BIOLOGY OF THE WHITE CRAPPIE, *POMOXIS ANNULARIS*, IN LAKE TEXOMA, OKLAHOMA

By

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INTRODUCTION

Lake Texoma, presently the largest lake in Oklahoma and the sixth largest in the United States, is impounded by Denison Dam. The dam is located on the Red River in Grayson County, Texas, and Bryan County, Oklahoma, 751 river miles upstream from the mouth of Red River. The lake was impounded for flood control and generation of hydroelectric power. It was completed and in operation for flood control in 1944, although impoundment of water had begun as early as 1942. The maximum power pool at elevation 617 covers approximately 95,000 acres. Bottom lands were cleared up to permanent power pool level. The lake is divided into two main portions, the Red and Washita River arms, approximately corresponding to the old river channels. Various creeks empty into the lake, contributing to its total volume and area and causing its dendritic shape. The Red River arm at normal pool level is about 45 miles long and the Washita arm about 30 miles long.

The white crappie, Pomoxis annularis Rafinesque, a centrarchid, is one of the most important sport fishes in Lake Texoma and is considered one of the better food fishes. It is taken mostly on live bait, except during the spawning season, and a large minnow raising industry has been established to meet this need. Since production rate and survival of white crappie is high, many lakes contain large populations of slow growing fish to small to be in demand by fishermen. Knowledge of crappie reproduction may prove to be useful to biologists in developing methods of limiting already stunted populations. Because of its importance the white crappie cannot be overemphasized in fishery research and management programs. Therefore, the Oklahoma Fish and Game Council suggested this study.

The population of the closely related black crappie, Pomoxis nigromaculatus (LeSueur), must be extremely small since only one specimen was taken in the 1962-63 collections.

Satisfactory crappie fishing is dependent on: proper environmental conditions, relatively clear and moderately deep water; the habit of crappie to aggregate around submerged brush piles, trees, piers and rocky bluffs; and an adequate forage-fish food supply. Angling success has been improved in recent years on Lake Texoma by installation of marked brush shelters, and heated fishing docks.

Sneed and Thompson (1950) and Wilson (1951) studied age and growth of white crappie in Lake Texoma. By incorporating their results with mine a fairly continuous growth history of white crappie in the lake was obtained. Continuous growth history data may be useful in comparing growth rates with changing biological conditions due to aging of the lake.

Hall, et al. (1954) consolidated available data, published and unpublished, into a state average growth rate for crappie in Oklahoma to provide fisheries workers with a standard for evaluation of growth.

Life history studies on white crappie were made in Illinois by Hansen (1951), and in Ohio by Morgan (1954). I found no papers pertaining to life history of white crappie in the southern states.

METHODS AND MATERIALS

Collecting

Data were collected at Lake Texoma from July 1962 to July 1963 (1,070 fish). Data from fish taken in Lake Texoma between October 1959 and May 1960 (758 fish), by Dr. E. B. Kilpatrick and students, were also used in this study. Most of the fish collected during 1962-63 were taken from Buncombe Creek arm by means of trap nets and other methods described below. All 1959-60 fish were collected in Newberry Creek arm by use of two trap nets, lifted approximately once a week. The equipment I used consisted of trap nets, latin-square gill nets, collapsible nylon fish traps, one- and two-inch bar-mesh gill nets, seines, electric shockers and hook and line. The trap nets used were essentially the same type as the Great Lakes trap net (Lagler, 1956) with only one pot. The pot was constructed with a 3/8-inch bar-mesh nylon netting and the throat, lead (300 feet) and two wings (40 feet each) were made from 1 1/4-inch bar-mesh nylon netting. With the trap nets placed on the bottom and the pot in the deeper water (25-30 feet) white crappie were effectively taken during the summer, fall and spring. Latin-square gill nets described by Houser and Ghent (in press) and the collapsible nylon fish traps illustrated by Houser (1960) were used, in cooperation with B. G. Grinstead (unpublished MS), in a set pattern to collect data on the distribution of white crappie. The collapsible nylon fish traps were not effective in catching white crappie in Lake Texoma. One- and two-inch bar-mesh gill nets were set at various times and placed on the lake during times of small catches. Seines were used with little success to collect young-of-year. The electric shocker was used in an attempt to take crappie entering shallow water to spawn. A few fish were taken on hook and line by means of minnows and artificial lures.

Information taken from each specimen collected in 1962-63 included total length; standard length; body weight; gonad length, width and condition; scale sample; and stomach content. Information taken from each specimen collected in 1959-60 included total length, body weight, scale sample and gonad weight. All data were taken from living or freshly killed specimens. In the 1962-63 collections, only a few selected fish from each size group were used when a large catch was available; in small catches all fish were used. Data were taken from all fish in the 1959-60 collections.

All data from each fish, except that pertaining to age and growth, were placed on an IBM card to facilitate calculations by means of a digital computer. The age and growth data were treated by means of a desk calculator.

Measurements

Total and standard lengths were measured on each fish and were in accord with the systematic method of Hubbs and Lagler (1949). Gonadal lengths and maximum widths of the 1962-63 collections were measured in millimeters with dividers and the average length of gonads of each fish was recorded. Gonads of the 1959-60 collections were weighed, after blotting with a paper towel, to the nearest one hundredth gram after storage in seventy per cent ethanol. Body weight was measured in grams to the nearest tenth on 500- and 1000-gram Hanson spring scales. The number of mature eggs per specimen was determined by the volumetric method (Lagler, 1956).

Scale collection and analyses

Each scale sample for age determination and growth calculation was removed from an anteroventral area below the lateral line of the left side. Scale samples were read from 310 fish collected in 1959 and 1960, and from 343 fish collected during 1962-63. A few scales of average size from each sample were mounted in water and studied with a projector, similar to that described by Van Oosten, et al.(1934), at a magnification of 43X. Age determination was based on the year of life completed as indicated by the number of annuli (year marks). Scale growth was assumed to be directly proportional to increase in length. Total lengths were calculated for each annulus using a nomograph and an assumed zero intercept. All growth calculations were made from total length measurements in inches. The mean total length at each annulus was calculated separately for each year class in each year's collections.

REPRODUCTION

Sexual maturity

Sexual maturity in Lake Texoma white crappie was reached in the second or third year of life. The same was true for the white crappie in Illinois (Hansen, 1951) and in Ohio (Morgan, 1954). Many believe sexual maturity is a matter of growth; when a fish reaches a certain length it will begin to spawn regardless of age. This seems to apply to Lake Texoma white crappie. In general, fish two years old and over 7 inches in total length were mature while fish two years old and under

7 inches were immature. Eschmeyer, et al. (1944) found that some 2-year old white crappie from a Tennessee river were mature while others were immature. Carter (1953) found one mature female and three mature male white crappie in age group I in Kentucky Lake.

Breeding coloration

The color of the male and female white crappie was the same, except during the spawning season when the male was usually much darker. Dark pigmentation was most noticeable on the sides of the head, lower jaw, breast and to a lesser extent on the sides of the body. It began to appear in the middle of March, reached a maximum intensity during the period from late March to early May and began to disappear by the end of May. By the end of June most males and females again looked alike. During the height of the spawning period practically all mature males were sexed correctly on the basis of coloration.

Egg production

The number of mature eggs produced per female ranged from 25,600 to 91,700 (average 53,000), and varied with size of the fish and degree to which the ovaries were spent. Morgan (1954) found the number of mature eggs produced by white crappie varied from 970 in a fish 5 7/8 inches in length to 213,213 in a fish 13 inches in length. Huber and Binkley (1935) reported 2,900 to 14,750 (average 7,120) eggs per female white crappie. My measurements of mature egg diameters (0.82 to 0.92, average 0.89 mm) are in close agreement with those of Morgan (1954), 0.82 to 0.90 mm, and Hansen (1951), with an average of 0.89 mm.

Early in the spawning period the ovaries were plump and as the season progressed plumpness varied considerably. Many fish were taken with partially spent ovaries containing both mature and immature eggs, indicating that only part of the eggs were laid in a single spawning act. Completely spent ovaries still contained immature eggs. The immature eggs appeared to be resorbed at the end of the spawning period. Laying of eggs in more than one nest was not determined.

