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# PLANKTON PRODUCTION AND SPECIES DISTRIBUTION IN THE LIMNOLOGICAL PROVINCES OF OKLAHOMA

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PLANKTON PRODUCTION AND SPECIES DISTRIBUTION
IN THE LIMNOLOGICAL PROVINCES OF OKLAHOMA

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# PLANKTON PRODUCTION AND SPECIES DISTRIBUTION IN THE LIMNOLOGICAL PROVINCES OF OKLAHOMA

## INTRODUCTION

By 1974, Oklahoma is estimated to have more than 1,300,000 surface acres of water; fifty percent will be in large reservoirs and thirty-two percent will be in farm ponds (Lambou, et al., 1965). If the water chemistry and biological production of these impoundments could be characterized, it would enhance their management and study.

Regional limnology is based on a study of biological production (Naumann, 1932) and the relation of production to its controlling factors. The concept of regional limnology includes the recognition of two principal classes of factors, edaphic and climatic, operating upon the lake biocoenosis with a third class, the morphometric, responsible for lakes being products of their substrate and drainage (Deevey, 1940). Edaphic factors determine the kinds and amounts of primary nutritive materials while morphology and climate largely determine the utilization of these materials (Rawson, 1939).

Deevey, working on Connecticut lakes, stated that in circumscribed regions under essentially uniform climatic conditions the edaphic factors are of supreme importance. Naumann (1932) showed the relationship between "surficial geology" and water-type in lakes in Sweden. A similar relationship was alluded to by Birge and Juday in their many studies on Wisconsin lakes.

Rawson, in his work on lakes in the Canadian Rockies and Central British Columbia, suggested that the total mineral content of waters (1951) and the total dissolved solids (1961) provided crude indices of the edaphic conditions which in some measure affect the productivity of lakes. Toth and Smith (Frey, 1963) showed a correlation between soil constituents, water characteristics and fish productivity in three edaphically distinct regions of New Jersey.

Little in the way of regional limnology has been done in the state of Oklahoma. Limnological work has been restricted to studies in connection with fisheries biology (Summers, 1961; Gasaway, 1961; Orr, 1958), pre-impoundment fishery investigations (Clemens, 1954; Jenkins, *et al.*, 1952) and studies of oil pollution (Baumgardner, 1966; Mathis, 1965; Minter, 1964; Wilhm, 1965; Copeland, 1963; Clemens and Finnell, 1957). Hornuff (1957) conducted a limnological survey of four Oklahoma streams and concluded that edaphic features did not correlate with production; morphological characteristics appeared to be the principal factors influencing production through rate of flow and bottom type.

The present study was undertaken to see if there were any differences in production within the state. Oklahoma waters contain a wide range in ion content and this presents a fine opportunity to see if edaphic factors are influencing production.

## The Study Area

Oklahoma is a plain which slopes from the highest altitude in the northwest toward the lowest in the extreme southeast and is interrupted by the Ozark Mountains in the northeast, the Ouachita Mountains in the southeast and the Arbuckle and Wichita Mountains in the south.

The climate is temperate with relatively short and mild winters. In the north and west the temperatures are usually cooler than in the south and east which is affected by the Gulf of Mexico (Snider, 1917). Killing frosts are not common in the southern section later than early April or earlier than mid-November. The average annual precipitation ranges from 18 to 50 inches with over half of the state receiving 30 inches mostly occurring during the warmer months (Gray and Galloway, 1959).

Shelford (1963) placed eastern Oklahoma in the temperate deciduous forest and western Oklahoma in the temperate grassland. Webb (1950) recognized the major part of the state as being an ecotone between the two biotic provinces. The physiographic areas of the state were mapped by Curtis and Ham (1957).

Oklahoma is underlain by sedimentary rock with the exception of small areas along the axes of the Wichita and Arbuckle Mountains where there are igneous outcrops. The oldest rocks occur in the eastern and the youngest in the western parts of the state (Walling, et al., 1951). The geology of the state has been well mapped by Miser (1954). Pre-cambrian granite rocks occur only as cores of the Arbuckle and Wichita Mountains where they are surrounded by Paleozoic rocks. These older Paleozoic rocks are also present in valleys in the Ozark Mountains and in a few areas of the Ouachita Mountains.

Mississippian rocks occur in the Ozark Mountain region as limestone, flint and chert, and in the Ouachita Mountains as shale and sandstone. In the east, Pennsylvanian rocks occupy a broad L-shaped area which in the southern and eastern part consists of sandstones and shales with several limestone beds in the north.

Permian rocks of soft red shales and sandstones outcrop over most of the western half of the state. They were deposited in and around the Permian Sea which covered most of the central and western part of the state. Deposition of these rocks was in an evaporating environment resulting in the concentration of large quantities of sodium, calcium, potassium, magnesium, carbonates and sulfates.

During the lower Cretaceous, the sea advanced from the south covering the eastern part of the state north to the Ouachita and Arbuckle Mountains. The lower Cretaceous rocks consist primarily of limestones and soft shales with some sandstones.

Tertiary rocks are soft unconsolidated clays, sands and gravel which form a covering in the northwest. In the valleys of the streams, the alluvial soil is of sufficient depth—to be classed as a distinct formation--the Recent Alluvium. Along the rivers, in the west, there are large areas of sand hills blown from the river beds.

Calcium carbonate is the principal constituent of limestone and calcium-magnesium carbonate is the chief constituent of dolomite; therefore water analyses from these areas show relatively large amounts of calcium, magnesium and carbonates. Calcium carbonate occurs in many sandstones and shales. Waters traversing siliceous rocks are relatively free of dissolved inert substances and silica is often the predominant constituent (Walling, *et al.*, 1951).

## The Limnological Provinces

During the spring of 1959 a study of 70 different impoundments by Dr. Howard Clemens with the aid of his Limnology class revealed remarkable similarities in ionic values of impoundments of given regions of the state and that these similarities could be related to specific rock types. Originally it appeared that soil types might be the basis for regional considerations of edaphic control but it was discovered that the details of soil distribution had not been worked out to a suitable extent. Since then they have been studied (Gray and Galloway, 1959).

To determine the influence of geologic rock types on the ionic content of water, 135 impoundments throughout the state, exclusive of the Panhandle, were sampled during the spring of 1961. Each sample was analyzed for calcium, sodium, potassium, magnesium, sulfates, phosphates, bicarbonates, carbonates, hydrogen-ion and total electrolytes. There were rather consistent values for certain ions in waters in specific rock types. Fluctuations of a given ion in a geologic unit could be related to specific geologic causes.

Twelve limnological provinces, demarcated on the geological areas of Miser, are recognized as having waters with distinctive ionic compositions (Figure 1). The geological areas having waters of similar ionic composition have been grouped. Gypsum had a marked affect on the ionic composition when it occurred and these areas have been separated from the non-gypsum areas (non-gyp) in each of the provinces.

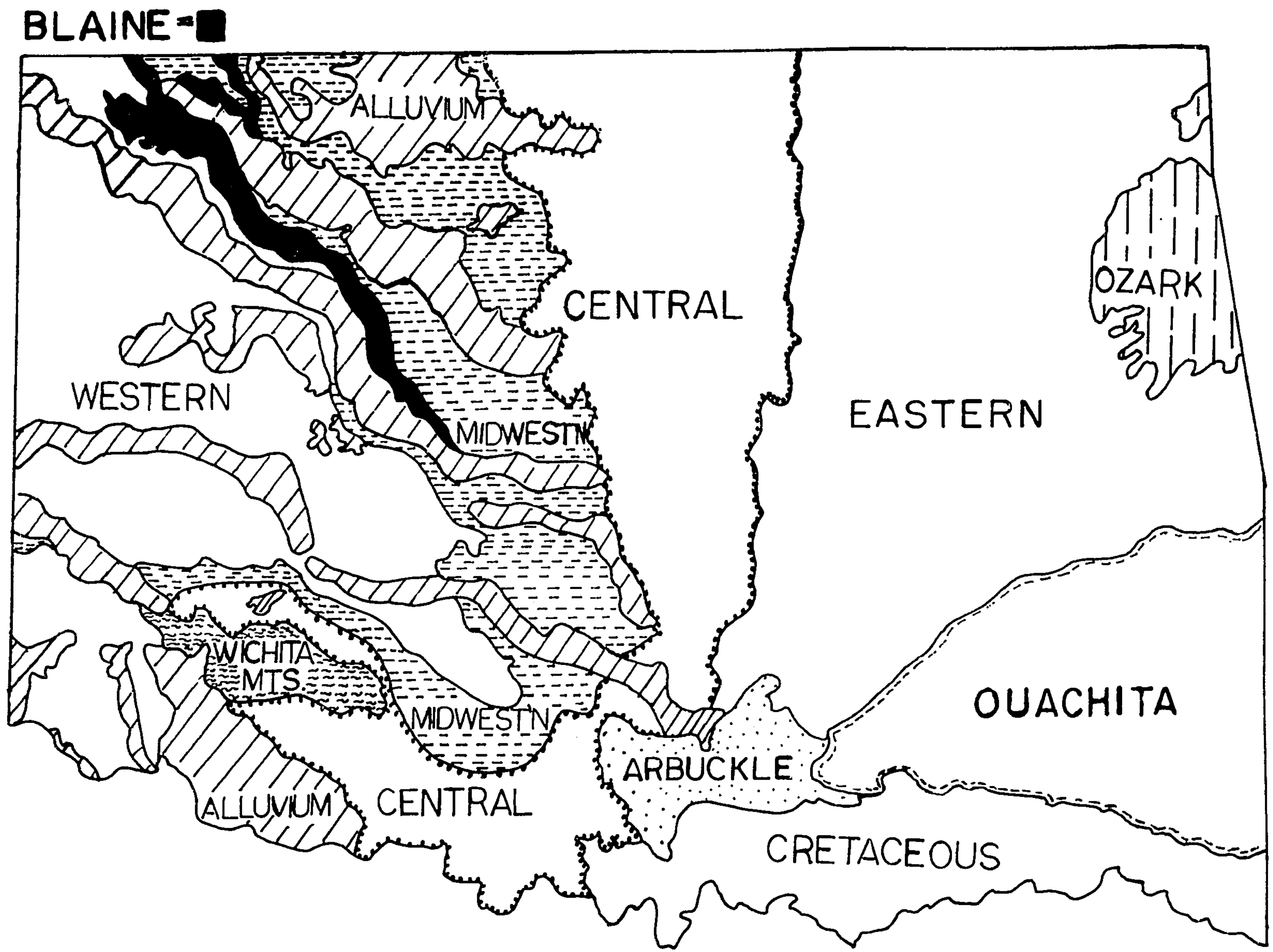



Figure 1: The Limnological Provinces of Oklahoma.

Western Oklahoma Provinces

In western Oklahoma, the large amount of salts deposited in the Permian rocks influenced the water in this region to be rich in sodium, calcium, potassium, magnesium, bicarbonates and sulfates as compared to waters in other parts of the state (Table 1).

Blaine Province.--Impoundments located in the Blaine gypsum in northwestern Oklahoma were characterized by consistently high values for all cations as well as sulfates. The average specific conductance was 2,866 $\mu$ mhos/cm$^3$ at 25$^{o}$C.

Western Province.--The Western Province was generally lower in ions than other provinces of Permian rock. Ion concentrations were similar to those of the Central Province with the exception of sodium which was less in the Western. The average specific conductance was 225 $\mu$ mhos/cm$^3$.

Midwestern Province.--The calcium, sodium, bicarbonate and specific conductance values were higher than for the Permian areas of the western half of the state. The average specific conductance was 422 $\mu$ mhos/cm$^3$.

Alluvium Province.--The western alluvium is rich in salts drained from salt rich areas. Leaching in some regions has resulted in a reduction making the ionic composition of the Alluvium Province varied. The specific conductance in the non-gyp areas averaged 523 $\mu$ mhos/cm$^3$ and 1,922 $\mu$ mhos/cm$^3$ in the gyp areas.

Table 1: Chemical characteristics of the Limnological Provinces, 1961. Province mean ± standard error.

| PROVINCE (N) | $PO_4$ ppm | $HCO_3$ ppm | Ca ppm | Na ppm | K ppm | Mg ppm | $SO_4$ ppm | Conductivity u mhos/cm$^3$ at 25°C |
|---|---|---|---|---|---|---|---|---|
| OUACHITA (4) | .0925 ± .1673 | 33.50 ± 7.36 | 10.75 ± 1.38 | 3.25 ± 0.56 | 1.75 ± 0.48 | 3.00 ± 0.00 | < 50 | 60.75 ± 15.29 |
| OZARK (4) | .0750 ± .0195 | 37.00 ± 14.88 | 6.50 ± 3.77 | 1.50 ± 0.91 | 6.25 ± 2.18 | 3.50 ± 0.29 | < 50 | 76.75 ± 26.83 |
| CRETACEOUS SANDSTONE (7) | .0614 ± .0005 | 67.14 ± 15.30 | 15.14 ± 1.05 | 4.14 ± 0.88 | 10.57 ± 7.73 | 16.28 ± 6.33 | <50 | 146.71 ± 40.71 |
| CRETACEOUS LIMESTONE (5) | | 184.40 ± 51.96 | 30.80 ± 11.55 | 7.40 ± 1.60 | 3.40 ± 1.08 | 3.80 ± 0.58 | <50 | 271.60 ± 48.99 |
| EASTERN (20) | .0935 ± .0073 | 49.90 ± 7.94 | 11.70 ± 2.02 | 6.70 ± 0.52 | 7.00 ± 0.72 | 6.25 ± 1.47 | <50 | 131.90 ± 18.54 |
| CENTRAL (20) | .1010 ± .0145 | 106.70 ± 12.14 | 25.75 ± 3.05 | 14.65 ± 3.75 | 6.60 ± 0.72 | 7.85 ± 1.49 | <50 | 249.75 ± 28.75 |
| WICHITA MTS. (3) | .0766 ± .0334 | 51.66 ± 3.26 | 17.33 ± 6.74 | 6.33 ± 1.67 | 7.00 ± 4.51 | 3.33 ± 1.14 | <50 | 130.33 ± 18.44 |
| ARBUCKLE MTS. (6) | .0633 ± .0033 | 116.66 ± 28.96 | 26.30 ± 3.21 | 11.30 ± 7.49 | 3.50 ± 0.88 | 20.16 ± 6.89 | <50 | 271.50 ± 66.05 |
| MIDWESTERN NON-GYP (13) | .1190 ± .0296 | 148.92 ± 17.71 | 39.77 ± 4.01 | 28.75 ± 3.46 | 8.55 ± 1.76 | 21.23 ± 4.32 | <50 | 441.62 ± 69.25 |
| MIDWESTERN GYP (11) | .1180 ± .0162 | 126.73 ± 22.18 | 199.82 ± 62.40 | 203.36 ± 75.30 | 14.73 ± 3.04 | 55.00 ± 20.70 | 462.4 ± 116.9 | 1,735.27 ± 447.20 |
| WESTERN NON-GYP (12) | .1569 ± .0009 | 100.60 ± 11.30 | 31.54 ± 4.29 | 4.77 ± 1.40 | 11.77 ± 3.29 | 10.61 ± 2.32 | <50 | 224.9 ± 10.10 |
| ALLUVIUM NON-GYP (16) | .1456 ± .0608 | 149.30 ± 24.00 | 34.18 ± 6.42 | 65.81 ± 19.66 | 10.00 ± 1.59 | 17.75 ± 3.36 | <50 | 523.00 ± 116.70 |
| ALLUVIUM GYP (3) | .1130 ± .0417 | 162.00 ± 61.08 | 188.00 ± 29.40 | 150.30 ± 35.87 | 9.33 ± 3.77 | 46.00 ± 5.39 | 640.7 ± 163.7 | 1,922.00 ± 350.23 |
| BLAINE (5) | | 66.80 ± 5.46 | 294.40 ± 41.70 | 189.20 ± 93.40 | 13.00 ± 1.52 | 85.00 ± 43.93 | 1,086.6 ± 92.0 | 2,866.40 ± 472.80 |

Central Province.--The waters of the Central Province had a lower ionic composition than the Midwestern Province to the west and higher values than provinces to the east. The average specific conductance was 250 μ $mhos/cm^3$.

## Eastern Oklahoma Provinces

Although the waters of eastern Oklahoma are not so varied as those of the western part and have moderate to low concentrations of ions, there appears to be sufficient reason for recognizing six provinces. The names are modifications of the physiographic provinces (Curtis and Ham, 1957).

Eastern Province.--The Eastern Province includes a wide range, from the very low ionic areas on the east to the much higher areas in the northern part. The average specific conductance was 132 μ $mhos/cm^3$.

Cretaceous Limestone Province and Cretaceous Sandstone and Shale Province.--Relatively uniform ion concentrations characterized the two Cretaceous provinces. Some ionic values were similar to the Eastern Province and others were higher. Ionic content of the Cretaceous Sandstone and Shale Province was higher than that of the Ouachita Mountain Province. The Cretaceous Limestone Province is separated from the surrounding province of sandstone and shale by the higher calcium, bicarbonate, carbonate and specific conductance values. The average specific conductance for the

Cretaceous Limestone Province was 272 $\mu$ mhos/cm$^3$ and 147 $\mu$ mhos/cm$^3$ for the Cretaceous Sandstone Province.

<u>Arbuckle Mountain Province</u>.--The Arbuckle Mountain Province while surrounded by the Central, Eastern, Ouachita and Cretaceous provinces is delineated by geology. Its average specific conductance was 272 $\mu$ mhos/cm$^3$.

<u>Ozark Plateau Province</u>.--The Ozark Plateau Province is demarcated by low ionic values. The major rocks of the area are cherts with highly insoluble silicates and low ionic values are expected. The average specific conductance was 77 $\mu$ mhos/cm$^3$.

