7

TOXIC MATERIALS

Chattooga River

STUDIES on the Chattooga River* with a mean daily discharge of 94 c.f.s. began upstream from Trion, Ga., across the Georgia-Alabama State line and into Lake Weiss (Figure 32). Textile wastes and organic wastes entered the stream at Trion, Ga. and organic wastes, principally, entered at Summerville, Ga.

Water samples were collected daily for 14 days for dissolved oxygen determinations. Downstream from Trion, Ga., industrial and domestic wastes drastically reduced, and at times eliminated, the dissolved oxygen resources of the river (figure 39). This display of data is dramatic because a particular level or concentration of a water quality constituent could be chosen as an acceptable minimal criterion and the percentage of time that the criterion was not met was accentuated.

Discharged industrial wastes to the Chattooga River contained dyes in abundance. When river waters are polluted by dyes or similar wastes containing a variety of unnatural hues and colors, visual observations can often be more informative and provide a more realistic picture of stream appearance than routine comparison with laboratory color intensity standards. The color of the river downstream from Trion changed from day to day according to the type, volume, and intensity of dye stuffs included in the textile mill wastes. Changing from deep blue to black to brillant green, it faded to less intense shades of gray and green downstream.

During August 1962, 20 different kinds of stream bed animals, predominantly insects sensitive towards pollution were found in the rocks and coarse gravels upstream from Trion, Ga. Three miles downstream from Trion, no stream bed animals were found (figure 40). Only a layer of black sludge covered the stream bed. Industrial wastes were clearly toxic; and, they were present in sufficient concentration to eliminate the bottom animal community.

* Report on Coosa River System, Georgia-Alabama. Op. cit.

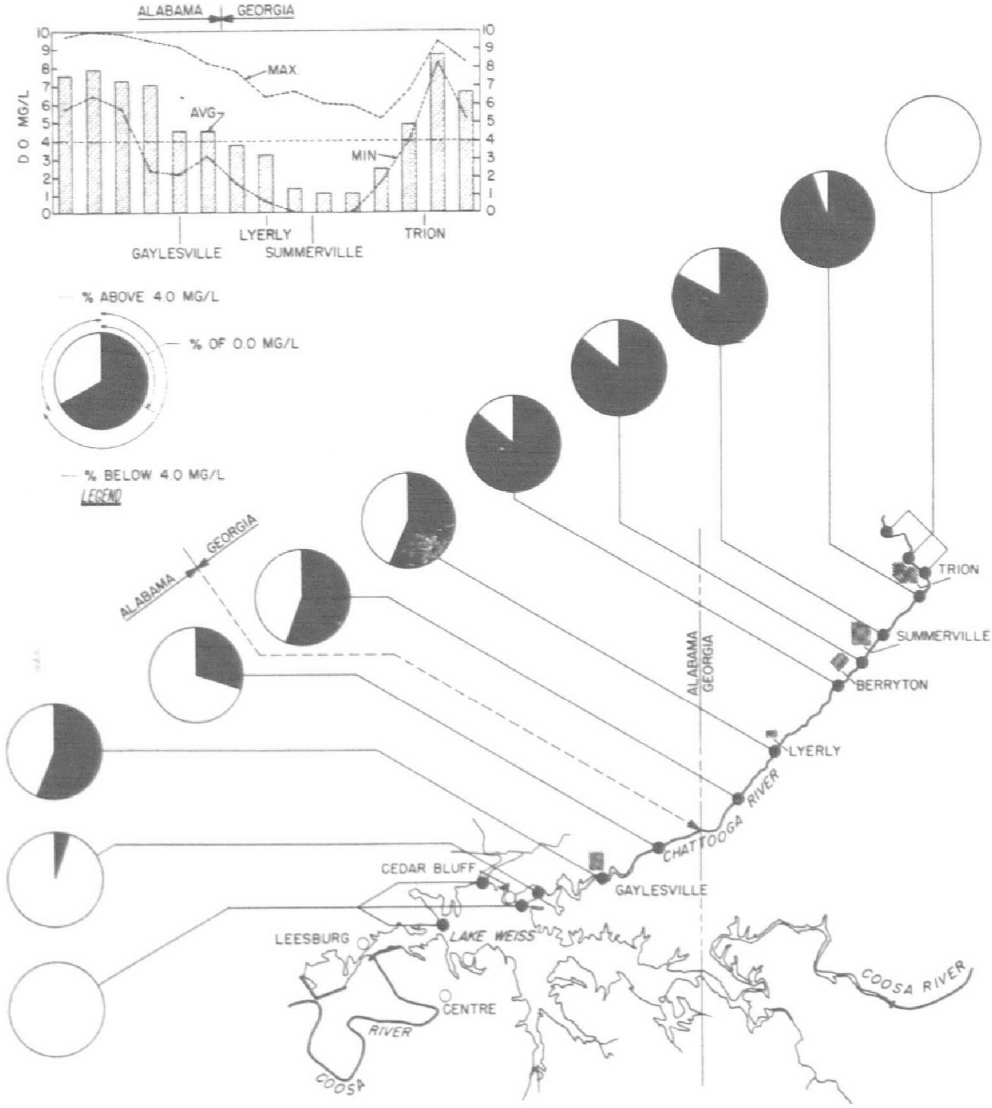

Figure 39. Dissolved oxygen in the Chattooga River showing the percentage D.O. below 4 mg/1, August 1962

Six miles downstream from Trion, stream bed conditions were only slightly improved. The settled sludge was less than 1-inch thick. Tolerant and very tolerant animals were predominant. A tolerant green alga, *Stigeoclonium* sp., adhered to bottom deposits.

