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Aspects of the feeding ecology of *Petenia kraussii* (STEINDACHNER, 1878) (Pisces, Perciformes) in Lake Valencia, Venezuela

OTTO INFANTE

With 2 figures and 8 tables in the text

Introduction

Petenia kraussii is a cichlid fish that is common in rivers and lakes of northern South America. Its large size (30 cm T.L.) and good taste make it acceptable for human consumption. Its use in fisheries has been proposed recently (INFANTE & LABAR 1977).

The fish was introduced into Lake Valencia in the sixties and is now the dominant fish.

Material and methods

The 435 fish used in the present study were collected bi-weekly using a large beach seine and a deep net over a period of one year (see INFANTE & LABAR 1977).

The stomach and intestine contents were examined in order to determine the frequency of occurrence of the different foods and their abundance related to the total volume (rank method). Values from 1 to 4 were assigned according to the following values: up to 10 % = 1; 11 % to 50 % = 2; 51 % to 70 % = 3; and 71 % to 100 % = 4.

Because of the impossibility of aging the fish, the animals were classified in 5 size groups, with each group having a 5 cm difference. The groups were numbered from I to V. The degree of food similarity between pairs of groups was measured using the non-parametric SPEARMAN rank correlation coefficient (r_s) (FRITZ 1974; SIEGEL 1975).

The breadth of the trophic niche was calculated according to COLWELL & FUTUYMA (1971). The niche overlap is given as a percentage following the formula proposed by SCHOENER (1970).

Results and discussion

Food habits

The food items present in the alimentary canal of *P. kraussii* vary from microscopic algae to small fish. The food items were grouped in 18 categories. The frequency of occurrence was calculated for each type of food. The percentage was determined by the rank method. The results obtained by both methods were similar (Table 1), indicating that *P. kraussii* obtains its food mainly from the bottom and solid substrates.

Diet variation and fish size

The smallest fish (size I) ingests mainly organisms living either on submerged vegetation or near the bottom in the littoral. The most important food items are ostracods, chironomid larvae and diatoms (Table 2). They also feed actively on

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Table 1. Food habits of *Petenia kraussii*. a) Number of animals with a particular food item. b) Percentage related to total number of animals. c) Summatory of rank values for all the animals with a particular food item. d) c divided by the total number of animals.

		Cyanophyta	Chlorophyta	Chrysophyta	*Najas* sp.	*Potamogeton* sp.	Ciliata	Rotifera	Cladocera	Ostracoda	Copepoda	*Campsurus* sp.	Chironomidae	Other insects	Gastropoda	Pisces	Fish eggs	Bryzoa	Detritus
Frequency	a)	66	73	107	27	7	10	17	43	166	50	166	86	109	64	86	126	16	97
of occurrence method	b)	15.17	17.93	24.60	6.21	1.61	2.30	3.91	9.89	38.16	11.49	38.16	19.77	25.06	14.71	19.77	28.97	3.68	22.30
Rank	c)	73	92	119	46	9	15	18	65	235	75	289	109	145	121	162	271	18	148
method	d)	0.17	0.21	0.27	0.11	0.02	0.03	0.04	0.15	0.54	0.17	0.66	0.25	0.33	0.28	0.37	0.62	0.04	0.34

Table 2. Food ingested by size groups. Numbers were calculated by the frequency of occurence method. Those in parenthesis were calculated following the rank method.

Size I (n = 142)		Size II (n = 55)		Size III (n = 46)	
Ostracoda	78.87 % (1.15)	Fish eggs	67.27 % (1.56)	Fish eggs	58.70 % (1.48)
Chrysophyta	65.49 % (0.73)	Ostracoda	49.09 % (0.73)	Pisces	52.17 % (1.04)
Chironomidae	35.21 % (0.47)	Other insects	43.64 % (0.51)	*Campsurus* sp.	50.00 % (0.72)
Copepoda	33.80 % (0.51)	*Campsurus* sp.	36.36 % (0.29)	Detritus	34.78 % (0.41)
Other insects	32.39 % (0.46)	Pisces	32.63 % (0.51)	Gastropoda	23.91 % (0.54)
Chlorophyta	32.39 % (0.33)	Chironomidae	23.64 % (0.29)	*Najas* sp.	15.22 % (0.15)
Cladocera	31.64 % (0.46)	Cyanophyta	21.92 % (0.31)	Chironomidae	13.04 % (0.13)
Cyanophyta	30.99 % (0.32)	Detritus	21.82 % (0.27)	Bryozoa	10.87 % (0.11)
Fish eggs	14.08 % (0.18)	Bryozoa	12.73 % (0.13)	Other insects	8.70 % (0.11)
Rotifera	11.97 % (0.13)	Gastropoda	5.45 % (0.05)	Ostracoda	6.52 % (0.07)
Size IV (n = 155)		**Size V (n = 37)**			
Campsurus sp.	59.35 % (1.15)	*Campsurus* sp.	54.05 % (1.14)		
Detritus	34.19 % (0.53)	Detritus	37.43 % (0.76)		
Gastropoda	25.16 % (0.48)	Fish eggs	27.03 % (0.73)		
Pisces	20.65 % (0.44)	Pisces	21.62 % (0.46)		
Fish eggs	20.65 % (0.41)	Gastropoda	18.92 % (0.43)		
Other insects	17.42 % (0.26)	Other insects	10.81 % (0.16)		
Ostracoda	15.48 % (0.21)	Chironomidae	10.81 % (0.11)		
Chlorophyta	14.19 % (0.29)	*Najas* sp.	8.11 % (0.16)		
Najas sp.	9.03 % (0.18)	Chlorophyta	5.41 % (0.05)		
Chironomidae	8.39 % (0.08)				

