**The interplay of nutrients, dissolved inorganic carbon and algae in determining macrophyte occurrences in rivers**

Willem Kaijser1,\*

Armin W. Lorenz1, 2

Sebastian Birk1, 2

Daniel Hering1, 2

1University Duisburg-Essen, Faculty of Biology, Aquatic Ecology, Universitätsstraße 5, D-45141

Essen, Germany

2University Duisburg-Essen, Centre for Water and Environmental Research, Universitätsstraße 5, D-45141

Essen, Germany

\*corresponding author (willem.kaijser@uni-due.de)

Table S1: The number of species occurrences and type of carbon use (based on Iversen et al. (2019)) identification of obligate submersed species and own assumptions.

| **Species** | **Occurrences** | **Bicarbonate use user** | **Not in the list of Iversen et al. (2019)** | **Obligate submerged species** | **Assumption** |
| --- | --- | --- | --- | --- | --- |
| *Callitriche brutia* | 74 | 0 |  |  |  |
| *Callitriche cophocarpa* | 11 | 0 |  |  |  |
| *Callitriche hamulata* | 49 | 0 |  |  |  |
| *Callitriche palustris* | 5 | 0 | 1 |  | Since most are CO2-only users *C. palustris* is assumed as well. |
| *Callitriche platycarpa* | 30 | 0 |  |  |  |
| *Callitriche stagnalis* | 9 | 0 |  |  |  |
| *Ceratophyllum demersum* | 35 | 1 |  | 1 |  |
| *Ceratophyllum submersum* | 1 | 1 |  | 1 |  |
| *Chara globularis* | 1 | 1 | 1 | 1 | (Pentecost, 1984) |
| *Elatine hexandra* | 1 | 0 | 1 |  | *Elatine californica is a CO2-only-user E. hexandra is assumed as well.* |
| *Eleocharis acicularis* | 2 | 0 |  |  |  |
| *Elodea canadensis* | 76 | 1 |  | 1 |  |
| *Elodea nuttallii* | 13 | 1 |  | 1 |  |
| *Fontinalis antipyretica* | 222 | 0 |  | 1 |  |
| *Fontinalis squamosa* | 5 | 0 |  | 1 |  |
| *Hippuris vulgaris* | 1 | 0 |  |  |  |
| *Hydrocharis morsus-ranae* | 17 | 0 | 1 |  | Floating species like *Nuphar* only use CO2, this species is assumed similar. |
| *Lemna gibba* | 32 | 1 | 1 |  | As assumed for *L. minor.* |
| *Lemna minor* | 114 | 1 | 1 |  | (Filbin and Hough, 1985) |
| *Lemna trisulca* | 18 | 1 |  | 1 |  |
| *Myriophyllum alterniflorum* | 1 | 1 |  | 1 |  |
| *Myriophyllum heterophyllum* | 1 | 1 | 1 | 1 | (Hussner and Jahns, 2015) |
| *Myriophyllum spicatum* | 39 | 1 |  | 1 |  |
| *Myriophyllum verticillatum* | 2 | 0 |  | 1 |  |
| *Najas minor* | 1 | 1 | 1 | 1 | Tolerant to eutrophication and all other *Najas* spp. in Iversen et al. (2019) are bicarbonate users. |
| *Nitella flexilis* | 2 | 1 | 1 | 1 | The walls are slightly encrusted with calcium carbonate. However, bicarbonate use of this species is unclear. |
| *Nitellopsis obtusa* | 1 | 1 | 1 | 1 | (Smith, 1968) |
| *Nuphar lutea* | 34 | 0 |  |  |  |
| *Nuphar pumila* | 1 | 0 |  |  |  |
| *Octodiceras fontanum* | 11 | 0 |  | 1 |  |
| *Potamogeton alpinus* | 9 | 0 |  |  |  |
| *Potamogeton berchtoldii* | 17 | 1 |  | 1 |  |
| *Potamogeton crispus* | 66 | 1 |  | 1 |  |
| *Potamogeton lucens* | 4 | 1 |  | 1 |  |
| *Potamogeton natans* | 36 | 0 |  |  |  |
| *Potamogeton nodosus* | 1 | 1 |  |  |  |
| *Potamogeton obtusifolius* | 4 | 1 |  | 1 |  |
| *Potamogeton perfoliatus* | 11 | 1 |  | 1 |  |
| *Potamogeton polygonifolius* | 5 | 0 |  |  |  |
| *Potamogeton praelongus* | 1 | 1 | 1 | 1 | (Prausová et al., 2015) |
| *Potamogeton pusillus* | 3 | 1 |  | 1 |  |
| *Potamogeton trichoides* | 2 | 1 | 1 | 1 | Eutrophic species often found in ponds and under high alkalinity (Lamers et al., 2002), thus assumed to be a bicarbonate user, although unclear. |
| *Ranunculus aquatilis* | 5 | 1 |  | 1 |  |
| *Ranunculus fluitans* | 29 | 1 |  | 1 |  |
| *Ranunculus peltatus* | 24 | 1 |  | 1 |  |
| *Ranunculus penicillatus* | 14 | 1 |  | 1 |  |
| *Ranunculus trichophyllus* | 7 | 1 |  | 1 |  |
| *Ricciocarpos natans* | 2 | 0 | 1 |  | Assumed not to use bicarbonate |
| *Sparganium emersum* | 110 | 0 |  |  |  |
| *Spirodela polyrhiza* | 56 | 1 | 1 |  | As assumed for *L. minor.* |
| *Stratiotes aloides* | 1 | 1 |  |  |  |
| *Stuckenia pectinata* | 76 | 1 |  | 1 |  |
| *Utricularia australis* | 1 | 0 |  | 1 |  |
| *Veronica anagallis-aquatica* | 9 | 0 |  |  |  |
| *Veronica catenata* | 6 | 0 |  |  |  |
| *Zannichellia palustris* | 19 | 1 |  | 1 |  |

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Chart, scatter chart

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Figure S1: Trend of TP and chlorophyll-a.