



Coeur d'Alene, Idaho
31 March – 4 April, 2003

Section 4f: Methods for Sampling Benthic Macroinvertebrates in Large Rivers

Presented by
**Joseph E. Flotemersch, USEPA,
Office of Research & Development**

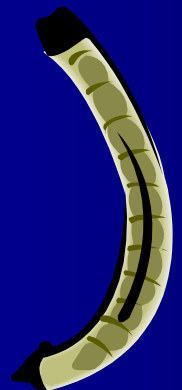


Benthic Macroinvertebrates

- Definition
 - *Benthic* - Inhabit the sediment or live on the bottom substrates
 - *Macroinvertebrates* - retained by the Standard No. 30 sieve (0.595 mm opening) Klemm et al. 1990
- Includes insects, oligochetes, leeches, molluska, crustaceans, others
- Both active and passive collection methods are commonly employed
- Not as commonly employed in non-wadeable systems as in wadeable

Benthic Macroinvertebrates

- Life history characteristics that make them useful indicators:
 - Many have short life cycles and fast reproduction
 - Present in a variety of habitats
 - Standardized protocols are well developed
 - Sampling has limited impact on resident biota
 - Are relatively sedentary
 - Sensitive to a wide range of chemical stressors
 - Broad range of pollution tolerant species
 - Response to stressors widely described
 - Many states have background data

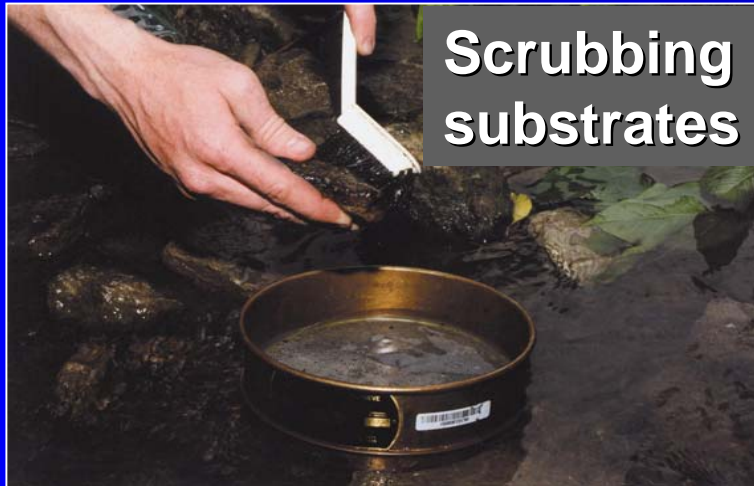


Benthic Macroinvertebrates Field Sampling

- Important questions to consider during program development.
 - Which methods?
 - Which habitats?(single vs. multi-habitat)
 - To composite or not to composite?
 - Which methods?
 - Allocation of samples?
 - How/where to process samples?
 - Identification
 - What is the final indicator?

Benthic Macroinvertebrates

Active Sampling Methods Examples



Picking

Net-based methods
(including kicks,
dips, jabs, sweeps,
& picks)



Grab samplers

Benthic Macroinvertebrates

Active Sampling Methods Examples

- Net-based examples
 - Quantitative - USEPA-EMAP – timed kick net (595 μm) sampling conducted at assigned transects
 - Qualitative - USGS-NAWQA – kicking, dipping, or sweeping all available habitats (212 μm)
 - Semi-Quantitative Methods – Pilot SAM method – combines timed kicks and dipping (595 μm)
 - Timed sampling / approximate set area
- Ponar example
 - Quantitative – Lower Missouri, depositional areas. ? Grabs per habitat unit.

Benthic Macroinvertebrates

Passive Sampling Methods Examples

- Quantitative



- Artificial substrates (Cairns 1982)

- Containers with various substrates (e.g., Rock Baskets)
 - Multiplate samplers (e.g., Hester-Dendy (Ohio EPA, ORSANCO))

- Drift-Nets

- USEPA-EMAP – timed deployment
 - Used in large river pilot studies
 - Could not be deployed at sites with insufficient flow velocities

Benthic Macroinvertebrates

Passive Sampling Methods Examples

- Quantitative
 - Ohio-EPA – Hester-Dendy artificial substrate samplers. Five samplers exposed for six weeks



Benthic Macroinvertebrates

Typical Field Site Processing

- Sample materials are usually composited
- Sieved to reduce excess water and mud
- Large objects (e.g., rocks) are cleaned and removed **Sieving also controls for size of organisms
- Sample is transferred to jar
- Preserved with ethanol
- Some people still fix with formaldehyde, better for long term storage
- Sampling information recorded
- Sample is labeled
- Transported to laboratory



Benthic Macroinvertebrates

Typical Laboratory Processing

- Arrival of sample to lab is recorded
- Macroinvertebrates are picked from the sample following a predetermined protocol
- Organisms are identified to a predetermined taxonomic level
- Data entered in database
- QA/QC analysis is conducted
- Data ready for analysis



Laboratory processing questions/issues

- Pick in field or lab
- Sub-sample
- ID level
- QA/QC
- Cost of sample
- Sample sizes

