Section 8
Sediment Community Metabolism

Brian H. Hill and Alan T. Herlihy

This section describes procedures to collect a composite sediment sample from the sampling reach. Sediment samples are collected from each transect at the same time as periphyton samples (Section 7) and benthic macroinvertebrate samples (Section 9). At each river, a composite "index" sample of sediment is prepared and used in the determination of sediment community metabolism.

The method outlined here for determining sediment community metabolism is designed for headwater to mid-order streams, and has been adapted for larger rivers or lakes. The method measures changes in dissolved oxygen (DO) concentrations of the overlying water within microcosms containing small amounts (ca. 10 mL) of sediments as a means of assessing benthic microbial community activity. Sediments are collected from depositional habitats along the study reach. Following incubation, the DO is re-measured and the sediments are saved for ash-free dry mass (AFDM) analysis. Respiration rate, estimated as the change in DO concentration per hour within each microcosm, is adjusted for AFDM, yielding a measure of community respiration per gram of AFDM. Organic carbon turnover time can be calculated from the empirical relationship between the organic carbon content of the sediment (estimated as 0.5 × AFDM) and oxygen consumption.

8.1 Sample Collection

Table 8-1 describes the procedure for collecting the composite sediment sample. Collect sediment from depositional areas (e.g., pools, eddies, and backwaters) located at or near each of the cross-section transects within the sampling reach. If soft sediments are scarce, collect them from wherever you can within the sampling reach. At each sampling point, use a small plastic scoop to collect the top 2 cm (1 inch) of soft surface sediment. Combine sediments from different sampling points into a single jar or self-sealing plastic bag to prepare a single composite index sample

[1]U.S. EPA, National Exposure Research Laboratory, Ecological Exposure Research Division, 26 W. Martin L. King Dr., Cincinnati, OH 45268.
[2]Department of Fisheries and Wildlife, Oregon State University, c/o U.S. EPA, 200 SW 35th St., Corvallis, OR 97333.

Table 8-1. Sediment Collection Procedure.

1. At the first cross-section, locate a depositional habitat (a pool, eddy, or backwater).
   - If soft sediments are scarce, collect them wherever you can within the reach
2. Use a plastic scoop to collect a sample of surficial sediment (top 2 cm). Remove any visible organisms from the sediment. Place the sample in a plastic jar with volume graduations labeled "SEDIMENT SAMPLE".
   - Approximately 250 mL of sediment (~ 30 mL per transect) is required for sediment metabolism.
3. Repeat Steps 1 through 2 for Transects "B" through "K".

for the river reach. A composite sample volume of 250-mL is sufficient to prepare sediment metabolism samples.

8.2 Determining Sediment Respiration

The procedure to measure sediment respiration in presented in Table 8-2. A dissolved oxygen meter, equipped with a biological oxygen demand (BOD) probe and stirrer, is used for the determination of respiration rates. This may or may not be the same meter used

Table 8-2. Procedure To Measure Sediment Respiration.

1. Inspect the probe of the dissolved oxygen meter for outward signs of fouling and for an intact membrane. Do not touch the electrodes inside the probe with any object. Always keep the probe moist by keeping it inside its calibration chamber. Check the batteries and electronic functions of the meter as described in the meter's operating manual.
2. Calibrate the oxygen probe in water-saturated air as described in the operating manual. Allow at least 15 minutes for the probe to equilibrate before attempting to calibrate.
   - NOTE: Try to perform the calibration as close to river temperature as possible (not air temperature) by using river water to fill the calibration chamber prior to equilibration.
   - NOTE: For doing the elevation correction, the elevation of the sample site is provided on the site information sheet in the dossier for the site. Alternatively, obtain the elevation from a topographic map.
3. Prepare a set of five sediment metabolism sample labels. Note that each label will have a different sample ID number (barcode). Attach each completed label to a 50-mL screw-cap centrifuge tube.
   - NOTE: Avoid covering volume gradations on the tube with the label. Cover each label with a strip of clear tape.
4. Fill a small insulated cooler full with river water. Measure the dissolved oxygen and temperature of the water in the cooler. Record the values in the "Initial O2" and "Initial Incubation Temp." fields in the metabolism section of the Field Measurement Form.
5. Thoroughly mix the composite sediment sample. Use a small plastic spoon to transfer 10 mL of sediment from the composite sample container to each of the five labeled tubes.
6. Fill each tube to the top (no head space) with river water from the cooler and seal the tube. Fill a centrifuge tube labeled "BLANK" with river water from the cooler and seal. This tube serves as a control for changes in ambient conditions during the incubation period.
7. Place the six tubes in a 1-L plastic beaker and place the beaker inside the cooler. Record the start time in the "Incubation Time" area of the Field Measurement Form. Close the cooler and incubate the sediment samples for 2 hours.
8. After incubation, re-calibrate the oxygen probe (i.e., the meter was turned off or you have moved to a different elevation during the incubation) before the end of the incubation period.
9. At the end of the incubation period, record the end time in the "Incubation Time" area of the Field Measurement Form. Measure the DO in each tube, including the blank. Record the sample ID number of each tube and its measured DO concentration on the Field Measurement Form.
10. Decant the overlying water from each labeled tube, retaining the sediment. Tightly seal each tube and place in a cooler with bags of ice as soon as possible. Keep the samples frozen until they can be shipped. Discard the water from the "BLANK" tube.

to determine in situ dissolved oxygen concentration (Section 5). If a separate meter is used to measure sediment respiration, check the probe membrane and the meter's batteries and electronics according to the instrument's operating manual (see Sections 3 and 5, also). Calibrate the meter as directed in the instrument's operating manual.

