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The link between community composition and function is a useful tool in ecology – demonstration using five decades of phytoplankton data from Lake Constance

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Understanding how environmental change drives compositional change in ecological communities is a central goal in ecology. Trait-based approaches have been useful in understanding how compositional change is mediated by the traits of a community's members. However, in trait-based approaches, the link between community composition and function is often lost. Here, we derive a quantity – which we call the principal trait – linking the community weighted mean traits with principal components of community composition. We demonstrate the usefulness of this approach with nearly five decades of phytoplankton monitoring data from Lake Constance. We find that the same tradeoff between the resource acquisition traits phosphate affinity and light affinity emerged during the summer bloom in response to long-term changes in nutrient status, but also in response to seasonal changes in light availability from winter to spring. We show that emergence of these tradeoffs was associated with two different compositional shifts, which depended on the requirement of the community to be defended against grazing.