Protocols for the analysis of algal samples collected as part of the U.S. Geological Survey National Water-Quality Assessment Program

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ACRONYMS

ANSP The Academy of Natural Sciences of Philadelphia
APHA American Public Health Association
ASR Analytical Services Request
AWWA American Water Works Association
BIO-TDB Biological Transactional Database
CAR Corrective Action Report
DCF Dilution/Concentration Factor
DHDB Diatom Herbarium Database
DIC Differential Interference Contrast
DTH Depositional Targeted Habitat
DW Distilled Water
EPA Environmental Protection Agency
FTP File Transfer Protocol
ID Identification
MSDS Material Safety Data Sheet
NADED North American Diatom Ecological Database
NAWQA National Water-Quality Assessment
PC Personal Computer
PCER Patrick Center for Environmental Research
PIMS Phycology Information Management System
PP Phytoplankton
PPE Personal Protective Equipment
PS Phycology Section
PSI Pounds per Square Inch
QA Quality Assurance
QAM Quality Assurance Manager
QAU Quality Assurance Unit
QC Quality Control
QMH Qualitative Multihabitat
RO Reverse Osmosis
RTH Richest Targeted Habitat
SOP Standard Operating Procedure
USGS United States Geological Survey
WEF Water Environment Federation
WPCF Water Pollution Control Federation
INTRODUCTION

These protocols describe procedures for laboratory analysis of algae samples collected by the U.S. Geological Survey National Water-Quality Assessment Program (NAWQA) (http://water.usgs.gov/nawqa/). They are used by staff in the Phycology Section (PS) of the Patrick Center for Environmental Research (PCER) at The Academy of Natural Sciences in Philadelphia (ANSP), and subcontractors. Nearly all procedures have been in use since 1998, and many since 1995 when ANSP began analyzing NAWQA samples. They cover all steps in analysis, from receipt and log-in of samples at ANSP, to final transmission of data to NAWQA.

Algal samples are analyzed as part of a Cooperative Agreement between ANSP and the USGS. The overall objective of research performed under this agreement is to evaluate water quality using data on algae samples collected from rivers throughout the U.S. Roles of the ANSP include analysis of samples, ecological synthesis of data at the national scale, and development of new approaches for using algae as water quality indicators. This cooperative research effort is intended to benefit the public through the availability of a national database of algal data, and the publication of USGS reports and scientific journal articles.

These protocols apply to the analysis of the four kinds of algal samples collected by the NAWQA program: three types of periphyton samples, two quantitative and one qualitative, and phytoplankton samples (Porter et al. 1993; Moulton et al. 2002). Each is a composite sample collected from a defined sampling reach. The two quantitative periphyton sample types are Richest Targeted Habitat (RTH) and Depositional Targeted Habitat (DTH). The RTH samples are collected from the most common hard substrate, usually rocks or wood. The DTH samples are taken from sand/silt depositional areas, usually pools or areas with slow current. Protocols for analysis of quantitative samples are designed to provide data on algal densities (as cells per cm² of sampling surface) and amount of algal biovolume (µm³ per cm² of sampling surface) at a sampling site. Qualitative Multihabitat (QMH) samples are a composite collection of algae from the majority of individual micro-habitats in the sampling reach.

Individual protocols were written and reviewed by staff who perform the analyses and are in the format specified by the PCER Quality Assurance Unit (QAU). This format requires that each protocol be understandable and usable by itself (independently), in conjunction with listed references. Many protocols pertain to samples analyzed for all Phycology Section projects; most precede NAWQA. Some apply specifically to NAWQA sample analysis and contain the phrase “USGS NAWQA Program” in their title. All protocols have been reviewed and approved by the ANSP Quality Assurance Manager (QAM).

Data needs of the NAWQA program change as the program progresses, requiring modifications to these procedures. All deviations in protocols are noted in field and/or laboratory notebooks at the time of the deviation, or at the time deviations are realized. If the deviation is such that the quality or integrity of the study is affected, the Phycology Section Laboratory Manager is informed immediately. Minor modifications of project protocols are sometimes necessary. Minor changes are noted in the margin of a laboratory copy of each protocol, initialed and dated. This may be done by the Principal Investigator, the Phycology Section Laboratory Manager or the staff member responsible for performing the procedures outlined in the protocol. All such notes are also entered into the master copy and a copy sent to the QAM. Major modifications require a formal revision of protocols. Formal revisions are reviewed by the Phycology Section Leader and the Phycology Section Project Manager and must be approved by the QAM. This approval process ensures that
work performed using these protocols is in compliance with the standards set by the Quality Assurance Unit and thereby produce credible data.

The references in each protocol are often not cited in the text. They are included to provide additional resources for users to help them better understand the background of protocols and how to implement them.

**Computer Applications and Databases**

Most protocols make use of specially designed computer applications, and nearly all protocols require addition of data to one of the Phycolgy Section Microsoft Access databases. All databases are on an Academy server and available to staff at their work stations via the Academy’s computer network. All databases are backed-up daily by the Academy’s Information Technology staff. The PHYCLGY database is the primary system for entering, reviewing and retrieving data related to routine laboratory operations. It is accessed primarily through its “Phycolgy Information Management System (PIMS)” interface. The NAWQAdat database contains data and working files that pertain only to the NAWQA project. NAWQAApp contains an application for downloading of sample identification data (Analytical Service Request, ASR) from the NAWQA BioTDB database. The North American Diatom Ecological Database (NADED) is primarily an archival database for all Phycolgy Section projects. NADEDdat is where data identifying samples and sites, and all algal count result and taxonomic data are stored. NADEDapp contains many applications for entry, management and analysis of data in NADED. “Tabulator” is a stand-alone program used by algal analysts to record data when making counts. “BioTDB Export” is an application used by data managers to prepare data to load into the USGS BioTDB database. Its functions include the abilities to aggregate data, ensure taxonomic consistency, and perform the “biovolume per area” calculations. All paper forms and other records are stored in a set of three folders that accompany each group of samples: “Sample Tracking and Subsampling,” “Diatom Analysis,” and “Soft-Algae Analysis.”

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**References**


ANSP Protocols for Analysis of NAWQA Algae Samples

PROTOCOLS