Distribution of chironomids in the littoral zone of Lake Texoma, Oklahoma and Texas

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Keywords: Chironomidae, littoral, reservoir, salinity, chlorides, particulate organic matter, temperature, wind

Abstract

Lake Texoma in southcentral Oklahoma was formed by the impoundment of the Washita and Red Rivers. The Red River is more highly saline than the Washita and creates a complex salinity gradient across the reservoir. Populations of chironomids were monitored with multiple-plate samplers in areas of high (34–113 mg l^{-1} Cl^-), intermediate (35–60 mg l^{-1} Cl^-) and low (4–27 mg l^{-1} Cl^-) salinity during the spring and summer of 1978. Food availability, temperature, salinity and wind direction influenced the distribution of the 14 genera and at least 22 species of chironomids which colonized the multiple-plate samplers. Filter-feeders attained their highest densities in the river-arm stations where levels of particulate organic matter (POM) were high. Algal grazers attained their highest densities in the clear intermediate area where the plates of the samplers were covered with algal mats. Most of the genera believed to be feeding primarily on POM decreased in density as the temperature and density of *Glyptotendipes* sp. rose. Certain species were restricted to either the Red River arm or the Washita River arm and this is probably a reflection of different salinity tolerances.

Introduction

A large reservoir, by nature of being an open system, is subject to a large amount of physical and chemical variability both within particular areas and throughout the body of the reservoir (Silvey & Stanford 1978). This variability may well influence the diversity of chironomid communities. This report presents the results of a survey of the chironomids in three areas of a reservoir, Lake Texoma, that differ seasonally in temperature and spatially and seasonally with regard to food availability and salinity.

A lake becomes saline when it acquires high solute loads from evaporation exceeding inflow and/or by the inflow being saline. Most saline lakes are formed in hydrologically closed basins in arid regions (Eugster & Hardie 1978), where they undergo seasonal salinity fluctuations, and are characterized by a high proportion of fugitive, opportunistic species (Williams 1970). Although some studies have examined the relationship between chironomid distribution and salinity (Buxton 1926; Edwards 1926; Thorpe 1931; Mozley 1966; Neumann 1976; Parma & Krebs 1977), most of these studies were concerned with marine, estuarine and salt-marsh habitats, rather than with large reservoirs. Edmondson (1969) and Lauer (1969), in examining several lakes in Washington, found that striking changes in the species composition of the chironomid fauna accompanied a reduction in the salt content of the lakes. Topping (1971) studied the distribution of *Chironomus tentans* in saline lakes in British Columbia, and reported that certain features of the water, such as salinity and sulfate concentration, affected the distribution of this species.

Cannings & Scudder (1978) observed that the distribution of littoral chironomids in a series of Canadian lakes depended on both salinity and

Hydrobiologia 89, 177–188 (1982). 0018-8158/82/0892-0177/$02.40.

productivity values. Other researchers have also linked increases in chironomid diversity and production with primary production (Smith 1969; Hall *et al.* 1970; Dermott *et al.* 1977; Davies 1980). This relationship becomes more complex in a large reservoir due to variability in bottom contours and allochthonous inputs (Silvey & Stanford 1978). Because a large reservoir may contain both shallow, turbid areas and deeper areas it cannot effectively be put into a single trophic category and may support several different chironomid communities.

Methods

Study area

Lake Texoma was formed in 1942 following the construction of Denison Dam on the Texas–Oklahoma border. The drainage basin of the reservoir is 99 170 km^2 and is composed of the watersheds of both the Red and Washita Rivers. The Red River flows through extensive streches of Permian, iron-rich strata and localized deposits of limestone and gypsum (Bullard 1926). The Washita River basin constitutes only 20% of the total watershed area, and most of the basin is outside the Permian deposits. The Red River contributes approximately 60% and the Washita River 40% of the reservoir inflow (Sublette 1953; White & White 1977).

I selected six sampling stations (Fig. 1) in shallow water in Lake Texoma, two in each of the river arms, and two where the arms meet near the Denison Dam (Little Mineral). The stations in the Washita arm were located about 10 m offshore from sandy banks. Station 1 was on the eastern shore and received considerably more wave action than Station 2. Stations 3 and 4 were located at the mouth of the Little Mineral area. This area of the lake is deeper than either of the river arms and is characterized by limestone deposits. Both stations were located about 6 m offshore from low, sandy banks. Stations 5 and 6 were in the Red River arm. Station 5 was located on the north shore of the lake about 8 m offshore from a steep, clay overhang. Station 6 was on the south shore directly across from Station 5, about 16 m offshore from a low, clay bank. Station 5 received more wind action than Station 6. The bottom substrata of Stations 1 and 2 were composed primarily of very fine sand. The

