10-1975

Algae Report

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ANDROSCOGGIN POOL

ALGAE

1975

algae

SUMMARY

1. Colored Algae appeared about the third week in July, rapidly multiplied until they were present in enormous numbers, from Gulf Island Dam to Mile 4.25, until mid-September, then disappeared upstream from Mile 1.7.

2. Algal growth was periodic, as evidenced by visual observation and by the dissolved oxygen record. The peaks occurred during August but rhythmic variations extended to mid-September. Algae were sampled as late as September 30 at Mile 1.7 when the water temperature was 15.0°C.

3. Four distinct colored Algae were observed, blue-green, olive-green, yellow-green and cerulean blue.

4. Objectionable Algal odor was not detected.

5. Many favorable variables nutrients, light, temperature and clarity must have coincided to produce such an enormous and rapid growth of Algae.

6. On balance, the oxygen contribution out weighed the negative aspects.

7. Colorless Algae, which grow on bottom deposits, may produce the so-called "zoological film" which has been observed on the Pool for more than thirty years.

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ALGAE

Background Information

More than twenty-five thousand (25,000) species of Algae are known, they are widely distributed from the Tropics to Artic zones. They are primitive plants and vary from microscopic size to about one hundred feet long. The genera which are of importance in stream and lake ecology are:

1. Cyanophyta: blue-green, olive-green
2. Chlorophyta: green
3. Phaeophyta: brown
4. Rhodophyta: red

Each of these genera have many species.

These plants usually contain chlorophyl plus other organic colors, phytocyanin (bright green), phytoerythrin ("black green") etc. Black Algae are dead and decomposing. Some form spores which may be colorless. They are related to bacteria, morphylogically and chemically.

Growth, Reproduction, Death. With favorable light and nutrients, these colored algae usually grow very rapidly, often doubling their numbers once every two or three days. They may reproduce by one or more methods; Vegetative, Asexual or Sexual. Life span varies with the species and the environment, it may be hours, days, weeks or months. At death colored algae are black. Cyanophyta usually have a mucilagenous outer envelope, a middle pectin layer and an

inner 'wall' of cellulose. When decomposing an offensive odor and an oil may accumulate.

Nutrients

Nitrogen and Phosphorus compounds have been extensively studied. Traces of Iron, Manganese compounds also are important for some species. Nitrogen is by far the most important element, without it growth is not possible. Ammonia, amino acids, polypeptides and peptones are preferred sources, often obtained from decaying bacteria, leaves and marine animals.

In the laboratory experiments potassium dihydrogen phosphate is a preferred source of phosphorus. In a river soluble phosphate and certain soluble organic phosphorus compounds are ingested.

The objective of many studies has been to determine the ratio of nitrogen to phosphorus necessary to support algal growth. Some research workers report a N: P ratio of 60:1, others a somewhat smaller Nitrogen figure.

Phosphorus minimum concentration appears to be 0.001 mg/l however, 'exact' determinations of phosphorus at this order of magnitude are often questionable.

Algal cells vary in the nature of their constituent composition but a minimum of 4.0 percent Nitrogen and 0.12 percent of phosphorus has been reported.

Light

Algae are plants and require energy in the form of light to maintain their metabolic and catabolic functions. They consume carbon (CO_2) and excrete oxygen only in the presence of light,

hence the intensity and duration of this source of energy is very important. One research gave results which indicate that the optimum utilization of light energy is 18% at 30°C.

Temperature — Algae can tolerate small, (4°C) slow, changes in water temperatures but are sensitive to larger sudden changes. They live and multiply from about 10°C to about 35°C. However, some species have adapted to a lower range and others to a much higher temperature. In general summer temperatures favor the growth of algae but long exposure to sunlight is equally important.

Clarity — Water color and suspended solids must be such as to permit sufficient light to penetrate, at least, two feet to sustain algal growth.

