



History and Evolution of the CSBP

November 2, 2005

Jim Harrington

WPCL Bioassessment Laboratory

California Department Of Fish and Game

Hot Creek Hatchery NPDES Permit Requirements 1993



Early Influences:

Point Source Design

Dave Herbst (SNARL)

USGS Richest Habitat

Rapid Biological Assessment

California Stream Bioassessment Procedure

(CSBP 1993, 1996 - 1999)

Cost effective

**0.5 mm Mesh
D-frame Net
Richest Habitat (Riffle)
Sample 18 ft² Habitat
3 Replicate Samples**



**Benthic
Macroinvertebraes**

CSBP 1993-1999

Sampling Universe is
Typically 5
Pool-Riffle Sequences

Randomly Pick 3 Riffles

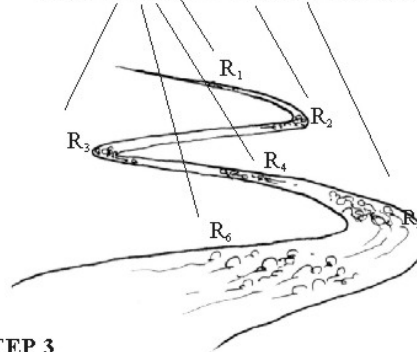
1 Sample Per Riffle

3 Samples Per Reach

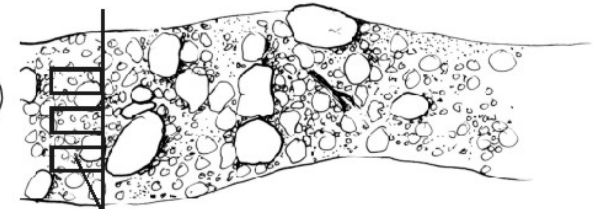
Graphic from Harrington and Born (2000)

Reach Design

STEP 1
Randomly select 3 riffles from your reach

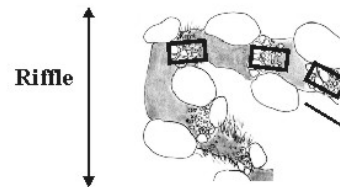


STEP 2
Randomly select 1 transect within the top 1/3 of riffle



STEP 3
Collect and combine from both margins and the thalweg, to obtain a representation of the whole width of the riffle.
Do this for each of the 3 randomly chosen riffles.

Excavate a total of 2ft²
1 net width (12 inches) x 2 feet
at each point

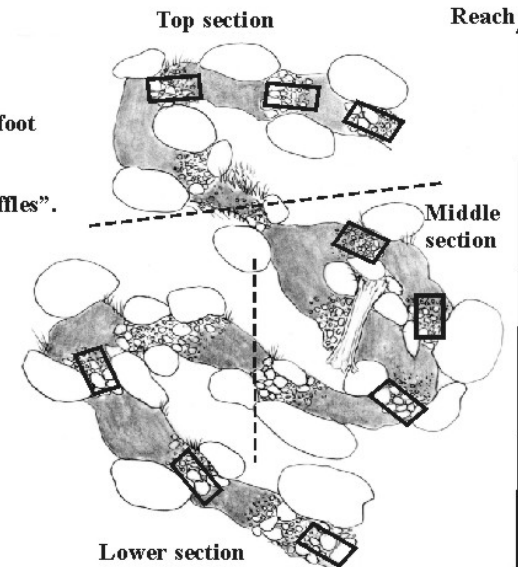


If the stream width is too narrow to collect three net-width across, randomly pick 3 square-foot from all the possible 1x2 sections in the riffle.

3- 1x2 section sampled out of 14 possible areas.

If your reach does not contain "traditional" riffles, divide the reach into top, middle and lower sections, and collect from three 1x2 area in each section, randomly picking 3 -1x2 square-foot to sample from all the possible 1x2 sampleable areas in the section.
In this instance, the sections function as your "riffles".

9- 1x2 areas sampled out of 14 possible.



**BENTHIC MACROINVERTEBRATE
SAMPLING USING THE CSBP**

**DELINIATE RIFFLE
USING TAPE**





LEFT MARGIN



CENTER



RIGHT MARGIN





**COMPOSITE INTO
ONE SAMPLE**

A person wearing a tan jacket and shorts is crouching in a field of tall grass and rocks. They are holding a large, light-colored net with a metal frame. A small jar with a white lid is on the ground nearby. The scene is outdoors with natural lighting.

**AND REPEAT
FOR
3 RIFFLES**

**PLACE IN JAR
AND REPEAT**

RBP FIELD WORKSHEET

CALIFORNIA DEPARTMENT OF FISH AND GAME
WATER POLLUTION CONTROL LABORATORY

WATER POLLUTION CONTROL LABORATORY
REVISION DATE - MAY 1999

CALIFORNIA BIOASSESSMENT WORKSHEET

WATERSHED/STREAM: _____ DATE/TIME: _____
COMPANY/AGENCY: _____ SAMPLE ID NO.(S): _____
SITE DESCRIPTION: _____

CREW MEMBERS

| |
|--|
| |
| |
| |

SITE LOCATION

GPS Coordinates
LONG: _____
LAT: _____
Elevation: _____
Ecoregion: _____
COMMENTS: _____

CHEMICAL CHARACTERISTICS

Water Temperature: _____
Specific Conductance: _____
pH: _____
Dissolved Oxygen: _____

Bioassessment Laboratory Information:

FOR MORE INFORMATION CONTACT:
DFG - WPCL
Rancho Cordova, Ca. 95670
Fax (916) 985-4301
dfg.ca.gov/cabw/cabwhome.html

RIFFLE/REACH CHARACTERISTICS

Point Source Sampling Design

Riffle Length: _____
Transect 1: _____
Transect 2: _____
Transect 3: _____
(Round Physical/Habitat Characteristic values in riffle 1 column)

