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SUMMARY OF DATA FOR PUERTO RICAN LAKES

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COLLEGE STATION, MAYAGUEZ, PUERTO RICO

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TWTRODUCTION

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 These data are sparse and the bulk of them have arisen from unpublished Government documents.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 (reshwater 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 Boo

Matrullas. Guajataca, Guayabal, Patillas, and
Cartagena. Averages for the water column temperatures were made
fon 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

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6 meters, respectively. Parameters include pi, dissolved oxygen
and total alkalinity. Color was measured by colored discs,
reportedly, calibrated to the Pt-Co Standard, but 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 by 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 Cor Dos Bocas included the drainages for Garzas and Caoniltas, so this was not used.

2. Candelas, G. and G. C. Candelas. 1964. Plankton studies on Puerto Rico's fresh-wate: laces: Physical and chemical nature. Carib. J, Soi, 4(4) 2431-458.

This paper was based on the dissertation and, therefore, is cited here jointly.

3. Martinez, R. R, 1979. Estudio comparativo de la iimnologia de los ?embalses iayores de Puerto Rico. Master's ?Thesis, Dept. Biol. University of Puerto Rico, Rio Piedras.

Lakes sampled were

4 Vaca, Guajataca, dos Bocas,

Caoniiias, Carite, ua Plata, Patillas, Matrullas, Cidra,

buchetti, and Caccaizo (uoiza). Lt was assumed that all

Measurements were taken once on each Lake (at the dam sites) at

various times of the year.

Concentrations evidently reported as P04, NO3-N, NOZ-N and

Nig-N were converted to PUg-P, NO3-N, NOZ-N and Nug-N by

multiplying the quoted values by .31¥, .226, .306 and .875,

respectively. The resultant values appeared consistent with

values from other studies, NO;-N and NOz-N ceported sepacately

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were summed for this report, Lake Caonillas and Matcullas lacked

NO2 data and the Nos data alone were used in the summary as

equivalent to NO, + NO2-N,

Akalinities were found to be twice the real value asa consequence of a calculation error (as determined in the methods Section). the given values were halved and used.

Profile averages given were disregarded in favor of means computed from surface and bottom values in keeping with the fact that more systems could be compared on that basis in this summary.

Net productivity vaiues given as "mg C/m2/4 he? on each

lake summary sheet were assumed to be yes m} on the basis

of integral values tabled elsewhere in the coport. Values were converted to hourly equivalents by 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 tor this study were aot used because no

other studies had them.

4. Gomez-Gonez, F. and A. Yorees-Gonzalez. 1978. Preliminary trophic state classification of seven reservoirs in Puerta Rico

(and extrapolation to othe: island lakes). U.3.G.

(administeative document.)

The seven lakes actually studied were Cacite, Dos Bocas,
Garzas, Guajataca, Guayo, Luchetti, and Patillas. Most of the
data used were from these lakes only. Each lake was sampled at
from to 3 stations (once per station) in a period from November
1977 through January 1976, Nitrate and phosphorus data trom
other lakes were used which were from documents unavailable to us

at the time or from written communication (Carvajal data for

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Cidra and La Plata). In the case of Lakes Caonillas, Cidra,
Guayabal, Jordan, ta Plata, Las Curias, wove. Tor Vaca, and Vivi,
only NO3-N data were available and these were reported as

equivalent to NO3+NU2-N. Data from this study rapocted Nox7N and

NOz-N separately, so these were summed for this ceport. This reference also supplies organic nitrogen so this was summed with NO3-N, NO2-N, and NH3-N to calculate total nitrogen for the summary.

Net productivity was converted from 9 0z/q3/nr to mg C/n3/ne vy multipiying by a fastoe of .575 (assuming a Photosynthetic ratio of 1).

The use of w single vslue for nel productivity for comparison with an average gross productivity for Lake Garzas Fesulted in the anomaly that the net oroductivity reported was greater than the gross.

Alkalinity was computed from picacbonate (HCO3) as: Alkalinity (Caos) = HC03/1-25.

For lakes Guayo and Patillas total averages (based on Surface and bottom samples) from page 39 were used for conductivity, temperature, and dissolved oxygen as the data for individual stations vece given on crude graphs for these two lakes.

Most reservoir volume estimates used in Table 1 came trom this ceport which had new volume estimates based on

sedimentation studies.