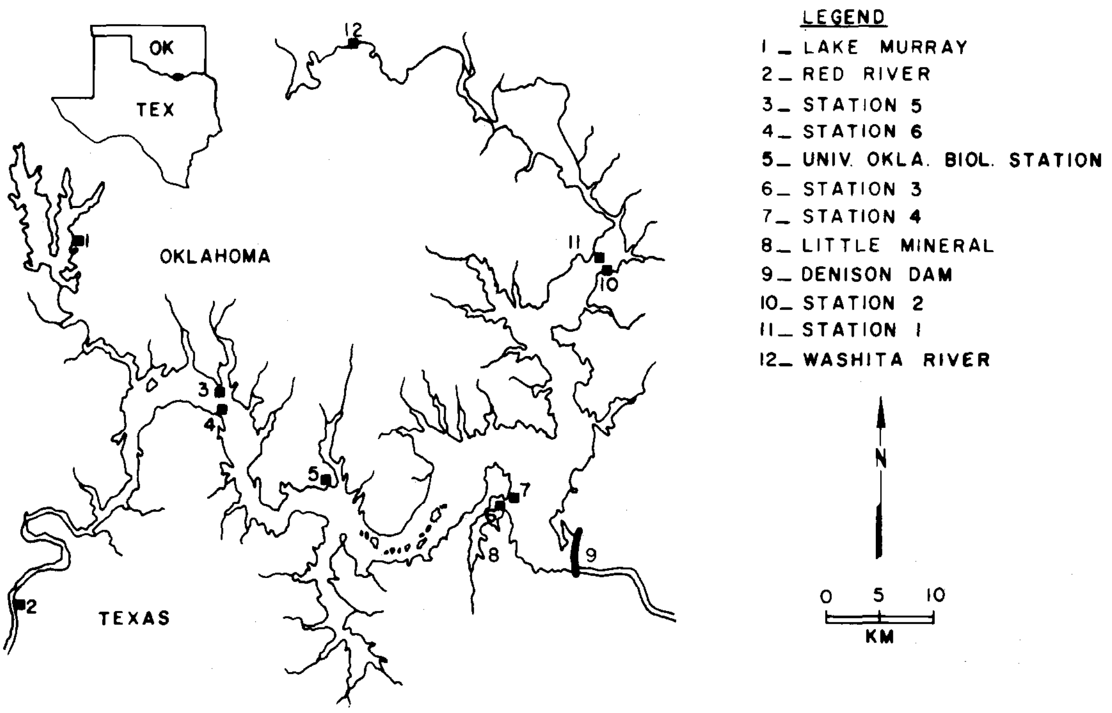

Fig. 1. Map of Lake Texoma showing sample stations.

substrata at Stations 3 and 4 were composed primarily of fine sand, whereas the substrata at Stations 5 and 6 were composed primarily of a watery silt/clay.

Physico-chemical parameters

Conductivity, chloride-ion activity and concentration, dissolved oxygen, pH and temperature were measured weekly at 1 m depths with a Hydrolab surveyor (model 6D-12). Secchi-disk transparency was also recorded weekly. To estimate algal food availability, water samples were collected on four occasions and analyzed for algal chlorophyll *a* and ATP (Strickland & Parsons 1968; Lind 1974). Samples of substratum were collected on three occasions with a 14 cm^2 Ekman dredge. Substrata were assigned to size classes using Hynes' (1970) classification.

Chironomidae

In late April 1978, six multiple-plate artificial substratum samplers (Hester & Dendy 1962) were placed at each station. Six samplers were used to help ensure that at least three would be available for retrieval. The samplers were attached by wires to a large, styrofoam float and suspended 1 m below the water surface. These artificial substrata were collected and replaced every four weeks until the end of September. Due to heavy rainfall and wind in early June, some floats and samplers had to be replaced, causing overlap in the collection schedule.

Three of the samplers were examined for each month. Specimens were examined under a dissecting microscope and the total number of chironomid larvae was recorded. Samples containing over 100 individuals were subsampled using the method of Thorpe & Bergey (1981) in which randomly numbered grids were examined. Subsample size was determined initially with a species area curve based on 70 to 80 individuals. Chironomids were identified to the generic level. Genera were placed into four dominance classes based on their monthly density at each station. Generic composition and abundance at the six stations were compared with each other and with physico-chemical parameters using the Pearson product-moment correlation procedure (Barr *et al.* 1976).

Adults were collected by rearing, from emergence traps and by on-shore blacklighting to obtain a minimal estimate of species richness in the three areas of the reservoir. Representative specimens were identified by James E. Sublette.

