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Food Selection of Various Size Groups of the Cyprinid Fish, *Cyprinion mhalensis* Al-Kahem & Behnke, 1983 from Saudi Arabia

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ABSTRACT. *Cyprinion mhalensis* is a selective feeder as it feeds on a variety of food items. Selection varies proportionally with prey abundance. Smaller fishes generally feed on zooplankton while larger ones mostly on phytoplankton. Detectability and acceptability may be the main factors for food selection.

In recent years, several investigators have directed their attention towards the selective feeding behaviour of fishes in their natural environment. Considerable literatures on the food selection of various tropical fish species are available. Notable contributions are those of Teska and Behmier (1981), Michaletz and Charles (1982), Colton and Alivizon (1983), Viljanen (1983), Mills *et al.* (1984) and Al-Akel *et al.* (1987). *C. mhalensis* (cyprinidae) is an endemic species to Saudi Arabia (Al-Kahem and Behnke 1983) and there is no information on food selection of this species have been published so far, hence an attempt was made by the authors to evaluate the food selection among different size groups of *C. mhalensis* from Wadi Abha (18° 27′N 42° 42′E) Saudi Arabia. The condition coefficient for length-weight relationship was also given.

Materials and Methods

Samples were collected from a permanent stream at Wadi Abha, Saudi Arabia in April, 1985. Some environmental conditions of water were; pH (7.4), dissolved oxygen (8.0 - 9.0 mg/1) and morning temperature (18.5°C). Field collection of water samples for the phytoplankton were taken with the sampling

bottle at different depths and different places and preserved in 1% Lugol's solution for identification. For the collection of zooplankton, 50 litres of water was filtered through plankton net made up of organdi's cloth (mesh size 50 μ) at different places and preserved in 10% formalin. Fishes were collected with cast and scoop nets and anaesthetized with MS-222. The collected fishes were measured to the nearest millimeter for their total length and weighed on Mettler (H-80) sensitive balance to the nearest milligram. Then, they were separated in four different size groups (I, 60-80 mm; II, 81-100 mm; III, 101-120 mm and IV, 121-150 mm) on the basis of length frequency distribution. The guts of each group were preserved in 10% formalin and the contents washed into a petri-dish with water. Then the contents were mixed thoroughly and the food items in the environment and gut were identified to the species level using the key of Ward and Whipple (1963). The gut content of individual fish of each group (40 specimens) was analysed and then pooled groupwise. "Number method" used by Jafri and Mustafa (1977) was used for analysis of the organism in the gut and in the environment. The abundance of the food organism was expressed in percentage. Percentage composition of planktonic organisms in the environment and in the sample was evaluated. The electivity index was calculated from the equation of Ivlev (1961):

$$E = \frac{ri - pi}{ri + pi}$$

Where, E = the electivity index, ri = percentage of food items in the gut and pi = percentage of food items in the environment. This index ranges from (−1) to (+1).

Length-weight relationship was carried out with the methods outlined by Snedecor and Cochran (1980):

$$\text{Log } W = \text{Log } a + b \text{ Log } L.$$

Where, W = Weight of fish (g), L = Total length of fish (mm), a = Empirically a constant, called intercept of the regression and b = Exponent termed as slope.

Results

Food selection in terms of percentage of each food item in the gut (ri) and in the environment (pi) together with the electivity index (E) of each group are presented in Table 1, and depicted graphically in Fig. 1.

For food selection, negative values indicate the avoidance or unaccessibility while the positive values indicate the preference of food organisms.

Table 1. Percentage of each planktonic food organism in the gut content (ri) of each group of fishes in the environment (pi), and the electivity index (E) of *C. mhalensis*.