Spawning period

In an attempt to develop a fast, accurate, field method for determining the extent of the spawning season and time and degree of ovarian development, I compared the product of gonad length by its width from fish in the 1962-63 collections with gonad weights from the 1959-60 collections. Both methods gave similar results. Methods used in determining the spawning season were basically the same as those of Litt (1952) and Morgan (1954) and yielded similar results. The relationship of season to gonad size is presented in Figs. 1-5 for age groups II, III and IV-VIII. Age groups IV-VIII were combined because of the extreme overlap of fish lengths (Fig. 7). The figures include: the average ovary weights (Fig. 1); average ovary length times width (Fig. 2); average ratio of ovary weight to body weight (Fig. 3); average ratio of ovary length times width to body weight (Fig. 4); average ratio of testis length times width to body weight (Fig. 5). Ovary length times width plotted against total length for individual fish taken in different months are presented in Fig. 6. The average ratio of ovary size to total length of fish for age groups II, III and IV-VIII plotted against time of year gave results that correspond to those in Figs. 1-4.

Other related field observations agreed with results shown in Figs. 1-6. The spawning time and beginning of ovarian development occurred earlier in the year in older fish than in younger ones (Figs. 1-4). This might be attributed to several factors. Younger fish grow at a faster rate than older ones and thus less nutritional material would be available for ovarian development. Older fish had more fat stored at the beginning of winter than did the younger ones, therefore, a large supply of energy was available for ovarian development. Body growth started earlier in the year in younger fish than in older fish, as indicated by the earlier development of annuli, and may have affected ovarian development. In general, ovary size increased slowly during the fall and winter from a low point in July, increased rapidly in March and April and reached a peak in April or May and, as a result of spawning, quickly fell off to a low point in June. Ovaries increased in size as the water warmed during spring (Figs. 2 and 4). The testes were well developed in size by October. This size was maintained until April and May (spawning period) when there was a sharp decline because of emission of milt (Fig. 5). Testicular size developed to a higher level than ovarian size earlier in the year, as in other fish species. Regardless of fish length ovary size increased throughout the year from July until spawning (Fig. 6). This increase was greater in larger fish than in smaller ones.

Spawning season of white crappie varies geographically. White crappie spawn in Illinois during May and June, with the maximum during late May and early June (Hansen, 1951). Lake of the Ozarks white crappie spawn in May and June (Litt, 1952). Ohio white crappie start spawning in late April and continue into July at temperatures of 51-80 F, with the height in May and early June (Morgan, 1954). The spawning period for Lake Texoma white crappie was April and May at temperatures of 60-77 F, with the height during late April and early May.

Nesting habits

Little is known of nest building habits or spawning behavior of the white crappie. Nesting sites are quite variable as to depth of water and kind of substrate. Nests have been observed in depths ranging from a few inches to 20 feet, and on substrata of mud, clay, rock, sand, gravel, concrete and vegetation. In common with other centrarchids, crappie of both species guard their eggs (Hansen, 1951). I observed no white crappie nesting in Lake Texoma during 1962-63 because of the turbidity and depth of the water. No crappie were taken in shallow water during the spawning season. Hansen (1943) reported white crappie spawning in Lake Springfield, Illinois, on May 26, 1941, in water 4 to 8 inches deep along an undercut sod bank of red caly. Nests were 2 to 4 feet apart and well concealed from the casual passer-by by the overhanging bank and by a small elm tree growing in the water near the bank. The fish were moving the pectoral fins as if fanning the eggs attached to nearby vegetation and tree roots above them. Nelson (1941) reported that crappie, species not specified, spawned on cowlot manure and straw in federal hatchery ponds at Elephant Butte, New Mexico. Nelson also observed crappie nesting at depths of 10 to 20 feet in Elephant Butte Lake according to Hansen (1951).

Sex ratios

Sex ratios calculated for Lake Texoma white crappie varied with the month and year of capture. The yearly totals showed a slightly larger percentage of females, but monthly totals varied in both directions. The male to female ratio in per cent was 45:55 for fish sexed. Two per cent of all fish could not be sexed. These variations may have been the result of the age of the fish and method and season of capture. Wilson (1951) reported a 9:11 male to female ratio in Lake Texoma white crappie. According to Hansen (1951), sex ratios of white crappie in Illinois varied with age and length of the fish, season of take and method of capture. The majority of the young crappie were males and the majority of the older ones were females. Carter (1953) found 335 females for each 100 male white crappie in Kentucky.

AGE AND GROWTH

The use to which age and growth data may be put depends to a large extent on the accuracy of age determinations. In many instances, annuli on the scales of white crappie appear to give only approximations of age because of the presence of false annuli and the absence of annuli for certain years in some fish. Many authors have reported the presence of accessory checks (false annuli) in the scales of white crappie. I had difficulty determining the age of many fish due to the absence of annuli for certain years and the presence of false annuli, especially in the first year of growth. Approximately 30 samples were discarded because of doubtful age determination. However, I believe that relatively few age estimates deviated from the true age by more than a year.

The problems involved in collecting a representative sample of fish for use in age and growth studies are generally recognized. No one net collects an unbiased sample of the population and each is selective within a relatively narrow size group. Therefore, no attempt was made to evaluate the relative abundance of year classes.

Annulus formation

The formation of annuli on the scales of Lake Texoma white crappie appears to range from early April to late May, with the younger fish forming annuli earlier than older ones. The expression "annulus formation" refers to the time when growth resumes and the annulus becomes apparent. Morgan (1954), Hansen (1937), Johnson (1945), Hall, et al. (1954) and Buck and Cross (1951) concluded that younger white crappie form annuli earlier than older ones. It appeared that fish in age groups I, II and III formed annuli during April, while fish in older age groups formed annuli during May. This difference in annulus formation might be correlated with the development of gonads, as indicated by older fish spawning earlier than younger ones.

Growth rates

Age and growth was determined for 653 fish and only 14.4% exceeded five years of age. The largest white crappie taken during the study weighed 906 grams and measured 15.1 inches in total length. The longest crappie measured 15.5 inches in total length and weighed 879 grams.

Weighted average calculated total lengths in inches at the end of each year of life for each year class are given in Tables II, III and IV. Average annual increments of growth for each age group are also given. The overall weighted average total lengths at the end of each year of life for 1959-60 and 1962-63 collections and a combination of these two collection periods (12-year growth history) are shown in Fig. 8. Analysis of the growth history, in general, indicates steady increase in fish length and steady decrease in annual increment with age. There was little overlap in fish lengths in age groups I and II, with an increasing amount of overlap among older age groups (Fig. 7), in agreement with Wilson (1951). Part of this overlap may be caused by a relatively long spawning period, thus, some of the young-of-year would have a longer first year growing season. There was no significant difference in growth rates of the different year classes during the 12-year period (1951-1962), strongly suggesting regularity in spawning success, length of growing season, availability of food and rate of mortality. Rate of growth seems to have been influenced little by water-level fluctuations and angling pressure. Cyclical trends in growth are not indicated. Jenkins (1953) found this to be true in an 11-year growth history of white crappie from Grand Lake, Oklahoma.

Comparison of growth rates

Comparison of growth in inches of total length of white crappie in Lake Texoma and in other waters is shown in Table V. Growth rates reported in other waters are approximately in the range reported in Lake Texoma. However, Kentucky Lake, Kentucky, and Cherokee Lake, Tennessee, showed exceptionally good growth rates. During the first few years of impoundment the growth rates of Lake Texoma white crappie (Sneed and Thompson, 1950) were similar to those of Kentucky and Cherokee lakes. Growth rates of white crappie observed in the three studies of Lake Texoma show only slight variations, possibly because of method and time of capture and the difference in interpretation of scales. Sneed and Thompson (1950) stated that by 1949, five years after impoundment, the average growth rate of Lake Texoma white crappie had decreased. White crappie growth in Lake Texoma now seems to have reached equilibrium.

