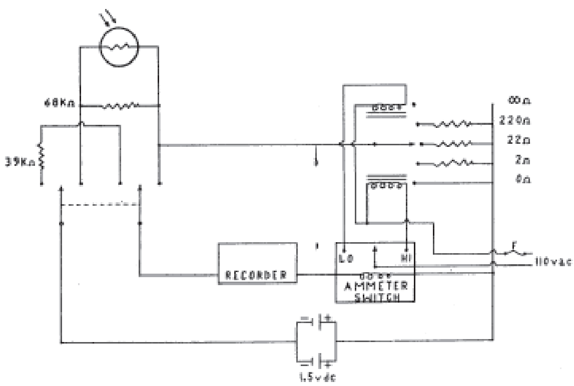

FIG. 1. Schematic diagram of recording photometer (all resistors 5%).

was needed, and to make the correct change, a 0–50 μa high-low switching microammeter (Api optical meter relay, model 503–LD) was used to activate an add-and-subtract stepping relay (Guardian, Model IR–RAS) on which resistances were mounted.

The switching microammeter has high and low set points which close their own appropriate circuits. The low set point was used to energize the low side of the stepping relay, to increase the resistance in the parallel loop. The high set point was used to energize the high side of the stepping relay to decrease the resistance in the parallel loop.

The unit was equipped with a battery testing circuit that is operated by an on-off-on 3 position DPDT toggle switch. When the switch is in the operate position, the photocell is placed in series with the microammeter, recorder and their parallel loop. When the switch is in test position, a 39K ohm resistor is placed in series with the microammeter, leaving the photocell and parallel loop circuit open. In addition to the battery testing circuit, the photometer was equipped with a 68K ohm resistor and a slow blowing fuse (MDL ⅛ amp 250-volt) to prevent accidental damage to the stepping relay switch when light intensities suddenly change or fall below .10 foot-candle. The photocell was protected from rain or accidental damage by a plexiglass shield.

The recorder does not indicate which range or relay position is being recorded. The ranges can easily be determined by following any sequence of change as from sunrise to sunset.

Figure 2 (A) is the equivalent μa values taken from the strip chart recording (Fig. 2, B) plotted at 15-min intervals against time. Ranges of the photometer and

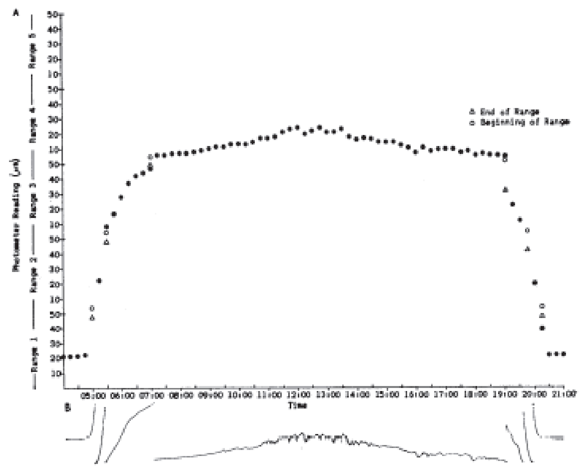

FIG. 2. (A) microampere values taken from strip chart recording (B) plotted against time.

equivalent μa values for periods when the photometer switched ranges are shown by a triangle and circle. The triangle represents the end of one range and the circle, the beginning of the next range. To prevent oscillation of the microammeter switch, the low set point was set at 2 and the high set point at 48.

Comparative readings were taken in sunlight with a Weston photometer (Model 756, quartz filter) to determine foot-candle and μa equivalents. That the photocell response is not linear results in a nonlinear relationship between ranges of the photometer. Therefore, each range should be calibrated separately with a standard photometer.

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LITERATURE CITED

Callahan, P. S. 1964. An expensive actinometer for continuous field recording of moonlight, daylight, or low-intensity evening light. J. Econ. Entomol. **57**(5): 758–760.

Stanley, J. M., Howard Haynes, and D. W. Pruitt. 1962. Recording ultraviolet intensity meter. Agr. Engr. **43**(8): 465, 469.

SUMMER BOTTOM FAUNA OF THE MISSISSIPPI RIVER, ABOVE DAM 19, KEOKUK, IOWA[1]

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Abstract. Over 1400 benthos collections were made from eight sampling areas near the Illinois shore of the Mississippi River above Dam 19 in the summers of 1960 and 1961. No significant difference was found in numbers of macroscopic organisms collected after sifting Ekman dredge contents through 20- and 40-mesh screens. *Sphaerium transversum* was the most abundant organism and was the only organism collected at every sampling plot on each collection date. *Hexagenia* naiads were the most abundant insects at all sampling areas in 1960. *Coelotanypus, Tendipes plumosus, Stenochironomus*, oligochaetes, *Campeloma*, and *Lioplax subcarinata* were also abundant and frequently collected. *Somatogyrus depressus* and *Oecetis* sp. b were abundant during certain time intervals. *Tendipes plumosus* became the most abundant insect in 1961 at the part of the study area nearest Dam 19. Several organisms were more abundant in 1961, when mayfly population densities were low, than in 1960. As the most abundant insects emerged during each summer, other elements of the benthos increased in abundance. An average of 2,924 organisms/m^2 was collected in the study area. Major elements of the benthos seem to have changed little in the last 30 years. The study area had a climax community characteristic of mature streams and showed no evidence of serious pollution.

