



# Lead sinkers in sediments impact aquatic snails

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## Background

- Lead is of very high concern and monitored as part of the Water Framework Directive.
- Lead pollution is mostly diffuse (air particles, roof run-off, traffic, waste-water), but also loss of fishing-gear and remnants of lead shot cause a build-up in aquatic environments with the majority sinking to the sediment.
- Ingestion of solid lead poses a direct risk to birds, and part of the lead dissolves to the water phase.
- The 2021 ECHA proposal calls to phase-out lead in sport fishing and hunting, with final decision by the Committee in 2023 (scan QR for updates).
- Lost lead objects will remain in terrestrial and aquatic environments for decades and may slowly release dissolved lead by oxidative corrosion.
- Maximum reported (freshwater) density is 105 sinkers/m<sup>2</sup> at a UK fishpond platform (Duerr 1999), but mostly <10/m<sup>2</sup>. Leaching of 4 shotgun pellets in 0.5L (500 per m<sup>2</sup>) for 30 d on fine sediment (pH 7) showed >20 µg/L (Binkowski 2017)
- Aquatic snails are among the most sensitive aquatic species to dissolved lead, at normal hardness water and neutral pH (EC50,growth 1-10 µg/L, Grosell et al. 2006, 2013).

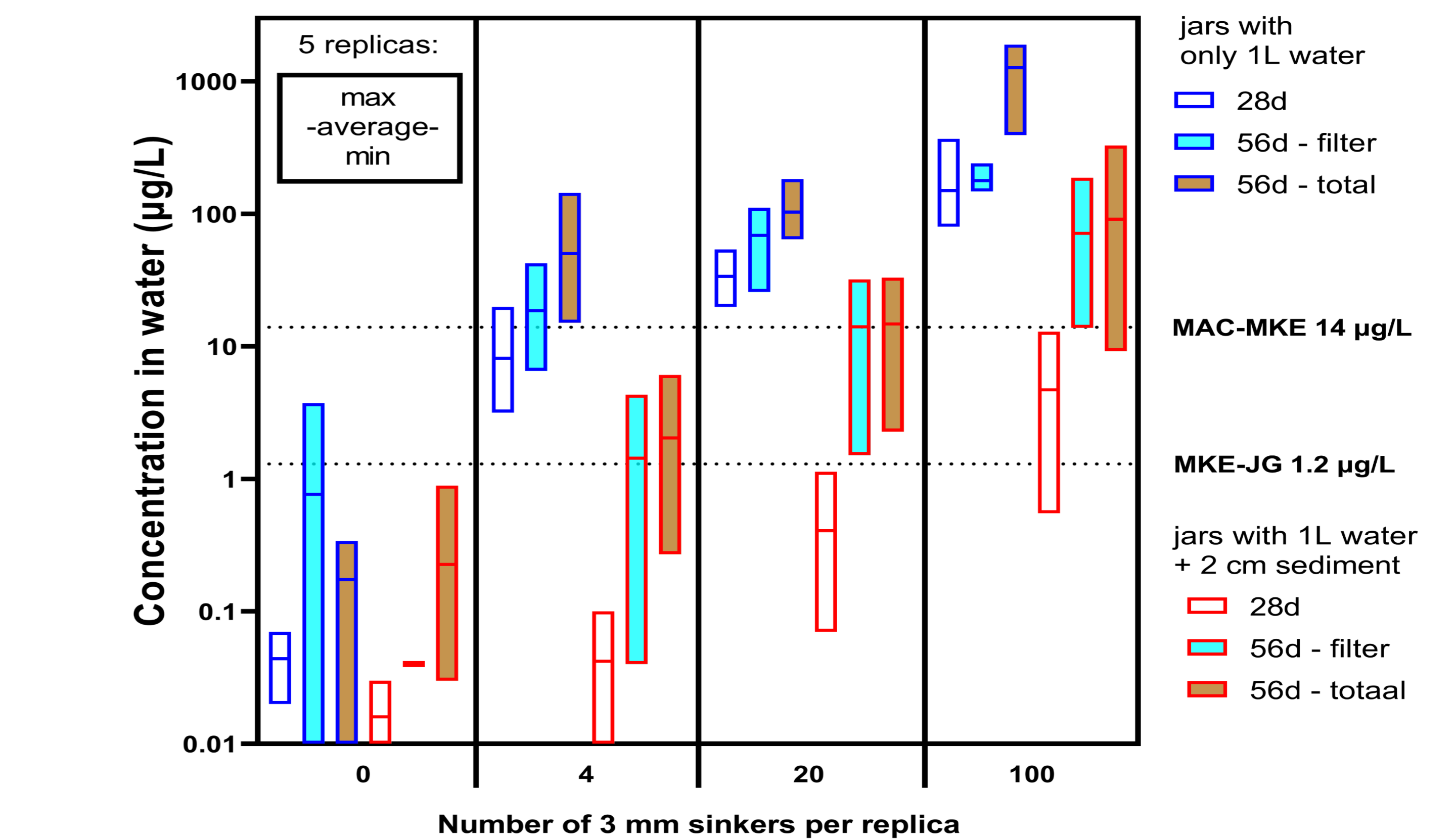


Figure 1. Overview of leaching concentrations, 28d (unfiltered) and 56d (± filter <45 µm)

## Objectives

- Compile lead concentrations from monitoring data in The Netherlands
- Testing sinker leaching (0-56d) and toxicity (28-56d) to snails

## 1. Monitoring data

Table 1. Overview of 2021 sampling in NL water bodies for dissolved lead (filtration <45 µm), data from <https://www.waterkwaliteitsportaal.nl/oppervlaktewaterkwaliteit>

No. of NL water authorities reporting with LOQ <1 µg/L	Nr. of locations	Nr. of samples	Nr. of NL water authorities reporting >1.2 µg/L	Nr. and % of samples >1.2 µg/L	Nr. and % of locations with yearly average > 1.2 µg/L