Results

Physico-chemical parameters

Like many reservoirs (McLachlan 1974) the physical and chemical conditions in Lake Texoma are highly variable, especially in terms of lake level fluctuations and rapid changes in salinity. For example, at the Denison Dam the water level rose 2.4 m after heavy rains from 186.5 m above M.S.L. on 22 May to 188.9 m above M.S.L. on 11 June. Following releases of flood waters over the dam, the water level then declined slowly, reaching 186.7 m above M.S.L. on 24 September. Salinity (in terms of conductivity, Cl^- and Na^+ concentrations) values dropped at all stations during the late spring flooding and then rose gradually throughout the summer, but salinity was always highest in the Red River arm and lowest in the Washita River arm. Conductivity and Cl^- and Na^+ concentrations all followed the same general trends (Vaughn 1979); hence, only Cl^- concentrations are given here (Fig. 2). Chloride concentrations ranged from 4.8 mg l^{-1} at Station 2 on 15 June to 113.4 mg l^{-1} at Station 5 on 26 May. Average concentrations for the entire study period in each area were 13.4 ± 8.5 mg l^{-1} in the Washita arm (Stations 1 and 2), 42.8 ± 5.9 mg l^{-1} in Little Mineral (Stations 3 and 4) and 61.3 ± 18.6 mg l^{-1} in the Red River arm (Stations 5 and 6).

Temperature increased throughout the spring and summer, but did not vary much among stations during the sampling period. Mean weekly temperatures for all stations were lowest on 29 April (18.5 ± 1.2 °C) and highest from 29 June to 27 July (approximately 29.0 ± 0.9 °C) (Fig. 3). Secchi transparency was always greatest at the Little Mineral stations, and usually slightly higher in the Washita arm than the Red River arm. Average Secchi transparencies for the entire study period were 0.4 ± 0.2 m in the Red River arm, 0.5 ± 0.2 m in the Washita arm and 1.36 ± 0.6 m in Little Mineral (Fig. 4).

Algal chlorophyll *a* and ATP were used as

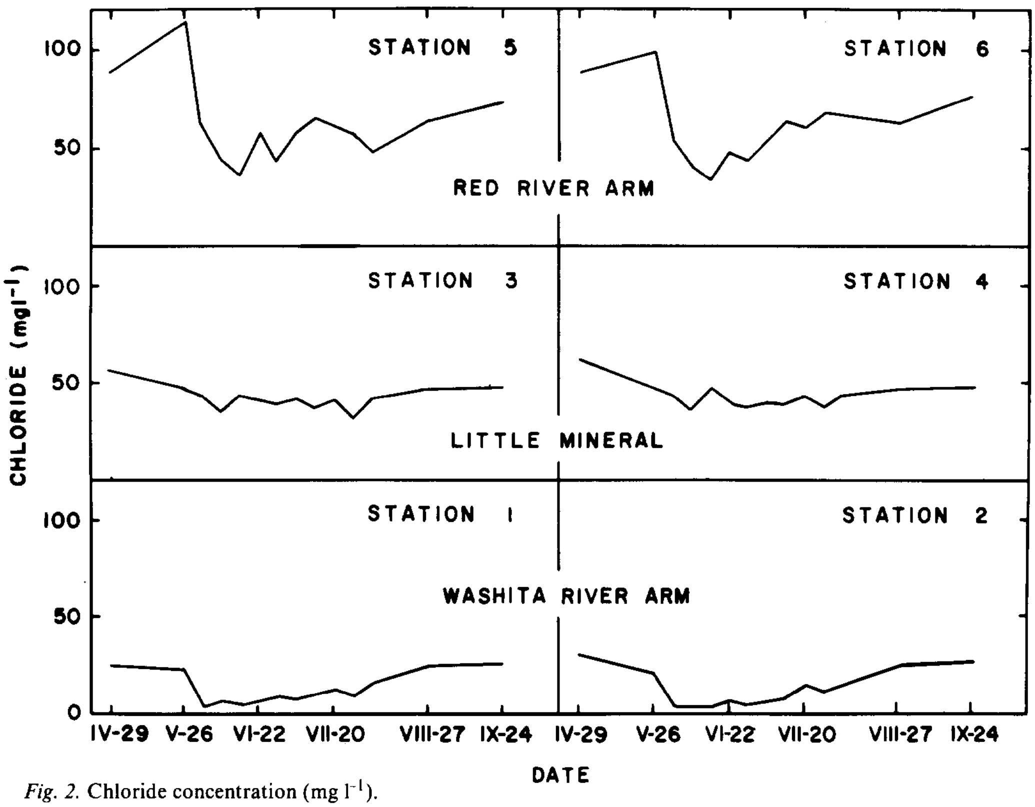

Fig. 2. Chloride concentration (mg l^{-1}).

