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## Qualitative and Quantitative Aquatic Algal Data Compilation to Determine Macrotrends - IV

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QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL  
DATA COMPILATION TO DETERMINE MACROTRENDS - IV

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Research Project Technical Completion Report

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## ABSTRACT

### QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS - IV

A data base of the algae of Arkansas ecoregions has been established by the use of a relational data base management system (dBase III plus). The system was chosen to be readily available for a variety of microcomputers using MS- and PC-DOS. The data base contains taxonomic fields from division through variety, synonymy, authors, initial description, date, and definitive descriptive source. The data are cross-referenced by ecoregion, Round's community and subcommunity designations.

The data base contains greater than 1,500 taxonomic records in all divisions and classes of freshwater algae. The data are sortable by any of the included parameters. The data have been used to initiate the publication of the algal flora of Arkansas. The listing of the Cyanophyta/Cyanobacteria or blue-green algae is presently available. Other taxonomic lists are in preparation.

Richard L. Meyer

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## INTRODUCTION

The use of algal indicators, particularly desmids, remains a classic in the study of algal ecology. West and West (1906 & 1909) compared the distribution of desmids of lakes and streams with the parental geological substratum in the British Isles. Later Pearsall (1932) contributed the chemical and limnological information which substantiated the use of the indicator organism concept. The distribution of algae in association with specific lake, reservoir and stream types has been emphasized in the recent literature. Particular emphasis, however, has been given to the occurrence of nuisance taxa in eutrophic systems used for water supplies or as receivers of various effluents. The application of algae as trophic indicators and pollution-tolerant taxa was last summarized by Palmer (1969). His index was derived from information primarily from the northeastern region, where it is commonly applied.

The research in Europe and northwestern Asia strongly suggests that the distribution of organisms is associated with the geological substrate (Hutchinson, 1967). In streams it is well established that the upstream condition have a major influence, as well as the in situ conditions, on which algae successfully establish residence. Within a climatic zone the primary influencing parameters under natural condition are the substrate of the locale, the drainage basin leachate and runoff.

A generally temperate climate with strong seasonal variation typifies the Arkansas region. Summer water temperatures may attain

temporary maxima of 42° while winter air temperatures may be as low as -25°. Lakes and reservoirs typically have surface temperatures five to seven degrees cooler than the spring, summer and fall air temperatures. Along the northern boundary of the state all or portions of reservoirs, lakes, ponds and streams may become ice covered for one to four weeks in January and/or February. The diversity in stream temperature is associated with the stream origin (spring or runoff) and slope.

Meyer (1985) has defined six "ecoregions" based upon the integration of chemical, physical and biological parameters associated with the geological substrata and generalized soil types. These ecoregions are closely associated, but not completely correlated, with typical surface vegetation. These vegetational types include the oak-hickory forest in the Ozark Highlands and Boston Mountains, the alluvial Arkansas River Valley, the pine with scattered hardwoods covered Ouachita 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

The diverse ecoregions of Arkansas have had sporadic sampling except for the northwest region of the Ozark Highlands and selected research sites. From these diverse sources of information approximately 1,500 taxa are known. Certain taxa are known to be widely distributed while others are restricted to a single site. This restriction may be the result of incomplete field collection and not

reflect the true distribution of the alga.

The objective of this research is to assemble the existing data into a cohesive body of information from which distributional and ecological questions can be addressed. The data base can then be correlated, sorted and the ubiquitous and rare taxa removed. Those taxa of intermediate frequency can be sorted by ecoregion and sequentially by community and subcommunity characteristics. These regionally, community or subcommunity sorted data can be used for environmental assessment and for the development, selection and monitoring of the best management practices.

The increase in sophistication of microprocessor and software has allowed the development of data summaries and bases. The first phase of the research included the selection of appropriate hard-and software, the development of record format, and the entry of a trial taxonomic data set. The present phase continues to expand the size of the taxonomic data, update, verify the files, and development of additional sets of parallel data. The parallel data files include not only the source, author and date but usually available references sources from which other researchers can identify the organism. Additional files contain the description of the ecoregion, community type and subcommunity in which the alga exists.

The incorporation of new hardware permits a greater amount of data to be stored in a more secure format. The installation of the 720 kb (3.5") drive has increased the storage per diskette twofold. These diskettes are encased in rigid enclosures. The robust enclo-



sures result in easier storage and greater safety in transport.