Two miles farther downstream the green alga was still evident; filamentous blue-green algae and diatoms were able to tolerate the environment here and were attached to rocks. Sludgeworms, the only benthic organism encountered, survived the diluted toxic materials and responded to the food in the organic pollution producing a population of 680 per square foot.

After receiving toxic and organic wastes at Trion, Ga. the stream did not support a stream bed animal population indicative of unpolluted waters for a distance of about 22 stream miles. In the affected stream reach,

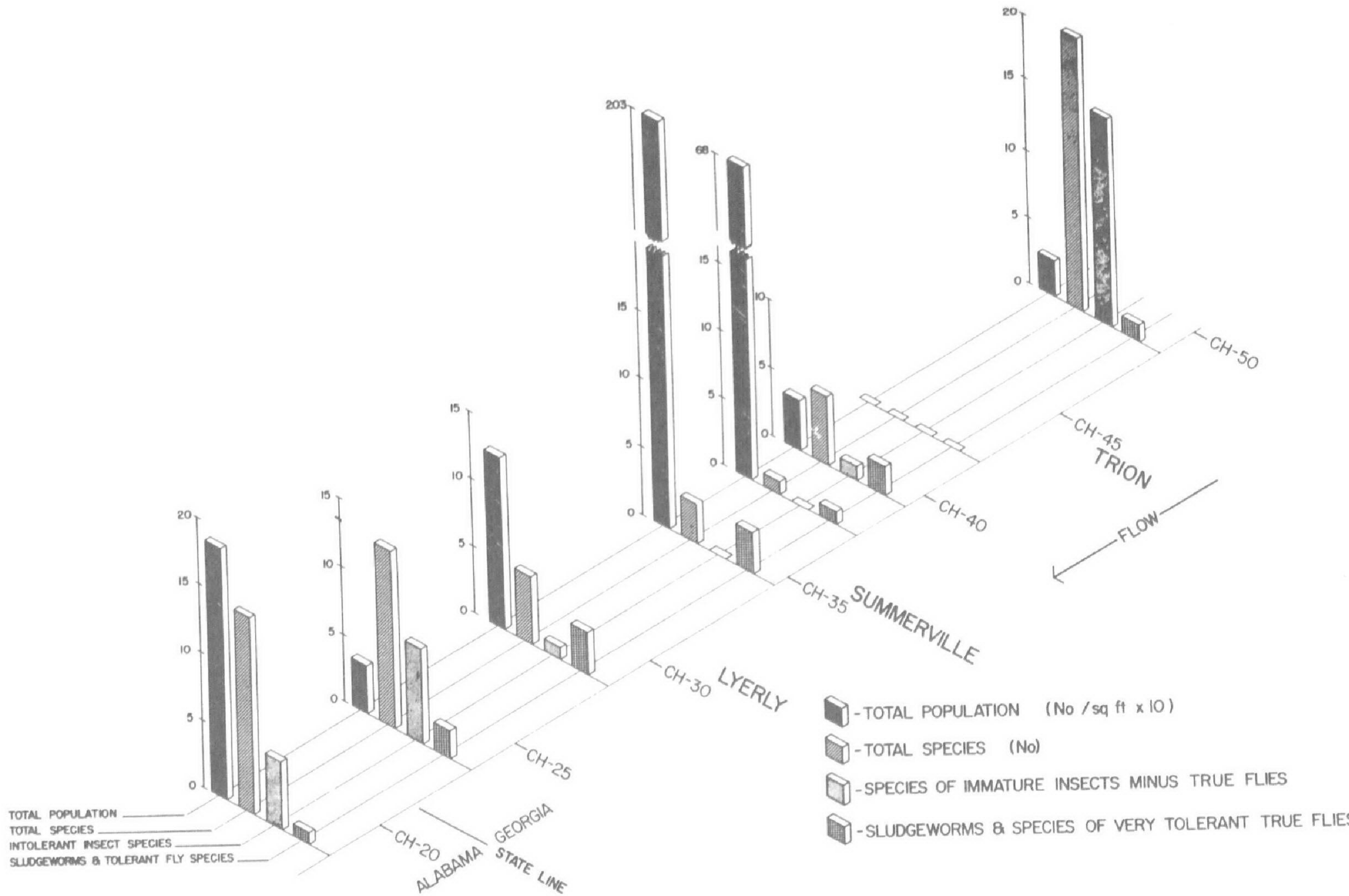

Figure 40. Stream bed animal population in Chattooga River, Ga. August 1962

sensitive insect larvae were drastically reduced or eliminated, and pollution tolerant sludgeworms and associates responded to organic wastes with dense populations where the concentration of toxic materials did not preclude or hamper their existence or development.

