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LIFE HISTORY OF WARMOUTH IN THE SUWANNEE RIVER AND OKEFENOKEE SWAMP, GEORGIA

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ABSTRACT

Life history data were collected from Suwannee River and Okefenokee Swamp warmouth (*Lepomis gulosus*) from 19 July 1968 through 28 June 1973. Suwannee River warmouth became sexually mature in the third year of life, while warmouth from the Okefenokee Swamp became sexually mature in the second year of life. Collection of fecund warmouth suggested that the nesting season extended from April to late July or early August and that peak spawning generally occurred in early May. Fecundity estimates varied from 3,029 to 22,850 ova per female and generally increased with fish length. The average total lengths of Suwannee River warmouth at ages I through VIII were 52, 73, 105, 132, 158, 177, 189, and 214 mm, respectively. Okefenokee Swamp warmouth were 54, 90, 127, 154, 179, 179, and 190 mm at ages I through VII, respectively. The length-weight relationship of Suwannee River warmouth was log W=-5.4996+3.3726 Log L. The equation, log W=-5.2395+3.2736 log L, described the length-weight relationship of Okefenokee Swamp warmouth. Warmouth of all lengths from both locations were carnivorous and fed on insects, fish, and crustaceans.

INTRODUCTION

The warmouth (*Lepomis gulosus*) is a native fish of the south and eastern United States (Hubbell, 1966). Warmouth are found in all the major drainage systems of Georgia (Dahlberg and Scott, 1971), and are one of the prinicpal game fishes of the Okefenokee Swamp and Suwannee River.

Creel surveys conducted since 1969 have shown that warmouth comprise from 14.5% to 41.7% of the yearly harvest (March-December) on the Suwannee River (Georgia) and from 55.5% to 67.0% of the yearly harvest (March-December) from the west side of the Okefenokee Swamp near Fargo, Georgia (Swanson and Holder, 1974a and 1974b).

Establishment of management programs which would maintain the warmouth fishery at optimum levels has been hampered by insufficient life history data from Coastal Plain populations. For this reason, a study was initiated to obtain pertinent life history information needed in formulating management programs for the warmouth fishery of the Suwannee River system.

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MATERIALS AND METHODS

Collection of warmouth for life history data on the Suwannee River began on 19 July 1968 and was completed 28 June 1973. The Suwannee River study area was located between U.S. 441 Hwy. bridge and the Okefenokee Swamp dike near Fargo, Georgia (Figure 1). Samples were taken monthly when time and water level conditions permitted. Collections of warmouth in the Okefenokee Swamp were taken from two study areas. These locations were the Suwannee Canal near Camp Cornelia, Georgia, and the Okefenokee dike area near Stephen Foster State Park, Georgia. Okefenokee Swamp samples were taken monthly March 1969 through June 1970, and in September 1970, May 1971, June 1972, and May 1973.

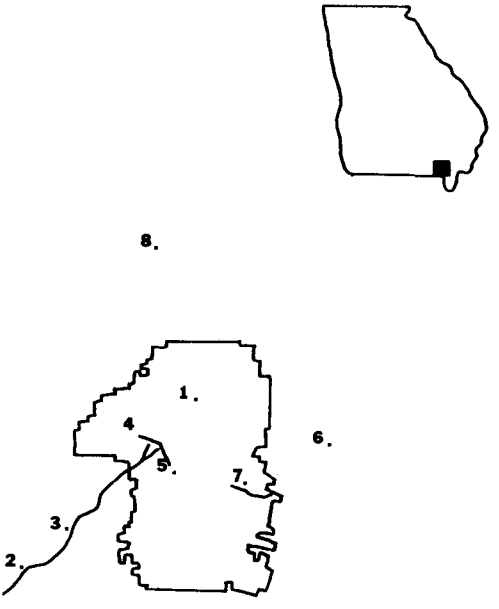

Figure 1. Study area of warmouth collections: 1.) Okefenokee Swamp, 2.) Suwannee River, 3.) Fargo, 4.) Suwannee River Sill, 5.) Stephen C. Foster State Park, 6.) Folkston, 7.) Camp Cornelia, and 8.) Waycross.

Warmouth were collected with an electrofishing boat, hook and line, 4 x 15 ft. seine, fish traps, and rotenone. The total length (mm), weight (g), sex, stage of sexual development, scales, and stomach contents were obtained from most specimens.

Ovaries for fecundity estimates were collected and preserved in a 10% to 15% formalin solution. Ova estimates were obtained by expanding numerical counts of three weighed subsamples.

