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LONG-TERM (1980–94) POPULATION TRENDS OF PESTIFEROUS CHIRONOMIDAE (DIPTERA) ALONG A LAKEFRONT IN CENTRAL FLORIDA

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ABSTRACT. Populations of adult chironomids occurring along 5–6 km of waterfront in the city of Sanford facing Lake Monroe, central Florida, were monitored from January 1980 to December 1994 using New Jersey light traps. The annual mean number of total midges per trap per day ranged from 269 (1994) to 8,009 (1980). Among the more than 20 species of midges occurring in the traps, *Glyptotendipes paripes* was the most abundant, followed by *Chironomus crassicaudatus.* These 2 species comprised 95.6% of total midges collected. Annual cycles of midge abundance were positively correlated with air temperature. Maxima of most species occurred in late spring/early summer; *G. paripes* peaked in late summer. Year-to-year midge population levels showed significant inverse correlations with Lake Monroe water depth and annual rainfall in the Sanford area.

INTRODUCTION

Massive emergences of nonbiting aquatic chironomid midges are a serious nuisance to humans and livestock. They restrict outdoor activity, cause health problems, such as allergies (Cranston 1995), and in extreme cases may cause asphyxia (Cranston et al. 1983). Ali (1995) described the nature of nuisance and economic problems associated with midges when occurring in phenomenal numbers.

In central Florida, USA, there are numerous lakes that support large populations of chironomids. These lakes, where situated amid urbanized centers, such as Lake Monroe, are a great source of midge nuisance and the related economic loss to the nearby residents and business owners. The results of a local midge nuisance survey (Anonymous 1977) revealed that the city of Sanford, located along the southern shore of Lake Monroe, suffered an annual economic loss of 3–4 million dollars because of chironomid swarms emanating from the lake.

This paper reports population trends of adult Chironomidae trapped in Sanford from January 1980 to December 1994. These trends were analyzed in relation to selected local environmental parameters (air temperature, rainfall, and lake water depth) that possibly directly or indirectly influenced midge population dynamics.

MATERIALS AND METHODS

Lake Monroe is a natural lake located at approximately 28°50′N, 81°15′W in Seminole and Volusia counties, Florida. It is *ca.* 8.5 km long east to west and ca. 6 km at its widest point north to south. The St. Johns River flows east to west through the lake, with flow rates of only 10–40 cm/min. Water depth ranges from <1 m near the periphery to *ca.* 3 m in some central portions of the lake. The city of Sanford borders the lake along 5–6 km of its southern shoreline. The lake outline in relation to Sanford was given in Ali et al. (1988).

Four New Jersey light traps, each equipped with a photoelectric switch and fitted with a 60-W bulb, were permanently placed at 1–1.5-km intervals and 2–3 m above ground level at businesses and residences along the Sanford lakefront. Midges were initially (1980–84) collected on a daily basis except for the weekends and holidays. This was reduced to 2–3 times or less per week in subsequent years until December 1994, depending upon the intensity of midge occurrence and accumulations in the collection jars. The collections were identified and counted in the laboratory. Large accumulations were subsampled by weight, and the total number of adults was estimated by examining the greater of 0.25 g or $\frac{1}{16}$ of the sample. For each month from January 1980 to December 1994, mean number of midges per trap per day was determined.

Air temperature and rainfall were recorded daily near Lake Monroe at the weather station of the Central Florida Research and Education Center (CFREC), University of Florida, Sanford. Lake Monroe water depth data for the study period were obtained from records of the United States Geological Survey, Water Resources Division, Altamonte Springs, FL. Adult midge data and environmental parameters were analyzed using InStat™ version 2.0 (GraphPad Software, Inc., San Diego, CA).