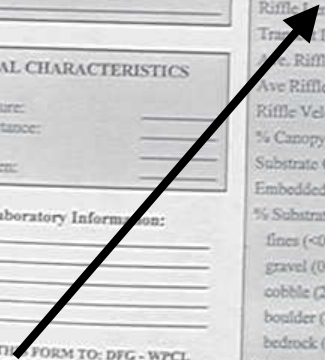
Non-Point Source Sampling Design

Reach Length: _____
Physical/Habitat Quality Score: _____

Physical/Habitat Characteristics

| | riffle 1 | riffle 2 | riffle 3 |
|--------------------------|----------|----------|----------|
| Riffle Length: | _____ | _____ | _____ |
| Transect Location: | _____ | _____ | _____ |
| Ave. Riffle Width: | _____ | _____ | _____ |
| Ave Riffle Depth: | _____ | _____ | _____ |
| Riffle Velocity: | _____ | _____ | _____ |
| % Canopy Cover: | _____ | _____ | _____ |
| Substrate Complexity: | _____ | _____ | _____ |
| Embeddedness: | _____ | _____ | _____ |
| % Substrate: | | | |
| fines (<0.1") | _____ | _____ | _____ |
| gravel (0.1-2") | _____ | _____ | _____ |
| cobble (2-10") | _____ | _____ | _____ |
| boulder (>10") | _____ | _____ | _____ |
| bedrock (solid) | _____ | _____ | _____ |
| Substrate Consolidation: | _____ | _____ | _____ |
| % Gradient: | _____ | _____ | _____ |

PYSICAL-HABITAT CHARACTERISTICS



For Each of the 3 Riffles:

Riffle Velocity

Canopy Cover

Substrate Complexity

Embeddedness

Substrate Composition

Substrate Consolidation

Gradient

CALIFORNIA DEPARTMENT OF FISH AND GAME
AQUATIC BIOASSESSMENT LABORATORY

WATER POLLUTION CONTROL LABORATORY
REVISION DATE - MAY 1999

CALIFORNIA BIOASSESSMENT WORKSHEET

WATERSHED/STREAM: _____ DATE/TIME: _____
COMPANY/AGENCY: _____ SAMPLE ID NO./S: _____
SITE DESCRIPTION: _____

| CREW MEMBERS | |
|--------------|--|
| | |
| | |

| SITE LOCATION | |
|-----------------|--|
| GPS Coordinates | |
| LONG: | |
| LAT: | |
| Elevation: | |
| Ecoregion: | |
| COMMENTS: | |
| | |
| | |

| CHEMICAL CHARACTERISTICS | |
|--------------------------|--|
| Water Temperature: | |
| Specific Conductance: | |
| pH: | |
| Dissolved Oxygen: | |

| RIFFLA/REACH CHARACTERISTICS | | | |
|---|----------|----------|----------|
| Point Source Sampling Design | | | |
| Riffle Length: | | | |
| Transect 1: | | | |
| Transect 2: | | | |
| Transect 3: | | | |
| <i>(Record Physical/Habitat Characteristic values in riffle 1 column)</i> | | | |
| Non-Point Source Sampling Design | | | |
| Reach Length: | | | |
| Physical/Habitat Quality Score: | | | |
| Physical/Habitat Characteristics | | | |
| Riffle Length: | riffle 1 | riffle 2 | riffle 3 |
| Transect Location: | | | |
| Ave. Riffle Width: | | | |
| Ave Riffle Depth: | | | |
| Riffle Velocity: | | | |
| % Canopy Cover: | | | |
| Substrate Complexity: | | | |
| Embeddedness: | | | |
| % Substrate: | | | |
| fines (<0.1") | | | |
| gravel (0.1-2") | | | |
| cobble (2-10") | | | |
| boulder (>10") | | | |
| bedrock (solid) | | | |
| Substrate Consolidation: | | | |
| % Gradient: | | | |

SEND A COPY OF THIS FORM TO: DFG - WPCL
2005 Nimbus Rd., Rancho Cordova, Ca. 95670
(916) 358-2858 FAX (916) 985-4301
Web Site: www.dfg.ca.gov/cabw/cabwhome.html

CALIFORNIA STREAM BIOASSESSMENT PROCEDURE

Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams

“Measurements of the chemical and physical/habitat characteristics are used to describe the riffle environment and help the water resource specialist interpret the BMI data. The information can be used to classify stream reaches and to explain anomalies that might occur in the data. They are not necessarily a good substitute for a quantitative fisheries habitat survey.”

EPA PHYSICAL/HABITAT QUALITY PROCEDURE

CALIFORNIA DEPARTMENT OF FISH AND GAME WATER POLLUTION CONTROL LABORATORY
 QUANTICO RECREATION LABORATORY WATER POLLUTION CONTROL LABORATORY
 REVISION DATE - MAY 1999