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5. Brown, R. A, #. R. Jobin, A, Laracusate. R. Mercado, and V. Quifiones. 1974." Preliminary results trom a sucvey of water quality in some "Puerto Rican lakes. Center for Energy and Environment Researca, University 5? Puerto Aico. U.S. Department of Energy, CEER-15, 1979.

The lakes sampled wore Caomiiias, ?acite, cnveaizo, Ciéra,

Dos Bocas, Garzas, Guajatacas, Guayo, Mutruilas, Patillas,

Prieto, and Toro, ?This study vas carried out as 2 part of the

Schistosoma study progam. ?There were 9 oambs

of sample sites

on most lakes and thesy were looked at veasonaliy for six lakes,

while others were sampied once a year fo: tue years. All

values were from sucface sample.

taker ar 2.5 @ depth,

Phytoplankton valves enpeaced anomatously low and were

excluded. Because they ware basca ©

pottle messurements Erom 24

hour periods and definitely not compacabte co other values,

Productivity measurements were not used.

6 Gnvironmental Quality Board. i942. fruphic classification

and priority ranking for tie cestoracion of lakes in Puerto Rico.

Water Quality Flarning Bureau

Lakes studied were Cidra,Guayabel. oa Vaca, Caoni! las,

Guinec, Las Curias, Carrizo, Toro, Loco, Matcullas, and

Pellejas, The lakes were visited only once rnd at difterent

times of the year. Most Lskes had 3 stations: few had L. bata

from reference 4 (Gomez and vorres, 1974) wece inciuded in the

study, but excluded from coneid

tion since tney had already

been used, Water Quality data were taken trom vable IV, pp. 123-

124. All samples in this study were taken at Secchi depth but,

For our purposes, recorded as "surface".

Net and grocs productivity were

?eported as g 02/a4/ne and

Were converted to my C/w3/hr by multiplying by a tactur of .375

{assuming a photosyntaetic ratio of 1).

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Te ghivera~Gonzalez, J.B. 1976. kein: ionsivip between che population dynamics aad enviccnmentai «2:ec quality of four fisheries in Puerto Rico: Guajataca, boisa, Patilias, and Toa Vaca. Departwent of Natural Resources, sj. Fisheries Research and Surveys.

one to 3

Sations pec lake were isited wonthly for Loiza

(Carzaizo) and quarterly for the other lasis, except for Toa Vaca

at which sampling was discontinued. 411 saapies vere taken at

2m depths and were recorded as ?surface? for ove summary.

Most of the data were from Appendix 4: P05 (asgumed to be

SRP), TP, pH, alkalinity, specific cone Noa""y

Nog

ehlorophy1i 4, These data were a1! in raw torm so surface

averages Were computed. A few data poinus were judged to be

impossible and, therefore, excluded {cow considecation: (total

phosphorus for 1/4/75, sta

nS 1 and 2 hosa,

soluble reactive

Phosphorus for 3/4/75, station 2 Loiss; ana specific conductance

for 7/11/75, station 2 Guajataca, aad 6/14/75 for station 2

Patillas). In all of these cases cheze were wany other data

Points for comparison. NO3-N and No2~N ?iuparatety reported ware

summed for this ceport.

Oxygen and temperature deta were peotite geaphs only

which were too difficult to read accurately aad, therefore, not

used.

vata for volume, surface area, Giasasge and caintall were

taken trom the text tor use in the sumua:s

8. Wuiflones-Marquez, FP. 19¥9. Limaod of Lago Loiza,

Puerto Rico. U.S. Geological Survuy. Water Mesuucces

Investigations 79-97.

Most of the data was obtained trom thiee take stations (3,

6 and 7). Apparently, profiles were taken tor dissolved oxygen,

temperature, and specific conductance. Aithough it was not

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Stated whether the otter 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 Nig-¥ wore extracted from

the text of the report (pp. 74-76). Maay data shown on graphs

were too difficult to cead accurately and, therefore, were not used. A data summary, (guinones-Marquez, 1976. Chemical, physical, biochemical and bacteciolegical deteriinations in Lago Loiza, P.R. and in its main tribuearics. Sept. ?73 - Dec. ?74. U.8.6.5, Open File Keport 6-7.) was not available to us at this time.

Dissolved oxygen data were read off geaphs for station 7 (2-68) and were used to make surface~botton averages for the data summary.

Productivity data were given from 2 sampling periods at 9.5 and 2m depths. Data for 0.5 m depths were used as this vas Judged closest to Secchi depths. Data trom the cwo periods were averaged and converted From q 02/m@'/day to m4 C/m3/he (again assuming a photosynthecic ratio ut Lj). to obtain net Productivity, vaiues for night cespirativa were doubled and subtracted from gross productivity values (this resulted ina negative overall net productivity value). All peoductivity

values used were from p. 98.