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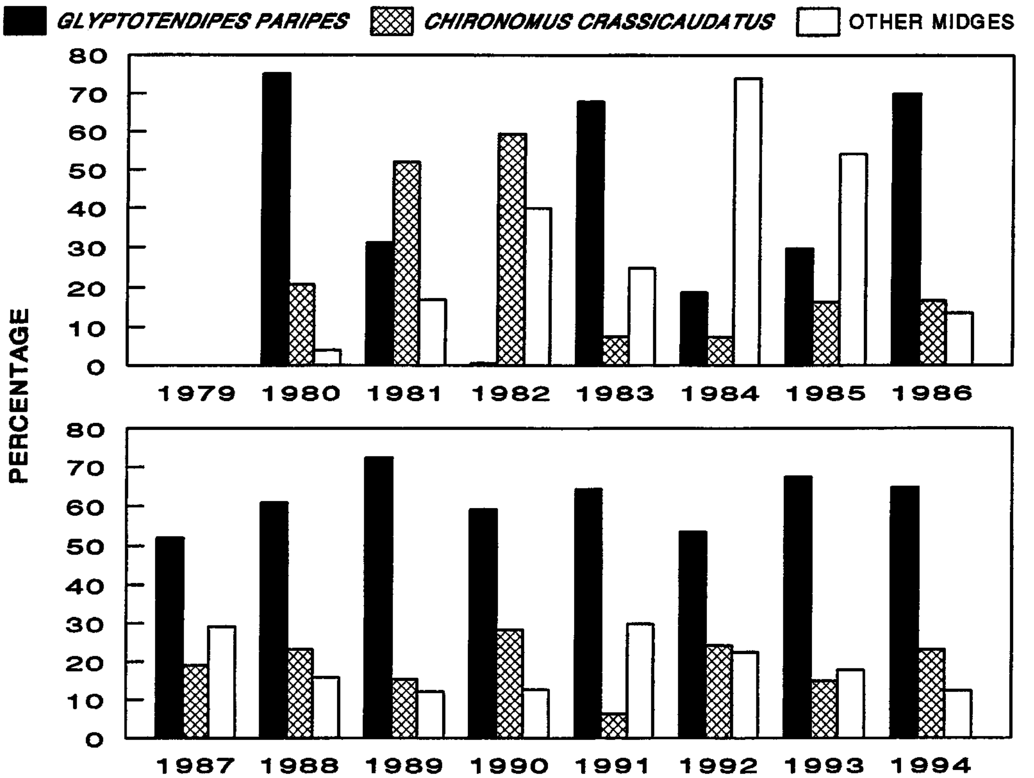

Fig. 1. Annual percentage of adults of *Glyptotendipes paripes, Chironomus crassicaudatus,* and other midge species collected in New Jersey light traps along the south shore of Lake Monroe, Sanford, FL (1980–94).

RESULTS AND DISCUSSION

Lake Monroe supports in excess of 20 chironomid species (Ali and Fowler 1983). However, most abundant and more regularly occurring species in the collections were *Glyptotendipes paripes* (Edwards), *Chironomus crassicaudatus* Malloch, *Chironomus decorus* (Johannsen), *Chironomus* sp., *Parachironomus* sp., *Goeldichironomus carus* (Townes), *Goeldichironomus holoprasinus* (Goeldi), *Cryptochironomus fulvus* (Johannsen), *Polypedilum halterale* (Coquillett), and *Polypedilum* sp. Several species of *Tanytarsus* and *Rheotanytarsus* could not be determined further because of taxonomic difficulties. Tanypodinae primarily included *Coelotanypus scapularis* (Loew), *Coelotanypus concinnus* (Coquillett), and *Procladius sublettei* Roback. Orthocladiinae were represented by *Cricotopus* spp. that occurred periodically in small numbers. At least 5 more midge species occurring in negligible numbers were collected sporadically.

Glyptotendipes paripes was the most abundant species, with an annual percentage share ranging from 19 to 75% of the total midges except in 1982, when this species represented only 1% of the total midges (Fig. 1). During the entire study period, *G. paripes* formed 69.5% of the total midges collected. The 2nd most prevalent species was *C. crassicaudatus,* which ranged annually from 6 to 59% and comprised 26.1% of the total midges collected from 1980 to 1994. Paired *t*-tests of annual mean numbers of *G. paripes* and *C. crassicaudatus* (t = 2.58, df = 14, P = 0.02) and *G. paripes* and all other midge species combined (t = 2.60, df = 14, P = 0.02) were highly significant. A paired *t*-test of *C. crassicaudatus* with all other midge species combined (excluding *G. paripes*) did not show any significant difference ($P > 0.05$).

The monthly population trends of total midges from 1980 to 1994 and the air temperatures for the same time period are shown in Fig. 2. The highest numbers were collected in 1980, with a mean of 8,009 adults per trap per day. The lowest numbers occurred in 1994, with a mean of 269 adults per trap per day. Generally, adult populations annually were at the highest in late spring/early summer and lowest during the winter period (Fig. 3). In many years, *C. crassicaudatus* was most abundant in late spring and early