#### B. Related Research or Activities

A search of the literature and personal contacts with other phylogonists indicates that the research program and protocol represents initial efforts into forming quickly retrievable and sortable statewide data bases for microprocessors. Also, the software selected allows the transfer of data into other programs for statistical procedures, etc. Our protocol will permit the retrieval of all or portions of the information via modem with commonly available computer hardware and software. Other known data bases are hardware and program unique and not easily exported or imported. The database uses commonly designated field names and standard literature base designations rather than numeric codes or other cryptographic techniques. This protocol permits the data to be retrieved and applicable to both the specialist and the non-specialist.

#### METHODS AND PROCEDURES

The selection of the hardware and software has been outlined by Meyer (1985). The hardware is based upon the IBM-type microcomputer so that numerous compatible machines can use the data base. The software selected was a relational data base management system. The software has been upgraded to dBase III plus (Aston-Tate). This software is compatible with word processing and reporting programs as well as spreadsheets, graphics and statistical programs.

Continued data entry has expanded the initial taxonomic file to include new records. Additional files for taxonomic reference by

author and reference source have been established. A habitat file has been initiated to record the characteristics of the locale in which the alga has been collected. Also, taxonomic designation have been updated as new literature becomes available.

#### PRINCIPAL FINDINGS AND SIGNIFICANCE

The taxonomic file included within the data base has the algae classified to Class, Order, Genus, Species, and where appropriate, variety and form. Family epithets are not given because of the dynamics of phylogenetic research in progress at the present time; although new class and order level designations have been entered, ie., Eustigmatophyceae. The taxonomic levels assigned are based upon commonly available systematic literature and may differ from the other recent recommendations. However, a new file has been developed which includes alternate higher taxonomic category assignment (either new or previous designations).

The present data set also contains multiple secondary files including a identification file and a habitat file. The identification file contains the generic and specific names, the author(s) name and original date of description. The latter file includes the references source(s) from which an illustration, a word description and a key are available. The habitat file contains the generic and specific name plus information concerning the ecoregion, community and subcommunity. Temporal and spatial information are in a separate file. A synonymy file is under construction to clarify the use of older names and recent changes in scientific epithet. Future

data input includes cross reference to a developing photomicro-graphic record of each taxon. Also records of archived field samples and/or prepared microscope slides are planned to be entered as components of the data base. These additions will allow users to retrieve filed data as well as view and verify the actual specimens upon which the data base has been developed. This linkage between field data and "view-and-verified" samples will allow any necessary modifications by specialists and function as a common reference source for consistent identification by non-specialists.

The software data base management program used allows sorting and merging the various file to produce customized reports for specific needs. To date a customized listing of the Cyanophyta/Cyanobacteria (blue-green algae) has been published which includes the complete complement of taxonomic citation. This flora has been supplied to the Arkansas Academy of Science for distribution with its Arkansas Flora and Fauna series. Additional floristic listings are in preparation and will be released periodically.

A copy of all or part of the data base is available from the author. Periodically updated copies will be deposited with the Phycology Laboratory at the University of Arkansas.

#### CONCLUSIONS

The selection of hardware and software compliment have been shown to be applicable in developing a "friendly" data base for the taxonomy, identification and distribution of the freshwater algae.

The data base design permits the retrieval of complexes of information from several files so that customized output requests can be addressed. These outputs can be as hardcopy and/or in 3.5 or 5.25 inch diskettes, 720 or 360 kb, respectively. The management system allows for the development of new input files and the merging of these with all or part of existing files.

At the present time the files contain information concerning greater than 1,500 taxa of algae from all ecoregions, communities and subcommunities of Arkansas. The new taxa and associated information continues to be entered and verified. The data base is archived with the Phycology Laboratory at the University of Arkansas at Fayetteville.

#### LITERATURE CITED

- Hutchinson, G.E. 1967. A treatise on limnology. Vol. II. Introduction to lake biology and limnoplankton. J. Wiley & Sons. New York. 1115p.
- Meyer, R.L. 1985. Qualitative and quantitative aquatic algal data compilation to determine macrotrends. Arkansas Water Resources Research Center. Publication No. 114. 7p
- Palmer, M.C. 1969. A composite rating of algae tolerating organic pollution. J. Phycol. 5(1):78-82
- Pearsall, W.H. 1932. Phytoplankton of the English Lake District. II. The composition of the phytoplankton in relation to dissolved substances. J. Ecol. 20:241-262.
- West, W. and West, G.S. 1906. A comparative study of the plankton of some Irish lough. 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