# AGE, GROWTH, CONDITION AND FOOD HABITS OF LARGEMOUTH BASS COLLECTED FROM A LOUISIANA COASTAL FRESHWATER MARSH

*by*
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## ABSTRACT

*A total of 710 largemouth bass was collected from a 4047 ha coastal freshwater marsh in Southwestern Louisiana. Seven age-groups (0-VII) were present in the marsh. Annual increments were smaller for the first 3 years of life when compared to other Louisiana areas, but greater during the remainder of life. Condition factors were comparable to those obtained by other Louisiana authors. Food habits of young-of-the-year bass > 95 mm in length were not different from age groups I and II. Fish and adult odonates were the principal forage for bass in the summer. During the winter, stomachs of bass from age groups 0-II contained principally fish and freshwater shrimp whereas those from age groups ≥ III contained predominantly fish.*

Considerable biological data pertaining to largemouth bass (*Micropterus salmoides*) have been collected in lakes, ponds and reservoirs; however, bass populations in freshwater marshes have not been studied to any extent. This observation is especially surprising for Louisiana, where coastal freshwater marshes are extensive, comprising 482,939 ha. Centrarchids are important members of the marsh ecosystem as indicated by a study conducted in the recent delta marsh of the Mississippi River (Carver 1965). Centrarchids ranked first in poundage and second in abundance of the fishes collected.

Studies of march ecosystems are becoming increasingly important. Although marshes are expansive in Louisiana they are being lost because of man-caused salt intrusion, conversion to agricultural land and pollution. The construction of canals for flood control, navigation and pipelines have had considerable influences on the marsh (Chabreck 1970).

The Big Burn marsh in Southwestern Louisiana was chosen as a study area because of accessibility and productivity as a bass fishing area. Although the importance of marshes for waterfowl and fur-bearing animals in well documented, studies concerning the fishery potential of these freshwater habitats are not well known. For this reason we initiated a study of bass populations in a coastal freshwater marsh.

## STUDY AREA

All bass used in this study were collected from sampling stations located within a 4047 ha freshwater marsh commonly known as the Big Burn. This marsh is located approximately 24 km south-southeast of Lake Charles, Louisiana, and 12.9 km north of Grand Chenier, Louisiana, in Cameron Parish.

The Big Burn marsh received its name following the 1924-25 drought. During the drought, extensive peat burns scoured the marsh 1.5 to 1.8 meters to the clay subsoil (Lynch 1941); O'Neill 1949). Since the 1924-25 burn, many of the ponds created by the peat burn havę reverted back to climax vegetation.

The freshwater vegetative types are chiefly those of the Chenier Plain fresh marsh as described by Chabreck (1970). Casual observation revealed *Sagittaria lancifolia, Ottelia alismoides, Alternanthera philoxeroides, Nelumbo lutea,* and *Cephalanthus occidentalis* were the most abundant emergent species. The relative abundance of plant types varies within the study area. Open water areas are heavily vegetated with submergent (*Utricularia* sp., *Ceratophyllum demersum, Cabomba caroliniana,* and *Chara* sp.) and short emergent plants. Shallower marsh areas, near Little Chenier Ridge, are vegetated with

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stands of *Scirpus californicus, Typha* sp., *Phragmites communis,* and *Cephalanthus occidentalis.*

Man-made levees along Superior Oil Company Canal, Intracoastal Waterway, and Louisiana Highway 27, as well as the naturally formed Little Chenier, are the only areas above water level and are dominated by *Salix nigra, Phragmites communis,* and *Baccharis halimifolia.* Approximately 30-40% of the marsh consists of ponds and watery flats interconnected by mudboat trails.

This marsh is slightly alkaline, with pH ranging from 7.0 to 8.2 Secchi disc readings indicated turbidity is influenced directly by the Intracoastal Waterway. During periods of low precipitation, turbid water from the waterway moves into the marsh. Clear water (secchi disc visible on marsh bottom) is present during periods of abundant rainfall in most areas of the Big Burn marsh. Salinity readings were taken during the study and ranged from 0.8 to 1.0 parts per thousand. Heat transfer is extremely rapid due to the shallow water (15 to 61 cm), thus water temperatures usually coincide with air temperatures. Daily mean water temperatures ranged from 28 to 37 C from June to September, and 15 to 24 C from October to December.