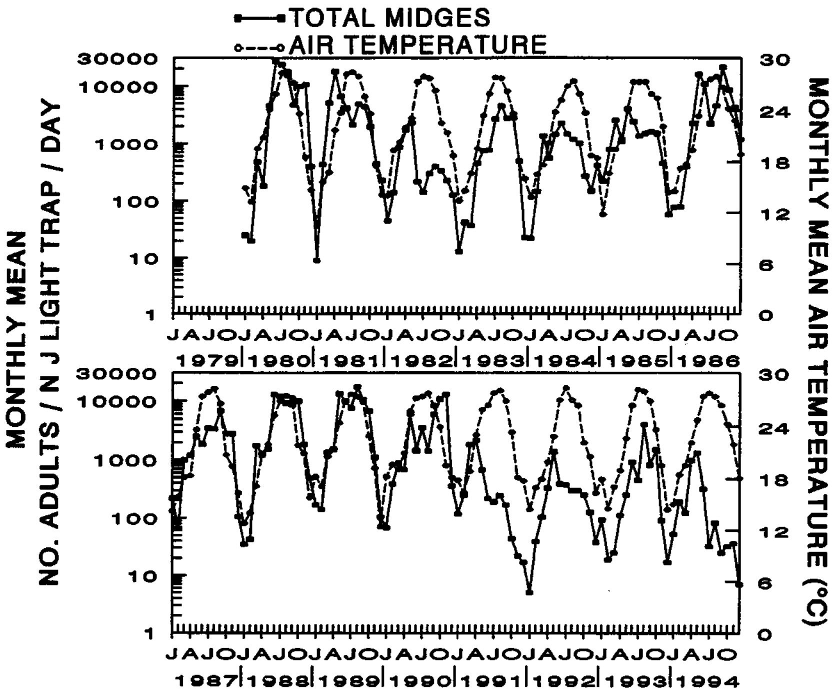

Fig. 2. Mean monthly air temperatures and adult Chironomidae (all species) collected in New Jersey light traps along the south shore of Lake Monroe, Sanford, FL (January 1980–December 1994). The monthly mean air temperature is the average of daily maximum and minimum temperatures recorded at the Central Florida Research and Education Center in Sanford, FL.

summer, whereas *G. paripes* peaked in late summer at nearly the highest air temperatures. The mean number of adults generally remained >4,000 per trap per day from May to October. Linear regressions of 15-year averages of the monthly mean *G. paripes, C. crassicaudatus,* and total midge numbers on the monthly mean air temperature revealed highly significant relationships (*G. paripes:* $r = 0.90$, $P < 0.01$, $n = 12$; *C. crassicaudatus:* $r = 0.66$, $P < 0.05$, $n = 12$; total adults: $r = 0.97$, $P < 0.01$, $n = 12$; Fig. 4). Adult chironomids, in significant numbers, were first collected in the traps when air temperatures in the area were at 15°C or higher and increased numerically with the rising air temperature. Although no chironomid larval data from Lake Monroe are presented in the present study, it was documented that the water temperature in this shallow lake closely followed the pattern of air temperature in the area (Ali and Baggs 1982), and the abundance and seasonality of midge larval populations in Lake Monroe were significantly correlated to prevailing air and water temperatures and, in turn, to adult midge abundance and seasonality (Ali and Fowler 1985).

Annual total rainfall in the study area and annual mean water depth (lake elevation) were significantly correlated ($r = 0.82$, $P < 0.01$, $n = 15$). Adult midge populations were generally lower during the years of high lake elevation (Fig. 5). Regression analysis of these factors revealed highly significant inverse relationships between lake elevation and *G. paripes* ($r = -0.67$, $P < 0.01$, $n = 15$), *C. crassicaudatus* ($r = -0.80$, $P < 0.01$, $n = 15$), and total adults ($r = -0.78$, $P < 0.01$, $n = 15$). As expected, total annual rainfall also was inversely correlated with annual mean number of total adults ($r = -0.59$, $P < 0.05$, $n = 14$).

The reduced population levels of adult midges in the Sanford area during high water conditions in Lake Monroe are likely related to lower larval populations of midges in the lake (Ali and Fowler 1985). Lake Monroe, being part of the St. Johns River system, has the possibility of regulated water discharge into the lake from the upstream areas. An artificial increase of water flow through the lake at times of midge nuisance may dilute and displace the midge larval food (Ali 1990) and perhaps some midge larvae and thus, directly or indirectly, influence reductions of the larval populations.

