A COMPARISON OF THE DIETS OF REDBREAST SUNFISH AND SPOTTED SUCKER IN A COASTAL PLAIN STREAM

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Abstract: The diets of redbreast sunfish (*Lepomis auritus*) and spotted sucker (*Minytrema melanops*) in the Satilla River, Georgia, were shown to be quantitatively different using Spearman rank correlation coefficients. The index of overlap of Pianka by number and weight showed considerable overlap in the diet during the fall. Chironomids were the main food component contributing to this overlap. The index of electivity of Ivlev indicated moderate to high selectivity by both species for chironomids in the winter, spring, and summer and some selectivity in the fall. The diet overlap between the 2 species was not considered to be a problem.

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Redbreast sunfish is regarded as one of the more important game fish species in the streams of the Lower Coastal Plain (Sandow et al. 1974, and Holder and Ruebsamen 1976). Rotenone samples have shown that spotted sucker is one of the most abundant non-game fishes in these streams (Sandow et al. 1974, Ruebsamen and Holder 1976). Life history studies on redbreast sunfish by Sandow et al. (1974), Bass and Hitt (1974), and Davis (1971) and on spotted sucker by Johnson and McSwain (1974) indicated that both species utilize similar food items. However, no previous work has been conducted comparing the diet of the 2 species in the same stream.

The Lower Coastal Plain streams commonly inhabited by high populations of both species are characterized by fluctuating water levels with periods of extreme high and low flows. During certain seasons or low flow periods, interspecific competition could be severe. This study compares the food habits of the 2 species in the same stream to determine the extent of diet overlap.

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MATERIALS AND METHODS

Description of Study Area

The Satilla River near Waycross, GA. contains a high population of redbreast sunfish and spotted suckers (Holder and Ruebsamen 1976) and is a typical Coastal Plain stream in its flow regime. The tannic acid, blackwater stream has a pH range of 4.5-6.0 (Sandow et al. 1974). Numerous cypress swamps, lowlands and pine forests border the river. The bottom substrate is sand with some sandstone outcropping and rubble. Five sampling sites were established on the river (Fig. 1).

Food Habits

Between September 1973 and September 1974, redbreast sunfish and spotted suckers were collected monthly at each sample site by electroshocking. A total of 526 redbreast sunfish and 516 spotted suckers were collected on the Satilla River during 83 hours of effort. Redbreast sunfish specimens ranged in total length from 34 mm to 278 mm; spotted suckers ranged from 56 mm to 541 mm.

Fish were placed in ice water and transported to the laboratory where stomachs and part of the intestines were removed and preserved in 10 percent formalin for later analysis.

Stomach samples were categorized seasonally: winter (January, February, and March), spring (April, May, and June), summer (July, August, and September), and fall (October,

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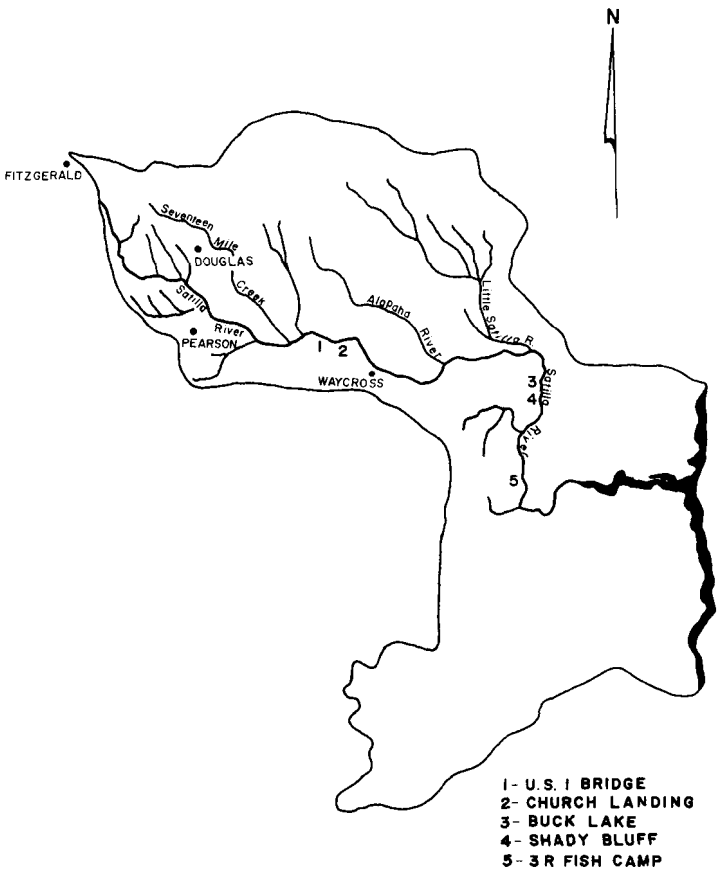