17	1063	6905	14	189 / 2.7%	28 / 2.7%

In the Netherlands, 2.7% of the sampling locations show exceedance of the yearly average limit (JG-MKE) dissolved concentration (filtered) of 1.2 µg/L. The highest reported dissolved concentration was 12 µg/L, still below the maximum allowable concentration limit (MAC-MKE) of 14 µg/L.

## 2. Leaching experiment: water only, or with 2 cm sediment

- Set-up:** split lead (0.3 g) leaching analysis after 28 and 56 d
  - Aerated water, 15 °C, static, demi-water to cover evaporation
  - Sinker densities of 4 - 20 - 100 per 2 L jar;
  - 'Only 1 L water (pH8)' versus '1L water + 2cm sediment layer'
  - Lead analysis: in water (ICP-MS) and sediment samples (ICP-OES); before and after filtration of water samples

## Test Findings

Water only	Controls: ~LOQ 0.04 µg/L
	4 sinkers average C <sub>w</sub> : 8 µg/L after 28 d; 20 µg/L after 56 d
	20 sinkers average C <sub>w</sub> : 34 µg/L after 28 d; 54 µg/L after 56 d
Water with sediment layer	100 sinkers average C <sub>w</sub> : 150 µg/L after 28 d; 370 µg/L after 56 d
	<b>Conclusion:</b> all conc. >JG-MKE: expected to delay growth of snails
	Control sediment: 9 mg/kg
Water with sediment layer	Overall lower C <sub>w</sub> than system with only water
	Lowest density of 4 sinkers (=500 per m <sup>2</sup> ) average C <sub>w</sub> <JG-MKE after 28 d, but exceedance at 56 d (period of snail testing).
	20 sinkers: sediment conc. (after mixing) increased to 28 mg/kg
Water with sediment layer	<b>Conclusion:</b> mass balance indicates 0,04% leaching after 56 d.

## 3. Toxicity experiment: aquatic snails with lead sinkers

- Set-up:** After 28 days 11 sub-adult snails were added to each leaching test jar for 2 species: *Physella acuta* and *Potamopyrgus antipodarum*. Survival and growth were determined after 28d.

