6

SILTS

Coosa River System

THE Coosa River, formed by the confluence of the Etowah and Oostanaula rivers in Rome, Ga., flows westerly across Georgia into Alabama (Figure 32). Etowah River investigations began just downstream from Allatoona Dam near Cartersville, Ga.; they extended downstream to the confluence with the Oostanaula River in Rome, Ga., and continued in the Coosa River to Lake Weiss, Ala.*

Process wastes from mineral, chemical and textile industries, and raw domestic sewage were discharged to the Etowah River in the vicinity of Cartersville, Ga. During the August survey, silts from mining operations were carried downstream into the Coosa River and across the Georgia-Alabama State line.

In the upstream Etowah River study reach, flow was 300 c.f.s. for about 17 hours of the day; it climbed rapidly to a 7,300 c.f.s. peak at 12:15 p.m. and subsided again for the next 6 hours according to Allatoona Dam turbine operating schedules. Just upstream from the mouth of the Etowah River, flows ranged from 700 to 4,500 c.f.s. Flow in the Oostanaula River in Rome normally ranged between 800 and 1,000 c.f.s. except for an early morning low when the water surface elevations at the mouth were influenced by peak Etowah River flows. The more regular undulating flow pattern in the Coosa River reflected the combined flow characteristics of both the Etowah and Oostanaula rivers and ranged from about 2,000 to 4,600 c.f.s. diurnally.

The dominant pollution discharged to the Etowah River was silt. One ore processing company discharged 500 tons of mineral washing waste solids per day to the river a short distance downstream from Allatoona Dam. Other sources of silt pollution included road bank erosion and soil erosion.

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* Report on Coosa River System, Georgia-Alabama. U.S. Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, January 1963.

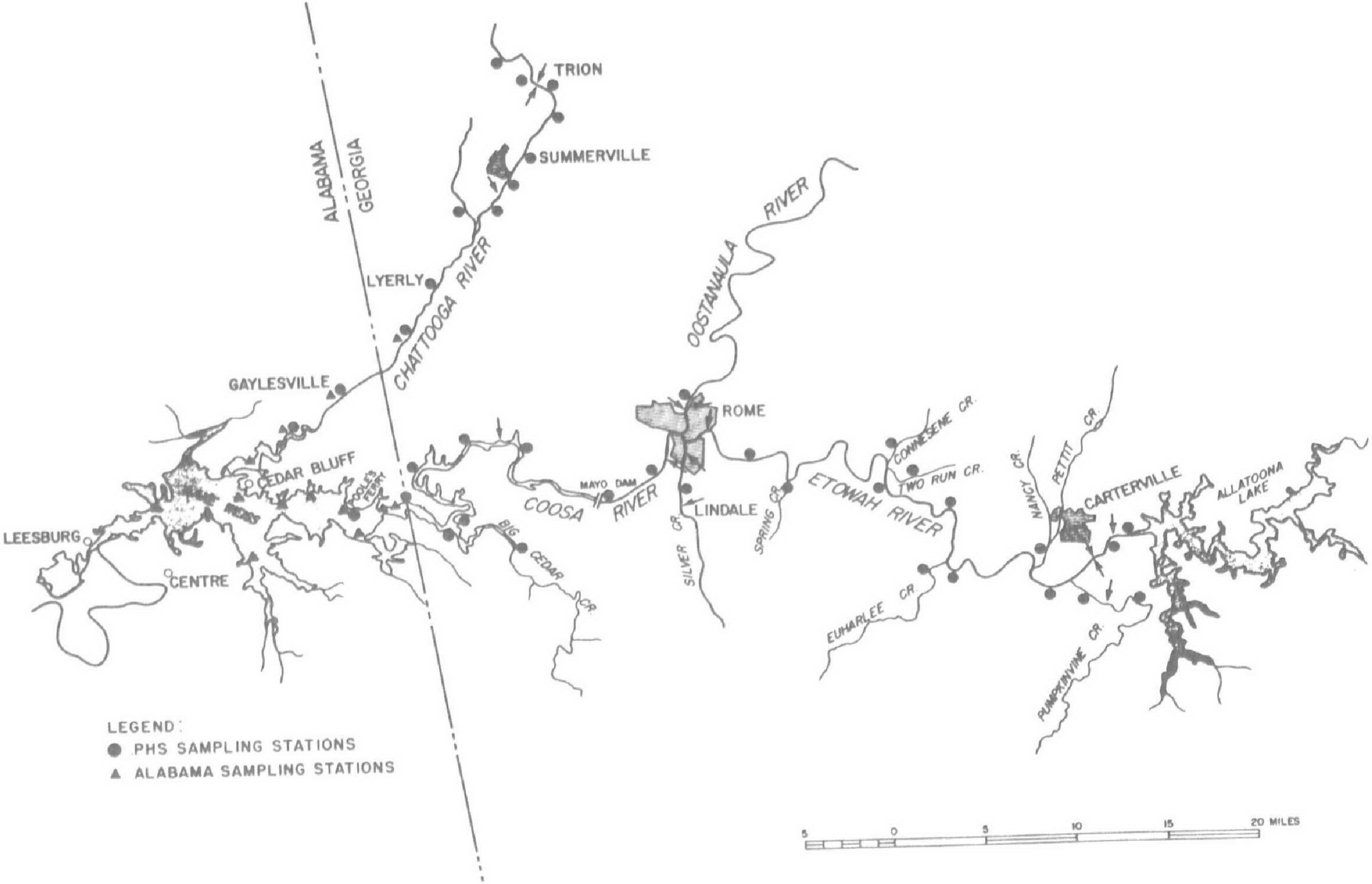

Figure 32. Location map and sampling stations on Coosa River system, Alabama-Georiga.