PHYSICAL/HABITAT QUALITY

California Stream Bioassessment Procedure

WATERSHED/STREAM: _____ DATE/TIME: _____
 COMPANY/AGENCY: _____ SAMPLE ID NO.(S): _____
 SITE DESCRIPTION: _____

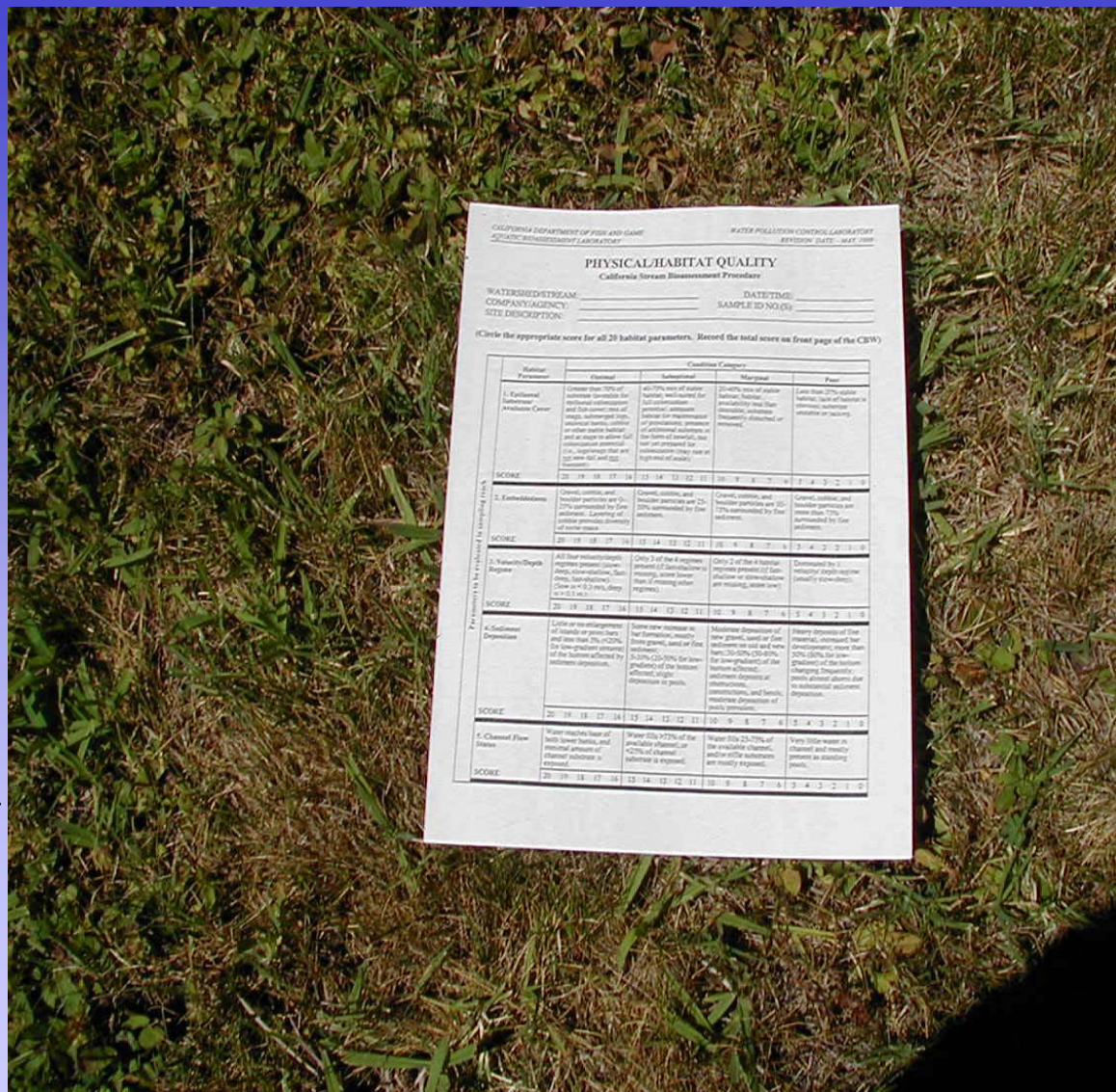
(Circle the appropriate score for all 20 habitat parameters. Record the total score on front page of the CBW)

| Habitat Parameter | Condition Category | | | |
|--|--|--|--|---|
| | Excellent | Substantial | Marginal | Poor |
| 1. Epifaunal Invertebrate Availability/Cover | Greater than 70% of substrate (available for epifaunal invertebrates) and 50% cover; mix of emergent forms, surface or other suitable habitat, and an edge to allow (1) attachment potential (i.e., logarithm that are not well flat and not rounded). | 40-70% mix of suitable habitat, available for full colonization potential; adequate balance for measurement of productivity; presence of additional substrate in the form of twigs, but not yet prepared for colonization (they may be high end of scale). | 20-40% mix of suitable habitat; suitable invertebrate diversity may be limited; substrate possibly disturbed or removed. | Less than 20% suitable habitat; lack of habitat in stream; 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. Embellishments | Creek, cotton, and twigs; particles are 50-75% surrounded by fine sediments. Layering of suitable provides diversity of some taxa. | Creek, cotton, and twigs; particles are 25-50% surrounded by fine sediments. | Creek, cotton, and twigs; particles are 10-25% surrounded by fine sediments. | Creek, cotton, and twigs; particles are less than 10% surrounded by fine sediments. |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All flow indicators (e.g., particles, debris, logs, twigs, etc.) show a 0.2 m/s, depth to 0.5 m/s). | Only 3 of the 4 regimes present (i.e., 3 of the 4 is missing, score lower than if missing other regimes). | Only 2 of the 4 regimes present (i.e., 2 of the 4 is missing, score lower). | Dominated by a velocity/depth regime (usually slow-deep). |
| 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 sands or pebbles and less than 2% (v20%) for (open stream) or of the bottom affected by sediment deposition. | Some new increase in bed formation, mostly from gravel, sand or fine sediment; 5-10% (v20-50%) for low-priority of the bottom without slight depression in pools. | Moderate deposition of new gravels, sand or fine sediment; no old and new bars; 30-50% (v50-80%) for low-priority of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pebbles present. | Heavy deposits of fine material; increased bar formation; more than 50% (50%) for low-priority of the bottom; changing frequency; 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 50% (v75%) of the available channel; or <20% of channel substrate is exposed. | Water 25-50% of the available channel, and/or 10% substrate 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 |

Parameters to be evaluated in sample truck

EPA RBP P/hab Quality (Barbour et al. 1999):

- 1 Epifaunal Substrate
- 2 Embeddedness
- 3 Velocity/Depth
- 4 Sediment Deposition
- 5 Channel Flow Status
- 6 Channel Alteration
- 7 Frequency of Riffles
- 8 Bank Stability
- 9 Vegetative Protection
- 10 Riparian Vegetation Zone Width



CALIFORNIA DEPARTMENT OF FISH AND GAME WATER POLLUTION CONTROL LABORATORY
QUALITY MANAGEMENT LABORATORY DIVISION (DATE: MAY 1999)