Food organism	pi	group I		group II		group III		group IV	
		ri	E	ri	E	ri	E	ri	E
MXYOPHYCEAE									
Tetrapedia sp.	0.87	–	−1.00	1.50	+0.26	1.60	+0.29	2.40	+0.47
Anabaena variabilis	0.58	2.40	+0.61	0.92	+0.23	1.60	+0.47	1.90	+0.37
Oscillatoria tenuis	2.89	10.00	+0.55	5.80	+0.33	5.30	+0.29	6.10	+0.36
Spirulina major	2.32	–	−1.00	3.10	+0.14	2.70	+0.07	2.90	+0.11
Polycystis sp.	2.61	–	−1.00	3.90	+0.19	2.70	+0.02	3.10	+0.08
Merismopedia sp.	1.45	–	−1.00	–	−1.00	0.50	−0.49	0.70	−0.35
Lyngbya aşetuaru	2.03	–	−1.00	–	−1.00	–	−1.00	–	−1.00
Phormidium autumnale	1.45	–	−1.00	–	−1.00	–	−1.00	–	−1.00
CCHLOROPHYCEAE									
Ophiocytium sp.	3.77	6.00	+0.23	3.67	−0.01	4.50	+0.09	3.60	−0.02
Crucigenia sp.	2.03	4.00	+0.33	2.70	+0.14	2.70	+0.14	3.10	+0.21
Protococcus viridis	3.48	2.80	−0.11	5.80	+0.25	4.00	+0.07	4.60	+0.14
Scenedesmes sp.	0.87	0.80	−0.04	0.61	−0.26	0.5	−0.27	0.20	−0.63
Kirchneriela sp.	2.32	–	−1.00	2.10	−0.05	1.30	−0.28	0.70	−0.54
Pediastrum sp.	1.74	0.80	−0.37	–	−1.00	0.30	−0.71	0.70	−0.43
Ankistrodesmus spiralis	2.61	1.20	−0.37	–	−1.00	1.30	−0.33	1.2	−0.37
Tetradron sp.	1.45	–	−1.00	1.20	−0.09	1.10	−0.14	0.70	−0.35
Ulothrix zonata	1.74	1.20	−0.18	0.61	−0.48	0.80	−0.37	0.96	−0.29
Characium arruthocephalum	3.48	–	−1.00	–	−1.00	–	−1.00	–	−1.00
Botryoccoccus sp.	0.87	–	−1.00	–	−1.00	–	−1.00	–	−1.00
DESMIDIACEAE									
Gyrosigma kutzingii	1.74	–	−1.00	2.10	+0.09	3.70	+0.36	4.30	+0.42
Closterium sp.	9.56	16.40	+0.26	14.10	+0.19	12.80	+0.14	12.3	+0.12
Netrium digitus	2.61	–	−1.00	4.30	+0.24	3.50	+0.15	2.70	+0.02
Roya anglica	3.48	–	−1.00	2.10	+0.25	4.50	+0.15	3.9	+0.06
Eunotia praerupta	2.89	–	−1.00	2.10	−0.16	3.20	+0.5	3.40	+0.08
Gonatozygon kenaharu	1.16	0.80	−0.18	0.61	−0.31	0.30	−0.59	0.20	−0.71
Staurastrum sp.	1.74	–	−1.00	–	−1.00	–	−1.00	–	−1.00
BACILLARIOPHYCEAE									
Fragilaria capurina	0.58	–	−1.00	1.50	+0.44	4.00	+0.75	4.80	+0.78
Tabellaria finestrata	0.58	–	−1.00	1.50	+0.44	2.10	+0.57	3.40	+0.71
Navicula radiosa	2.61	7.20	+0.47	8.30	+0.52	11.20	+0.62	8.90	+0.55
Nitzschia sp.	2.32	–	−1.00	3.90	+0.25	4.30	+0.29	4.60	+0.33
Synedra sp.	4.64	4.0	−0.07	6.70	+0.18	6.90	+0.19	6.50	+0.17
Diatoma vulgare	6.66	12.40	+0.31	8.60	+0.13	6.90	+0.02	7.90	+0.08
Tetracyctus lacustris	3.48	–	−1.00	–	−1.00	0.80	−0.83	1.4	−0.43
Cyclotella stettigera	0.87	–	−1.00	–	−1.00	–	−1.00	–	−1.00
PROTOZOANS									
Volvox aureus	5.22	8.4	+0.23	2.40	−0.37	1.10	−0.65	0.70	−0.76
Chlamydomonas chrcnberg	6.38	10.0	+0.22	4.90	−0.13	3.70	−0.26	1.40	−0.64
Euglena sp.	1.74	3.2	+0.29	1.5	−0.07	–	−1.00	–	−1.00
ROTIFERS									
Asplanchna sp.	1.45	4.80	+0.54	2.10	+0.18	–	−1.00	–	−1.00
Keratella sp.	1.74	3.60	+0.35	0.92	−0.31	–	−1.00	–	−1.00