<u>Ouachita Mountain Province</u>.--The Ouachita Mountain Province was also characterized by low ionic values. The average specific conductance was 61 $\mu$ mhos/cm$^3$, the lowest of all provinces.

In summary, the provinces are separated by geology, geographic location and by unique combinations of ionic values. The ionic values of the gyp area were separated from the non-gyp areas (Table 1). Ion concentrations of adjoining provinces were tested for significantly different ion concentrations with the "t" test. Adjoining provinces were usually separated by two or more ions which are of statistically different concentrations (Figure 2).

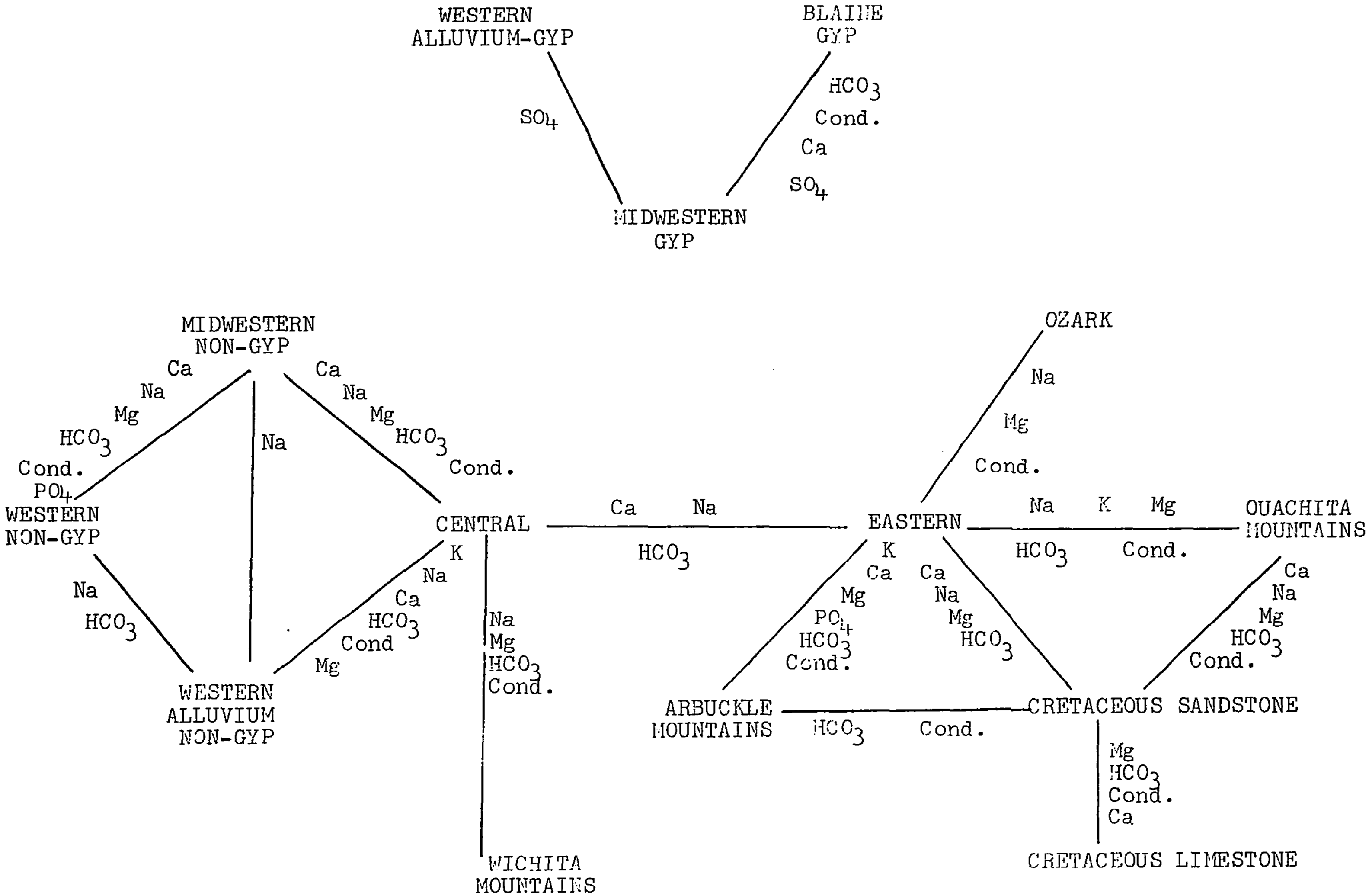



Figure 2: Chemical differences between adjoining provinces. The factors listed are those which are significantly different between provinces using the "t" test.

Cladocera and Copepoda

The Cladocera, are sometimes cited as a group where a geographical distribution study promises little because such species as *Chydorus sphaericus* are cosmopolitan. But the range of many forms includes several continents while a significant number are restricted even further. Studies of taxonomy and distribution could be of considerable zoogeographical interest (Brooks, 1959).

Most species of Cladocera are littoral but the limnetic region of lakes has a cladoceran population large in individuals but not rich in species (*Daphnia*, *Diaphanosoma*, *Bosmina* and *Holopedium*; Brooks, 1959). The Cladocera of Oklahoma have been described by Jones (1954, 1955).

The number of generations of perennial species may be ten per year in temperate lakes. The number may be less than occurs in rotifers, but more than would be expected in copepods (Hutchinson, 1967).

The Copepoda contain the most important planktonic crustacea. The fresh water copepods, particularly the Diaptomidae, appear to exhibit a great deal of regional endemicity. In the list of North American copepods approximately half the cyclopoid species are known in the Old World, whereas only about 10 percent of the Calanoida occur in both areas (Hutchinson, 1967).

Most Calanoida belong permanently to the plankton. There is a differentiation between pond and lake and between limnetic and littoral species. The calanoids mature in one to two months and live for 10 to 13 months. Some are multivoltine, with many generations per year, while others are univoltine, exhibiting a single generation per year.

The Cyclopoida are mainly littoral benthic pond forms but the small proportion of planktonic species is of immense importance. Nearly all species are cosmopolitan and of wide distribution.

The Cladocera and Copepoda represent major planktonic groups which are basic to fresh water food chains. They have a longer life span and period of development than do phytoplankton and rotifers and their populations are not as likely to have as rapid a fluctuation.

The objectives were: primarily, to study copepod and cladoceran productions in relation to the limnological provinces in Oklahoma to determine whether or not differences in production could be detected between provinces during the spring; and secondarily, to study species distribution of copepods and cladocera in relation to the limnological provinces in Oklahoma to determine whether or not species were limited in their distribution from province to province.

# METHODS

## The Lakes Sampled

From April 16 to May 2, 1965, 32 impoundments were visited and in 1966 between April 7 and May 1, 54 lakes were visited. Of these 86 lakes, 81 are included in this study. A total of 65 different impoundments were visited during the two years. Each year collections were begun in the southern part of the state and continued northward. It was hoped that in this way the lakes would be sampled more at the same state of seasonal development and the effect of seasonal succession could be minimized.

The lakes sampled were grouped into eleven provinces. The Cretaceous Limestone Province is a narrow band and no lakes existed in it alone. Several lakes in the Cretaceous Sandstone appeared to have drainages which included some of the Cretaceous Limestone. In this investigation, the lakes of these two areas were grouped as Cretaceous. Otherwise lakes were selected whose drainages were restricted to one province.

The average size of the lakes was 200 acres and the average maximum depth of the samples was 5 meters. Lakes in

Oklahoma are almost all man-made, very shallow and relatively smaller than lakes in other parts of the continent. These small shallow lakes are more subject to rapid temperature changes and stratify only during periods of no wind and high temperatures. During the summer the bottom temperatures are lower than the surface but never reach 4°C, thus classifying the lakes as temperate, third order lakes (Welch, 1952). Exact locations for the lakes may be obtained from the Oklahoma Water Resources Board (1965).

## Methods of Collection

All plankton collections were made in the deep-water area of the lakes. Ruttner (1963) stated that observations of a particular place are valid for the lakes as a whole because the horizontal distribution of plankton is approximately of the same density provided the basin is not too extensive, not divided into separate basins and not too shallow. Horizontal distribution depends on age, sex, food organisms and the species. Species have been shown to be randomly distributed horizontally and then the same forms have been shown to be superdispersed horizontally by other investigators (Hutchinson, 1967).

Three methods were used in sampling the plankton populations. With the first, called the vertical haul sample, a No. 25 silk bolting plankton net 20 cm in diameter was allowed to sink to the bottom, then drawn to the surface. All the contents were washed into the collecting bottle and preserved. The number in the vertical haul was divided by the depth of the water column sampled to get a quantitative measurement per meter.

With the second method, ten liters were collected at a certain depth using the Kemmerer water bottle and emptied into a No. 25 plankton net and preserved. This way the plankton from a definite quantity of water at a particular depth was sampled. In lakes where the top, middle and bottom meters were sampled, these values were averaged to give a top, middle and bottom mean. The Kemmerer water bottle was filled five times for each depth to minimize any clumping effect of the plankton.

In the 1966 collections, an additional method was the horizontal tow. A No. 25 mesh nylon net, 50 cm in diameter was towed 20 feet behind the boat through the deep water area for one minute. The boat was headed into the wind and speed was maintained to keep the net in the upper three meters. This sample was preserved after all the plankton was in the collecting jar. The sample, composed of plankton and water, was measured into a graduated tube and the water was drawn off by a Buchner funnel. The total volume minus the volume of water removed gave the volume of plankton present.

To give an indication of the amount of variation within a lake, five lakes were sampled twice in 1966 (Table 2). Collections were taken under different conditions

Table 2: Differences of standing crops and specific conductance within a lake, 1966.

| Province | Lake | Date | Time | Sp. Cond. µmhos/cm$^3$ at 18$^o$C | Vertical Haul (No.) | Vertical/ Depth (No./m) | Horizontal Tow (ml) | Top, Middle Bottom, Ave (No./l) |
|---|---|---|---|---|---|---|---|---|
| Wichita Mts. | Q. Parker I | 4/16 | 06:30 | 174 | 744 | 186 | 8.7 | 27.0 |
| | Q. Parker II | 4/14 | 12:45 | 158 | 2,482 | 354 | 11.0 | 22.0 |
| Wichita Mts. | E. Thomas I | 4/15 | 18:00 | 171 | 7,300 | 1,043 | 8.8 | 113.7 |
| | E. Thomas II | 4/14 | 09:15 | 166 | 3,580 | 398 | 9.1 | 17.1 |
| Eastern | Wetumka I | 4/30 | 18:30 | 271 | 1,588 | 318 | 3.0 | 30.5 |
| | Wetumka II | 4/28 | 13:30 | 260 | 427 | 81 | 5.9 | 7.2 |
| Alluvium | Elmer I | 4/17 | 10:45 | 367 | 8,080 | 3,026 | 8.0 | 79.1 |
| | Elmer II | 4/21 | 12:30 | 384 | 1,868 | 467 | 38.5 | 85.0 |
| Blaine | Watonga I | 4/17 | 08:00 | 1,878 | 9,592 | 1,599 | 8.1 | 73.3 |
| | Watonga II | 4/21 | 10:50 | 1,404 | 4,076 | 816 | 3.5 | 48.7 |

and the variation within a lake was large with all three methods.

During the summer of 1967, I did a study to get an indication of the amount of variation between repeated collections using the same three methods. The vertical haul samples had a coefficient of variation (Steel and Torrie, 1960) of 23% while the horizontal tow was 42%. Ten liter samples taken repeatedly at the same depth had coefficients of variation from 35% to 71%. The samples were taken during mid-summer when the plankton is minimal and this may have magnified the amount of variation. However, it seemed that the vertical haul had the best reliability between replicate samples.

Winsor and Clarke (1940) reported a coefficient of variation of 53% in repeated vertical hauls taken on the same lake while other investigators reported 43% and 47%. Ruttner (1963) stated that variations of 10 to 20% are to be expected in plankton counts.

At the plankton sampling station, an Industrial Instruments Soil Conductivity Bridge Model No. RC-12 CIP was used to measure specific conductance. The conductivity bridge had been modified by the addition of a photoelectric cell and photoresistance readings for light penetration were taken until zero penetration or the bottom was reached. Water temperatures were recorded for every meter using a Foxboro underwater thermometer.

Juday and Birge (1933) found specific conductance was characteristic of a lake and tended to remain approximately the same. Rodhe (1949) demonstrated that measuring total content of electrolytes provided a measurement of total mineral content. Edmondson (1956) used electrical conductivity to measure salt content, while Williams (1966) used conductivity to measure total dissolved solids.

Previous work has shown that the specific conductance values can be characteristic of a province (Table 1). A comparison of province conductivities between 1961 and the current study (Tables 1 and 3) illustrated the relative constancy of this measurement for a province. The specific conductance for a province will fall within a certain range, and thus can be helpful in determining the province of a lake. The variation found between lakes sampled in both 1965 and 1966 (Table 3) was with a few exceptions, small.

## Methods of Counting and Identification

In the vertical and quantitative samples the number of adult copepods and cladocera were counted using a gridded petri dish and dissecting scope. If individuals were scarce, the entire sample was counted. If a large number of individuals was present the total number was estimated by a partial count. Organisms were identified to genus during the counting and representative individuals were withdrawn, dissected when necessary, then permanently mounted in glycerin jelly or Turtox CMC-S, sealed and identified using

Table 3: Specific conductance differences between years and province means 1965, 1966.

| Province Lake | 1965 | 1966 | Province N | Specific Conductance Mean ± Standard Error |
|---|---|---|---|---|
| OUACHITA | | | 8 | 66.3 ± 3.10 |
| Clayton | 54.2 | 53.8 | | |
| O. Cobb | 65.2 | 58.8 | | |
| N. Waiya | 75.6 | 73.2 | | |
| Schooler | 73.6 | 63.4 | | |
| OZARK | | | 6 | 119.8 ± 15.66 |
| Francis | 243.3 | 201.9 | | |
| Greenleaf | 191.9 | 127.9 | | |
| CRETACEOUS | | | 5 | 177.3 ± 23.62 |
| Carter | 243.9 | 212.0 | | |
| R. Gary | 157.4 | 166.9 | | |
| EASTERN | | | 20 | 271.5 ± 42.49 |
| Holdenville | 161.3 | 154.6 | | |
| Okmulgee | 265.0 | 297.9 | | |
| Bluestem | 546.0 | 482.2 | | |
| Hominy | 869.4 | 282.4 | | |
| Carleton | 78.3 | 57.2 | | |
| CENTRAL | | | 11 | 325.7 ± 37.54 |
| Shawnee | 265.0 | 213.7 | | |
| Pawnee | 446.6 | 339.0 | | |
| WICHITA MTS. | | | 9 | 144.1 ± 15.66 |
| Rush | 105.6 | 90.2 | | |
| ARBUCKLE MTS. | | | 3 | 295.9 ± 18.40 |
| Mountain | 281.7 | 332.4 | | |
| MIDWESTERN | | | 5 | 459.7 ± 71.58 |
| WESTERN | | | 4 | 615.2 ± 74.75 |
| Hobart | 780.4 | 588.2 | | |
| Clinton | 696.8 | 455.4 | | |
| ALLUVIUM | | | 6 | 1,044.4 ± 210.45 |
| Mahoney #1 | 1,459.2 | 1,207.4 | | |
| BLAINE | | | 3 | 1,772.1 ± 176.72 |
| Watonga | 1,989.6 | 1,904.8<br>1,422.0 | | |

Pennak (1963) and Yeatman (1959) for the cyclopoid copepods, Wilson (1959) for the calanoid copepods, and Brooks (1957, 1959) for the cladocera.

## PLANKTON PRODUCTION

### The Amount of Plankton Collected

Horizontal tows yielded from 0.9 ml of plankton per minute of towing in Lake Carleton to 69.5 ml in Yashoo Lake; however, most values were around 2 to 4 ml or 9 to 10 ml. The top, middle and bottom mean ranged from 286 individuals per liter in Snyder Lake to 0.9/1 in Lake Francis. Six lakes had means of over 100/1 while three lakes were under 10/1.

The horizontal tow collected only those organisms present in the upper water layers. Collections were made under varying conditions of cloud cover and at different times of the day. These factors influence the vertical migration of the Cladocera and Copepoda and the amount of plankton present at the towing depth. The top, middle and bottom mean tended to offset the different amounts of plankton resulting from the movement of plankton with light changes but sometimes collections occurred in the area of greatest concentration, while other times they did not.

The vertical haul counts ranged from a total of 9,592 adult copepods and cladocera in Watonga Lake to 49 in Lake Francis. Seven lakes had counts of over 5,000 while twelve were below 1,000 and six of these were below 500. Only in the vertical hauls where the entire water column was sampled could the entire population be represented. The data from this method are used in the remainder of the paper (Table 4).

The coefficient of variation of the vertical samples ranged from 6.86% in the Arbuckle Mts. Province to 114.69% in the Ozark Province (Table 5). The mean of all the coefficients of variation for all provinces for the vertical haul was 58.33%. This was higher than the coefficient of variation obtained for replicate samples on one lake (23%) during the summer of 1967 but not much higher than the values others have reported for replicate samples on the same lake (Winsor and Clarke, 1940).

## Plankton Production with Respect to Province

The most comprehensive measurement taken of the water chemistry was specific conductance which is a result of all the ions present. In general, the conductivity for each province increased as each of the various ions increased (Table 6). Thus there was a general increase in conductivity as the amount of plankton increased (Figure 3). The correlation coefficient between the mean province conductivity and the mean province vertical haul was .57 indicating a positive correlation between the two variables.

