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A multi-sensor method for in-situ quantification of multiple biodiversity and ecosystem service indicators in wetland vegetation

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Biodiversity and ecosystem services are in the focus of biogeosciences research and conservation management worldwide. However, their quantification is notoriously difficult. Since full coverage of biodiversity and/or ecosystem services is unfeasible due to their complexity, indicators are recommended: biophysical quantities that are measureable and are expected to be closely related to biodiversity or to ecosystem processes. Nevertheless, many biodiversity and ecosystem service assessments are based on upscaling very few (if any) in-situ measurements using models driven by basic land cover data. Also, many assessments select only a single or very few indicators, which then does not enable analysis of trade-offs and interconnections.

Here we propose a system of simple yet reliable field measurements, based on basic sensors, measurements, imaging and sampling technology, suitable for quantitatively representing many components of biodiversity and ecosystem services in emergent wetland vegetation. Along a transect from open water to the shore, sampling stations are laid out that include water temperature, air temperature and humidity sensors, zenith facing photographs and pole contact counts of vegetation in height intervals. Additionally, for some of these stations, small quadrats of vegetation are harvested, separated to individual species and weighed in height intervals above ground/water. Underwater surface of vegetation is estimated by counting stalks and registering average diameter. Finally, decomposition is quantified by leaving a standard amount of biomass in a plastic net bag and re-weighing it a year later. This system allows measuring alpha and beta diversity together with vertical structural diversity, leaf area (as a proxy of shading and pollution absorbtion), biomass (as a proxy of carbon sequestration), underwater surface (as a proxy of fish population sustaining), microclimate influence and soil provision. The necessary tools are temperature and humidity sensors, field scales, pruning shears, plastic net bags, measuring poles (for water depth), a digital camera and a GPS; all small and lightweight enough to be carried and operated by one person under wetland field conditions. Additionally, such measurements are suitable for remote sensing-based direct upscaling of biophysical parameters to create area-covering maps of biodiversity and ecosystem service indicators.