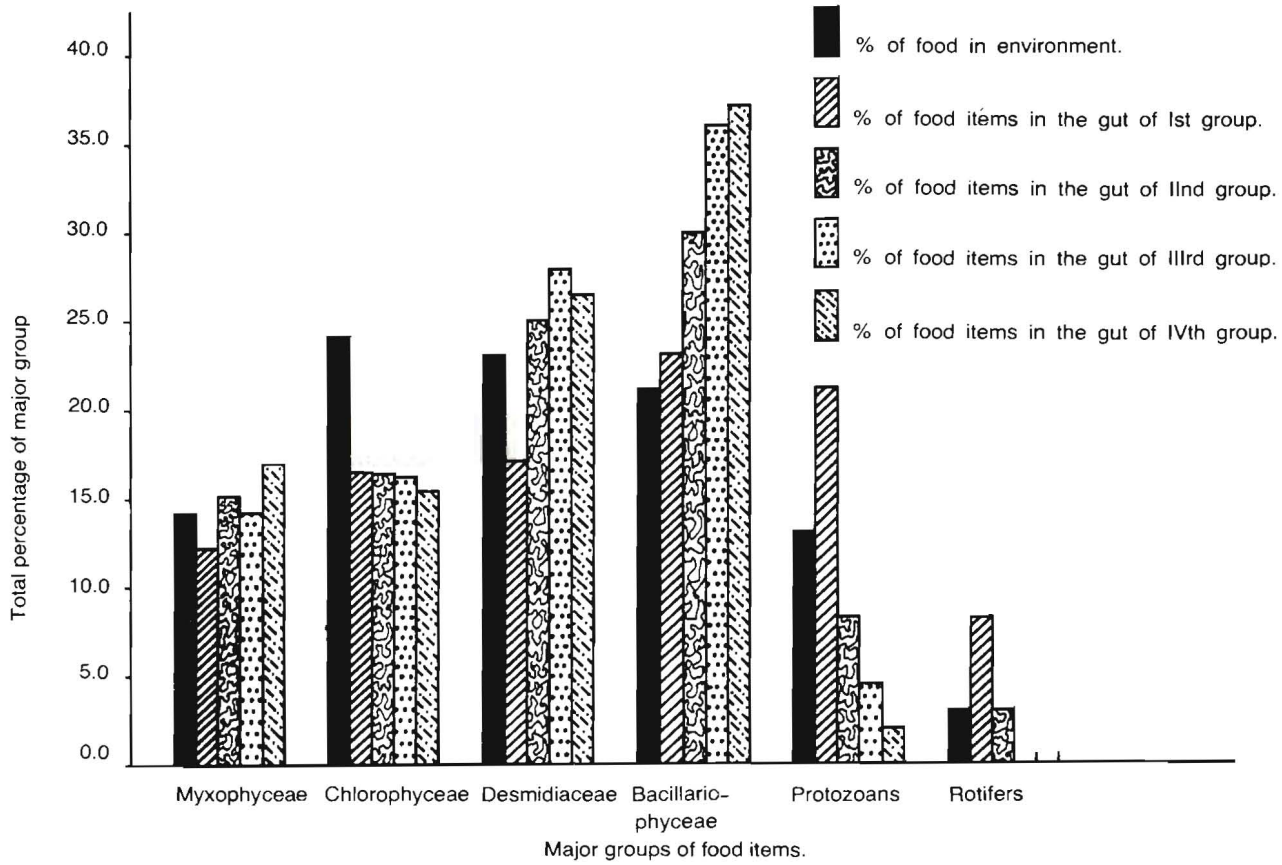

Fig. 1. Percentage composition of food items in the gut of different size groups of *C. mhalensis*.

Group I: (60-80 mm TL)

This size group of fish feeds upon both, the phyto-and-zooplanktons. The fish preferred protozoans, rotifers and some phytoplanktonic food items (Table 1). *Anabaena variabilis, Oscillatoria tenuis, Ophiocytium* sp., *Closterium* sp., *Navicula radiosa* and *Diatoma vulgare* were positively selected and the remaining food items either negatively taken or completely avoided.

