

Gravimetric method for biomass (B-3520-85)

Parameters and Codes:

Periphyton, biomass, dry weight, total (g/m²): 00573

Periphyton, biomass, ash weight (g/m²): 00572

Gravimetric measurements are instantaneous; that is, they measure biomass at a moment in time in a community that is constantly changing. Because of large variability in biomass within a site, and because of control of periphyton growth by numerous physical (light, current velocity, storm frequency), chemical (nutrient regime), and biological (grazing) factors, comparisons between sites are impossible using casual sampling. To be used successfully, the gravimetric method should be employed with a specific objective in mind. To make comparisons between sites, samples should be collected from environments as nearly identical as possible. Application, as a mechanism to approximate the rate of biomass accumulation (net periphyton community productivity), is more valuable than a single estimate of biomass. The latter determination generally is done by incubating clean natural or artificial substrates in as nearly identical conditions as possible, and sampling on several dates for 2 to 4 weeks, or by incubating fresh substrates for specific periods (2-4 weeks) during different seasons (Castenholz, 1960; Sladeczek and Sladeczkova, 1964; Lyford and Gregory, 1975; Liaw and MacCrimmon, 1978; Rodgers and others, 1979). The equal and simultaneous time periods should be reported with the data.

1. Applications

The method quantifies all organic mass, autotrophic and heterotrophic, living and dead, associated with the periphyton community. Gravimetric determinations are suitable for all water.

2. Summary of method

Samples of the periphyton community are collected from known areas of natural or artificial substrates. The dry weight and ash weight are determined.

3. Interferences

3.1 Inorganic matter in the sample will cause erroneously large dry and ash weights.

3.2 Dead periphyton and organic detritus that settles on the substrate will cause an overestimate of living biomass.

3.3 Natural variability generally is large for biomass and may cause a problem when the method is used for comparison.

3.4 When used as an index of production of the net periphyton community, grazing can result in an underestimate,

and detrital settling will result in an overestimate of production.

3.5 Colonization rates vary depending on orientation of substrates (horizontal or vertical) because orientation affects the settling of organic and inorganic detritus. Vertical orientation is preferred because it decreases the settling problem (Castenholz, 1960; Liaw and MacCrimmon, 1978).

4. Apparatus

Most of the materials and apparatus listed in this section are available from scientific supply companies.

4.1 *Artificial substrates*, glass slides, Plexiglas or polyethylene strips, tygon tubing, styrofoam, or other materials. See figures 1 and 2 for selected types of artificial substrates.

4.2 *Balance*, capable of weighing to at least 0.1 mg.

4.3 *Collecting devices*, for the removal of periphyton from natural substrates. Three devices for collecting a sample of periphyton from natural substrates are shown in figure 3.

4.4 *Desiccator*, containing silica gel or anhydrous calcium sulfate.

4.5 *Drying oven*, thermostatically controlled for use at 105°C.

4.6 *Filtration apparatus*, non-metallic, and has a vacuum.

4.7 *Forceps*, stainless steel, smooth tip, or tongs.

4.8 *Glass filters*, 47-mm diameter disks.

4.9 *Muffle furnace*, for use at 500°C.

4.10 *Porcelain crucibles*.

4.11 *Sample containers*, glass or plastic, suitable for the types and sizes of samples. Sturdy plastic bags are useful containers for artificial substrates or for pieces of natural substrate. Do not use glass containers for samples to be frozen.

4.12 *Scraping devices*, razor blades, stiff brushes, spatulas, or glass slides are useful for removing periphyton from artificial substrates. The edge of a glass microscope slide is excellent for scraping periphyton from hard, flat surfaces (Tilley, 1972).

5. Reagents

5.1 *Distilled or deionized water*.

6. Analysis

6.1 Calculate the tare weight of a crucible containing a glass-fiber filter. Heat at 500°C for about 20 minutes, cool

to room temperature in a desiccator, and weigh to the nearest 0.1 mg.

6.2 Filter the water and the scrapings from the periphyton strip in the sample bottle through the tared glass-fiber filter. Place filter in crucible and dry at 105°C to a constant weight. Cool crucibles containing dried periphyton to room temperature in a desiccator before weighing. Weigh as rapidly as possible to decrease moisture uptake by the dried residue. Use these weight values to calculate dry weight.

6.3 Place the crucible containing the dried residue in a muffle furnace at 500°C for 1 to 4 hours. Cool to room temperature.

6.4 Moisten the periphyton ash using distilled water and again oven dry at 105°C to constant weight as described in 5.2. Use these weight values to calculate ash weight.

7. Calculations

7.1 Dry weight of periphyton (grams per square meter)

$$\frac{\text{Dry weight of crucible and residue (grams)} - \text{Tare weight of crucible (grams)}}{\text{Area of scraped surface (square meters)}}$$

7.2 Ash weight of periphyton (grams per square meter)

$$\frac{\text{Ash weight of crucible and residue (grams)} - \text{Tare weight of crucible (grams)}}{\text{Area of scraped surface (square meters)}}$$

8. Reporting of results

Report periphyton biomass to three significant figures.

9. Precision

No numerical precision data are available.

10. Sources of information

Castenholz, R. W., 1960, Seasonal changes in the attached algae of freshwater and saline lakes in the Lower Grand Coulee, Washington: *Limnology and Oceanography*, v. 5, no. 1, p. 1-28.

Liaw, W.K., and MacCrimmon, H.R., 1978, Assessing changes in biomass of riverbed periphyton: *Internationale Revue der Gesamten Hydrobiologie*, v. 63, no. 2, p. 155-171.

Lyford, J.H., and Gregory, S.V., 1975, The dynamics and structure of periphyton communities in three Cascade Mountain streams: *Verhandlung Internationale Vereinigung Limnologie*, v. 19, p. 1610-1616.

Rodgers, J.H., Jr., Dickson, K.L., and Cairns, John, Jr., 1979, A review and analysis of some methods used to measure functional aspects of periphyton, in Weitzel, R.L., ed., *Methods and measurements of periphyton communities-A review*: American Society for Testing and Materials Special Technical Publication 690, p. 142-167.

Sladeczek, Vladimir, and Sladeczkova, Alena, 1964, Determination of periphyton production by means of the glass slide method: *Hydrobiologia*, v. 23, no. 1, p. 125-158.

Tilley, L.J., 1972, A method for rapid and reliable scraping of periphyton slides, in *Geological Survey Research 1972*: U.S. Geological Survey Professional Paper 800-D, p. D221-D222.