PHYSICAL/HABITAT QUALITY
California Stream Assessment Procedure

WATER/STREAM: _____ DATE/TIME: _____
COMPANY/AGENCY: _____ SAMPLE ID NO. (S): _____
SITE DESCRIPTION: _____

(Circle the appropriate score for all 20 habitat parameters. Record the total score on front page of the CRW.)

| Rating Parameter | Condition Category | | Score |
|---|--|--|-------|
| | Excellent | Poor | |
| 1. Channel/Velocity Cover Cover less than 70% of substrate (percentage for all reaches) indicates an easily submerged bank, submerged bank, or other bank feature and an open to slow full cross-sectional potential flow, appropriate flow for top new fall and old. | 40-70% use of substrate, well suited for aquatic life; bank cover better for riparian habitat; or additional sediment in the channel (level, but not unprepared for sedimentation) there was at high end of scale. | 20-40% use of substrate; bank feature probably not functional; sediment deposited or missing. | 1-3 |
| SCORE | 20 19 18 17 16 15 14 13 12 11 | 10 9 8 7 6 5 4 3 2 1 0 | |
| 2. Embankments Channel banks are 20% composed by fine sediments. Lapping of visible granules diversity of bank mass. | Channel banks are 20% composed by fine sediments. | Channel banks and bank particles are more than 70% lapped by fine sediments. | 1-3 |
| SCORE | 20 19 18 17 16 15 14 13 12 11 | 10 9 8 7 6 5 4 3 2 1 0 | |
| 3. Velocity/Depth Regime All flow measurements are present (scale 0-100%); flow velocity is 0.2 m/s, depth is 0.3 m. | Only 2 of the 4 measurements present (2 measurements missing, score lower than of missing other regime). | Only 2 of the 4 measurements present (2 measurements missing, score lower than of missing other regime). | 1-3 |
| 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 encroachment of stands or growth of low channel banks; no visible sediment deposition. | Some new increase in low channel banks; some growth, seed or fine sediment; 5-20% of the bank's surface of the bank's surface; slight encroachment or growth. | Marked deposition of new growth, seed or fine sediment on soil and new bank; 20-50% of the bank's surface of the bank's surface; slight encroachment; and bank's encroachment or growth of bank's perimeter. | 1-3 |
| 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 Lines Flow reaches base of both lower banks and channel adjacent to stream. | Flow 50-75% of the bank's channel; 25% of channel adjacent to stream is exposed. | Flow 25-50% of the bank's channel; and/or other sediments are mostly exposed. | 1-3 |
| SCORE | 20 19 18 17 16 15 14 13 12 11 | 10 9 8 7 6 5 4 3 2 1 0 | |

Advantage of EPA PHab Quality:

Nationally Standardized EPA Approved Procedure

Excellent educational tool

Requires very little time when done with biological sampling

One value reflecting all aspects of in-stream and riparian habitat

Disadvantage of EPA PHab Quality:

