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Comparison of macroinvertebrate abundances of different sampling methods in mesocosms.

Methods:

Analysis of control data from three aquatic mesocosms studies (2012, 2013, and 2015) at gaiac's mesocosm test facility, Aachen, Germany).

Pond volume: 4.9 m^3 (at 1 m water depth), sediment area: 4.9 m^2 , height of sediment layer: 10 cm.

Macroinvertebrate samplers used in the evaluated studies:

- Macroinvertebrate substrate samplers (**MASS**) for epibenthic macroinvertebrates.
- Leaf cages** (optimized for *Asellus* and *Crangonyx*) including Poplar leaves.
- floating **macrophyte or "Elodea" cages** (primarily designed for *Cloeon* larvae).
- Ekman sediment grab** for sediment samples (0-2 cm sediment depth), area: 225 cm^2 .



Leaf cage
(epibenthic samplers)



MASS



Leaf cage
during
sampling



Floating cages with *Elodea*



Ekman
sediment
grab

**Phytal zone with
macrophytes**



**Open water area
(Planktonic zone)**



Views of mesocosms in 2012.

Number of evaluated samples:

In 2012 and 2013: 4 control ponds with 8 sampling dates (n=32), in 2015: 6 controls with 12 dates (n=72).

For each pond, 2 leaf cages, 2 MASS, 1 macrophyte cage and 2 sediment samples were used.

For this evaluation, counted individuals from all cage and MASS samples were summed per sampling date. A mean per study, sampling technique, and taxon was calculated for all replicated ponds and dates.

Results:

Tab. 1: Counted individuals per sample (mean of all samples).

	2012 (4 controls, 8 dates)		2013 (4 controls, 8 dates)		2015 (6 controls, 12 dates)	
	Cages & MASS	Sediment	Cages & MASS	Sediment	Cages & MASS	Sediment
Cloeon dipterum	91.6	0	49.4	0.04	5.6	0
Asellus aquaticus	59.5	0.21	321.6	1.47	16.9	0.96
Crangonyx pseudocracilis	212	0.5	302.8	0.06	131.2	0.9
Sum of chironomid larvae	9.8	7.1	95.6	52.8	<i>n.d.</i>	<i>n.d.</i>
Odonata	15.25	0	3.2	0	5.8	0
Oligochaeta	503	250.5	179.7	89.1	<i>n.d.</i>	<i>n.d.</i>
Sum of snails	53	0.53	63.9	4.3	16.5	1.7

Tab. 2: Calculated relative abundance on the total mesocosm sediment area (4.9 m²) compared to the numbers of individuals in the cage and MASS samples.

	2012	2013	2015
Cloeon dipterum	0	0.09	0
Asellus aquaticus	0.38	0.5	6.2
Crangonyx pseudocracilis	0.26	0	0.75
Sum of chironomid larvae	78.9	60.1	<i>n.d.</i>
Odonata	0	0	0
Oligochaeta	54.2	54.0	<i>n.d.</i>
Sum of snails	1.1	7.3	11.2

Tab. 3: Calculated relative abundance on 1 m² sediment area compared to the numbers of individuals in the cage and MASS samples.

	2012	2013	2015	Mean value
Cloeon dipterum	0	0.02	0	0.006
Asellus aquaticus	0.08	0.10	1.3	0.5
Crangonyx pseudocracilis	0.05	0	0.15	0.07
Sum of chironomid larvae	16.1	12.3	<i>n.d.</i>	14.1
Odonata	0	0	0	-
Oligochaeta	11.1	11.0	<i>n.d.</i>	11.0
Sum of snails	0.22	1.5	2.3	1.3

Comments:

Enrichment of dominant invertebrates by artificial sampling substrates can be clearly demonstrated (is also the purpose of these systems), but is highly species-specific.

Oligochaetes and chironomid larvae are only slightly enriched in the artificial substrates relative to the sediment samples. The other organisms are significantly (snails) to massively (Cloeon, Asellus, Crangonyx, Odonata) enriched.

Two sediment samples (450 cm² in total) correspond to approximately 1% of the sediment area of the mesocosms used in this studies.

It should be noted that the number of animals counted on the samplers is highly dependent on the type and number of samplers as well as the size of the mesocosms.

Theoretically, one could calculate a taxon-specific enrichment factor of the artificial substrates versus the sediment samples, and then extrapolate to the total area of the mesocosms. The goal would be to transfer this factor to other studies for which no data are available.

Whether such an approach actually reduces uncertainty in estimating macroinvertebrate abundance in the overall system should be critically discussed.



View over the gaiac mesocosm facility in 2012.