Group II: (81-100 mm TL)

Selection indices of this size group (E on Table 1) was positive for *Tetrapedia* sp., *Anabaena variabilis, Oscillatoria tenuis, Spirulina major* and *Polycystis* sp. (Myxophyceae) and *Fragilaria capurina, Tabellaria finestrata, Navicula radiosa, Nitzschia* sp., *Synedra* sp. and *Diatoma vulgare* (Bacillariophyceae), but some food items of Chlorophyceae and Desmidiaceae were positively selected and some were avoided.

Group III: (101-120 mm TL) & IV (121-150 mm TL)

Fish of these two groups fed on the same food items, although some differences were found in the proportion of the individual food organisms in the diet. Generally, the positive selection of food items was obtained in the major groups of Myxophyceae, Desmidiaceae and Bacillariophyceae (Table 1) but in Chlorophyceae, *Ophyiocytium* sp., *Crucigenia* sp. and *Protococcus viridis* were the only acceptable food items and the remaining were negatively taken. The complete avoidance of Protozoans and Rotifers was recorded for both groups (Table 1). The length-weight data of all specimens are also represented graphically in Fig. 2. The calculated value of the regression equation is: Log W = −2.01 + 2.956 Log L. The correlation coefficient (r = 0.994) which is highly significant ($P < 0.001$).

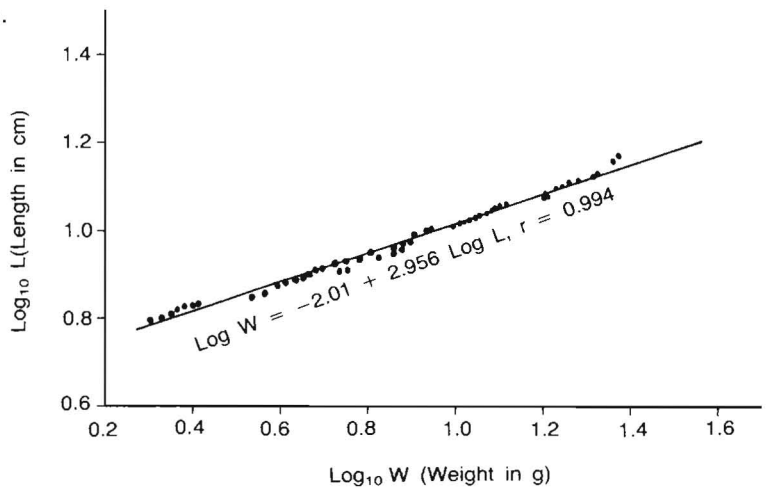

Fig. 2. Length-weight relationship of *C. mhalensis*.

Discussion

Food preference of *C. mhalensis* was found to be correlated to its size. Small fishes have selected zooplanktons while larger ones feed mainly on phytoplankters. The main causative factors for this selective feeding behaviour of this fish may be the acceptability and detectability of the individual food organisms. Concordant view for the selective feeding behaviour of carp (*Esomus danricus*) and a freshwater fish (*Aphanius dispar*) were presented by Mustafa (1976) and Al-Akel *et al.* (1987), respectively. Data embodied in Table 1, clearly indicate that the smaller fishes fed mainly on zooplanktonic food items. This feeding behaviour may be due to the fast and active movement of smaller fishes which gave an easy access of the fish to the prey. It is clear from the data presented in Table 1 that phytoplankters are preferred by the larger fishes. Normally, the activeness of the fish slows down with the increase in size and weight, therefore, the access of the larger fish to fast moving food organisms (zooplanktons) became difficult. Hence, they may prefer to feed on those organisms (phytoplanktons) which are procured easily. This view strengthen with the statement presented by Mustafa (1976) that selective feeding can be expected from the fish when the energy gained by feeding on preferred food items exceeds the energy lost in its efforts to procure them.

Negative selection and avoidance of some food organisms may be due to either unaccessibility of the fish to procure these food items or their distastefulness, or possibly the intestine may lack the adapations to digest them easily. There is no evidence of the modification of the gut length in this fish, as the gut length proportional to the total length is same in smaller and larger fishes. In larger fishes the gill rakers are quite long and widely spaced in comparison to smaller fishes where they are small and narrow. In this condition the ability of gill rakers to hold the small food items, in larger fishes, became low. But the results of the present study indicate that these fishes feed upon the phytoplankters. Probably they ingest these small food items by making the mucus-food aggregate which is formed by entrapping the food (phytoplankters) in mucus. Absence of zooplankters from the diet of larger fishes may be either due to unability of fish to procure them or due to modification in some of the digestive enzymes but remains to be investigated.

