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Authors: Lobinske, Richard J., Cichra, Charles E., and Ali, Arshad

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PREDATION BY BLUEGILL (*LEPOMIS MACROCHIRUS*) ON LARVAL CHIRONOMIDAE (DIPTERA) IN RELATION TO MIDGE STANDING CROP IN TWO CENTRAL FLORIDA LAKES

RICHARD J. LOBINSKE[1], CHARLES E. CICHRA[2] AND ARSHAD ALI[1]
[1]University of Florida, IFAS, Mid-Florida Research and Education Center
2725 Binion Road, Apopka, FL 32703-8504

[2]University of Florida, IFAS, Department of Fisheries and Aquatic Sciences
7922 NW 71st Street Gainesville, FL 32653-3071

Large swarms of non-biting midges (Diptera: Chironomidae) emanating from some central Florida lakes can cause severe nuisance and economic problems for businesses, residents, and visitors within the dispersal range of these insects (Ali 1995). Midges are also a cause of allergies to humans (Cranston 1995). Because of these problems, a systematic research program on the bionomics and management possibilities of midge populations in central Florida has continued for the past two decades (Ali 1996). As a part of this program, a preliminary investigation of fish predation on chironomid midge larvae for the biological control perspective of midges was conducted. Midge predatory fish (bluegill, *Lepomis macrochirus*) were collected from two lakes on four occasions to elucidate any relationships between consumption of midge larvae by these fish and the associated larval composition and distributions in the lakes. Information concerning fish predation on midge larvae, species or habitat specific, would be useful in devising new control strategies.

Fish were collected (May 1999, July, September and December 2000) from Lakes Dora and Yale (Lake County, Florida) by electrofishing under permit from Florida Fish and Wildlife Conservation Commission. Collections were made between 0830 and 1200 h and up to twenty fish were collected from near-shore areas. Fish were identified and killed immediately, maintained on ice while transported to the laboratory, and stored at -10°C until examined. For examination, each fish was thawed and the foregut was dissected (Bowen 1996), and the contents transferred to 4-dram vials containing 70% ethanol. Gut contents were examined under variable magnification of a dissecting microscope and enumerated. Chironomidae head capsules and associated fragments were wet mounted on slides and examined at 400× magnification using a phase-contrast microscope and identified to lowest possible taxonomic level using the keys of Epler (1995). Only head capsules with sufficient morphological features remaining for identification were counted for gut content enumeration, other fragments were used to improve identification where possible.

Five to 20 fish were successfully collected per sampling occasion (Table 1). Midge larvae of the tribe Tanytarsini (>90% *Cladotanytarsus* spp.) were most numerous in gut contents of fish from both lakes (Table 1), comprising 55.9-62.8% of total consumed midge larvae from Lake Dora and 4.8-48.1% from Lake Yale. *Geoldichironomus* spp. larvae were the next most common in the gut contents of fish from Lake Dora (0.0-27.5% of total larval chironomids). Other midge larvae consumed by fish from Lake Dora included *Chironomus crassicaudatus*, *Glyptotendipes paripes*, *Cryptochironomus* spp., *Pseudochironomus* spp. and Tanypodinae. Seasonal mean number of total midge larvae in fish gut contents ranged from 4.7 to 44.0. Midge larvae were present in the gut contents of all fish from Lake Dora, except those collected in December 2000, when 40% of collected fish had empty guts. This was likely due to low water temperatures reducing feeding activity, as suggested for bluegill during winter months by Gilinsky (1984). *Pseudochironomus* spp. larvae were the second most prevalent midge larvae in the fish gut contents of Lake Yale, forming up to 46.2% of total midge larvae, followed by *C. crassicaudatus* (collected only during May 1999), *G. paripes*, *Cryptochironomus* spp., and Tanypodinae. Seasonal mean number of larvae per fish in Lake Yale ranged between 1.0 and 18.9. Bluegill feeding on midge larvae in Lake Yale was also reduced during December 2000, though only one fish had an empty gut. Other food items identified from fish in these two lakes included immature Insecta (Odonata, Ephemeroptera and Trichoptera), Crustacea (Decapoda, Amphipoda and Ostracoda), Nematoda, Oligochaeta, Gastropoda, and some unidentifiable material. These food items numerically were only a small part of total gut contents in most fish examined (data not shown).

To estimate relative selective feeding by bluegill on examined chironomid larvae, percent composition of chironomid larvae in gut contents of collected fish was compared to overall percent composition of chironomid larvae in study lakes and percent composition of midge larvae in the nearshore areas with firm sediments representative of the areas from where the fish were caught, collected concurrently and reported by Lobinske (2001) (Fig. 1). In Lake Dora, Tanytarsini were most common, exhibiting similar percent compositions in fish gut contents in the entire lake as well as in nearshore areas. During July, Septem-

TABLE 1. GUT CONTENTS OF BLUEGILL (*LEPOMIS MACROCHIRUS*) COLLECTED ON FOUR OCCASIONS (MAY 1999-DECEMBER 2000) FROM LAKES DORA AND YALE (LAKE CO., FL). MEAN ± SD NUMBER OF MIDGE LARVAE PER FISH AND PERCENT COMPOSITION OF TOTAL MIDGE LARVAE IN PARENTHESES.