FOOD HABITS

Food habit information was collected from Lake Texoma white crappie in 1962-63. Table VI shows the frequency of occurrence of food organisms in the stomachs. A total of 719 stomachs were examined of which 476 (66%) contained food. The fish examined ranged from 2 to 15.5 inches in total length. Shad and unidentified fish remains were the main food items during July through January; however, only a few stomachs were examined during September through January. Dipterans, mayfly naiads, copepods and cladocerans were major food items during February through May. In June, shad and unidentified fish remains again were the most common food items. This is to be expected because of the abundance of small fishes in the lake at this time of the year. During February through May large fish as well as small ones had their stomachs packed with copepods, cladocerans and dipterans (mostly chironomid larvae and pupae). Although partially digested, identification of shad, Dorosoma (species not often determined), was easily made by the presence of the gizzard-like stomach. Many unidentified fish remains were definitely not those of shad. Miscellaneous food items were Lepomis, Menidia audens, Aplodinotus grunniens, Percina caprodes, hemipterans, dragon-fly naiads, watermite, grasshopper and Eubranchipoda. Marcy (1954), Crawley (1954), Burris (1956), Hansen (1951) and Morgan (1954) found that the principal foods of white crappie were small fishes, aquatic insects and small crustaceans.

DISEASE (LYMPHOCYSTIS)

The virus disease, lymphocystis, which appeared as white, granular, irregularly shaped tumors on the fins and occasionally on the body of the fish, is the only disease known to occur commonly in white crappie. The disease causes an enlargement of the host's connective tissue cells (Witt, 1957), but is not known to be lethal. Lymphocystis occurred more commonly on the caudal and pectoral fins than on any other portion of the body. Nigrelli (1954) stated that lymphocystis tumors may appear or disappear within a few days or may persist for a year or more. The growths in the skin make the fish so unsightly that infected individuals are often discarded by fishermen. The presence of lymphocystis on white crappie is comparatively high in some localities and is of some economic importance. Its frequency of occurrence on Lake Texoma white crappie from February to June 1963 (Table VII) was 0% for the 2.0 to 3.9-inch group, 2.1% for the 4.0 to 5.9-inch group, 4.2% for the 6.0 to 7.9-inch group, 7.9% for the 8.0 to 9.9-inch group, 1.5% for the 10.0 to 11.9-inch group and 0% for fish 12.0 inches and larger. The monthly percentages of infected fish were as follows: 5.6% in February, 5.5% in March, 3.7% in April, 1.8% in May and 0.7% in June, with an overall average of 3%. Infected fish were frequently observed during July and August 1962. This seems to correspond with Nigrelli (1954) who stated that lymphocystis usually appears in the spring, reaches a maximum level of infection during the summer and gradually disappears in the fall and winter. Hansen (1951) reported lymphocystis in 1.4% of the white crappie from Senachwine Lake, April 29, 1942; in

9.5% from Lake De Pue, April 25-27; and in 19.5% from Lake Chautauqua, September 17-18, 1943. Borges (1950), studying white crappie in Missouri, found 10.7% of the fish to be diseased in the following proportions by size classes: 4-inch (31%), 5-inch (16%), 6-inch (8%) and 7- to 12-inch (0%).

PARASITES

Lake Texoma white crappie were more frequently parasitized by the nematode *Camallanus* than by any other parasite in the summer of 1962. Of the 10 parasitized fish examined, eight were parasitized by *Camallanus*, one by *Argulus* (fish louse), one by Hirudinea (leech), one by *Posthodiplostomum* (fluke) and one by an unidentified nematode. Bangham (1941) examined 20 white crappie in Buckeye Lake, Ohio, of which only seven were parasitized. Of the infected fish, one was parasitized by a gill fluke of the family Gyrodactylidae, one by four *Cryptogonimas chyli* Osborn (trematode), one by two immature hook-headed worms, *Leptorynchoides thecatus* (Linton), and one by an adult of this form, one by a leech and one by the copepod, *Ergasilus caeruleus* (Wilson). Hugghins (1959) examined 10 white crappie of which four were parasitized by *Posthodiplostomum minimum*, *Camallanus oxycephalus* and *Argulus biramosus*. Hughes (1927) found a white crappie parasitized by the trematode *Uvulifer amblοplitis*.

SUMMARY AND CONCLUSIONS

During 1959, 1960, 1962, and 1963, 1,828 white crappie taken from Lake Texoma, Oklahoma, were studied.

Sexual maturity was reached in the second or third year of life and was probably correlated with size of the fish.

Dark breeding coloration in the males began to appear in the middle of March, reached a maximum intensity during the period of late March to early May and began to disappear by the end of May. By the end of June the males and females again looked alike.

The number of mature eggs produced per female ranged from approximately 25,600 to 91,700 (average 53,000), and varied with the size of the fish and degree to which the ovaries were spent. Mature eggs varied in size from 0.82 to 0.92 mm (average 0.89) in diameter. Many fish were taken with partially spent ovaries containing both mature and immature eggs, indicating that only part of the eggs were laid in a single spawning act.

The spawning period was April and May, at temperatures of 60-77 F, with the height of spawning during late April and early May. Spawning time and the beginning of ovarian development occurred earlier in older than in younger fish. Regardless of fish length ovary size increased throughout the year from July until spawning. This increase was greater in larger fish than in smaller ones. Testicular size developed to a higher level than ovarian size earlier in the year.

No white crappie were observed nesting in Lake Texoma during 1962-63 because of the turbidity and depth of the water. No crappie were taken in shallow water during the spawning season.

The male to female ratio in per cent was 45:55 for fish sexed. Two per cent of all fish could not be sexed. The yearly totals showed a slightly larger percentage of females, but monthly totals varied in both directions.

Formation of annuli appeared to range from early April to late

May, with the younger fish forming annuli earlier than the older ones.

In general, there was a steady increase in fish length and a steady decrease in annual increment with age. There was little overlap in fish lengths in age groups I and II, with an increasing amount of overlap among older age groups. There was no significant difference in growth rates of different year classes, strongly suggesting regularity in spawning success, length of growing season, availability of food, and rate of mortality. Five years after impoundment, the average growth rate of Lake Texoma white crappie had decreased, but now growth seems to have reached equilibrium.

Shad and unidentified fish remains were the main food items in the stomachs during July through January. Dipterans, mayfly naiads, copepods and cladocerans were major food items during February through May. In June, shad and unidentified fish remains again were the most common food items.

The monthly percentages of fish infected with lymphocystis (virus disease) were as follows: 5.6% in February, 5.5% in March, 3.7% in April, 1.8% in May and 0.7% in June, with an overall average of 3%.

White crappie in the summer of 1962 were more frequently parasitized by the nematode <u>Camallanus</u> than by any other parasite. <u>Argulus</u>, Hirudinea and <u>Posthodiplostomum</u> were also found to parasitize white crappie.

