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STANDARD OPERATING PROCEDURE

Instructions for sampling benthic macroinvertebrates in wadeable waters using the multi-habitat method (Non-point source)

KEY WORDS

Bioassessment, aquatic insects, benthic macroinvertebrates

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1.0 INTRODUCTION

1.1 Purpose

This Standard Operation Procedure (SOP) discusses the specific method for sampling benthic macroinvertebrates in wadeable surface waters, using a modified version of the U.S. EPA Multi-Habitat method.

1.2 Definitions

1.2.1 Reach – A 100-meter section of a stream or creek to be sampled

1.2.2 Riffle – A stretch of choppy water caused by a rocky shoal or sandbar

1.2.3 Run – A stretch of smooth flowing water, not choppy

1.2.4 Transect – A transverse line perpendicular to the flow of water

1.2.5 Jab – Thrusting the net into vegetation, holding the net still while rubbing the vegetation (1 x 2 ft section), allowing any attached macroinvertebrates to fall into the net. When no flow is present, sweep the area of the water with the net once the vegetation has been rubbed.

1.2.6 Kick – A stationary sampling accomplished by positioning the net and disturbing the substrate in a 1 x 2 foot area (with feet), for approximately 30 seconds, upstream of the net.

1.2.7 Sweep – To move the net through the water, back and forth.

2.0 MATERIALS

2.1 100-meter measuring tape

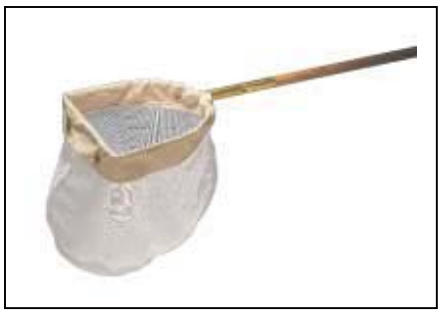
2.2 D-framed kick net (0.5mm mesh)

2.3 1-pint or larger plastic containers

2.4 Plastic tray (i.e. 9 x 12 inches)

2.5 Forceps

2.6 Denatured alcohol



2.7 Gloves with rubber palms

2.8 Water quality field data form

2.9 Physical habitat quality form

2.10 Bleach

2.11 5-gallon bucket

2.12 Small pieces of white paper (approximately 2 inches by 2 inches) to use as labels

2.13 Pencils

3.0 PROCEDURES

Instructions included here are modified from the following documents:

- California Department of Fish and Game, 1999. California Stream Bioassessment Procedure. Aquatic Bioassessment Laboratory.
- U.S.EPA, 2001, Western Pilot Study Field Operations Manual for Wadeable Streams

3.1 Determining the reach

3.1.1 Each sampling site will consist of a reach of a stream or creek. The reach will be 100 meters in length. It should begin 100 feet above or below any bridge abutment or structure to avoid hydrology differences caused by the obstruction.

3.1.2 Prior to sampling, document the site description by mapping the reach. The map should include habitat-types (e.g., riffles, pools, bends, ect.) and important structures, plants and attributes of the stream and bank area. Indicate direction of flow and each sampling point within the reach.

3.1.3 Further document the site by photographing the reach.

3.1.4 Collect water quality data and additional physical habitat data by completing the Physical Characterization/Water Quality Field Data sheet and the Physical Habitat Quality sheet as instructed. Unless otherwise noted on the form, physical habitat data should be collected at the 0, 50, and 100 meter marks and averaged.

3.2 DETERMINING SAMPLING POINTS

3.2.1 Samples are collected from the reach in approximate proportion to their representation of all major habitat types in the reach. For example, if 20% of the habitat consisted of cobble then 20% of the samples would be collected from cobble habitat. Habitat types contributing less than 5% of the habitat will not be sampled.

3.3 SAMPLING PROCEDURE

3.3.1 There will be a total of 20 jabs or kicks collected per reach. The following stream habitat types are those that are colonized by macroinvertebrates and generally support the diversity of the macroinvertebrate assemblage in stream ecosystems. The sampling site may contain additional habitats not included here. A combination of all habitats should be sampled.

