Aquatic community effects of copper exposure

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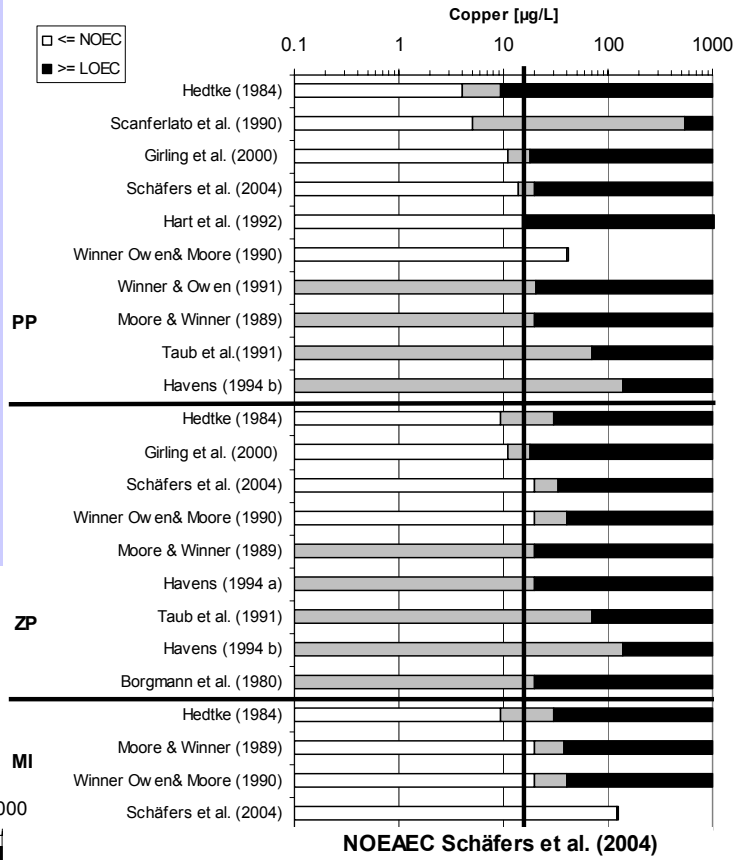
Background

The objective of this review of existing aquatic model ecosystem and field tests is to estimate an ecologically acceptable concentration of copper in freshwater ecosystems. Since lentic systems are usually characterized by a higher amount of organic matter in the water column than streams, lentic and lotic systems were assessed separately.

Findings

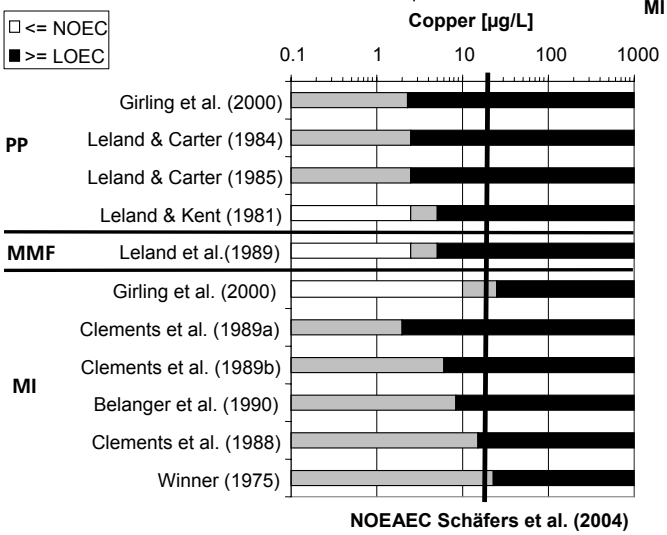
Lentic systems

- Lowest observed effects start around 20 µg total Cu/L
- Exception: Hedtke 1984 (Laboratory microcosm, 15 L, flow-through, DOC of inflow 0.7-1.8 mg/L
- Winner et al: effects at 20 µg total Cu/L in spring; no effects at 40 µg Cu/L in summer due to higher complexation capacity (higher phytoplancton density)
- Macroinvertebrates less sensitive compared to planktonic oragnisms
- Oligotrophic systems most sensitive. Confirmation: No effects of copper in the „Altes Land" (Müller et al.)
- Copper complexation capacity of at least 20 µg/L is associated with presence of planctonic communities; free Cu ions ≤ 0.01 µg/L (Schäfers et al. 2004)



Lowest NOECs & LOECs of model ecosystem studies:

PP = primary producers
ZP = zooplankton
MMF = meio- and microfauna
MI = macroinvertebrates



Effect thresholds for sensitive systems

- General: 0.01 µg/L of free Cu ions
- Lentic: 15 - 20 µg dissolved Cu/L
- Lotic (low Cu complexation): 2-5 µg dissolved Cu/L

Lotic systems

- Lowest observed effects down to 2 µg total Cu/L (Periphyton, Macroinvertebrates)
- Leland and Carter: oligotrophic stream; effects at 2.5 µg total Cu/L = 0.012 µg/L of free Cu ions
- Clements et al.: studies in soft water more sensitive compared to those in hard water
- Belanger et al.: clam sensitivity less in harder water

Conclusions

- Small lotic systems are more sensitive than lentic systems.
- Availability of free Cu ions is the driving factor
- Species sensitivity is of less importance
- Acceptable concentration depend on water quality

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