Population trends are more easily visualized in figure 40 than in previously discussed three dimensional presentations because the amount of data displayed in one area is less. By means of this device it is possible to form a mental concept among displayed data grouped for a particular station, as well as any single data component among several stations.

Field investigations such as has been described above depict severely toxic conditions. Toxic wastes may eliminate fish populations in certain areas or they may decimate only certain species or certain developmental stages. Adult fish may migrate into an area and live where reproduction is not successful. Some fishfood organisms are more sensitive to certain toxic materials than are fish, and fish populations may be reduced because of a lack of food rather than a direct killing of fish.

Toxic wastes may interfere with the natural purification process in water by interfering with the life processes of those organisms that break down the wastes. The character of the water and its mineral content can alter considerably the toxic effects of a given chemical or waste. The combination of two or more metals may make them several times more toxic to aquatic life than when they occur separately in the environment.

The bioassay is a very important biological tool to use in conjunction with field investigation when toxicities are suspected. The bioassay, conducted under controlled experimental conditions, may be short term (96 hours or less) to determine acute toxicity or long term (days, weeks or months) to determine effects of chronic exposure to test organisms of suspected toxicants, and physiological changes produced within test organisms when exposed to sublethal concentrations of a material that is toxic in higher concentrations. The bioassay may be conducted in a static water environment such as an aquarium, jar, or tank, in a complex flow-through laboratory test chamber, or in situ within the stream or lake. Details for conducting bioassays are presented in the current edition of "Standard Methods for the Examination of Water and Wastewaters."

Mahoning River

In 1952, a steel strike curtailed industrial production along the Mahoning River, Ohio, (Ingram and Bartsch, 1960). July collections were made in that year while the load of remaining pollution came from untreated municipal sewage (Figure 41). September collections were made at the same stations after industrial production was resumed, and the pollutional load consisted of both industrial and municipal wastes. Differences in the number of genera of plants and animals under conditions existing in July and September are shown in the right-hand part of figure 41. Stations 1