Fig. 1. Map of Satilla River showing samples sites.

November, and December). A minimum of 48 stomachs from each species was examined per season. If available, one-third was selected from each of the size classes (fingerling, intermediate, and harvestable) described by Surber (1959). If a high proportion of stomachs from a size class were empty, additional stomachs from that class were examined.

The part of the digestive tract examined was limited to the stomach of the redbreast sunfish and the stomach and first loop of the intestinal tract of the spotted sucker. The contents were removed and preserved in 70 percent isopropanol and later identified to the lowest possible taxon using Pennack (1953) and Usinger (1963) as the primary keys.

Methods of Analysis of Food Habits

Three basic methods of analysis described by Windell (1971) were used to compare the diet of the redbreast sunfish to that of the spotted sucker: frequency of occurrence, numerical and gravimetric.

Results of the frequency of occurrence method were used for interspecific comparisons of the total diet differences using Spearman rank correlation coefficients as described by Fritz (1974). The overlap in diets both in number and biomass was calculated using the index of overlap of Pianka (1973). Individual food classes which might be possible sources of competition in terms of biomass for both redbreast sunfish and spotted sucker were analyzed using the index of electivity (Ivlev 1961).

Food Availability

Drift and benthic invertebrate samples were taken in conjunction with the fish samples to determine food availability. Two drift samples were taken monthly at each site using a trapped silk net with a mesh size of 575μm. The nets were supported at the mouth by a 30.5 x 30.5 cm wide frame. The net was attached by wire loops to 2 iron rods driven into the stream bottom and suspended 5 cm above the substrate.

Hourly drift samples taken between dusk and midnight 8 June 1971 indicated that a peak in drift occurs about 2 hr after sunset. Based on these results, all drift sampling was begun approximately 2 hr after sunset. The nets were suspended for the approximate time required to sample 14 kl of water. The samples were removed from the nets, placed in jars, and refrigerated. The following day macroinvertebrates were handpicked from each sample and preserved in 80 percent isopropanol.

The actual number of invertebrates counted in each sample was expanded to obtain an estimate of the numerical density per 10 kl. The individual sample values were averaged to obtain a seasonal estimate of density for each invertebrate group.

Two benthic samples were collected monthly in both pool and riffle areas of each sample site with a .07 m^2 Peterson dredge. Each sample was sieved through a #30 sieve bucket and/or No. 30 mesh sieves. Organisms were picked from the debris, placed in 80 percent isoproponal, and returned to the laboratory. Samples were subsequently sorted, identified, and enumerated. Benthic samples were expanded to obtain estimates of the number of benthic organisms per square meter for each season.

Representative samples of each invertebrate group in both drift and benthic samples were weighed to the nearest 0.1 mg. An average weight was determined for each category and then multiplied by the corresponding number of individuals found in the stomachs to obtain the reconstructed weight of each food class in the fish's diet. These average weights were also used to obtain the percentage of each food class in the environment.

RESULTS

The orders Diptera, Coleoptera, Trichoptera, and Ephemeroptera, respectively, showed the highest frequency of occurrence in the stomachs of redbreast sunfish in the Satilla River (Table 1). Nichols (1976) also reported these 4 groups to be dominant but not in the same order. Sandow et al. (1974) in an earlier study on the Satilla River stated that Diptera (actually dipteran larvae) was the most frequently occurring order followed by Odonata.

Bass and Hitt (1974) reported the Diptera family Tendipedidae (Chironomidae) as composing the highest percentage by number of food items consumed by redreast sunfish in the Suwannee and the Santa Fe Rivers in Florida. Chironomidae was also the most frequently occurring family in the stomachs of redbreast sunfish from the Satilla River in our study. Overall the diet of the redbreast sunfish from the Satilla appears typical to that reported in other streams in the southern United States.