The color and turbidity in the Etowah River increased sharply around 11:30 a.m., about one-half hour after the turbines in Allatoona Dam were opened. During the next hour, stream suspended solids increased to 900 mg./l. peaks, and the color turned deep reddish-tan as most of the waste solids, which had been deposited the previous evening, were resuspended and flushed downstream. The suspended solids concentration subsided from about 12:30 a.m. to 2:30 p.m. and remained at or below 25 mg./l. during the next 20 hours of the daily cycles. The arithmetic average from 120 samples in a 24-hour suspended solids concentration study was 52 mg./1.; this calculated to 550 tons of suspended solids per day (figure 33). The entire Etowah River downstream from Allatoona Dam and the Coosa River to Lake Weiss were kept highly turbid because of their silt pollution.

A study of stream bed organisms indicated that deposition of silt and other particulate materials on the stream bed affected the quantitative and qualitative distribution of the benthos. The processes of erosion or of mining debris deposition increased greatly the relative proportion of finer materials in the stream bed and reduced the number of usable habitats in which organisms may live. These deposits were principally inorganic, and the combined impact of deposition and the abrasive action of the sand carried by strong currents was so great that the characteristic population response to organic wastes discharged at several points was not observed, except in the reach just downstream from Rome, Georgia.

Only a few organisms, mostly sludgeworms and midges, were able to survive in the silt-laden Etowah River (figure 34). The penstock discharge, deep in Allatoona Reservoir, was very low in dissolved oxygen resulting in a bottom organism population restricted to a very few tolerant forms. *Crenothrix* and other iron bacteria deposited a reddish-brown floc over much of the vegetation and portions of the near shore stream bed. A short distance downstream, the silty mineral washing wastewaters were discharged creating a restrictive habitat for most aquatic life. Limited numbers of sensitive organisms such as aquatic stages of mayflies and hellgrammites were restricted to the few remaining shallow riffles where the effects of silt pollution were least pronounced. The Coosa River also was very turbid and the population of stream bed organisms was only slightly enhanced over that found in the Etowah River. This study again demonstrated the adverse effects of silt and sand deposition upon the biota, both in restricting species diversity and also in limiting organism production to low numbers.

The three dimensional charts used to display the data in figures 34 and 35 are not well understood by the nonprofessional report reader; they should be used with caution. There is too often the tendency to display too much data on one page with confusion the result that ends in frustration and despair for the reader making the interpretation. As with most graphs, the three dimensional presentation is most effective to illustrate a