zooplankton (mainly *Notodiaptomus venezolanus, Leydigia ciliata* and *Echinisca triserialis*). Another important food during this period of life is aquatic insects (Corixidae, Odonata, Diptera — except Chironomidae —, Trichoptera, Coleoptera and Hymenoptera), grouped here under the name "other insects". Algae such as Chlorophyta and Cyanophyta are present in 30 % of all fish of this size.

In size II there is no planktophagic habit, as food is captured in the aquatic vegetation, indicated by the presence of fish eggs, larvae, "other insects" and ostracods. The presence of *Campsurus* sp. nymphs (Ephemeroptera) and detritus suggests an increase in the bentophagic habit.

Fish eggs and fish are the main food in size III. The increased ingestion of Gastropoda, *Campsurus* sp. and detritus are indicative of the bottom origin of the food.

Animals of size IV and V obtain their food mainly from the benthic zone. The diet variation in the different size groups is shown in Fig. 1. It can be concluded that the diet of *P. kraussii* varies with fish size. This variation seems to be determined by prey size as suggested by POLLARD (1973), CADWALLADER (1975), and KEAST (1978).

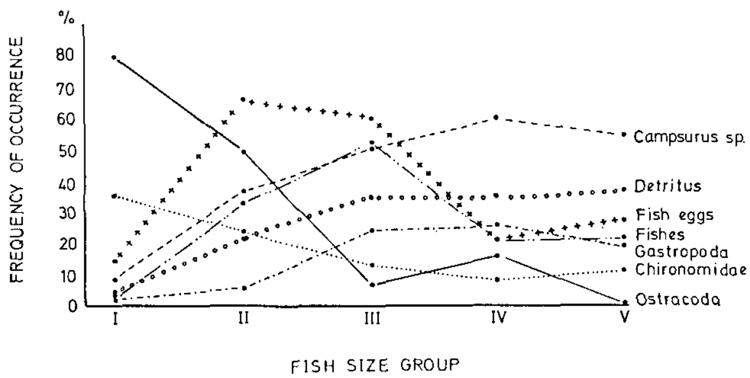

Fig. 1. Percentage occurrence of selected food items in diet of different *Petenia* size classes.

Fish diet is also influenced by habitat. *Petenia kraussii* has different habitats depending on fish size. The smallest animals inhabit the shallow water next to the shore and they swim grouped in small schools. As the fish size increases, the fish moves away from the shore, frequenting the submerged vegetation, and the grouping tendency decreases. The bigger specimens prefer deeper waters and benthic food. They swim alone or in small groups.

Number of food items per individual fish

Table 3 summarizes the relation between the number of the food items ingested and the number of fish guts analysed. With 2 and 3 food items the frequency values are the highest and with 1 and 4 the percentages are slightly lower. Frequency values show a steady decrease from 5 to 8 food items.

Lake Valencia being a tropical lake has a great availability of food, which explains our result. On the contrary POLLARD (1973) studying another euryphagic fish in a temperate lake of Australia found a maximum of 5 food types.

Table 3. Frequency of occurrence of food items per fish.

Nr. of food items per fish	1	2	3	4	5	6	7	8	Total
Nr. of fishes	80	103	102	75	40	22	8	5	435
% of fishes	18.39	23.68	23.45	17.24	9.20	5.06	1.84	1.15	100

The number of food items per fish of each size group was determined (Table 4). As the fish grows the maximum number of food types per individual fish is lower, indicating that an increase in size is correlated with a decrease of the generalist food habit.

Table 4. Frequency of occurrence of different number of food items per fish of each size group. (Number in italics is maximum percentage for each size group.)

Nr. of food items	1	2	3	4	5	6	7	8	Maximum nr. food items
Size I	7.04	14.08	21.83	*23.94*	14.08	12.68	2.82	3.52	8
Size II	16.36	16.36	*23.64*	18.18	20.00	1.82	3.64		7
Size III	15.22	*28.26*	21.74	21.74	4.35	4.35	4.35		7
Size IV	25.81	*29.68*	27.74	12.26	3.87	0.65			6
Size V	37.84	*40.54*	13.51	5.14	2.70				5

Diet diversity

Total diversity of the diet was calculated for each size group by the SHANNON-WIENER index (PIELOU 1974) (Table 5).

Table 5. Food diversity calculated by SHANNON-WIENER index. H'_i (S) = Food diversity for each size group. H′ (SG) = Total diversity.

