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Standard Classification for Sampling Phytoplankton in Surface Waters[1]

This standard is issued under the fixed designation D4149; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This classification covers both qualitative and quantitative techniques that are used commonly for the collection of phytoplankton. The particular techniques that are used during an investigation are dependent upon the study objectives. Of additional importance in the selection of a technique is the uneven distribution of organisms both temporally and spacially. This classification describes qualitative and quantitative ways of collecting phytoplankton from inland surface waters. Specifically, qualitative samplers include conical tow nets and pumps; quantitative samplers include the Clarke-Bumpus plankton sampler, Juday plankton trap, water sampling bottles, and depth-integrating samplers.

2. Referenced Documents

2.1 *ASTM Standards:*
D1129 Terminology Relating to Water[2]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this method refer to Terminology D1129.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *phytoplankton*—is the community of suspended or floating, mostly microscopic plants that drift passively with water currents. Frequently, phytoplankton are differentiated on the basis of size. The generally accepted size ranges, as commonly used are **(1)**:[3]

Macroplankton	>500 µm
Microplankton (net plankton)	10 to 500 µm
Nannoplankton	10 to 50 µm
Ultraplankton	<10 µm

4. Significance and Use

4.1 Because of the direct association of phytoplankton with the water and the water masses that move in response to wind-or-gravity-generated currents, the species composition and abundance of phytoplankton are related to water quality. Moreover, the phytoplankton directly affect water quality, notably dissolved oxygen, pH, concentrations of certain solutes, and optical properties. At times the abundance or presence of particular species of algae result in nuisance conditions **(2).**

4.2 Organisms of the phytoplankton communities are collected and studied for many reasons, and the techniques used will vary with the study objectives. In the design of a sampling program and in the selection of techniques, the investigator must take into consideration the uniqueness of each study area and the natural characteristics of phytoplankton communities.

4.3 The principal factors to consider when collecting phytoplankton are the uneven distribution, composition, and abundance of phytoplankton in space and time. Phytoplankton blooms can occur quickly and can be of short duration. Succession of taxa can occur in a matter of 1 to 2 weeks. Furthermore, phytoplankton abundance and composition can change abruptly in the horizontal plane. There also can be remarkable numerical and qualitative differences between depths. The heterogeneous abundance and composition can occur not only over small areas but also over large areas. The uneven distribution makes it difficult to collect a representative sample from a given area and makes replication of samples and, especially, an adequate vertical and horizontal sampling program essential **(3).**

5. Basis of Classification

5.1 Qualitative samplers include the conical tow nets and pumps. Quantitative samplers include the Clarke-Bumpus plankton sampler, Juday plankton trap, water-sampling bottles, and depth-integrating samplers.

5.2 *Conical Tow Nets*—Most qualitative samplers are cone-shaped nets constructed of silk bolting cloth or a synthetic material such as nylon. Nets should not be used for quantitative

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The boldface numbers in parentheses refer to the references at the end of this classification.

studies because they do not retain all the phytoplankton taxa; for example, nannoplankton and ultraplankton generally will pass through a net. Even so, nets are valuable collecting tools and excellent for many types of studies.

5.3 *Pumps*—Pumping systems of various kinds have been used to collect qualitative or semiquantitative samples of phytoplankton. Several papers summarizing these techniques have been published in the literature **(4, 5, 6).** Although a variety of pump apparatus have been used, the basic design consists of a pump, generally with a volume register, a base, and a concentrating net, such as a simple tow net sampler or Wisconsin net sampler. Water is pumped from a discrete depth and through the net. The sample is removed from the net.

5.4 *Clarke-Bumpus Plankton Sampler*—The sampler utilizes a net for the concentration of organisms and, as such, may be considered to be a semiquantitative sampler. It is quantitative in that the actual volume of water entering the sampler is measured by a calibrated flow meter.

5.5 *Juday Plankton Trap*—Like the Clarke-Bumpus plankton sampler, the Juday plankton trap utilizes a net for the concentration of organisms. The trap collects a discrete sized sample from a predetermined depth.

5.6 *Water-Sampling Bottles*—The closing water bottles, which are actuated by a messenger, are perhaps the most satisfactory and simple quantitative sampling device.

5.7 *Depth-Integrating Samplers*—Depth-integrating samplers are used to obtain a representative, quantitative sample of phytoplankton in the cross section of a stream. The sampler and sampling procedure compensates for the disparity of phytoplankton density in the cross section.

REFERENCES

(1) Wetzel, R. G., *Limnology,* W. B. Saunders Co., Philadelphia, PA, 1975, p. 743.

(2) Greeson, P. E., et al., "Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples." *U.S. Geological Survey Technology of Water-Resources Investigations,* Book 5, Chapter A4, 1977, p. 332.

(3) National Academy of Sciences, "Recommended Procedures for Measuring the Productivity of Plankton Standing Stock and Related Oceanic Properties," National Academy Sciences, Washington, 1969, p. 59.

(4) Aron, W., "The Use of a Large Capacity Portable Pump for Plankton Sampling, with Notes on Plankton Patchiness," *Journal of Marine Research,* Vol 16, 1958, pp. 158–174.

(5) Gibbons, S. G., and Fraser, J. H., "The Centrifugal Pump and Suction Base as a Method of Collecting Plankton Samples," *Journal Construction Permanent International Explorer Merchants,* Vol 12, 1937, pp. 155–170.

(6) Weber, C. I., ed., "Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents," U.S. Environmental Protection Agency. EPA-670/4-73-001, 1973.