Scales for age and growth determinations were cleaned in a 50% bleach solution before impressions were made on plastic slides with a heated hydraulic scale press. An Eberbach scale projector (x43) was used to obtain scale measurements. The Frazier modification (Frazier, 1916) of the Dahl-Lee method was used to back calculate lengths of warmouth.

Most warmouth taken for food habits analysis were fixed in 10% formalin and preserved in 40% isopropyl alcohol until the stomach contents were identified and enumerated. Food habits of larger fish were determined in the field. Specimens collected with rotenone were not used for food habits determinations.

RESULTS AND DISCUSSION

Reproduction

Holder (1970) indicated that most Suwannee River warmouth became sexually mature between 102 mm and 152 mm (TL). Our age and growth data indicated that most Suwannee River warmouth did not reach this size interval until they were age III. However, the majority of warmouth collected from the Okefenokee Swamp attained

this size at age II. Larimore (1957) found that warmouth in Vernard Lake, Illinois, matured at one year of age and at lengths between 79 mm and 86 mm. In Park Pond, Illinois, warmouth matured at two years of age (89 mm) (Larimore, 1957). Larimore concluded that size was more important than age in determining maturity. Our data support his findings.

Gonadal development of warmouth began in late February. Peak spawning generally occurred in early May and extended through the month. Spawning activity then decreased, although some nesting continued through July. No ripe or recently spent fish were taken in September or October 1972 collections on the Suwannee River.

In the Suwannee River and Okefenokee Swamp spawning began in April, peaked in early May, and terminated in late July or August. Larimore (1957) found warmouth nesting in central Illinois from mid-May into August with peak spawning occurring in June.

Attempts to visually locate spawning areas and fry of warmouth in the Suwannee River and Okefenokee Swamp were unsuccessful, due primarily to the dark color imparted to those waters by tannin. Ripe warmouth were collected from around the bases of tupelo (*Nyssa* sp.) and cypress (*Taxodium* sp.) trees in the river and swamp and in sluggish water areas of the swamp that possessed stands of water lilies (*Nymphaea* sp.) and panic grasses (*Panicum* sp.). These observations suggested that spawning occurred in those areas, even though no beds were observed. Larimore (1957) reported nesting occurring in areas with similar characteristics.

Fecundity estimates were made from 14 warmouth collected from the Okefenokee Swamp and Suwannee River during April and May 1971 and from 29 Okefenokee Swamp warmouth collected 27 and 28 April 1972. The number of mature or nearly mature ova varied from 3,029 to 22,850 per female (Table 1). The average number of ova per female generally increased with fish length. Ovary weight increased with increasing body weight (Table 1). Suwannee River and Okefenokee Swamp warmouth contained substantially fewer eggs than warmouth from Illinois; however, in that study all egg sizes were enumerated.

Table 1. Average number of ova from 43 Suwannee River and Okefenokee Swamp warmouth collected April and May 1971 and April 1972.

NO. OF FISH	LENGTH INTERVAL (TLmm)	WEIGHT RANGE	MEAN NO. OF EGGS	OBSERVED RANGE	MEAN % OVARY WT. OF TOTAL BODY WT.
1	150-159	80	8721	----	3.16
6	160-169	76-120	6816	3659-15151	3.48
6	170-179	93-152	7708	3029-10950	3. 5
11	180-189	138-180	12502	7802-17315	4.29
3	190-199	163-215	10362	7831-12267	2.51
7	200-209	202-240	12994	8530-22850	4.18
6	210-219	205-280	15448	10256-21877	5.27
2	220-229	278-332	18914	18461-19368	5.52
1	230-239	316	20064	----	4.44
Grand Average			11768		

The ovaries of warmouth examined during the spawning season contained both large and small ova. No ova in an intermediate stage of development were observed. The small ova appeared to be poorly developed (0.45 mm avg. diameter) and were uniformly distributed throughout the ovaries of all fish examined. The larger ova were in one of two stages of maturation. Only one stage of large ova was found in any one female. The more developed large ova (0.97 mm avg. diameter) were found in warmouth 200 mm TL or larger. Warmouth less than 200 mm contained the less developed maturing ova (0.85 mm avg. diameter). The less developed large ova were opaque, yellow to dark yellow in color and were polygonal in shape. The more mature of the large ova were translucent, light pinkish-orange in color and were globular in shape.

The presence of both immature and maturing ova in an ovary suggested that Suwannee River and Okefenokee Swamp warmouth had the physiological capability of spawning more than once during a season (Larimore, 1957). However, our observations indicated that this did not occur. Indications were that larger females ($\geq$200 mm) spawned earlier than smaller females. A lengthened spawning season seemed to be the result of individual females becoming ripe at different times during the spring and summer.