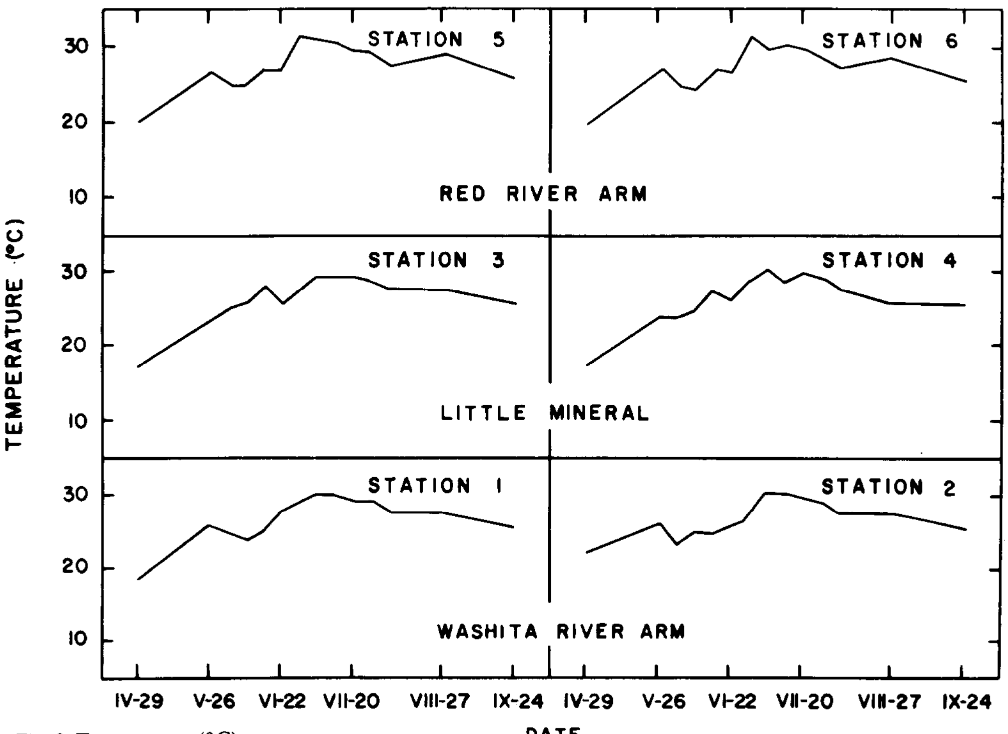

Fig. 3. Temperature (°C).

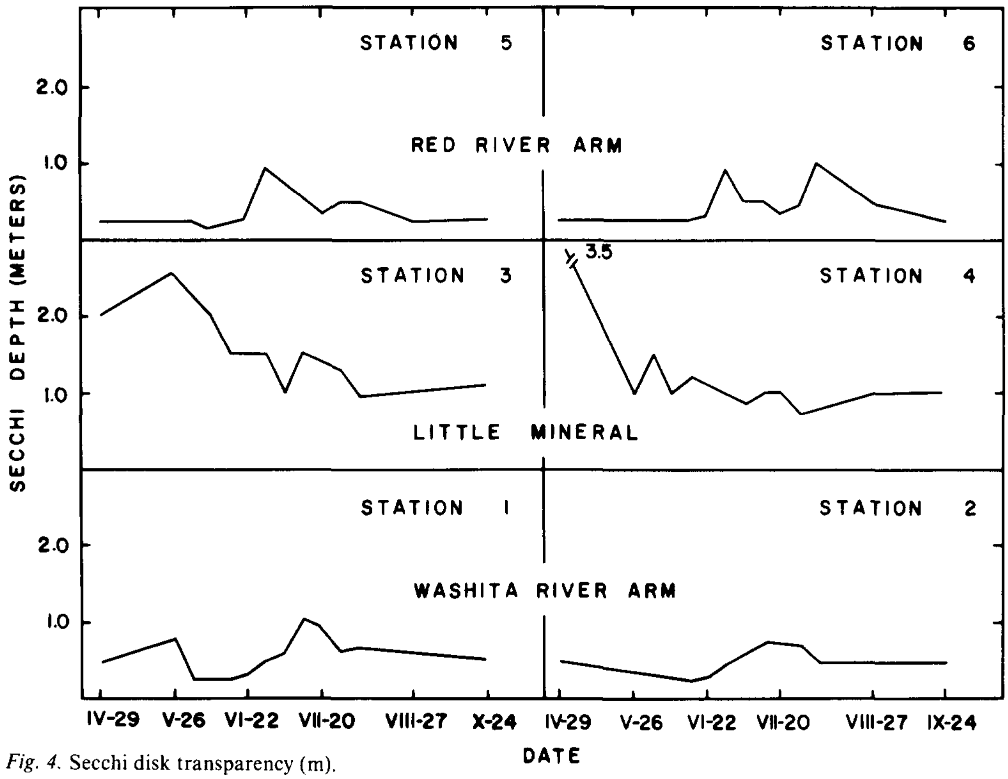

Fig. 4. Secchi disk transparency (m).

indicators of standing crop production. Production was always highest in the Red River arm and lowest in Little Mineral. The overall average concentrations for algal chlorophyll *a* were 33.6 ± 7.7 mg m^{-3} in the Red River arm, 25.5 ± 9.3 mg m^{-3} in the Washita arm and 16.8 ± 8.5 mg m^{-3} in Little Mineral. Mean concentrations of ATP were 752.94 ± 302.83 mg Cl^{-1} in the Red River arm, 446.38 ± 167.98 mg Cl^{-1} in the Washita River arm and 358.57 ± 67.78 mg Cl^{-1} in Little Mineral.