A small cooler filled with stream water is used as an incubation chamber. The initial dissolved oxygen concentration and temperature of the water in the cooler are measured and recorded on the Field Measurement Form as shown in Figure 8-1. This concentration is assumed to be the initial concentration of all subsamples. Five sediment subsamples (10-mL ±1 mL) are prepared from the composite sediment sample. A set of completed sample labels for these subsamples is shown in Figure 8-2. A 10-mL subsample of water from the incubation cooler is used as a control for changes in ambient conditions during the incubation. The subsamples are incubated in the cooler for 2 hours. After the incubation, the final DO concentration of each tube is determined and recorded on the Field Measurement Form (Figure 8-1). The sediment in each tube is retained and stored frozen until it can be shipped to the laboratory (Section 3) to determine the AFDM.

8.3 Equipment and Supplies

Figure 8-3 is a checklist of equipment and supplies required to conduct sediment sampling and to determine sediment community respiration. This checklist is similar to the checklist presented in Appendix A, which is used at the base location (Section 3) to ensure that all of the required equipment is brought to the river. Use this checklist to ensure that equipment and supplies are organized and available at the river site in order to conduct the activities efficiently.

Reviewed by (initial) DKA

FIELD MEASUREMENT FORM - STREAMS/RIVERS

SITE NAME: BEAVER RIVER DATE: 8 / 5 / 98 VISIT L0 [X] L2 L3

SITE ID: ORRV 98-999 TEAM ID (X): [X] 2 3 4 5 6 7 8

WEATHER CONDITIONS (X)

CLOUD COVER	[X] < 5%	[ ] 5-25%	[ ] 25-50%	[ ] 50-75%	[ ] > 75%
PRECIPITATION	[X] NONE	[ ] LIGHT	[ ] MODERATE	[ ] HEAVY	
PREVIOUS PRECIPITATION (24 H)	[X] NONE	[ ] LIGHT	[ ] MODERATE	[ ] HEAVY	
AIR TEMPERATURE XX	28 °C				

IN SITU MEASUREMENTS

STATION ID: K Assume X-site unless marked

		FLAG	COMMENTS
CCCS COND µS/CM XXXX	75		AT TRANSECT "K"
STREAM/RIVER COND µS/CM XXXX	110		AT TRANSECT "K"
STREAM/RIVER DO MG/L XX.X	8.8		AT TRANSECT "K"
STREAM/RIVER TEMP °C XX.X	17.6		AT TRANSECT "K"

FISH TISSUE SAMPLES - SECONDARY SAMPLE (where available: 5 individuals)

INITIAL O_2 (MG/L) XX.X	INITIAL INCUBATION TEMP (°C) XX.X	INCUBATION TIME (24-HR TIME) START (HH:MM)	INCUBATION TIME (24-HR TIME) FINISH (HH:MM)	DURATION OF INCUBATION (HH:MM)	FLAG	COMMENTS
9.0	18.4	18:30	22:30	4 : 00		

SAMPLE ID (RABCOOP)	FINAL O_2 (MG/L)[2] XX.X	FLAG	COMMENTS
243663	7.5		INITIAL D.O. AT 1000' ELEVATION
243664	7.2		FINAL D.O. AT 2200' - METER CALIBRATED
243665	7.8		FOR EACH ELEVATION
243666	8.1		
243667	7.0		
CONTROL	8.8		

OXYGEN METER CALIBRATION INFORMATION

MEMBRANE CHECK [X] ELECTRONIC ZERO [ ] RED LINE [X]

CALIBRATION CHAMBER TEMPERATURE: °C

STATION ELEVATION (FROM TOPO. MAP OR ALTIMETER): 1000 FT

SATURATED O_2 @ TEMP: MG/L

ELEVATION CORRECTION FACTOR: x

The calibration value is obtained by multiplying the saturated DO concentration times an elevation correction factor (obtained from the tables on the back of the YSI meter). Adjust the meter reading to the calibration value.

CALIBRATION VALUE: MG/L

COMMENTS:

Flag codes: K = no measurement or observation made; U = suspect measurement or observation; Q = unacceptable QC check associated with measurement; F1, F2, etc. = miscellaneous flags assigned by each field crew. Explain all flags in comments section.

Rev. 05/28/98 (strvfldm.98)

FIELD MEASUREMENT FORM - STREAMS/RIVERS - 1

Figure 8-1. Field Measurement Form (page 1), showing data for sediment metabolism samples.

Figure 8-2. Completed sample labels for sediment metabolism.

Equipment And Supplies For Sediment Metabolism		
Qty.	Item	
1	Small scoop sampler for sediments	
1	Wide-mouthed plastic jar labeled "COMPOSITE SEDIMENT SAMPLE". If sediment is only being collected for metabolism samples, a 250-mL jar is sufficient.	
1	YSI Model 95 Dissolved Oxygen meter	
1 set	Spare batteries for DO meter	
1	Small plastic spoon or spatula to transfer sediment from the composite sample container to respiration tubes	
5	50-mL, screw-top, centrifuge tubes	
1	50-mL screw-cap centrifuge tube labeled "BLANK"	
1	Small cooler used as incubation chamber	
1	1,000-mL plastic beaker to holding centrifuge tubes during incubation	
5	Sediment metabolism sample labels (each with different ID number)	
1	Field Measurement Form	
	Soft (#2) lead pencils to fill in field data forms	
	Fine tip indelible markers for preparing labels	
1 pkg	Clear tape strips for covering labels	
1	Cooler with bags of ice to store sediment metabolism samples	
1 copy	Field operations and methods manual	
1 set	Laminated sheets of procedure tables and/or quick reference guides for sediment community metabolism	

Figure 8-3. Checklist of equipment and supplies for sediment metabolism.