Diptera were also the most frequently occurring order in the guts of spotted suckers from the Satilla River (Table 1). Copepoda and Cladocera were the next most frequent orders. In comparison, Johnson and McSwain (1974) reported that Diptera, Ephemeroptera, and Trichoptera, respectively, were the most common orders by number in spotted sucker stomachs from the Flint River, Georgia.

The percent numerical composition of the total food items consumed by each size group of both species was examined (Table 2). Fingerling redbreast sunfish heavily utilized copepods (38.8%) and chironomids (39.5%). Spotted sucker fingerlings fed extensively on copepods (44.9%), cladocerans (28.3%), and chironomids (22.8%). Intermediate redbreast sunfish consumed chironomids in high numbers (74.8%) while intermediate spotted suckers relied heavily on copepods (62%). Harvestable redbreast sunfish and spotted suckers both consumed a high percentage of chironomids (41.5% and 47%, respectively); however; trichopterans were taken in high numbers only by harvestable redbreast sunfish.

The total diets of different size redbreast sunfish and spotted suckers were compared by weight composition (Table 3). Chironomids were the most abundant food group in both the fingerling redbreast and spotted suckers (35.9% and 38.9%, respectively); however, copepods (35.1%) were also abundant in the fingerling suckers. Odonates (33.0%) and chironomids (29.8%) made up the bulk of the diet in the intermediate redbreast sunfish while in intermediate spotted suckers the oligochaetes (40.7%) and chironomids (34.0%) were the major food components. The most abundant food groups by

Table 1. Percent frequency of occurrence of food items in the stomachs of redbreast sunfish (RS) and spotted suckers (SS) captured in the Satilla River from 20 September 1973 to 26 September 1974.

	Winter		*Spring*		*Summer*		*Fall*		*Total*	
Food Items	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*
Annelida										
Oligochaetae		7.5		3.7	10.0	10.9			3.9	5.5
Others	2.0	5.7	2.0	14.5	6.0	10.9			2.4	7.7
Arachnoidea										
Hydracarina	4.0	1.9	2.0	1.8	2.0		1.9		2.4	0.9
Others	8.0				10.0				2.4	
Crustacea										
Cladocera	2.0	37.7	4.0	25.5	6.0	36.4	9.3	29.8	5.4	32.3
Copepoda	4.0	33.9	5.9	43.7	10.0	41.8	9.2	43.9	7.3	40.9
Others	24.0	3.8	8.0	3.6		3.6			7.8	
Insecta										
Coleoptera	48.0	9.4	36.0	9.1	50.0	10.9	22.2	3.5	38.6	8.2
Diptera	90.0	60.4	90.0	65.1	66.0	70.9	61.1	40.4	76.5	59.1
Ceratopogonidae	30.0	18.9	50.0	18.2	36.0	16.3	7.4	12.3	28.8	14.1
Chironomidae	86.0	58.5	88.0	61.8	74.0	54.5	46.3	24.5	71.2	28.2
Culicidae	15.9					4.4			3.9	0.9
Simulidae	8.0	7.5			4.0	3.7		1.8	2.9	3.2
Tipulidae	4.0		2.0						1.5	
Others	8.0	5.7	4.0	10.9		1.2	25.9	22.8	9.8	10.5
Ephemeroptera	48.0	3.8	14.0	1.8	18.0	14.5	20.3	10.5	26.4	5.0
Hemiptera			4.0		4.0				1.9	
Hymenoptera	12.0		8.0		6.0				6.4	
Odonata	16.0	5.7	14.0		14.0		16.6	1.8	15.1	1.8
Plecoptera	26.0		5.9		4.0		11.1	7.0	11.7	1.8
Trichoptera	56.0	13.2	48.0	9.1	62.0	10.9	35.1	7.0	66.3	10.0
Insect pupa	24.0	26.4	16.0	20.0	24.0	9.1	5.5	7.0	17.1	15.5
Osteichthyes	6.0	1.9			4.0		11.1		3.9	0.9
Unidentified remains	38.0	5.7	27.9	7.3	32.0	1.8	29.6	17.6	31.7	8.2
% Empty	4.0	30.2	2.0	18.2	0.0	21.8	7.4	38.6	3.4	22.7
No. Examined	50	53	50	55	50	55	54	57	204	220

weight in the harvestable redbreast sunfish were odonates (29.2%) and trichopterans (27.2%). Chironomids (35.5%) and oligochaetes (32.5%) were the dominant food groups taken by harvestable suckers.