## METHODS

A total of 710 fish were collected from 22 November, 1969, through 12 December, 1970, with a 220-volt ac generator equipped with boom electrodes, and with hook and line. Not all areas were sampled during each sampling period because of inaccessibility. Superior Oil Company canal was sampled most frequently in order to avoid disturbing hunters, trappers, and fishermen utilizing the marsh.

The captured fish were placed on ice, and taken to the laboratory. Total and standard lengths were measured to the nearest millimeter and weight to the nearest gram. Scale samples were taken from the area posterior to the depressed pectoral fin and below the lateral line and stored in coin envelopes.

Scales were prepared according to the procedures of Arnold (1951) and Smith (1954). Scale impressions were magnified 20 times with a microprojector. Each slide was examined on two separate occasions. Differences in annulus readings were resolved by closer examinations. Scales showing signs of regeneration were not used.

The total length of fish at each annulus was estimated with a nomograph corrected for scale formation (Carlander and Smith 1944). The linear relationship of total body length and scale radius (x20) was estimated using least squares regression.

Stomachs were removed upon returning to the laboratory and stored in 10% formalin. A sample of 278 randomly selected stomachs was used for food habit analysis. Stomach contents were identified to the lowest possible taxonomic level. Order of first ranking (prey organisms comprising greatest volume of stomach contents) and frequency of occurrence was used for comparative purposes.

The study period was divided into two time periods based on water temperatures. Summer samples were collected by angling; winter samples were obtained with electrofishing gear. Young-of-the-year bass were not collected during the summer due to gear selectivity.

## RESULTS & DISCUSSION

*Age and Growth*

Previous Louisiana studies indicate the scale method is valid for determining the age of Louisiana largemouth bass (Brashier 1965, Carver 1965, Muncy 1965, Shay and Ward 1969). Annual increment data for individual age-groups indicate one annulus is formed each year during the spring months. The actual time of annulus formation could not be determined.

Linear, cubic and quadratic relationships of total length in millimeters to scale length (x20) were calculated. Linear regression explained 84.5% of the variability, whereas quadratic and cubic relationships explained 87.22 and 87.54% of the variability respectively. Because these two relationships resulted in little improvement over the linear relationship, linear regression was used to explain the growth histories of Big Burn bass

