STANDING CROP OF BENTHIC INVERTEBRATES
OF LAKE WINGRA AND LAKE MENDOTA, WISCONSIN

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ABSTRACT

Significant differences existed in the number and biomass of benthic invertebrates in Lakes Wingra and Mendota. Bottom organisms are highly diversified and more abundant in Lake Mendota than in Lake Wingra. Maximum differences occur in early summer and least differences in August. Hyalella was found in Lake Mendota samples but not in Lake Wingra. Chironomid larvae and Mayfly nymphs were caught from both lakes, although numbers and weights were higher in Lake Mendota.

INTRODUCTION

Like other fresh water fishes, bluegills are known to feed on insects and macro-food particles (Scott and Crossman 1973 and Carlander 1973). Thus, studies on benthic macroinvertebrates of Lake Wingra and Lake Mendota will reveal if fish of Lake Wingra feed selectively on microcrustaceans or whether the macrofauna of the lake has been depleted due to the dense fish community. It is also of importance to identify the role which benthic invertebrates of Lake Wingra play on the dynamics of the stunted fish population of the lake.

Study Sites

Lake Wingra and Lake Mendota are located in Dane County near Madison, Wisconsin. Lake Wingra is a relatively shallow lake with an average depth of 3 meters and a surface area of 140 hectares. Lake Mendota is larger with an area of 3938 hectares and a mean depth of 12 meters. Study areas in the two lakes were chosen to have similar depths and substrate structures, described as mostly muddy with few silted areas.

Methods of Collection

Bottom samples were taken with a 15 X 15 cm (225 cm²) Ekman dredge of standard weight on the same dates (or consecutive dates)
on both lakes from late June through August. Twenty samples, every 2 weeks, were collected from Lake Wingra, 4 at each station at north, south, east, west, and middle regions of the lake and at comparable depths as Lake Mendota samples (2 m). In Lake Mendota the bottom samples were taken at 4 stations along a transect from Picnic Point to a distance of about 200 m south along the shoreline, at an average depth of about 2 m. Four replicates were collected at each station (50 m apart). Bottom fauna were screened (500 mesh), washed with distilled water, and counted. They were then classified to major taxonomic groups. Dry weights were estimated after the samples were kept for 48 hr at 85C.

RESULTS

Lake Wingra

Maximum number of bottom animals per 225 cm$^2$ dredge catch was found in mid-July and the minimum number at the end of August (Fig. 1-top). Dry weights followed closely the same pattern, as shown in Fig. 1-bottom. Differences among number of bottom animals caught in mid-June and August were significant. Average number of animals per dredge varied from 8.2 in early July to 2 animals per dredge in late August. Mean numbers of animals found per dredge declined from late June till late August.

Dry weight of bottom organisms of Lake Wingra was significantly low, from July through August. Although few bottom organisms were caught in the dredge, they were relatively large. The benthic collections of Lake Wingra have poorly diversified animal community. Species of the order Diptera constituted 95% or more throughout the sampling period. Members of Ephemeroptera were seldom found and Amphipoda were completely absent. Members of Diptera made up 99% of the benthic community in August. Average number per 225 cm$^2$ dredge varied from 3.5 in mid-August to 2 in late August. The corresponding dry weights were 3.9 and 3.7 mg per 225 cm$^2$, respectively. Species of Diptera made up the collection of benthic organisms in late June and in July. Number of Diptera rose sharply from 4.3 organisms per 225 cm$^2$ in late June to 8.2 animals in mid-July. Similarly, the biomass (dry weight per 225 cm$^2$) of benthic invertebrates varied from 2.5 mg in late June to an average of 5.2 mg in mid-July.
FIGURE 1. Total number (top figure) and total dry weight (bottom figure) in mg of invertebrates caught in 225 cm$^2$ Ekman dredge from Lake Mendota and Lake Wingra, June-August, 1972. Circles are means of 16-20 samples. Vertical lines are ranges.
Lake Mendota

Lake Mendota can be described as having a highly diversified benthic community. Members of *Amphipoda*, *Ephemeroptera*, *Tricoptera*, *Diptera*, and others were abundant and were represented in the collections at one time or another during the sampling period. Because of such diversity, the data are handled here in a detailed fashion.

Bottom organisms varied in abundance from mid-June through August. Dipterans and ephemeropterans constituted the bulk of the bottom fauna collected. A decline in dry weight of bottom organisms per 225 cm² from June through August was obvious; the same can be said regarding the number of the organisms (Fig. 1).

*Amphipoda*. *Hyalella* sp. in the bottom samples were common, although not substantial. They varied in number from 1.3 animals per 225 cm² in June to 4.3 in August. *Hyalella* made up the bulk of the bottom fauna caught in August, with values of about 38% in number and 33% dry weight for all animals. The minimum contribution of *Hyalella* to the bottom fauna was in July when they were 3% and 1.5% of the total number and weight, respectively, of the animals caught per dredge. Data of the bimonthly samples do not show a consistent pattern in the abundance of these animals in the bottom collections. For example, from the second half of June through the end of August values for different samples were highly variable, with variation reaching 43% of the catch in the first half of July, 4.7% at the end of July, 44.2% in mid-August and 30.9% at the end of August. *Hyalella*, therefore, does not contribute significantly to the bottom fauna caught in June or July while it does in the month of August. The low values of *Hyalella* in June may mean that they were really few at this time or it could also be that *Hyalella* associate with the surrounding vegetation rather than settling at the bottom. Buscemi (1961) found few animals in the bottom samples taken from Parvin Lake, while many *Hyalella* were on the overlying vegetation. Similar observations were reported by Mundie (1959).