This long-term study has documented that *G.*

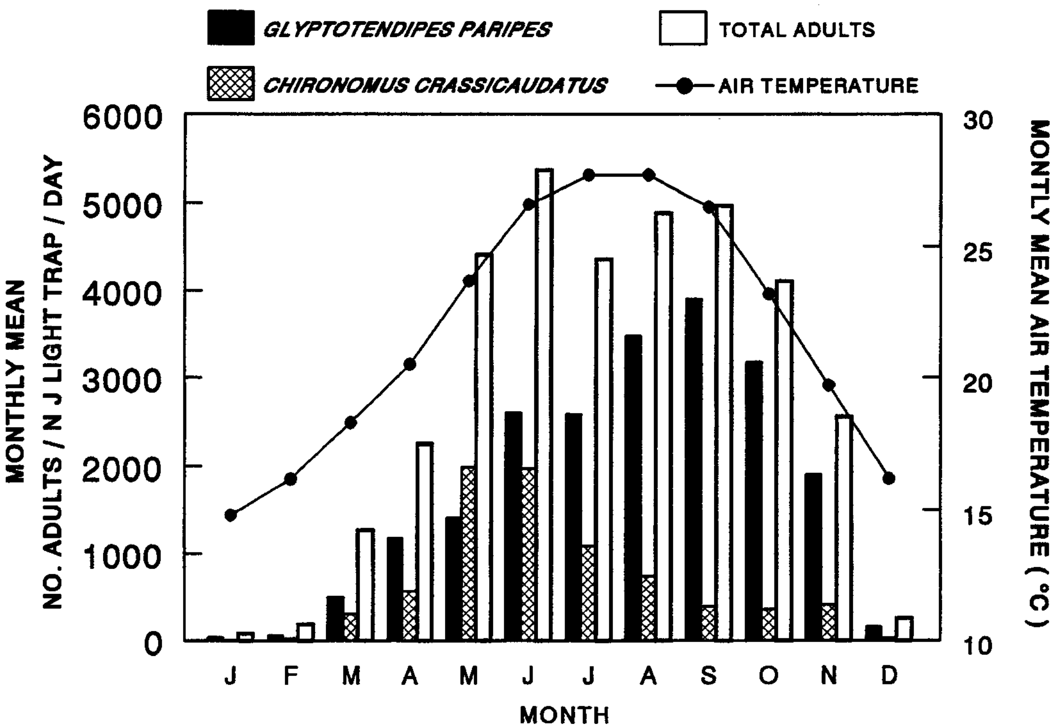

Fig. 3. Fifteen-year (1980–94) averages of mean monthly air temperatures and numbers for *Glyptotendipes paripes, Chironomus crassicaudatus,* and total adult midges collected in New Jersey light traps along the south shore of Lake Monroe, Sanford, FL.

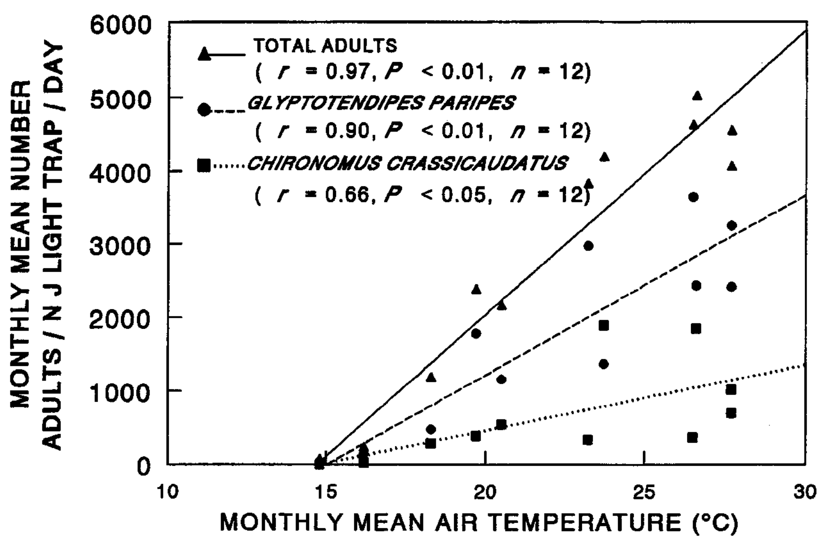

Fig. 4. Relationships between mean monthly numbers of adult Chironomidae collected in New Jersey light traps and mean monthly air temperature. Each symbol represents the 15-year average (1980–94) of means for one calendar month.