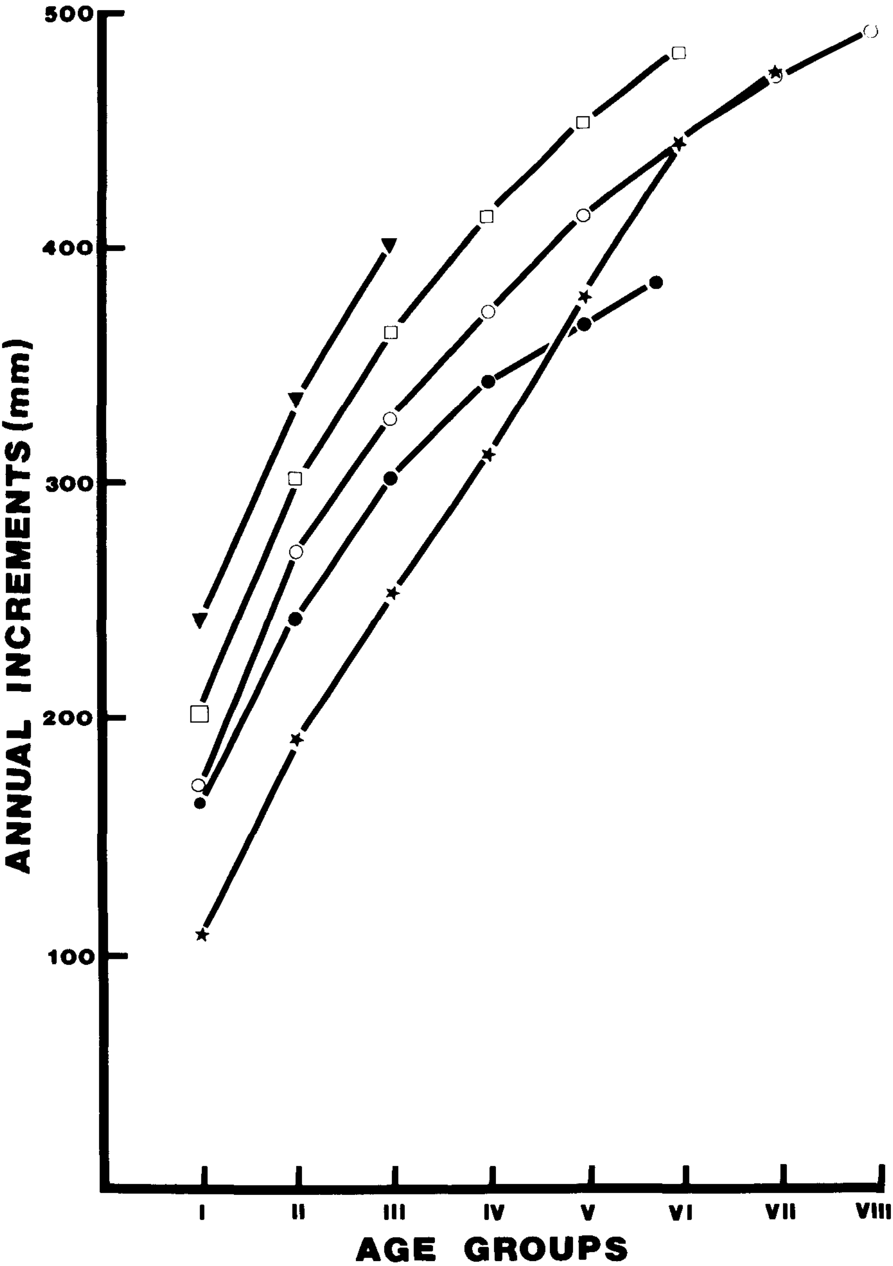


Figure 1. Annual increments of largemouth bass collected from Louisiana waters: {▲ - Mississippi Delta (Carver, 1965) □ - Old River (Brashier 1965), ○ - False River (Brashier 1965), ● - Darbonne Pit (Shay and Ward, 1968) and ★ -present study}.

(scale radius x 20 = 13.6+ 0.38 total length). The intercept was used to correct for the body length attained before scales were formed.

Seven age-groups were present; however, age-group seven contained only two specimens. The second, third, and first year age-groups were the largest with 245, 162, and 80 members respectively (Table 1). These numbers may not necessarily be an indication of relative abundance of year classes due to the selectivity of the sampling gear. Young-of-the-year fish were represented only in electro-fishing collections.

Mean weighted total lengths obtained from Big Burn bass were compared with bass from other Louisiana waters (Figure 1). The overall growth of the Big Burn bass was slower than in other areas until they reached age V. Annual increments for the first two years of growth were also smaller. Big Burn bass showed greater annual increments from age three through the seventh year.

Length-weight relationships were calculated for all bass collected. The relationship was $W = 0.745 \times 10^{-5} \times L^{3.119}$. Condition factors were determined using the cubic relationship. Fish were separated according to age class and time of collection (Table 2). The mean $K_{TL}$ value for the entire collection was 2.72. Condition values varied with season and were generally lower in February increasing during the spring and summer months. The lowest values were recorded in November (Table 2). The November sample contained less than five fish and may not be an indication of the true condition factor. As expected, condition factors for older fish were generally greater than those of younger fish.

Condition factors for Big Burn bass were compared to those of Louisiana freshwaters. They were similar in condition to False River and Old River bass (Brashier 1965), more robust than Darbonne Pit bass (Shay and Ward 1969) and not as robust as Delta Wildlife Refuge bass (Carver 1965). Condition factors for Big Burn bass were higher than most reports cited by Carlander (1950).

Table 1. Calculated mean weighted total length of largemouth bass collected from the Big Burn marsh, Cameron Parish, Louisiana, 1969 through 1970.