Taxa	May 1999	July 2000	September 2000	December 2000
		Lake Dora		
No. fish collected	10	20	20	20
Chironomus crassicaudatus	0 ± 0 (0.0)	0.1 ± 0.3 (0.3)	0 ± 0 (0.0)	0.8 ± 2.6 (16.1)
Glyptotendipes paripes	0.4 ± 0.7 (0.1)	1.8 ± 2.5 (6.0)	0.2 ± 0.7 (0.5)	0.3 ± 1.1 (5.4)
Cryptochironomus spp.	0 ± 0 (0.0)	2.5 ± 3.4 (8.2)	4.4 ± 7.3 (10.4)	0.3 ± 1.1 (6.5)
Pseudochironomus spp.	0 ± 0 (0.0)	0 ± 0 (0.0)	0.5 ± 1.5 (1.2)	0 ± 0 (0.0)
Geoldichironomus spp.	0 ± 0 (0.0)	8.3 ± 11.0 (27.5)	10.5 ± 13.1 (24.7)	0.7 ± 1.7 (14.0)
Tanytarsini	25.1 ± 18.2 (57.0)	16.9 ± 17.5 (56.3)	26.7 ± 22.1 (62.8)	2.6 ± 6.3 (55.9)
Tanypodinae	0.7 ± 1.3 (1.6)	0.5 ± 1.1 (1.5)	0.1 ± 0.3 (0.2)	0 ± 0 (0.0)
Unidentified/other midges*	17.8 ± 7.8 (40.5)	0 ± 0 (0.0)	0.1 ± 0.4 (0.2)	0.1 ± 0.4 (2.1)
Total Chironomidae	44.0 ± 21.0	30.0 ± 31.6	42.5 ± 34.2	4.7 ± 12.0
		Lake Yale		
No. fish collected	5	7	15	10
Chironomus crassicaudatus	6.2 ± 13.9 (75.6)	0 ± 0 (0.0)	0 ± 0 (0.0)	0 ± 0 (0.0)
Glyptotendipes paripes	0.2 ± 0.4 (2.4)	1.7 ± 4.1 (9.0)	0 ± 0 (0.0)	0.2 ± 0.4 (20.0)
Cryptochironomus spp.	0 ± 0 (0.0)	1.7 ± 3.1 (9.0)	0.5 ± 1.3 (18.5)	0.2 ± 0.4 (20.0)
Pseudochironomus spp.	0 ± 0 (0.0)	8.6 ± 9.6 (45.5)	0.6 ± 1.6 (22.2)	0.2 ± 0.4 (20.0)
Tanytarsini	0.4 ± 0.9 (4.8)	6.0 ± 6.4 (31.7)	1.3 ± 1.3 (48.1)	0.3 ± 0.5 (30.0)
Tanypodinae	1.4 ± 3.1 (17.1)	0.4 ± 1.1 (2.1)	0 ± 0 (0.0)	0.1 ± 0.3 (10.0)
Unidentified/other midges*	0 ± 0 (0.0)	0.5 ± 1.1 (2.6)	0.3 ± 0.8 (11.1)	0 ± 0 (0.0)
Total Chironomidae	8.2 ± 13.5	18.9 ± 17.2	2.7 ± 3.0	1.0 ± 0.9

*Larvae could not be identified due to damage to head capsules.

ber and December 2000, *Geoldichironomus* spp. larvae in gut contents represented a much larger percentage of total chironomids when compared to their percentage composition in the entire lake and nearshore populations. In Lake Dora, no significant differences (*t*-test) were noted between percent composition of individual midge taxa in gut contents and the prevailing populations in the nearshore or entire lake area. In Lake Yale, *C. crassicaudatus* was the most common chironomid in gut contents during May 1999, but was only a minor component (<20%) of overall midge community in the lake during that time. During July 2000, *Pseudochironomus* spp. and Tanytarsini comprised a similar percentage of nearshore chironomids and in the gut contents of collected fish. In the remaining periods of the study in Lake Yale, Tanytarsini were the most common midge larvae in fish gut contents, as well as in the firm sediments. *Glyptotendipes paripes* was the most common midge in Lake Yale during July and September 2000 and composed a large proportion of total midge larvae during December 2000, but comprised a smaller component of the gut contents. This was probably because *G. paripes* larvae were aggregated in deeper areas of the lake (Lobinske 2001) and thus were not in the immediate grazing area of the collected fish. Mean percent composition of *G. paripes* larvae in all gut contents and their overall percent composition in lake total larval population was significantly different ($t = 2.938$, $P = 0.026$, $n = 4$), but there was no significant difference noted with percent composition in firm sediment areas ($t = 0.440$, $P = 0.676$, $n = 4$). No significant differences were noted among any other chironomid taxa collected from Lake Yale.

