

# science summary



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## Sampling littoral diatoms in lakes for ecological status assessments: a literature review Science Summary SC030103/SS1

The Environment Agency has reviewed the existing literature and established a theoretical basis plus practical recommendations for sampling the microscopic plants that live near the shore surface (littoral phytobenthos) in UK standing waters.

The Water Framework Directive created a statutory obligation for EU Member States to monitor phytobenthos in lakes, one of the biological elements for ecological status assessments. Although a considerable amount of work has been done using phytobenthos to monitor river water quality in Europe, considerably less has been carried out on the use of phytobenthos in lakes. Most of the work in rivers focussed on unicellular algae capable of photosynthesis (diatoms), which are often the most diverse division of green plants (part of the photoautotrophic group) present in freshwaters. The work has resulted in the production of a number of diatom indices for use in water monitoring programmes, which, in turn, led to the development of standard methods for the collection and analysis of material throughout Europe.

The principles that underlie sampling diatoms and phytobenthos for rivers are broadly applicable to sampling diatoms from littoral zones in lakes. The purpose of this report is to review the literature to provide justification for the Diatom Assessment of Lake and Loch Ecological Status (DALES) sampling protocol. A key assumption underlying DALES is that the diatom species composition from a single substratum, obtained from analyses of cleaned valves, is a valid proxy of the signal for the entire phytobenthos assemblage present in the littoral zone of a lake. Studies of lake phytobenthos have addressed a wide range of theoretical and applied issues, with a variety of methods employed. Many of the conclusions from these studies are relevant to sampling for routine monitoring purposes. While the focus of this review is on diatoms, the reality in the lake littoral zones is that the diatoms live in close proximity, and compete for resources, with many other photoautotrophs and it is necessary to include references to studies that embrace these. Similarly, while our focus is on the species composition of the littoral diatom assemblage, many of

the factors that affect this diatom assemblage also influence the biomass of algae present.

As a result of the literature review, it is recommended that diatoms from rock surfaces (the epilithon) be sampled in preference to those from plant surfaces (the epiphyton) for waterbodies in which stones and rocks represent the dominant habitat for lake-bed (benthic) diatoms. This is likely to be the case in the relatively nutrient-poor, upland waters of the UK. This sampling strategy avoids the problem of host-specificity or substratum variability. Nevertheless, in the soft, muddy, more productive waterbodies of lowland UK, where epilithic habitats may be lacking or limited and do not represent a significant component of the lake phytobenthos, an epiphytic sample should be collected. An epiphytic sample should be taken from emergent larger plants (macrophytes) and ideally should be standardised to a single species, such as *Phragmites australis*. When sampling emergent macrophytes, we recommend that five healthy established stems from different individuals of the same species are selected, and that dead material and new shoots are avoided. Sampling in this way reduces the effect of colonisation stage on the community composition. The mud (epipelon) should be avoided, as this may more closely reflect sediment properties than the water column physicochemistry.

Importantly, this literature review indicates that the magnitude of spatial and temporal variation of the epilithon within a given waterbody during the sampling period is small, relative to the variation among waterbodies, especially for waterbodies with low nutrient concentrations. If the sampling location is chosen carefully, within-waterbody variability in diatom composition should be less than between-waterbody variability. Locations likely to be affected by point-source contaminants or stream in-flow factors should be avoided. Any sampling programme should ensure that samples are collected from the same location within a waterbody on each visit, to reduce spatial variability.

The Environment Agency, DALES and others can use the findings of the report to ensure that the collection of data to monitor ecological status is effective.

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