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APPENDIX

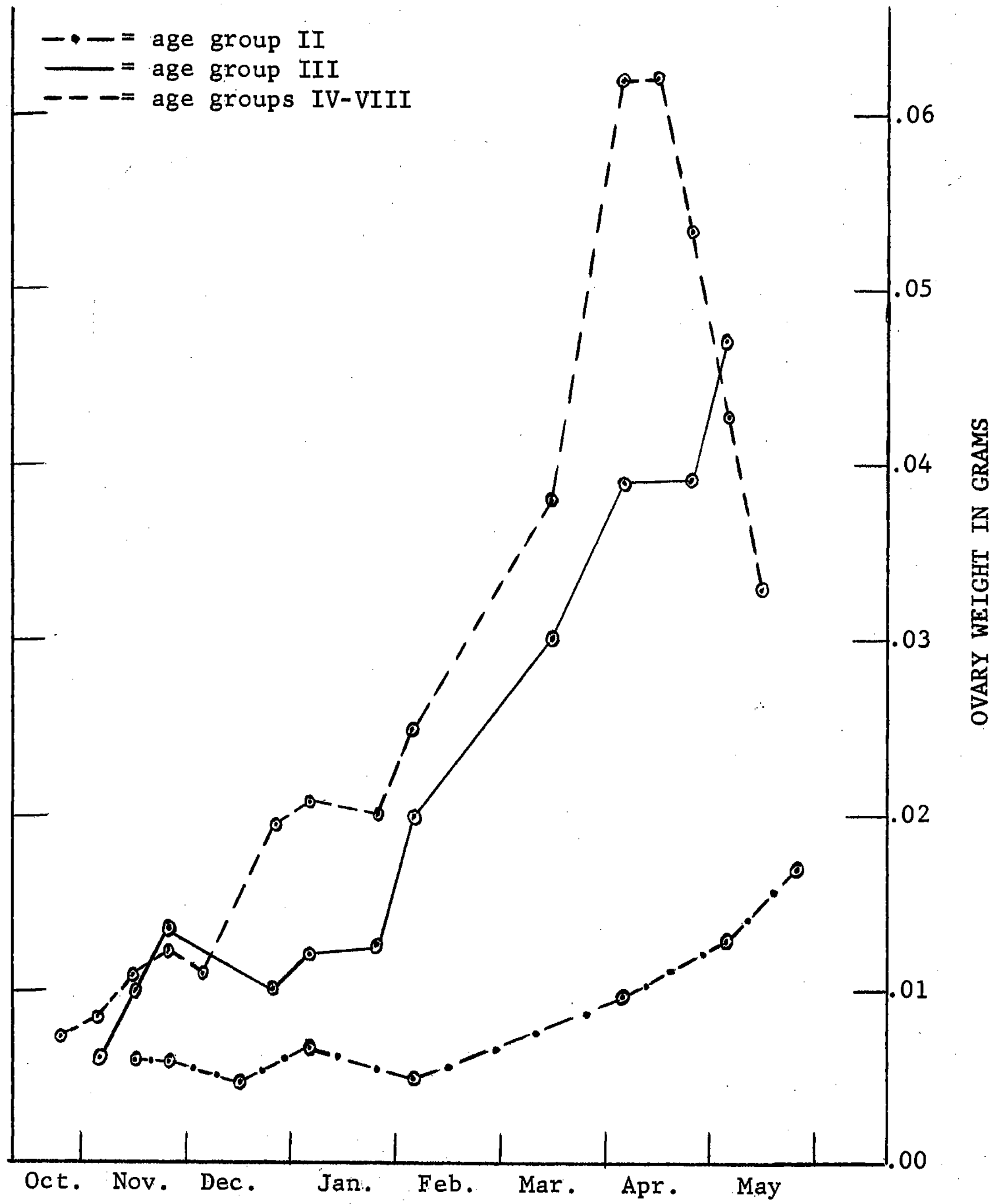

Fig. 1. Relationship of average ovary weight to season, 1959-60 collections.

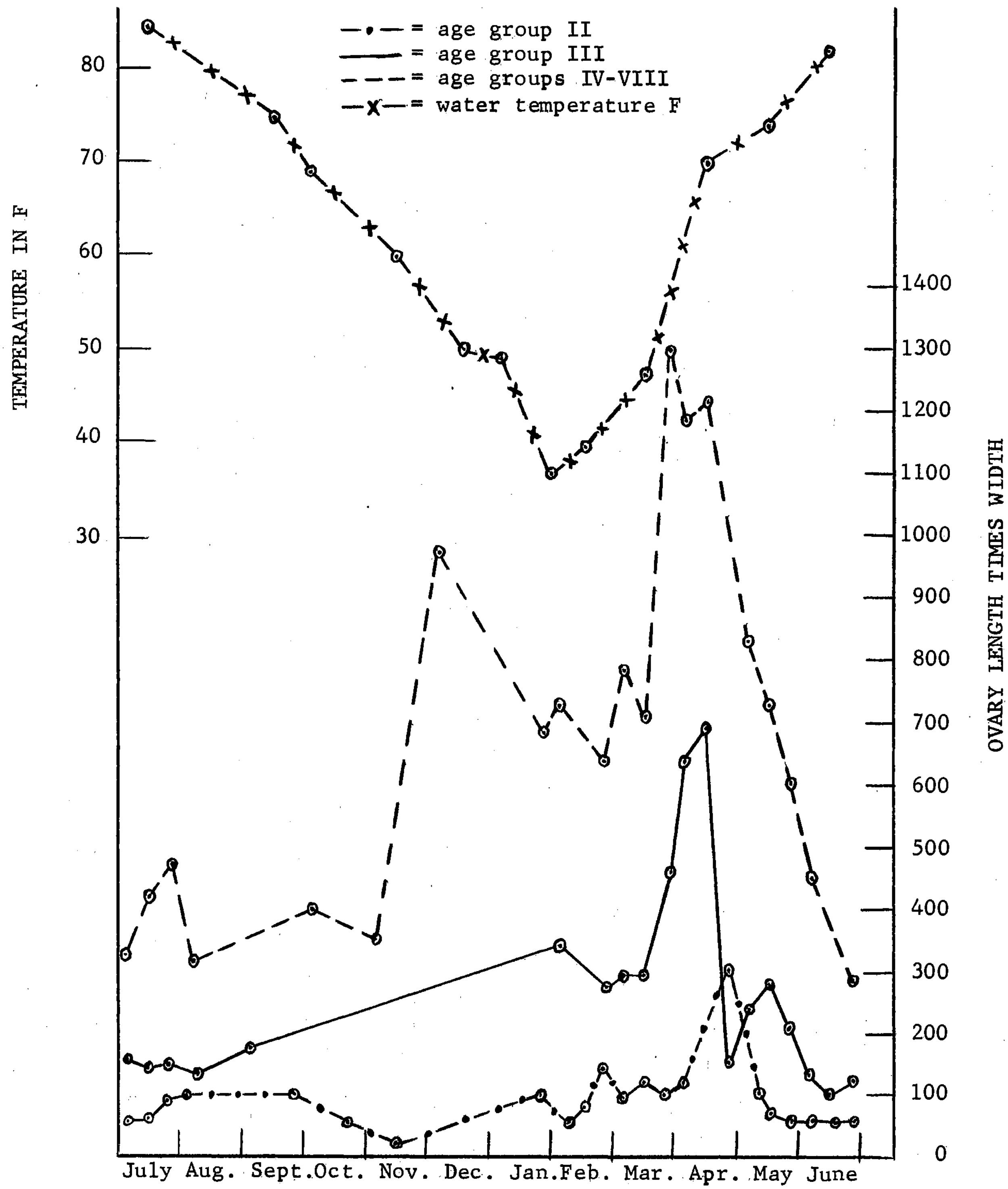

Fig. 2. Relationship of average ovary length times width to season and water temperature, 1962-63 collections.