*Ephemeroptera*. Mayflies varied in number from an average of 0.5 to 2 animals per dredge and from 0.2 mg to 1.4 mg dry weight. They were available at all times but few animals were caught. They reached a maximum at the end of August with 19.4% of the total catch in terms of numbers and 18.1% in total dry weight. They have their minimum values of 5.4% and 11.1% of total number and weight,
respectively, in June. Regarding their abundance, they occupy a third position after Diptera and Amphipoda.

Odonata and Tricoptera. Members of these groups were not significant in the bottom catch of Lake Mendota. Odonata make up 1% of the fauna per dredge caught in July and 0.9% of the August catch, while none was caught in June. Tricoptera were as scarce as Odonata.

Hirudinea. Although abundant in the area (personal observations), few leeches were caught in the dredge. It is possible that these animals were able to avoid the dredge because of their relatively high speed of swimming. None of these organisms was caught in June, while they made up 13.9% of the total number of organisms collected in late July and about 5% in August collections of bottom fauna. Their weights, however, varied from 6.2% to 2.8% of total dry weights of organisms collected per dredge during the same period.

Diptera. Diptera participated significantly in fauna caught throughout the summer. They constituted about 88.9% of total number of animals caught in August. Their weights constituted 75% to 68% of total weight during the same period.

Chironomid larvae comprised about 95% of all the dipterans, the remaining 5% being chironomid pupae. Mean number of chironomid larvae was as high as 33 animals per 225 cm² in June, 13 in July and 4.5 in August. It seems obvious that there is a descending trend from June through August which may be related to the time of emergence.

Hydracarina. Water mites, although caught in July and August, were of little importance in the bottom community. They constituted about 1.5% of the total number of bottom organisms in July and 2% in August. Mundie (1959) reported low uniform densities of water mites in all of his bottom catches.

DISCUSSION AND CONCLUSION

Extensive studies conducted on bluegill of Lake Wingra and Lake Mendota (El-Shamy 1976) indicated that fish of Lake Mendota grew faster than fish of Lake Wingra. In the same studies, all size classes of Lake Mendota bluegill were shown to have higher daily
rations (food consumption) than those of Lake Wingra. The least differences existed among small fish but there were significant differences for larger fish. When the daily ration of Lake Wingra bluegill was compared to data from the literature, Lake Wingra bluegill showed smaller values than those given by Seaburg and Moyle (1964) and Keast and Welch (1968) for bluegill in other lakes.

Data from stomach analyses of Lake Wingra and Lake Mendota fish revealed the importance of the macroinvertebrates in the bluegill diet. Studies on stomach contents of panfish by other investigators (Buscemi 1961, Etner 1971, and Baumann 1972) also emphasized the significance of the macroinvertebrates in the diet of the fish. However, stomach analysis of Lake Wingra bluegill revealed their dependence on planktonic organisms throughout the growing season. Measurements of food particles recovered from their stomachs showed an interesting characteristic: small and large fish fed on similar size food particles. In contrast, Lake Mendota fish preyed almost exclusively on benthic macroinvertebrates. They also showed a definite correlation between food particle size and fish size.

It should be emphasized that there is more energy expenditure in catching these small organisms than in catching the large organisms. Therefore, Lake Wingra bluegill actually waste more energy in feeding. Also, large organisms should have less indigestible materials relative to their body weight than do microscopic animals, i.e. the amount of chitin, for example, per unit dry weight in *Hyalella* or chironomid larvae should be less than that in small cladocerans or copepods of equivalent weight. Animals caught from Lake Wingra were mainly chironomid larvae and, to a very limited extent, water mites and Mayfly nymphs. *Hyalella* was completely absent and damsel flies and caddis flies were rare. In contrast, *Hyalella* was abundant and caught throughout the summer from Lake Mendota, while damsel flies, caddis flies, and stone flies were only occasionally found. Thus it is seen that Lake Wingra bluegill, by feeding on these microscopic animals, actually receive less digestible material than do their counterparts in Lake Mendota which feed on larger organisms.

In summary, then Lake Wingra bluegill feed on the small planktonic organisms available, expend a considerable amount of energy in pursuit of food, receive more indigestible materials per unit of food consumed, and attain smaller body size and weight than bluegill in other, more nutritive waters.

Other facts related to the history of Lake Wingra and its fish
during the last 70 years are of interest in relation to the feeding habits discussed. Helm (1958) reported changes in species and their relative abundance as well as changes in growth rates of fish in the lake. Also, three fundamental changes in Lake Wingra over the past decades have taken place (Baumann et al. 1974a and b): 1. A decline in large predators such as northern pike and northern long nose gar, 2. An increase in the population density of pan fish, and 3. The disappearance of large invertebrates such as Hyalella which were reported to be abundant in the lake in the early twentieth century.

We therefore conclude that the decline in the benthic invertebrate population in Lake Wingra has played a significant role in the dynamics of the fish population in the lake.

BIBLIOGRAPHY


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