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Qualitative and Quantitative Aquatic Algal Data Compilation to Determine Macrotrends

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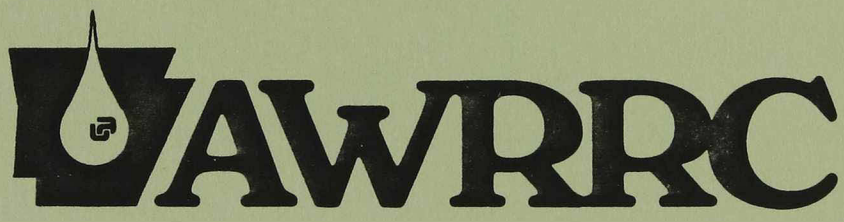

Arkansas Water Resources Research Center

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ABSTRACT

QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS

A data base of the algae of Arkansas has been initiated by the selection of a relational data base management system. The system was chosen to be readily available for microcomputers using MS- or PC-DOS. The initial parameters chosen for entry are associated with the classification of the organisms from Class to the Variety level with author and year of initiation. Further annotation includes identification source.

Presently, the data base of 1,162 taxa includes 226 Cyanophyceae, 367 Chlorophyceae, 124 Euglenophyceae, 26 Xanthophyceae, 81 Chrysophyceae, 279 Bacillariophyceae, 33 Pyrrhophyceae, 14 Cryptophyceae, and 5 Rhodophyceae. These taxa are sortable by any of the included parameters. The data base will be archived as a portion of the flora and fauna series of the state of Arkansas.

Richard L. Meyer

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Keywords -- Algae/Taxonomy/Classification/Habitat/Lakes/Reservoirs/Streams

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INTRODUCTION

The modern literature concerning the distribution of freshwater algae is primarily associated with specific lakes reservoirs and streams. In a few instances generalizations are established relative to trophic status, i.e. bluegreen algae and Cladophora are associated with eutrophic conditions. Palmer's (1969) summarization of pollution-tolerant algae is used as a guideline for this type of correlation. Also, there is a general understanding of the seasonal distribution of phytoplankton and benthos. This annual succession has been well documented and summarized by Hutchinson (1967), Smayda (1980), Round (1981), and Reynolds (1984).

Earlier literature by West and West (1906, 1909) on the distribution of desmids in association with geological formation and resultant lake and stream types remains a classic in the study of algal ecology. The 1924 and 1932 studies of Pearsall contributed the chemical and limnological information which substantiated the use of desmids as indicator taxa. The great body of German, Scandanavian and Eastern European literature reports the presence on numerous species from the tiaga (boreal coniferous forest) not found in more temporate deciduous or mediteranian biomes.

From this early research, a developing body of information strongly suggest that the distribution of organisms was strongly associated with the geological substrate. It is intuitively obvious that the aquatic environment in which the algal resides is influenced by the in situ, as well as the up-stream conditions. Within a single climatic zone

the major influencing parameters under natural condition will be the substrate of the locale and drainage basin.

The state of Arkansas lies within a generally temporate climate with strong seasonal variation. Winter air temperatures may be as low as -25°. Therefore, lakes, ponds and streams frequently have ice cover for one to four weeks. Summer water temperatures may reach temporary maxima of 42°. Typical maximum temperatures are usually five to seven degrees cooler in lakes and reservoirs. Streams, however, have a wider range of maxima temperatures. This diversity is associated with stream origin and slope. Spring fed streams in the Ozark highlands tend to be cooler than the shallow slow-moving streams in the flat lands of the Mississippi River delta.

Not only is the physical parameter of temperature variable by location but also a number of associated chemical, physical and biological parameters. Although these are not as completely defined as temperature these variations are known to exist. In general, the preliminary observations suggest that the distribution of algae in Arkansas is strongly influenced by the general ecological region (ecoregion). These ecoregions are outlined by the geological substrata, generalized soil types and the typical surface vegetation. The state contains six clearly deliniated ecoregions. These include the oak-hickory forest in the Ozark Highlands and Boston Mountains, the alluvial Arkansas River valley, the pine with scattered hardwoods covered Ouchita Mountains, the prairie-like Mississippi delta, the beech-maple forest along Crowley's Ridge, and the southern pine forest of the gulf coastal plain.

A. Purpose and Objectives

These diverse ecoregions of Arkansas have had limited systematic sampling for algal taxa. However, greater than one thousand species are known. An objective of the research is to assemble this existing data source into a cohesive body of information. The information can then be sorted and correlated with ecoregion and a suite of physical, chemical and biological parameters. These regionally sorted data can then be used for environmental assessment and selection of best management practices.

The advent of the general availability of microprocessers has permitted the use data summaries and bases for a much wider audience. Although the technology for accumulating, sorting and display data is readily available, the accumulated knowledge tends to be widely scattered. The research presented in the report is the first phase in the assembly of this dispersed knowledge into a collated information or data base. The research included the search for the scattered information sources, selection of a generally available microprocesser and the chosing of an appropriate data base software program.

