CEER-¥-209 SUMMARY OF DATA FOR PUERTO RICAN LAKES by I.D. Tilly and B.A. Buchanan. The Center for Energy and Environment Research, College Station, Mayaguez, Puerto Rico, October, 1984.

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INTRODUCTION

The purpose of this document is to provide in one source most of the data available for Puerto Rican Lakes. These data are sparse and the bulk of them have arisen from unpublished Government documents. Because the data were collected for different purposes by a variety of persons using a variety of methods, changes had to be made to render them comparable. In most cases the changes made were straightforward conversions to equivalent units. Where data were omitted or assumptions made to accomplish the conversions, these are noted in the explanations.

The user is cautioned to examine carefully the assumptions and conventions adopted here before unqualifiedly accepting the data in the summary tables. Table 1 indicates the methods used for most of the chemical and limnological parameters.

The available data for 27 lakes are presented as "Physical Features", Table 2; "Chemical Features", Table 3; and "Limnological Features", Table 4.

ANNOTATED LIST OF DATA SOURCES

A. Candelas, G. R. 1956. Studies on the freshwater plankton of Puerto Rico. Ph.D. Dissertation, University of Minnesota. Sampling in this program was done once (or occasionally twice) at each lake with the exception of Lake Caonillas which was sampled monthly for one year. Other lakes sampled were Cidra, Dos Bocas, Matrullas, Guajataca, Guayabal, Patillas, and Cartagena. Averages for the water column temperatures were made on the basis of surface and bottom samples ("bottom" samples being from 3.05 m, in Dos Bocas and Guayabal to 12.19 m. in Patillas). Most surface and bottom measurements were from 0 and...

Meters, respectively. Parameters include pi, dissolved oxygen, and total alkalinity. Color was measured by colored discs, reportedly calibrated to the Pt-Co Standard, but the values were so different from any other for these lakes that they were not used. Phytoplankton counts were also omitted as they seemed to be 2 to 3 orders of magnitude too low. Plankton was collected using a 30-40 um mesh net and by collecting ten-gallon water samples which were preserved (54 formalin) and settled for 20 days. Low counts may have been a result of poor preservation or undersampling due to the use of nets. The drainage basin area given for Dos Bocas included the drainages for Garzas and Caonillas, so this was not used.

2. Candelas, G., and G. C. Candelas. 1964. Plankton studies on Puerto Rico's freshwater lakes: Physical and chemical nature. Carib. J, Sci, 4(4) 2431-458. This paper was based on the dissertation and, therefore, is cited here jointly.

Disregarded in favor of means computed from surface and bottom values, in line with the fact that more systems could be compared on that basis for this summary. Net productivity values presented as "mg C/m2/4 hr" on each lake summary sheet were assumed to be accurate, based on integral values listed elsewhere in the report. These values were converted to hourly equivalents through simple division. The value closest to Secchi depth (as determined from other studies) was used or, in most cases, an average of the 0 and 2 meter depths. Integrals calculated for this study were not used because no other studies had them.

Alkalinity was computed from bicarbonate (HCO3) as: Alkalinity (Caos) = HCO3/1.25. The total averages for lakes Guayo and Patillas (based on surface and bottom samples from page 39) were used for conductivity, temperature, and dissolved oxygen, as the data for individual stations were provided on crude graphs for these two lakes. Most reservoir volume estimates used in Table 1 came from this report, which included new volume estimates based on sedimentation studies.

5. Brown, R. A, Jobin, R. R, Laracuente, A, Mercado, R. and Quiñones, V. 1974. "Preliminary results from a survey of water quality in some Puerto Rican lakes." Center for Energy and Environment Research, University of Puerto Rico. US Department of Energy, CEER-15, 1979.

The lakes sampled were Caonillas, Jacite, Carraizo, Cidra, Dos Bocas, Garzas, Guajatacas, Guayo, Matrullas, Patillas, Prieto, and Toro. This study was carried out as part of the Schistosoma study program. There were 9 sample sites on most lakes, and they were examined seasonally for six lakes, while others were sampled once a year for two years. All values were from surface samples taken at 2.5 m depth. Phytoplankton values appeared anomalously low and were excluded because they were based on bottle measurements from 24-hour periods and were not compatible with other values. Productivity measurements were not used.