Age and Growth

The scale method had not been previously used for assessment of age and growth of warmouth in South Georgia. Necessary assumptions and criteria outlined by Lagler (1956) and Larimore (1957) for establishing the validity of the scale method were followed.

Annuli were characterized by the cutting over of circuli in the lateral posterior field. An annulus was considered true only when it could be followed from one lateral field through the anterior field to the posterior portion of the opposite lateral field. A break in the uniform arrangement of the circuli in the lateral and anterior fields was noted in the region of an annulus on scales with two or more annuli. The spacing of circuli in the lateral fields and the presence of dark bands in the posterior fields were used as supporting characteristics for defining a year mark. Some scales had checks which were characterized by cutting over in only one lateral field. These checks were considered false annuli.

Scales from 252 Suwannee River warmouth collected 27 April 1971 to 28 June 1973 and 112 Okefenokee Swamp warmouth collected 12 June 1972 and 24 May 1973 were examined for age and growth data. The observed range of Suwannee River warmouth at capture was 32 mm to 240 mm. The range was 47 mm to 236 mm for Okefenokee Swamp warmouth. Scales from 215 river fish (85%) and 85 swamp fish (76%) could be read. Data from the river and swamp were analyzed separately.

Annulus formation on warmouth scales generally occurred from March through April. Most scales from warmouth less than 90 mm in length possessed an annulus at the scale edge in mid-March. The frequency of a completed annular mark on scales from warmouth greater than 90 mm increased through April. All scales collected from warmouth in late April possessed a newly formed annulus. These data indicated slightly earlier annulus formation than reported by Larimore (1957) for Illinois warmouth.

Table 2. Average calculated total length in millimeters at the end of year for 215 warmouth collected from the Suwannee River 27 April 1971 to 28 June 1973.

Age Group	No. of Fish	Average TL at Capture	Observed Range at Capture	Average Calculated Total Length at End of Year								Calculated Range at End of Last Year
				1	2	3	4	5	6	7	8	
I	77	73	35-107	54								33- 79
II	54	84	58-136	50	69							47-107
III	29	121	62-162	54	77	104						59-139
IV	14	162	1$5-185	51	71	111	141					119-158
V	16	188	135-219	55	84	109	137	166				120-202
VI	19	198	171-240	52	76	101	124	154	179			138-231
VII	4	204	177-229	46	66	92	126	143	166	185		156-222
VIII	2	229	217-240	47	69	98	126	154	178	193	214	201-228
Average total length (mm)				52	73	105	132	158	177	189	214	
Average subtraction increment (mm)				52	22	28	27	28	24	18	22	
Average total length (inches)				2.0	2.9	4.1	5.2	6.2	7.0	7.4	8.4	

Table 3. Average calculated total length in millimeters at the end of year for 85 warmouth collected from the Okefenokee Swamp June 1972 to May 1973.

Age Group	No. of Fish	Average TL at Capture	Observed Range at Capture	Average Calculated Total Length at End of Year 1	2	3	4	5	6	7	Calculated Range at End of Last Year
I	30	70	47- 94	53							37- 81
II	6	109	85-137	55	82						60- 96
III	12	134	120-170	58	86	122					98-149
IV	16	171	121-204	56	97	126	149				106-196
V	17	195	118-236	52	90	138	164	184			124-231
VI	3	195	181-211	43	65	99	130	157	181		163-203
VII	1	197*	----	57	72	95	132	160	175	190	----
Average total length (mm)				54	90	127	154	179	179	190	
Average subtraction increment (mm)				54	36	36	25	21	22	15	
Average total length (inches)				2.1	3.5	5.0	6.1	7.0	7.0	7.5	

*not an average

The respective body-scale relationships determined for the Suwannee River and Okefenokee Swamp warmouth were Y=30+0.8305X (r=0.9836) and Y=24+0.9104X (r=0.9837). The intercepts of these equations were used with scale measurements to calculate lengths at previous annular formations.

The average calculated total lengths of Suwannee River warmouth in age groups I through VIII were 52, 73, 105, 132, 158, 177, 189, and 214 millimeters, respectively (Table 2). The average calculated total lengths of Okefenokee Swamp warmouth for age groups I through VII were 54, 90, 127, 154, 179, 179, and 190 millimeters, respectively (Table 3).

Warmouth of age groups I through III grew faster in the Okefenokee Swamp (Figure 2) than in the Suwannee River. Swamp fish were 16 mm to 22 mm longer than Suwannee River warmouth at ages II through V. Warmouth from the Okefenokee Swamp generally reached harvestable size (152 mm) at younger ages than did Suwannee River fish.

