The NANNOPLANKTON and the METALS

Intertwined with the other pollution difficulties of the Coeur d'Alene and Spokane region is the problem of the metals and the nannoplankton. Metals, such as cadmium, lead, copper, and zinc, are coming down the South Fork to the main stem of the Coeur d'Alene River, and thence to Coeur d'Alene Lake. Some quantities of these materials are reaching the Spokane River. The sources of these metals are the tailing piles, drainage from old, closed mines, and wastewaters from smelters. The nannoplankton are those aquatic animals and plants which drift in the waters of ponds, lakes, and the oceans and are so small they cannot be seen except through a microscope.

WSU professors Funk and Filby and University of Idaho faculty member Rabe are concerned about the possibility of these metals migrating "up" through the food chains of the South Fork, Coeur d'Alene Lake, and the Spokane River. Such a food chain could consist of plankton to microcrustaceans to small forage fish to larger predator fish.

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At each stage in the food chain, the zinc, etc., may be concentrated in the tissues of the plant or animal. As each larger individual eats the smaller one, the amount of harmful metals that could be consumed by the next level increases drastically. This is the same problem —as has been given widespread publicity— with the concentration of DDT as it moves up the food chain from insects to fish to fish-eating birds.

The WSU-UI study is being funded by the U.S. Office of Water Resources Research through the State of Washington Water Research Center and the State of Idaho Water Research Institute. Graduate students from both universities are playing a key role in the research. The investigation has been funded for one year and a renewal has been requested for a second year.

As part of their work, the university team is collecting samples of the nannoplankton found in Coeur d'Alene Lake waters. These will be used in bioassay tests to determine the effect of the various concentrations of the metals. In addition, nutrients such as nitrates and phosphates will be added to laboratory algal cultures to assess the effects of growth stimulation.

According to Dr. Funk, there has been relatively little information published concerning the effects of toxic metals on natural nannoplankton communities. The techniques developed in the past several years at WSU, which utilize activation analysis equipment and techniques, have made it possible to measure the extremely small quantities of these trace metals in plant and animal tissues and in aquatic environments.

In addition to the nannoplankton specimens, the investigators are collecting sediments from the lake and river bottoms, as well as water samples. According to Dr. Funk, chemical determinations are being routinely made of the carbonate and bicarbonate alkalinity, total CO_2, pH, DO (Dissolved Oxygen), electrical conductivity, nitrates, phosphates, sulfates, and BOD (Biological Oxygen Demand). Physical measurements are being made of the transparency, water temperature, turbidity, depth illumination and light intensity, he states.

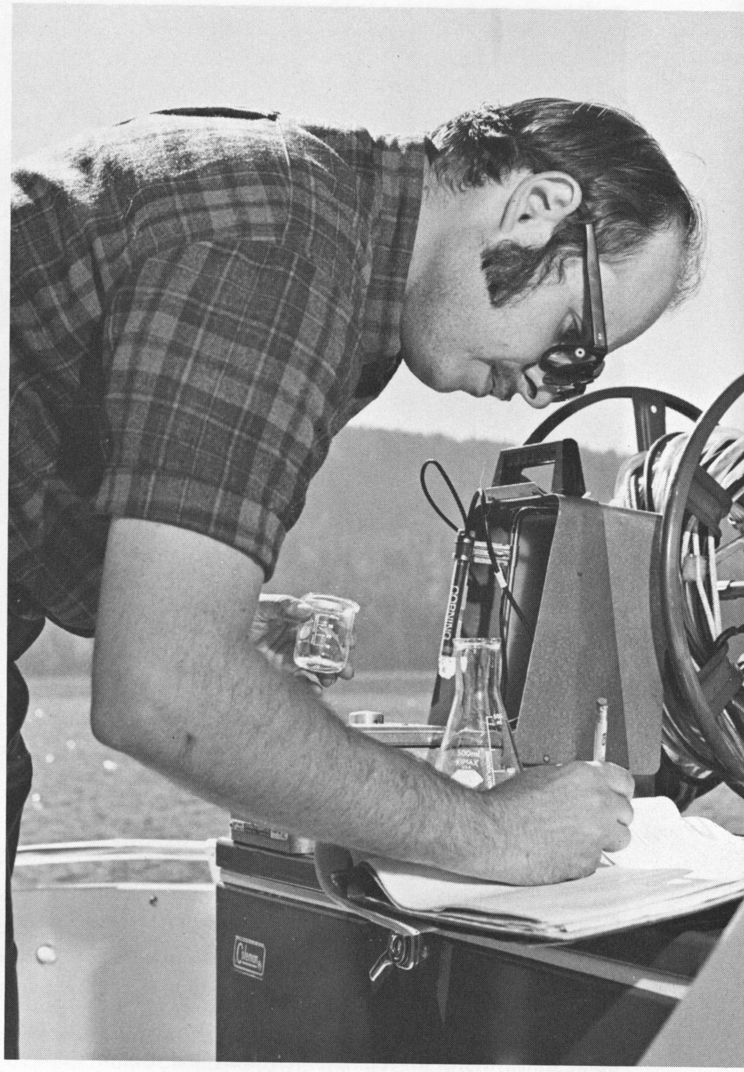
The presence and quantities of more than twenty elements are being determined, including sodium, aluminum, chlorine, potassium, scandium, chromium, manganese, iron, cobalt, copper, zinc, bromine, rubidium, strontium, antimony, cesium, barium, gold, mercury, thorium, lead, cadmium, and possibly molybdenum. Both neutron activation analysis and atomic absorption spectrophotometry are used to make these measurements. A coring device is being utilized to bring up six-foot samples of the bottom muds.