6. Environmental Quality Board. 1992. "Trophic classification and priority ranking for the restoration of lakes in Puerto Rico." Water Quality Planning Bureau.

Lakes studied were Cidra, Guayabal, La Vaca, Caonillas, Guineo, Las Curias, Carraizo, Toro, Loco, Matrullas, and Pellejas. The lakes were visited only once and at different times of the year. Most lakes had three stations; a few had 4. Data from reference 4 (Gomez and Torres, 1974) were included in the study but excluded from consideration since they had already been used. Water Quality data were taken from Table IV, pp. 123-124. All samples in this study were taken at Secchi depth. For our purposes,

The text should read:

The data was recorded as "surface". Both net and gross productivity were reported as g O2/a4/ne and were converted to mg C/m3/hr by multiplying by a factor of .375 (assuming a photosynthetic ratio of 1).

Reference: Rivera-Gonzalez, J.B. 1976. The relationship between the population dynamics and

environmental water quality of four fisheries in Puerto Rico: Guajataca, Loisa, Patillas, and Toa Vaca. Department of Natural Resources, Fisheries Research, and Surveys. One to three stations per lake were visited monthly for Loiza (Carraizo) and quarterly for the other lakes, except for Toa Vaca where sampling was discontinued. All samples were taken at 2m depths and were recorded as "surface" for summary. Most of the data were from Appendix 4: PO5 (assumed to be SRP), TP, pH, alkalinity, specific conductance, and Chlorophyll 4. These data were all in raw form, so surface averages were computed. A few data points were judged to be impossible and, therefore, excluded from consideration: (total phosphorus for 1/4/75, stations 1 and 2 Loisa, soluble reactive phosphorus for 3/4/75, station 2 Loisa; and specific conductance for 7/11/75, station 2 Guajataca, and 6/14/75 for station 2 Patillas). In all of these cases, there were many other data points for comparison. NO3-N and NO2-N separately reported were summed for this report. Oxygen and temperature data were presented as graphs only which were too difficult to read accurately and, therefore, not used. Data for volume, surface area, drainage and rainfall were taken from the text for use in the summary.

Reference: Quinones-Marquez, F.P. 1979. Limnology of Lago Loiza, Puerto Rico. U.S. Geological Survey. Water Resources Investigations 79-97. Most of the data were obtained from lake stations (3, 6, and 7). Apparently, profiles were taken for dissolved oxygen, temperature, and specific conductance. Although it was not stated whether the other averages cited were profile or surface bottom averages, they were recorded as equivalent to surface-bottom means for this summary. Monthly

Samples were taken from September 1973 to October 1974. Average values for total Phosphorus, total Nitrogen, NO3-N, and Ni-¥ were extracted from the text of the report (pp. 74-76). Many data shown on graphs were too difficult to read accurately and, therefore, were not used. A data summary, (Quinones-Marquez, 1976. Chemical, physical, biochemical, and bacteriological determinations in Lago Loiza, P.R. and in its main tributaries. Sept. ‘73 - Dec. ‘74. U.S.G.S., Open File Report 6-7.) was not available to us at this time. Dissolved oxygen data were read off graphs for station 7 (2-68) and were used to make surface-bottom averages for the data summary. Productivity data were given from 2 sampling periods at 9.5m and 2m depths. Data for 0.5m depths were used as this was judged closest to Secchi depths. Data from the two periods were averaged and converted from q 02/m3/day to mg C/m3/hr (again assuming a photosynthetic ratio of Lj). To obtain net productivity, values for night respiration were doubled and subtracted from gross productivity values (this resulted in a negative overall net productivity value). All productivity values used were from p. 98.