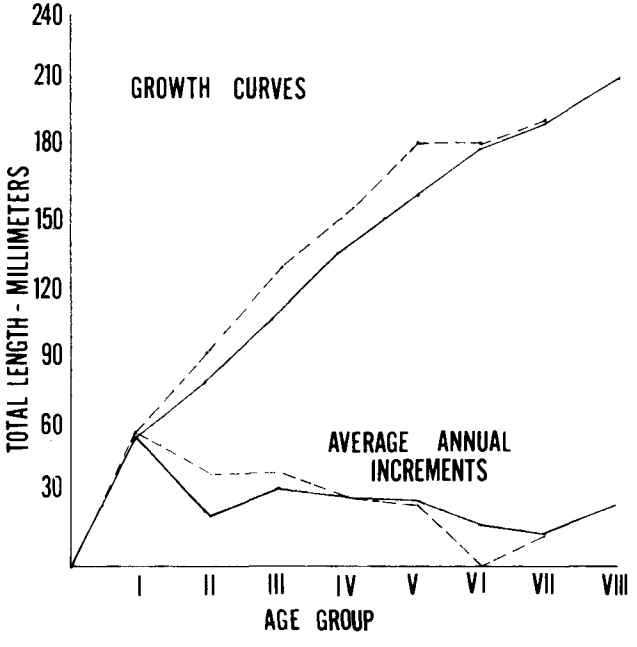

Figure 2. Calculated growth curves and average annual increments for 215 warmouth from the Suwannee River (solid line) and 85 warmouth from the Okefenokee Swamp (broken line).

Incremental growth of Suwannee River warmouth (Table 4) was relatively constant for the third through the fifth years of life. After the first year of life, incremental growth of Okefenokee Swamp warmouth (Table 5) was highest in the third year. Growth steadily decreased in the remaining years.

Growth rates were calculated for 8 year classes of warmouth from the Suwannee River (Table 4). The average back calculated lengths for river warmouth of the 1964, 1967, 1968 and 1971 year classes were greater in most years of life than the weighted average lengths for all fish of all year classes. The average calculated lengths of the 1967 and 1970 Okefenokee Swamp warmouth year classes (Table 5) were greater in most years of life than the weighted mean lengths for all fish.

Table 4. Average calculated total lengths and annual length increments in millimeters at end of indicated year of life for 215 Suwannee River warmouth collected 27 April 1971 to 28 June 1973.

Year Class	No. of Fish	Year of Life 1	2	3	4	5	6	7	8
1964	2	44	72	108	150	172	191	19'	201(1)*
		44	28	36	42	22	19	8	2
1965	5	53	78	93	123	144	169	182	228(1)
		53	25	15	30	21	25	13	46
1966	17	50	72	97	119	151	175		
		50	22	25	22	32	24		
1967	17	55	84	110	139	166	201(1)		
		55	29	26	29	27	35		
1968	17	54	75	112	141(14)				
		54	21	37	29				
1969	25	53	76	103					
		53	21	27					
1970	57	51	69(56)	90(6)					
		51	18	21					
1971	75	57							
		57							
Weighted avg. lengths		54	74	104	132	157	176	187	214
Weighted avg. growth increment		54	21	27	27	28	24	12	24

Table 5. Average calculated total lengths and annual length increments in millimeters at end of year of life for 85 Okefenokee Swamp warmouth collected 12 June 1972 and 24 May 1973.

Year Class	No. of Fish	Year of Life 1	2	3	4	5	6	7
1966	3	50	68	95	133	162	185	190
		50	18	27	38	29	23	5
1967	14	53	94	142	169	188	163(1)*	
		53	41	48	27	19	-25	
1968	18	53	92	126	149	159(4)		
		53	39	34	23	10		
1969	12	56	85	120	142(2)			
		56	29	35	22			
1970	6	62	93	124(2)				
		62	31	31				
1971	32	53	65(2)					
		53	12					
Weighted avg. lengths		54	89	127	155	179	180	190
Weighted avg. growth increments		54	34	38	26	19	11	5

*Number of fish in year of life

*Number of fish in year of life

Germann (1973) determined age classes of Suwannee River warmouth by use of length-frequency histograms. A comparison of his findings with the age groups determined by the scale method is shown in Figure 3. These data show the inconsistancies of the two methods for determining the age class structure of the Suwannee River warmouth population.

Suwannee River and Okefenokee Swamp warmouth grew at rates similar to those reported for populations in North Carolina Coastal Plain lakes (Louder, 1961), North Carolina coastal streams (Dickson, 1955) and Park Pond Slough (Larimore, 1957). However, the populations we studied generally grew slower than reported by investigators in Iowa (Lewis and English, 1949), Oklahoma (Jenkins, Elkin, and Finnell, 1955) and Illinois (Larimore, 1957).