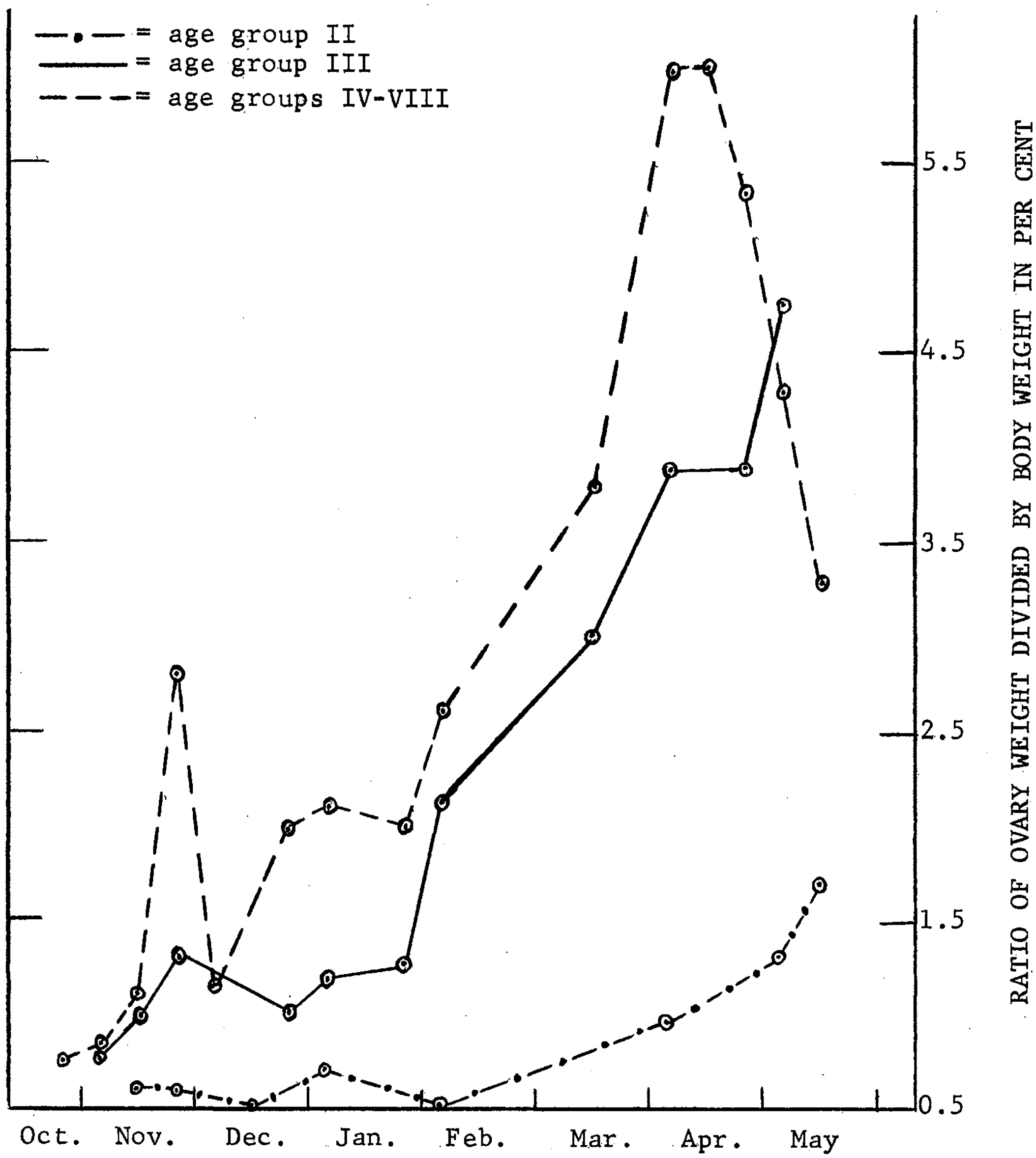

Fig. 3. Relationship of average ratio of ovary weight and body weight to season, 1959-60 collections in per cent.

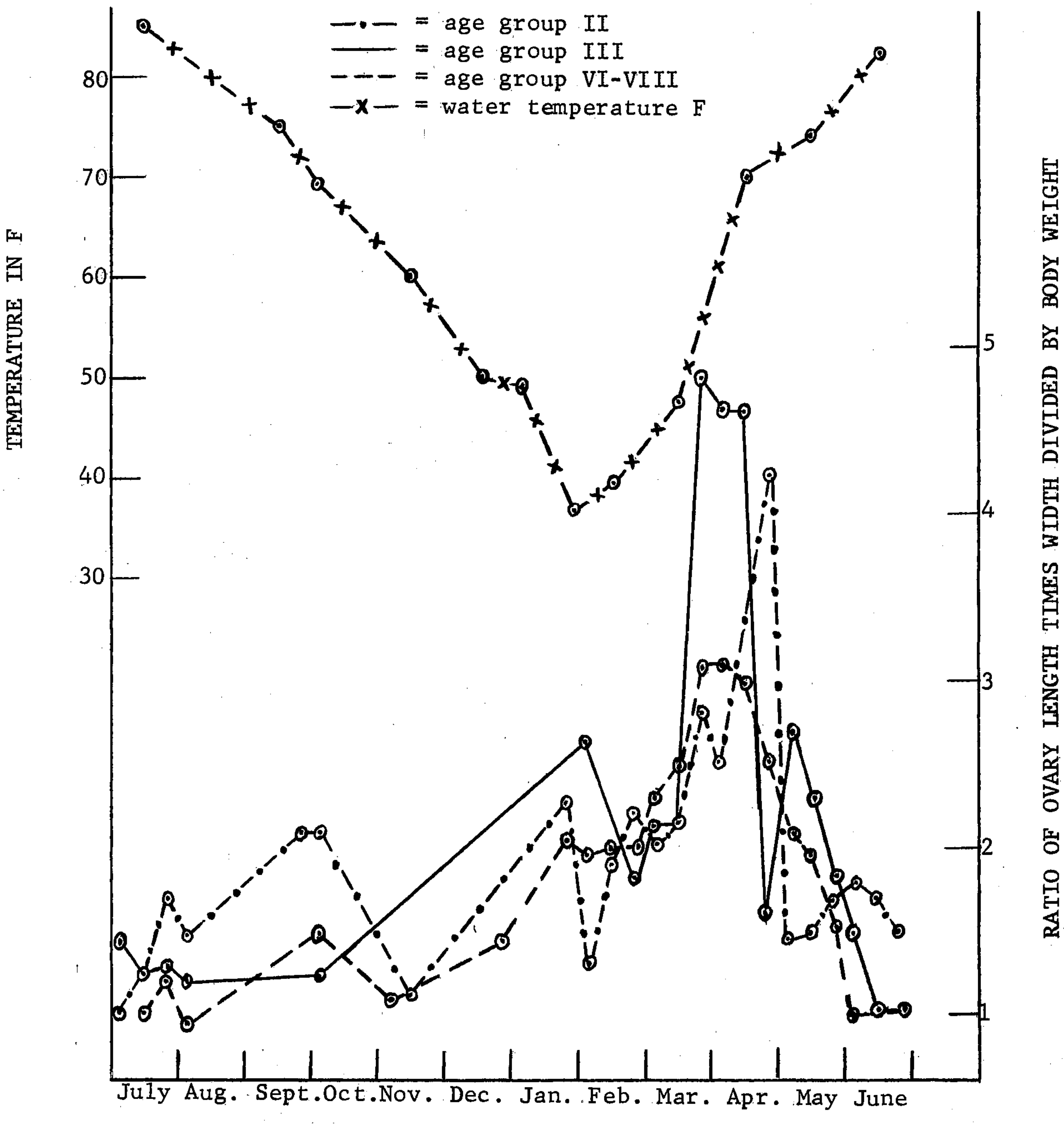

Fig. 4. Relationship of average ratio of ovary length times width divided by body weight to season and water temperature, 1962-63 collections.