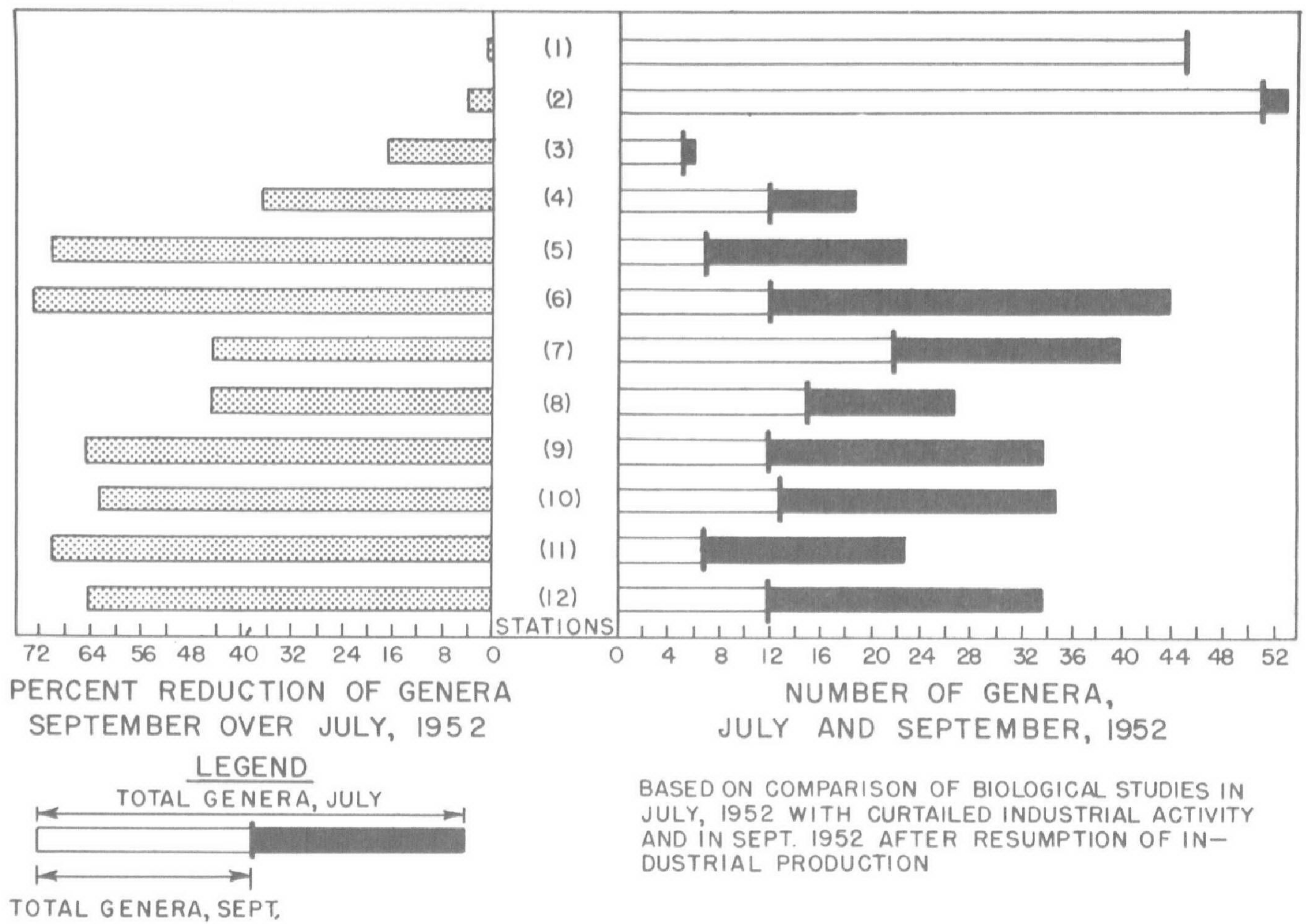

Figure 41. Effects of industrial wastes on genera of organisms in Mahoning River, 1952.

and 2 were control reaches; all other stations were subjected to varying loads of pollution. The left-hand side shows the percentage reduction of genera in September over July, 1952. It is obvious at a glance that the biotic variety of the river was reduced concurrently with resumption of industrial activity and the resulting increased toxic pollutional loads reaching the stream. That the indicated reduction is not attributable to seasonal variation of aquatic life is attested to by the similarities in generic numbers collected at upstream Control Stations 1 and 2 in both July and September.

The Mahoning River drains an area of 1,131 square miles; it begins near Alliance, Ohio, flows northeasterly to Warren, Ohio, southeasterly through Youngstown, Ohio, and joins the Shenango River near New Castle, Pa., to form the Beaver River. One of the most highly industrialized areas in the United States is drained by the Mahoning where 10 percent of this country's steel production is concentrated in its basin.

Maximum river temperatures at Lowellville, Ohio, exceeded 93° F. during 7 months in 1964 in May through November, and exceeded 100° F. in June, July, and September; phenol concentrations were as high as 0.28 mg/l here in January 1965; cyanide values averaged 0.25 mg/l from November, 1952, through September, 1953; ammonia (as NH_3) averaged 3.3 mg/l annually.* Reclaiming operations in the Mahoning River at Youngstown were employed in a 4½-mile reach to separate and remove iron deposits from river bottom sludge.

In a study during the week of January 4, 1965, bottom organisms were reduced in numbers from over 1,300 per square foot upstream from Newton Falls, Ohio, to about 350 per square foot upstream and downstream from Warren, 300 per square foot at Lowellville (Mile 11), and 850 per square foot at the first bridge crossing downstream from the Ohio-Pennsylvania State line (figure 42). Similarly, 11 different kinds of organisms were found upstream from Newton Falls, only one kind, a pollution-tolerant organism, was found at Lowellville (Mile 11), and 3 kinds were found at the first bridge crossing downstream from the State line (figure 43). Although few in numbers downstream from Newton Falls, clean-water associated organisms were found to the highway 422 bridge upstream from Warren, Ohio. Clean-water-associated organisms were not found throughout the remainder of the Mahoning River. Only pollution-tolerant sludgeworms persisted at Lowellville, and only pollution-tolerant sludgeworms and leeches and one kind of tolerant snail were found at the station downstream from the State line. The absence of clean-water-associated fish food organisms in the Mahoning River downstream from Warren, Ohio, the severe decrease in the diversity of bottom organisms, and the generally low numbers of stream bed animals at most sampling

* Report on Quality of Interstate Waters of Mahoning River, Ohio-Pennsylvania. U.S. Department of Health, Education, and Welfare, Public Health Service, Region V, Chicago, Ill., Jan. 1965.

stations, attests to the severely polluted condition of the river and its toxicity from Warren, Ohio, to its confluence with the Shenango River in Pennsylvania.