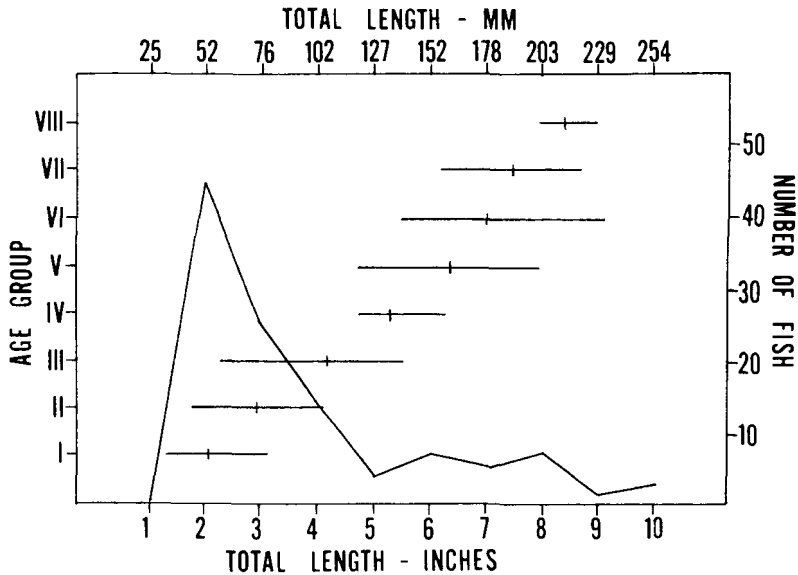

Figure 3. Calculated range and mean of total length at annulus formation of 215 Suwannee River warmouth collected April 1971 to June 1973 superimposed on the length-frequency distribution of 112 Suwannee River warmouth collected May 1972.

Length-Weight Relationships and Condition

The length-weight relationship and coefficient of condition (K) were determined for 443 Suwannee River warmouth collected July 1968 to June 1973 (Table 6) and 184 Okefenokee Swamp warmouth collected 5 March 1969 to 24 May 1973 (Table 7).

Table 6. The seasonal coefficient of condition (K) of 443 Suwannee River warmouth collected July 1968 to June 1973.

LENGTH CLASS INTERVAL (mm)	WINTER* NO.	WINTER* K	SPRING NO.	SPRING K	SUMMER NO.	SUMMER K	FALL NO.	FALL K	TOTAL NO.	AVG. TL (mm)	AVG. WT. (g)**	AVG. K
20- 29							13	1.39	13	27	0.3	1.39
30- 39			1	2.32			71	1.51	72	34	0.6	1.52
40- 49			7	1.59	1	1.65	33	1.58	41	45	1.4	1.59
50- 59			5	1.57	1	1.54	19	1.57	25	55	2.6	1.57
60- 69			15	1.82	4	1.62	15	1.80	34	65	4.9	1.79
70- 79			23	1.93	4	1.62	9	1.86	36	74	7.6	1.88
80- 89			6	1.91	11	1.85	7	1.81	24	85	11.4	1.86
90- 99			8	2.05	6	1.76	12	1.82	26	94	15.6	1.88
100-109			9	2.09	2	1.87	5	2.03	16	105	24.0	2.04
110-119			1	2.11	4	1.96	3	1.92	8	114	29.0	1.96
120-129			2	2.12	3	1.86	3	1.90	8	124	38.0	1.94
130-139			2	2.36	1	2.10	4	2.06	7	134	52.0	2.15
140-149			2	2.16	3	2.08	1	2.17	6	146	66.0	2.12
150-159			1	2.56	2	2.34	5	2.16	8	154	82.0	2.26
160-169			6	2.28	4	2.32	2	1.91	12	164	98.0	2.23
170-179	1	2.14	2	2.50	2	2.51	13	2.12	18	174	116.0	2.21
180-189	1	2.34	4	2.41	4	2.34	8	2.22	17	184	144.0	2.30
190-199			5	2.45	4	2.45	8	2.28	17	194	172.0	2.37
200-209			10	2.48	1	2.79	4	2.28	15	204	207.0	2.45
210-219			6	2.70	4	2.58	5	2.25	15	215	250.0	2.52
220-229	1	2.53	13	2.47			2	2.47	16	224	278.0	2.47
230-239			2	2.14	1	2.81			3	232	295.0	2.36
240-249			5	2.81			1	2.52	6	243	395.0	2.76

*Winter=December, January and February.
**Fish larger than 100 mm were weighed to the nearest gram.

