6-1-1987

Qualitative and Quantitative Aquatic Algal Data Compilation to Determine Macrotrends- III

Richard L. Meyer
University of Arkansas, Fayetteville

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

Richard L. Meyer
Department of Botany & Microbiology

University of Arkansas
Fayetteville, AR 72701

Publication No. 126

June, 1987

Technical Completion Report Research Project G-1212-32

Arkansas Water Resources Research Center
University of Arkansas
Fayetteville, Arkansas 72701

Arkansas Water Resources Research Center

Prepared for
United States Department of the Interior

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

Richard L. Meyer
Department of Botany & Microbiology
University of Arkansas
Fayetteville, AR 72701

Research Project Technical Completion Report

Project G-1212-32

The research on which this report is based was financed in part by the United States Department of the Interior as authorized by the Water Research and Development Act of 1978 (P.L. 95-467).

Arkansas Water Resources Research Center
University of Arkansas
112 Ozark Hall
Fayetteville, AR 72701

Publication No. 126

June, 1987

ABSTRACT

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

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 approximately 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

Completion Report to the U.S. Department of the Interior, Geological Survey, Reston, VA, June 1987.

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

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The consultation, helpful suggestions and able assistance of Ms. Christina Laurin was valuable in continuing this research.

Special appreciation is expressed to Ms. Sheila Harmon for her careful entry of the data and cross-referencing numerous source materials.

The support of the U.S. Department of the Interior, Geological Survey, who provided the funds, and Dr. Leslie E. Mack, Director, Arkansas Water Resources Research Center, is greatly acknowledged.

INTRODUCTION

The association of algae with geological formations and the resultant lake and stream types was initiated by the 1906 and 1909 studies of West and West on the distribution of desmids. The use of algal indicators, particularly the desmids, remains a classic in the study of algal ecology. In 1932, Pearsall contributed the chemical and limnological information which substantiated the use of the indicator organism concept. The distribution of algae in association with specific lakes, reservoirs and streams is presented in the recent literature. Particular emphasis has been given to the occurrence of nuisance taxa in water supplies. The application of algae as trophic indicators and pollution-tolerant taxa was last summarized by Palmer (1969).

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 conditions, as well as the in situ conditions, have a major influence on which algae successfully established residence. Within a climatic zone, the primary influencing parameters under natural condition are the substrate of the locale and the leachate drainage basin.

Arkansas is influenced by a generally temperate climate with strong seasonal variation. Summer water temperatures may attain temporary maxima of 42^{o} while winter air temperatures may be as low as -25^{o}. Lakes and reservoirs typically have surface temperatures

five to seven degrees cooler than the spring, summer and fall air temperatures. Also, portions of reservoirs, lakes, ponds and streams may be 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.

Six "ecoregions" have been delimited by Meyer (1985) based upon the integration of chemical, physical and biological parameters associated with the geological substrata, generalized soil types and typical surface vegetation. These 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.

The objective of this research is to assemble the existing data into a cohesive body of information from which distributional and ecological questions are 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 se-

quentially by community and subcommunity characteristics. These regionally, community or subcommunity sorted data can be used for environmental assessment and for the selection of 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 expands the size of the taxonomic data, updates, verifies the files, and includes the development of additional parallel data sets. 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.

B. Related Research or Activities

A search of the literature and personal contacts with other phycologists indicates that the research program and protocol represents initial efforts into forming quickly retrievable and sortable statewide data bases for microprocessors. 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 data base uses commonly designated field names and standard literature base designations rather than numeric codes or

other cryptographic techniques.

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.

The data entry has expanded the initial taxonomic file to include additional 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 designations 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, i.e., Synurophyceae. 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 includes multiple secondary files including an 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.

The software data base management program used allows sorting and merging of the various files 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 "to date" 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 informa-

tion from several files so that customized output requests can be addressed. The management system allows for the development of new input files and the merging of these files or portion of these files with all or part of existing files.

At the present time, the files contain information concerning approximately 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 and 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 G.S. West. 1906. A Comparative Study of the Plankton of Some Irish Lough. Proc. Roy. Ir. Acad., B, 32:77-116.

West, W. and G.S. West. 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.