The bottom of the Mahoning River throughout the reach studied was generally rock and rubble with sludge along the shores and in many slack water areas. Such a rubble substrate would be expected to support a bountiful fish food organism population when not polluted. In many areas, oil formed a film on the water's surface, adhering to twigs, shoreline grasses and debris, and became mixed with the sludges. Substrate

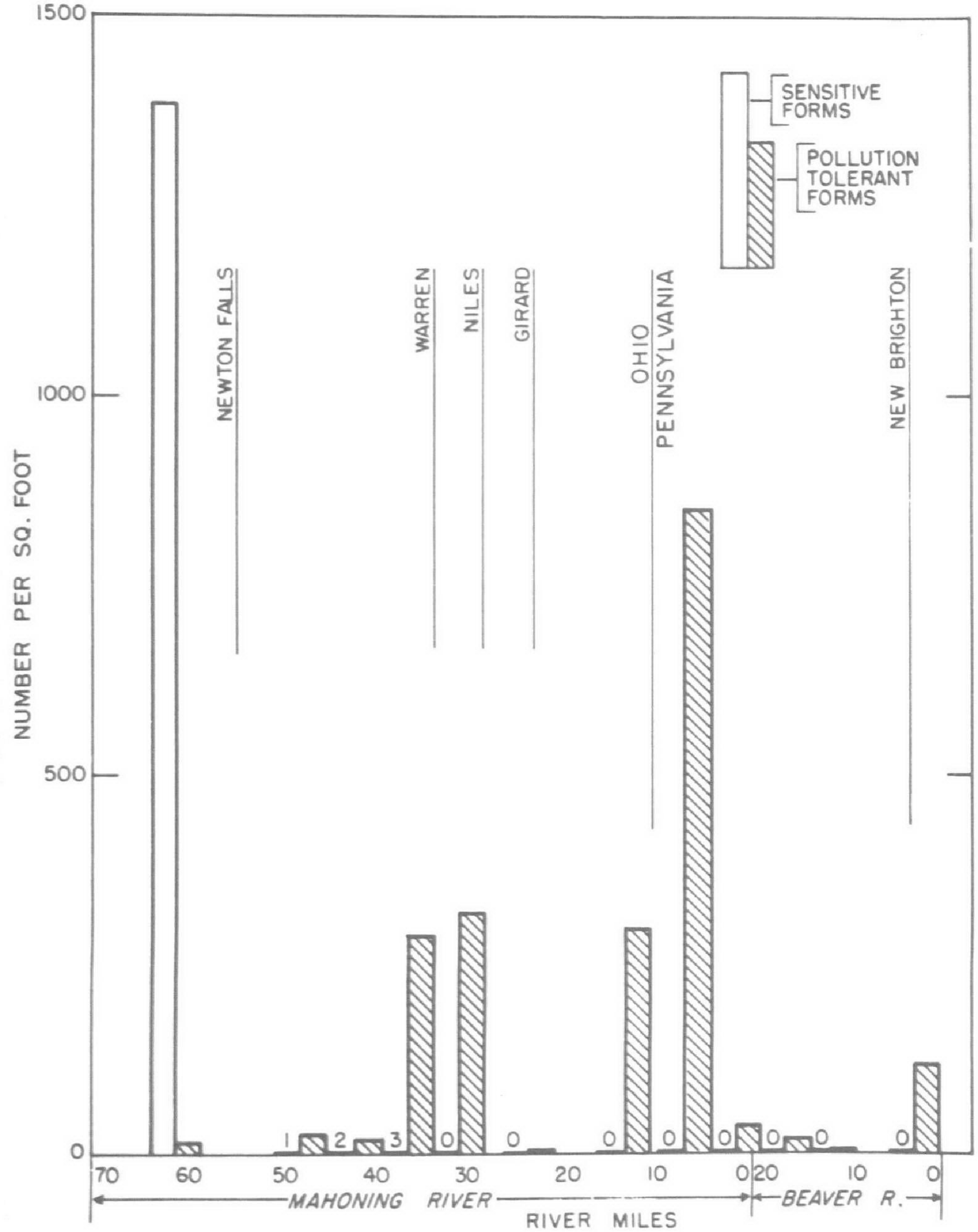

Figure 42. Numbers of stream bed animals, Mahoning-Beaver Rivers, January 1965.