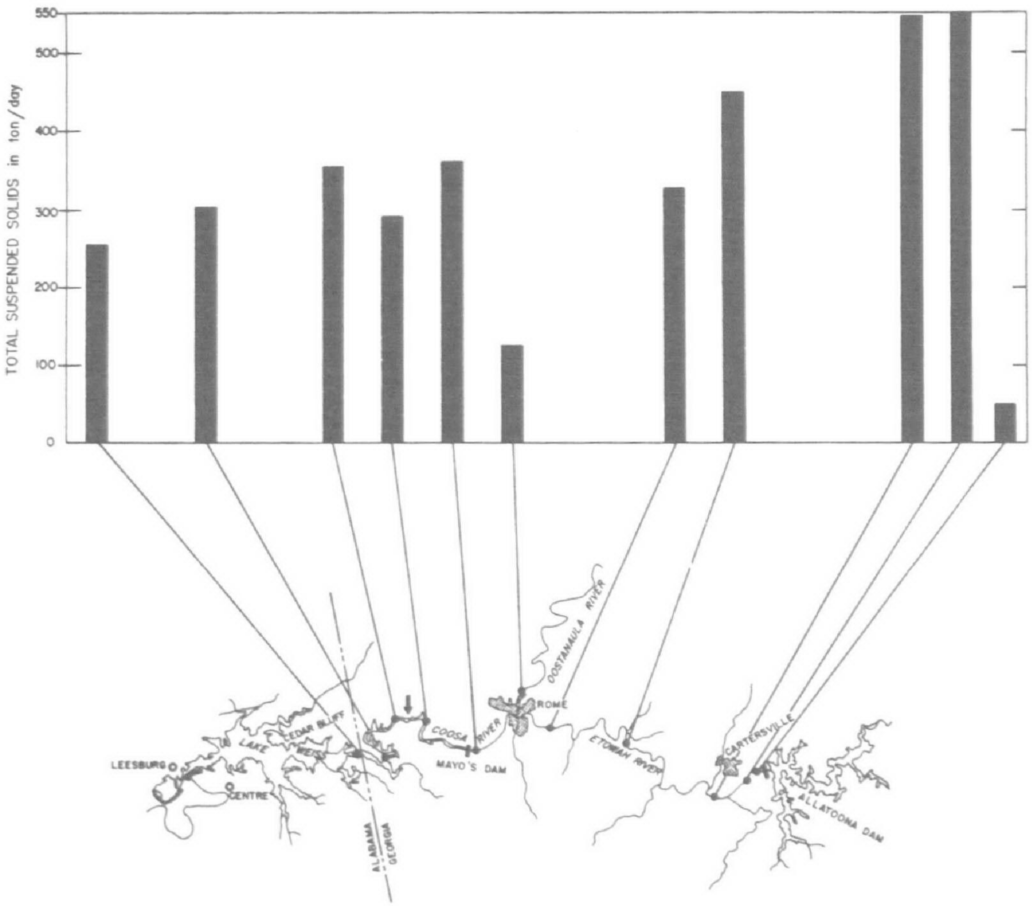

Figure 33. Total suspended solids in tons/day in Coosa River system.

minimal number of projections where trends can be noted easily without undue effort expended in interpretation. Figure 35, especially, does not meet this basic requirement.

Samples for planktonic algal determinations were collected from a depth of 2 feet at three locations in the Etowah River and four locations in the Coosa River (figure 35). A short distance downstream from Lake Allatoona, the waters in the Etowah River were very clear with 10 percent of the incident light remaining at the bottom in 60 inches. Planktonic algae had not had time to develop fully at this point. Five genera of algae other than diatoms and nine species of diatoms were found. Twenty-five miles downstream in the reach exposed to the effects of silt turbidity, the planktonic algal population was low (126 cells per ml.) and the genera of algae other than diatoms was reduced to two. Here, 1 percent of the incident light remained in only 26 inches of water. Because the algal population, which could affect light transmission through increased turbidity, was very low at this station, the low transparency was attributed to the inorganic silt load. The potential for algal development here was restricted to about 2 feet by the availability of light, and further was hampered by the adverse physical actions of sands and silts on algal cells.

