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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 on the ecology of Swan Lake of the introduction of the effluent from the treatment plant handling sewage from the Colter Bay area was continued. The treatment plant was enlarged to include two additional sand filter traps which more than double its capacity. In contrast to 1958, at no time to my knowledge did any raw sewage go into the Lake without first passing through the sand filters. The week of July 23 was the first time that the new filters were put into use.

The Lake study during the summer of 1959 included the following:

1. The weekly determination of pH and O_2 and CO_2 content.
2. Occasional checks on the spread of nutrients throughout the lake, especially phosphates.
3. Weekly collection of vertical plankton samples.
4. Collection and study of bottom fauna from Stations I and II on alternate weeks.
5. Fish population samples from Stations I and III were taken.
6. A study was made of the damage to pond lilies as a result of leaf miner action and fungus growths, comparing Swan Lake with other lakes in the area which support pond lilies.
7. A study was made of the algae both in the plankton and associated with the pond lilies as indicators of pollution.

Detailed analysis of pH, O_2 and CO_2 content has not been made, however, a rough analysis indicates that in all Stations the O_2 content was lower than in previous years. Carbon dioxide and pH seemed to remain fairly constant. The reduction in the O_2 content can be correlated in some instances with the tremendous increase in the zooplankters.

The phosphate checks revealed a considerable increase in the spread of nutrients throughout the entire lake. On August 27, 1959, the tests showed high phosphate content throughout the lake, while on August 15, 1958, phosphate was relatively high near the sewage outlet with only traces in Stations III and II, with no phosphate apparent at Station I, which is at the end of the lake opposite the sewage outlet.

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The plankton samples have not been counted, however, each year for the past three years there seems to have been an increase in the volume of plankters with periodic fluctuations throughout the summer. Bottom fauna, likewise, showed a considerable increase in numbers especially during the last part of July and first part of August. Some decrease in bottom organisms was noted during the last part of August. Chaoborus and Tendipeds continued to constitute by far the largest numbers of the bottom fauna.

An interesting variation in fish populations was noted by comparing samples taken by a 100 foot graduated gill net in 1958 and 1959, as is indicated by the following tabulation.

	<u>1958</u>		<u>1959</u>		
	<u>Sta. I</u>	<u>Sta. III</u>	<u>Sta. I</u>	<u>Sta. III</u>	
	July 18	July 18	July 14	July 14	July 18
Utah Lake Chubs	136	94	124	9	12
Rosyside Suckers	70	77	51	5	6
Brook Trout	2	0	0	0	0

A comparison of these samples shows a reduction in total fish population throughout the lake during 1959. However, an even more significant difference is noted in the population at Station III near the outlet. It seems evident from these results that increase in the nutrient material near the outlet has made it impossible for fish to survive in large numbers in that part of the lake.

Observations over the past three years had indicated that many of the pond lilies, especially in the region of the lake near the sewage outlet, were dying out. In an attempt to determine the extent of the damage, a study was made comparing percentage of pond lily leaf damage in Swan Lake with Half Moon Lake and other lily ponds in the area. The following table gives the percentage of leaf damage in comparison with the total leaf area for leaf miner action with accompanying fungus growth, target spot fungus and both leaf miner and target spot fungus.

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Pond Lily Leaf Damage

Comparison in percent to total leaf area.

	<u>Border</u>			<u>Middle</u>		
	<u>Leaf Miner</u>	<u>Target Spot</u>	<u>Both</u>	<u>Leaf Miner</u>	<u>Target Spot</u>	<u>Both</u>
Lily Pond	1.36	18.63	2.27	1.2	17.36	4.18
Signal Mtn. Pond	3.87	12.9	10.3	6.93	6.93	6.93
Half Moon Lake	10.9	12.24	8.16	4.00	12.00	8.66
Swan Lake Sta. I	4.9	8.52	2.69	1.74	10.17	0.87
Sta. II	2.74	18.82	4.31	1.55	21.18	2.49
Sta. III	11.8	36.02	24.22	9.19	32.04	7.72

Dr. John W. Baxter, a mycologist, did the major portion of this part of the study. Samples were taken near the border of the lakes and out toward the middle in each case. The most significant results can be observed by comparing percentages in Station III, which is near the sewage outlet, to other Stations in Swan Lake as well as other lakes mentioned. It will be noted that the total fungus damage in Station III near the sewage outlet was 72.04 percent of the total leaf area. This same Station area out in the middle of the lake, although less than near the border, shows a much higher percentage damage than in other Stations in Swan Lake or in the other lakes. This would indicate that the target spot fungus, particularly, is able to thrive in an area with a high nutrient content. What the ultimate effect will be is problematical. However, it seems that on the basis of the present trend, the pond lilies will continue to disappear from the lake.

A study was initiated to determine what algae are present in the lake and to what extent these algae were indicators of pollution. It was noted that algae normally associated with high nutrient content and pollution were in abundance.

An additional summer is needed in order to determine the full effect of the improved secondary treatment plant before the results of this study are published.

Assisted by Hugh Bradford House, University of Wyoming.