Based on the data, bluegill (*L. macrochirus*) seem to be indiscriminate feeders on midge larvae inhabiting nearshore areas of Lakes Dora and Yale. However, Gilinsky (1984), Rieradevall et al. (1995), and Wolfram-Wais et al. (1999) reported selectivity of fish predation on chironomids. The significant difference between *G. paripes* in Lake Yale benthos and fish gut contents indicates bluegill collected during this study were possibly focusing their feeding efforts in sandy, nearshore areas, a behavior similar to the preference of midge predatory fish foraging in restored, sand bottom areas of Lake Tohopekaliga reported by Butler et al. (1992). Rieradevall et al. (1995), Butler et al. (1992) and Gilinsky (1984) reported that

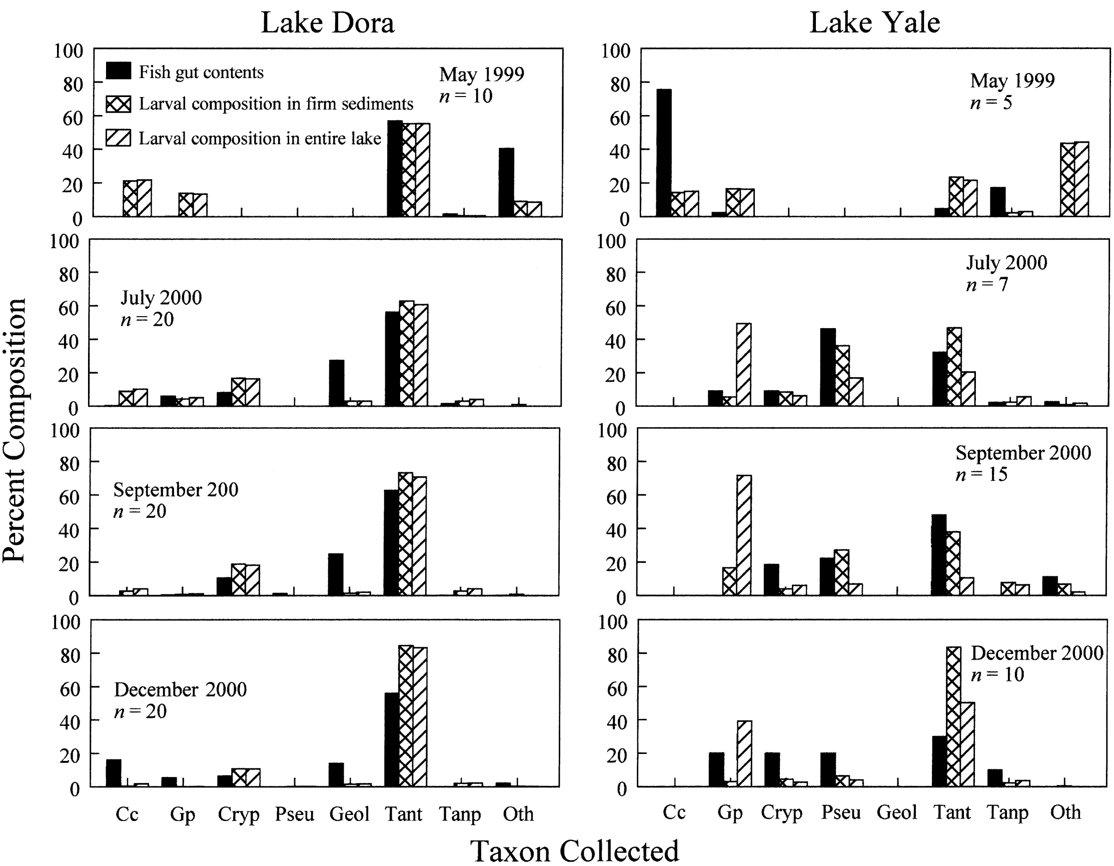

Fig. 1. Composite percent composition of total midge larvae of various midge taxa in bluegill (*Lepomis macrochirus*) gut contents and prevailing field populations in Lakes Dora and Yale (Lake County, Florida) May 1999-December 2000. *Chironomus crassicaudatus* (Cc), *Glyptotendipes paripes* (Gp), *Cryptochironomus* (Cryp), *Pseudochironomus* (Pseu), *Geoldichironomus* (Geol), Tanytarsini (Tant), Tanypodinae (Tanp), and unidentified/other chironomid taxa (Oth).

fish predation significantly lowered chironomid larval density in various studied habitats. However, Batzer et al. (2000) reported that fish predation in a marsh weedbed did not significantly reduce chironomid densities when compared to fish-excluding enclosures because of increased predation by other macroinvertebrates. Rasmussen (1990) reported midge larvae were a major part of whitefish diet in Hjarbaek Fjord, Denmark, but whitefish only consumed 2-5% of total chironomid productivity. Further work is needed to refine these preliminary results, enumerate actual standing crop of bluegill in Florida lakes to estimate the total consumption of midge larvae in relation to the chironomid standing crop and to determine if bluegill are a major source of midge reduction.

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Summary

Compositions of midge larvae consumed by the predaceous fish, bluegill (*Lepomis macrochirus*) were examined in relation to associated standing crop of midge larvae in two central Florida lakes. Overall, these preliminary results indicate that bluegill may be indiscriminate predators on midge larvae in shallow, nearshore areas and display limited predation on larvae aggregated in deeper areas of the lakes.

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