Mean dissolved carbonate/bicarbonate concentrations were 7.3/98 ± 4.9/23 mg l^{-1} in the Red River arm, 12.0/101 ± 3.5/13.9 mg l^{-1} in Little Mineral and 10.8/108 ± 4.5/15 mg l^{-1} in the Washita arm. The pH did not vary among stations. Mean pH was 8.0 ± 0.4. The pH dropped at all stations during the late spring flooding and gradually rose during the rest of the study period. Dissolved oxygen did not show any definite relationship to water level fluctuations. Mean concentrations for the study period were 6.7 ± 1.9 mg l^{-1} in the Red River arm, 7.1 ± 1.8 mg l^{-1} in Little Mineral and 6.4 ± 1.4 mg l^{-1} in the Washita River arm.

Chironomidae

Fourteen genera of chironomids were collected on the multiple-plate samplers. *Glyptotendipes* sp. was the most dominant form collected (Table 1, Fig. 5). In July, August and September *Glyptotendipes* sp. made up approximately 90% of the chironomids collected in the Red and Washita arm stations and 57% in Little Mineral. The relative abundance of *Glyptotendipes* sp. was positively correlated with temperature (Table 2). Adults of *Glyptotendipes meridionalis* Dendy et Sublette were collected from all three areas of the lake.

Dicrotendipes spp. ranked second in abundance. During the summer the density of *Dicrotendipes* spp. decreased in the river arms and increased in Little Mineral (Table 1). The occurrence of *Dicrotendipes* spp. was negatively correlated with chlorophyll *a* and positively correlated with fine sand (Table 2). Adults of *Dicrotendipes neomodestus* Malloch were collected from the Washita and Little Mineral areas, and adults of *D. nervosus* Staeger were collected from Little Mineral and the Red River arm.

Table 1. Distribution and abundance of chironomid larvae per station. Dominance classes based on density (No. m $^{-2}$) in monthly samples (M–May, J–June, J–July, A–August, S–September) and for the entire study period (T): D, dominant (1 000+); A, abundant (500–1 000); C, common (50–500); U, uncommon (1–50).

	Station																																			
	1						2						3						4						5						6					
Genus	M	J	J	A	S	T	M	J	J	A	S	T	M	J	J	A	S	T	M	J	J	A	S	T	M	J	J	A	S	T	M	J	J	A	S	T
Glyptotendipes	D	D	D	D		D	C	C	D	D	D	D	C	C	C	C	D	D			D	A		D	A		D	D		D	C	C	A	C	C	D
Dicrotendipes	D	C	C	C		D	C	C	C	C	C	D	C	C	D	D	A	D		C	C	A		A	A		C	U		D	U	C	C	C	U	C
Rheotanytarsus	D					D	A					A																								
Polypedilum	D					D	C					C										C		C	D					D	C	U				C
Cricotopus	D					D	C					C	D	U				D		C	U	C		C												
Tanytarsus							U	U				U		U			C	C			U	U		C	D					D	U					U
Psectrocladius	C	C				C	C	U			U	C	U	U		C	C	C		U	C	C		C	C					C		U		U	U	C
Ablabesmyia	C		U	C		C		U		C	U	C		U	C	U		C		U	C	U		C								U		U	U	U
Tribelos			U	U		C			U	U		C																								
Parachironomus													U					U		U	C			C												
Chironomus																															C	U				C
Einfeldia													U					U																		
Cryptochironomus																															U					U
Cladotanytarsus							U					U																								