The Oostanaula River, which joins the Etowah River at Rome, Ga.,

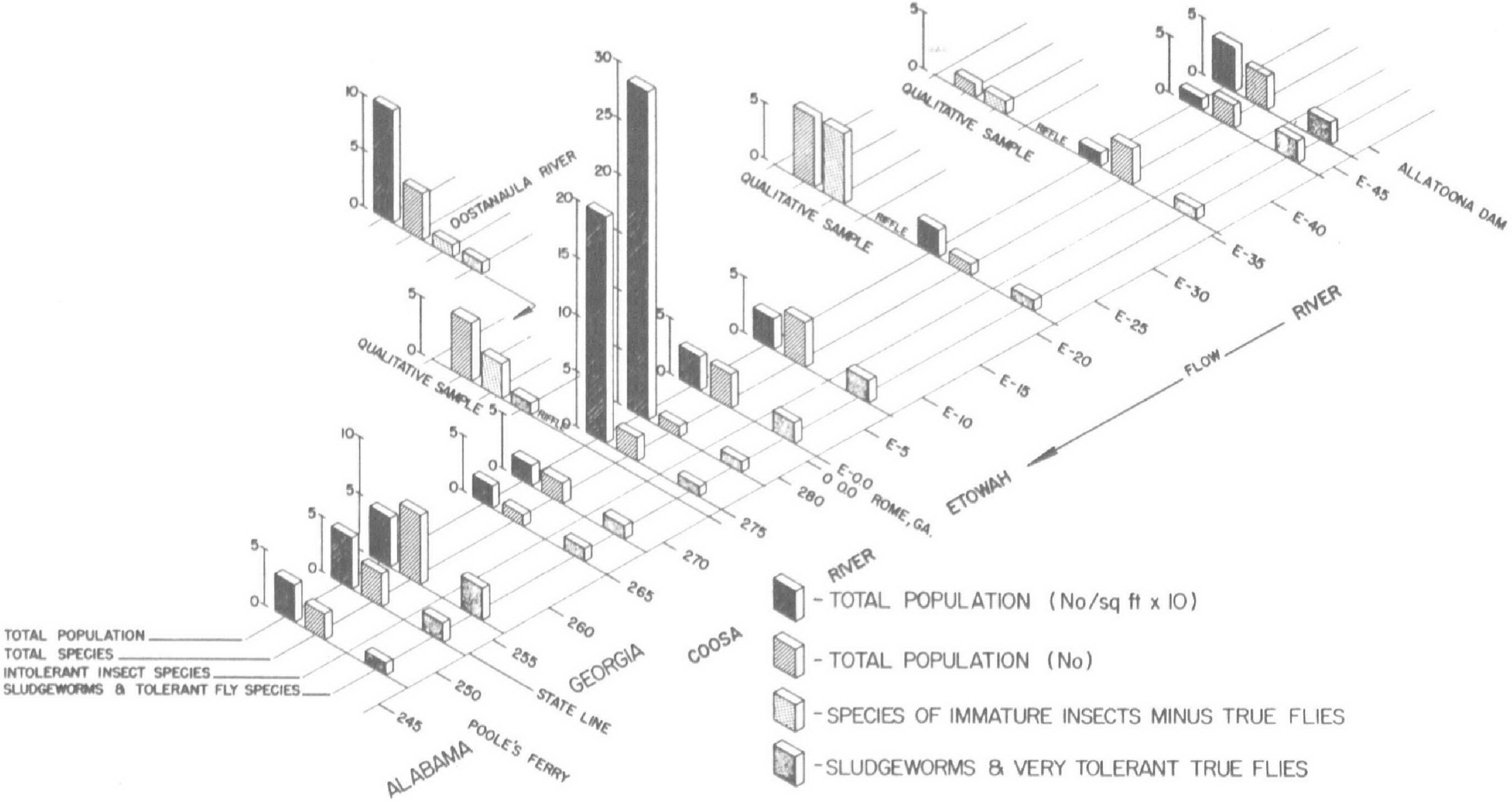

Figure 34. Population of stream bed associated organisms in Coosa River system, 1963.

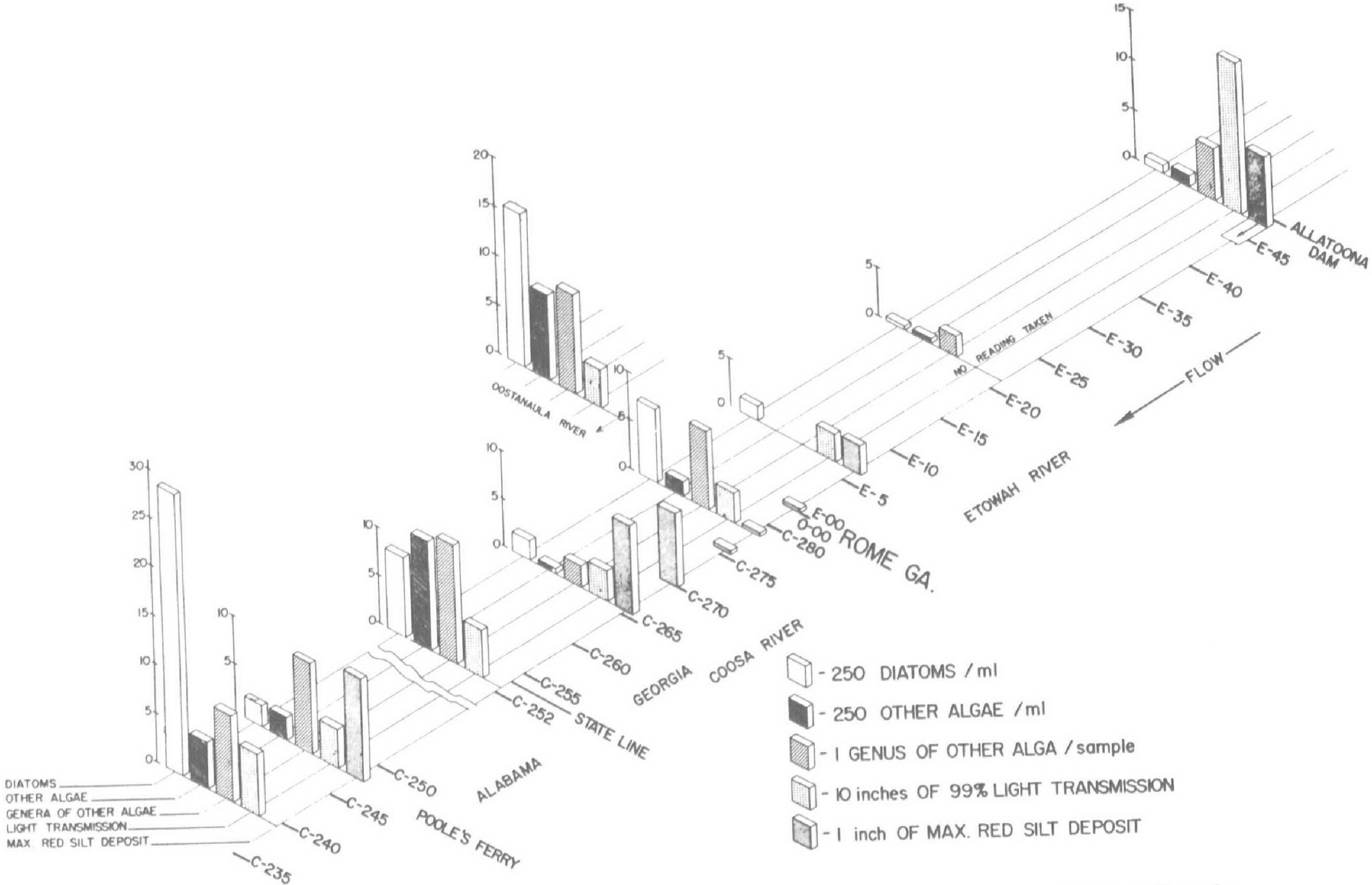

Figure 35. Algal population, light transmission and silt deposits, Coosa River system, Alabama-Georgia.

was used as a control environment unaffected by silt pollution other than land runoff. Here, the planktonic algal population was 10 times more abundant than at any place sampled in the Etowah River; 10 algal genera excluding diatoms were found.

