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1972

PHYTOPLANKTON SUCCESSIONS AND LAKE DYNAMICS IN LAS VEGAS BAY, LAKE MEAD, NEVADA

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INTRODUCTION.—Investigation of intermixing of nutrient rich waters of an influent stream (Las Vegas Wash) with the waters of an exorheic basin lake (Las Vegas Bay of Lake Mead) and the resulting impact on productivity were basic objectives of the work reported here. To simplify a highly complex problem, the project was structured to consider only the point of junction between the stream and the lake, and to examine events in this area in some detail, employing standard methods for identifying phytoplankton, application of the general growth equation, and physical measurements.

Specifically, the answers sought were (1) the extent of channelization of inflowing waters, (2) the duration and extent of mixing brought about by dynamic factors operating on the lake, and (3) phytoplankton successions. Results of Anderson's (1951) work on Lake Mead, the topographic features of the bay (Fig. 1), the meteorological data suggested that the location chosen for this investigation would be dynamically complex and well suited to the proposed study.

We thank Dr. Aaron Goldman, Department of Mathematics, UNLV, for assistance with analysis of data and the Nevada Department of Fish and Game for providing the boat that made this work possible.

SAMPLING AND ANALYTICAL METHODS.

—Samples were collection from the stations indicated in Figure 1. Station 1 is adjacent to the center buoy of three buoys designating the west harbor limit of Las Vegas Marina, and marks the point of entry of Las Vegas Wash. Station 2 is adjacent to a permanent marker buoy (#12L) located 1 kilometer east of Station 1. Water depths of Stations 1 and 2 were 7 and 14 meters respectively.

Surface water samples were collected weekly for phytoplankton studies. Also, one liter samples from just above the sediment interface were collected at each station with a 2 liter Van Dorn sampling bottle. Temperatures and specific conductances were recorded for both the surface and bottom samples.

Two hundred milliliters of each surface sample were filtered through a millipore .45 μ white filter. The filters were stained, cleared, and mounted following methods described by Wood (1965). Ten fields were randomly selected on the mounted membrane and the phytoplankton count by calibrated Whipple disc was recorded for each field. Phytoplankton identifications were substantiated by observing wet mounts of centrifuged aliquots of each sample. Data taken from the ten fields were statis-

tically examined and distribution of phytoplankton on the millipore filter was found to be poisson.

The data for organisms per milliliter in Table 1 were calculated according to the formula:

$$N = \frac{T \times 960 \times 8.1}{V \times 10}$$

where N=organisms/ml, T=total count in 10 fields, V=volume of sample filtered, 960=area of the millipore filter, and 8.1=factor for conversion of field area to 1 mm². Since the volume of sample filtered was always 200 ml, the formula became N=T x 3.888.

The errors indicated in Table 1 were calculated for 95% confidence limits, assuming a poisson distribution, where the variance of T, sigma_T² equals T, and sigma_N² = 3.888² x T.

As a tentative means of establishing nutrient limitation, 50 ml of surface water in 125 ml flasks was reinforced individually with the major elements of Gerloff and Skoog's (1954) solution, with Rhode's iron citrate (Droop, 1969), and incubated at 200 foot candles continuous fluorescent illumination.

Table 1 shows the six phytoplankton genera occurring in Las Vegas Bay during the period of study in sufficient numbers to permit detection of successions. These data reflect only numbers observed per ml without dimensional measurements or determination of physiological activity, and do not represent the total phytoplankton standing crop.

The *Cyclotella* peak of May 13 is of interest for several reasons. Upon applying the general growth formula and solving for generation time, this value for *Cyclotella* at Station 1 was determined to be 1.14 hours, and 1.19 hours at Station 2. These data reflect improbably rapid growth for *Cyclotella* (Fogg, 1965). Specifically the formula employed was

$$G = \frac{t}{3.3 \log b/B_0}$$

Where G=generation time, t=time in hours, B₀ the initial population, and b=the population after time t. It is not likely that the *Cyclotella* peak was due to current transport from other areas of Lake Mead because sinking rates indicated by Hutchinson (1967) suggest that this form is unlikely to be transported long distances.