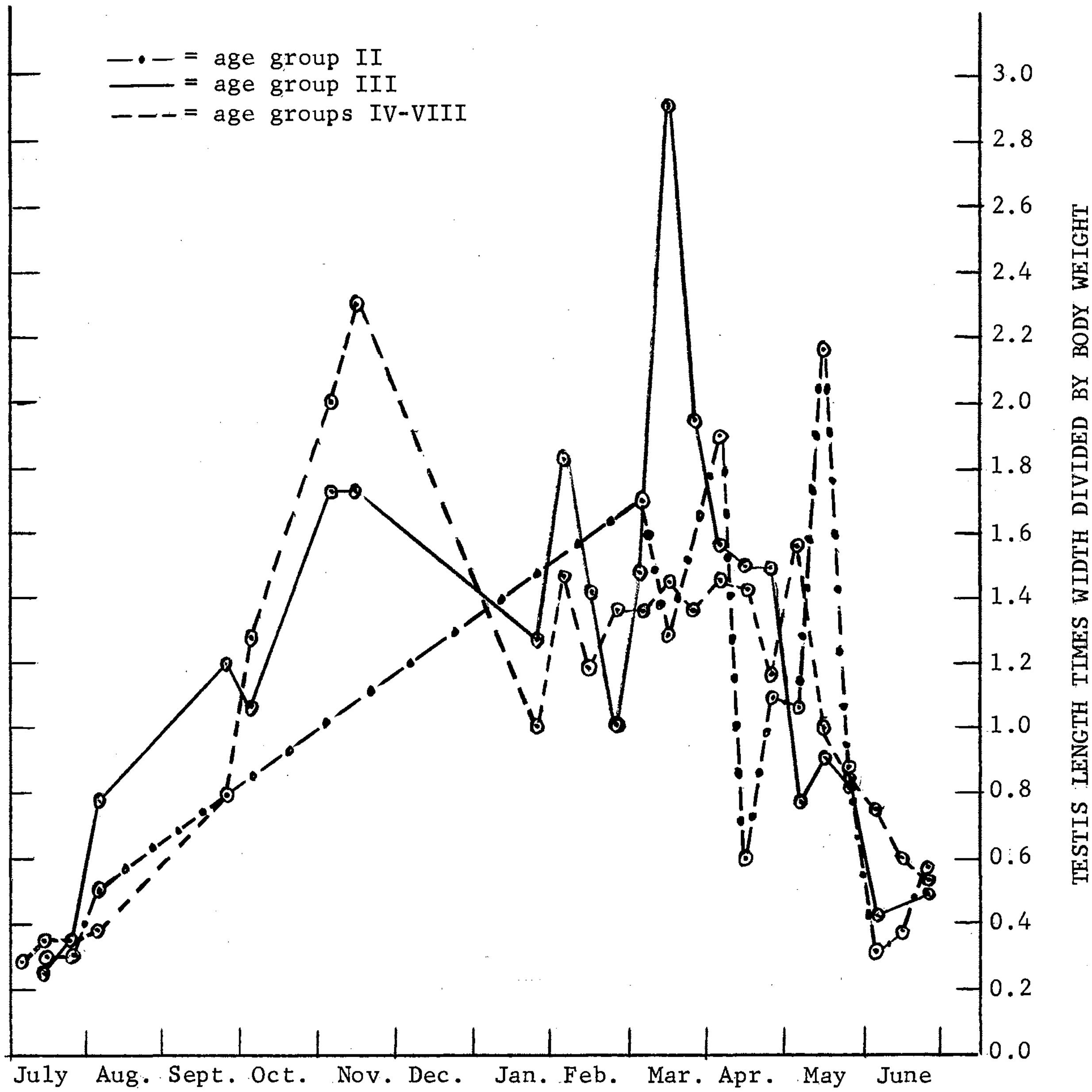

Fig. 5. Relationship of average ratio of testis length times width divided by body weight to season, 1962-63 collections.

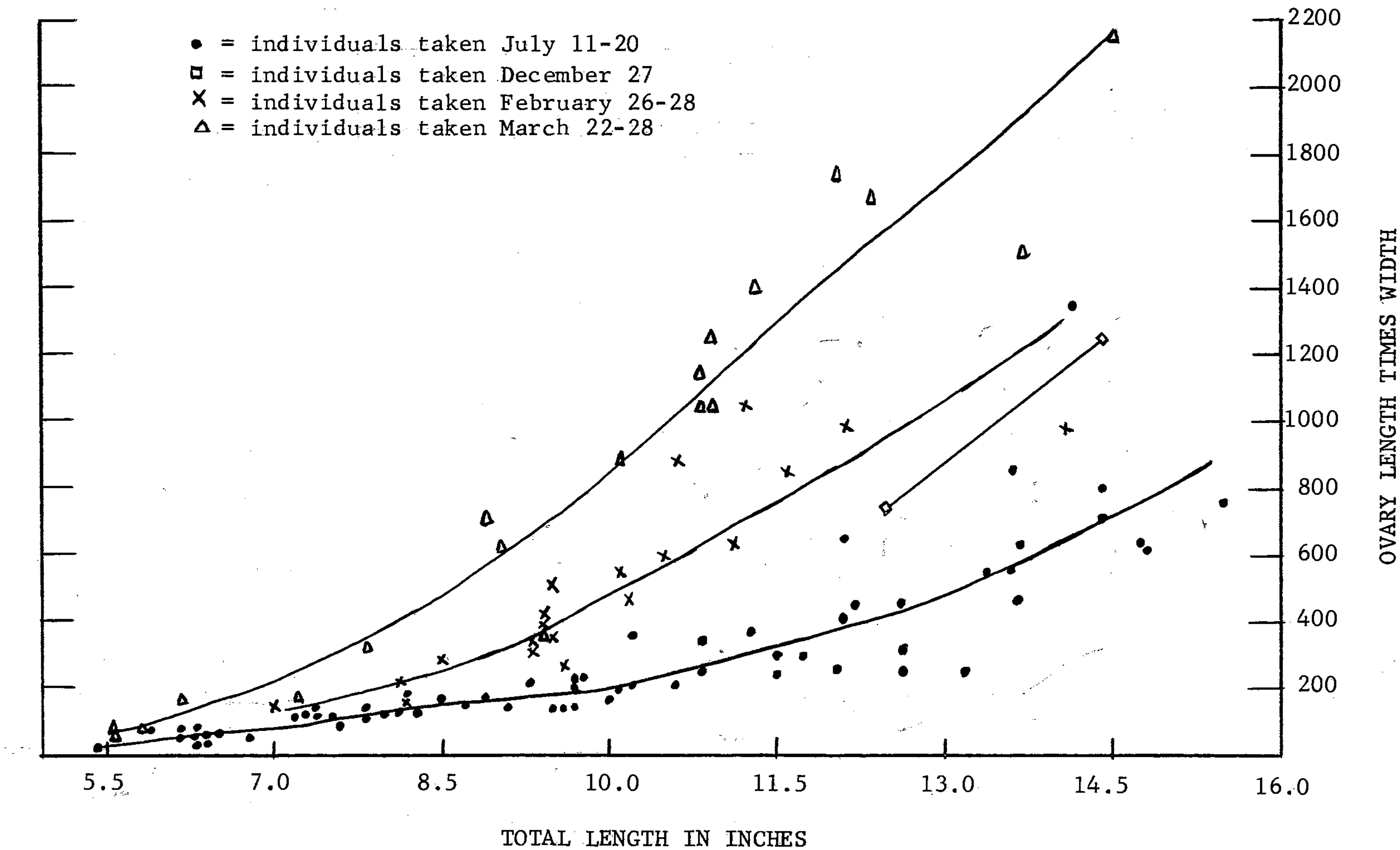

Fig. 6. Relationship of ovary length times width to length of the fish and season, 1962-63 collections.