Whenever possible, control stations should be located upstream on the same stream in which pollutional effects from waste sources are being observed. Occasionally this is not possible or practical as in the study of the Etowah River because of the presence of Lake Allatoona. In these cases, control stations may be selected on other streams within the same drainage basin and, as nearly as possible, with morphometric features similar to those of the study stream.

Light transmission was restricted in the Coosa River, and since the algal population was low, silt was the contributing factor. The depth of effective light penetration gradually increased downstream in the Coosa until at the State line 1 percent of the incident light, considered adequate for algal development, remained at a depth of 48 inches and 2.5 percent of the incident light, which is generally considered adequate for rooted aquatic plant development, remained at 37 inches.

Samples from a station near the center of Lake Weiss yielded the greatest algal population found during the survey (8,383 cells per ml.), as well as the deepest light transmission zone with 1 percent of the incident light penetrating to a depth of 65 inches.

Results of an electrofishing survey of 1-hour duration each on the Oostanaula River, the Coosa River 2 miles downstream from Rome, Ga., and the Coosa River near the State line were comparable with a similar number of game fish being observed at each station. Thus, no effects from silt on the catchable fish population were demonstrated by this investigation.

Observations indicated that heavier silts and sands continually rolled downstream in the Etowah River, temporarily settling above riffle areas and becoming resuspended immediately below them as the current pushed the particles over the riffles. This phenomenon produced a muddy water appearance below shallow obstructions in the main channel. Any type of current deflector in the center of the stream bed caused immediate settling of silt on the downstream side of the obstruction.

A thin layer of fine silt gradually settled into the bottom sand in the channel during times of low stream flow. At times of substantially increased flow, the silt is rolled up and resuspended from the sandy bottom by the force of the current, forming clouds of red water.

In regions of reduced stream velocity along the stream banks, and downstream from an inside meander, the silt settled and deposited on bottom substrates. A reduction in stream velocity also occurred in the upstream end of Lake Weiss with the resultant buildup of silt on the bottom of the flowage in the region of the old channel.

Results of core sampling of sediments deposited on the stream bed indicated a red silt layer 7-inches thick in the upper Etowah River reaches and about 10-inches thick in the upstream backwaters of Lake Weiss. Barium, which occurred in the mineral ores but not in soil erosion sediments, was used to trace the deposition of mineral washing waste solids in the Etowah and Coosa Rivers. Barium was found in Etowah and Coosa River core sediments in concentrations ranging from 1.6 to 7.0 mg./g. dry weight and in the mineral washing sludge ponds in a concentration of 10.8 mg./g. It was not found in sediments taken from tributary streams.

Potomac River

The physical effects of inert inorganic solids in the Potomac River in 1952 have been described by Ingram and Towne (1960). Glass sand wastes were discharged to a stream that joined the Potomac River approximately one-half mile downstream. Upstream form this junction, the sparklingy clear Potomac was bedded with rocks, rocky ledges, coarse gravels, and some naturally occurring clean sand. Beds of *Elodea* sp. and *Potamogeton* spp. were plentiful. Gill-breathing snails and mayflies predominated in the invertebrate population, and were found everywhere on the bottom substrates. Large unionid, pearl-button clams were common marginally. Small fish were observed in abundance. Thirteen genera of bottom animals were represented in collections from this station (figure 36).

At a station 600 yards downstream, and on the same side as the confluence of the small creek receiving glass sand wastes with the Potomac River, the stream bed was devoid of visible animal life. Blue-green algae grew marginally on the wave-washed streambank areas. On the opposite side of the stream, 13 genera of animals were found in bottom samples, making the variation, displayed between the two sides of the stream, a dramatic presentation. From the affected bank to mid-stream, rocky ledges and bottom substrata of the original Potomac River were covered by a blanket of wasted glass sand fines up to 2-feet deep. It was reported that the effects of such deposits in 1958 were observed to suppress bottom organism abundance as far as 10 miles downstream. The displayed portion of the 1952 data (Figure 36) indicates the potential for stream recovery within a shorter distance.

Bear River and Tributaries

A study was made on the Bear River and tributaries, Idaho and Utah, in August and November 1962, to obtain information leading to the development of a pollution abatement plan and to indicate levels of pollution during the irrigation and bean canning season in August and the sugar beet processing and sauerkraut canning season in November.* A

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* Survey of Interstate Pollution of the Bear River and Tributaries, Idaho-Utah, 1962. U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Water Supply and Pollution Control, R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio, April 1963.