The length-weight relationships of Suwannee River and Okefenokee Swamp warmouth were expressed by the respective equations, log W=-5.4996+3.3726 log L (r=0.9556) and log W=-5.2395+3.2736 log L (r=0.9878) (Figure 4). Analysis of covariance (Snedecor and Cochran, 1967) indicated that the regressions were not significantly different ($P > .05$). Both length-weight regression slopes were higher than reported for warmouth in Illinois (Larimore, 1957), Oklahoma (Jenkins, Elkin, and Finnell, 1955) and Alabama (Swingle, 1965). This suggested that Suwannee River and Okefenokee Swamp warmouth became more plump with respect to body length as they grew when compared with warmouth from those areas.

The condition of Suwannee River and Okefenokee Swamp warmouth 20 mm to 150 mm was greatest in the spring months. Warmouth 160 mm and greater from both locations were generally more plump in the summer months. Conditions of larger Suwannee River warmouth declined during the fall months as was reported by Larimore (1957). Typically low fall water levels in the Suwannee River may contribute to this decline in condition of warmouth.

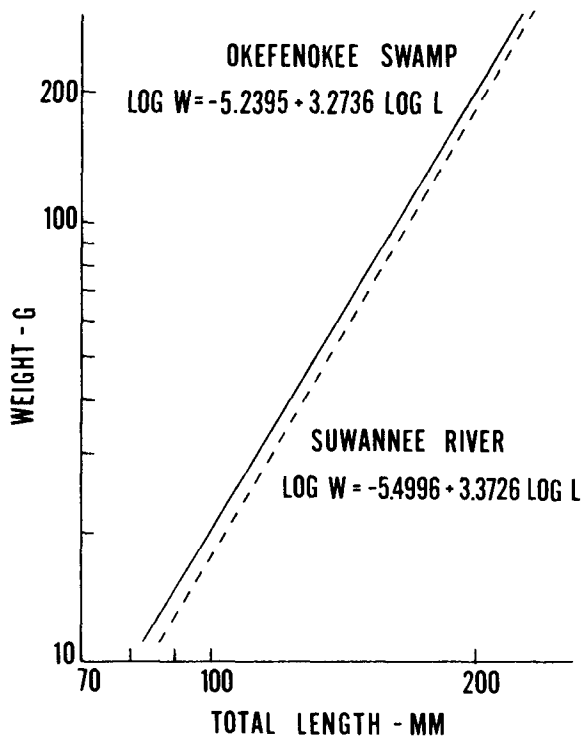

Figure 4. Length-weight relationships for 443 warmouth from the Suwannee River collected July 1968 to June 1973 (broken line) and 184 warmouth from the Okefenokee Swamp collected March 1969 to May 1973 (solid line).

Table 7. The seasonal coefficient of condition (K) of 184 Okefenokee Swamp warmouth from March 1969 to May 1973.

CLASS INTERVAL (mm)	WINTER* NO.	K	SPRING NO.	K	SUMMER NO.	K	FALL NO.	K	TOTAL NO.	AVG. TL (mm)	AVG. WT. (g)**	AVG. K
40- 49					1	1.93			1	47	2.0	1.93
50- 59					7	1.76			7	55	2.8	1.76
60- 69					7	1.66			7	64	4.3	1.66
70- 79					8	1.86			8	75	7.8	1.86
80- 89			1	2.13	3	1.85			4	86	12.1	1.92
90- 99					7	2.04			7	92	15.8	2.04
100-109			2	2.30					2	106	26.0	2.30
110-119			4	2.24	1	2.14			5	113	32.0	2.22
120-129			2	2.42	2	2.23			4	123	43.0	2.32
130-139			2	1.60	6	2.18			8	134	49.0	2.04
140-149					1	2.25			1	145	69.0	2.25
150-159			3	2.35	7	2.40			10	155	89.0	2.39
160-169			3	2.89	12	2.45			15	164	112.0	2.54
170-179	1	1.88	4	2.50	8	2.53			13	174	133.0	2.51
180-189			8	2.49	7	2.63			15	185	160.0	2.53
190-199			7	2.64	6	2.75			13	194	195.0	2.67
200-209			16	2.52					16	203	209.0	2.50
210-219			14	2.57					14	214	252.0	2.57
220-229			23	2.42					23	225	276.0	2.42
230-239	1	2.25	4	2.31					5	233	302.0	2.31
240-249			5	2.77					5	244	402.0	2.77
250-259			1	3.06					1	256	512.0	3.06

*Winter=December, January and February.
**Fish larger than 100 mm were weighed to the nearest gram.