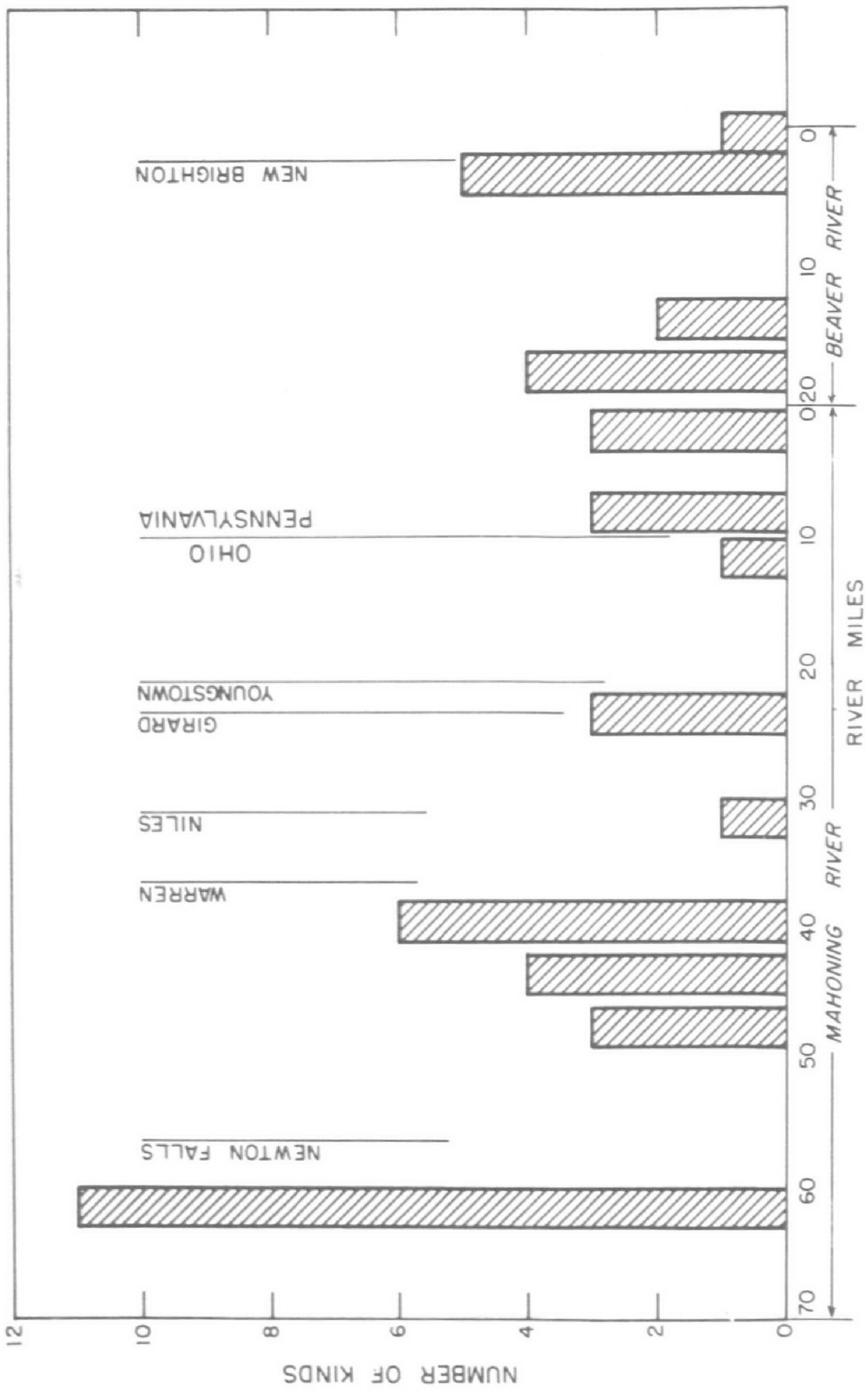

Figure 43. Kinds of stream bed animals, Mahoning-Beaver Rivers, January 1965.

rocks and rubble were covered with a thick iron deposit that was harmful to bottom organisms in the Lowellville-State line reach.

Conditions of existence were only slightly improved in the Beaver

River. Sludgeworm populations were reduced from those found in the more polluted reaches of the Mahoning River, which indicates a reduction in the organic food supply. At New Brighton, Pa., partial stream recovery was found. The different kinds of organisms had increased and stoneflies were observed in small numbers on rocks in the shallow water near the shore. These were not found in quantitative samples taken from deeper water where the impact of pollution would be expected to be greatest.

Oil was also found throughout the Beaver River. Many of the bottom rock were red in color and showed evidence of an iron precipitate. Colonizing the rock's surface in shallower waters was a growth of slick, slimy algae often characteristic of polluted water.

Fisheries investigators have reported that the Mahoning River does not support a catchable fish population downstream from Warren, Ohio, to its confluence with the Shenango River, and that the Beaver River supports a catchable fish population only in its lower reach in the New Brighton area. This was substantiated by an examination of the bottom organism population. In those areas where fishing was not reported, there were no bottom organisms on which fish normally feed.

Results of an examination of the phytoplankton population were similar to those found for the bottom organism population. Values of total counts upstream from Newton Falls, Ohio, were in a range that would be expected in an unpolluted stream during the winter months (figure 44). Downstream from the U.S. Highway 5 bridge (mile 47.4) total count values were substantially reduced and remained so throughout the remainder of the Mahoning River. At Lowellville, Ohio, and at the first bridge crossing downstream from the Ohio-Pennsylvania State line, total count values were one-fourth of those upstream from Newton Falls. Some recovery was found at the highway 18 bridge upstream from the confluence of the Mahoning River with the Shenango River. Depressed algal counts demonstrate the degrading effects of pollution on this primary food source for aquatic life in the stream. The low phytoplankton total count values and the low population numbers found in the bottom organism population is strongly suggestive of the action of a toxic substance or substances to aquatic life.