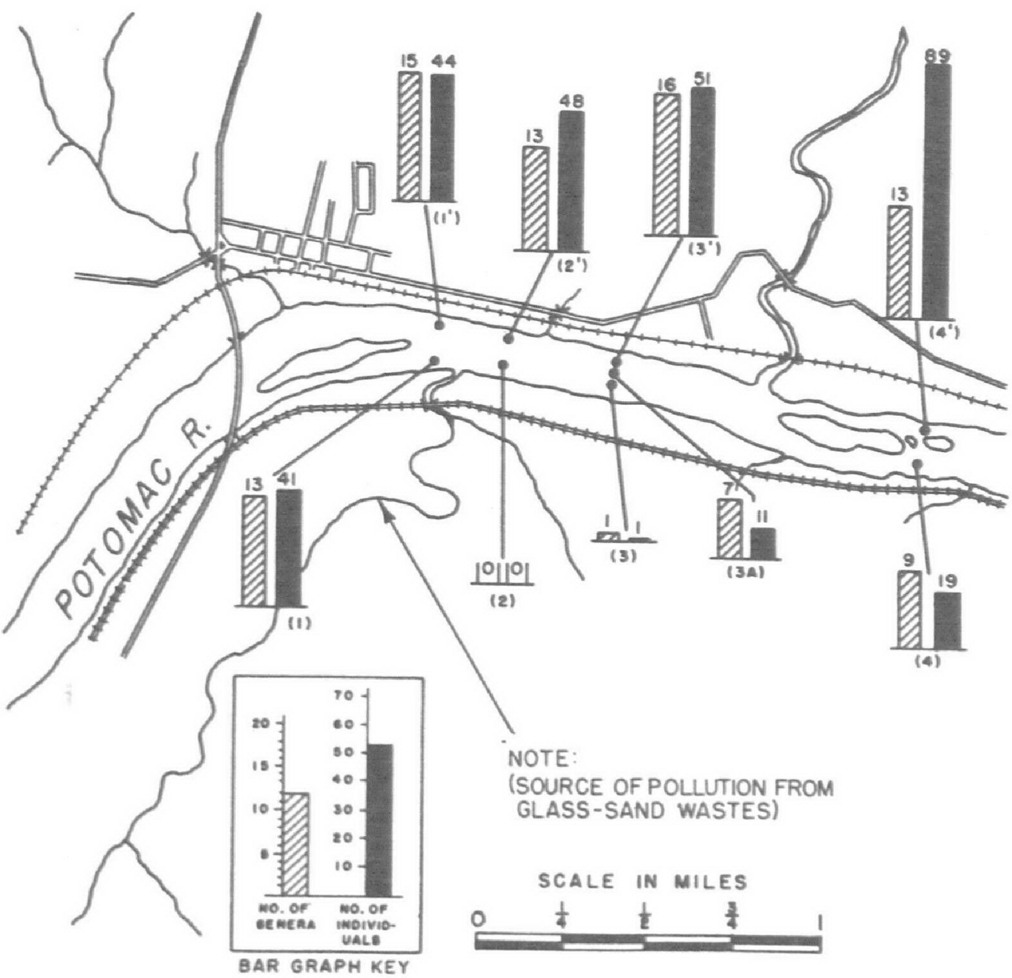

Figure 36. Genera and population numbers of bottom animals per square foot in Potomac River, September, 1952.

portion of the Bear River drains the Cache Valley lowlands where water is used to irrigate agriculture. The valley was interlaced with canals that transported water from reservoirs and stream diversion points to agricultural lands where is was applied. Ditches drained excess water from these areas and discharged it to natural drainage courses (figure 37).

Average monthly flows of 400 to 500 c.f.s. were the rule in the Bear River. During spring months, flows in excess of 1,000 c.f.s. may be expected, and in fall flows may fall short of the 400 c.f.s.

Ten stations were sampled in the Bear River from mile 99.5 to mile 51.8 (figure 38). In the two uppermost sampling stations, the stream bed was a long series of riffles interspersed with deep clear pools that offered excellent trout fishing. Here many different kinds of stream bed animals were found that formed a population of 400 per square foot.

At station 89.5, just downstream from Five Mile Creek (figure 37), sensitive caddisfly larvae and mayfly naiads were reduced and all of the remaining mayflies belonged to the genus *Tricorythodes,* which can withstand large amounts of silt. From this point downstream to Cutler Reservoir, the stream bed was silt-laden.

