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Assessment of field-grown duckweed biomass by spectral indices

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High phenotypic plasticity of duckweeds affects their biomass productivity. Reliable estimation of biomass quantity and quality, hence, are important when culturing duckweed outdoors. Spectral proxies, that is, indices derived from light reflectance and transmittance, became fundamental in crop production, but their application on duckweeds has only been reported scarcely. We aimed at sampling naturally occurring duckweed populations and analyzing their biomass with analytical (dry matter and protein contents) and optical (hyperspectral reflectance and transmittance) approaches due to test applicability of the latter proxies. A total of $n=20$ duckweed and water samples were analyzed from 10 sites in the Trans-Tisza region (E-Hungary) during two sampling campaigns in June and September of 2025. The sampled waters showed wide gradients of N- and P-concentrations, but biomass dry matter and protein contents showed no significant correlation with the nutrient availability. Similarly, neither seasonality, nor species-specific patterns were found in biomass traits. Cell phone imaging proved to be reliable in estimating plant biomass (Pearson's correlation: $p<0.001$) under field conditions. We could not establish link, however, between the reflectance- (e.g. NDVI, PBI) and transmittance-based (CCI) indices, and the biomass composition, respectively. Our results highlight, that duckweed biomass traits cannot be predicted mechanistically from spectral indices, but customized approach is needed for particular applications. This research was funded by the NKFIH OTKA grant No. FK 134296, and was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences, by the University of Debrecen Program for Scientific Publication, and by the Tempus Public Foundation.

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References

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