Size groups	Diversity values	
I	H'_1 (S)	2.3539 nats
II	H'_2 (S)	2.2704 nats
III	H'_3 (S)	2.2900 nats
IV	H'_4 (S)	2.3078 nats
V	H'_5 (S)	1.9747 nats
I–V	H′ (SG)	3.6916 nats

Total diversity values represent more than 80 % of the maximum diversity values. Diet diversity values for each size group are high, ranking from 63.3 % to 81.3 %, the highest value is for size group I, and the lowest one for size group V. These results show that as the fish grows, food diversity decreases. A t-test showed that differences found are not statistically significant.

The high values for H′ indicate that *P. kraussii* is a generalistic feeder. This feature is maintained throughout its whole life.

Table 6. SPEARMAN rank correlation coefficient (r_s) for size groups.

Size groups	Frequency of occurrence	Rank method
I– II	0.2029	−0.1760
II–III	0.4581	0.3725
III– IV	0.6442	0.6377
IV– V	0.8479	0.7673

Diet similarity in the different size groups

Values were calculated according to the SPEARMAN rank correlation coefficient (Table 6). Diet differences were found between groups I—II and II—III. On the other hand size groups III—IV and IV—V show no differences.

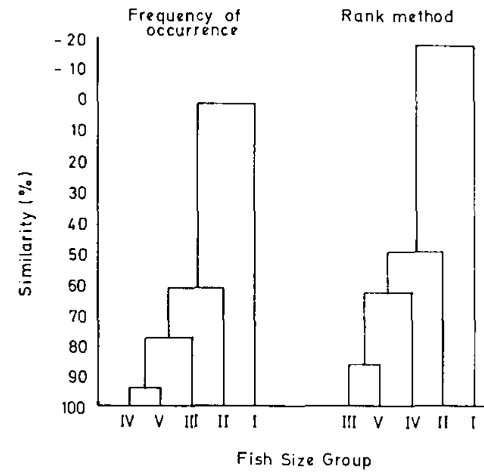

Fig. 2. Dendrogram from cluster analysis for the food habits of *Petenia kraussii* using the method of frequency of occurrence and the rank method.

Similarity was quantified by cluster analysis (Fig. 2). Food habits become more similar as the fish grows. Size group I shows the least similarity when all the groups are compared. An explanation for this result can be drawn from the finding that group I individuals are very scarce during the dry season, and abundant in the rainy season, when there is plenty of food.

Trophic niche breadth

This parameter narrows as the fish get bigger (Table 7).

In order to facilitate the interpretation of the results the maximum theoretical niche value was calculated. Niche breadth values are expressed as a percentage of the theoretical value. These results confirm the generalistic condition of *P. kraussii.*

Our results seem to confirm LARKIN's suggestion (LARKIN 1965) that the freshwater habitat is difficult for spezialization. Most of the fish species studied by KNÖPPEL (1970) in Brazil rivers, were generalistic feeders. Nevertheless ZARET & RAND (1971) found in Panama that 3 species out of 12 were specialists. Obviously more research is necessary to clarify this situation.

Table 7. Trophic niche breadth for each size group.

Size group	Niche breadth	Percentage
I	8.7068	48.37
II	8.2443	45.80
III	7.8894	43.83
IV	7.9501	44.17
V	6.0703	38.72
All sizes	12.4924	69.40

Trophic niche overlap

As the difference in size becomes greater, niche overlaps diminish (Table 8). Niche overlaps are higher in the bigger sizes. Notice how the values increase when comparing groups I—II, II—III, etc.

Table 8. Effect of the rainy season and the dry season upon niche overlap of the group sizes. Values are expressed in percentage. (Dry season values for size group I are not given since the number of animals was too small.)

		Dry season				
		I	II	III	IV	V
Rainy season	I		–	–	–	–
	II	50.8		65.2	60.5	54.5
	III	20.4	52.3		75.3	72.1
	IV	44.8	63.0	59.1		80.9
	V	26.8	52.0	69.0	62.5	

Seasonal variation of trophic niche overlap

Data from Table 8 show more overlap during the dry season than in the rainy season. Our results are in disagreement with those of ZARET & RAND (1971). On the contrary an increased overlap was reported by LOWE-MCCONNELL (1964) for those fish species trapped in the river pools formed in the dry season. It has been stated that in the rainy season the availability of food for fish is higher (LOWE-MCCONNELL 1964; ZARET & RAND 1971). Apparently a similar situation occurs in Lake Valencia. An increase in phyto- and zooplankton has been reported for this lake during the rainy season (INFANTE 1978). It is at this time of the year that the macrophyte belt recovers, and *P. kraussii* reproduction peaks. Presumably due to the abundance of food, the trophic niche overlaps decrease as a consequence of the narrower niche breadth observed for each size group. According to size and energy needs each group will choose from the now plentiful food.

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Author's address:

Univ. Central de Venezuela, Apartado 47106, Los Chaguaramos, Caracas 1041, Venezuela