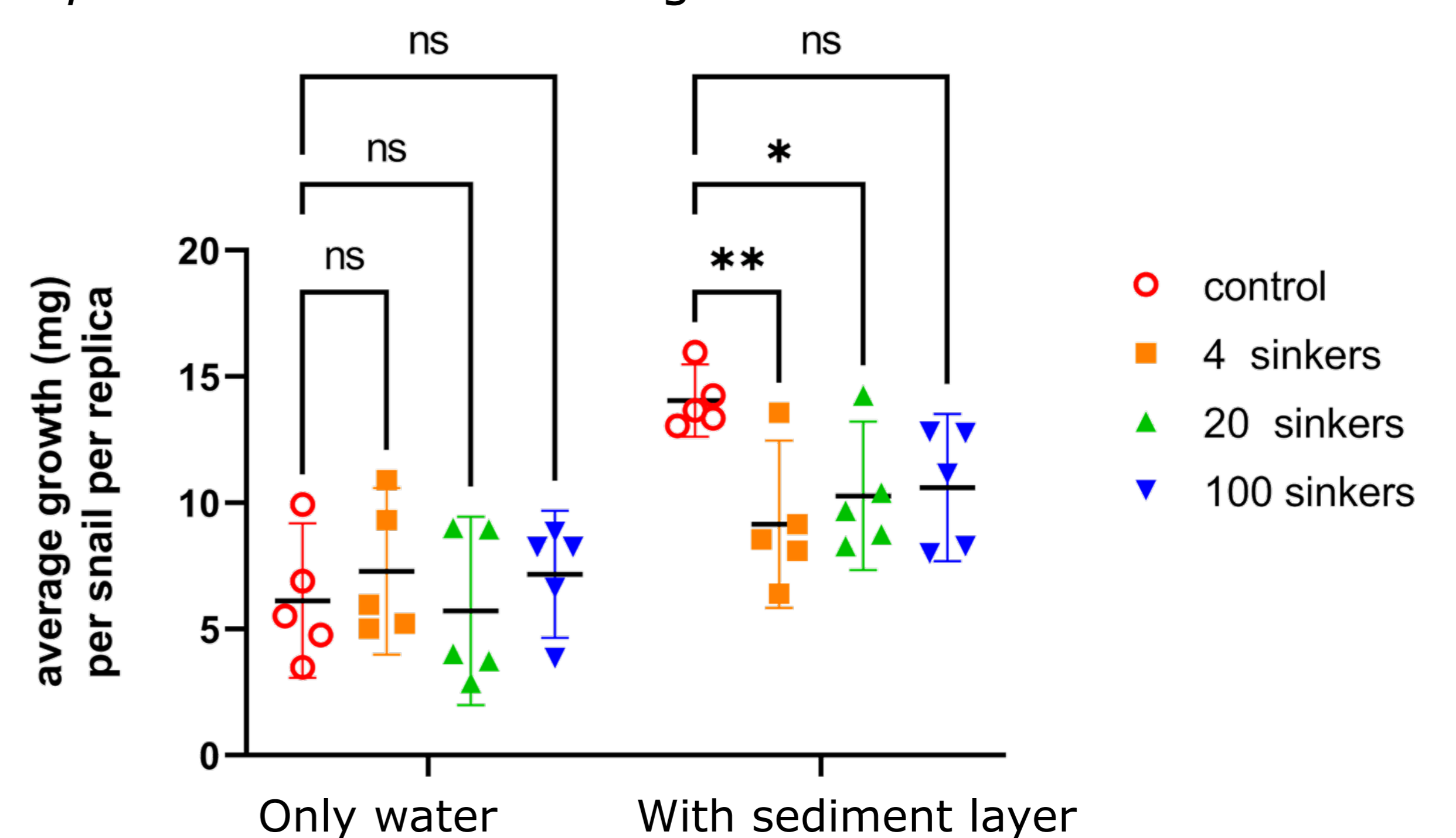


Figure 2. Overview of *P. acuta* growth after 28d exposure (28-56d leaching period)

## Results toxicity experiments:

- P. antipodarum*: poor control survival, *P. acuta*: >90% survival
- P. acuta*: faster growth with sediment present
- P. acuta*: no effect on growth in water only, despite high C<sub>w</sub>
- P. acuta*: effect on growth in all treated sediment systems
- Conclusion:** Tested lead sinker densities are high, but the lowest density in a test with sediment already presents risks for juvenile *Physella acuta*.

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