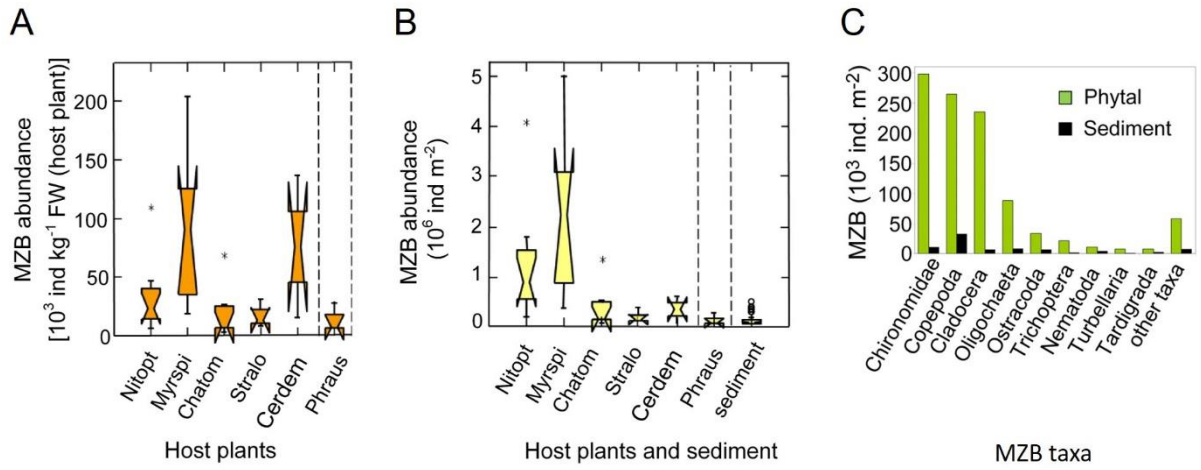
SUPPLEMENTARY MATERIAL_4

Stands of submerged macrophytes provide a valuable habitat for phytal invertebrate species in Alte Donau



Supplementary material_4, Figure_S4: Role of water plants as habitat for macrozoobenthos (MZB) in Alte Donau. A) Abundance of phytal MZB per FW of five host macrophytes and of the underwater stem of one host helophyte Phraus (n=31) and B) per m² of sediment area covered by the same aquatic host plants (n=31) and per m² sediment surface without underwater vegetation cover (n=57); C) Abundance of MZB inhabiting phytal habitat (n=31) and sediment (n=57); monthly data April to October 1987 retrieved from Löffler (1988); Notched boxplots with abbreviation of water plants in A and B: Cerdem - *Ceratophyllum demersum* L., Chatom - *Chara tomentosa* L., Myrspi - *Myriophyllum spicatum* L., Nitopt - *Nitellopsis obtusa* (Desv.) J. Groves, Phraus - *Phragmites australis* (Cav.) Trin. ex Steud., Stralo - *Stratiotes aloides* L.

METHOD

Macrozoobenthos (MZB) data shown in Suppl. Fig. S4 A refer to the seasonal sampling during the mesotrophic state in Alte Donau, i.e., in the reference year with dense charophyte meadows covering almost the whole sediment surface. Seasonal MZB samples from sediment were taken with an Eckman-sampler (sampling area: 100 cm2) at sites and seasons of no or almost no macrophytes and with a Kajak-corer (sampling area: 30 cm2, sampling depth: 15 cm) at sites of dense underwater vegetation (Löffler et al, 1988). MZB was collected with a sieve of 300µm mesh size. Phytal MZB (Suppl. Fig. S4 B) were sampled in mono-specific hostplant sites using a Minto-sampler or dip net, both of 300 µm mesh size. MZB attached to plant surface was collected by washing through a net of 300µm mesh size.

RESULTS and DISCUSSION

The density of phytal invertebrates varied depending on the host plant (Suppl. Fig. S4 A, B). According to retrieved results from a field macrophyte study in 1987 (Löffler, 1988), pronounced MZB abundances were reached in stands of vascular macrophytes when related to fresh weight of the host macrophyte species (40% of all invertebrate animals in *Myriophyllum spicatum*, another 23% in *Ceratophyllum demersum*), while charophytes harboured a smaller number (16% in stands of corticated *Chara tomentosa* and up to 9% in ecorticated *Nitellopsis obtusa*, Suppl. Fig. S4 A). As identified by Suppl. Fig. S4 A and B, however, it seems particularly important to compare the two macrophytes species, which dominated the macrophyte community throughout the study period: the vascular plant *M. spicatum* and the charophyte *N. obtusa* and (see methods). *N. obtusa* harboured a relatively low number of

individuals of phytal invertebrates when compared with *M. spicatum*. Nevertheless, these two submerged macrophyte species mainly contributed to the phytal organisms per m² if compared with other host macrophyte species or submerged stems of *Phragmites australis* in the littoral. This enhanced number of phytal invertebrates during the reference year 1987 indeed verifies that the provisioned macrophytes serve as valuable habitat in Alte Donau. Chironomids are most abundant in the phytal, where their density was 28 times higher than on the sediment surface. In the case of copepods, which is the second most abundant group in the phytal, the abundance is about 8 times higher than in the sediment surface layer.

Our result of having found highest phytal invertebrates on *M. spicatum* when compared with other macrophytes in Alte Donau, cannot support the main finding by Schultz and Dibble (2012) claiming that such an invasive macrophyte species would hinder MZB harbouring and would therefore be responsible for negative effects on fish by decreasing food-availability (an overall positive effect of macrophytes on fish was found in Alte Donau as shown in Waidbacher and Drexler, 2018). Many MZB studies are supporting MZB results in Alte Donau by identifying that submerged macrophytes often allocated higher yields of invertebrates than compared with hard materials like stone and sand (Heck and Crowder, 1991; Kuczyńska-Kippen and Nagengast, 2003; Cremona et al., 2008; Eidinger, 2018; Yofukuji et al., 2021), submerged shoots of *P. australis* or the littoral zone in general (Feldmann and Nõges, 2007; Cremona et al., 2008, Cyr and Downing, 1988).

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