California Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street, Sacramento CA 95814-2828
P.O. Box 4015, Sacramento CA 95812-4015

STANDARD OPERATING PROCEDURE

Instructions for sampling for benthic macroinvertebrates in wadeable waters using the California Stream Bioassessment Procedure (Non-point source)

KEY WORDS

Bioassessment, aquatic insects, benthic macroinvertebrates

APPROVALS

APPROVED BY: _____ DATE: 5/14/2003
Kean Goh, Ph.D.
Environmental Monitoring Branch Management

APPROVED BY: _____ DATE: 4/25/03
James Harrington
Dept. of Fish & Game, Consulting Senior Scientist

APPROVED BY: _____ DATE: 4/29/03
Carissa Ganapathy
Environmental Monitoring Branch Quality Assurance Officer

PREPARED BY: _____ DATE: 4/28/03
Juanita Bacey
Environmental Research Scientist

Environmental Monitoring Branch organization and personnel, such as management, senior scientist, quality assurance officer, project leader, etc., are defined and discussed in SOP ADMN002.

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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 the California Stream Bioassessment Procedure. This document includes modifications for low-gradient sites.

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 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 California bioassessment worksheet
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 length of the reach is determined by the presence and repetition of geomorphic channel characteristics (i.e. pool, run, riffle) as described in section 3.2. When various characteristics are not present, the reach should be 100 meters in length (see section 3.2.3). It should begin approximately 30 meters above or below any bridge abutment or structure to avoid hydrology differences caused by the obstruction.

3.1.2 There will be a total of three samples collected per reach. A single sample will be a composite of three sub-samples collected from each riffle or transect. Samples will be collected using a D-framed kick-net as described in section 3.3.

3.1.3 Before sampling, document the site by photographing the reach and collecting water quality data. The California Bioassessment Worksheet and the Physical Habitat Quality form can be completed before or after sampling reach. Follow the instructions on the forms to complete. Unless otherwise noted on the forms, physical habitat data should be collected from each riffle or transect.

3.2 Determining the sampling point

3.2.1 Riffles present: The length of the reach is dependent on the presence of riffles. A minimum of three riffles must be present within the reach. Randomly select three riffles to collect samples from (fig. 1). From the upstream third of each riffle, collect three sub-samples (net-widths across) and composited into one sample (fig. 2). Repeat in the other selected riffles.

Figure 1

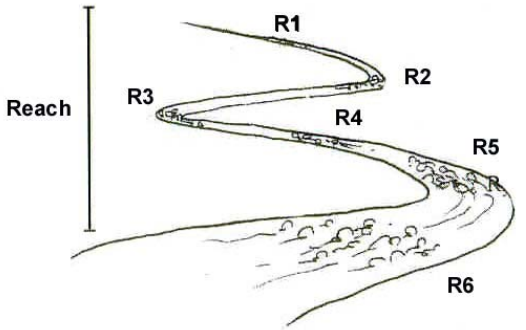
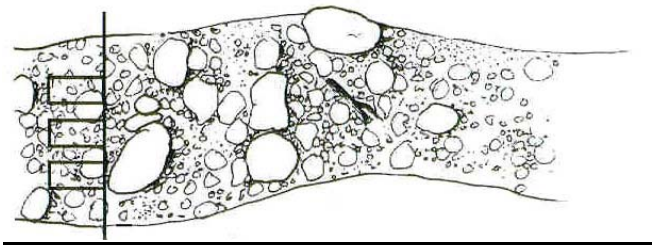


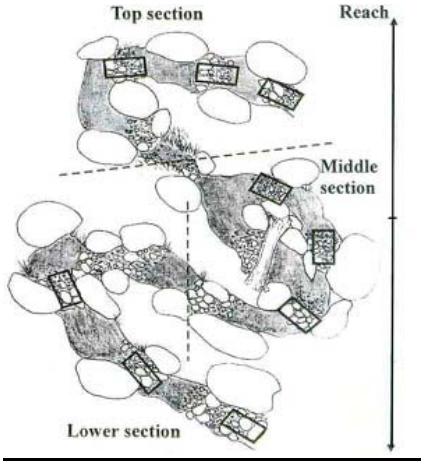
Figure 2



Harrington and Born, 1999

3.2.2 Narrow stream reach (with riffles): If the stream width is too narrow to collect three net-widths across, partition the reach into three sections, upper, middle, and lower. Within each section identify all possible 1x2 square-foot areas, and randomly pick 3 of these areas from which to collect the sample (one from each section, top, middle and lower, fig. 3). Combine these 3 into one composite sample. You will obtain a total of 3 composite samples.