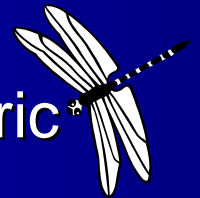
Benthic Macroinvertebrates

Field Sampling Methods Comparison Notes

Study conducted comparing 6 sampling methods

Conclusions: Methods matter

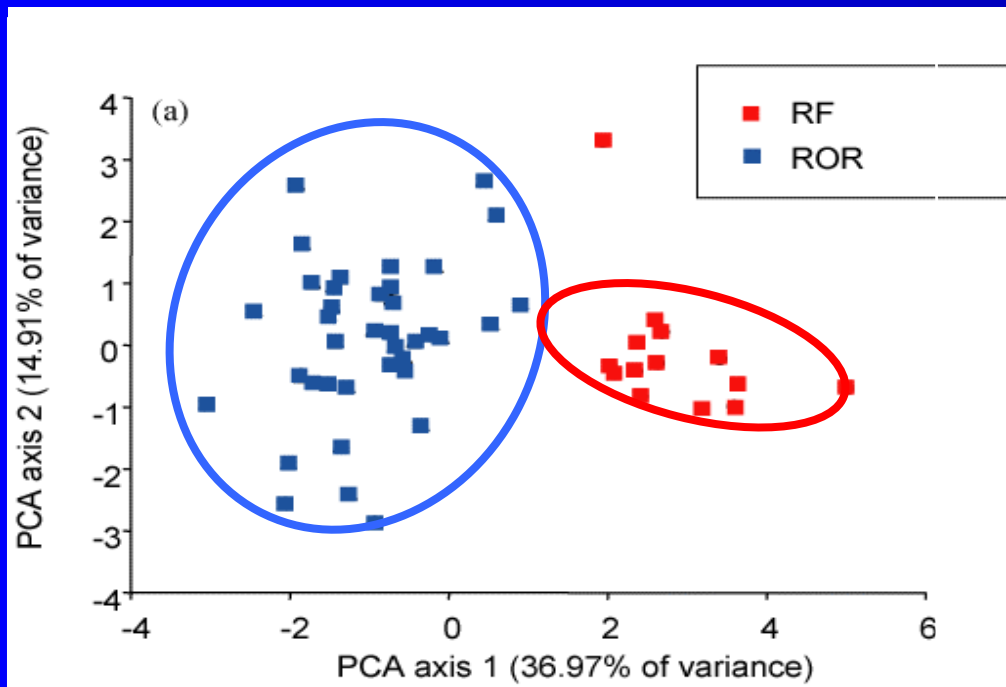
- Different field methods result in different metric values
- Performance of methods was not consistent between sites of differing impoundment status
- Even when metric values were similar, correlations with abiotic stressors differed across methods
- Merging data indiscriminately across field methods is not advised for bioassessment



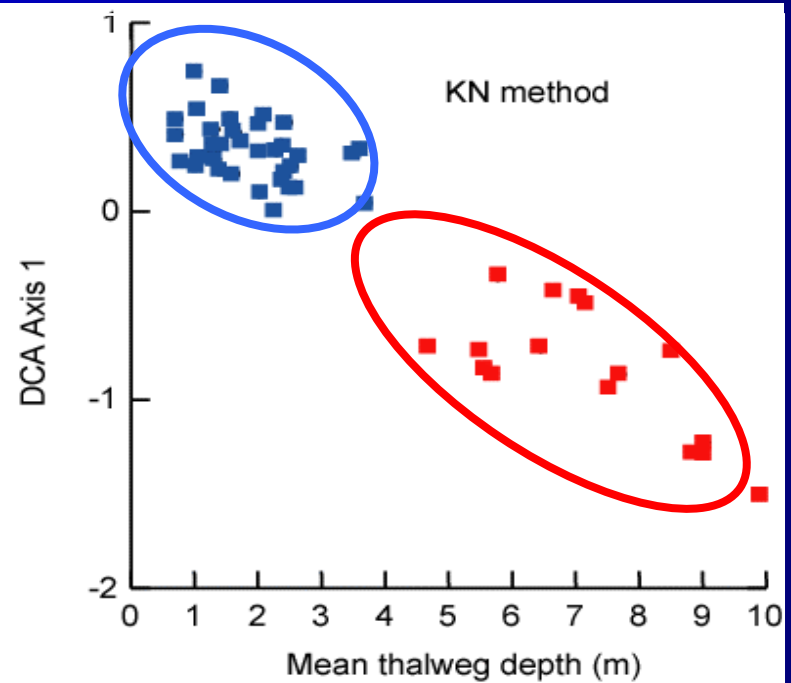
Ref: Blocksom & Flotemersch, submitted

Principal Component Analysis

Physical Habitat Data



Macroinvertebrate Data



Correlations With Stressors?

Metric	Riparian Disturbance All Types	Riparian Disturbance Non-Agriculture	Riparian Disturbance Trash/Landfill	Natural Fish Cover	% Canopy Density	Cobble and Larger	Large Woody Debris Volume	Large Woody Debris Quantity
Number of taxa	00-00	00-00	00-00		+0+00		0000+	
Number Individ. per taxon	+0+00	+0+00	0++00		---00		0000-	
% Chironomidae Individual	00+00	00+00	00+00		-0000		0000-	0000-
% Coleoptera Individual						+00+0	++0++	++0++
% Tolerant Individuals	00+0+	00+0+	00+00				--0--	-000-
% Scrapers					00+00	++0+0	+00++	000++

SAM Method: Number of Taxa

Metric level off
after about 500m
or 6 transects

↑ Subsample size

↑ Separation of sites