Professor Rabe and his University of Idaho students have been conducting studies in the Coeur d'Alene region for a number of years. Rabe states that they began their earlier work by attempting to find out what effect zinc— one of the heavy metals found in the river— has on cutthroat trout. These fish are endemic or native to the North Fork but have not been found in the main river. According to Dr. Rabe, a graduate student began working first with a static bioassay setup. Later, a switch was made to a system in which water was recirculated through a series of small tanks in which cutthroat fingerlings were placed. By exposing these trout to certain concentrations of zinc, he came up with the median-tolerance limit, i.e., the amount of zinc that it would take to kill 50% of the fish population.

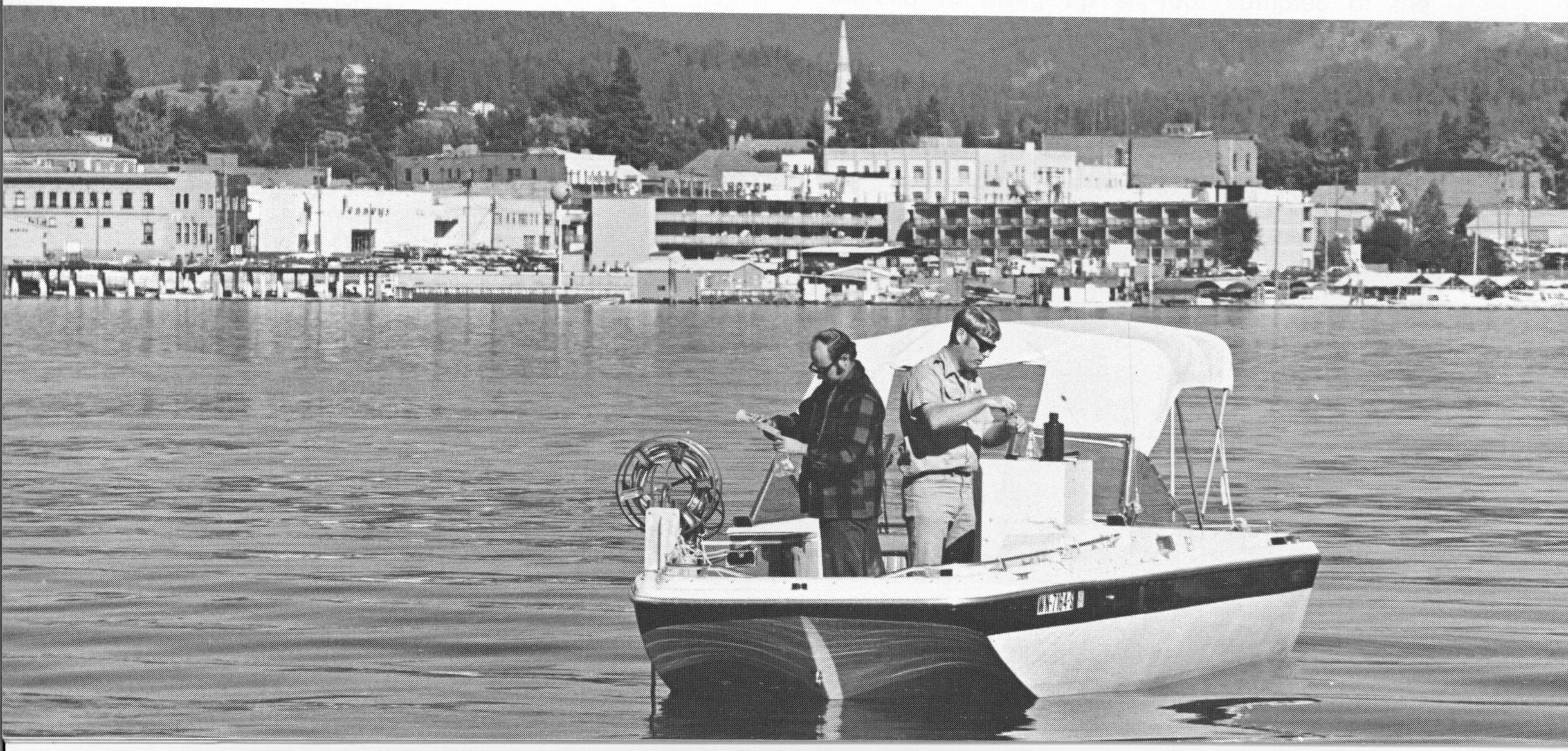
Results of the tests showed that over a 24-