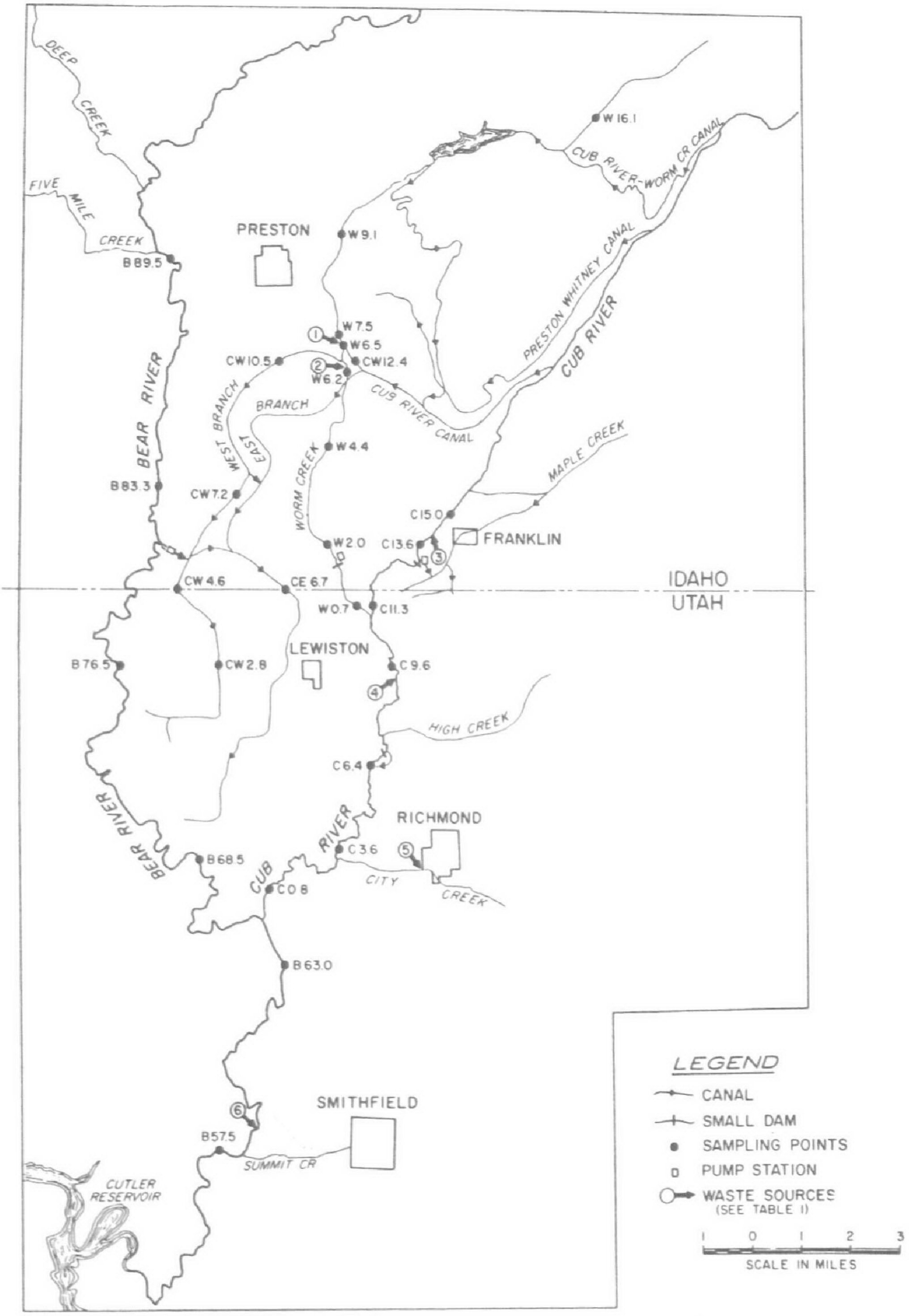

Figure 37. Bear River and tributaries drainage system.

Downstream only qualitative samples of bottom organisms, taken largely from rocks used in riprapping bridge approaches, could be obtained in August because of the sandy stream bed devoid of organisms. During the fall survey, artificial masonite substrates were used with a 3-week set. These were most successful in capturing a wide variety of organisms with populations as high as 250 organisms per square foot including many intolerant mayfly naiads and caddisfly larvae.

Downstream from the entrance of organic pollution from the Cub River, there were no mayflies on the substrates in the fall and there was an increase in tolerant bloodworms. Also there was a growth of *Sphaerotilus* that practically covered the artificial substrate within the 3-week period of its set.