| *Year Class* | *Age Group* | *No. of Fish* | *Total Length (millimeters) at Annulus* 1 | 2 | 3 | 4 | 5 | 6 | 7 | *Mean Total Length at Capture* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 0 | 48 | | | | | | | | 126.5 |
| 1969 | 0 | 34 | | | | | | | | 125.1 |
| 1969 | I | 80 | 105.8 | | | | | | | 212.1 |
| 1968 | | 15 | 119.2 | | | | | | | 191.9 |
| 1968 | II | 183 | 100.9 | 186.2 | | | | | | 243.7 |
| 1967 | | 62 | 111.9 | 194.3 | | | | | | 236.0 |
| 1967 | III | 141 | 114.5 | 187.8 | 245.8 | | | | | 279.0 |
| 1966 | | 21 | 98.5 | 191.3 | 254.0 | | | | | 284.1 |
| 1966 | IV | 51 | 113.9 | 204.3 | 259.2 | 298.5 | | | | 325.9 |
| 1965 | | 8 | 126.9 | 225.4 | 290.1 | 335.9 | | | | 367.6 |
| 1965 | V | 17 | 120.4 | 221.0 | 277.1 | 311.3 | 351.1 | | | 376.8 |
| 1964 | | 6 | 150.2 | 260.0 | 316.3 | 362.0 | 416.2 | | | 443.5 |
| 1964 | VI | 2 | 123.5 | 196.0 | 268.5 | 325.5 | 381.0 | 418.5 | | 448.0 |
| 1963 | | 4 | 127.0 | 238.0 | 313.3 | 384.5 | 432.8 | 470.8 | | 498.0 |
| 1963 | VII | 2 | 131.5 | 237.5 | 294.0 | 346.5 | 392.5 | 436.5 | 474.0 | 522.0 |
| Mean Weighted Total Length | | | 109.2 | 193.1 | 256.0 | 314.0 | 378.8* | 449.2* | 474.0* | |
| Mean Weighted Annual Increment | | | 109.2 | 83.9 | 62.9 | 58.0 | 64.8 | 70.4* | 24.8* | |

*Values affected by large fish of the 1963 and 1964 year classes.

Table 2. Condition index (K) values for largemouth bass collected from the Big Burn marsh, Cameron Parish, Louisiana, 1970.

| *Month* | *Age Groups* 0 | I | II | III | IV | V | VI | VII | *Mean Weighted Monthly K Values* |
|---|---|---|---|---|---|---|---|---|---|
| February | 2.31* | 2.45* | 2.53 | 2.55 | 2.82* | 2.97* | 2.68* | — | 2.58 |
| June | — | 2.82 | 2.78 | 2.74 | 2.63* | 2.77* | — | — | 2.76 |
| July | — | 2.76 | 2.78 | 2.79 | 2.74 | 2.93 | — | — | 2.78 |
| August | — | 2.65 | 2.72 | 2.65 | 2.64 | 2.77 | 2.69* | 2.83* | 2.70 |
| September | — | 2.86* | 3.00 | 2.67 | 2.63 | 2.90* | — | — | 2.81 |
| October | 2.46 | — | 2.87 | 2.67* | 2.69* | — | — | — | 2.67 |
| November | 2.41* | 2.47* | 2.29* | 2.51* | — | 2.62* | — | — | 2.43 |
| December | 2.59 | 2.44 | 2.43 | 2.57* | 2.98 | 2.87* | 3.05* | 2.90* | 2.62 |
| Average K Values | 2.56 | 2.70 | 2.76 | 2.70 | 2.76 | 2.86 | 2.76 | 2.87 | |
| Mean Weighted K Value for the Entire Sample | | | | | | | | | 2.72 |

*Values represented by less than 5 fish.

*Food Habits*

Initial examination of stomach contents revealed that food organisms could be pooled into six major categories; fish, freshwater shrimp (*Palaemonetes* sp.), hemipterans, odonate naiads, odonate adults, and miscellaneous (Table 3). Because no fish prey species was predominant and a large percentage of the fish were unidentifiable, all fish were pooled for statistical analysis. Pooled data were arranged in contingency tables and differences with respect to age groups, seasonal periodicity, and diurnal periodicity were tested statistically with chi-square analysis. Significance in all tests was based on $P<0.05$.

Significant influence of age upon the occurrence of specific food items occurred at age III (≥ 267 mm). Prior to age III significant differences did not occur. Thus, young-of-the-year bass compete for food with age I and II fish. However, bass < 95 mm were not examined for food habits. No significant differences were found in the food items of bass age III and older. Significant differences during the summer were caused by consumption of freshwater shrimp, by bass < 267 mm (Table 4). A shift to a piscivorous diet by age III bass, caused significant differences during the winter.

