BRIEF NOTE

DAPHNIA SWARMS IN THE HARBOR AT PUT-IN-BAY.[1]

Large concentrations of two *Daphnia* taxa were observed in the harbor at Put-in-Bay, Ohio. These swarms occurred in the Gibraltar Island dock area on 18 July, 1974 and 15 July, 1975 between 7:15 a.m. and 9:00 a.m. One collection in each of the swarms was made and *D. galeata mendotae* Birge and *D. retrocurva* Forbes were identified. Densities of the *Daphnia* swarms were calculated to vary from 10,000 to 20,000 organisms per liter. No other *Daphnia* and few other crustaceans were present in the samples.

Other such swarms have been observed in the western basin of Lake Erie. A "white soup" of Daphnia was observed in Schoolhouse Bay of Middle Bass Island in the late 1940's and a similar swarm occurred in Put-in-Bay Harbor in mid-July 1970 (D. C. Chandler and C. E. Taft, 1975, personal communication). Ragotzkie and Bryson (1953) reported the same phenomena in Lake Mendota.

Surface plankton collections were made from Gibraltar Island using a number 20 standard, silk bolting cloth net on the swarm dates. Collections were preserved in Transeau's fixative (six parts water, three parts 95% ethanol, and one part formalin) and returned to Franz Theodore Stone Laboratory for examination. Whole cell counts of zooplankters were made using a Sedgewick-Rafter cell at magnifications of one hundred diameters. A total of eight hundred *Daphnia* were counted from each of the two yearly collections.

Our observations of the occurrence of large numbers of these two taxa do not agree entirely with the observations of other investigators. Britt *et al.* (1973) report that, in the western basin of Lake Erie, *D. g. mendotae* becomes abundant in late July and remains so through the end of summer. They found that *D. retrocurva* exhibits two summer peaks, the first occurring in early July and the second in late August. Birge (1898) reported that, in Lake Mendota, *D. g. mendotae* pulsed in mid-July and *D. retrocurva* did not pulse until August. Our collections show simultaneous pulses in these two *Daphnia* populations in mid-July.

Reproductive capacities of *D. g. mendotae* and *D. retrocurva* were estimated from enumeration of the brood sizes (table 1). The mean brood sizes (ratio of retained eggs to mature *Daphnia*) differed more between collections than between taxa. In the 1974 collection, *D. retrocurva* had a mean brood size of 2.2 with a range of 1 to 10; and *D. g. mendotae* had a mean brood size of 2.8 with a range of 1 to 14. The 1975 collection showed mean brood sizes of 1.3 (range, 1 to 10) and 1.4 (range, 1 to 8) for *D. retrocurva* and *D. g. mendotae*, respectively.

TABLE 1

Population and brood size data for Daphnia retrocurva *and* D. g. mendotae.

	18 July 1974	15 July 1975
Total *Daphnia* counted	800	800
# *D. retrocurva*	361	464
% of total *Daphnia*	45	58
# *D. g. mendotae*	439	336
% of total *Daphnia*	55	42
D. retrocurva with brood	195	236
% with brood	54	51
Mean brood size	2.2	1.3
Range of brood size	1–10	1–10
D. g. mendotae with brood	250	166
% with brood	57	49
Mean brood size	2.8	1.4
Range of brood size	1–14	1–8

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Birge (1898) and Hall (1962) both found that brood size of *Daphnia* is affected by temperature. Birge reported that reproductive capacity of *D. g. mendotae* was impaired above 18°C. Hall determined that the maximum brood size in *D. g. mendotae* occurred at 20°C, contrary to Birge's data. Higher water temperatures in 1975 (data on file at Center for Lake Erie Area Research, Put-in-Bay, Ohio) may account for the lower mean brood size occurring in both *Daphnia* taxa.

The source of adequate food necessary to support the swarms remains unknown. *Ceratium hirundinella* represented 60% (by number) of the plankton algae in the 1974 collection with *Stephanodiscus astraea, Melosira* spp., and *Pediastrum* spp. representing an additional 28%. *Aphanizomenon flosaquae* represented 63% of the plankton algae in the 1975 collection with *S. astraea* and *P.* spp. as the other other major phytoplankton constituents. Quantitative phytoplankton samples were not available for the pre-swarm periods; however, *C. hirundinella* was observed to be abundant from the end of June, 1974 through the swarm period. The same is true of *A. flos-aquae* in 1975. Hutchinson (1967) doubts that the filamentous Myxophyceans, *Aphanizomenon* in this case, are utilized as a food source by Cladocera. He further states that the size and shape of other algae (e.g., *C. hirundinella* and *Pediastrum*) render them unsuitable as food.

Physical processes may explain the concentration of *Daphnia* observed in Put-in-Bay Harbor. Water currents in the harbor are dependent on periodic lake level oscillations. As the lake level rises in the western basin, water flows into the harbor around Gibraltar Island. This would result in the transport and concentration of organisms from the lake into the harbor. Water level records for 1975 at Put-in-Bay (Ohio Department of Natural Resources, Division of Geological Survey, Sandusky, Ohio) demonstrate a continuous rise in the lake level from 11:00 p.m., 14 July to 9:00 a.m., 15 July corresponding to the occurrence of the *Daphnia* swarm. These data also correspond to the sudden dispersal of the swarm after 9:00 a.m. when the lake level began to drop. Lake level data for 1974, however, do not account for the swarm occurring in that year due to irregular oscillations in the lake level at that time. Similar concentrations of *Daphnia pulex* were reported in Lake Mendota by Ragotzkie and Bryson (1953) and were attributed to mechanical concentrations and transport as a result of water currents rather than biological phenomena. Southerly winds would further concentrate the *Daphnia* swarm from the harbor into the immediate Gibraltar Island area. Wind direction data for swarm dates (on file at the Center for Lake Erie Area Research, Put-in-Bay, Ohio) lend support to this possibility. These factors may account for the *Daphnia* swarms observed in Put-in-Bay Harbor, but the large populations of *D. g. mendotae* and *D. retrocurva* occurring simultaneously in mid-July of two successive years remain unexplained.—M. M. BOUCHERLE AND V. RAY FREDERICK. *Franz Theodore Stone Laboratory, The Ohio State University, Columbus, Ohio 43210.*

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