3.3.1.1 Cobble (hard substrate) – Cobble will be prevalent in the riffles (and runs), which are a common feature throughout most high-gradient streams. In low-gradient streams riffles are not a common feature. Sample cobble by holding the bottom of the kick-net against the substrate, and then dislodge organisms by kicking or rubbing the substrate by hand (using rubber-palmed gloves if possible) for approximately 30 seconds.

3.3.1.2 Snags – A tree or other woody debris that has been submerged for a relatively long period (not recent deadfall). Sample snags by jabbing the net into medium-sized snag material (sticks and branches), or after the net is placed downstream of the snag, the snag may be kicked to help dislodge organisms. Large logs will be avoided because they are generally difficult to sample adequately.

3.3.1.3 Vegetated banks – Submerged lower banks with roots and emergent plants should be sampled similar to snags. Sample by jabbing the net into the habitat. The bank habitat may also be kicked to help dislodge organisms, but only after placing the net downstream. When no flow is present, sampling can be done by holding the net still and shaking or rubbing the vegetation in the water, allowing any attached macroinvertebrates to fall into the net.

3.3.1.4 Submerged macrophytes – Aquatic plants that are rooted on the bottom of the stream are seasonal in occurrence and may not be common in high-gradient streams. Sample submerged macrophytes by bumping or jabbing the net along the bottom of the stream in the rooted areas, avoiding sediments where possible.

3.3.1.5 Sand (and other fine sediment) – This habitat may be very prevalent in some streams. It is the least productive macroinvertebrate habitat. Sample sand by holding the bottom of the kick-net against the substrate and by disturbing a 1 x 2 foot area just upstream of the net, with ones feet, allowing disturbed macrophytes to flow into the net. When water flow is very low bump the net along the surface of the substrate or disturb the area with ones feet and then sweep the net through the water above.

3.3.1.6 Mud – Wet, soft soil. This habitat may be very prevalent in some streams. It is a very unproductive macroinvertebrate habitat. Sample mud by bumping the net along the surface of the substrate, or by disturbing the area with ones feet and then sweep the net through the water above, similar to 3.3.1.5.

3.3.2 Begin sampling at the downstream end of the reach and proceed upstream until all 20 kicks or jabs have been collected.

3.3.3 A single sample will be a composite of these 20 jabs or kicks, for a total of one sample per reach.

3.3.4 Rinse the sample to the bottom of the net by splashing creek water on the net. Remove the larger twigs, leaves and rocks by hand after carefully inspecting for clinging organisms. Place a pan under a sample container to catch spills as the net is carefully inverted, transferring the sample from the net to the container.

3.3.5 Fill the container with denatured alcohol. Gently agitate the container to ensure thorough mixing of ethanol and sample. Do not fill a jar more than 2/3 full with sampled material so that complete ethanol coverage of the sample will allow for proper preservation.

3.3.6 Place a label (written on white paper and in pencil) inside the container with the following information:

- Stream name
- Reach number or location
- Date/time
- Sampler name(s)

3.3.7 Complete a chain of custody (COC) form for each sample according to protocol and SOP ADMN006.00.

4.0 MAINTENANCE OF SAMPLING EQUIPMENT

4.1 Nets and any wading equipment used should be rinsed in a 1% bleach solution after use in each reach.

4.2 When sampling is complete inspect nets for tears or damage and repair as needed.

5.0 SAMPLE STORAGE

5.1 For long-term storage, samples should be regularly checked for alcohol loss and degradation of the sample.

5.1.1 Within one week of sample collection, replace alcohol with new alcohol. A second and final replacement of alcohol should be conducted on the samples three weeks after sample collection. The samples can be stored up to one year in the final replacement alcohol.

5.1.2 Inspect alcohol level in samples every three months and refill as necessary.

5.2 Samples will be stored in a nonflammable cabinet at less than or equal to 25º C, until sample disposal has been approved.

6.0 REFERENCES

California Department of Fish and Game, 1999. California Stream Bioassessment Procedure. Aquatic Bioassessment Laboratory.