The best explanation for the peak of May 13 seems to be that the organism was suspended in the water from the bottom by turbulence. This conclusion is reinforced by the observation that the samples

of May 13 contained 731 and 859 small abraided $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (gypsum) crystals per ml respectively at Stations 1 and 2. The Pliocene Muddy Creek Formation in which Las Vegas Bay rests contains an abundance of gypsum (Longwell, *et al.*, 1965).

It is also possible that sedimented cells engaged in the formation of oil droplets incident to uptake of excess phosphate or deficiency in nitrogen might

develop a reduced density resulting in a mass vertical migration. However, considerations discussed by Fogg (1965) indicate that this alternative is unlikely.

The data for *Stephanodiscus* are strongly reminiscent of the observations of Birge and Juday (cited in Hutchinson, 1967) on Lake Mendota during turnover. Although *Stephanodiscus* may have been a turbulence indicator, all other genera noted may

Figure 1

Table 1. Phytoplankton Cells/ml in Las Vegas Bay, 1 March to 13 May 1971.

Date	Station	<i>Stephanodiscus</i>	<i>Peridinium</i>	<i>Asterionella</i>	<i>Chlamydomonas</i>	<i>Platymonas</i>	<i>Gymnodinium</i>	<i>Cyclotella</i>
March	1	1423 ± 149	86 ± 36	<10				
4	2	1271 ± 141	58 ± 30					
March	1	1256 ± 140	58 ± 30	<10				
11	2	1559 ± 155	78 ± 35					
March	1	4051 ± 251	35 ± 23	<10				
18	2	2811 ± 209	51 ± 28					
March	1	688 ± 103	194 ± 55	<10				
25	2	498 ± 88	66 ± 32					
April	1	1602 ± 157	31 ± 22	<10				
1		1182 ± 136	27 ± 20					
April	1	86 ± 36	121 ± 43	<10				
8	2	86 ± 36	82 ± 36					
April	1	156 ± 44		74 ± 34				
15	2	70 ± 33		82 ± 36				
April	1	222 ± 59	82 ± 36	16 ± 15				
22	2	97 ± 38	12 ± 13	78 ± 55				
April	1	31 ± 22	54 ± 29	<10	280 ± 66	12 ± 12	66 ± 32	
29	2	12 ± 12	39 ± 25		222 ± 59	105 ± 40	58 ± 28	
May	1	105 ± 40	<10	<10	2970 ± 214	956 ± 122		
6	2	78 ± 35			925 ± 120	272 ± 65		
May	1	35 ± 23	19 ± 17	<10	128 ± 45	82 ± 35		20,650 ± 567
13	2	89 ± 37			51 ± 28	82 ± 36		21,271 ± 575

*See text for explanation of computations.

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have been successional (Table 1) by growth. These were green algae or dinoflagellates. Planktonic blue-green algae were absent.

In addition to the common genera, the following were identified but in numbers too small to be significant in determining successions: *Gyrosigma*, *Cymbella*, *Denticula*, *Fragilaria*, *Meridion*, *Surirella*, *Pinnularia*, *Tabellaria*, *Navicula*, *Scenedesmus*, *Pediastrum*, *Quadrigula*, *Coelastrum*, and *Gomphosphaeria*.

As is shown in Table 2 the specific conductance of the surface waters at the sampling stations during the period of study underwent little fluctuation. The bottom conductance readings at both stations were much higher than the surface readings and underwent great change. These data and the observations on fluctuations in numbers of diatoms indicate that the nutrient rich Las Vegas Wash water may run through the bay as a density current and that this density current may be strongly affected by external and internal forces operating in the area. It is also evident that the density current interchange and turbulence have a marked effect on the phytoplankton distributions in Las Vegas Bay.