B. Related Research or Activities

A search of the literature and personal contacts with other phycologists suggests that the research program and protocol represents the initial step into forming quickly retrievable and sortable statewide data bases for microprocessers.

METHODS AND PROCEDURES

The microprocesser for the development of the data base was selected

on the basis of its general availability, its ability to operate with more than one disc operating system, the presence of compatable hardware, and potential mainframe interface. The system used was an IBM PC with two diskette drives managed with PC-DOS. The data base management software program chosen was selected on the basis of its ready availability, common usage, capability of handling large quantities of information, and the ability to combine data stored in separate files. The software constraints required the use of a relational database management system. The commercial available dBase III by Aston-Tate was selected. The data can be displayed on the computer monitor and printed by any compatable printer.

The initial data entry included summarizing the known taxa in the Phycology Laboratory and University Library at the University of Arkansas at Fayetteville. These data were listed by the several taxanomic levels from Class to Variety. The originating author and date as well as the identification reference and known synonomy has been included. The information continues to be updated as new taxa or sources are discovered. This information is stored on diskette for duplication and distribution.

PRINCIPLE FINDINGS AND SIGNIFICANCE

The taxa included within data base are classified to Class, Order, Genus and Species. In certain instances Variety or Form is noted. Family names are not provided at this time because of the dynamic contributions of ultrastructural research and the resultant reassociation of numerous taxa. The higher systematic annotations are based upon histor-

ically established nomenclature. Although new classifications have been suggested, the associated genera are limited to those few examined with the aid of an electron microscope. The class and ordinal systematic levels chosen are those familiar to the general aquatic researcher.

The following example demonstrates the type of information stored within the data base. The data base can be sorted by several combinations of fields; i.e. from one to seven fields.

CLASS	Cyanophyceae
ORDER	Chroococcales
GENUS	Dactylococcopsis
SPECIES	Raphidioides
AUTHOR	G.M. Smith
DATE	1922
SOURCE	Geitler 1925

The data base is open so that addition can be inserted or modification can be entered. Future files will include citations of taxonomic sources as well as information concerning the collecting sites and ecoregion associations. A copy of the "to date" data base is available from the author. Periodically updated it will be deposited with the Arkansas Water Resources Research Center, University of Arkansas.

CONCLUSIONS

A data base for the collation of the algae of the ecoregions of Arkansas has been initiated by the selection of a relational database management software (dBase III). The software was chosen to be readily available for microcomputers using MS- or PC-DOS operating software.

The initial parameters chosen for entry into the data base are

associated with the classification of the organisms from Class to Variety level with author and year of initiation. Further annotation includes the taxonomic identification source when known and possible synonomy. Information sources, sampling site and associated parameters are to be added later.

The current data base of 1,162 taxa includes 226 Cyanophyceae, (blue-green algae), 367 Chlorophyceae (green algae with conjugates, desmids and Charales), 124 Euglenophyceae (euglenoids), 26 Xanthophyceae (yellow-green algae), 81 Chrysophyceae (golden-brown algae), 279 Bacillariophyceae (diatoms), 33 Pyrrhophyceae (dinoflagellates), 14 Cryptophyceae (cryptomonads), and 5 Rhodophyceae (red algae).

The data base will be archived with the Phycology Laboratory at the University of Arkansas at Fayetteville and the Arkansas Water Resources Research Center. It will be contributed to the Arkansas Academy of Science as a portion of the flora and fauna series for the State of Arkansas.

LITERATURE CITED

Hutchinson, G.E. 1967. A treatis on limnology. Vol. II. Introduction to lake biology and the limnoplankton. J. Wiley & Sons. New York. 1115p.

Palmer, M.C. 1969. A composite rating of algae tolerating organic pollution. J. Phycol 5(1):78-82.

Pearsall, W.C. 1924. Phytoplankton and environment in the English Lake District. Revue Algol. 1:54-67.

Pearsall, W.C. 1932. Phytoplankton of the English Lakes II. The composition of the phytoplankton in relation to dissolved substances. J. Ecol. 20:241-262.

Reynolds, C.S. 1984. The ecology of freshwater phytoplankton. Cambridge University Press. Cambridge. 383 p.

Round, F.E. 1981. The ecology of algae. Cambridge University Press. Cambridge. 653 p.

Smayda, T. 1980. Phytoplankton species succession. In I. Morris (Ed.). The physiological ecology of phytoplankton. Univ. of California Press. Berkeley. pp. 493-570.

West, W. and West, G.S. 1906. A comparative study of the plankton of some Irish loughs. Proc. Roy. Ir. Acad., B, 32:77-116.

West, W. and West, G.S. 1909. The British freshwater phytoplankton, with special reference to the desmid-plankton and the distribution of British desmids. Proc. R. Soc., (B) 81:164-206.