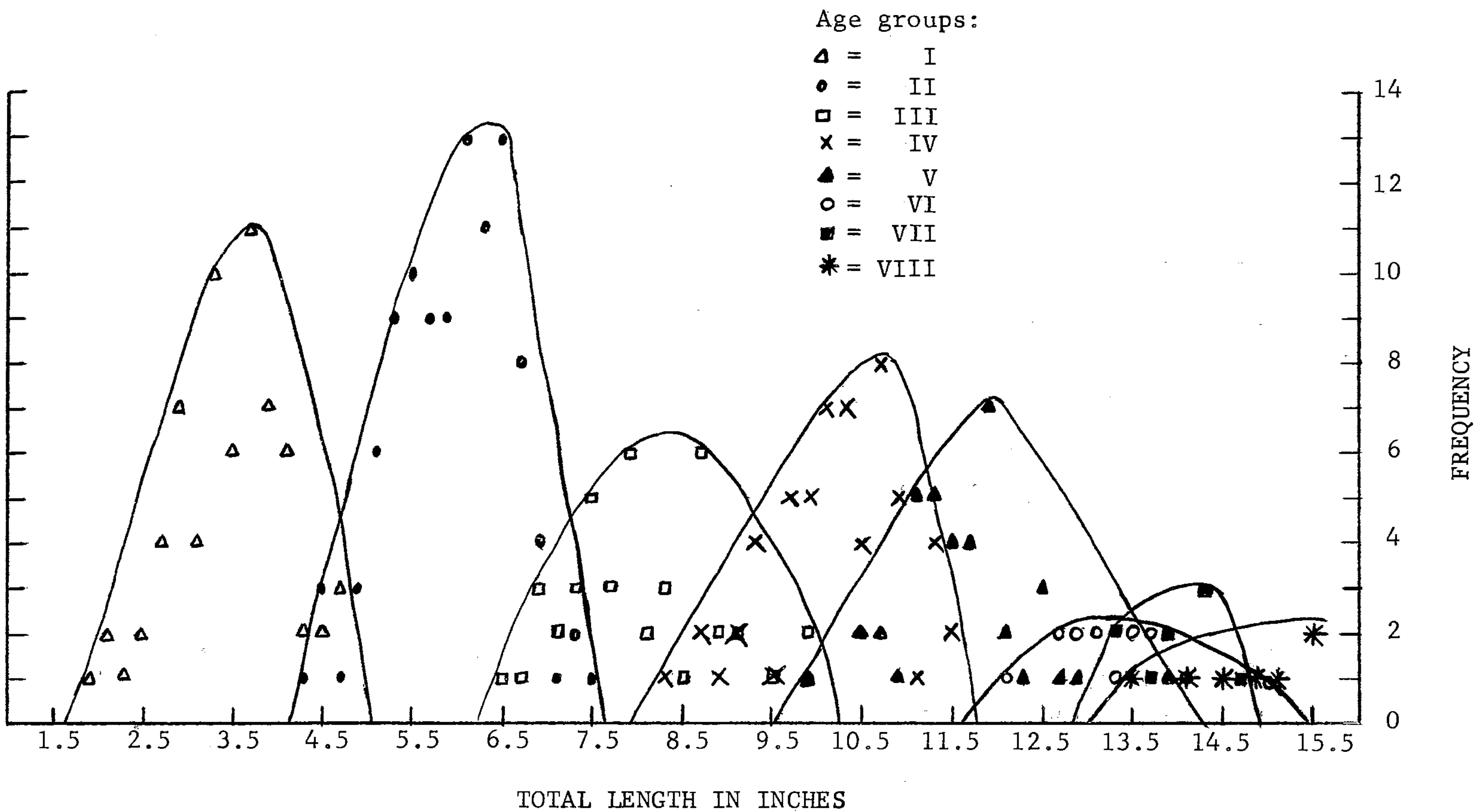

Fig. 7. Distribution and range of fish lengths in different age groups, 1962-63 collections.

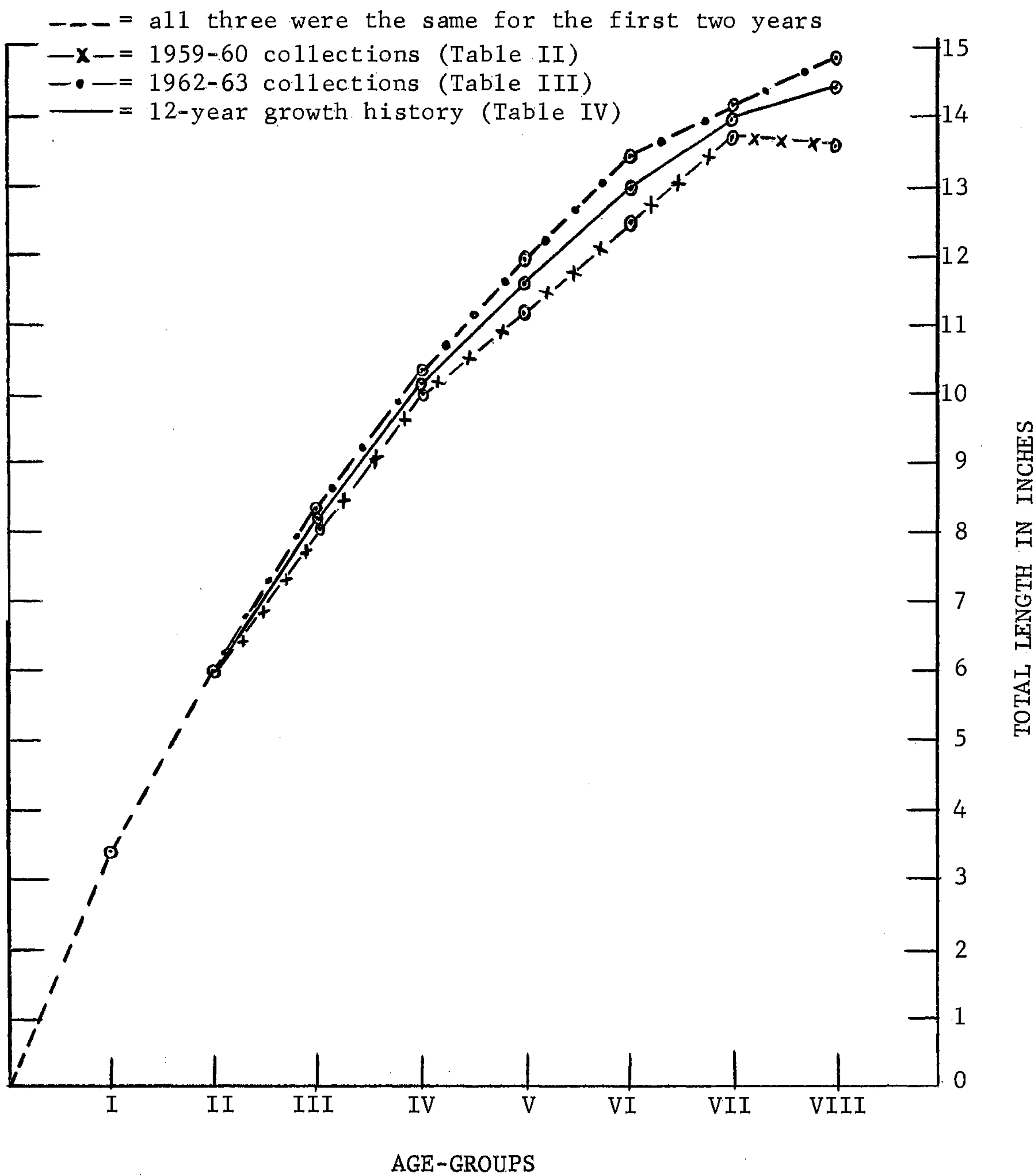

Fig. 8. Calculated growth in total length for Lake Texoma white crappie.

TABLE I

COMPARISON OF TIMES OF ANNULUS FORMATION OF WHITE CRAPPIE

State	Author	Date of annulus formation
Illinois	Hansen (1951)	Early May to late August
Iowa	Neal (1963)	June and July
Ohio	Morgan (1954)	Early March to early fall
Ohio	Roach and Evans (1948)	July and August
Oklahoma	Hall et al. (1954)	Middle of April to late May
Oklahoma	This study (1964)	Early April to late May

TABLE II

AVERAGE CALCULATED TOTAL LENGTH IN INCHES AT THE END OF EACH YEAR OF LIFE FOR EACH YEAR CLASS OF WHITE CRAPPIE, COLLECTED 1959-60. Numbers of specimens in parenthesis

Year Class	Age Groups I	II	III	IV	V	VI	VII	VIII
1958	3.2 (32)	5.9 (30)						
1957	3.4 (82)	6.0 (82)	7.8 (54)					
1956	3.5 (110)	6.0 (110)	8.3 (110)	10.2 (76)				
1955	3.5 (58)	6.1 (58)	8.2 (58)	9.9 (58)	11.3 (41)			
1954	3.3 (14)	5.8 (14)	8.0 (14)	9.4 (14)	11.1 (14)	12.2 (12)		
1953	3.3 (11)	5.6 (11)	7.9 (11)	9.8 (11)	11.4 (11)	12.8 (11)	13.9 (9)	
1952	2.9 (2)	4.9 (2)	7.5 (2)	9.6 (2)	11.0 (2)	12.4 (2)	13.0 (2)	13.8 (2)
1951	3.2 (1)	5.0 (1)	7.5 (1)	10.2 (1)	10.8 (1)	11.7 (1)	12.7 (1)	13.3 (1)
Weighted Average	3.4	6.0	8.1	10.0	11.2	12.4	13.7	13.6
Average Increment	3.4	2.6	2.1	1.9	1.2	1.2	1.3	-0.1
Total No. of Fish	310	308	250	162	69	26	12	3