Former University of Idaho graduate student Nancy Savage making aquatic invertebrate collections in the North Fork of the Coeur d'Alene River so as to measure the diversity of the community there for comparison with the South Fork and the Main Fork where invertebrates are not as diverse or where the bottom community consists of fewer numbers of species.

Robert Minter, University of Idaho graduate student, attaches bottles to a hanger device for suspension in the lake. The bottles are filled with nannoplankton for determining plant production at various levels and locations in Coeur d'Alene Lake.



Above: A barge-mounted piston corer is used to bring up samples of bottom muds for later laboratory analyses to determine metal content. From left to right, WSU sanitary engineering section members Pat Syms, William Funk, and civil engineering department member Leo Cunningham. **Below:** Water samples are taken at a number of Coeur d'Alene Lake locations as well as in the Spokane River. At left, WSU sanitary engineer Richard Condit. At right, student Neil Thompson. **To the right:** Some water quality measurements are made on-board as soon as the sample has been collected. Richard Condit records his finding.



hour period of exposure, 50 percent of the fingerlings tested would be killed by a concentration of 0.42 parts per million (ppm) zinc, as compared to a control group of fingerlings which were not exposed to the toxic conditions. Professor Rabe says the present zinc readings in the main river exceed this value.

Measurements made during the past year by the WSU-UI group reveal that large masses of periphyton (a class of algal forms) have become attached to rocks in some areas of the South Fork channel. The investigators believe these growths have been the unexpected result of the tailing ponds being constructed by the mines. Rabe believes the tailing ponds are holding back much of the sediment, thus providing conditions of greater transparency. This permits more sunlight to penetrate below the river's surface, which improves growth conditions for certain species of algae.

The presence of these periphyton may be having an adverse effect as far as other forms of life in this section of the river are concerned. Professor Rabe declares these attached plants have made it almost impossible for many bottom-dwelling insects and other invertebrate groups to colonize the substrate in the Main Fork of the Coeur d'Alene. These small organisms are a vital link in the food chain leading up to fish.

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Rabe asserts that in the past, the lack of suitable attachment sites for these invertebrates was probably due to the heavy siltation from the mine tailings. At present, the organisms may be limited in diversity because the massive plant growths make it difficult for the bottom invertebrates to find any room for attachment. These factors may be as important a limiting factor as the high concentrations of metals in the water, Rabe states. To test out this thesis, the investigators propose to establish in the North Fork, the Main Fork, and the South Fork a series of colonization boxes to establish the rate at which new forms would move into the various sectors of the river drainage. Funk declares: "If we provide artificial attachment sites in the drainage, the drift organisms may then have an equal opportunity to colonize the study sites." Information obtained from these test colonies will provide additional inputs as to the effect of metals on life in the streams.

Professor Rabe reports the concentrations of metals which are coming down the South Fork may be somewhat higher or at least as high as what they were before the mines constructed the tailing ponds. One reason for this higher concentration, according to the University of Idaho ecologist, is that the sediment from the mining operations used to be flushed down the river instead of into the holding ponds. Some of the metals combined with the clay particles and thus were taken out of circulation. Now that the sediment is considerably reduced, the metals apparently are not combining as much with the particulates in the sediment, thus causing higher metal concentrations. Rabe explains that what this all amounts to is a much cleaner river physically but chemically the waters are somewhat toxic.

As far as the effect of the metals upon the algae in Coeur d'Alene Lake is concerned, the Idaho researchers have found evidence of a synergistic effect. The three most common metals coming down the river are cadmium, copper, and zinc. By means of algae growth tests made in the laboratory, as well as in Coeur d'Alene Lake, Rabe's students have found that copper has an over-riding effect on how the algae take up carbon. And when copper is present in combination with the cadmium and the zinc, it has a still greater effect.

These Washington State University-University of Idaho studies now being made by Funk, Filby, Rabe and their students will provide some badly needed information on the current health of the South Fork, Coeur d'Alene Lake and the Spokane River. Their information should make it possible to prescribe the proper corrective measures. It may not be possible to return this region to like it was when prospector Andy Pritchard first made his way through the pristine Spokane Valley, past the deep, blue lake, and into the fateful Coeur d'Alenes; however, considerable improvement is possible. D.C.F.