The diets of both fish species were examined seasonally using percent composition by number (Table 4). Chironomids were the most numerous food item eaten by redbreast sunfish in all seasons (39.7%-82.5%); however, redbreast fed heavily on trichopterans (34.6%) in the summer and on copepods (36.4%) in the fall. The high utilization of trichopterans was by the harvestable fish, while the copepods were consumed mostly by fingerlings (Table 2). Copepods were the most numerous food item consumed by spotted suckers in all seasons (52.8%-63.4%), but chironomids were also taken in substantial numbers (13.0%-31.0%).

The seasonal diets were also examined using percent weight composition (Table 5). Odonates and trichopterans were the more abundant food items taken by redbreast sunfish in the winter (39.5% and 17.8%, respectively) and summer (43.4% and 30.5%, respectively). In the spring chironomids (45.7%) and odonates (32.4%) made up the bulk of the diet. In the fall fish (40.6%) and chironomids (30.0%) were the dominant food groups.

Oligochaetes were the most abundant food items taken by spotted suckers in the winter (48.7%), spring (42.5%), and summer (53.0%). Chironomids (52.6%) made up the bulk of the diet in the fall and were also abundant in other seasons (14.0-38.4%). Copepods were abundant in the diet of spotted suckers in the fall (24.6%).

Seasonal and total diets, represented by the frequency of occurrence data (Table 1) were compared using Spearman rank correlation coefficients (Fritz 1974). Only those food classes occurring in 3 percent or more of the stomachs of at least one species, excluding unidentified remains, were ranked and compared. The r values obtained ranged from 0.02 to 0.49 seasonally with a total diet r value of 0.05. No significant correlation in relative abundance of the major food classes exists either seasonally or for the total diet at $P < .01$. This method indicates that the two species do indeed have different diets.

Table 2. Percent composition by number of food items found in various size groups of redbreast sunfish and spotted suckers captured in the Satilla River from 20 September 1973 to 26 September 1974.

	Redbreast sunfish				*Spotted suckers*			
Food Items	*Fingerling*	*Intermediate*	*Harvestable*	*Total*	*Fingerling*	*Intermediate*	*Harvestable*	*Total*
Annelida								
Oligochaetae	0.2	0.3	1.9	0.8	T[a]	2.0	6.1	2.0
Others	0.5	0.4	T	0.3	1.0	0.3	3.6	0.6
Arachnoidea								
Hydracarina		0.1	0.2	0.1		T	0.2	T
Others	0.2		0.3	0.1				
Crustacea								
Cladocera	3.7	0.1	T	0.7	28.3	11.1	5.1	13.3
Copepoda	38.8	0.3	0.1	7.0	44.9	62.0	14.1	55.9
Others		0.5	2.3	1.0	0.5	0.6	0.7	0.6
Insecta								
Coleoptera	0.8	2.2	3.4	2.4	1.0	T	3.1	0.4
Diptera								
Ceratopogonidae	2.6	3.0	2.8	2.9	0.2	1.3	8.7	1.6
Chironomidae	39.5	74.8	11.5	56.9	22.8	19.1	47.0	21.6
Culicidae							0.8	0.1
Simulidae	2.1	0.4	0.7	0.8	T		0.5	0.1
Tipulidae		0.1	1.7	0.7				
Other	4.4	0.8	0.1	1.2	0.2	2.0	0.5	1.7
Ephemeroptera	0.8	1.8	4.8	2.7		0.3	1.3	0.3
Hemiptera	0.2	0.8	0.1	0.5				
Hymenoptera	0.1	0.2	0.5	0.3				
Odonata	0.3	1.6	1.5	1.3	T		0.2	T
Plecoptera	0.9	0.4	1.2	0.8		0.1	0.3	0.1
Trichoptera	1.8	9.9	35.2	17.3	0.2	0.2	3.2	0.4
Insect pupa	2.4	0.9	1.0	1.2	0.5	0.2	2.4	0.4
Nematoda	0.1	0.1	0.1	0.1	0.3	0.8	2.0	0.8
Osteichthyes	0.1	0.3	0.1	0.2	0.1			
Others	0.5	1.0	0.5	0.7		T	0.2	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. Fish Examined	32	91	81	204	34	74	112	220