Table 4: Standing crops of Plankton according to province (mean ± standard error).

| Province | N | Vertical Haul (No.) | Vertical/ Depth (No./m) | Horizontal Tow (ml) | Top, Middle, Bottom Ave. (No./l) |
|---|---|---|---|---|---|
| Ouachita | 4 | 1,436 ± 213 | 376 ± 61 | 4.9 ± 2.1 | 50.1 ± 14.5 |
| Ozark | 3 | 734 ± 484 | 112 ± 83 | 2.2 ± 0.4 | 14.5 ± 7.7 |
| Cretaceous | 3 | 2,120 ± 576 | 440 ± 103 | 30.9 ± 19.2 | 94.3 ± 38.2 |
| Eastern | 14 | 1,042 ± 187 | 168 ± 44 | 4.9 ± 0.9 | 18.9 ± 2.7 |
| Central | 7 | 2,046 ± 421 | 369 ± 58 | 5.4 ± 1.0 | 64.8 ± 12.1 |
| Wichita Mts. | 6 | 4,872 ± 1,224 | 680 ± 208 | 10.3 ± 1.0 | 55.3 ± 20.9 |
| Arbuckle Mts. | 2 | 2,331 ± 115 | 307 ± 63 | 23.4 ± 14.6 | 16.1 ± 8.2 |
| Midwestern | 4 | 3,355 ± 1,579 | 1,047 ± 661 | 19.4 ± 6.9 | 67.5 ± 17.5 |
| Western | 2 | 3,952 ± 2,016 | 687 ± 232 | 9.5 ± 2.0 | 59.6 ± 31.4 |
| Alluvium | 5 | 2,679 ± 428 | 902 ± 146 | 18.7 ± 1.9 | 124.7 ± 43.7 |
| Blaine | 2 | 6,834 ± 2,759 | 1,207 ± 392 | 5.8 ± 2.3 | 61.0 ± 12.3 |

Table 5: Coefficient of variation of the sampling methods.

| Province | Vertical Haul | Vertical/ Depth | Horizontal Tow | Top, Middle, Bottom Ave. |
|---|---|---|---|---|
| OUACHITA | 29.60 | 32.18 | 85.71 | 58.08 |
| OZARK | 114.69 | 128.57 | 36.36 | 92.41 |
| CRETACEOUS | 47.03 | 40.45 | 107.77 | 69.99 |
| EASTERN | 66.99 | 97.62 | 65.31 | 54.50 |
| CENTRAL | 54.45 | 41.73 | 50.00 | 49.38 |
| WICHITA MTS. | 61.53 | 75.00 | 24.27 | 92.77 |
| ARBUCKLE MTS. | 6.86 | 28.99 | 88.46 | 72.05 |
| MIDWESTERN | 94.10 | 126.17 | 70.62 | 51.85 |
| WESTERN | 72.14 | 47.60 | 29.47 | 74.33 |
| ALLUVIUM | 37.74 | 38.14 | 24.60 | 82.76 |
| BLAINE | 57.08 | 45.90 | 56.90 | 28.52 |
| Mean C.V. for all Provinces | 58.38 | 63.85 | 58.13 | 66.06 |

Table 6: Relationship of plankton standing crop to the chemical characteristics of the provinces.

| Province | $PO_4$ ppm | $HCO_3$ ppm | Ca ppm | Na ppm | K ppm | Mg ppm | $SO_4$ ppm | 1961 Specific Conductivity $\mu$ mhos/cm3 at 25°C Mean + Standard Error | 1966 Vertical Haul (No.) Mean + Standard Error |
|---|---|---|---|---|---|---|---|---|---|
| Ouachita | .09 | 34 | 11 | 3 | 2 | 3 | <50 | 61 ± 15 | 1,436 ± 213 |
| Ozark | .08 | 37 | 7 | 2 | 6 | 4 | <50 | 77 ± 29 | 734 ± 484 |
| Cretaceous Sandstone | .06 | 67 | 15 | 4 | 11 | 16 | <50 | 147 ± 41 | 2,120 ± 576 |
| Eastern | .09 | 50 | 12 | 7 | 7 | 6 | <50 | 132 ± 18 | 1,042 ± 187 |
| Central | .10 | 107 | 26 | 15 | 7 | 8 | <50 | 250 ± 29 | 2,046 ± 421 |
| Wichita Mts. | .08 | 52 | 17 | 6 | 7 | 3 | <50 | 130 ± 18 | 4,872 ± 1,224 |
| Arbuckle Mts. | .06 | 117 | 26 | 11 | 4 | 20 | <50 | 272 ± 66 | 2,331 ± 115 |
| Midwestern non-gyp | .12 | 149 | 40 | 29 | 9 | 21 | <50 | 442 ± 69 | 3,355 ± 1,579 |
| Western non-gyp | .16 | 101 | 32 | 5 | 12 | 11 | <50 | 225 ± 10 | 3,952 ± 2,016 |
| Alluvium gyp | .11 | 162 | 188 | 150 | 9 | 46 | 641 | 1,922 ± 350 | 2,679 ± 428 |
| Blaine | -- | 67 | 294 | 189 | 13 | 85 | 1,087 | 2,866 ± 473 | 6,834 ± 2,759 |

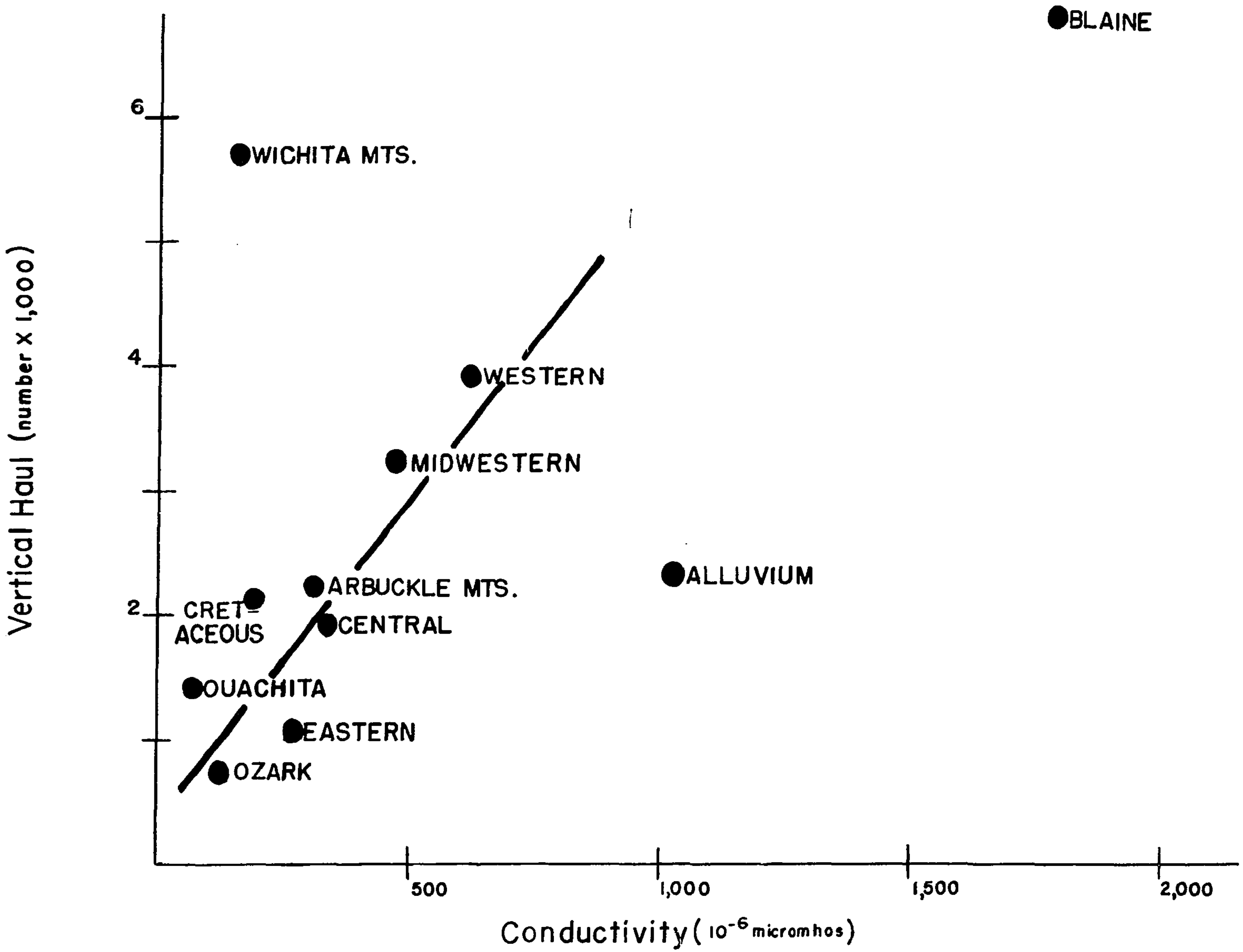



Figure 3: Province vertical haul in relation to province conductivity.

## Plankton Production with Respect to Physical and Morphological Conditions

Attempts were made to correlate the amount of plankton to the depth, surface area and water temperature of the lakes. Smaller shallower lakes are usually more productive than deeper larger lakes (Welch, 1952). The correlation coefficient between the lake vertical haul and lake size was -.11. The correlation coefficient between lake vertical haul and lake depth was .026. Thus in this study, the size and depth of the lakes showed no relationship to the amount of plankton collected.

The correlation coefficient between the mean lake temperature and the amount of plankton present in the vertical haul was -.12 showing that there was no correlation even though thermal stratification was present in 33% of the lakes in 1966. Stratification was present in 55% of the 1965 lakes and the mean air temperature was 8$^{\circ}$F higher than in 1966 (Weather Bureau, 1965, 1966).

Light penetration values showed that the small lakes of the Wichita Mountains were all relatively clear. These lakes supported large growths of higher aquatic vegetation in the limnetic area. Some of the organisms collected from these lakes were weed-inhabiting forms which may account for the increased production in the Wichita Mountain Province.

## SPECIES DISTRIBUTION

### Kinds of Plankton Collected

A total of four Diaptomidae, six Cyclopoidae and twenty-one Cladocera were identified from the limnetic samples of all the lakes during the two years of sampling. The species found most frequently, the cladoceran *Bosmina longirostris*, occurred in 60 of the 81 lakes or in 74% of all the samples (Table 7). Other cladocerans collected in order of decreasing frequency were: *Daphnia parvula*, *Diaphanosoma* sp., *Ceriodaphnia lacustris*, *Chydorus sphaericus*, *Daphnia ambigua*. Cladocerans occurring in less than 10% of the samples were: *Daphnia laevis*, *Pleuroxus denticulatus*, *Simocephalus serrulatus*, *Daphnia schodleri* and *Holopedium amazonicum*.

*Diaptomus pallidus* (68%) was the most frequently collected diaptomid while *Mesocyclops edax* (72%) was the most frequently collected cyclopoid. Other copepods ranked in decreasing frequency were: *Cyclops bicuspidatus thomasi*, *D. siciloides*, *Cyclops vernalis*, *D. reighardi*, *D. clavipes* and *Macrocyclops albidus*.

Even though a total of 31 species was found only about 10 of these comprised a major part of the plankton

Table 7: Percentage of lakes in each province in which the major species occurred 1965, 1966.

| Species | Province (N): Ouachita (6) | Ozark (6) | Cretaceous (7) | Eastern (21) | Wichita Mts. (9) | Central (11) | Arbuckle Mts. (3) | Midwestern (5) | Western (4) | Alluvium (6) | Blaine (3) | Total Occurrences (81) | % Occurrence in all lakes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. edax | 100 | 50 | 100 | 85 | 56 | 82 | 67 | 40 | 25 | 50 | 67 | 58 | 72 |
| B. longirostris | 83 | 83 | 100 | 76 | 100 | 73 | 67 | 60 | 50 | 33 | 33 | 60 | 74 |
| C. lacustris | 67 | 67 | 100 | 67 | 33 | 18 | 33 | 40 | 50 | 67 | 33 | 44 | 54 |
| C. sphaericus | | 17 | 57 | 38 | 89 | 27 | 67 | 40 | 75 | 33 | 67 | 34 | 42 |
| D. pallidus | 100 | | 100 | 62 | 89 | 55 | 100 | 60 | 75 | 100 | 100 | 55 | 68 |
| C. vernalis | | 33 | | 15 | 33 | 55 | 33 | 80 | 100 | 17 | 67 | 26 | 32 |
| B. coregoni | 17 | | | 19 | 11 | 27 | 33 | 60 | 75 | 50 | | 19 | 23 |
| D. siciloides | 17 | | | 38 | | 91 | 33 | 60 | 75 | | | 26 | 32 |
| D. parvula | 50 | 100 | 86 | 81 | 11 | 82 | | 100 | 100 | 50 | | 54 | 67 |
| D. ambigua | 50 | 33 | 29 | 38 | 89 | 9 | | | | 33 | 100 | 29 | 36 |
| Diaphanosoma sp. | 83 | 50 | 100 | 81 | 33 | 82 | | 20 | | | 33 | 46 | 57 |
| C. b. thomasi | | 67 | 43 | 29 | 11 | 45 | | 20 | | 67 | 100 | 27 | 33 |
| D. laevis | | | | | 22 | 18 | 67 | | | 17 | | 7 | 9 |
| D. schodleri | | | | | 22 | 9 | 33 | | | | | 4 | 5 |
| D. clavipes | | | | 10 | | 9 | | 20 | | 17 | | 5 | 6 |
| Pleuroxus sp. | | | 17 | | 67 | | | | | | | 7 | 9 |
| M. albidus | | | | | 22 | | | | | | | 3 | 4 |
| D. reighardi | | 83 | | 43 | | | | | | | | 14 | 17 |
| Holopedium sp. | 67 | | | | | | | | | | | 4 | 5 |

populations while the remainder occurred occasionally. Limnetic communities have a few species each of which may have many individuals and the dominant species are important when community types and the percentage similarity between lakes are being determined. Some of the dominant forms were *Diaptomus pallidus*, *D. siciloides*, *D. reighardi*, *Daphnia parvula*, *D. ambigua*, *C. b. thomasi* and *M. edax*. Distributional patterns will be presented for these major forms.

Certain of the major forms of the limnetic zooplankton communities were found in almost all lakes sampled. For this reason it appears that the ion content of the water is not limiting their distribution. These forms were: *Mesocyclops edax*, *Bosmina longirostris*, *Ceriodaphnia lacustris* and *Chydorus sphaericus* (Table 7).

When co-existing species association of *Diaptomus* were studied (Table 8), 76% of the lakes contained only one species. The most frequently found association was *D. pallidus* with *D. siciloides*. Since diaptomid species are known to co-exist (Rigler and Langford, 1967; Cole, 1961) some parameter must be limiting the distribution of the missing species.

## Kinds of Plankton Collected with Respect to the Province

Since the provinces represent areas of similar water quality, a percentage occurrence of each major species was calculated for each province (Table 7). This represented

Table 8: Species associations of *Diaptomus*.

| | Type of Association | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DIAPTOMUS SPP. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| *D. pallidus* | X | | | | X | X | X | X | | | |
| *D. siciloides* | | X | | | X | | | X | X | X | |
| *D. reighardi* | | | X | | | X | | X | X | | |
| *D. clavipes* | | | | X | | | X | | X | X | |
| No. of lakes, 1965 | 15 | 3 | 5 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 28 |
| No. of lakes, 1966 | 21 | 3 | 7 | 0 | 10 | 1 | 1 | 1 | 1 | 2 | 47 |
| Total No. of lakes | 36 | 6 | 12 | 1 | 14 | 1 | 1 | 1 | 1 | 2 | 75 |

the percentage of lakes of each province in which the species occurred. Twelve of the major species were found in conductivity ranges which included the mean conductivities of all the provinces. This suggested that the distribution of these forms was not limited by either the high or low conductivities represented and that the distributions of these species was primarily influenced by factors other than edaphic. However, there are some forms (Diaptomus pallidus, D. reighardi, D. siciloides, Daphnia ambigua, Holopedium) where edaphic control did appear to influence their occurrence in the limnological provinces.

Diaptomus pallidus (Figure 4) occurred from 55 to 100% of the time in lakes of all provinces with the exception of the Ozark Province (Table 7). This gap in occurrence may be influenced directly by the presence of high silicate waters which inhibit the species or indirectly by the high silicate waters enhancing the presence of D. reighardi. D. reighardi (Figure 4) occurred only in the Ozark Province (83%) and the neighboring Eastern Province (43%). D. reighardi distribution is centered in the Great Lakes area and extends into the southern part of the United States (Kincaid, 1953; Wilson, 1959) and Oklahoma may be on the western edge of its distribution.