Some elements a problem for western arid streams

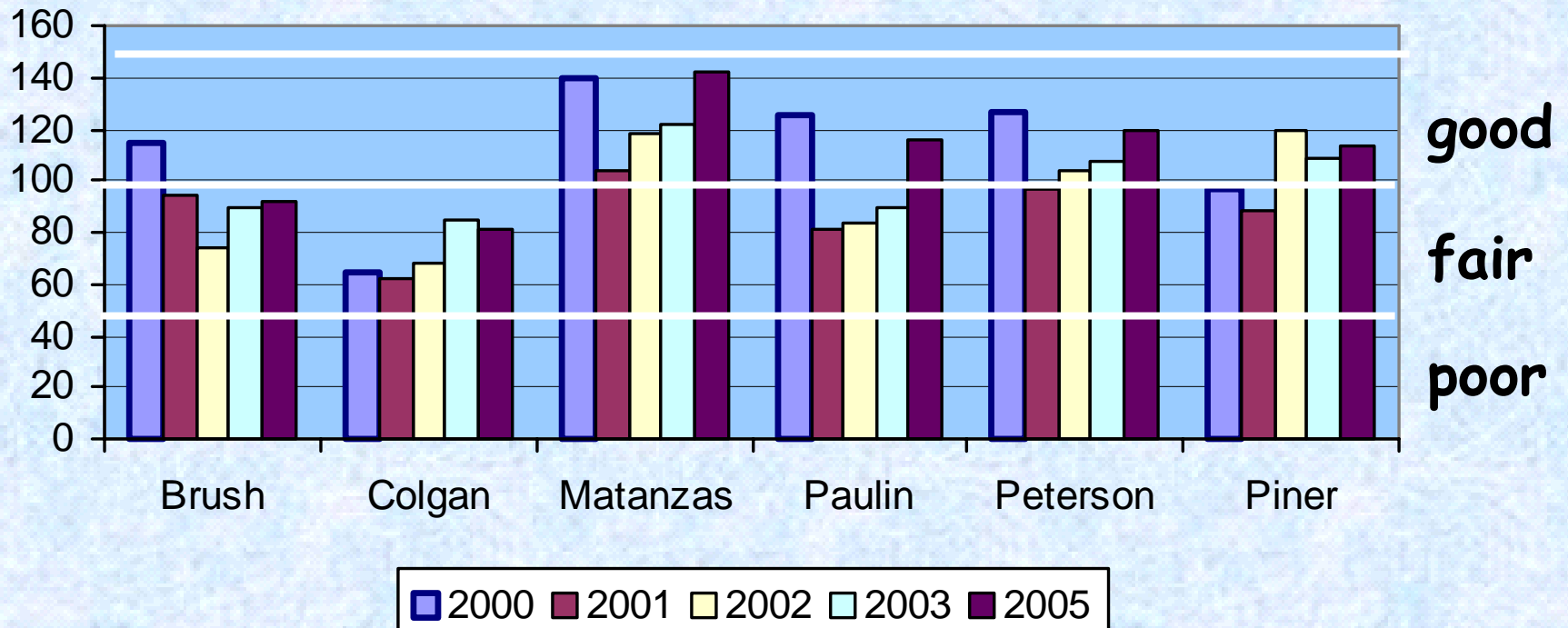
Prone to subjectivity and variability

Meant to give categorical not continuous values

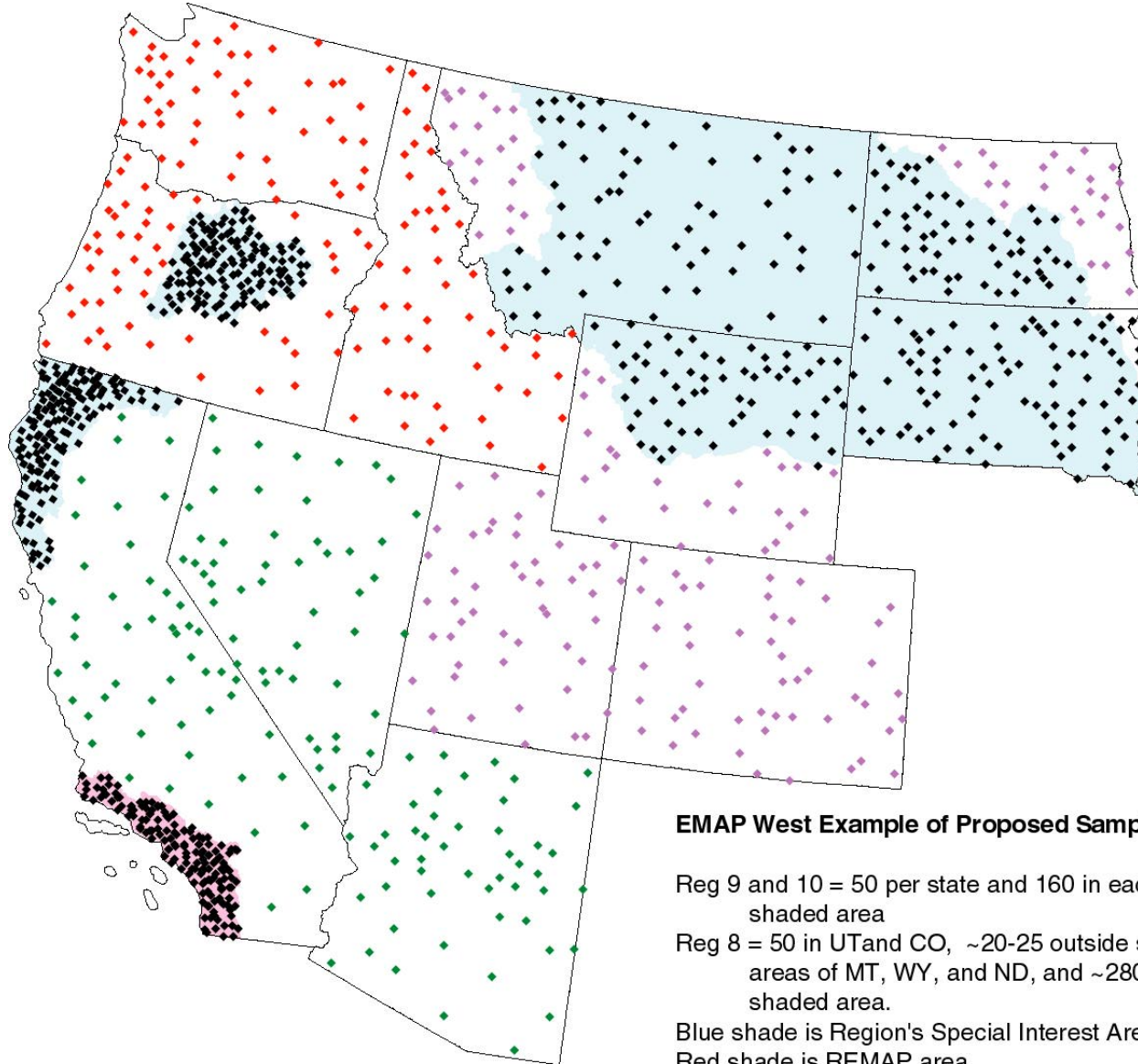
“This procedure is an effective measure of a stream’s physical/habitat quality, but requires field training prior to use and implementation of quality assurance measures throughout the field season.”

Variability in Urban Stream Scores

Physical/Habitat Scores



Environmental Monitoring and Assessment Program Western Pilot (EMAP-WP)



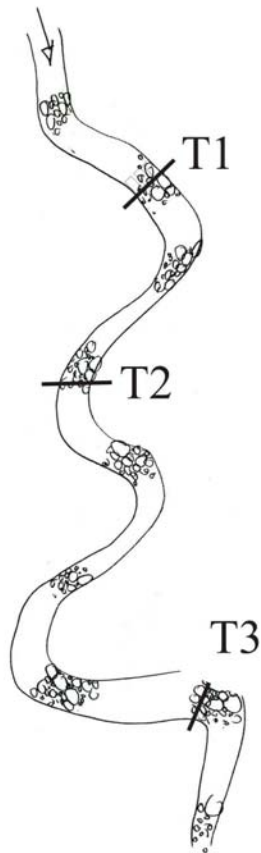
Calibration Study of CSBP with the EMAP Protocol

Sites sampled throughout California (across habitats, ecoregions, etc.)