Table 2. Conductance Measurements of Las Vegas Bay, Spring, 1971.

	Specific Conductance, umhos/cm			
	Station 1		Station 2	
	Top	Bottom	Top	Bottom
3/ 4	1175	2580	1206	2380
3/11	1230	1350	1206	1335
3/18	1318	1605	1295	2000
3/25	1255	3280	1230	2400
4/ 1	1335	2000	1255	2380
4/ 8	1206	2960	1195	2180
4/15	1255	1600	1230	2480
4/22	1255	1900	1206	2000
4/29	1260	1800	1230	2000
5/ 6	1295	2380	1255	2180
5/13	1225	2760	1255	2750

The evidence for segregation of heavier nutrient

rich water is reinforced by data from the nutritional enrichment studies. Mineral nutrient limiting factors on growth in decreasing order of their effect were Fe, P, P-8 minor elements, Mg, and S for surface samples taken March 4, 1971, and April 1, 1971. On April 22, these factors were Fe, N, P-8 minor elements, and Mg.

These results suffer from deficiencies inherent in maintaining in small vessels static samples taken from a relatively large body of water. Obviously, there are no turbulence effects on buoyancy, the organism sample is limited, access to nutrients in a large volume is not possible, and encouragement of surface growth and cascading effects of successions on changing growth conditions may be intertwined.

Even so the data for phosphate are especially interesting since the waters of Las Vegas Wash consistently contain concentrations greater than 5 p.p.m. Apparently this continuous input of phosphate is only intermittently available to the phytoplankton of Las Vegas Bay. Also, the persistence of iron and minor elements as limiting factors points out the importance of conditions affecting the availability of these elements for phytoplankton growth. The slightly increased growth noted in cultures reinforced with Mg and S requires further substantiation of significance.

SUMMARY.—Phytoplankton successions, applications of the general growth equation, and physical measurements have been employed to investigate events occurring at the interface between industrial and sewage effluent contained in Las Vegas Wash and the waters of Lake Mead, Nevada. The data indicate that the entering waters tend to form a density current interrupted at intervals by dynamic effects generated in the lake. The dynamic relationships described here for the spring months suggest that a much more thorough understanding of physical, chemical and biological interactions is necessary to permit solution of the numerous problems of Las Vegas Bay discussed or alluded to by Hoffman, *et al.* (1967, 1971), FWPCA (1967).

LITERATURE CITED

- ANDERSON, E. R., and D. W. PRITCHARD, 1951. Physical limnology of Lake Mead. Final report on NEL Project 2JL, 3 October 1951. U. S. Naval Electronics Laboratory, San Diego, Calif.
- DROOP, M. R., 1969. Algae. In *Methods in Microbiology* (J. R. Norris and D. W. Ribbons, Eds.) Academic Press, New York.
- FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, 1967. Report on pollution in Las Vegas Wash and Las Vegas Bay.
- FOGG, G. E., 1965. *Algal Cultures and Phytoplankton Ecology*. University of Wisconsin Press, Madison.
- GERLOFF, G. C., and F. SKOOG, 1954. Cell contents of nitrogen and phosphorus as a measure of their availability for growth of *Microcystis aeruginosa*. *Ecology* 35:348-353.
- HOFFMAN, D. A., P. R. TRAMUTT, and F. C. HELLER, 1967. Water quality study of Lake Mead. U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.
- , 1971. The effects of Las Vegas Wash effluent upon the water quality of Lake Mead. U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.
- HUTCHINSON, G. E., 1967. *A Treatise on Limnology*. V. 2. John Wiley.
- LONGWELL, C. R., E. H. PAMPEYAN, B. BAWYER, and R. J. ROBERTS, 1965. *Geology and Mineral Deposits of Clark County, Nevada*. MacKay School of Mines, University of Nevada, Reno.
- WOOD, E. J. FERGUSON, 1965. *Marine Microbial Ecology*. Rhinehold, New York.

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