Since D. siciloides occurred in a wide range of soft and moderately hard waters (Hutchinson, 1967) it would be expected to occur in all provinces. However, it was found

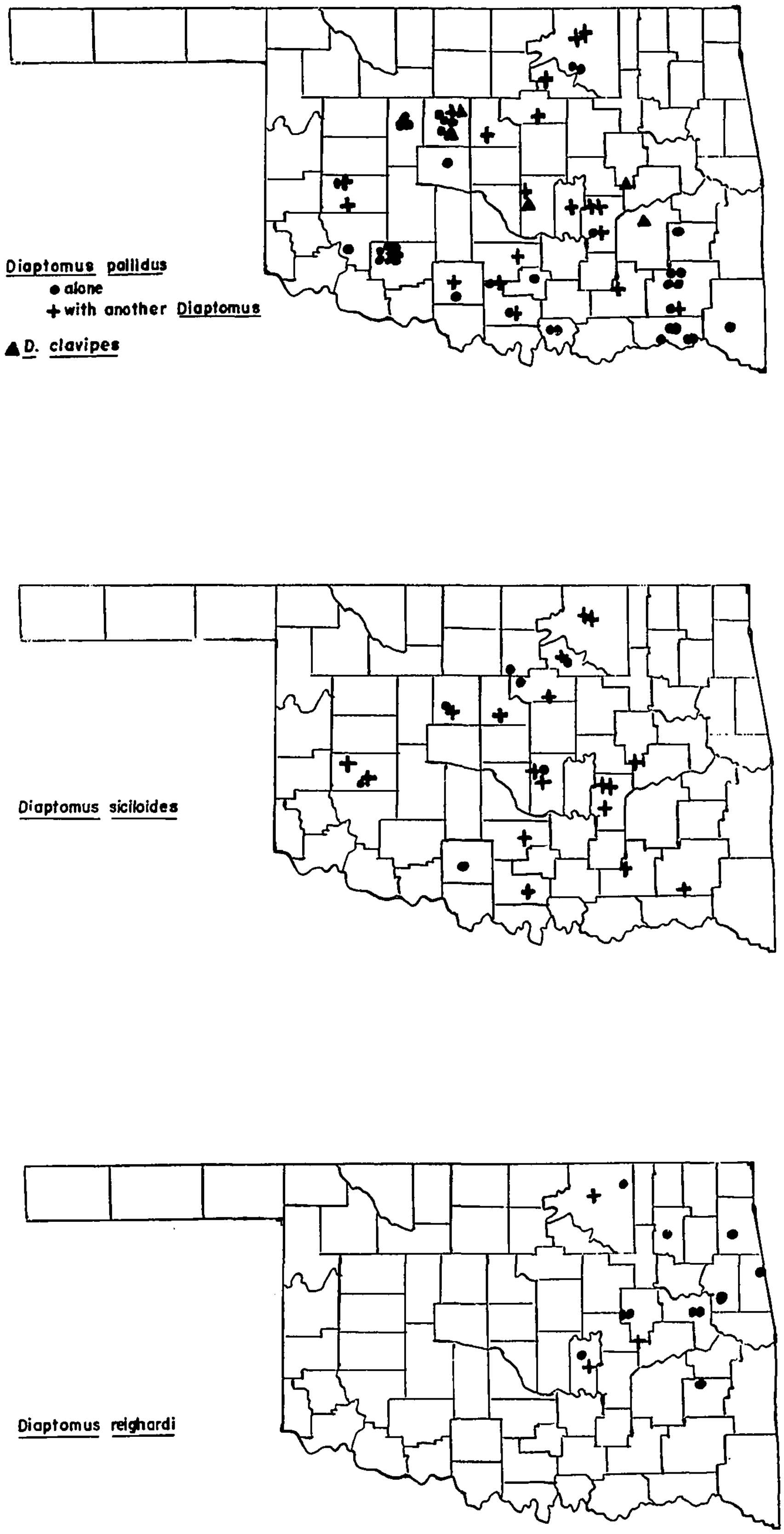
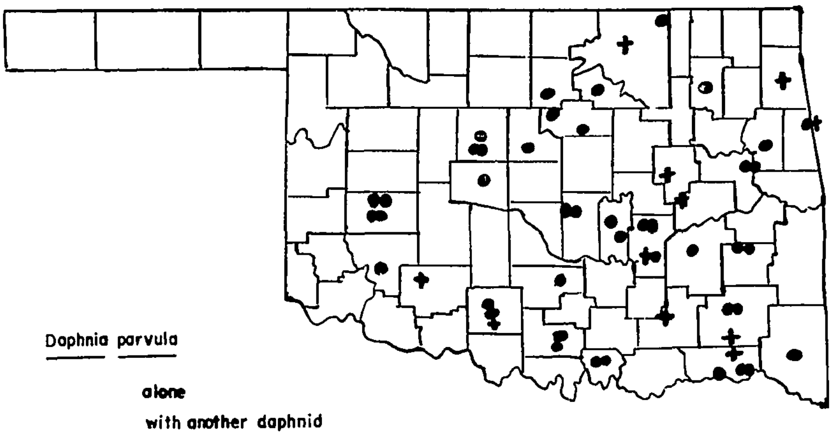



Figure 4: Diaptomid distribution.

only in the Ouachita, Eastern, Central, Arbuckle Mt., Midwestern and Western Provinces (Figure 4) and its absence from the Alluvium, Blaine, Cretaceous and Ozark Provinces is difficult to explain on an edaphic basis.

Since *Daphnia parvula* and *D. ambigua* are southern forms characteristic of ponds and small lakes (Brooks, 1957), they might be expected to occur throughout the state. Absences in the distribution of *D. parvula* were observed in the Arbuckle and Blaine Provinces (Figure 5). The high gypsum of the Blaine Province may exclude *D. parvula* but there is no apparent edaphic basis for its exclusion from the Arbuckles. In Oklahoma, *D. ambigua* (Figure 5) was concentrated in the eastern part suggesting that the higher ionic waters of the western provinces may exert some edaphic control. It occurred in the Blaine 100% of the time suggesting its ability to thrive in high ionic waters even though all the occurrences in this province were in the same lake.

*Daphnia rosea*, *D. laevis*, and *D. schodleri* are primarily inhabitants of ponds (Brooks, 1957). Oklahoma is apparently the eastern limit for *D. schodleri* and it occurred in the Wichita Mountain and Central Provinces. *D. rosea* is also a western species but it was found in the Eastern, Alluvium and Arbuckle Provinces. *D. laevis* is a southern species occurring in the southern third of the United States. In Oklahoma, it was found in the Eastern, Arbuckle and



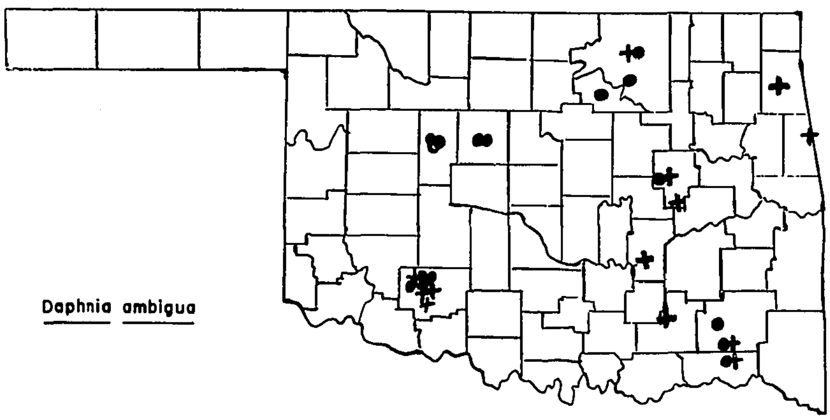




Figure 5: Daphnid distribution.

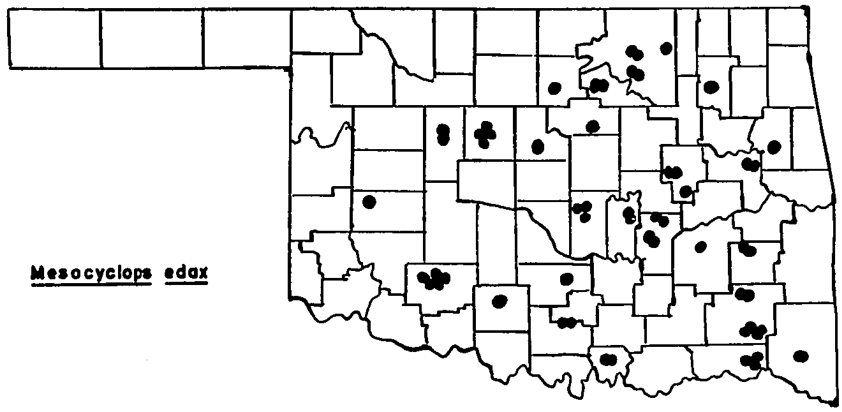
Alluvium provinces. The distribution of these pond daphnids is hard to explain especially in the Arbuckle Mountain Province where _D. laevis_ and _D. schodleri_ seemed to replace _D. parvula_ and _D. ambigua_ in small lakes of 133 and 70 acres.

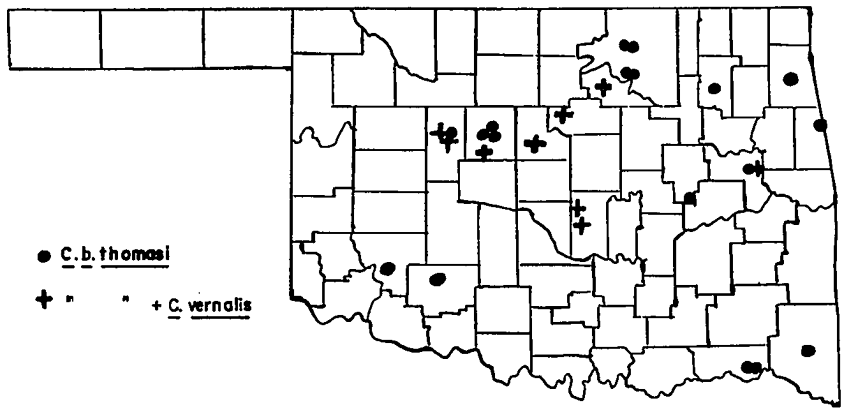
A fairly clear case of edaphic control was presented by _Holopedium_. Its distribution was restricted to a single province, the Ouachita, whose waters are characteristically soft and low in calcium. _H. amazonicum_ is a South American form with its northern most distribution reaching into Oklahoma (Brooks, 1959; Jones, 1954). Its exclusion from other low calcium waters of the state (Eastern and Ozark Provinces) may be due to the limit of its geographical distribution.

## Miscellaneous Factors Influencing Plankton Distribution

Other environmental influences incidental to this study were temperature, light, depth and biological factors. The distribution of certain plankton appeared to be influenced by these factors.

_Cyclops bicuspidatus thomasi_ occurred more in the northern part of the state while _Mesocyclops edax_ was found throughout Oklahoma (Figure 6). The former species is a winter form and the latter a summer species (Cole, 1961) which are believed to go through a seasonal alternation. Temperature seemed to limit the distribution of _C. b. thomasi_ during the spring in Oklahoma.



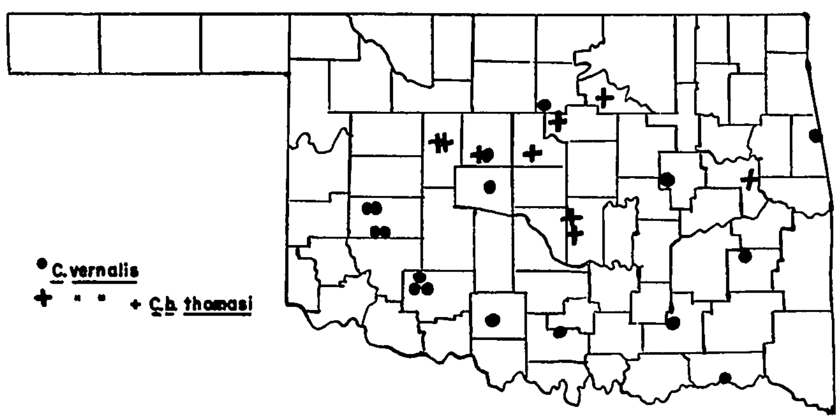




Figure 6: Cyclopoid distribution.

Since eastern temperatures are slightly higher than western temperatures in the spring and Diaphanosoma is a summer form, temperature control was also suggested. This may be the same for D. ambigua but its seasonal distribution is unknown.

Littoral forms limited by depth occurred more frequently in the limnetic plankton of the lakes of the Wichita Mountain Province. This could be directly influenced by the large amount of vegetation covering the bottom of the limnetic zones of these small lakes (10, 11, and 54 acres). Two clear water littoral forms, Eurycercus lamellatus and Leydgia quadrangularis, occurred in one of the clearest lakes of the state in the Cretaceous Province.

The severe amount of competition expected between members of the same subgenus with the same size (which determines food requirements), may account for the fact that Diaptomus pallidus and D. reighardi rarely occurred in the same lake. D. reighardi is known to out-compete D. pallidus (Yeatman, 1956). The coexistence of D. pallidus and D. siciloides occurred more on the eastern side of the range of D. siciloides (Figure 4). When they co-existed in the Central Province, D. siciloides usually outnumbered D. pallidus while in the Eastern Province, D. pallidus usually outnumbered D. siciloides.

Competition may also have influenced the distribution of Cyclops vernalis which occurred in all but one of the provinces. However, it was usually important only in lakes where *M. edax* and *C. b. thomasi* were rare or absent.

# DISCUSSION

The quantity of plankton is influenced by the amount of primary nutritive materials entering a lake and the way these materials are used within a lake. The utilization depends on the climate and the morphology of the lake basin (Rawson, 1941). The amount of primary nutritive materials entering is determined by the kinds of materials in the surrounding area. Thus if the climate and morphological factors could be kept relatively constant, the edaphic influence could be measured.

In this investigation, the influence of morphology and climate were undoubtedly influencing production but exactly how and how much were not determined, since production, in general, showed no correlation with temperature, size or depth of the lake. Therefore, we can conclude that edaphic factors primarily influenced the production level.

This influence could be related to the conductivity in general but not to any specific ion. Conductivity represents a complex of separate ion gradients which are interrelated and together they may have various physiological implications. In addition, there are biological influences such as competitive relations which may produce different biological communities. Conductivity represents the chemical characteristic of an environment in which the biological community is determined and develops.

The quality of plankton is influenced by morphological, climatological and edaphic factors. Some organisms exist only under very special conditions while cosmopolitan forms exist over a wide range.

It was noticed that some species were restricted to certain provinces indicating that edaphic factors were largely operative (D. reighardi in the Eastern and Ozark and Holopedium in the Ouachita) while other species were found in all provinces (M. edax, B. longirostris). D. ambigua and D. parvula were complementary in all provinces to D. laevis and D. schodleri.

When the coefficient of community and percentage similarity (Whittaker and Fairbanks, 1957) were applied to Table 7 to compare community composition both methods showed that distinct communities could not be determined for any of the provinces (Table 9).

The limnological province concept appears to be most useful in the study of crustacean plankton production and of limited use in the study of species distribution. The concept needs to be studied for other trophic levels to determine if the same relationship holds. Further work with plankton should be extended to include all seasons. Limnology needs improved methods for characterizing biological

Table 9: Matrix for comparison of species composition between provinces. Values above the diagonal correspond to accumulative percentage similarities, those below to correspond to the coefficient of community.

| | Blaine | Alluvium | Western | Midwestern | Central | Arbuckle Mts. | Eastern | Cretaceous | Wichita Mts. | Ozark | Ouachita |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ouachita | 316 | 350 | 284 | 304 | 403 | 301 | 493 | 512 | 366 | 333 | |
| Ozark | 299 | 265 | 275 | 330 | 377 | 200 | 461 | 425 | 304 | | 43 |
| Wichita Mts. | 444 | 338 | 313 | 319 | 364 | 400 | 384 | 496 | | 56 | 47 |
| Cretaceous | 395 | 405 | 343 | 366 | 471 | 324 | 548 | | 67 | 67 | 54 |
| Eastern | 348 | 401 | 378 | 441 | 536 | 334 | | 60 | 61 | 71 | 69 |
| Arbuckle Mts. | 333 | 316 | 349 | 332 | 354 | | 50 | 33 | 56 | 33 | 43 |
| Central | 342 | 357 | 414 | 473 | | 67 | 81 | 56 | 76 | 56 | 56 |
| Midwestern | 313 | 360 | 515 | | 80 | 57 | 86 | 57 | 59 | 57 | 57 |
| Western | 330 | 333 | | 75 | 60 | 73 | 64 | 46 | 50 | 46 | 58 |
| Alluvium | 366 | | 62 | 71 | 80 | 57 | 73 | 57 | 69 | 47 | 47 |
| Blaine | | 62 | 50 | 62 | 60 | 46 | 64 | 73 | 60 | 73 | 46 |

production on a regional basis and the limnological province concept offers such a possibility.

# SUMMARY

1. Specific conductance was used to confirm the limnological province for 81 lakes sampled in April 1965 and April 1966. The mean specific conductance for these provinces ranged from 61 to 1,922 $\mu$ mhos/$cm^3$ at 18°C.

2. Limnetic plankton samples were taken and studied quantitatively by counting and qualitatively by species identification. Three methods were used in sampling the standing crop of zooplankton.

3. Plankton production as measured by the vertical haul showed no correlation with the depth, size or temperature of the lake.

4. The quantity of Cladocera and Copepoda showed an increase with conductivity in most cases.

5. No one measure was ideally suited to the above hypothesis but vertical hauls suggested this trend. The top, middle and bottom mean was helpful but horizontal tows showed too much variation and may have been influenced by time of sampling.

6. Certain microcrustaceans were cosmopolitan in the state (*Mesocyclops edax*, *Bosmina longirostris*, *Ceriodaphnia lacustris*, *Chydorus sphaericus*) while others

were restricted. These restrictions appeared to be more influenced by physical and morphological factors than edaphic factors. However, some zooplankters did not appear in certain limnological provinces. In some of these situations edaphic control seemed to be limiting their appearance (*Holopedium*, *Diaptomus reighardi*, *Diaptomus siciloides*, *Daphnia laevis*, *Daphnia schodleri*, *Daphnia ambigua*).

7. Distributional patterns were presented for three species of *Diaptomus*. *D. reighardi* was limited to the northeastern part of Oklahoma while *D. pallidus* was found abundantly over the remainder of the state. *D. siciloides* was characteristic of the western half of the state. *D. clavipes* was found infrequently.

8. Edaphic conditions appeared to influence zooplankton production to a much greater degree than species distribution.

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* Original reference not seen.