Three methods used to sample each reach at the same time:

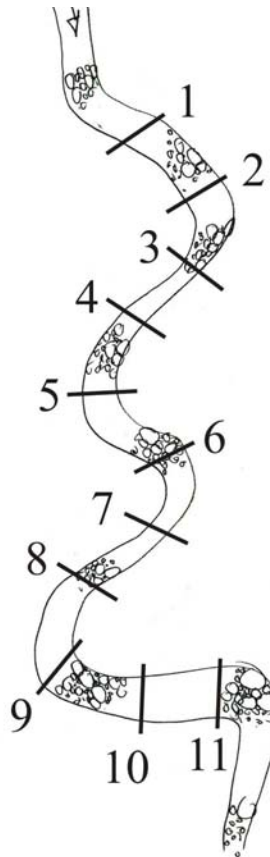
- EMAP (multihabitat)
- Hawkins (RIvPACS, USFS) (targeted riffle)
- CSBP (riffle)

CSBP



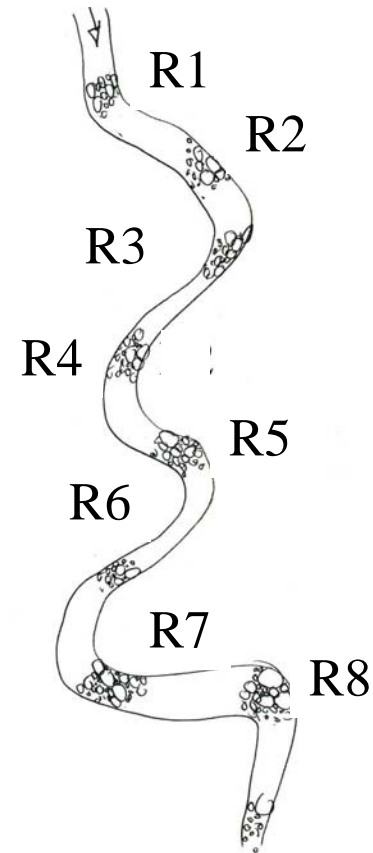
- 3- 2ft² areas composited at each of 3 transects
- 18ft² total area