Food Habits

Between 19 July 1968 and 28 June 1973, 348 Suwannee River warmouth ranging from 27 to 228 mm in length and from 0.1 g to 338 g in weight were collected for food habits determinations. The stomach contents were analyzed by the frequency of occurrence method. Fish taken for food habits were generally collected along the river bank around the root bases of tupelo and cypress trees.

Fish were divided into four length intervals (25 mm to 76 mm, 77 mm to 127 mm, 128 mm to 178 mm and 179 mm to 229 mm) to facilitate comparisons. Food items were found in 54% of the 25-76 mm length class, 60% of the 77-127 mm class, 49% of the 128-178 mm class and 49% of the 179-229 mm length class. There was a tendency for the percentage of stomachs containing food to decline in the larger length classes.

In the 25 mm to 76 mm length class, river warmouth (Table 8), fed mainly on insects. The most frequently encountered insects were larval forms of Odonata and Diptera. Fish were found in 14% of the stomachs examined. Four species of fish (mosquitofish, *Gambusia affinis*; swamp darter, *Estheostoma fusiforme*; pirate perch, *Aphredoderus sayanus*; and pygmy sunfish, *Elassoma* spp.) were identified in the stomachs of 11 warmouth. Crustaceans were found in 8% of the stomachs of this size class.

Table 8. The number of stomachs containing items and frequency of occurrence (FO) of food items for four length classes of warmouth collected on the Suwannee River from 19 July 1968 to 28 June 1973.

	Length Class (mm)									
	25-76		77-127		128-178		179-229		ALL	
Food Item	NO.	(FO)	NO.	(FO)	NO.	(FO)	NO.	(FO)	NO.	(FO)
Crustacea	6	(08)	15	(31)	10	(43)	26	(74)	57	(31)
Copepoda	1	(01)							1	(T)*
Ostracoda	1	(01)							1	(T)
Isopoda										
Decopoda	4	(05)	15	(31)					19	(10)
Crayfish	2	(03)	7	(15)	10	(43)	26	(74)	45	(24)
Freshwater Shrimp	2	(02)	8	(17)					10	(05)
Insecta	63	(79)	35	(73)	8	(35)	10	(29)	116	(62)
Ephemeroptera	2	(02)							2	(01)
Odonata	19	(24)	14	(29)	4	(17)	7	(20)	44	(24)
Hemiptera	15	(19)	3	(06)					18	(10)
Coleoptera	5	(06)	12	(25)	1	(04)	1	(03)	19	(10)
Trichoptera	13	(16)	13	(27)	2	(09)	1	(03)	29	(16)
Diptera	18	(22)	2	(04)	1	(04)			21	(11)
Unidentified	7	(09)	1	(02)	1	(04)	1	(03)	11	(06)
Osteichthyes	11	(14)	8	(17)	8	(35)	5	(14)	32	(17)
Mosquitofish	2	(03)					1	(03)	3	(02)
Swamp Darter	1	(01)							1	(T)
Pirate Perch	1	(01)	2	(04)			1	(03)	4	(02)
Pygmy Sunfish	1	(01)							1	(T)
Pickerel					1	(04)	1	(03)	2	(01)
Bluespotted Sunfish					1	(04)			1	(T)
Bullhead					1	(04)			1	(T)
Unidentified	6	(08)	6	(12)	5	(22)	2	(06)	19	(10)
Detritus	5	(06)	1	(02)			1	(03)	7	(04)
No. stomachs containing food	80		48		23		35		186	
Percent of stomachs containing food	54		60		49		49		53	
Total number of stomachs examined	149		80		47		72		348	

*Trace (01)

Insects were the main food items found in Suwannee River warmouth 77 mm to 127 mm. They occurred in 73% of the stomachs of this size class. The most frequently encountered insects were odonates, coleopterans and trichopterans. Crustaceans occurred in 31% of the stomachs. Crayfish were found in 7 stomachs and freshwater shrimp were found in 8 stomachs. The frequency of occurrence of fish items increased to 17%. The only identifiable fish species consumed was pirate perch.

Crustacea was the main food group in the 128 mm to 178 mm length interval. Crayfish was the most common item found in the warmouth stomachs. Insect occurrence decreased, while fish items increased in occurrence. Three species (pickerel, *Esox* spp.; bluespotted sunfish, *Enneacanthus gloriosus*; and bullhead, *Ictalurus* sp.) were identified from 8 stomachs.

Crustaceans, exclusively crayfish, were the main food items of river warmouth 179 mm to 229 mm. Crayfish were found in 74% of the stomachs. Insects, primarily odonates, were found in 29% of the fish in this length interval. Fish occurred in 14% of the stomachs examined.

Seasonal analysis of Suwannee River warmouth food habits showed that crustaceans occurred more frequently in warmouth stomachs during December to May and less frequently during June to November (Table 9). Insects were most frequently encountered in warmouth stomachs during June to November. Fish were most common during March to May.