[a]trace

Table 3. Percent composition by weight of food items found in various size groups of redbreast sunfish and spotted suckers captured in the Satilla River from 20 September 1973 to 26 September 1974.

	Redbreast sunfish				*Spotted suckers*			
Food Items	*Fingerling*	*Intermediate*	*Harvestable*	*Total*	*Fingerling*	*Intermediate*	*Harvestable*	*Total*
Annelida								
Oligochaetae	0.8	0.6	2.7	1.1	4.4	40.7	32.5	25.9
Arachnoidea								
Hydracarina		0.1	T[a]	T	T	T	T	T
Others	2.0			0.7				
Crustacea								
Cladocera	0.1	T	T	T	6.3	1.0	0.1	2.5
Copepoda	5.4	T	T	1.8	35.1	16.7	1.3	17.7
Others		1.5	1.9	2.1	0.2	0.1	0.1	0.1
Insecta								
Coleoptera	1.5	3.5	2.0	2.3	1.8	0.4	9.7	4.0
Diptera								
Ceratopogonidae	1.9	0.9	0.7	1.3	0.2	3.0	7.3	3.5
Chironomidae	35.9	29.8	15.1	26.9	38.9	34.0	35.5	36.0
Culicidae							T	T
Simulidae	0.8	0.1	0.1	0.3	T		0.1	T
Ephemeroptera	6.3	3.2	6.2	5.2		2.5	3.2	1.9
Hemiptera	3.0	1.8	0.5	1.8				
Hymenoptera	0.2	0.1	0.2	0.2				
Odonata	11.2	33.0	29.2	24.5	6.9		3.0	3.3
Plecoptera	5.5	0.6	0.9	2.3			0.3	0.1
Trichoptera	14.2	11.5	27.2	17.6	0.6	1.5	6.2	2.8
Insect pupa	1.0	0.1	0.2	0.4	0.9	0.1	0.7	0.6
Osteichthyes	10.2	13.2	10.1	11.2	4.7			1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. Fish Examined	32	91	81	204	34	74	112	220

[a]trace

Table 4. Percent composition by number of food items found in the stomachs of redbreast sunfish (RS) and spotted suckers (SS) captured from the Satilla River during the different seasons.

	Winter		*Spring*		*Summer*		*Fall*	
Food Items	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*
Annelida								
Oligochaetae		0.6	0.1	5.9	2.6	4.4		
Others	0.1	0.1	0.2	0.1	0.8	0.8		
Arachnoidea								
Hydracarina	0.3	T[a]	T	0.1	0.1		0.1	
Others	0.3				0.3			
Crustacea								
Cladocera	0.1	9.3	0.2	4.5	0.5	15.2	2.8	25.2
Copepoda	0.7	59.3	0.2	63.1	0.7	52.8	36.4	56.0
Others	4.9	0.1	0.3	2.7	0.1	2.3	0.2	0.3
Insecta								
Coleoptera	4.4	0.2	1.3	0.8	2.9	1.0	1.3	0.1
Diptera								
Ceratopogonidae	4.8	1.5	3.3	0.6	2.6	3.6	0.4	1.0
Chironomidae	50.1	31.0	82.5	18.7	44.0	13.9	39.7	13.0
Culicidae						0.3		
Simulidae	1.9	0.1			1.5	0.1		
Tipulidae	1.0		0.1		0.8		0.9	
Other	0.2	1.8	0.3	1.3	0.2	0.8	5.4	2.3
Ephemeroptera	5.8	0.2	0.6	0.1	3.7	0.1	1.6	0.8
Hemiptera	0.2		0.9		0.4		0.1	
Hymenoptera	0.5		0.3		0.3			
Odonata	2.7	T	0.5		1.6		1.0	0.4
Plecoptera	3.2		0.2		0.1		0.5	
Trichoptera	15.9	0.3	6.7	0.3	34.6	0.6	8.5	0.5
Insect pupa	2.0	0.4	1.0	0.6	1.4	0.5	0.2	0.2
Nematoda	0.2	T	0.1	0.8	0.1	3.5		0.2
Osteichthyes	0.3	T		0.1	0.1		0.6	
Others	0.4	0.1	1.2		0.6	0.1	0.3	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5. Percent composition by weight of food items found in the stomachs of redbreast sunfish (RS) and spotted suckers (SS) captured from the Satilla River during the different seasons.