Introduction

With development of large metropolitan areas along the Upper Mississippi River, the river has received increasingly large amounts of organic pollutants. Certain areas of the Upper Mississippi have been considered seriously polluted for some time, and a recent study of the distribution of burrowing mayflies indicates particularly serious pollution in areas down river from Minneapolis–St. Paul and from St. Louis (Fremling 1964). Bottom fauna data collected during 1960 and 1961 near Keokuk, Iowa, are herein presented as an indicator of the biological conditions in the portion of the Mississippi between southeastern Iowa and western Illinois.

Bottom fauna collections were made as part of a study of the advisability and practicability of local control of nuisance species of mayflies and caddisflies in the Keokuk area (Fremling 1960a and 1960b, Hoopes 1960, Carlson 1966). Several possible methods of reducing numbers of nuisance insect species were considered, including the local removal of benthic immature stages by application of insecticides to the river. The present paper records the bottom fauna of the relatively shallow silted areas above Dam 19 at Keokuk prior to any control measures which may be attempted.

Materials and Methods

Eight sampling areas (Table 1) were established in early June, 1960, on the Illinois (eastern) side of the navigation channel above Dam 19 at Keokuk, Iowa. Each sampling area included two stations, 20 m^2 and 20 m apart. The bottom sediments at all areas were classified as silt-loam rich in organic matter. Current was negligible except at area C, where a moderate current existed. Collections were made at each sampling area once each week from June 14 to August 17, 1960. Eight dredge hauls were taken with a 15.5 $\times$ 15.5 cm Ekman dredge within each station each time an area was sampled. Four samples were washed in a screened pail (Fremling 1961) containing 20-mesh wire screen. The other four were washed in a screened pail containing 40-mesh screen. The numbers of macroscopic organisms collected from the two screens were not different. Three areas were selected at random, and the numbers of *Hexagenia* and combined numbers of leeches, chironomids, and oligochaetes collected with the two pails were compared in tests of differences (Snedecor 1956). All six tests for significance resulted in "t" values that were nonsignificant at the 95% level, indicating no reason to assume that the two pails would yield different results. Data resulting from use of the two pails in 1960 were, therefore, combined to provide single estimates of the number of organisms. In 1961, only the 20-mesh pail was used, and four Ekman dredge samples were taken from each station in June, in July, and in August. The total number of individually-preserved Ekman dredge samples was 1280 in 1960 and 192 in 1961.

During the analysis of collections, specimens were identified at least to the generic level in almost all cases. Because of the large numbers of *Sphaerium transversum* collected, their numbers were estimated after several counts had been made. *Sphaerium* from 55 collections selected at random and representing all 16 plots and both years were counted, and their total volume after air drying was measured. An average of 38.5 *Sphaerium*/cm^3 was calculated. Thereafter, in collections containing more than a few *Sphaerium*, only the volume of the air-dried clams was measured. Their number was later estimated by multiplying their volume in cc by 38.5.

To ensure accurate identification of chironomid larvae, it was necessary to prepare slide mounts, as described by Curry (1961), of the larvae and their severed heads. Several mounting media were employed, but the use of "Euparal" as described by Johannsen (1937) for mounting of Nematocera was most efficient.

Representatives of each genus of chironomids were sent to Dr. LaVerne L. Curry of Central Michigan University for confirmation of determinations. Gastropoda and Sphaeriidae were sent to Dr. Henry van der Schalie of the University of Michigan Museum of Zoology for confirmation. The oligochaetes encountered above Dam 19 fragmented excessively in alcohol and could not be positively identified by the author. Representatives were sent to Dr. Ralph O. Brinkhurst of the University of Toronto for identification. Many Ephemeroptera and Trichoptera had been previously identified by Dr. H. H. Ross of the Illinois Natural History Survey, Mr. Thomas Thew of the Davenport Public Museum, and Dr. C. R. Fremling. All other organisms were identified only by the author with existing keys and other descriptive literature.

Annotated List

In the following list of organisms, an asterisk indicates those collected only rarely. Numbers taken at each station and dates are given in the thesis on file in the Iowa State University library (Carlson 1963).

Platyhelminthes
  Turbellaria
    Planariidae* only 1960. Most specimens probably passed through screen.

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