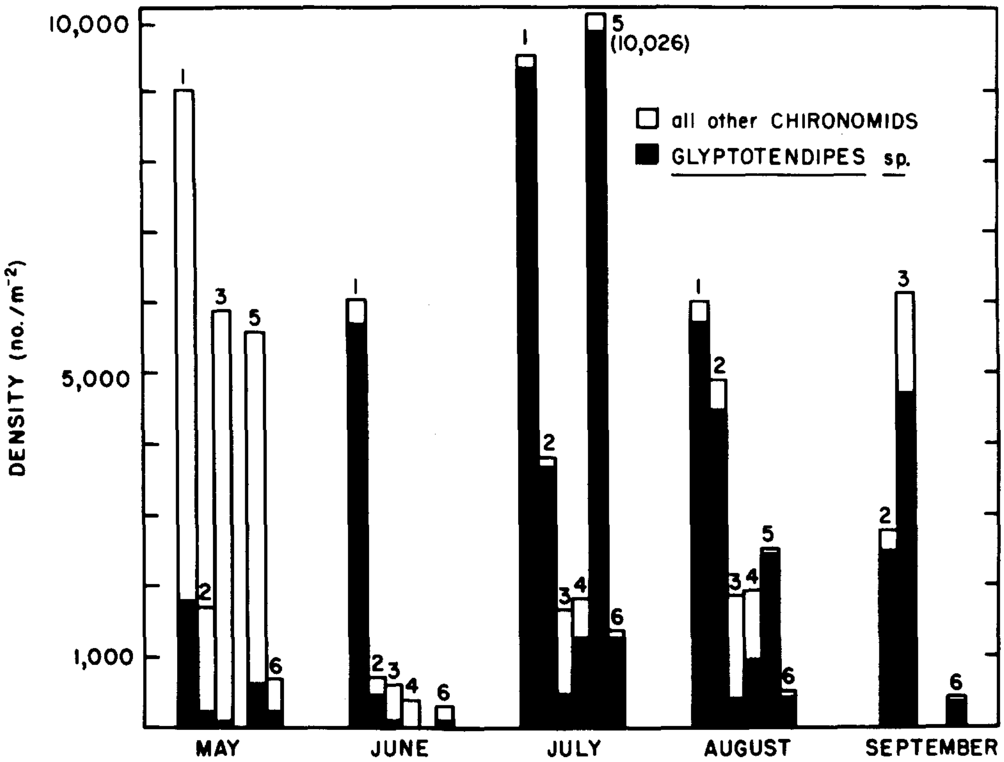

Fig. 5. Seasonal dominance relationships of *Glyptotendipes* sp.

Tanytarsus sp. was dominant in the Red River arm early in the study but generally uncommon in the other areas (Table 1). The relative abundance of *Tanytarsus* sp. was positively correlated with Cl^- concentration, conductivity and the relative abundance of *Polypedilum* spp. (Table 2). Adults of *Tanytarsus recurvatus* Goetghebuer were collected from the Washita and Little Mineral areas. *Polypedilum* spp. was dominant in both river arms in May but was rare during the rest of the study (Table 1). The occurrence of *Polypedilum* spp. was negatively correlated with temperature and positively correlated with the relative abundances of *Rheotanytarsus* sp. and *Dicrotendipes* spp. (Table 2). *Polypedilum digitifer* Townes adults were collected from all three areas. Adults of *P. floridense* Townes were collected from the Washita and Little Mineral areas.

Psectrocladius sp. and *Ablabesmyia* spp. occurred at low densities in all three areas (Table 1). The relative abundance of *Psectrocladius* sp. was positively correlated with the relative abundances of *Dicrotendipes* spp., *Tanytarsus* sp. and *Polypedilum* spp., and negatively correlated with temperature (Table 2). No adults were collected. The relative abundance of *Ablabesmyia* spp. was negatively correlated with substratum water and silt/clay content and positively correlated with the relative abundances of *Dicrotendipes* spp. and *Rheotanytarsus* sp. (Table 2). Adults of *Ablabesmyia ramphe* Sublette and *A. annulata* (Say) were collected from the Washita arm. *Ablabesmyia mallochi* (Walley) was collected from the Red River arm.

Cricotopus spp. was dominant in the Washita arm and in Little Mineral in May. This genus was then found in low densities in Little Mineral through August, but was not encountered again in the Washita arm and was never collected in the Red River arm (Table 1). The relative abundance of *Cricotopus* spp. was positively correlated with transparency and negatively correlated with temperature and chlorophyll *a* concentration (Table 2). Adults of *Cricotopus bicinctus* Meigen and *C. n. sp.* 1 were collected from the Washita and Little Mineral areas. *Cricotopus n. sp.* 2 adults were

Table 2. Pearson product – moment correlation test results. Positive (+) or negative (–) correlations of chironomid densities, substrate type and physical and chemical factors are indicated by + or – for a 0.5 significance level, ++ or –– for 0.01, and +++ or ––– for 0.001.

	TEMPERATURE	CHLORIDE	CONDUCTIVITY	SODIUM	SECCHI DEPTH	CHLOROPHYLL-A	ATP	BICARBONATE	CARBONATE	pH	OXYGEN	% WATER	% GRAVEL	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND	% SILT/CLAY	*Glyptotendipes*	*Dicrotendipes*	*Rheotanytarsus*	*Polypedilum*	*Cricotopus*	*Tanytarsus*	*Psectrocladius*	*Ablabesmyia*	*Tribelos*	*Parachironomus*	*Chironomus*	*Einfeldia*	*Cryptochironomus*
CHLORIDE																															
CONDUCTIVITY		+++																													
SODIUM		+++	+++																												
SECCHI DEPTH																															
CHLOROPHYLL-A																															
ATP																															
BICARBONATE																															
CARBONATE																															
pH																															
OXYGEN																															
% WATER		+++	+++	+++		++																									
% GRAVEL		––	–––	––																											
% COARSE SAND		–––	–––	–––																											
% MEDIUM SAND				–																											
% FINE SAND					+	–––						–––																			
% VERY FINE SAND		–––	–––	–––								––																			
% SILT/CLAY		+++	+++	+++		+++						+++																			
Glyptotendipes	+																														
Dicrotendipes						––										+															
Rheotanytarsus	–													+						+											
Polypedilum	––																			++	+++										
Cricotopus	–––				+	–																									
Tanytarsus		++	+																			+++									
Psectrocladius	–																			+		++		++							
Ablabesmyia												–						–		++	+										
Tribelos		––	–											++					++												
Parachironomus															+++	+															
Chironomus		+		+																											
Einfeldia	––				+																		+++								
Cryptochironomus		+		+																									+++		
Cladotanytarsus	–																														

collected from Little Mineral only. The new species will be described by James E. Sublette.