Harrington, J. and M. Born. 1999. Measuring the Health of California Streams and Rivers. Sustainable Land Stewardship International Institute.

U.S.EPA, 2001. Environmental Monitoring and Assessment Program – Surface Waters: Western Pilot Study Field Operations Manual For Wadeable Streams. Regional Ecology Branch, Western Ecology Div., Natl. Health and Env. Effects Research Lab.

Physical Characterization/Water Quality Field Data Sheet

(Modified EPA multi-habitat method)

Study #: _____ **Date/Time:** _____

Sampling Crew: _____ **Location:** _____

Weather Conditions:

_____

GPS Coordinates		**Site Information**		**Water Quality**	
Lat:		Reach Length:		Temperature	
Long:		Physical habitat quality score:		EC (µS/cm)	
Elevation:				DO (mg/L)	
% canopy cover:				pH	

(Canopy cover = Avg. of 3 measurements taken from center channel, top, middle, and bottom of reach)

Sample #s

OP	
DI	
PY	
TR	
BU	
Insects	
Sediment	

Water odors: (i.e. normal, fishy, sewage) _____

Water Surface Oils: (i.e. slick, sheen, globs, flecks, none) _____

Turbidity: (i.e. clear, slightly turbid, turbid, opaque, stained)

Comments: _____

_____

_____

Watershed features		**Local watershed NPS pollution**	
Forest		No evidence	
Field/Pasture		Some potential sources	
Agricultural		Obvious sources	
Residential		**Local watershed erosion**	
Commercial		None	
Industrial		Moderate	
Other		Heavy	

Instream features

Stream width is an avg. of 3 measurements taken from top, middle, and bottom of reach.

Stream depth and velocity is an avg. of 3 measurements taken across the width of the creek.

			0 m	50m	100m
Reach length (m)		Stream depth			
Stream width (m)		Surface velocity (ft/sec)			
Sampling reach area (m^2)		(feet x 0.3048m = meters)			
Area in km^2 (m^2x1000)		(yards x 0.9144m = meters)			

Aquatic vegetation (Indicate the dominant type (%) and record the dominant species present)

Rooted emergent		Free floating	
Rooted submergent		Floating algae	
Rooted floating		Attached algae	
Dominant species present			

Portion of the reach with aquatic vegatation _____

Inorganic substrate components (should add up to 100%)			**Organic substrate components** (does not necessarily add up to 100%)	
Substrate type	**Diameter**	**% Composition in sampling reach**	**Substrate type**	**% Composition in sampling area**
Bedrock			Detritus (Sticks, wood, coarse plant materials (CPOM))	
Boulder	>256 mm(10")			
Cobble	64-256mm(2.5-10")		Muck-mud (Black, very fine organic (FPOM))	
Gravel	2-64mm(0.1-2.5")			
Sand	0.06-2mm(gritty)		Marl (Grey, shell fragments)	
Silt	0.004-0.06mm			
Clay	<0.004mm (slick)			

Habitat Types (Indicates the % of each habitat type present)

Cobble	_____	Sand and fine sediment	_____	Submerged macrophytes	_____
Gravel	_____	Snags	_____	Other	_____
Mud	_____	Vegetated Banks (undercuts & overhangs)	_____		

Diagram of reach and sampling locations:

HABITAT ASSESSMENT FIELD DATA SHEET

Low Gradient Streams

STREAM NAME:		Location	
STATION #:		STREAM CLASS:	
LAT:	LONG:	RIVER BASIN:	
STORET #:		AGENCY	
INVESTIGATORS:			
FORM COMPLETED BY:	DATE: TIME: AM PM	REASON FOR SURVEY	

Parameters to be Evaluated in Sampling Reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/Available Cover	Greater than 50% of substrate favorable for epifaunal condition and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hardpan clay or bedrock; no root mat or vegetation.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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Parameters To Be Evaluated Broader Than Sampling Reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (i.e., dredging greater than 20 years ago) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In-stream habitat greatly altered or removed entirely.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 and 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 and 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: Determine left or right side by facing downstream.	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score: _____

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