	Winter		*Spring*		*Summer*		*Fall*	
Food Items	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*	*RS*	*SS*
Annelida	T[a]	48.7	0.2	42.5	5.8	53.0		
Arachnoidea			T		T		T	
Crustacea								
Cladocera	T	0.2	T	0.3	T	0.7	0.1	3.1
Copepoda	T	2.7	T	9.4	T	15.3	3.0	24.6
Other	8.6	0.1	2.9	T	0.2	0.4		0.1
Insecta								
Coleoptera	0.7	0.1	0.9	2.0	3.1	5.7	5.4	1.2
Diptera								
Ceratopogonidae	0.7	1.0	1.9	1.2	0.5	3.4	0.2	3.4
Chironomidae	13.5	38.4	45.7	33.7	8.2	14.0	30.0	52.6
Culicidae						3.7		
Simulidae	0.1	T			0.2	0.1		
Ephemeroptera	12.8	2.0	0.7	0.3	2.3	0.5	2.3	8.8
Hemiptera	0.3		1.9		2.6		0.3	
Hymenoptera	0.1		0.2		0.1			
Odonata	39.5	3.2	32.4	7.7	43.4		2.5	
Plecoptera	2.3		1.5		T		0.4	1.8
Trichoptera	17.8	1.3	11.0	1.4	30.5	3.0	15.2	4.4
Insect pupa	0.1	0.1	0.7	1.5	0.1	0.2	T	T
Osteichthyes	3.5	2.2			3.0		40.6	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Trace

The index of overlap of Pianka (1973) was applied to the numerical and gravimetric food habits data to determine the extent of seasonal overlap in the diets of the 2 species. The index values of the numerical abundance data showed some overlap in the spring (0.28) and summer (0.27), a moderate overlap in the winter (0.47), and a higher overlap in the fall (0.77). The index values of the weight comparison showed little overlap in the winter (0.23) and summer (0.17) and moderate overlap in the spring (0.57) and fall (0.55). The overlaps that occurred in the spring and fall are attributed to the high uptake of chironomids during those seasons and of copepods in the fall.

An estimate was made of food organisms available in both the drift and benthic habitats (Tables 6 and 7). In both habitats Diptera was the order with the highest average density with Chironomidae the second most common family of dipterans in the drift and the most common one in the benthic samples.

Since chironomids were abundant in the diets of both species and in the environment, the index of electivity of Ivlev (1961) was determined for this food item for both species (Table 8). Redbreast sunfish exhibited some selection for chironomids (based on their abundance in the drift) in all seasons with values ranging from + 0.15 to + 0.94. Spotted sucker fingerlings exhibited strong selectivity (+ 0.86 to + 0.92) for chironomids in the drift biomass in all seasons, except fall (— 0.60). Harvestable and intermediate spotted suckers showed high selectivity for chironomids only in the spring (+ 0.81 and 0.94, respectively) and the summer (+ 0.86 and + 0.82, respectively).

The selectivity for chironomids by both species, as determined from benthic abundances, was somewhat similar to the drift indices. Chironomids were positively selected for in all seasons (+ 0.32 to + 0.87) by all size redbreast, except that they were not selected for by harvestable redbreast sunfish in the spring (— 0.12). Selection for chironomids was high in the winter (+ 0.85 to + 0.97) and summer (+ 0.71 to + 0.78) in all size spotted suckers. Some selectivity for chironomids by the suckers occurred in the spring (+ 0.06 to + 0.60) and fall (+ 0.47 and + 0.61), except that fingerling suckers did not select for them in the fall (— 0.60). The negative selection by the fingerling suckers in the fall is probably an artifact of the data since only two stomachs were examined.