Ten Mile River

Ten Mile River begins at the outlet of a pond in the northwest part of Plainville, Mass. It follows an irregular course for 21 miles before it joins the Seekonk River in East Providence, R.I. At one time it was stocked with brook trout at Attleboro, Mass., some 8.3 miles downstream from its mouth. During the 1964 survey, it received municipal, plating, pickling, chemical, and textile wastes, and was considered too polluted to be

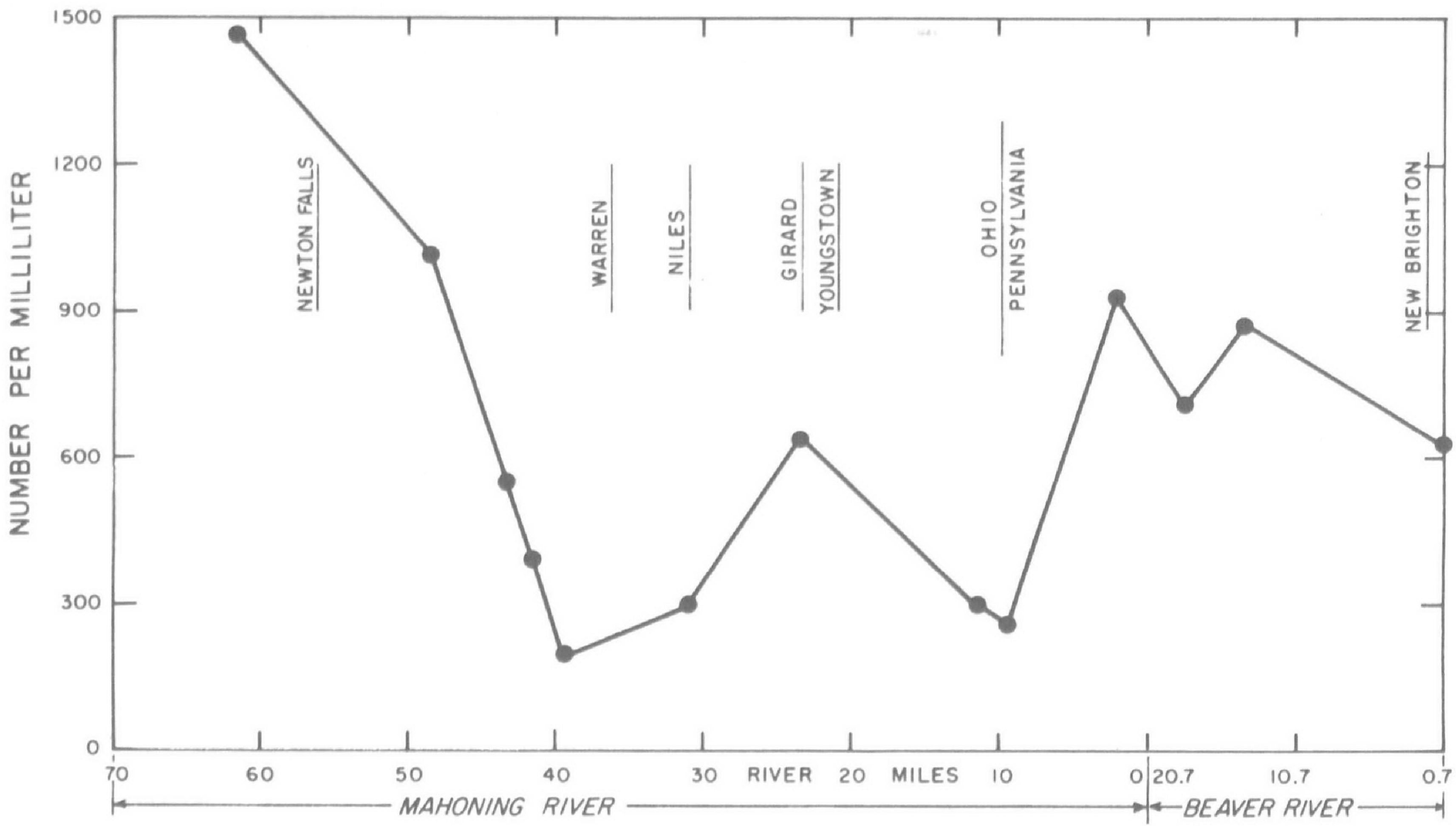

Figure 44. Phytoplankton in Mahoning-Beaver Rivers, January 1965

stocked with any fish downstream from its headwaters.* Thirty-five small metal plating plants are situated in Plainville, North Attleboro, and Attleboro, Mass.

Ten Mile River was severely degraded downstream from North Attleboro, Mass., to the point where it joins the Seekonk River in East Providence, R.I. In this 19 mile reach, Ten Mile River supported a minimal population of clean-water-associated organisms only upstream from North Attleboro.