# APPENDICES

Appendix I: Miscellaneous collecting data 1965, 1966.

| PROVINCE<br>Lake | Size | Date | Time | Sky |
|---|---|---|---|---|
| OUACHITA | | | | |
| Clayton | 75 acres | 4/17/65 | 10:30 | Clear |
| Nanih Waiya | 131 | 4/17/65 | 09:35 | Clear |
| Ozzie Cobb | 117 | 4/17/65 | 12:00 | Clear |
| Schooler | 35 | 4/17/65 | 14:00 | Clear |
| Clayton | 75 | 4/10/66 | 12:45 | Clear |
| Nanih Waiya | 131 | 4/10/66 | 14:30 | Clear |
| Ozzie Cobb | 117 | 4/10/66 | 12:30 | Clear |
| Schooler | 35 | 4/ 9/66 | 14:45 | Clear |
| OZARK | | | | |
| Greenleaf | 920 | 4/30/65 | 16:30 | Clear |
| Francis | | 5/ 2/65 | 10:15 | Clear |
| Tenkiller | 12,500 | 5/ 2/65 | 15:50 | Clear |
| Greenleaf | 920 | 4/30/66 | 09:00 | Rain |
| Eucha | 2,880 | 4/23/66 | 12:45 | Cloudy |
| Francis | | 4/23/66 | 11:00 | Cloudy |
| CRETACEOUS | | | | |
| Carter | 68 | 4/17/65 | 19:00 | Clear |
| Raymond Gary | 390 | 4/17/65 | 15:15 | Clear |
| Carter | 68 | 4/ 8/66 | 19:00 | Clear |
| Raymond Gary | 390 | 4/ 9/66 | 18:00 | Clear |
| Yashoo | 42 | 4/10/66 | 09:35 | Cloudy |
| EASTERN | | | | |
| Holdenville | 550 | 4/16/65 | 15:15 | Clear |
| McAlester | 2,100 | 4/16/65 | 20:30 | Clear |
| Carleton | 46 | 4/17/65 | 06:30 | Clear |
| Okmulgee | 643 | 4/30/65 | 12:00 | Clear |
| Ardmore Club | 20 | 4/18/65 | 10:00 | Clear |
| Bluestem | 800 | 4/25/65 | 09:45 | Cloudy |
| Hominy | 18 | 4/25/65 | 11:30 | Cloudy |
| Carleton | 46 | 4/10/66 | 17:00 | Clear |
| Atoka Res. | 5,500 | 4/ 9/66 | 10:00 | Clear |
| Okmulgee | 643 | 5/ 1/66 | 10:45 | Cloudy |
| Henryetta | 616 | 4/22/66 | 17:00 | Rain |
| Wetumka I | 185 | 4/30/66 | 18:30 | Cloudy |
| Wetumka II | 185 | 4/28/66 | 13:30 | Cloudy |
| Ardmore City | 115 | 4/ 8/66 | 17:15 | Clear |
| Claremore | 470 | 4/23/66 | 18:30 | Rain |
| Wewoka | 200 | 4/28/66 | 10:00 | Cloudy |
| Sportsman | 355 | 4/28/66 | 09:00 | Cloudy |
| Holdenville | 550 | 4/28/66 | 12:15 | Rain |
| Bluestem | 800 | 4/24/66 | 10:00 | Clear |

Appendix I: Miscellaneous collecting data 1965, 1966 (cont.)

| PROVINCE<br>Lake | Size | Date | Time | Sky |
|---|---|---|---|---|
| EASTERN (cont.) | | | | |
| Hominy | 18 acres | 4/24/66 | 12:30 | Clear |
| Hudson | 335 | 4/24/66 | 06:30 | Clear |
| CENTRAL | | | | |
| Blackwell | 3,380 | 4/25/65 | 15:00 | Clear |
| Pawnee | 257 | 4/25/65 | 12:30 | Cloudy |
| Shawnee | 1,336 | 4/30/65 | 10:45 | Clear |
| Comanche | 201 | 4/18/65 | 13:15 | Cloudy |
| Tecumseh | 127 | 4/28/66 | 15:30 | Cloudy |
| Guthrie | 184 | 4/17/66 | 16:20 | Clear |
| Pawnee | 257 | 4/24/66 | 14:15 | Clear |
| Perry City | 400 | 4/17/66 | 13:45 | Clear |
| Paul's Valley | 750 | 4/ 8/66 | 15:30 | Clear |
| Cushing | 440 | 4/24/66 | 16:00 | Clear |
| Shawnee | 1,336 | 4/30/66 | 15:30 | Rain |
| WICHITA MTS. | | | | |
| Caddo | 11 | 4/23/65 | 15:30 | Clear |
| Post Oak | 10 | 4/23/65 | 16:30 | Clear |
| Rush | 54 | 4/23/65 | 14:30 | Clear |
| Rush | 54 | 4/14/66 | 11:00 | Cloudy |
| Quanah Parker I | 96 | 4/16/66 | 06:30 | Clear |
| Quanah Parker II | 96 | 4/14/66 | 12:45 | Cloudy |
| Jed Johnson | 58 | 4/16/66 | 07:15 | Clear |
| Elmer Thomas I | 422 | 4/15/66 | 18:00 | Clear |
| Elmer Thomas II | 422 | 4/14/66 | 09:15 | Cloudy |
| ARBUCKLE MTS. | | | | |
| Mountain | 133 | 4/18/65 | 11:15 | Clear |
| Mountain | 133 | 4/ 7/66 | 15:40 | Clear |
| Veterans | 70 | 4/ 7/66 | 12:00 | Clear |
| MIDWESTERN | | | | |
| Duncan | 400 | 4/18/65 | 15:30 | Cloudy |
| Northwood | 110 | 4/21/66 | 08:45 | Clear |
| Elmer I | 58 | 4/17/68 | 10:45 | Clear |
| Elmer II | 58 | 4/21/66 | 12:30 | Clear |
| Clear | 560 | 4/14/66 | 16:00 | Clear |
| WESTERN | | | | |
| Hobart | 450 | 4/23/65 | 18:35 | Clear |
| Clinton | 335 | 4/24/65 | 08:40 | Cloudy |
| Hobart | 450 | 4/16/66 | 14:45 | Clear |
| Clinton | 335 | 4/16/66 | 16:30 | Clear |

Appendix I: Miscellaneous collecting data 1965, 1966 (cont.)

| PROVINCE<br>Lake | Size | Date | Time | Sky |
|---|---|---|---|---|
| ALLUVIUM | | | | |
| Mahoney #1 | 10 acres | 4/24/65 | 14:00 | Clear |
| Mahoney #1 | 10 | 4/17/66 | 12:00 | Clear |
| Mahoney #2 | 10 | 4/21/66 | 14:30 | Clear |
| Vincent | 20 | 4/21/66 | 15:30 | Clear |
| Roebuck | 350 | 4/ 9/66 | 16:30 | Clear |
| Snyder | 130 | 4/16/66 | 10:30 | Clear |
| BLAINE | | | | |
| Watonga | 65 | 4/24/65 | 11:25 | Clear |
| Watonga I | 65 | 4/17/66 | 08:00 | Clear |
| Watonga II | 65 | 4/21/66 | 10:50 | Clear |

Appendix II: Conductivity, temperature and light profiles 1965, 1966.

| PROVINCE | OUACHITA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Clayton 1965 | N. Waiya 1965 | O. Cobb 1965 | Schooler 1965 | N. Waiya 1966 | O. Cobb 1966 | Clayton 1966 | Schooler 1966 |
| Conductivity $\mu$mhos/cm$^3$ at 18$^o$C | 54 | 76 | 65 | 74 | 73 | 59 | 54 | 64 |
| Water Temp $^o$F | | | | | | | | |
| Surface | 66.0 | 66.6 | 69.2 | 70.0 | 62.5 | 64.5 | 59.5 | 68.0 |
| 1 meter | 66.0 | 66.6 | 69.2 | 69.0 | 62.3 | 62.0 | 59.5 | 67.0 |
| 2 | 65.6 | | 69.0 | 60.5 | 62.2 | 61.5 | 59.5 | 62.0 |
| 3 | 63.0 | | | 50.0 | 62.5 | 60.0 | 59.5 | 58.0 |
| 4 | | | | 49.2 | 61.5 | 58.5 | 59.5 | 55.0 |
| 5 | | | | 49.2 | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 27 | 28 | 29 | 42 | 11 | 32 | 46 | 86 |
| 2 | 9 | 14 | 3 | 9 | 1 | 5 | 20 | 54 |
| 3 | 4 | | | 3 | 1 | 1 | 8 | 31 |
| 4 | | | | 1 | | 0 | 2 | 11 |
| 5 | | | | 1 | | | 1 | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | OZARK | | | | | | CRETACEOUS | |
|---|---|---|---|---|---|---|---|---|
| Lake | Francis 1965 | Greenleaf 1965 | Tenkiller 1965 | Greenleaf 1966 | Eucha 1966 | Francis 1966 | Carter 1965 | R. Gary 1965 |
| Conductivity $\mu$mhos/cm$^3$ at 18$^\circ$C | 243 | 191 | 210 | 128 | 212 | 202 | 244 | 157 |
| Water Temp $^\circ$F | | | | | | | | |
| Surface | 66.6 | 66.7 | 67.7 | 63.0 | 60.5 | 61.0 | 66.2 | 71.0 |
| 1 meter | 66.6 | 66.4 | 67.9 | 64.0 | 59.0 | 60.5 | 66.2 | 71.0 |
| 2 | 66.4 | 64.1 | 68.1 | 64.0 | 57.9 | 60.0 | 66.2 | 67.5 |
| 3 | 66.2 | 63.4 | 68.0 | 64.0 | 56.9 | 60.0 | 66.2 | 64.0 |
| 4 | | 62.8 | 68.0 | 64.0 | 55.7 | | 66.2 | |
| 5 | | 62.2 | 68.0 | 63.0 | 53.5 | | 60.4 | |
| 6 | | 58.6 | 68.0 | 63.0 | 53.0 | | 50.9 | |
| 7 | | 54.9 | 67.8 | 63.0 | | | 50.1 | |
| 8 | | 52.7 | 66.8 | 63.0 | | | 50.1 | |
| 9 | | 52.3 | 66.5 | 63.0 | | | | |
| 10 | | 51.9 | 65.7 | 63.0 | | | | |
| 11 | | 51.7 | 63.4 | 61.5 | | | | |
| 12 | | | 63.0 | 61.5 | | | | |
| 13 | | | 63.0 | 61.5 | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 55 | 37 | 57 | 29 | 100 | 4 | 5 | 32 |
| 2 | 16 | 16 | 24 | 0 | 100 | 0 | 4 | 9 |
| 3 | 7 | 7 | 14 | | 100 | | 3 | 3 |
| 4 | 3 | 3 | 6 | | 67 | | 3 | |
| 5 | 2 | 2 | 4 | | 57 | | 3 | |
| 6 | | 1 | 3 | | 40 | | 0 | |
| 7 | | | 2 | | 0 | | | |
| 8 | | | 1 | | | | | |
| 9 | | | 0 | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | CRETACEOUS (cont.) | | | EASTERN | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Carter 1966 | R. Gary 1966 | Yashoo 1966 | Holdenville 1965 | McAlester 1965 | Carleton 1965 | Okmulgee 1965 | Ardmore Club 1965 |
| Conductivity µmhos/cm³ at 18°C | 212 | 169 | 164 | 161 | 72 | 77 | 269 | 287 |
| Water Temp °F | | | | | | | | |
| Surface | 63.0 | 69.0 | 64.5 | 65.0 | 65.9 | 63.5 | 67.8 | 68.3 |
| 1 meter | 63.0 | 66.5 | 64.5 | 65.0 | 64.3 | 63.5 | 67.3 | 66.5 |
| 2 | 63.0 | 65.0 | 64.5 | 65.0 | 63.0 | 63.5 | 67.3 | 66.3 |
| 3 | 62.0 | 63.0 | 62.5 | 64.5 | 63.0 | 49.5 | 67.0 | 66.3 |
| 4 | 62.0 | 63.0 | 61.0 | 64.0 | 63.0 | 48.0 | 67.0 | |
| 5 | | | | 64.0 | 62.5 | | 66.9 | |
| 6 | | | | | 62.5 | | 66.8 | |
| 7 | | | | | 62.5 | | 65.1 | |
| 8 | | | | | 55.5 | | 63.7 | |
| 9 | | | | | 51.0 | | 56.2 | |
| 10 | | | | | | | 54.0 | |
| 11 | | | | | | | 53.2 | |
| 12 | | | | | | | 52.0 | |
| 13 | | | | | | | 50.9 | |
| 14 | | | | | | | 50.7 | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | --- | 100 | 100 | 100 | --- | 100 | 100 | --- |
| 1 meter | --- | 31 | 100 | 53 | --- | 19 | 24 | --- |
| 2 | --- | 10 | 95 | 16 | --- | 6 | 5 | --- |
| 3 | --- | 4 | 95 | 6 | --- | | 0 | --- |
| 4 | --- | 1 | 91 | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | EASTERN (cont.) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Carleton 1966 | Atoka 1966 | Okmulgee 1966 | Henryetta 1966 | Wetumka I 1966 | Ardmore City 1966 | Claremore 1966 | Wewoka 1966 |
| Conductivity µmhos/cm$^3$ at 18°C | --- | 113 | 285 | 122 | 271 | 329 | 202 | 268 |
| Water Temp °F | | | | | | | | |
| Surface | 61.0 | 57.0 | 59.5 | 60.0 | 62.0 | 63.0 | 60.0 | 62.5 |
| 1 meter | 61.0 | 57.0 | 60.0 | 60.9 | 62.0 | 63.0 | 60.0 | 63.0 |
| 2 | 61.0 | 57.0 | 60.0 | 59.5 | 62.0 | 61.5 | 60.0 | 63.0 |
| 3 | 61.0 | 57.0 | 60.0 | 60.9 | 61.5 | 61.0 | 60.0 | 63.0 |
| 4 | 59.0 | 57.0 | 60.0 | 58.9 | 61.5 | 59.5 | 60.0 | 63.0 |
| 5 | | 57.0 | | 59.0 | 61.5 | 59.5 | | 63.0 |
| 6 | | 57.0 | | 58.0 | | 59.5 | | 63.0 |
| 7 | | 57.0 | | 58.0 | | 59.5 | | 63.0 |
| 8 | | 57.0 | | | | 59.0 | | 63.0 |
| 9 | | 57.0 | | | | | | |
| 10 | | 57.0 | | | | | | |
| 11 | | 57.0 | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 7 | 26 | 27 | 2 | 13 | 38 | 5 | 33 |
| 2 | 1 | 3 | 7 | 2 | 0 | 18 | 4 | 7 |
| 3 | 0 | 1 | | 2 | | 7 | 0 | 2 |
| 4 | | 0 | | 2 | | 2 | | 1 |
| 5 | | | | 0 | | 1 | | 0 |
| 6 | | | | | | 0 | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | EASTERN (cont.) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Sportsman 1966 | Holdenville 1966 | Wetumka II 1966 | Bluestem 1965 | Hominy 1965 | Bluestem 1966 | Hominy 1966 | Hudson 1966 |
| Conductivity µmhos/cm$^3$ at 18°C | 372 | 154 | 260 | 548 | 882 | 370 | 280 | 315 |
| Water Temp °F | | | | | | | | |
| Surface | 62.0 | 63.0 | 64.5 | 65.8 | 69.9 | 56.0 | 59.5 | 60.5 |
| 1 meter | 62.0 | 63.0 | 65.0 | 65.8 | 69.9 | 55.5 | 59.5 | 60.5 |
| 2 | 62.5 | 63.0 | 65.0 | 65.8 | 66.7 | 55.0 | 58.0 | 60.5 |
| 3 | 62.5 | 63.0 | 65.0 | 65.8 | 66.7 | 55.0 | 58.0 | 60.5 |
| 4 | 62.5 | 63.0 | 65.0 | 66.0 | 66.7 | 55.0 | 58.0 | 60.5 |
| 5 | 63.0 | 63.0 | 65.0 | 66.0 | 66.3 | 55.0 | 58.0 | 60.5 |
| 6 | | 63.0 | 65.0 | 66.0 | 66.2 | 55.0 | 58.0 | 60.5 |
| 7 | | 63.0 | 65.0 | 66.0 | 62.3 | 54.5 | 57.0 | 59.5 |
| 8 | | 63.0 | 65.5 | 66.0 | | 54.5 | 57.0 | 59.0 |
| 9 | | 63.0 | | 66.0 | | 54.5 | 56.5 | 58.0 |
| 10 | | | | 65.0 | | 54.5 | 56.5 | |
| 11 | | | | 62.1 | | | 56.5 | |
| 12 | | | | 61.0 | | | | |
| 13 | | | | 60.3 | | | | |
| 14 | | | | 60.1 | | | | |
| 15 | | | | 59.5 | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 57 | 16 | 15 | 28 | 58 | 81 | 76 | 62 |
| 2 | 24 | 4 | 3 | 15 | 42 | 54 | 54 | 37 |
| 3 | 8 | 3 | 2 | 9 | 26 | 43 | 39 | 22 |
| 4 | 5 | 3 | 2 | 8 | 17 | 36 | 27 | 12 |
| 5 | 3 | 3 | 2 | 7 | 12 | 31 | 22 | 7 |
| 6 | 0 | 2 | 0 | 0 | 8 | 23 | 19 | 4 |
| 7 | | 2 | | | 7 | 17 | 10 | 2 |
| 8 | | | | | | | 7 | |
| 9 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | CENTRAL | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Blackwell 1965 | Pawnee 1965 | Shawnee 1965 | Comanche 1966 | Tecumseh 1966 | Guthrie 1966 | Pawnee 1966 | Perry City 1966 |
| Conductivity $\mu$mhos/cm$^3$ at 18$^{o}$C | 729 | 475 | 270 | 325 | 160 | 492 | 338 | 272 |
| Water Temp $^{o}$F | | | | | | | | |
| Surface | 65.2 | 71.4 | 68.6 | 65.4 | 60.5 | 62.6 | 62.0 | 57.8 |
| 1 meter | 65.3 | 71.4 | --- | 65.1 | 62.0 | 62.9 | 62.0 | 57.4 |
| 2 | 65.0 | 71.4 | --- | 65.1 | 62.0 | 62.6 | 62.0 | 57.8 |
| 3 | 65.0 | 71.5 | | 65.1 | 62.0 | 62.2 | 58.5 | 57.9 |
| 4 | 65.0 | 71.5 | | 64.8 | 61.5 | 62.1 | 58.5 | 57.8 |
| 5 | 64.9 | 71.0 | | 64.2 | | 62.5 | 58.5 | |
| 6 | 64.9 | 70.1 | | 64.2 | | 61.6 | 58.5 | |
| 7 | 64.5 | 67.4 | | | | 57.6 | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 43 | 15 | 12 | 63 | 1 | 31 | 23 | 0 |
| 2 | 13 | 7 | 3 | 37 | 1 | 6 | 8 | |
| 3 | 7 | 0 | 2 | 19 | 0 | 0 | 2 | |
| 4 | 5 | | 2 | 16 | | | | |
| 5 | 4 | | 0 | 6 | | | | |
| 6 | 0 | | | 4 | | | | |
| 7 | | | | 0 | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | CENTRAL (cont.) | | | WICHITA MOUNTAINS | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake | Paul's Valley 1966 | Cushing 1966 | Shawnee 1966 | Caddo 1965 | Post Oak 1965 | Rush 1965 | Rush 1966 | Q. Parker II 1966 |
| Conductivity µmhos/cm³ at 18°C | 270 | 198 | 187 | 234 | 92 | 178 | 58 | 158 |
| Water Temp °F | | | | | | | | |
| Surface | 60.5 | 65.0 | 64.5 | 70.6 | 71.7 | 71.0 | 60.0 | 62.0 |
| 1 meter | 60.5 | 63.0 | 62.0 | 70.4 | 71.0 | 70.8 | 60.0 | 62.0 |
| 2 | 60.5 | 60.0 | 62.5 | 65.3 | 68.3 | 70.0 | 59.0 | 62.0 |
| 3 | 60.5 | 60.0 | 62.0 | 60.0 | 61.9 | 63.0 | 59.0 | 62.0 |
| 4 | 60.5 | | 62.0 | 53.3 | 55.8 | | 59.0 | 62.0 |
| 5 | 61.0 | | 62.0 | 50.0 | 50.0 | | 59.0 | 60.0 |
| 6 | 61.0 | | 62.0 | | 48.8 | | 59.0 | 60.0 |
| 7 | 61.0 | | 62.0 | | 48.5 | | | 60.0 |
| 8 | 60.0 | | 61.5 | | 48.0 | | | 60.0 |
| 9 | 57.0 | | 61.5 | | 48.0 | | | |
| 10 | | | 61.5 | | 48.0 | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| Light Pent. (%) | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 24 | 0 | 18 | 15 | 43 | 48 | 64 | 62 |
| 2 | 5 | | 7 | 4 | 12 | 21 | 52 | 53 |
| 3 | 1 | | 3 | 2 | 4 | 18 | 37 | 41 |
| 4 | 0 | | | 1 | 2 | 0 | 22 | 30 |
| 5 | | | | | 0 | | 15 | 23 |
| 6 | | | | | | | 11 | 17 |
| 7 | | | | | | | | 14 |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | WICHITA MOUNTAINS (cont.) | | | | ARBUCKLE MOUNTAINS | | |
|---|---|---|---|---|---|---|---|
| Lake | Q. Parker I 1966 | J. Johnson 1966 | E. Thomas II 1966 | E. Thomas I 1966 | Mountain 1965 | Veterans 1966 | Mountain 1966 |
| Conductivity µmhos/cm³ at 18°C | 174 | 106 | 166 | 171 | 282 | 274 | 332 |
| Water Temp °F | | | | | | | |
| Surface | 62.5 | 60.0 | 59.0 | 62.0 | 65.8 | 63.5 | 62.0 |
| 1 meter | 62.5 | 60.0 | 59.0 | 62.0 | 65.8 | 63.5 | 62.0 |
| 2 | 62.0 | 60.0 | 59.0 | 62.0 | 64.9 | 64.0 | 61.0 |
| 3 | 60.0 | 60.0 | 59.0 | 62.0 | 64.9 | 64.0 | 61.0 |
| 4 | 60.0 | 60.0 | 59.0 | 62.0 | 64.1 | 64.0 | 61.0 |
| 5 | | 58.5 | 59.0 | 62.0 | 63.8 | 64.0 | 61.0 |
| 6 | | 58.5 | 59.0 | 62.0 | 63.8 | 64.0 | 61.0 |
| 7 | | 58.5 | 59.0 | 60.0 | 59.9 | 64.0 | 61.0 |
| 8 | | 58.5 | 59.0 | | 50.6 | 64.0 | 59.0 |
| 9 | | 58.5 | | | 49.1 | | |
| 10 | | 58.5 | | | 48.5 | | |
| 11 | | | | | 48.5 | | |
| 12 | | | | | 43.2 | | |
| 13 | | | | | 43.2 | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| Light Pent. (%) | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | --- | 100 | 100 |
| 1 meter | 79 | 72 | 88 | 56 | | 67 | 74 |
| 2 | 75 | 55 | 62 | 37 | | 67 | 43 |
| 3 | 71 | 43 | 46 | 25 | | 60 | 23 |
| 4 | 54 | 33 | 33 | 17 | | 46 | 12 |
| 5 | | 26 | 22 | 11 | | 34 | 6 |
| 6 | | 16 | 15 | 5 | | 30 | 2 |
| 7 | | 12 | 9 | | | | 1 |
| 8 | | | 7 | | | | |
| 9 | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | MIDWESTERN | | | | | WESTERN | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lake | Duncan 1965 | Northwood 1966 | Elmer 1966 | Elmer 1966 | Clear 1966 | Hobart 1965 | Clinton 1965 | Hobart 1966 | Clinton 1966 |
| Conductivity µmhos/cm$^3$ at 18$^o$C | 490 | 719 | 384 | 367 | 600 | 796 | 700 | 522 | 450 |
| Water Temp $^o$F | | | | | | | | | |
| Surface | 68.2 | 58.5 | 58.0 | 61.5 | 62.0 | 67.4 | 66.4 | 59.5 | 62.0 |
| 1 meter | 68.2 | 59.0 | 58.0 | 61.5 | 62.0 | 67.4 | 66.0 | 59.5 | 62.0 |
| 2 | 68.0 | 59.0 | 57.5 | 61.5 | 62.0 | 67.4 | 66.0 | 60.5 | 62.0 |
| 3 | 68.0 | 59.0 | 57.5 | 61.5 | 62.0 | 67.4 | 66.0 | 59.0 | 62.0 |
| 4 | | 59.0 | 57.5 | | 62.0 | 66.0 | 66.0 | 57.0 | 62.0 |
| 5 | | 59.0 | 57.5 | | | | 66.0 | 57.0 | 62.0 |
| 6 | | 58.5 | | | | | 66.0 | | 62.0 |
| 7 | | | | | | | | | 62.0 |
| 8 | | | | | | | | | 62.0 |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| Light Pent. (%) | | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 meter | 20 | 20 | 0 | 13 | 57 | 21 | 26 | 14 | 15 |
| 2 | 7 | 5 | 0 | 0 | 25 | 0 | 14 | 0 | 3 |
| 3 | 6 | 0 | | | 13 | | 11 | | 0 |
| 4 | | | | | 4 | | 10 | | |
| 5 | | | | | 2 | | 9 | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