2 of Jobiny We Ry P. P. Ferguson, and & Brown. 1976. Ecological review of hydroelectric reservoirs in Puerto Rico. Center for Energy and Environment Research, University of Puerto Rico. CEER-1, 1976. Lakes sampled were Adjuntas, Caonillas, Carite, Carraizo, Cartagena, Cidra, Coamo, Comerio #1 #2, Dos Bocas, Garzas, Guajataca, Guayabal, Guayo, Guineo, Jordan, La Plata, Las Curias, Loco, Luchetti, Matrullas, Patillas, Peñuelas, Prieto, Toa Vaca, Toro, Tortuguero, Vivi, and Yahuecas (29 lakes 2 of which, Cartagena and Tortuguero, are not considered in our summary). Samples were for a number of stations on each lake and were often taken near the mouths of inlets. Very small lakes were only sampled at one station. All were surface samples and were usually collected in only one or two visits (some were sampled through 1 or 2 consecutive months, each station visited once).

Once, values for pH were only given in the appendix. Values for color, turbidity, total phosphorus, and NO2 + NO3-N were taken from Table 6. 10. Garefa-Sais, J. R. and V. Tilly, 1983. An environmental evaluation of La Plata Lake, Toa Alta. Center for Energy and Environmental Research. University of Puerto Rico, CEER. Monthly sampling was conducted at a number of stations over a one year period. Profile averages were given for most parameters so surface and bottom values were extracted to make surface-bottom averages comparable to the other studies. Parameters measured included temperature, dissolved oxygen, pH, specific conductivity, alkalinity, NK3-N, NO2 + NO3-N, TKN, TN, SRE, TP, Phytoplankton (cells/ml), and chlorophyll-A. Secchi values and productivity values were also extracted. Productivity values for Secchi depth were used. Total nitrogen was calculated by adding surface and surface-bottom averages for NO3 + NO2N and TKN.

L. Tilly, L. J. Unpublished. The following computations were made using rainfall-runoff coefficients, available lake volume information and published rainfall data to augment the lake inflow and turnover data available from other sources. The complete table for these data is reproduced here.

Lake Volume Flushing Basin total catchment layout:
- Yabucoa: 10862 tons/volume/year
- Cidra: 22.2, 3 out of 1 6s
- Patillas: 65.9, 10, 0.57, 14.9, 42
- Matrullas: 11.4, as 6.5, 1.26, a 2.9
- Guajataca: 63.7, 0.4, 0.5, 5.07, 50.2, 1
- Toa Vaca: 58

32. Sevaret, Re and J. Villamil. 1981. Productivity and nutritional content of the water hyacinth, Eichhornia crassipes (Solms), in relation to some limnological aspects of Lake Carraizo, Puerto Rico. Center for Energy and Environment Research, University of Puerto Rico, CEER-I-096. Data used from this study came from one lake station on Lake Carraizo located approximately 1 km from the dam. Samples were taken twice monthly for a period of 5 months (June-October, 1980) at three depths (surface, mid, and bottom). In

In-situ measurements were made at 1-meter intervals for pH, DO, temperature, specific conductivity, and light. Secchi measurements were also taken. Laboratory analysis included TKN, TP, COD, BOD, Mn, Cu, Cay, Pb, Ca, and Hg. Data for total phosphorus (three times the concentrations found by Quiñones-Marquez) were judged to be in error and excluded. Alkalinity values from only one sampling were double other available values for Carraizo and were, therefore, excluded. To make them comparable to other studies, values used were from surface and bottom only.

Lie Pedlegesin, F. 1943. A study of eutrophication and aquatic plant growth in selected lakes and rivers of Puerto Rico, Project No. A-071-PR. Final Technical Report, Bureau of Reclamation, U.S. Department of the Interior, Washington, D.C. The lakes sampled in this study were Guajataca, Yauco (Tuchetti), Toa Vaca, Cidra, and Loiza (Carraizo). Sampling for each lake was done twice at two stations each having three depths: surface, mid, and bottom. The time between samplings was 2 months. Water was collected with an Alpha (Model 1120-c40) from Wildco.

Water samples were analyzed for pH, color, turbidity, and temperature in the field. Dissolved oxygen, conductivity, dissolved orthophosphate, total phosphorus, TKN, NO3-N, NO2-N, NH3-N and other parameters were analyzed in the laboratory. The NO3-N and NO2-N data were combined for this summary. Mid water column data were ignored and averages were computed based on the surface and bottom values for each lake.

Table 1. (cont.)

'Second Priority Establishing Ion Sequences'

'Over Every Obstacle Establishing Ion Sequences'

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