Extensive sludge deposits, slimes, stalked protozoa, and pollution-tolerant populations of sludgeworms and midges approaching 22,000 organisms per square foot of stream bottom were found in the reach between the North Attleboro sewage treatment plant and Farmers Pond near Attleboro, Mass. (figure 45). Pollution-tolerant sludgeworms and midges were less abundant downstream in Attleboro. Few different kinds of organisms and the presence of extensive sludge deposits impregnated with grease indicated severe pollution and toxicity in this reach of Ten Mile River.

Only 4 kinds of bottom organisms were present in Ten Mile River upstream from the Attleboro sewage treatment plant and the confluence with

* Report on Pollution of Interstate Waters of the Blackstone and Ten Mile Rivers. Op. cit.

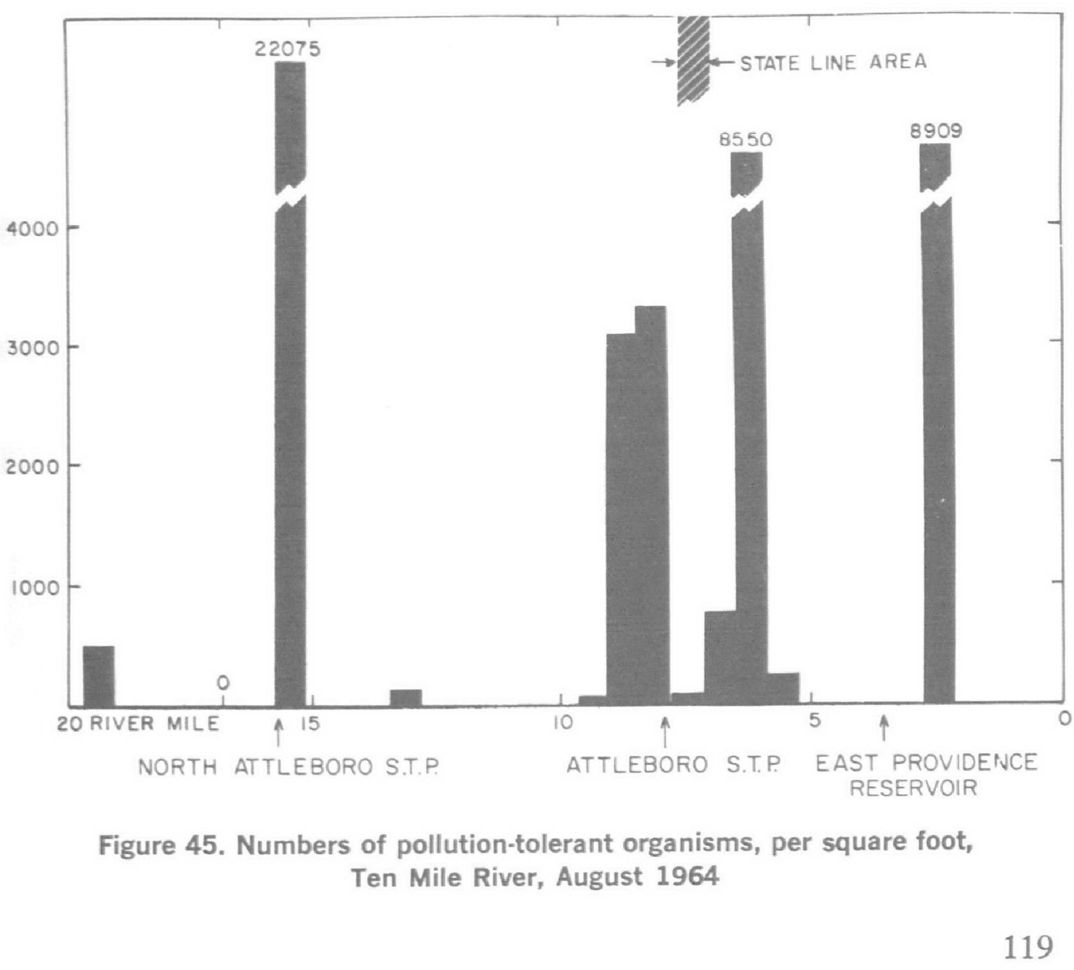

Figure 45. Numbers of pollution-tolerant organisms, per square foot, Ten Mile River, August 1964

an unnamed tributary. Pollution-tolerant midges and sludgeworms were well represented, and stream bottom materials were covered with an oily sludge and slimes. Downstream from this tributary the number of individuals representing the four kinds of bottom organisms was much reduced. Although four kinds of organisms were still present, the decrease in numbers of individuals suggests that wastes entering from the tributary were toxic. No organisms were found in the oily sludge-covered bottom of this purple-black tributary downstream from one of the dyeing and finishing plants.

Effluents from the Attleboro sewage treatment plant contributed to extensive deposition of sludge and, because of unsuitable water quality, a reduction in both numbers and kinds of bottom organisms occurred (Figure 45). Even sludgeworms found conditions of existence restrictive. Slimes, algae, and sludges covered much of the gravel and sandy stream bottom. For the remainder of its length, Ten Mile River exhibited varying degrees of degradation, usually severe.