Algal Color — Four colors were observed, Blue-green and Olive-green. Myxophyacea were dominant, but the bright Yellow-green genera, Chlorophyta?, were present in large numbers, occasionally for a few days, then disappeared to return later. A sky-blue algae was observed for a few days and was not seen again. Fortunately, the writer obtained an excellent photograph of this species. A Cryptophyceae, named Groomanas, is described in the literature as "very small and a cerulean-blue color, common in streams".

River Water

'Highly' polluted river water, deficient in dissolved oxygen, usually contain only Euglenoids. Most Pools and Ponds show regular variations in flood due to seasonal change in light intensity, temperature, rainfall and velocity of flow. Rate of flow is important, if too high some algae species with delicate cells do not survive and if silt is present even more resistant species may be destroyed.

Water that is twenty or more days old and moving slowly is reported to be a very suitable media for Alage blooms, especially when light and clarity are favorable. Under these conditions Euglenoids (sanguinea and polymorpha) are often dormant in Pools and Lakes and viridis and pisciformis in streams. Nutrients must be present but the concentration of inorganics necessary to sustain growth is very low, frequently less than 0.01 mg/liter.

Evaluation

After reviewing recent literature opinions may be abstracted as:

1. Unfavorable
   a. Aesthetic
   b. Malodorous when dead
   c. Kill animal life
   d. Expensive to control

2. Favorable
   a. Excrete oxygen
   b. Consume products from dead bacteria
   c. Food for marine animals
   d. Food for terrestrial animals

On balance many unbiased investigators conclude that Algal have an important positive role in nature.

ANDROSCOGGIN POOL

ALGAE

Preliminary

Algae probably have been present in the Pool since it was created when Gulf Island Dam was built, 1925-1927. This writers annual reports frequently contain brief notes of the presence or absence of blue-green algae in the Pool. However, when observed they were growing on small areas of floating sludge and/or logs. They were never seen in the water and were never observed in water sampled daily for testing.

In previous years when examining and testing, water, sampled a few minutes after the eruption to the surface of benthal deposits, always was transluscent and at times contained numerous colorless small particles. The uniformity of the particles was recorded but not investigated. Hind-sight now indicates they may have been colorless Euglenoids which live on organic bottom deposits and secrete small amounts of polysaccharouse "macilaginous" substance. This supposition, if correct, may account for the extremely thin, but persistent, film which has been observed by the writer over large areas of the Pool each season for over thirty years and for the lack of a better term referred to as a "zoogleal" film.

Observations 1975

At Gulf Island Dam, on July nine, the writer observed a small growth of blue-green algae on one log stranded, among others, on water at inlet number one. This incident was recorded and almost forgotten. The sudden increase, 0.7 to 2.0 then 3.4 ppm,

of dissolved oxygen at the Dam (July 15, 16 and 17) was due to upstream and local precipitation but after a slow decline to 0.9 ppm (July 31), a rapid increase to 3.8 ppm on August one and then to 6.0 ppm August two. This increase occurred when water temperatures were 25° to 27°C!

Blue-green Alage were observed in the water on July 30 in the upstream area at Gulf Island Dam and at the landing dock, Mile 1.7. Growth was very rapid and on August nine they were present from Mile 4.25 to Gulf Island Dam. The Algae during this period were living about 1.25 cm to about 40 cm under the surface. However, on Sunday, August ten, large (several feet diameter) masses of bright green Algae were floating on the surface from Mile 1.75 to Mile 1.0. Several telephone conversations with Mr. Tom Linder, International Paper Company, resulted in a decision to make a joint inspection of the Pool on Friday August fifteen. The observations may be summarized:

1. Algae were present from the Dam to Mile 4.25.
2. Blue-green were abundant from Mile 0.5 to Mile 2.5. The cove near the boat dock (Mile 1.7) was completely covered with bright green algae.
3. From Mile 3.0 to 4.25 a gradient existed from maximum to practically zero.
4. Algae were confined to a depth seldom exceeding twelve inches.
5. From Mile 4.25 to Mile 6.0 and Bay 13, Algae were not seen and water samples did not contain any Algae.
6. Algae were present in the sector, Gulf Island Dam - Deer Rips Dam but much fewer than those upstream. (Passage through the power-house at the Dam must have destroyed vast numbers of Algae.)