Rheotanytarsus sp., *Cladotanytarsus* spp. and *Tribelos* sp. were collected only in the Washita River arm. *Rheotanytarsus* sp. was dominant in May but was not found later in the year (Table 1). Its occurrence was positively correlated with coarse sand and negatively correlated with temperature (Table 2). No adults were collected. *Cladotanytarsus* spp. was uncommon at Station 2 in May (Table 1) and its relative abundance was negatively correlated with temperature (Table 2). *Cladotanytarsus cruscula* (Saether) adults were collected from all three areas. *Cladotanytarsus n. sp. 1* was found in Little Mineral only. *Tribelos* sp. was found in low densities in July and August (Table 1). Its occurrence was negatively correlated with Cl^- concentration and conductivity and positively correlated with coarse sand and the relative abundance of *Glyptotendipes* sp. (Table 2). *Tribelos fusicornis* Malloch adults were collected from the Washita area only.

Parachironomus spp. and *Einfeldia* sp. were found only in Little Mineral where they occurred in low densities during the early part of the study (Table 1). The relative abundance of *Parachironomus* spp. was positively correlated with fine and medium sand (Table 2). *Parachironomus monochromus* (Wulp) and *P. frequens* (Joh.) adults were collected from Little Mineral. *Einfeldia* sp. showed a high, positive correlation with the relative abundance of *Cricotopus* spp. and transparency and was negatively correlated with temperature (Table 2). No adults were collected.

Cryptochironomus sp. and *Chironomus* spp. occurred in low densities in the Red River arm early in the study (Table 1). The relative abundances of both genera were positively correlated with Na^+ and Cl^- concentrations (Table 2). *Cryptochironomus ponderosus* adults were collected from the Red River arm. Adults of *Chironomus decorus* complex were collected from Little Mineral, and *C. crassicaudatus* Malloch adults were collected from all three areas.

Discussion

The most important factors associated with the distribution of the chironomids in the littoral zone of the three areas of Lake Texoma were food availability, temperature, salinity and wind direction.

Dams interrupt the sediment and detritus processes of rivers so that reservoirs have trophic systems intermediate between the classic autochthonous-based lentic and allochthonous-based lotic food webs (Brennan *et al.* 1978; Goldman & Kimmel 1978). In Lake Texoma the turbid river-arm areas appear to more closely approach the riverine, detritus-based system. Production and transparency measures indicated that these areas contained higher levels of particulate organic matter (POM) than Little Mineral, and these areas were dominated by filter-feeding detritivores such as *Glyptotendipes* sp., *Tanytarsus* sp. and *Rheotanytarsus* sp. (Table 3). *Rheotanytarsus* sp. is typically a riverine form (Coffman 1978) and its initial presence in the Washita arm is probably due to flooding which swept many logs and other debris from upstream sites into this area of the lake in May. Little Mineral is deeper, clearer and generally more stable than the river arms and more closely

Table 3. Trophic classification of chironomid genera from Lake Texoma. (1) Armitage (1978); (2) Beck (1977); (3) Brock (1960); (4) Carlson (1968); (5) Coffman (1978); (6) Curry (1965); (7) Danks (1971); (8) Darby (1962); (9) Invino (1962); (10) Invino & Miner (1970); (11) Konstantinov (1971); (12) Lavallee (1976); (13) Mundie (1957); (14) Provost & Branch (1959); (15) Roback (1969); (16) Sublette (1957); (17) Thut (1969); (18) Walshe (1951).

Genus	Trophic level	Trophic mode	References
Glyptotendipes	Detritivore	Filterer	5, 11, 12, 13, 14, 17
Dicrotendipes	Detritivore, herbivore	Gatherer	5
Rheotanytarsus	Detritivore	Filterer	4, 5, 18
Polypedilum	Omnivore	Gatherer	2, 5
Cricotopus	Herbivore	Miner	3, 5
Tanytarsus	Detritivore	Filterer	4, 5, 18
Psectrocladius	Detritivore, herbivore	Gatherer, miner	5, 8, 15
Ablabesmyia	Omnivore	Engulfer	6, 10, 15
Tribelos	*	*	
Parachironomus	Omnivore	*	5, 16
Chironomus	Detritivore	Filterer, gatherer, miner	5
Einfeldia	Herbivore	*	7
Cryptochironomus	Predator	Engulfer	1, 5, 9, 16
Cladotanytarsus	*	*	

* Information was not obtained.

approaches a natural lake system. Algal grazers such as *Cricotopus* spp. and *Einfeldia* sp. attained their highest densities here (Table 3). The plates of the samplers in Little Mineral were typically covered with filamentous algae.

