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Effects of Sewage Effluent on the Ecology of Swan Lake,
Grand Teton National Park, Wyoming
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The study of the effects of the introduction of the effluent from the secondary treatment plant handling the sewage from Colter Bay, Grand Teton National Park, upon the ecology of Swan Lake was initiated in 1954. This study was expanded in 1955 and 1956 and continued during the summer of 1957 with the purpose of determining the long range effects of sewage effluent on a natural lake.

The operation of the treatment plant and subsequent introduction of effluent into Swan Lake was initiated in early summer, 1956, when only sewage from the campgrounds and trailer area was treated. In 1957 the sewage from the 125 cabins was added to the treatment plant. During June and July the rate of water utilization by Colter Bay increased to approximately 125,000 gallons per day. The capacity of the treatment plant is about 50,000 gallons per day. By July 30 the filters were overloaded to the extent that park personnel found it necessary to install a pump which pumped the effluent from the septic tanks directly into the lake with only primary treatment.

In 1957 standard chemical examination of the lake waters was performed at three stations at two week intervals. Bottom fauna was sampled at Station I and III every two weeks. The plankton was sampled each week from June 11 through August 27 at all three stations. Analysis for nitrates, nitrites and phosphates in the water was conducted twice during the summer and a single bacterial count was made. Miscellaneous collections of larger organisms were also made at irregular intervals during the summer.

The nutrient effects of the sewage effluent could be detected throughout the lake in 1957 although they were more obvious at the north end of the lake near the outlet pipe. After August 1, the odor of sewage was very discernible near the sewer outlet and a profuse growth of algae formed a green scum on the surface of the water near the sewer pipe outlet. The dissolved oxygen content of the water was practically the same at Stations I and II, averaging 6.0 ppm. at the surface and 5.9 ppm. at the bottom. Slightly higher concentrations of oxygen were measured at Station III where the surface waters contained an average of 7.8 ppm. and the bottom water 6.2 ppm.

Free CO_2 varied between 0 and 12.5 ppm. The higher concentrations were found in bottom water at Station III. The alkalinity varied between 33 and 63 ppm. of methyl orange alkalinity. The pH varied between 7.1 and 9.1 at the various sampling stations.

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The Secchi disk readings averaged 5.9 feet, 5.4 feet and 3.5 feet at Stations I, II, and III respectively. Water temperatures measured on all sampling dates and usually between 8:00 and 10:30 a.m. averaged 65.0°F. at the surface and 61.5°F. at the bottom.

The density of the populations of bottom dwelling organisms was lower than that in previous years. At Station I the mean count for an Ekman dredge sample ($\frac{1}{4}$ sq. ft.) was 27.5 organisms. These were 76.3% Chaoborus, 18.1% midge larvae, (Tendipedidae) and 5.4% oligochaete worms. At Station III an average of 41.9 organisms was 92.6% Chaoborus, 3.5% Tendipedidae, and 3.8% oligochaetes.

The net plankton in the open water in the summer of 1957 had, in general, the same species composition as in previous years, with some exceptions. After the middle of July the colonial Coelosstrum and Eudorina, genera which had not been conspicuous in samples taken in 1955 and 1956, became predominate in the open water at all stations. The yellow-green Mallomonas and colonial green alga Volvox, as in 1956, were conspicuous also.

In response apparently to a spread of the nutrient effect of the treated sewage through the lake, the average density of plankton populations was higher at all stations.

The conditions existing in the lake at the end of the summer of 1957 seem to be that of a general spread of the nutrient effect through the lake and of an overload of raw sewage near the sewer pipe outlet in late summer. No profound effects of the sewage effluent on the extensive growth of pond lilies in the lake or on the fish life are yet evident. The ability of the plankton organisms to modify raw sewage to the extent that the development of offensive conditions has been prevented or at least postponed is certainly noteworthy, and future conditions in the lake should be studied.

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