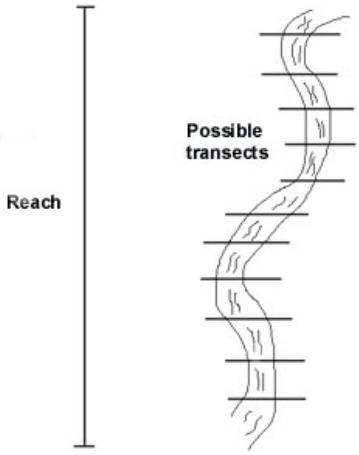
Figure 3



Harrington and Born, 1999

3.2.3 No riffles present: When no riffle-pool sequence is present select a 100-meter length reach representative of the characteristics of the stream. Stretch a 100m measuring tape along the bank. Each meter mark represents a possible transect location (fig. 4). Randomly select 3 transects to collect samples from. Collect three sub-samples (net-widths across as per section 3.3) from each transect and composite into one sample per transect. If the transect is not homogeneous, each sub-sample should be taken from the various habitats found on that transect.

Figure 4



3.3 Sample Collecting with a D-frame net

3.3.1 Begin at the farthest, randomly selected downstream riffle or transect. Collect 3 sub-samples from the upstream third of each riffle or directly along the randomly selected transect as described in section 3.2. An obstruction could alter the actual placement of the net. The sub-samples will consist of one collection taken from each side margin and one from the center of the stream.

3.3.2 The net opening is held perpendicular to the direction of flow and held tightly against the stream bottom so that as substrate is disturbed in front of the net, invertebrates flow into it.

3.3.2.1 Moderate to high gradient/coarse substrates (mixed gravel, cobble or larger) - Disturb a 1 x 2 foot section of substrate upstream of the net to approximately 4 to 6 inches in depth. Pick-up and scrub large rocks by hand under water in front of the net.

3.3.2.2 Low gradient/sandy or silty sediments – Sample 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.

3.3.2.3 Snags and vegetated banks – To sample submerged woody debris or banks with protruding roots and plants hold the net still and rub 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.

3.3.3 Maintain a consistent collection/disturbing of substrate for each sub-sample of approximately 1 to 3 minutes.

3.3.4 By splashing creek water on the net, rinse the sample to the bottom of 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 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
- Riffle/transect number
- Date and time
- Sampler name(s)

3.3.7 Proceeding upstream, repeat the above steps for the next two riffles or transects within the stream reach.

3.3.8 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 ethanol 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.

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California Bioassessment Worksheet

(CSBP Method: Low Gradient)

Study #:_____ Date/Time:_____

Sampling Crew: _____ Location: _____

Weather conditions: _____

Site Information

GPS Coordinates:

Lat: _____

Long: _____

Elevation: _____

Water Quality

Temperature _____

EC _____

DO (mg/l) _____

pH

Insect sample #'s: _____

_____

Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

Non-Point Source Sampling Design

Reach Length: _____

Percent Gradient: _____

Physical habitat quality score: _____

	Trans 1	Trans 2	Trans 3
Trans. Loc.:			
Avg. stream Width (meter)			
Avg. stream depth (cm)			
Stream velocity (ft/sec)			
Canopy cover:			
Substrate characterization:			
% Organic material:			
Substrate particle size (%):			
Mud (<0.1")			
Sand (~0.1")			
Gravel (0.1-2")			
Cobble (2-10")			
Boulder (>10")			
Bedrock (solid)			
Hardpan clay			
Substrate consolidation:			
(loose, ect)			

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

Aquatic Toxicology Laboratory
VM: APC
1321 Haring Hall
University of California, Davis
Davis, CA 95616
(530) 752-0772

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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