Table 9. The number of stomachs containing items and frequency of occurrence of major food groups in the stomachs of warmouth collected during each season on the Suwannee River from 22 February 1968 to June 1973.

	HIGH WATER				LOW WATER			
	Dec.—Feb.		March—May		June—Aug.		Sept.—Nov.	
Food Item	NO.	FO	NO.	FO	NO.	FO	NO.	FO
Crustacea	2	(75)	17	(63)	28	(49)	11	(11)
Insecta	1	(25)	4	(15)	34	(60)	77	(77)
Osteichthyes	-	--	8	(30)	7	(12)	17	(17)
No. of stomachs containing food	2		27		47		100	
No. of stomachs examined	3		51		95		199	
Percent of stomachs containing food	67		53		60		50	

The highest occurrence of crustaceans in warmouth stomachs generally corresponded with the period of river inundation. Higher occurrences of fish in the stomachs were probably due to spring spawns of the fish species which were identified from warmouth stomachs and to crowding by normally receding water levels in the spring.

Of the 104 Okefenokee Swamp warmouth stomachs examined between 30 May 1969 and 24 May 1973, 63% contained food items (Table 10). In the 25 mm to 76 mm interval, insects were the principal food items in stomachs of swamp warmouth. The more common insects found were dipteran and odonate larvae. Crustaceans (freshwater shrimp) were second in frequency of occurrence and were found in 27% of the stomachs. No stomachs collected contained fish.

The occurrence of food items was similar in the 77 mm to 127 mm and 128 mm to 178 mm intervals. Insects were the main food items of swamp warmouth in both size classes. Odonate larvae and coleopterans were the main insects consumed. In both length classes crustaceans occurred in 45% of the stomachs. The frequency of occurrence of fish increased from 9% in the 77 mm to 127 mm size class to 27% in the 128 mm to 178 mm interval. Mosquitofish, sunfish (*Lepomis* spp.) and bluespotted sunfish were identified in the stomachs.

Table 10. The number of stomachs containing items and frequency of occurrence (FO) of food items for four length classes of warmouth collected from the Okefenokee Swamp from 30 May 1969 to 24 May 1973.

	Length Class (mm)									
	25-76		77-127		128-178		179-229		ALL	
Food Item	NO.	(FO)	NO.	(FO)	NO.	(FO)	NO.	(FO)	NO.	(FO)
Crustacea	3	(27)	5	(45)	10	(45)	11	(50)	29	(44)
Copepoda										
Ostracoda										
Isopoda			1	(09)	1	(04)			2	(03)
Decopoda					9	(41)			9	(14)
Crayfish			4	(36)	2	(09)	11	(50)	17	(26)
Freshwater Shrimp	3	(27)							3	(05)
Insecta	9	(82)	7	(64)	13	(59)	10	(45)	39	(59)
Ephemeroptera	1	(09)							1	(02)
Odonata	3	(27)	5	(45)	7	(32)	7	(32)	22	(33)
Hemiptera					2	(09)			2	(93)
Coleoptera					4	(18)	2	(09)	6	(09)
Trichoptera					1	(04)	1	(04)	2	(03)
Diptera	5	(45)	2	(18)	1	(04)	2	(09)	10	(15)
Unidentified	1	(09)							1	(02)
Osteichthyes	0	(0)	1	(09)	6	(27)	3	(14)	10	(15)
Mosquitofish			1	(09)			1	(04)	2	(03)
Swamp Darter										
Pirate Perch										
Pygmy Sunfish										
Pickerel										
Bluespotted Sunfish					1	(04)			1	(02)
Sunfish					2	(09)	1	(04)	3	(05)
Unidentified					3	(14)	1	(04)	4	(06)
Detritus	1	(09)			2	(09)	2	(09)	5	(08)
No. of stomachs containing food	11		11		22		22		66	
Percent of stomachs containing food	50		55		69		73		63	
Total number of stomachs examined	22		20		32		30		104	

Crustaceans (all crayfish) were the main food items of 179 mm to 229 mm Okefenokee Swamp warmouth. Insects were second in frequency of occurrence. Odonates comprised 32% of the insect group. Fish decreased to 14% frequency of occurrence.

The frequency of occurrence of the major food groups (crustaceans, insects and fish) in the stomachs of Suwannee River and Okefenokee Swamp warmouth was generally comparable. Okefenokee Swamp warmouth relied more on crustaceans and less on fish than did Suwannee River warmouth. Suwannee River warmouth consumed a wider variety of fish species. Insect occurrence was similar between locations.

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