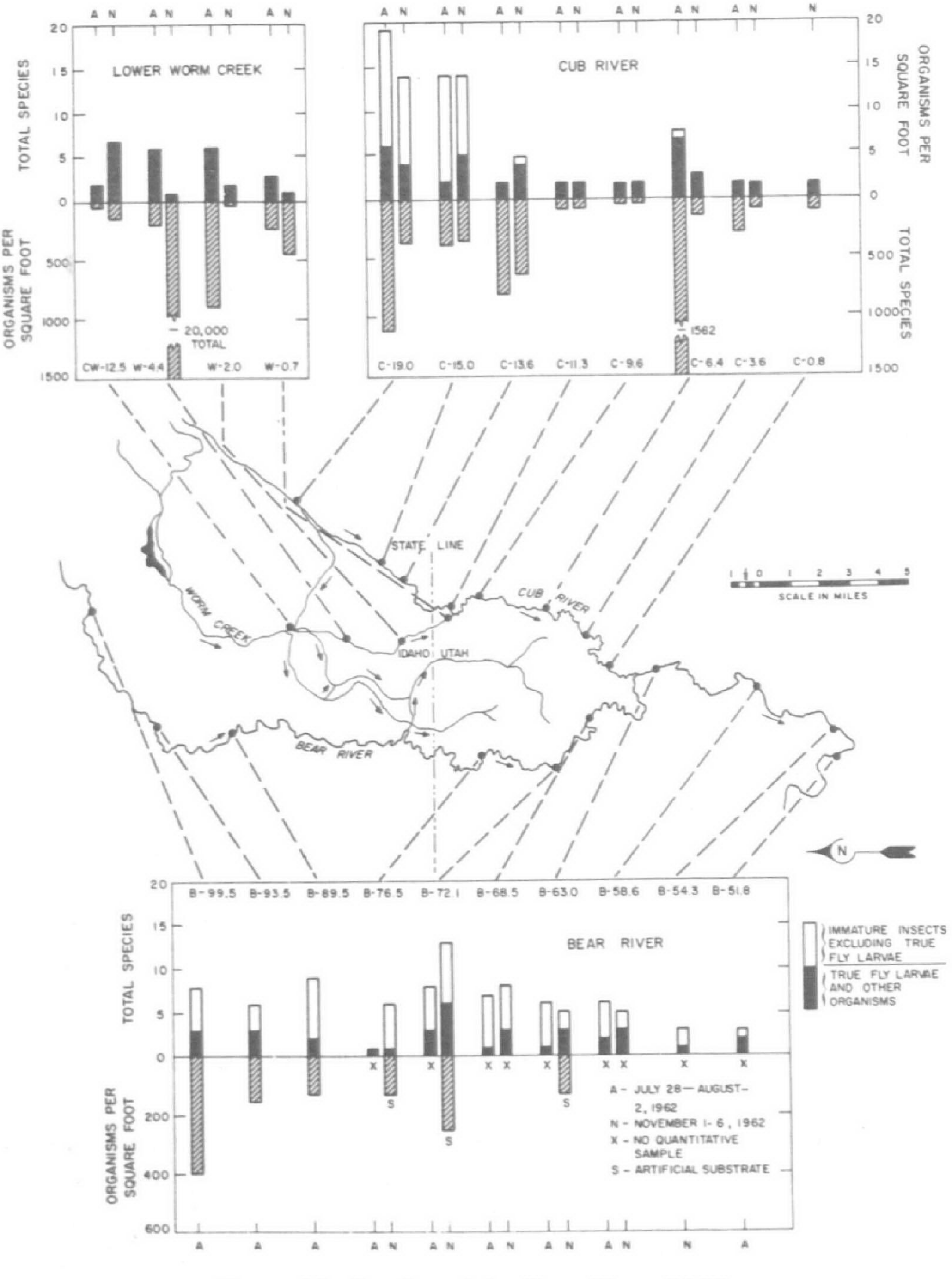

Figure 38. Benthos data, Bear River, 1962.

Stomach analyses of fish captured in this area showed that fish were feeding on the same types of organisms that were captured on the artificial substrates. Some of the individual stomachs contained as many as 15 caddisfly larvae and mayfly naiads. It seemed probable that the source of this fish food, and the source of the animals on the artificial substrates, was the highly productive riffle areas 30 or more miles upstream. Drifting mayflies have been reported as abundant as 170×10^6 *Baetis* sp. nymphs per day in large rivers (Pearson and Franklin, 1968).

It has been reported* that in the years 1910 to 1950, "The Bear River has deposited about 10 million tons of sandy sediment in its channel." This sand, 0.1 to 1 mm. in diameter, has been evenly deposited 5 to 6 feet deep over the natural gravel, clay, and silt bottom from Preston, Idaho, to Cutler Reservoir. It has come from gullies, drained by Five Mile Creek and Deep Creek, developed as a result of improper agricultural practices and poor land management. The deposited sand is of an entirely different character and origin than that of the original river channel; it not only covers the original stream bed, but also covers all but a few rocks along the river bank, thus further reducing available living spaces for organisms. Collected data on the Bear River indicate that stream bed animals were reduced from 400 per square foot in upstream natural areas to those few that were found on rocks near bridge abutments in the approximately 40 stream miles affected by sand intrusion.

Figure 38 is made somewhat unattractive as a form of data display chiefly because of the effort to show the location that each piece of data represented on a complicated stream flow system. The same graphs could have been used without drawing in the stream or using the connecting dashed lines, but, there is some advantage for data interpretation when stream locations can be viewed to gain mental perspective. The Bear River system does not lend itself well to this type of presentation because of its interlacing streams. Also, some may object to showing the number of organisms per square foot as projections below the dividing (0) line because their first impression, incorrectly, is that this represents a negative number.

Although there may be too much data displayed on one page, Figure 38 does permit the examination of the effects of more than one type of waste on stream biota. In addition to the silt pollution investigated in the Bear River, lower Worm Creek was polluted by sugar beet processing wastes. In August the stream was almost dry and the restricted flow was insufficient to permit stream recovery from the preceding fall. During fall, beet tops and pulp sludge exceeded 3 feet in depth in some stream reaches. Sludgeworms exceeded 20,000 per square foot. Only pollution tolerant organisms were found.

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* Einstein, A. J. 1951. Preliminary Report on the Sedimentation in the Bear River Channel between Cutler Dam and the Preston Bridge, Utah, to the Utah Power and Light Company, Salt Lake City (Typed Copy).

The Cub River offered excellent trout habitat in its upper reaches. Its rock and coarse gravel stream bed here provided a habitat for many stonefly naiads, mayfly naiads, caddisfly larvae, and aquatic beetle larvae, as well as a hatchery for trout eggs and developing young trout. Just upstream from Station C–13.6 (figure 38), effluent from an industrial operation that canned peas, green beans, and sauerkraut entered the stream, and the Cub River became seriously degraded. For the following 14 downstream miles, the stream bed animal population was composed principlly of a few kinds of pollution tolerant sludgeworms, bloodworms, and leeches and occasionally large populations of these formed when water quality would permit.