DISCUSSION

The various methods of comparing the diets of redbreast sunfish and spotted suckers showed that a portion of the diets of both species was similar. The Spearman rank correlation coefficients (Fritz 1974) showed that the diets were quantitatively different in relative abundance of important food items; however, this technique does not indicate the extent of overlap of food items between the two species. The technique of Pianka (1973) indicated a high overlap in the diets during the fall and less so during the other seasons. These overlaps were attributed primarily to the extensive utilization of chironomids all year and, to some extent, of copepods in the fall.

The copepods were utilized primarily by fingerlings of both species (Table 2). However, in terms of weight, they were of little importance (Table 3) especially in the redbreast fingerling diet. Although copepods contributed to the diet overlap, their overall contribution is negligible.

Both redbreast sunfish and spotted suckers actively select chironomids as food throughout the year although the intensity varies with season and size class (Table 8). The electivity values are based on the relative density of chironomids in the environment as a measure of abundance. However, when the density of chironomids in the drift samples was regressed against water flow at the time of sampling, no significant relationship existed ($P < 0.01$) (i.e. no linear slope). A regression was also tested for density of total food organisms in the environment against flow. Again no significant relationship was established. Since these densities were not significantly different with flow, it seems reasonable to assume that the abundance of total food (and chironomid abundance) would be greater at higher flows and less at lower flows.

Water flow records of the Satilla River by USGS (1974 and 1975) show that winter and summer had high flows while spring had moderate flows and fall low flows. The high selection for chironomids in the winter, spring, and summer would be offset somewhat by the apparent increased total food supply at higher flows. Chironomids were less selected for in the fall although they did contribute to the diet overlap.

Redbreast sunfish tend to be opportunistic feeders taking any food item of the proper size whether available on the surface or on the bottom (Bass and Hitt 1974). In contrast

Table 6. Estimated number of organisms per 10 kl by season calculated from drift samples taken in the Satilla River from 20 September 1973 to 26 September 1974.

Classification	*Winter*	*Spring*	*Summer*	*Fall*	*Average*
Annelida	0.1	0.1	0.1	0.2	0.1
Arachnoidea	0.1	0.6	0.2	0.3	0.3
Crustacea	2.2	8.6	2.4	9.3	5.6
Cladocera	1.6	1.9	0.2	7.4	2.8
Copepoda	0.5	6.6	2.2	1.8	2.8
Decapoda	0.1	0.1		0.1	0.1
Isopoda		T[a]			T
Insecta	34.7	42.9	78.0	39.1	48.7
Coleoptera	0.9	4.4	9.5	2.2	4.3
Dytiscidae (adult)	0.2	0.5	0.8	1.1	0.7
Dysticidae (larvae)	0.1	0.2	1.8	T	0.5
Elmidae (adult)	0.4	2.8	5.0	0.7	2.2
Elmidae (larvae)	0.2	0.7	2.6	0.4	1.0
Gyrinidae (larvae)		0.2	0.1		0.1
Staphylinidae		T			T
Diptera	13.7	9.2	13.7	7.1	10.9
Ceratopogonidae	0.1		0.1		0.1
Chironomidae	2.1	1.2	3.1	6.1	3.1
Culicidae	0.2	0.2	0.4	0.1	0.2
Empididae		T	0.5		0.1
Simulidae	11.3	7.8	9.6	0.9	7.4
Tipulidae				T	T
Ephemeroptera	0.7	2.4	3.1	5.7	3.0
Ephemeridae	0.1	0.6	0.4	0.5	0.4
Heptagenidae		0.1	0.5		0.2
Baetidae	0.2	0.5	2.2	1.4	1.1
Other	0.4	1.2		3.8	1.4
Megaloptera (Corydalidae)	T	T	0.1		0.1
Neuroptera (Sisyridae)	T	T	0.1		0.1
Odonata	0.2	0.1	0.9	0.1	0.3
Coenagrionidae	0.1	0.1	0.2	T	0.1
Gomphidae	0.1		0.1	T	0.1
Libellulidae			0.5	0.1	0.2
Others[b]			0.1	T	0.1
Plecoptera	2.0	0.4	0.1	0.2	0.7
Trichoptera	0.5	4.6	10.8	4.1	5.0
Hydropsychidae	0.2	1.7	8.8	1.3	3.0
Leptoceridae	0.1	0.1	0.4	T	0.2
Psycomiidae	T	0.2	0.9	0.2	0.3
Philopotamidae	T	0.1	0.7	0.1	0.2
Other	0.2	2.5		0.1	0.7
Insect pupae	0.7	1.1	1.9	0.5	1.1
Non-aquatic	0.3	0.4	0.5		0.3
Osteichthyes	0.1	0.5	0.4	T	0.3

[a]T = Trace.