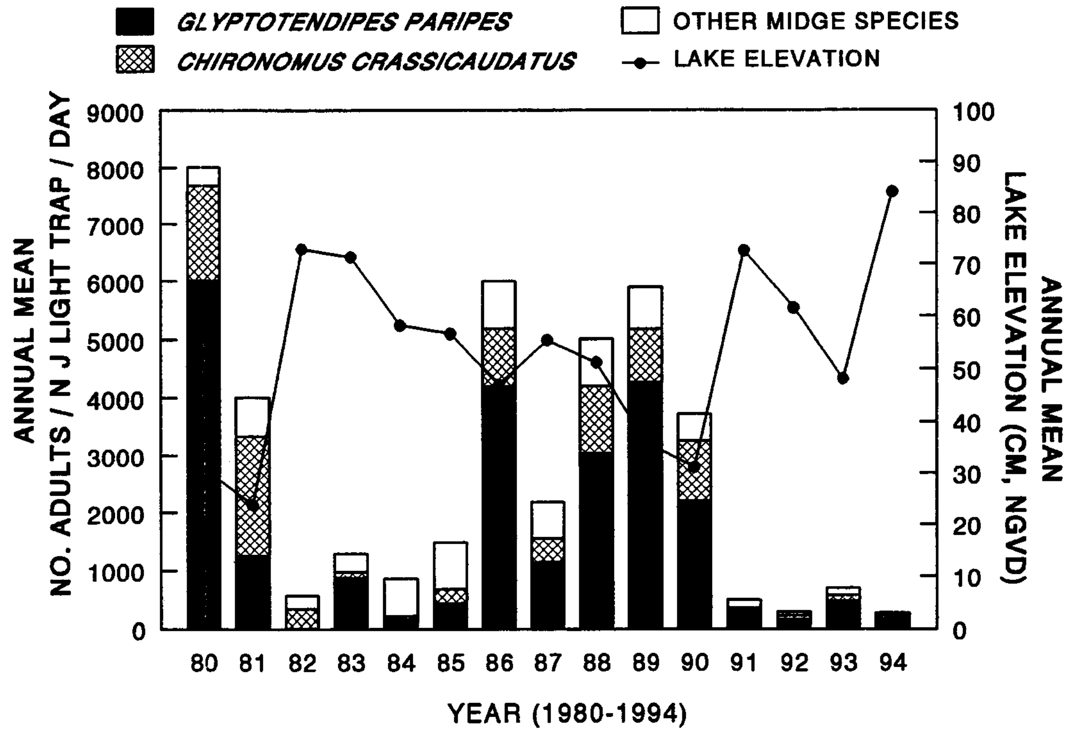

Fig. 5. Lake Monroe water depth (elevation) and mean annual individual numbers for *Glyptotendipes paripes, Chironomus crassicaudatus,* and other chironomid species collected in New Jersey light traps along the south shore of Lake Monroe, Sanford, FL, in the years 1980–94. Continuous line shows mean lake elevation (cm, National Geodetic Vertical Datum) for Lake Monroe (station no. 02234499) provided by the United States Geological Survey, Water Resources Division, Altamonte Springs, FL.

paripes and *C. crassicaudatus* are the primary pest species of midges in the Sanford area and are permanent inhabitants of Lake Monroe. Although Tanypodinae, Tanytarsini, and *Polypedilum* spp. formed 40–74% of the annual number of adult midges collected in 1982, 1984 and 1985 (Fig. 1), these midges are less noticeable, because of their smaller adult size, than *G. paripes* and *C. crassicaudatus* and may not be considered as pestiferous at the levels collected during this investigation. The possibility that adults (particularly *G. paripes* and *C. crassicaudatus*) collected in the traps were from sources other than Lake Monroe is highly improbable because all other known local midge sources were at least 7–10 km away from any trap location. The adults of the major pest species do not fly in any significant numbers beyond 0.5 km under normal weather conditions (Ali and Fowler 1983).

Numerous intrinsic and extrinsic factors influence the qualitative and quantitative changes of insect populations in any year and between years. Among these factors, temperature is regarded as the most important, affecting seasonal cycles and abundance of aquatic insects (Elliott 1967), particularly chironomids (Ali et al. 1977). Other factors, such as availability of larval food, reproductive success including nature and intensity of local oviposition, presence of natural enemies, competition for food and space, and prevailing chemical conditions may also significantly influence the populations.

The human threshold of midge tolerance in the Sanford area is not known. However, the reduced levels of adult midges during 1982–85 and 1991–94 could be considered tolerable because in those years no significant midge complaints (telephone calls) from Sanford lakefront residents and business owners were received at the University of Florida's CFREC at Sanford. Also, the annual mean number of adult midges per trap per day in those years ranged from 269 to 1,480 as opposed to 8,009 in 1980. On some occasions in 1980, >550,000 adult *G. paripes* and *C. crassicaudatus* accumulated daily in a New Jersey light trap (Ali and Fowler 1983), and at least 2 or 3 telephone calls concerning midge nuisance in Sanford were received every week at the CFREC-Sanford.

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