A definite visual periodicity existed from July 30 to September 27, the last of the daily surveys. On a certain day

Algae were abundant everywhere, a few days later none were visible and water sampled at the six inch depth contained very few specimens or none. After a few days interval they were abundant again.

Dissolved oxygen analyses on Gulf Island water revealed a definite periodicity and comparisons with the tests on Deer Rips water indicate that the oxygen, contributed by the Algae, was considerable in the upper layers. Dissolved oxygen concentration was more uniform at Deer Rips due to the 'bottom draw' mixing at Gulf Island.

DISSOLVED OXYGEN (ppm)

1975

Date	Gulf Island Dam		Deer Rips Dam	Temp. °C	Flow cfs
July 30	1.3		1.4	25.1	2470
31	0.9		1.2	24.8	2560
Aug. 1	3.4	28° max*	0.8	25.1	2530
2	6.0	29° max**	1.0	25.2	2370
9	1.0		1.5	25.1	2300
11	2.9		0.8	25.1	2180
13	4.8		1.0	25.0	2020
22	0.9		1.9	23.8	1890
23	2.4		1.9	23.0	1950
25	0.9		0.8	22.1	2020
29	3.2		1.9	21.5	2020

*Several hours **about three hours

About August 30, Algal growth slowly diminished until mid-September when the decrease became rapid in all areas upstream from Mile three. On September twenty seven, Algae were not found in water sampled north of Mile 1.7, but they were in the boat dock avea and Mile one water samples.

From late July to mid-September the volume of Algae in the Gulf Island Dam - Deer Rips Dam sector varied but, with a few exceptions usually during weekends, were never a visible nuisance. Downstream from Deer Rips green Algae 'stains', occasionally, were observed on rocks from the 'Third' bridge. However, although water in the Lewiston upper canal was sampled daily, through the entire season, only one sample contained Algae; two olive-green individuals!

Causation

The k_1 rate for July 1975 was for the Livermore Falls - North Turner stretch much higher than that recorded in 1974 and it occurred to the writer that the increased activity there and the Algae problem may be related to the secondary treatment process at Jay. Mr. Tom Linder arranged to have Nitrogen and Phosphorus analyses made at the International Paper Company laboratories, Tuxedo Park, New York. Four water samples were tested.

Location	Total Phosphorus mg/l	NH_3-N mg/l	Kjeldahl Nitrogen mg/l
1. Riley Dam Androscoggin Pool	0.050	0.1	1.8
2. Mile 3/4	0.072	0.1	1.3
3. Mile 3	0.072	0.1	1.5
4. Mile 4 3/4	0.081	0.1	1.8

These results indicate that the river and Pool have sufficient Nitrogen and Phosphorus to support Algal growth but whereas no blue-green have been observed upstream from Mile 4.25 other factors must be important.

Many other controlling factors are described in the literature but, this writer considers, the following are significant in the Androscoggin Pool Algae problem.

1. Pollution load (B.O.D.) entering the Pool was the smallest recorded for more than a decade.

2. Clarity of the water. Color and suspended solids were less this year.

3. Light intensity. Bright sunny days appeared to produce an increase of Algae.

4. Temperature Water temperatures were very high (25°C.) during the period of large floating Algae masses. However, the blue-green and olive-green were present in September water samples, when the temperature was 16.0°C.

5. Rate of Flow. Important for some species which require slow moving water. (Average flows south of Mile 4.25 seldom exceed two miles per day during the summer).

6. Benthal Some blue-green have been observed for many years living on floating sludge. Floating sludge was absent during the entire period when Algae were abundant.

7. Microbial Life Decomposing leaves, dead bacteria and other organisms and cellulose products provide a good substrate for some Algae.
During the summers of 1974 and 1975 many water samples taken at North Turner had a 'cloudy' appearance. Occasional microscopic examination revealed a large microbial population.