The consumption of adult odonates, primarily *Celithemis eponina,* during the summer and not in the winter caused significant seasonal feeding periodicity in both groupings (Table 5). This dragonfly is present year round, with ovipositing occurring chiefly from June to September (Westfall, personal communication[1]). Adults tap the surface several times with their abdomens while ovipositing, usually near other dragonflies. This surface striking combined with the shallowness of the Big Burn probably trigger feeding responses in largemouth bass. Such a high percentage occurrence of adult odonates for all age groups has not heretofore been reported. Chew (1974), Goodson (1965), Mullan and Applegate (1970), and Pasch (1974) reported largemouth bass shift almost exclusively to a diet of fish and crawfish at approximately 100 to 200 mm TL.

Fish and adult odonates were the principal prey, both in percent occurrence and percent first ranking, for 53 bass < 267 mm containing food during the summer (Figure 2). Although freshwater shrimp were present in 30% (16) of the stomachs, it was the principal prey in only 13% (7) of the fish. During the winter, stomachs contained principally fish and shrimp, with hemipterans and odonate naiads being of secondary importance. The diet of age group III and older bass shifted from fish and adult odonates during the summer to primarily fish in the winter. Adult odonates were present in 52% (28) of the 54 III+ bass

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Table 4. Chi-square analysis of difference of frequency of occurrence of food items in largemouth bass due to age.

*Observed frequency of occurrence (Expected frequency of occurrence)*

| | *Season* | | | |
|---|---|---|---|---|
| | *Summer* | | *Winter* | |
| *Food Item* | *I, II* | *≥III* | *0 I, II* | *≥III* |
| Fish | 23(24.3) | 22(20.7) | 18(25.4) | 16(8.6) |
| *Palaemonetes* sp. | 16( 9.7) | 2( 8.3) | 19(14.9) | 1(5.1) |
| Hemipterans | 2( 3.2) | 4( 2.8) | 10( 7.5) | (2.5) |
| Odonate Adults | 22(27.0) | 28(23.0) | | |
| Odonate Naiads | | | 8( 6.7) | 1(2.3) |
| Miscellaneous | 10( 8.7) | 6( 7.3) | 4( 4.5) | 2(1.5) |
| chi-square ($X^2$) | 12.4[a] | | 17.5[a] | |

[a]significant at $p < 0.05$

Table 5. Chi-square analysis of difference in seasonal occurrence of food items for two age groupings of largemouth bass.

*Observed frequency of occurrence (expected frequency of occurrence).*

| | *Age Group* | | | |
|---|---|---|---|---|
| | *0, I, II* | | *≥III* | |
| *Food Item* | *Summer* | *Winter* | *Summer* | *Winter* |
| Fish | 23(22.7) | 18(18.3) | 22(28.7) | 16(9.3) |
| *Palaemonetes* sp. | 16(19.4) | 19(15.6) | | |
| Hemipterans | 2( 6.6) | 10( 5.4) | | |
| Odonate Adults | 22(12.2) | ( 9.8) | 28(21.2) | (6.8) |
| Odonate Naiads | ( 4.4) | 8( 3.6) | | |
| Miscellaneous | 10( 7.7) | 4( 6.3) | 12[a](12.1) | 4[a](3.9) |
| chi-square ($X^2$) | 37.4[b] | | 15.5[b] | |

[a] includes *Palaemonetes* sp., hemipterans, adult odonates.
[b] significant at $P < 0.05$.

A larger percentage of the stomachs were empty during the winter (54%) after the bass had switched to fish forage. Zweiacker and Summerfelt (1973) used 56% as an average to evaluate forage conditions for age group I+ largemouth bass. The number of empty stomachs occurring in III+ fish in our study indicates an adequate fish forage base during the winter.

Mean total lengths of Big Burn bass age I were at least 35% less than bass from other Louisiana habitats, indicating a possible deficiency in adequate forage for optimum growth. Although an insect-plankton diet can produce bass to approximately 136 gm (220 mm TL), consumption of larger forage items such as fish and crawfish are needed for rapid growth (Swingle and Swingle 1967). Food habit analysis revealed that bass in the Big Burn did not intensively utilize fish as forage until Age III, indicating either a lack of small forage fish or excessive submerged vegetation impeding predation. Growth increments also reflect this, for after Age III the annual growth increment is greater in the Big Burn than other Louisiana waters compared.