Appendix II: Conductivity, temperature and light profiles 1965, 1966 (cont.).

| PROVINCE | ALLUVIUM | | | | | | BLAINE | | |
|---|---|---|---|---|---|---|---|---|---|
| Lake | Mahoney #1 1965 | Mahoney #1 1966 | Mahoney #2 1966 | Vincent 1966 | Roebuck 1966 | Snyder 1966 | Watonga 1965 | Watonga #1 1966 | Watonga #2 1966 |
| Conductivity µmhos/cm³ at 18°C | 1475 | 1192 | 1022 | 1172 | 339 | 560 | 2040 | 1878 | 1404 |
| Water Temp °F | | | | | | | | | |
| Surface | 70.2 | 62.5 | 62.5 | 64.0 | 65.5 | 60.0 | 72.5 | 60.0 | 60.0 |
| 1 meter | 70.2 | 62.0 | 62.5 | 64.0 | 65.5 | 60.0 | 71.7 | 63.0 | 60.0 |
| 2 | 69.8 | 61.8 | 62.0 | 63.0 | | 59.5 | 71.7 | 61.0 | 60.0 |
| 3 | 69.5 | 60.8 | 62.0 | 63.0 | | 59.5 | 71.7 | 64.0 | 60.0 |
| 4 | 68.9 | | 62.0 | 62.5 | | | 70.8 | 65.0 | 60.0 |
| 5 | | | 61.5 | | | | 70.6 | 64.0 | 60.0 |
| 6 | | | | | | | 69.8 | 64.0 | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| Light Pent. (%) | | | | | | | | | |
| Surface | 100 | 100 | 100 | 100 | 100 | 100 | --- | 100 | 100 |
| 1 meter | 64 | 86 | 71 | 80 | 8 | 16 | | 77 | 86 |
| 2 | 32 | 33 | 31 | 62 | 1 | 2 | | 54 | 73 |
| 3 | 27 | 11 | 13 | 57 | | 0 | | 40 | 55 |
| 4 | 23 | 0 | 5 | 38 | | | | 33 | 38 |
| 5 | | | 1 | | | | | 25 | 37 |
| 6 | | | | | | | | 17 | 33 |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

Appendix III: Climatological data (Weather Bureau 1965, 1966).

| 1965 | Average air temperature | | | | | |
|---|---|---|---|---|---|---|
| Region: | MARCH | | APRIL | | MAY | |
| | Ave. | d | Ave. | d | Ave. | d |
| North Central | 39.4 | -8.7 | 63.5 | 4.2 | 70.5 | 2.4 |
| North East | 39.7 | -9.3 | 64.8 | 4.7 | 70.9 | 2.7 |
| West Central | 40.5 | -8.7 | 63.7 | 3.8 | 70.3 | 1.9 |
| Central | 41.1 | -9.0 | 65.6 | 4.7 | 70.9 | 2.0 |
| East Central | 41.8 | -9.1 | 65.6 | 4.5 | 71.6 | 2.6 |
| South West | 42.9 | -8.6 | 65.8 | 3.8 | 71.8 | 1.6 |
| South Central | 44.0 | -9.1 | 66.9 | 3.8 | 71.4 | 0.8 |
| South East | 43.5 | -9.7 | 66.2 | 3.4 | 70.7 | 0.5 |
| 1966 | | | | | | |
| Region: | | | | | | |
| North Central | 52.1 | 4.0 | 56.8 | -2.5 | 68.1 | 0.0 |
| North East | 52.0 | 3.0 | 58.0 | -2.0 | 66.7 | -1.5 |
| West Central | 53.3 | 4.1 | 58.0 | -1.9 | 68.4 | 0.0 |
| Central | 53.9 | 3.8 | 59.5 | -1.4 | 68.1 | -0.8 |
| East Central | 53.3 | 2.4 | 60.1 | -1.3 | 67.7 | -1.3 |
| South West | 55.6 | 4.1 | 60.9 | -1.1 | 70.3 | -0.2 |
| South Central | 55.8 | 2.7 | 62.1 | -1.0 | 69.4 | -1.2 |
| South East | 53.7 | 0.5 | 61.4 | -1.4 | 67.7 | -2.5 |
| Precipitation | | | | | | |
| 1955 Central | 1.16 | - .96 | 2.48 | - .95 | 3.63 | -1.71 |
| 1966 Central | 0.75 | -1.37 | 3.68 | .25 | 1.91 | -3.43 |

Appendix IV: Plankton standing crops in 1966.

| PROVINCE<br>Lake | Vertical<br>(No.) | Vertical/<br>depth<br>(No/m) | Hori-<br>zontal<br>Tow<br>(ml) | Top, Middle,<br>Bottom Ave.<br>(No./1) |
|---|---|---|---|---|
| OUACHITA | | | | |
| Clayton | 1,056 | 211 | 3.1 | --- |
| N. Waiya | 1,804 | 481 | 4.0 | 67.9 |
| O. Cobb | 1,080 | 360 | 1.6 | 31.9 |
| Schooler | 1,804 | 451 | 11.1 | 50.5 |
| Mean | 1,436 | 376 | 4.9 | 50.1 |
| S.D. | 425 | 121 | 4.2 | 29.1 |
| S.E. | 213 | 61 | 2.1 | 14.5 |
| OZARK | | | | |
| Francis | 49 | 20 | 1.7 | 0.9 |
| Greenleaf | 485 | 37 | 3.1 | 15.2 |
| Eucha | 1,668 | 278 | 1.9 | 27.6 |
| Mean | 734 | 112 | 2.2 | 14.5 |
| S.D. | 838 | 144 | 0.8 | 13.4 |
| S.E. | 484 | 83 | 0.4 | 7.7 |
| CRETACEOUS | | | | |
| Carter | 2,848 | 407 | 10.6 | 52.4 |
| R. Gary | 2,528 | 632 | 12.5 | 170.4 |
| Yashoo | 984 | 281 | 69.5 | 60.2 |
| Mean | 2,120 | 440 | 30.9 | 94.3 |
| S.D. | 997 | 178 | 33.3 | 66.0 |
| S.E. | 576 | 103 | 19.2 | 38.2 |
| EASTERN | | | | |
| Carleton | 2,378 | 680 | 0.9 | 31.0 |
| Atoka Res. | 2,072 | 138 | 2.7 | 40.8 |
| Okmulgee | 632 | 158 | 3.7 | 11.0 |
| Henryetta | 788 | 113 | 2.8 | 7.3 |
| Wetumka | 1,588 | 318 | 3.0 | 30.5 |
| Ardmore City | 1,232 | 164 | 4.4 | 28.5 |
| Claremore | 388 | 97 | 1.2 | 12.1 |
| Wewoka | 410 | 59 | 8.7 | 12.6 |
| Sportsman | 246 | 62 | 12.5 | 15.6 |
| Holdenville | 1,452 | 182 | 7.4 | 14.3 |
| Wetumka II | 427 | 81 | 5.9 | 7.2 |
| Hominy | 676 | 61 | 7.6 | 10.2 |
| Bluestem | 1,754 | 175 | 3.6 | 20.7 |
| Hudson | 588 | 63 | 4.6 | 22.3 |
| Mean | 1,042 | 168 | 4.9 | 18.9 |
| S.D. | 698 | 164 | 3.2 | 10.3 |
| S.E. | 187 | 44 | 0.9 | 2.7 |

Appendix IV: Plankton standing crops in 1966 (cont.)

| PROVINCE Lake | Vertical (No.) | Vertical/ depth (No/m) | Hori- zontal Tow (ml) | Top, Middle, Bottom Ave. (No./1) |
|---|---|---|---|---|
| CENTRAL | | | | |
| Tecumseh | 1,040 | 347 | 4.9 | 24.6 |
| Guthrie | 1,932 | 276 | 9.0 | 83.2 |
| Pawnee | 2,790 | 507 | 2.5 | 111.2 |
| Perry | 960 | 240 | 8.0 | 54.2 |
| Paul's Valley | 4,160 | 460 | 4.0 | 26.6 |
| Cushing | 1,764 | 588 | 7.0 | 86.3 |
| Shawnee | 1,676 | 168 | 2.3 | 67.8 |
| Mean | 2,046 | 369 | 5.4 | 64.8 |
| S.D. | 1,114 | 154 | 2.7 | 32.0 |
| S.E. | 421 | 58 | 1.0 | 12.1 |
| WICHITA MTS. | | | | |
| Rush | 7,916 | 1,319 | 9.1 | 23.2 |
| Q. Parker I | 744 | 186 | 8.7 | 27.1 |
| Q. Parker II | 2,482 | 354 | 11.0 | 22.0 |
| J. Johnson | 7,320 | 781 | 15.1 | 128.5 |
| E. Thomas I | 7,300 | 1,043 | 8.8 | 113.8 |
| E. Thomas II | 3,580 | 398 | 9.1 | 17.1 |
| Mean | 4,874 | 680 | 10.3 | 55.3 |
| S.D. | 2,999 | 510 | 2.5 | 51.3 |
| S.E. | 1,224 | 208 | 1.0 | 20.9 |
| ARBUCKLE MTS. | | | | |
| Veterans | 2,218 | 370 | 8.8 | 7.9 |
| Mountain | 2,444 | 244 | 38.0 | 24.3 |
| Mean | 2,331 | 307 | 23.4 | 16.1 |
| S.D. | 160 | 89 | 20.7 | 11.6 |
| S.E. | 115 | 63 | 14.6 | 8.2 |
| MIDWESTERN | | | | |
| Northwood | 1,980 | 396 | 20.0 | 90.5 |
| Elmer I | 8,080 | 3,026 | 8.0 | 79.1 |
| Elmer II | 1,868 | 467 | 38.5 | 85.0 |
| Clear | 1,492 | 299 | 11.0 | 15.5 |
| Mean | 3,355 | 1,047 | 19.4 | 67.5 |
| S.D. | 3,157 | 1,321 | 13.7 | 35.0 |
| S.E. | 1,579 | 661 | 6.9 | 17.5 |

