.

[27] Peddley, R.B. and Jones, J.W. (1978). The comparative feeding behaviour of brown trout, *Salmo trutta* L., and the Atlantic Salmon, *Salmo salar* L., in Llyn Dwythwch, wales. *Journal of fish biology*, 12: 239-256.

[28] Pinkas, L.; Oliphant, M.S.; Iverson, L.K. (1971). Food habits of albacore, bluefin tuna, and bonito in California waters. California Dep. Fish Game Fish Bull., 152: 105.

[29] Pita, C.; Gamito, S.; Erzini, K. (2002). Feeding habits of the gilthead seabream (*Sparus aurata*) from the Ria Formosa (southern Portugal) as compared to the black seabream (*Spondyliosoma cantharus*) and the annular seabream (*Diplodus annularis*). *J. Appl. Ichthyol.*, 18: 81-86.

[30] Rader, R.B. (1997). A functional classification of the drift: traits that influence invertebrate availability to salmonids. *Canadian Journal of Fisheries and Aquatic Sciences*, 54: 1211-1234.

[31] Richardson, J.S. (1993). Limits to productivity in sreams: Evidence from studies of macroinvertebrates. *Can. Spec. Publ. Fish. Aquat. Sci.,* 118: 9-15.

[32] Ruginis, T., (2008). Diet and prey selectivity by age-0 brown trout (*Salmo trutta* L.) in different lowland streams of Lithuania. *Acta Zool. Lituanica*, 2: 139-146.

[33] Smith, I.P.; Metcalfe, N.B.; Huntingford, F.A. and Kadri, S. (1993). Daily and seasonal patterns in the feeding behaviour of Atlantic salmon (*Salmo salar* L.) in a sea cage. Aquaculture, 117: 165-178.

[34] Sugunan, V.V. and Vinci, G.K. (1981). Length weight relationship and food study of *Rhinomugil corsula*(Ham.) with a note on its spawning and fecundity from Nagarjunasagar reservoir, A.P., India. *J. Inland Fish.Soc. India.*, 13: 25-35.

[35] Thomas, J.D. (1962). The food and growth of brown trout (*Salmo trutta* L.) and its feeding relationships with the salmon parr (Salmo salar L.) and the eel (Anguilla anguilla (L)) in the River Teify, West Wales. *Journal of animal ecology*, 31: 175-205.

[36] Windell, J.T. (1971). Food analysis and rate of digestion. In: methods for assessment of fish production in fresh waters 2 nd ed. Ricker, W. E. (ed.). Blackwell, Oxford, 215-226.

AUTHORS

First Author – Nusrat Rasool, Ph.D, Department of Zoology, University of Kashmir, Pin-190006, India
Second Author – Ulfat Jan, Ph.D, Department of Zoology, University of Kashmir, Pin-190006, India,
Third Author – G. Mustafa Shah, Ph.D, Department of Zoology, University of Kashmir, Pin-190006, India

Correspondence Author – Nusrat Rasool, nusrat.r.k@gmail.com, +91 9419011494, +91 194 2431003.