Table 3. Percent occurrence (%0) and percent first ranking (% 1st) of food items in largemouth bass stomachs.

| *Age Class* | *≤ II* | | *≥ III* | |
|---|---|---|---|---|
| *Number examined* | *148* | | *130* | |
| *Number with food* | *102* | | *73* | |
| *Taxon* | *% 0* | *% 1st* | *% 0* | *% 1st* |
| Amphipoda | 3 | 2 | | |
| Decapoda Astacidae | 4 | 3 | 5 | 5 |
| *Palaemonetes* sp. | 34 | 21 | 4 | 3 |
| Anisoptera Libelluidae (naiad) | 8 | 6 | 1 | 1 |
| *Celithemis eponina* (adult) | 16 | 13 | 33 | 30 |
| *Anax* sp. (adult) | | | 1 | 1 |
| Zygoptera *Lestes* sp. (nymph) | 2 | 1 | | |
| *Lestes* sp. (adult) | 6 | 6 | 5 | 4 |
| Hemiptera *Rheumatobates* sp. | 2 | 2 | 1 | |
| Belostomatidae | | | 1 | 1 |
| Corixidae | 9 | 8 | | |
| Naucoridae | 2 | | 3 | 1 |
| Megaloptera (adult) | | | 1 | 1 |
| Coleoptera | | | 3 | 3 |
| Diptera Tendipedidae (pupae) | 1 | | | |
| Orthropoda Tettigoniidae | 3 | 3 | | |
| Anura | | | 3 | 3 |
| Osteicthyes *Gambusia affinis* | 2 | 1 | | |
| *Heterandria formosa* | 3 | 3 | | |
| *Dorosoma cepedianum* | | | 1 | 1 |
| *Etheostoma* sp. | 1 | 1 | | |
| *Lepomis macrochirus* | 1 | 1 | 3 | 3 |
| *Lepomis gulosus* | | | 1 | 1 |
| *Micropterus salmoides* | | | 4 | 3 |
| Unidentified Centrarchidae | 4 | 4 | 5 | 5 |
| Catostomidae | 1 | 1 | 1 | 1 |
| Syngnathidae | 1 | 1 | | |
| Unidentified | 30 | 25 | 37 | 34 |

containing food during the summer; fish were present in 84% (16) of the 19 III+ bass during the winter.

We have maintained that diet differences were due to season and age; however, gear selectivity and location of sample sites might have caused these shifts. During the summer, fish were collected primarily with hook and line in shallow marsh areas, whereas during the winter, fish were collected from the deeper Superior canal with electro-fishing gear. These habitats are quite different physically, which might influence the type of prey available to bass, however, younger bass from both sites have very similar food habits (Figure 2). The only major difference was the consumption of odonate adults. The percentage of fish in stomachs of the younger bass (0, I, II) was similar indicating that the type of prey available to bass < 267 mm was similar in the two areas. There are large differences in the frequency of occurrence of fish in the bass of age group III and older from the two collection areas. Larger bass in the canal utilized fish to a greater extent than those in the marsh. The most likely reasons for these differences were: (1) the larger fish were unavailable to smaller bass but were vulnerable to larger bass, (2) odonate adults were not available in the canal, (3) larger bass within the marsh consume invertebrates and fish, whereas larger fish from the canal consume primarily fish.