Appendix IV: Plankton standing crops in 1966 (cont.)

| PROVINCE Lake | Vertical (No.) | Vertical/ depth (No/m) | Hori- zontal Tow (ml) | Top, Middle, Bottom Ave. (No./1) |
|---|---|---|---|---|
| WESTERN | | | | |
| Hobart | 1,936 | 456 | 7.5 | 28.3 |
| Clinton | 5,968 | 918 | 11.5 | 91.0 |
| Mean | 3,952 | 687 | 9.5 | 59.6 |
| S.D. | 2,851 | 327 | 2.8 | 44.3 |
| S.E. | 2,016 | 232 | 2.0 | 31.4 |
| ALLUVIUM | | | | |
| Mahoney #1 | 2,020 | 808 | 24.5 | 42.2 |
| Mahoney #2 | 2,692 | 539 | 19.0 | 112.9 |
| Vincent | 1,796 | 449 | 21.0 | 30.4 |
| Roebuck | 2,520 | 1,260 | 17.0 | 152.1 |
| Snyder | 4,368 | 1,456 | 12.2 | 286.0 |
| Mean | 2,679 | 902 | 18.7 | 124.7 |
| S.D. | 1,011 | 344 | 4.6 | 103.2 |
| S.E. | 428 | 146 | 1.9 | 43.7 |
| BLAINE | | | | |
| Watonga I | 9,592 | 1,599 | 8.1 | 73.3 |
| Watonga II | 4,076 | 816 | 3.5 | 48.7 |
| Mean | 6,834 | 1,207 | 5.8 | 61.0 |
| S.D. | 3,901 | 554 | 3.3 | 17.4 |
| S.E. | 2,759 | 392 | 2.3 | 12.3 |

Appendix V: Depth distribution, 1965, 1966 (* = collections made in 1965).

| PROVINCE<br>Lake | Depth<br>1 Meter | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OUACHITA | | | | | | | | | | | | | |
| * Clayton | 304 | 390 | | | | | | | | | | | |
| * N. Waiya | 256 | 316 | | | | | | | | | | | |
| * O. Cobb | 226 | 58 | | | | | | | | | | | |
| * Schooler | 456 | 226 | | | | | | | | | | | |
| N. Waiya | 882 | 683 | 472 | | | | | | | | | | |
| O. Cobb | 452 | 377 | 129 | | | | | | | | | | |
| Clayton | --- | --- | --- | | | | | | | | | | |
| Schooler | | | | | | | | | | | | | |
| OZARK | | | | | | | | | | | | | |
| * Francis | 358 | 970 | | | | | | | | | | | |
| * Greenleaf | 176 | 104 | | | | | | | | | | | |
| * Tenkiller | 94 | 234 | | | | | | | | | | | |
| Greenleaf | 139 | 372 | | 212 | | | 66 | 124 | | | 180 | 252 | |
| Eucha | 355 | 330 | | | | 142 | | | | | | | |
| Francis | 10 | 7 | | | | | | | | | | | |
| CRETACEOUS | | | | | | | | | | | | | |
| * Carter | 182 | 388 | | | | | | | | | | | |
| * R. Gary | 348 | 122 | | | | | | | | | | | |
| Carter | 331 | 762 | | | | | 481 | | | | | | |
| R. Gary | 3,366 | 862 | | 884 | | | | | | | | | |
| Yashoo | 995 | 442 | 368 | | | | | | | | | | |
| EASTERN | | | | | | | | | | | | | |
| * Holdenville | 244 | 222 | | | | | | | | | | | |
| * McAlester | 57 | 58 | 36 | | | | | | | | | | |
| * Carleton | 122 | --- | | | | | | | | | | | |
| * Okmulgee | 286 | 502 | | | | | | | | | | | |
| * Ardmore Club | 324 | 740 | | | | | | | | | | | |

Appendix V: Depth distribution, 1965, 1966 ( * = collections made in 1965) (cont.).

| PROVINCE<br>Lake | Depth 1 Meter | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EASTERN (cont.) | | | | | | | | | | | | | |
| Carleton | 279 | 308 | 343 | | | | | | | | | | |
| Atoka | 440 | 216 | | | | | 384 | | | | | | 401 |
| Okmulgee | 127 | 66 | 137 | | | | | | | | | | |
| Henryetta | 98 | 87 | 33 | | | | | | | | | | |
| Wetumka I | 270 | 308 | 336 | | | | | | | | | | |
| Wetumka II | 61 | 32 | 68 | 27 | | 88 | | | | | | | |
| Ardmore City | 549 | 478 | 128 | | | | 178 | | | | | | |
| Claremore | 142 | 116 | 104 | | | | | | | | | | |
| Wewoka | 76 | 210 | 152 | 100 | 126 | | 202 | | | | | | |
| Sportsman | 139 | 125 | 144 | 218 | | | | | | | | | |
| Holdenville | 190 | 186 | 152 | 86 | | 86 | | | | | | | |
| * Bluestem | 358 | 336 | | | | | | | | | | | |
| * Hominy | 140 | 426 | | | | | | | | | | | |
| Bluestem | 43 | 130 | | | 396 | | | | | 182 | | | |
| Hominy | 143 | 165 | | | 37 | | | | | 126 | | | |
| Hudson | 392 | 180 | | 137 | | | 139 | | | | | | |
| CENTRAL | | | | | | | | | | | | | |
| * Blackwell | 134 | 204 | | | | | | | | | | | |
| * Pawnee | 750 | 786 | | | | | | | | | | | |
| * Shawnee | 84 | 184 | | | | | | | | | | | |
| * Comanche | 154 | 98 | | | | | | | | | | | |
| Tecumseh | 139 | 372 | | 212 | -- | | 66 | | 124 | | 180 | 252 | |
| Guthrie | 366 | | 426 | | | | 1,704 | | | | | | |
| Pawnee | 464 | 480 | | | 2,392 | | | | | | | | |
| Perry | 728 | 321 | 576 | | | | | | | | | | |
| Paul's Valley | 172 | 400 | | 416 | | | | | 210 | | | | |
| Cushing | 1,068 | | 858 | | | | | | | | | | |
| Shawnee | 380 | 1,558 | | | -- | | | | | | 97 | | |

Appendix V: Depth distribution, 1965, 1966 (* = collections made in 1965) (cont.).

| PROVINCE Lake / Depth | 1 Meter | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WICHITA MTS. | | | | | | | | | | | | | |
| * Caddo | 642 | 658 | | | | | | | | | | | |
| * Post Oak | 850 | 330 | | | | | | | | | | | |
| * Rush | 130 | 334 | | | | | | | | | | | |
| Rush | 291 | 245 | 350 | 150 | | 137 | | | | | | | |
| Q. Parker II | 211 | 144 | 177 | | 195 | | 271 | | | | | | |
| Q. Parker I | --- | 370 | 170 | | | | | | | | | | |
| J. Johnson | 148 | 478 | | 1,516 | | | | | 2,192 | | | | |
| E. Thomas II | 210 | 252 | 124 | 227 | 218 | | 163 | | 94 | | | | |
| E. Thomas I | 1,168 | 894 | 1,148 | | | | | | 1,097 | | | | |
| ARBUCKLE MTS. | | | | | | | | | | | | | |
| * Mountain | 998 | 652 | | | | | | | | | | | |
| Veterans | 17 | 45 | 54 | 220 | 172 | 23 | | | | | | | |
| Mountain | 250 | 872 | 908 | 270 | 316 | | 253 | | 229 | 162 | | | |
| MIDWESTERN | | | | | | | | | | | | | |
| * Duncan | 722 | 614 | | | | | | | | | | | |
| Northwood | 1,050 | 1,864 | 1,222 | | 422 | | | | | | | | |
| Elmer II | 770 | 912 | 824 | 840 | 956 | | | | | | | | |
| Elmer I | 424 | | 1,948 | | | | | | | | | | |
| Clear | 76 | 152 | 207 | | 183 | | | | | | | | |
| WESTERN | | | | | | | | | | | | | |
| * Hobart | 1,776 | 1,190 | | | | | | | | | | | |
| * Clinton | 762 | 1,060 | | | | | | | | | | | |
| Hobart | 432 | 191 | | 225 | | | | | | | | | |
| Clinton | 606 | 520 | 758 | | | 1,365 | | | | | | | |

Appendix V: Depth distribution, 1965, 1966 (* = collections made in 1965) (cont.).

| PROVINCE Lake | Depth 1 Meter | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLUVIUM | | | | | | | | | | | | | |
| * Mahoney #1 | 306 | 916 | | | | | | | | | | | |
| Mahoney #1 | ---- | 622 | 644 | | | | | | | | | | |
| Mahoney #2 | 956 | 564 | 2,852 | 144 | | | | | | | | | |
| Vincent | 174 | 120 | 262 | 660 | | | | | | | | | |
| Roebuck | 1,072 | 1,968 | | | | | | | | | | | |
| Snyder | 3,214 | | 2,516 | | | | | | | | | | |
| BLAINE | | | | | | | | | | | | | |
| * Watonga | 31 | 31 | | | | | | | | | | | |
| Watonga I | 498 | 464 | 1,212 | | | 490 | | | | | | | |
| Watonga II | 229 | 150 | 159 | | 1,074 | | | | | | | | |

Appendix VI: Systematic list of Copepoda and Cladocera, 1965, 1966.

Class Crustacea
  Order Copepoda
    Suborder Calanoida
      Family Diaptomidae
        Diaptomus (Aglaodiaptomus) clavipes Schacht 1897
        Diaptomus (Leptodiaptomus) siciloides Lilljeborg 1889
        Diaptomus (Skistodiaptomus) pallidus Herrick 1879
        Diaptomus (Skistodiaptomus) reighardi Marsh 1895
    Suborder Cyclopoida
      Family Cyclopidae
        Eucyclops agilis (Koch) 1838
        Tropocyclops prasinus (Fischer) 1860
        Cyclops vernalis Fischer 1863
        Cyclops bicuspidatus thomasi S.A. Forbes 1882
        Mesocyclops edax (S.A. Forbes) 1891
        Macrocyclops albidus (Jurine) 1820
  Order Cladocera
    Suborder Eucladocera
      Superfamily Sidoidea
        Family Sididae
          Diaphanosoma sp.
        Family Holopedidae
          Holopedium amazonicum Stingelin 1904
      Superfamily Chydoridea
        Family Daphnidae
          Daphnia ambigua Scourfield 1947
          Daphnia laevis Birge 1879
          Daphnia rosea Sars 1862 emend. Richard 1896
          Daphnia parvula Fordyce 1901
          Daphnia schodleri Sars 1862
          Simocephalus serrulatus (Koch) 1841
          Scapholeberis kingi Sars 1903
          Ceriodaphnia lacustris Birge 1893
        Family Bosminidae
          Bosmina longirostris (O.F. Muller) 1785
          Bosmina coregoni Baird 1857
        Family Chydoridae
          Eurycercus lamellatus (O.F. Muller) 1785
          Leydgia quadrangularis (Leydig) 1860
          Alona affinis (Leydig) 1860
          Alona costata Sars 1862
          Alona rectangula Sars 1861
          Alona quadrangularis (O.F. Muller) 1785
          Pleuroxus denticulatus Birge 1878
          Chydorus sphaericus (O.F. Muller) 1785
          Chydorus globosus Baird 1850
        Family Macrothricidae
          Macrothrix laticornis (Jurine) 1820
          Ilyocryptus sordidus (Liéven) 1848

Appendix VII: Species occurring in 1965.

| | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | M. albidus | unident. cyclops | E. agilis | A. affinis | A. costata | B. longirostris | B. coregoni | Diaphanosoma sp. | C. lacustris | C. sphaericus | P. denticulatus | S. serrulatus | H. amazonicum | L. quadrangularis | D. parvula | D. ambigua | D. laevis | D. rosea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OUACHITA | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clayton | X | | | | X | | | | | | | | X | | X | X | | | | X | | | X | | |
| N. Waiya | X | | | | X | | | | | | | | X | X | X | | | | | X | | X | | | |
| O. Cobb | X | | | | X | | | | | | | | X | | X | | | | | X | | | X | | |
| Schooler | X | | | | X | | | | X | X | X | | X | | X | X | X | | | | X | | X | | |
| OZARK | | | | | | | | | | | | | | | | | | | | | | | | | |
| Francis | | | X | | | X | | | | | | | X | | | X | X | | | | | X | | | |
| Greenleaf | | | X | | X | X | X | | | | | | | | | X | | | | | | X | | | |
| Tenkiller | | | X | | X | | | | X | | | | X | | X | | | | | | | X | | | |
| CRETACEOUS | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carter | X | | | | X | | | | | | | X | X | | X | X | X | | | | | X | | | |
| R. Gary | X | | | | X | X | | | | | | | X | | X | X | | X | | | | X | | | |
| EASTERN | | | | | | | | | | | | | | | | | | | | | | | | | |
| McAlester | | | | X | X | | | | | | | | | | X | | | | | | | X | | | |
| Carleton | | | X | | X | | | | X | | | | X | | X | | | | | | | X | | | |
| Okmulgee | | | X | | X | | X | | | | | | X | | X | X | | | | | | | X | | |
| Ardmore Club | X | | | | | | | | X | | | | X | X | X | X | X | | | | | X | | | |
| Holdenville | X | | | | X | | | | | | | | X | | X | X | | | | | | X | X | | |
| Bluestem | X | X | | | X | | | | | | | | X | | | | | | | | | X | X | | |
| Hominy | X | | | | X | X | | | | | | | X | | | | X | | | | | | | | X |
| CENTRAL | | | | | | | | | | | | | | | | | | | | | | | | | |
| Blackwell | | X | | | | X | X | | | | | | X | | X | | | | | | | X | | | |
| Pawnee | X | X | | | X | X | X | | | | | | X | | | | X | | | | | | X | X | |
| Shawnee | X | X | | | X | X | X | | | | | | X | | X | | X | | | | | X | | | |
| Comanche | X | | | | | | | | X | | | | X | | X | X | | | | | | X | | X | |
| WICHITA MTS. | | | | | | | | | | | | | | | | | | | | | | | | | |
| Caddo | X | | | | | | X | X | | X | | | X | | | | X | X | X | | X | | X | | |
| Post Oak | | | | | | | | | X | | | | X | | | | X | X | | | | | X | | |
| Rush | X | | | | | | X | X | | | | | X | | | | | X | X | | | | X | | |
| ARBUCKLE MTS. | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mountain Lake | X | X | | | X | | | | | | | | | X | | X | | | X | | | | | | X |
| MIDWESTERN | | | | | | | | | | | | | | | | | | | | | | | | | |
| Duncan | | X | | | | | X | | X | | | | X | X | | X | | | | | | X | | | |
| WESTERN | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hobart | | X | | | | | X | | | | | | X | | | | X | | | | | X | | | |
| Clinton | X | | | | X | | X | | | | | | | X | | | X | | | | | X | | | |

Appendix VII: Species occurring in 1965 (Cont.).

| | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | M. albidus | Unident. cyclops | E. agilis | A. affinis | A. costata | B. longirostris | B. coregoni | Diaphanosoma sp. | C. lacustris | C. sphaericus | P. denticulatus | S. serrulatus | H. amazonicum | L. quadrangularis | D. parvula | D. ambigua | D. laevis | D. rosea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLUVIUM | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mahoney #1 | X | | | | X | X | | | | | | | | | | | | | | | | | X | | |
| BLAINE | | | | | | | | | | | | | | | | | | | | | | | | | |
| Watonga | X | | | | X | X | X | | | | | | | | | | | | | | X | | X | | |
| Occurrences (29) | 19 | 7 | 5 | 1 | 20 | 9 | 11 | 2 | 7 | 2 | 1 | 1 | 23 | 5 | 15 | 13 | 10 | 4 | 3 | 3 | 3 | 17 | 12 | 2 | 2 |
| Percentage Occurrence | 65.6 | 24.1 | 17.2 | 3.4 | 69.0 | 31.0 | 37.9 | 6.9 | 24.1 | 6.9 | 3.4 | 3.4 | 79.3 | 17.2 | 51.7 | 44.8 | 34.5 | 13.8 | 10.3 | 10.3 | 10.3 | 58.6 | 41.4 | 6.9 | 6.9 |

Appendix VIII: Species occurring in 1966.