TABLE III

AVERAGE CALCULATED TOTAL LENGTH IN INCHES AT THE END OF EACH YEAR OF LIFE FOR EACH YEAR CLASS OF WHITE CRAPPIE, COLLECTED 1962-63. Numbers of specimens in parenthesis

Year Class	Age Groups I	II	III	IV	V	VI	VII	VIII
1962	3.5 (54)							
1961	3.5 (92)	6.0 (78)						
1960	3.2 (47)	6.1 (47)	8.2 (22)					
1959	3.4 (61)	6.0 (61)	8.3 (61)	10.4 (40)				
1958	3.1 (52)	5.7 (52)	8.1 (52)	10.0 (52)	11.6 (33)			
1957	3.4 (18)	6.1 (18)	8.4 (18)	10.7 (18)	12.3 (18)	13.3 (11)		
1956	3.3 (12)	6.1 (12)	8.2 (12)	10.5 (12)	12.0 (12)	13.2 (12)	14.0 (9)	
1955	3.7 (6)	6.8 (6)	9.0 (6)	10.8 (6)	12.4 (6)	13.6 (6)	14.2 (6)	14.7 (6)
1954	2.9 (1)	5.3 (1)	7.5 (1)	10.0 (1)	12.9 (1)	13.7 (1)	14.3 (1)	15.0 (1)
Weighted Average	3.4	6.0	8.3	10.3	11.9	13.4	14.1	14.8
Average Increment	3.4	2.6	2.3	2.0	1.6	1.5	0.7	0.7
Total No. of Fish	343	275	172	129	70	30	16	7

TABLE IV

TWELVE-YEAR GROWTH HISTORY OF LAKE TEXOMA WHITE CRAPPIE, EXPRESSED AS AVERAGE TOTAL LENGTH IN INCHES AT END OF YEAR; COLLECTED IN 1959-60 AND 1962-63. Numbers of specimens in parenthesis

Year Class	Age Groups I	II	III	IV	V	VI	VII	VIII
1962	3.5 (54)							
1961	3.5 (92)	6.0 (78)						
1960	3.2 (47)	6.1 (47)	8.2 (22)					
1959	3.4 (61)	6.0 (61)	8.3 (61)	10.4 (40)				
1958	3.2 (84)	5.8 (82)	8.1 (52)	10.0 (52)	11.6 (33)			
1957	3.4 (100)	6.0 (100)	8.0 (72)	10.7 (18)	12.3 (18)	13.4 (11)		
1956	3.5 (122)	6.0 (122)	8.3 (122)	10.2 (88)	12.0 (12)	13.2 (12)	14.0 (9)	
1955	3.5 (64)	6.2 (64)	8.3 (64)	9.9 (64)	11.4 (47)	13.6 (6)	14.2 (6)	14.7 (6)
1954	3.3 (15)	5.8 (15)	7.9 (15)	9.5 (15)	11.2 (15)	12.3 (13)	14.3 (1)	15.0 (1)
1953	3.3 (11)	5.6 (11)	7.9 (11)	9.8 (11)	11.4 (11)	12.8 (11)	13.9 (9)	
1952	2.9 (2)	4.9 (2)	7.5 (2)	9.6 (2)	11.0 (2)	12.4 (2)	13.0 (2)	13.8 (2)
1951	3.2 (1)	5.0 (1)	7.5 (1)	10.2 (1)	10.8 (1)	11.7 (1)	12.7 (1)	13.3 (1)
Weighted Average	3.4	6.0	8.2	10.1	11.6	12.9	13.9	14.4
Average Increment	3.4	2.6	2.2	1.9	1.5	1.3	1.0	0.5
Total No. of Fish	653	583	422	291	139	56	28	10

TABLE V

A COMPARISON OF GROWTH IN INCHES OF TOTAL LENGTH OF WHITE CRAPPIE IN LAKE TEXOMA AND IN OTHER WATERS

Water and Reference	Age Groups							
	I	II	III	IV	V	VI	VII	VIII
Lake Texoma, Okla. (This study, 1964)	3.4	6.0	8.2	10.1	11.6	12.9	13.9	14.4
Lake Texoma, Okla. (Sneed & Thompson, 1950)	3.6	5.9	9.3	10.0	12.5			
Lake Texoma, Okla. (Wilson, 1951)	3.8	5.6	7.3	8.9	10.0	10.2		
Okla. State Average (Hall et al., 1954)	2.9	5.9	7.8	9.8	11.9	13.2	14.2	15.0
Lake Decatur, Ill. (Hansen, 1951)		7.3	9.1	10.5	10.6	12.2	12.3	
Buckeye Lake, Ohio (Morgan, 1954)	2.3	4.2	5.9	7.6	9.1	10.2	11.9	
Ohio Lakes (Roach and Evans, 1948)	2.6	5.5	7.6	9.2	10.4			
Kentucky Lake, Ky. (Carter, 1953)	4.6	7.9	10.4	11.9	12.8			
Lake Marion, S.C. (Stevens, 1958)	1.9	6.9	9.9	11.2	12.3	12.6	13.1	
Clear Lake, Iowa (Neal, 1963)	2.9	6.0	7.5	8.5	9.3	10.0	12.7	
Foots Pond, Ind. (Ricker & Lagler, 1942)	2.8	5.8	8.6	10.2	11.5			
Cherokee Lake, Tenn. (Stroud, 1949)	1.5	8.7	11.6					
Douglas Lake, Tenn. (Stroud, 1949)	2.9	7.3	9.2					
Hiwassee Lake, N.C. (Stroud, 1949)	2.4	6.8	9.5	9.5				

TABLE VI

FREQUENCY OF OCCURRENCE OF FOOD ORGANISMS IN WHITE CRAPPIE STOMACHS, 1962-63

Month	July	Aug.	Sept.	Oct.	Nov.	Jan.	Feb.	Mar.	April	May	June	# Stom. Cont. Food	% Stom. Cont. Food
Food organisms in per cent													
Shad	58	96	100	67	60	50	37	6	0	1	18	115	24
Unidentified fish remains	45	4	0	67	40	50	24	28	29	37	52	164	35
Dipterans	4	0	0	0	0	0	17	78	75	65	29	208	44
Mayfly naiads	0	0	0	0	0	0	2	29	8	22	18	67	14
Copepods	0	0	0	0	0	0	39	52	35	6	0	92	19
Cladocerans	0	0	0	0	0	0	2	28	47	9	0	62	13
												Total	
No. of stomachs with food present	85	27	1	3	5	2	41	100	51	98	63	476	
No. of stomachs examined	141	37	1	5	10	8	70	108	67	163	109	719	
No. of empty stomachs	56	10	0	2	5	6	29	8	16	65	46	243	
Per cent of stomachs containing food	60	73	100	60	50	25	59	93	76	60	58	66	

TABLE VII

FREQUENCY OF OCCURRENCE OF LYMPHOCYSTIS ON WHITE CRAPPIE, 1963.
E = Number Examined; I = Number Infected

Months	Feb.		March		April		May		June		Grand Total		
Length Groups in Inches	E	I	E	I	E	I	E	I	E	I	E	I	%
2.0-3.99	2	0	1	0	0	0	0	0	0	0	3	0	0
4.0-5.99	2	0	10	1	7	0	19	0	55	1	93	2	2.1
6.0-7.99	5	1	27	1	27	3	36	1	46	0	141	6	4.2
8.0-9.99	20	2	21	4	29	2	24	1	19	0	113	9	7.9
10.0-11.99	17	0	38	0	75	2	49	1	14	0	193	3	1.5
12.0-up	8	0	12	0	49	0	39	0	12	0	120	0	0.0
Totals	54	3	109	6	187	7	167	3	146	1	663	20	3.0
%	5.6		5.5		3.7		1.8		0.7				

VITA

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Candidate for the Degree of

Master of Science

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