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2 og Jobiny We Ry P. P. Ferguson, and & Brown. 1976.

Ecological review of hydroelectric reservoirs in Puerto Rico.

Genter for Energy and Enviconaent Research, University of Puerto Rico. CEER-1, 1976.

Lakes sampled were Adjuntas, Caomilias, Carite, Carraizo,

Cartagena, Cidca, Coamo, Comerio #1

#2, 00s Bocas, Garzas,

Guajataca, Guayabal, Guayo, Guineo, Jordan, La Plata, Las Curias,

toco, Luchetti, Matrullas, Patillas, Peilejss, Prieto, Toa Vaca,

Toro, Tortuguero, Vivi, and Yahuecas (29 lakes 2 of which,

Cartagena and Tortuguero, axe not considered in our summary).

Samples were for a aumber of stations on each Lake and were often

taken near the moutas of inlets. Very small lakes were only

Sampled at one station. Ail were custace samples and were

usually coliected iz ony o: two visite (som were sampled through

1 or 2 consecutive months, each station visited once).

Values for pil were only aiven in the appendix, Values for

color, turbidity, total phosphorus, and 80, + noz-N were taken

from Table 6.

10. Garefa-Sais, J. R. and be v. Tilly, 1983. An environmental evaluation of ta Plata Lake, Toa Alta. Center tor Energy and Environmental Research. University of Puerto Rico, CHER.

Monthly semplioy was conducced at a number of stations over a fone year period, Profile averages were given foe most parameters so surface and bottom values were extracted to make surface-bottom averages comparable to the other studies. Parameters Measured included temperature, dissolved oxyaen, pil, specific conductivity, alkalinity, NK3-N, Nos + NOJ-N) TKN, TN, SRE, TP, Phytoplankton (celis/ml), and chlorophy1i-A. Secchi values and

produ

ivity values were also extracted. Productivity values for

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Secchi depth wece used. Total nitrogen wae calculated by adding surface and surface-bottom averages for No3 + No2N and TKN.

LL. Tilly, L. J. Unpublished, The following computations were made using rainfall-runoft coefficients, available lake volume information and published rainfall date to augment the lake inflow and turnover data available from omer sources.

The complete table for these data is reproduced here.

nin asin funory Lake Volume Flushing

Bazin lye otal caetvtefent Tayut?? Yo6no

10862 Ton? vimes/ye

cidra 22.2 3 ou 1 6s ae

Patilles 65.9 lo 0.57 ° 14.9 42

Matrullas 11.4 as 6.5 1.26 a 2.9

Guajatace 63.7 0.4 0.5 5.07 50.2 1

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32. en sevaret, Re and J. Viliamil. 1981. Productividaa y Gontenide mutricional del Jacinto de ?agua, Eichornia crassipes fare (Solms), en relacion a algunos aspectos limnoiogices del Ra90, 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 situ measurements were made at 1 meter intervals for pH, 0.0., temperature, Specific conductivity and iight. Secchi measurements were taken as well,

Laboratory analysis included TKN, TP, COD, BOD, Mn, Cu, Cay Pb, Ca, and Hg. bata for total phosphorus (thcee times the concentrations found by Quifones-Marquez) were judged to be in

error and excluded. Alkalinities given 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 pdlegesin, f. i943. A study of eutrophication and aquatic Blants growths in selected lakes and rivers of Pucrtot hice,

Project No. A-071-PR. Final Technical Report, Bureau of Reclamation, US. Department of the Interior, Washington, bic.

The lakes sampled in this study were Guajataca, Yauco (tuchetti), Toa Vaca, Cidra, and Loiza (Carraizo). Sampling for each luke was done twice at two stations each having three @epths: surface, mid and bottom. ?Time between sampling was 2 months. Water was collected with an Alpha (Model 1120-c40)

from Wildco.

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Water samples were analyzed for pli, color, turbidity and

temperature in the field. Dissolved oxygen, conductivity,

Gissolved ortho-phosphate, total phosphorus, TKN, NOs-9, No2-n,

NHg"N and other parameters were analyzed in the laboratory. The

NOs-W and NOg-W data were combined for this summary. Mia water

column data were ignores and avecages were computed based on the

Surface and bottom values for each lake.

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Table 1. (cont)

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