| PROVINCE Lake | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | M. albidus | E. agilis | T. prasinus | unident. cyclops | Holopedium | Diaphanosoma spp | D. ambigua | D. parvula | D. laevis | D. rosea | D. schodleri | S. serrulatus | C. lacustris | B. longirostris | B. coregoni | L. quadrangularis | C. sphaericus | S. kingi | E. lamellatus | A. affinis | A. costata | A. rectangula | A. quadrangularis | P. denticulatus | C. globosus | M. laticornis | I. sordidus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OUACHITA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N. Waiya | X | | | | X | | | | X | | | | X | | X | | | | | X | X | | | | | | | | | | | | | |
| O. Cobb | X | X | | | X | | | | | | X | | X | X | X | | | | | X | | | | X | | | | | | | | | | |
| Clayton | X | | | | X | | | | | X | | X | | | X | | | | | X | X | | | | | | | | | | | | | |
| Schooler | X | | | | X | | | | | | | | X | X | X | | | | | X | X | | X | | | | | X | | | | | | |
| OZARK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Greenleaf | | | X | | X | X | | | | | | | X | | X | | | | | X | X | | | | | | | | | | | | | |
| Eucha | | | X | | | X | | | | | | | | X | X | | | | | X | X | | | | | | | | | | | | | |
| Francis | | | X | | | | X | | | | | | X | X | X | | | | | | X | | | | | | | | | | | | X | |
| CRETACEOUS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carter | X | | | | X | | | | | | | | X | | X | | | | | X | | | | X | | | X | | | | | | | |
| R. Gary | X | | | | X | X | | | | | | | X | | X | | | | | X | X | | | X | | | | | | | | | | |
| Yashoo | X | | | | X | X | | | | | | | X | | X | | | | | X | X | | X | | | X | | | | | | | | |
| EASTERN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carleton | X | | | | X | | X | | | | | | X | | X | | | | | X | X | | | X | | | | | | | | | | |
| Atoka | X | X | | | | | X | | X | | | | X | X | X | | | | | X | X | | | | | | | | | | | | | |
| Okmulgee | | | X | | X | | | | | | X | | X | X | X | | | | | | | | | | | | | | | | | | | |
| Henryetta | | X | X | X | X | X | | | | | X | | X | X | X | | | | | | | | | | | | | | | | | | | |
| Wetumka I | X | X | | | X | | | | | | | | X | | X | | | | | X | X | | | | | | | | | | | | | |
| Wetumka II | X | X | | | X | | | | | | | | X | | X | | | | | X | X | | | X | | | | | | | | | | |
| Ardmore City | X | X | | | | | | | | | X | | X | | X | | | | | X | X | | | | | | | | | | | X | | |
| Claremore | | | X | | X | X | | | | | | | X | | X | | | | | X | | X | | | | | | | | | | | | |
| Sportsman | | | X | | X | | | | | | | | X | | X | | | | | X | X | | | | | | | | | | | | | |

Appendix VIII: Species occurring in 1966 (cont.).

| PROVINCE Lake | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | M. albidus | E. agilis | T. prasinus | unident. cyclops | Holopedium | Diaphanosoma spp | D. ambigua | D. parvula | D. laevis | D. rosea | D. schodleri | S. serrulatus | C. lacustris | B. longirostris | B. coregoni | L. quadrangularis | C. sphaericus | S. kingi | E. lamellatus | A. affinis | A. costata | A. rectangula | A. quadrangularis | P. denticulatus | C. globosus | M. laticornis | I. sordidus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EASTERN (cont.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Holdenville | X | X | | | X | | | | | | | | X | | X | | | | | | X | | | | X | | | | X | | | | | |
| Bluestem | X | X | X | | X | X | | | | | | | | X | | | | | | X | X | X | | X | | | | | | | | | | |
| Hominy | X | | | | X | X | X | | | | | | | X | | | | | | X | | X | | | | | | | | | | | | |
| Hudson | | | X | | X | X | X | | | | | | X | X | | | | | | X | X | | | X | | | | | | | | | | |
| Wewoka | X | | X | | X | | | | | | | | X | | X | | | | | X | X | | | X | | | X | | | | | | | |
| CENTRAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tecumseh | | X | | X | X | X | X | | | | | | X | | | | | X | | | | X | | | | | | | X | | | | | |
| Guthrie | X | X | | | X | X | X | | | | | | X | | X | | | | | | X | | | | | | | | | | | | | |
| Pawnee | | X | | | X | | | | | | | | X | | X | | | | | | X | X | | | | | | | | | | | | |
| Perry City | | X | | | X | | X | | | | X | | X | | X | | | | | | | X | | X | | | | | | | | | | |
| Paul's Valley | X | X | | | X | | | | | | X | | X | | X | | | | | X | X | | | | | | | | | | | | | |
| Cushing | X | X | | | X | | | | | | | | X | | X | | | | | | X | | | | | | | | | | | | | |
| Shawnee | | X | | | | | | | | | | | | | X | | | | | | X | | | X | | | | | | | | | | |
| WICHITA MTS. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rush | X | | | | X | | X | | | | | | | X | X | | | | X | | X | X | | X | | | | | | | | | | |
| Q. Parker I | X | | | | X | | | | | | | | X | X | | X | | | | X | X | | | X | | | | | | | X | | | |
| Q. Parker II | X | | | | | | | | | | | | | X | | | | | | X | X | | | X | | | X | | | | X | | | |
| J. Johnson | X | | | | X | | | | | | | | X | X | | X | | | | | X | | | X | | | | X | | | | | | |
| E. Thomas I | X | | | | X | X | | | | | | | X | | | | | X | | X | X | | | X | | | | | | | X | | | |
| E. Thomas II | X | | | | X | | | | | | | | | | | | | X | | | X | | | X | | | | | | | | | | |
| ARBUCKLE MTS. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Veterans | X | | | | | | | | | | X | | | | | X | | | | | X | | | X | | | X | | | | | | | |
| Mountain | X | | | | X | | X | | | | | | | X | | X | X | | | | X | | | X | | | | | | | | | | |

Appendix VIII: Species occurring in 1966 (cont.).

| PROVINCE Lake | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | M. albidus | E. agilis | T. prasinus | unident. cyclops | Holopedium | Diaphanosoma spp | D. ambigua | D. parvula | D. laevis | D. rosea | D. schodleri | S. serrulatus | C. lacustris | B. longirostris | B. coregoni | L. quadrangularis | C. sphaericus | S. kingi | E. lamellatus | A. affinis | A. costata | A. rectangula | A. quadrangularis | P. denticulatus | C. globosus | M. laticornis | I. sordidus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIDWESTERN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Northwood | X | | | | | | X | | X | | X | | | | X | | | | | | X | | X | X | | | | | | | | | | |
| Elmer I | | X | | X | | | X | | | | | | | | X | | | | | | | X | | | | | | | | | | | | |
| Elmer II | | X | | X | X | X | X | | | | | | | | X | | | | | | | X | X | | | | | | | | | | | |
| Clear | X | | | | X | | | | | | X | | X | | X | | | | | X | X | | | X | | | | | | | | X | | |
| WESTERN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hobart | X | X | | | | | X | | | | | | | | X | | | | | | | X | | X | | | | | | | | | | |
| Clinton | X | X | | | | | X | | | | | | | | X | | | | | X | X | X | | X | | | | X | | | | | | |
| ALLUVIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mahoney #1 | X | | | | X | X | | | | | | | | X | | | | | | X | | X | | X | | | | | | | | | | |
| Mahoney #1 | X | | | X | | X | | | | | | | | | X | | | | | | X | | X | X | | | | | | | | | | |
| Vincent | X | | | | X | | | | | | | | | | | | X | | | X | | X | | | | | | | | | | | | X |
| Roebuck | X | | | | | | X | | | | | | | | X | | | | | X | X | | | | | | | | | | | | | |
| Snyder | X | | | | | X | | | | | | | | | X | X | | | | X | | X | X | | | | | | | | | | | |
| BLAINE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Watonga I | X | | | | X | X | X | | X | | | | X | X | | | | | X | X | | | | X | | | | | | | | | | |
| Watonga II | X | | | | | X | | X | | | | | | X | | | | | X | | | | | X | | | | | | X | | | | |
| Number of Occurrences (52) | 38 | 19 | 10 | 5 | 38 | 18 | 15 | 1 | 4 | 1 | 9 | 1 | 31 | 18 | 37 | 5 | 2 | 3 | 3 | 31 | 38 | 14 | 6 | 26 | 1 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 |
| Percentage Occurrence | 73.1 | 36.5 | 19.2 | 9.7 | 73.1 | 34.6 | 28.8 | 1.9 | 7.7 | 1.9 | 17.3 | 1.9 | 59.6 | 34.6 | 71.2 | 9.7 | 3.8 | 5.8 | 5.8 | 59.6 | 73.1 | 26.9 | 11.5 | 50.0 | 1.9 | 1.9 | 5.8 | 5.8 | 3.8 | 1.9 | 5.8 | 3.8 | 1.9 | 1.9 |

Appendix IX: Percentage composition of the major species of the total crustacean population, 1966 (- = less than 1%).

| Province Lake | Total Vertical | No. Naupli | No. Adults | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | Other cyclopoids | D. parvula | D. ambigua | Other daphnids | C. lacustris | B. longirostris | Diaphanosoma sp. | Other cladocera |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OUACHITA | | | | | | | | | | | | | | | | | | |
| N. Waiya | 1,904 | 200 | 1,704 | 36 | | | | 1 | | 7 | | | 35 | | 1 | 15 | 3 | |
| O. Cobb | 1,280 | 200 | 1,080 | 11 | 3 | | | - | | | 73 | 3 | 1 | | - | - | 6 | 1 |
| Clayton | 1,256 | 200 | 1,056 | 36 | | | | - | | | 8 | - | | | - | 2 | | 52 |
| Schooler | 2,104 | 200 | 1,804 | 62 | | | | 4 | | | 4 | 10 | 19 | | - | | - | - |
| OZARK | | | | | | | | | | | | | | | | | | |
| Greenleaf | 621 | 136 | 485 | | | 52 | | 1 | 6 | | | 21 | | | - | 3 | 1 | 2 |
| Eucha | 1,948 | 280 | 1,668 | | | 43 | | - | 18 | | | 15 | 5 | | - | 18 | - | 1 |
| Francis | 72 | 22 | 49 | | | 8 | | | | 32 | | 6 | 10 | | | 22 | - | 13 |
| CRETACEOUS | | | | | | | | | | | | | | | | | | |
| Carter | 3,248 | 400 | 2,848 | 16 | | | | 5 | | | | 75 | | | 2 | | - | 3 |
| R. Gary | 2,728 | 200 | 2,528 | - | | | | 1 | 28 | | | 46 | | | 12 | 10 | 3 | 1 |
| Yashoo | 1,084 | 100 | 984 | 58 | | | | 3 | 4 | | | 24 | | | - | 1 | - | 3 |
| EASTERN | | | | | | | | | | | | | | | | | | |
| Wewoka | 448 | 38 | 410 | 10 | | 57 | | 12 | | | | 11 | | | 1 | 7 | 3 | 1 |
| Carleton | 3,144 | 800 | 2,378 | 37 | | | | - | | 16 | | 32 | | | 2 | 8 | 4 | 1 |
| Okmulgee | 708 | 164 | 708 | | | 46 | | 4 | | | 11 | 10 | 6 | | - | 3 | 19 | |
| Henryetta | 832 | 44 | 788 | | 32 | 24 | 16 | 1 | 3 | | | - | - | | | | 24 | |
| Atoka | 2,472 | 400 | 2,072 | 25 | 25 | | | | | 4 | | 5 | 2 | | - | 34 | - | |
| Wetumka I | 1,788 | 96 | 1,692 | 36 | 16 | | | 20 | | | 12 | 8 | | | - | 1 | 6 | |
| Wetumka II | 588 | 161 | 472 | 16 | 33 | | | 26 | | | | 13 | | | 2 | 1 | 8 | 1 |

Appendix IX: Percentage composition of the major species of the total crustacean population, 1966 (cont.) (- = less than 1%).

| Province Lake | Total Vertical | No. Nauplii | No. Adults | *D. pallidus* | *D. siciloides* | *D. reighardi* | *D. clavipes* | *M. edax* | *C. b. thomasi* | *C. vernalis* | Other cyclopoids | *D. parvula* | *D. ambigua* | Other daphnids | *C. lacustris* | *B. longirostris* | *Diaphanosoma* sp | Other Cladocera |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EASTERN (cont.) | | | | | | | | | | | | | | | | | | |
| Sportman | 542 | 296 | 246 | | | 24 | | 70 | | | | 6 | | | - | - | - | |
| Holdenville | 1,716 | 264 | 1,452 | 18 | 3 | | | 9 | | | | 8 | | | - | 58 | 2 | 3 |
| Claremore | 506 | 168 | 338 | | | 66 | | 3 | 20 | | | 4 | | | 2 | | 3 | 4 |
| Bluestem | 2,350 | 596 | 1,754 | 17 | 5 | 3 | | 3 | 17 | | | | 35 | | 1 | 10 | - | 8 |
| Hominy | 876 | 200 | 676 | 4 | | | | - | 24 | | | | 60 | | 1 | | 2 | 10 |
| Hudson | 1,020 | 432 | 588 | | | 52 | | 3 | 34 | | | 8 | | | 1 | 1 | - | 2 |
| Ardmore City | 1,332 | 100 | 1,232 | 6 | 52 | | | 20 | | | | 5 | | | 7 | 8 | 2 | 1 |
| CENTRAL | | | | | | | | | | | | | | | | | | |
| Tecumseh | 1,060 | 20 | 1,040 | | 22 | | 22 | 5 | 2 | 5 | | | | 22 | | | 22 | 2 |
| Guthrie | 2,000 | 68 | 1,932 | 20 | 47 | | | 1 | 11 | 2 | | 10 | | | | 5 | - | |
| Pawnee | 3,404 | 614 | 2,790 | | 42 | | | 2 | | | 4 | 49 | | | | 1 | 1 | 1 |
| Perry City | 1,152 | 192 | 960 | | 19 | | | 4 | | 21 | | 32 | | | | 20 | 2 | |
| Paul's Valley | 4,060 | 800 | 4,160 | 15 | 35 | | | 6 | | | | 27 | | | - | 15 | 2 | |
| Cushing | 2,020 | 256 | 1,764 | 9 | 85 | | | 1 | | | 2 | 4 | | | | | - | |
| Shawnee | 2,164 | 176 | 1,988 | | 32 | | | 5 | | | 16 | 34 | | | | 8 | 4 | 1 |
| WICHITA MTS | | | | | | | | | | | | | | | | | | |
| Rush | 11,132 | 3,216 | 7,916 | 30 | | | | 12 | | 12 | | 5 | 32 | | | 3 | - | 5 |
| Q. Parker I | 936 | 192 | 744 | 65 | | | | 20 | | | | | 3 | 1 | 2 | 7 | - | 3 |
| Q. Parker II | 2,938 | 456 | 2,430 | 54 | | | | 15 | | | | | 23 | | | 7 | - | 3 |

Appendix IX: Percentage composition of the major species of the total crustacean population, 1966 (cont.)(- = less than 1%).

| Province Lake | Total Vertical | No. Nauplii | No. Adults | D. pallidus | D. siciloides | D. reighardi | D. clavipes | M. edax | C. b. thomasi | C. vernalis | Other cyclopoids | D. parvula | D. ambigua | Other daphnids | C. lacustris | B. longirostris | Diaphanosoma sp | Other Cladocera |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WICHITA MTS (cont.) | | | | | | | | | | | | | | | | | | |
| J. Johnson | 8,120 | 800 | 7,320 | 32 | | | | 3 | | | | | 31 | 6 | | 29 | - | 2 |
| E. Thomas I | 8,120 | 800 | 7,320 | 32 | | | | - | 3 | | | | | 38 | | 29 | - | 2 |
| E. Thomas II | 4,288 | 1,708 | 3,580 | 35 | | | | 15 | | | | | | 30 | | 18 | - | 1 |
| ARBUCKLE MTS | | | | | | | | | | | | | | | | | | |
| Veterans | 2,784 | 516 | 2,268 | 53 | | | | | | | 2 | | | 44 | | - | | 2 |
| Mountain | 3,022 | 568 | 2,444 | 31 | | | | 13 | | 3 | | | - | 29 | | 17 | - | 2 |
| MIDWESTERN | | | | | | | | | | | | | | | | | | |
| Northwood | 3,096 | 1,062 | 2,034 | 41 | | | | 5 | | 2 | 1 | 50 | | | | 2 | | 2 |
| Elmer I | 8,080 | -- | 8,080 | | 36 | | 7 | | | 16 | | 14 | | | | | | 28 |
| Elmer II | 2,048 | 180 | 1,868 | | 9 | | 11 | 4 | 8 | 29 | | 24 | | | - | | | 15 |
| Clear | 1,902 | 430 | 1,472 | 42 | | | | 9 | | | | 46 | | | - | 1 | - | 1 |
| WESTERN | | | | | | | | | | | | | | | | | | |
| Hobart | 2,336 | 400 | 1,936 | 4 | 55 | | | | | 22 | | 18 | | | | | | |
| Clinton | 6,768 | 800 | 5,968 | 20 | 17 | | | | | 27 | | 21 | | | - | 10 | | 5 |
| ALLUVIUM | | | | | | | | | | | | | | | | | | |
| Mahoney #1 | 2,812 | 792 | 2,020 | 65 | | | | 8 | 27 | | | | 2 | | - | - | | 1 |
| Mahoney #2 | 4,124 | 1,432 | 2,692 | 34 | | | 4 | | 16 | | | 12 | | | | 36 | | 2 |

Appendix IX: Percentage composition of the major species of the total crustacean population, 1966 (cont.) (- = less than 1%).

| Province Lake | Total Vertical | No. Nauplii | No. Adults | *D. pallidus* | *D. siciloides* | *D. reighardi* | *D. clavipes* | *M. edax* | *C. b. thomasi* | *C. vernalis* | Other cyclopoids | *D. parvula* | *D. ambigua* | Other daphnids | *C. lacustris* | *B. longirostris* | *Diaphanosoma* sp | Other Cladocera |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLUVIUM (cont.) | | | | | | | | | | | | | | | | | | |
| Vincent | 3,500 | 1,704 | 1,796 | 37 | | | | 42 | | | | | | 11 | - | | - | 11 |
| Roebuck | 3,320 | 800 | 2,520 | 36 | | | | - | | 5 | | 8 | | | - | 40 | 10 | |
| Snyder | 5,168 | 800 | 4,368 | 1 | | | | | 48 | | | 29 | | 6 | - | | | 1 |
| BLAINE | | | | | | | | | | | | | | | | | | |
| Watonga I | 11,992 | 2,400 | 9,592 | 53 | | | | | 3 | 4 | 2 | | 36 | | - | 2 | - | 6 |
| Watonga II | 4,852 | 776 | 4,076 | 66 | | | | | 11 | | 5 | | 21 | | - | | | 3 |