Multi-hab

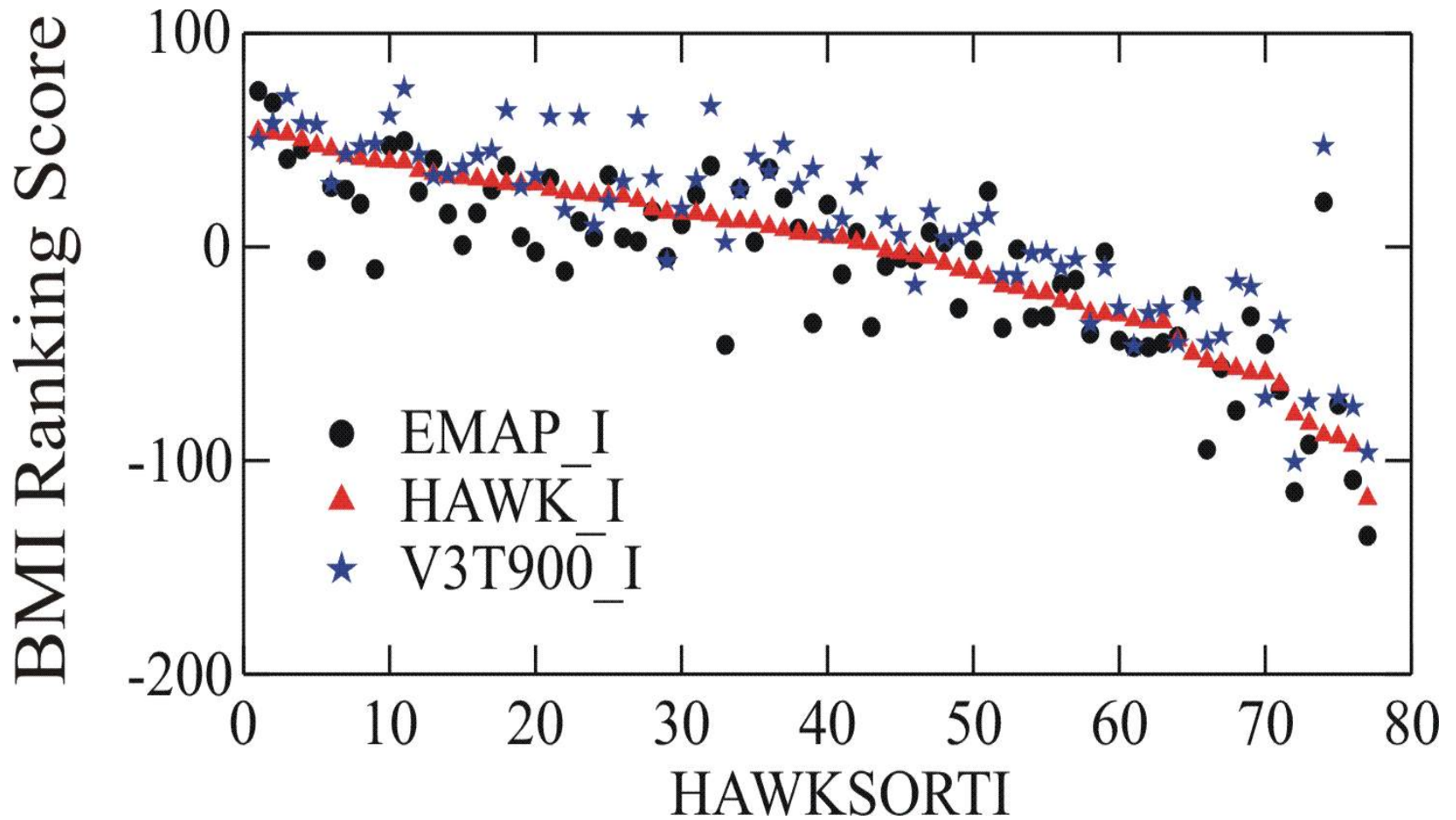


- 11- 1ft² areas composited at each site
- 11ft² total area

TargetedRiffle

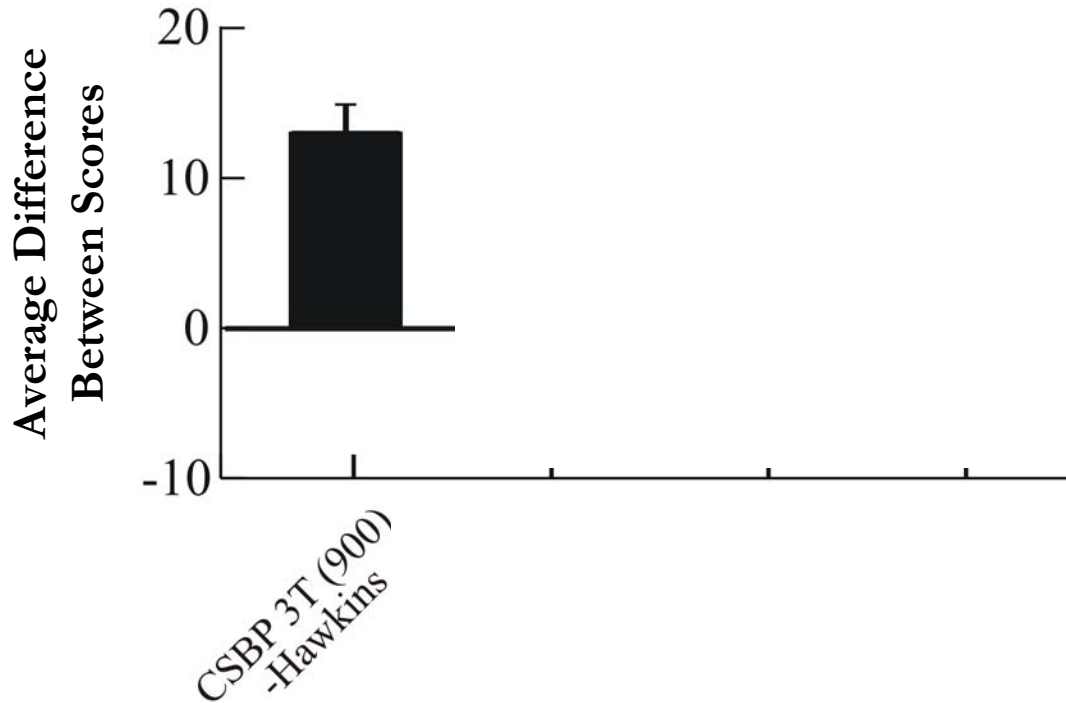


- 2- 1ft² areas at each of 8 riffles
- 8 ft² total area



Note: Variation appears exaggerated here because of use of BMI ranking score (IBI would compress the variation) and also because the Y axis is compressed.

Combining Data from Different Methods



Conclusion: CSBP and Hawkins/USFS are comparable with two modifications to CSBP

1. Combine all 3 CSBP transects into one cumulative taxa list for calculating metrics
2. Subsample 500 organisms from 900 organism (3*300) CSBP composite

Rapid Biological Assessment

California Stream Bioassessment Procedure

(CSBP 2003)

Cost effective

**0.5 mm Mesh
D-frame Net
Richest Habitat (Riffle)
Sample 9 ft² Habitat
3 Replicate Samples or
1 Composite**



**Benthic
Macroinvertebraes**

4 Notable Changes to CSBP

Stream Reach 100m

Area of Benthos Sampled is 9 ft²

Option to Composite the 3 Samples
and Subsample 500 Organisms

Collect Duplicate Samples at
10% of the Sites

CALIFORNIA STREAM BIOASSESSMENT PROCEDURE

Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams

“The BMI sampling procedures described in this Protocol Brief are intended for sampling wadeable, running water streams with available riffle habitats. There are modifications of this procedure for narrow (< 1m) streams, wadeable streams with sand or mud bottoms and channelized streams. Contact DFG for more information.”

MODIFICATIONS TO CSBP FOR UNUSUAL CHANNEL CONDITIONS

Intermittent or Ephemeral Channels

Bifurcated or Braided Channels

Channels <3 Feet Wide

Large Boulder Channels

Channels Immediately Below Water
Impoundments

MODIFICATIONS FOR UNUSUAL CHANNEL CONDITIONS

Cement Channels

Channels with Gradient Controls

*Channels with Three Channels with
Transitional Gradient*

CSBP for Homogeneous Channels



CSBP for Non-Wadeable Channels



Rapid Biological Assessment

California Stream Bioassessment Procedure (CSBP 2005)