[b]Individuals placed in this category could only be identified as to order. They may or may not be members of the families listed.

Table 7. Estimated number of organisms per square meter by season calculated from benthic samples taken in the Satilla River from 20 September 1973 to 26 September 1974.

Classification	*Winter*	*Spring*	*Summer*	*Fall*	*Average*
Annelida	2.0	8.0	34.7	17.6	15.6
Arachnoidea				1.1	
Insecta					
Coleoptera	2.4	6.8	5.6	0.4	3.8
Dytiscidae (larvae)			1.5		0.4
Elmidae (adult)		0.8	0.8	0.4	0.5
Elmidae (larvae)	2.4	6.0	3.3		2.9
Diptera	61.0	58.5	101.7	197.7	104.7
Ceratopogonidae	37.5	39.0	14.0	81.0	42.9
Chironomidae	23.5	19.1	86.2	103.3	58.0
Culicidae			0.5	9.9	2.6
Tipulidae		0.4	1.0	3.5	1.2
Ephemeroptera			0.8	75.0	19.0
Heptagenidae			0.8		0.2
Other[a]				75.0	18.8
Odonata	1.6	0.4	0.5	1.9	1.1
Coenagrionidae	1.2	0.4		1.9	0.9
Gomphidae			0.5		0.1
Other	0.4				0.1
Plecoptera	2.0			17.6	4.9
Trichoptera	0.8		11.1	45.7	14.4
Hydropsychidae			4.3		1.1
Psychomiidae			3.0		0.7
Philopotamidae			3.8		1.0
Other	0.8			45.7	11.6
Insect pupae	0.4		1.0	4.1	1.4
Osteichthyes	0.4			0.6	0.3

[a]Individuals placed in this category could only be identified as to order. They may or may not be members of the families listed.

Table 8. Ivlev's electivity indices of redbreast sunfish and spotted suckers for chironomids.

	WINTER						*SPRING*					
	Fingerling		*Intermediate*		*Harvestable*		*Fingerling*		*Intermediate*		*Harvestable*	
	RB	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*
Drift Biomass Indices	+0.51	+0.86	+0.15	+0.77	+0.46	+0.45	+0.94	+0.92	+ 0.94	+0.81	+0.74	+0.94
Benthic Biomass Indices	+0.87	+0.97	+0.72	+0.95	+0.85	+0.85	+0.58	+0.49	+ 0.56	+0.06	−0.12	+0.60
	SUMMER						*FALL*					
	Fingerling		*Intermediate*		*Harvestable*		*Fingerling*		*Intermediate*		*Harvestable*	
	RB	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*	*RB*	*SS*
Drift Biomass Indices	+0.92	+0.89	+0.76	+0.86	+0.60	+0.82	+0.32	−0.60	+ 0.43	+0.60	+0.29	+0.47
Benthic Biomass Indices	+0.82	+0.71	+0.63	+0.78	+0.41	+0.71	+0.35	−0.60	+ 0.45	+0.61	+0.32	+0.47

spotted suckers are reported to feed mostly on the bottom (Pflieger 1975). Our observations of redbreast sunfish and spotted suckers feeding behavior in an aquarium tended to support this. Robert L. Henry (personal communication, Georgia Institute of Technology, Atlanta, Georgia) in a related study stated that redbreast sunfish in the Satilla River utilize food organisms colonizing snags to a great extent whereas spotted suckers feed primarily on benthic organisms. This difference in feeding behavior would result in the exploitation of different spatial habitats by the two species for food.

From these analyses and observations the diet overlap between redbreast sunfish and spotted suckers in the Satilla River is not considered to be a problem.

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