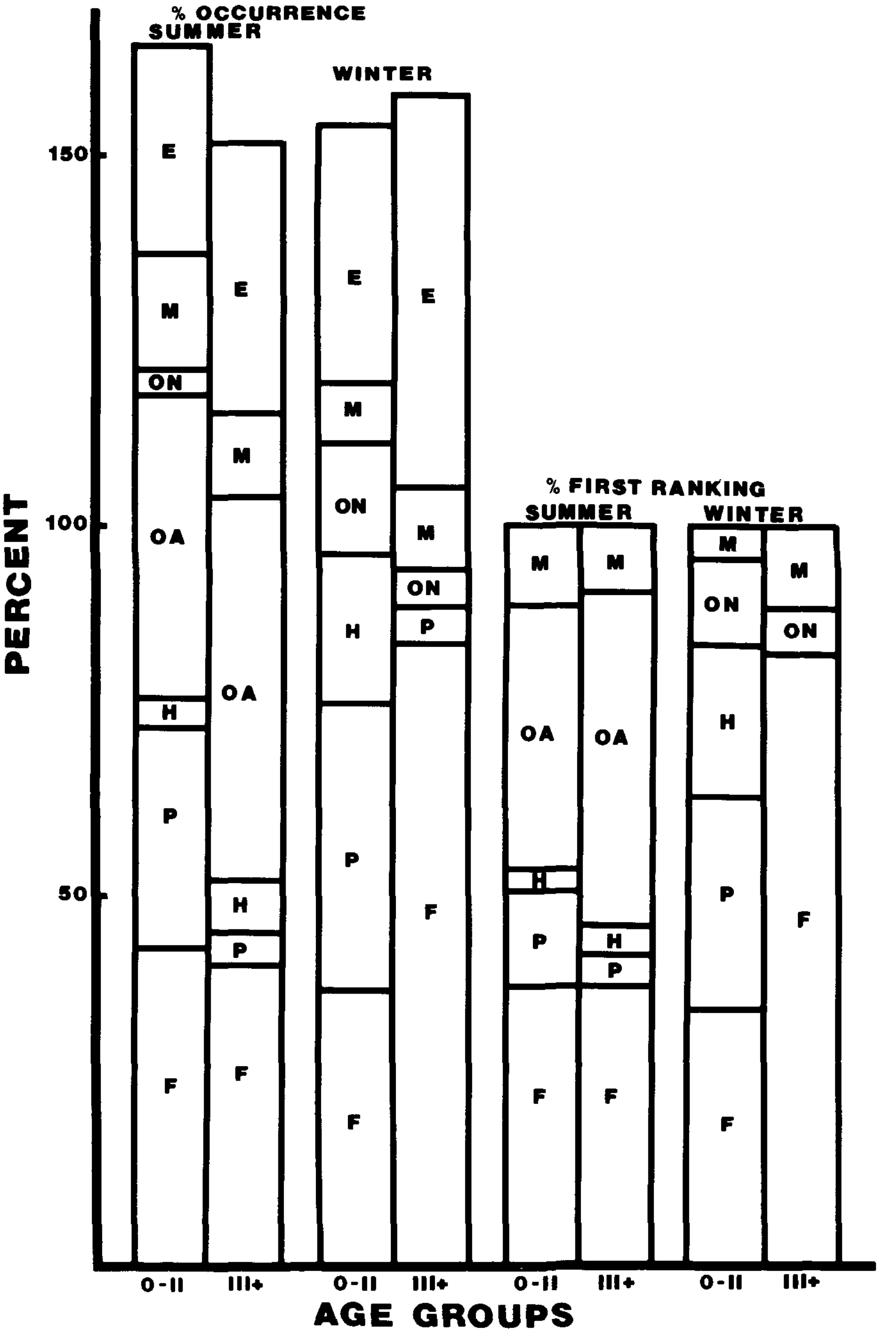


Figure 2. Percent frequency of occurrence and percent first ranking by season and age groups for Big Burn bass. (F - fish, P - *Palaemonetes* sp., H - hemipterans, OA - odonate adults, ON - odonate naiads, M - miscellaneous and E - Empty).

Sample size was adequate during the summer to assess diurnal feeding periodicity. The summer collections were allotted to three time periods; morning (0600-1030), noon (1030-1500), and afternoon (1500-1930). No collections were made from 1930 to 0600. Diurnal periodicity was assessed by the presence or absence of food rather than degree of fullness. The occurrence of food was found to be independent of time of day for both age groups (Table 6). Chew (1974) found no correlation between time of day and feeding in two Florida lakes. Largemouth bass exhibited significant diurnal periodicity in an Oklahoma reservoir, feeding from mid-morning through the afternoon (Zweiacker and Summerfelt 1973).

Table 6. Chi-square analysis of diurnal periodicity during the summer for largemouth bass.

| *Frequency of occurrence (Expected frequency of occurrence)* | | | | |
|---|---|---|---|---|
| | *Age Group* | | | |
| | *I, II* | | *≥III* | |
| *Time of Day* | *Empty* | *With food* | *Empty* | *With food* |
| morning | 8( 6.5) | 12(13.5) | 13(14.3) | 23(21.7) |
| noon | 4( 2.9) | 5( 6.0) | 6( 4.4) | 5( 6.6) |
| afternoon | 8(10.7) | 25(22.3) | 16(16.3) | 25(24.7) |
| chi-square ($X^2$) | 1.93[a] | | 1.21[b] | |

[a] not significant at $p < 0.05$.

Seventeen bass from 118 to 487 mm contained measurable fish. The relationship of largemouth bass length to forage fish length was linear with a significant $r^2$ of 0.75. In the Big Burn marsh a definite forage fish size selection in relation to length of bass was evident.

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