for High and Low Gradient Streams

**Riffle Habitat for
High Gradient Streams**

**Multi-habitat for Low
Gradient Streams**

**Other Protocols
for Historic Projects**

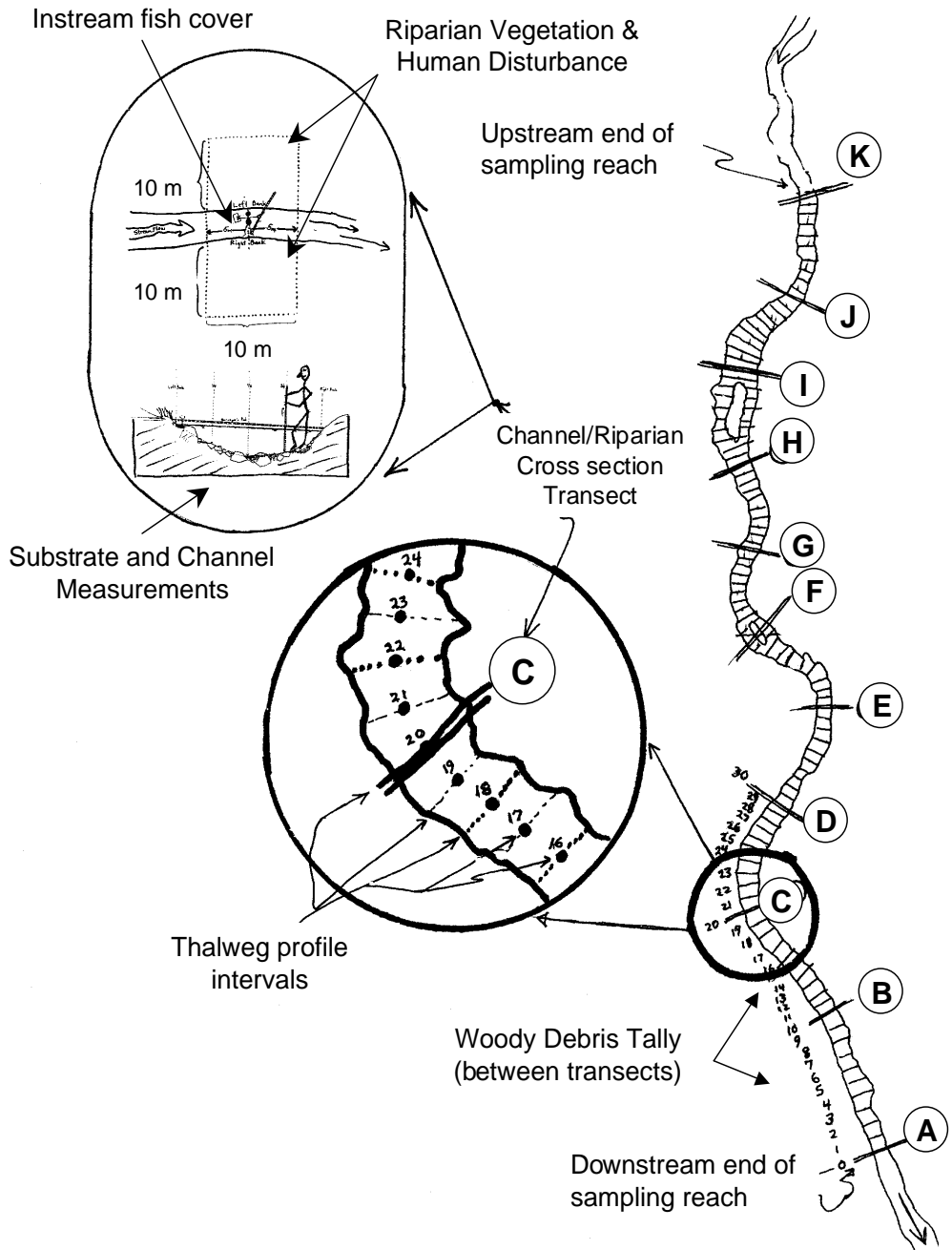
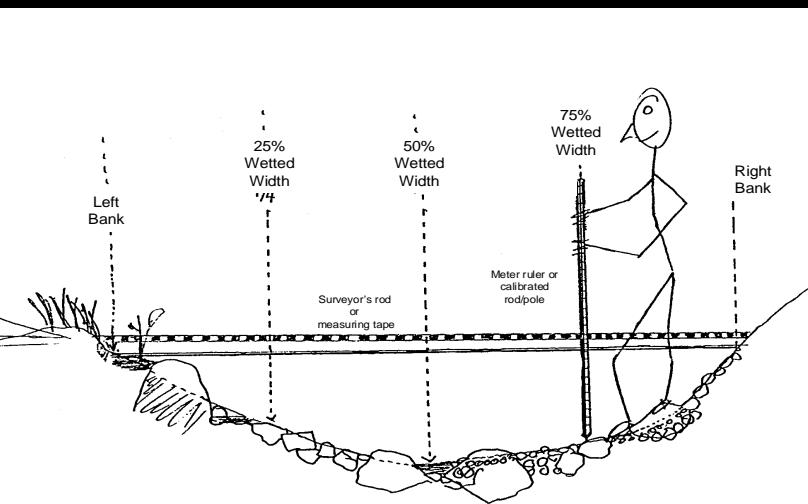
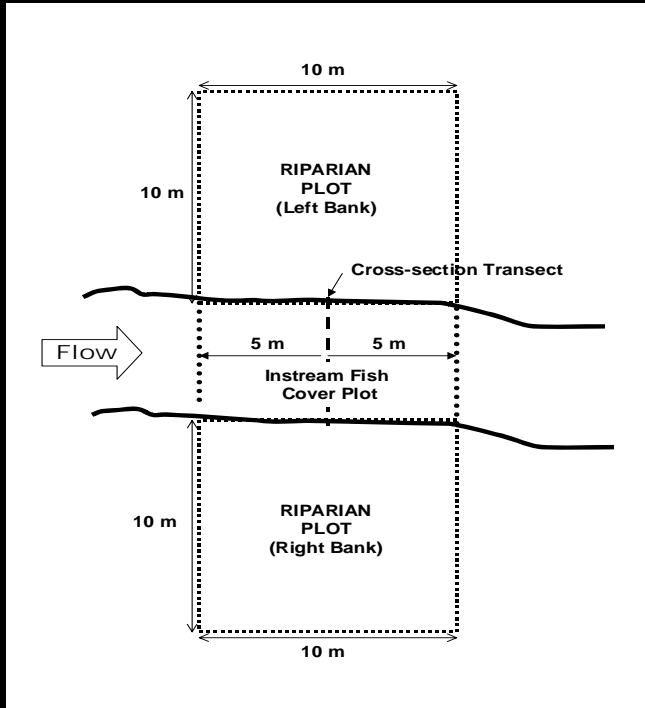


**Benthic
Macroinvertebrates**

EMAP WADEABLE STREAMS PROTOCOLS – 2004



EMAP Sampling Reach



A person wearing a green cap and khaki uniform is kneeling in a stream, using a densiometer to measure water density. The person is holding a long white transect line across the stream. The background shows a rocky stream bed and green vegetation.

Densimeter Readings on Transects

**Pebble counts
On Transects**





We need to discuss use of Phab data:

In ambient and compliance monitoring

In developmental data sets

What the endpoints will be and how
will they be used

Should an index for Phab be produced to
replace the EPA's RBP procedure