Thus, it can be concluded that the filter feeding efficiency of *C. mhalensis* increases with the size of the fish. The differences between the relative abundance of planktonic food organisms in the gut of different size groups and percentage of food in the environment indicate the *C. mhalensis* is a selective feeder as it change its habit from omnivory (small fishes) to herbivory (larger fishes).

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الانتقاء الغذائي لسمك السيبرنيون محالنس
Cyprinion mhalensis

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قسم علم الحيوان ـ كلية العلوم ـ جامعة الملك سعود ـ ص. ب ٢٤٥٥ الرياض ١١٤٥١
المملكة العربية السعودية

يعتبر سمك السيبرنيون محالنس من الأسماك المحلية الموصوفة حديثاً. لذلك نجد أن الدراسات البيولوجية مثل ظاهرة الانتقاء الغذائي لم تكن معروفة مثله في ذلك كمثل أفراد عائلة الشبوط المنتشرة في مختلف المواطن المائية العذبة لشبه جزيرة العرب. وحيث أن هذا النوع يكثر محلياً في المياه العذبة في المملكة العربية السعودية اتجهت هذه الدراسة للتعرف والكشف عن بعض المعلومات الضرورية عن ظاهرة الانتقاء الغذائي لهذا النوع، فشملت هذه الدراسة أفراداً جمعت من مناطق مختلفة من وادي أبها حيث تقع على ضفاف هذا الوادي مدينة أبها إحدى مدن المملكة العربية السعودية.

استخدمت في هذه الدراسة معادلة الانتقاء الغذائي والمعروفة بمعادلة «افلفس Ivelves» حيث قدرت نسبة المادة الغذائية في القناة الهضمية لهذا النوع وكذلك نسبتها في الموطن المائي ومن ثم حسبت قيمة الدليل الغذائي Electivity index = E كذلك نوقشت العلاقة بين أطوال أفراد هذا النوع وأوزانها معتمدة هذه الدراسة على العلاقة بين الطول والوزن والتي بُينت حسب الطريقة التي استخدمها سندكور Snedicor وكوشران Cochran في عام ١٩٨٠ م.

تبين من البحث أن قيمة الدليل الغذائي تتراوح ما بين (- ١) و (+ ١) وبناء على ذلك استنتج أن سمك السيبرنيون محالنس اختياري الغذاء حيث لوحظ أنه يتغذى على أنواع مختلفة من العوالق النباتية، والعوالق الحيوانية، ويختلف إنتقائه الغذائي نسبياً مع وفرة الفريسة أو العالق النباتي. ولقد وجد أن صغار هذا النوع تفضل العوالق الحيوانية بينما تفضل الأفراد الكبيرة العوالق النباتية.

كذلك لوحظ أن إنتقاء هذا النوع الغذائي يرتبط إرتباطاً وثيقاً مع حجم الأسماك، وتدل قيمة الدليل الغذائي الايجابية على أن هناك تحورات تركيبية وحسية وفسيولوجية ساعدت هذه الأسماك على انتقاء نوع مفضل من الغذاء ناهيك عن الحركة السريعة للأسماك الصغيرة والتي مكنتها من الحصول على غذائها بيسر وسهولة. كذلك تدل القيمة السلبية للدليل الغذائي دلالة واضحة على إمكانية وجود قصور في أعضاء الحس لشد إنتباه الأسماك للمادة الغذائية لنوع دون النوع الآخر أو أن تكون الأمعاء غير قادرة على هضم ذلك الغذاء.

واتضح من هذه الدراسة أن اكتشاف الفريسة أو العالق النباتي واستحسانها من أهم العوامل التي سيطرت على انتقاء هذا النوع للمادة الغذائية بالإضافة إلى عوامل أخرى ذكرت أثناء المناقشة المستفيضة للبحث.

ولمزيد من الايضاحات مُثلت نتائج هذا البحث بأرقام حسابية ورسومات بيانية مختلفة.