Most of the genera believed to be feeding primarily on POM (Table 3) decreased in density as the temperature and the density of *Glyptotendipes* sp. rose (Fig. 5). Resuspension of recently deposited materials occurs commonly in shallow regions of lakes and reservoirs (Tutin 1955; Davis 1968, 1973; Pennington 1974; Gasith 1976). In the littoral regions where I made my collections a large amount of the available POM may normally be in suspension and would, thus, be more accessible to filter-feeders such as *Glyptotendipes* sp. than to typical collector-gatherers. *Glyptotendipes* sp. may have outcompeted the other detritivores. Alternatively, the less dominant genera may possess different temperature requirements than *Glyptotendipes* sp. and competition may not have occurred.

The restriction of certain forms, such as *Cryptochironomus* sp. and *Tribelos* sp., to either the Red River arm or the Washita River arm is probably due to differences in salinity between these areas as all other measured factors are nearly equivalent. Chironomids vary in their ability to osmoregulate (Topping 1971; Neumann 1976) and many which can respond to freshwater environments through physiological uptake of sodium chloride cannot reverse this process and regulate to more saline waters (Lauer 1969).

Within the Washita and Red River arms of the reservoir chironomid densities were always highest at stations on the north, windward shore (Stations 1 and 5) (Fig. 5). Wind direction across Lake Texoma is predominately southerly during the late spring and summer. Studies have shown that floating egg masses of chironomids accumulate along wind-exposed shores, and that the area of a lake in which eggs are laid is largely determined by wind direction during oviposition and emergence flights (Hilsenhoff 1967; Davies 1976a). In addition, first instar chironomid larvae are often positively phototactic (Davies 1976b) and planktonic (Lellack 1968; Davies 1973, 1974; Coffman 1978). Thus, when they are near the surface they would be swept across the lake. As the pairs of stations within an arm did not vary much with respect to any of the measured physico-chemical parameters, differences in chironomid larval densities within an area can probably be attributed to wind action. Physical removal of larvae and egg masses from samplers by flood-generated currents early in the study probably resulted in the lowest densities being observed in June at all stations (Fig. 5).

Wind, temperature, rainfall, flow rates, stratification and retention time vary annually in Lake Texoma and the results obtained in this study may not be typical of every year in the reservoir. For example, the reservoir underwent a great deal of flooding during the early part of this study. As stated previously, this flooding resulted in dilution of chemical parameters. In drier years, devoid of such dilution, salinity and other parameters may reach higher concentrations and this could affect the chironomid distribution. Furthermore, these fluctuations were more severe in the river arms than in mid-reservoir (Little Mineral), especially with regard to salinity and production. It is highly probable that environmental fluctuations are always more severe in the river arms than mid-reservoir because these areas are more exposed to inflow and wind. Consequently, one would expect the river arms to harbor higher densities of opportunistic species, such as *Glyptotendipes* sp., and the mid-reservoir area more specialized forms, such as the algal grazers.

Summary

Lake Texoma in southcentral Oklahoma was formed by the impoundment of the Washita and Red Rivers. The Red River is more highly saline than the Washita and creates a complex salinity gradient across the reservoir. Populations of chironomids were monitored with multiple-plate samplers in areas of high (34–113 mg l^{-1} Cl^-), intermediate (35–60 mg l^{-1} Cl^-) and low (4–27 mg l^{-1} Cl^-) salinity during the spring and summer of 1978. Food availability, temperature, salinity and wind direction influenced the distribution of the 14 genera and at least 22 species of chironomids which colonized the multiple-plate samplers.

Filter-feeders such as *Glyptotendipes* sp. and *Tanytarsus* sp. attained their highest densities in the river-arm stations where production and transparency measures indicated that levels of particulate organic matter (POM) were higher than in

mid-reservoir. Genera believed to be grazers on filamentous algae, such as *Cricotopus* sp. and *Einfeldia* sp., attained their highest densities in or were restricted to the intermediate, mid-reservoir area where the plates of the samplers were covered with algal mats.

The restriction of certain species, such as *Cryptochironomus* sp. and *Tribelos* sp., to either the Red River arm or the Washita River arm is probably due to differences in salinity between these areas.

Many genera which were present during the early part of the study were either not collected in later months or were reduced in density. Most of the genera believed to be feeding primarily on POM decreased in density as the temperature and density of *Glyptotendipes* sp. rose. Whether these changes are due to temperature requirements, competition or a combination of these factors cannot yet be ascertained.

Acknowledgments

Initial funding for this study was provided through a Student Originated Studies grant from the National Science Foundation (#Spl78-03713). I would like to thank J. E. Sublette for identifying and verifying chironomids and A. P. Covich and W. P. Magdych for their advice in the preparation of this manuscript.

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Received 16 September 1980.