

# Evidence

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## The ecological classification of UK lakes using aquatic macrophytes

Project summary SC010080/S2

The EU Water Framework Directive (WFD) requires us to assess the ecological status of water bodies so that we can take action to protect and improve them. The work described here developed and tested a tool to classify lakes in the UK using aquatic macrophyte survey data. Macrophytes are water plants that are visible to the naked eye and this classification tool will be used alongside other techniques by Environment Agency staff to determine the ecological quality of our lakes.

The full report provides details of the scientific work underpinning the tool (it is not a user manual). It will be of interest to academics working in similar fields and practitioners implementing the classification requirements of the WFD in the UK and other EU member states.

Development of the tool followed a number of steps:

- collating existing data
- devising river survey methods
- defining river types and identifying macrophyte metrics (measures),
- screening of reference sites,
- modelling the biology expected under reference conditions
- establishing an ecological basis for class boundaries
- assessing the uncertainty associated with each water body classification.

Macrophyte survey data were collated from a range of sources including UK conservation agencies, research projects and historical records, providing comprehensive coverage of the geographical distribution and environmental conditions of UK lakes. Survey data were subsequently matched to basic environmental and pressure data.

The protocol for lake macrophyte surveys recommended in this report largely follows the method developed by the Centre for Ecology and Hydrology to support site condition monitoring of freshwater Special Areas of Conservation.

UK lakes were stratified into 20 types based on environmental variables (alkalinity and depth) that have a strong influence on lake macrophyte community composition and productivity.

Macrophyte metrics reflecting the composition (Lake Macrophyte Nutrient Index), richness (numbers of hydrophyte taxa and hydrophyte functional groups) and abundance (mean cover, relative algal cover and relative invasive species cover) of the vegetation were developed. Relationships between individual metrics and man-made pressures were assessed, mainly for eutrophication (raised levels of nutrients).

Individual metrics were sensitive to different pressures such as nutrient enrichment or acidification, but they were best used collectively to indicate the general degradation of a lake.

Ecological status is assessed by the deviation of survey sites from minimally impacted reference conditions. Reference sites were established by screening site data on water chemistry, land cover, hydromorphology and biology, or by reconstructing reference conditions using nineteenth century botanical records. For a test site, the flora expected under reference conditions was predicted from lake properties such as area, depth, altitude and alkalinity. Observed metric values in test sites were expressed relative to these reference values in the form of an Ecological Quality Ratio.

The class boundaries were aligned with WFD quality status definitions based on the sensitivity species to eutrophication. Statistical approaches were used to set class boundaries for other metrics. A rule based-approach was developed to combine the results from different macrophyte metrics.

A range of case studies are provided in the report to illustrate the geographical distribution of water bodies by type, and changes over time in the status of intensively surveyed water bodies in the Norfolk Broads and West Midland Meres.

This summary relates to information from Project SC010080/SR2, reported in detail in the following output:

**Report:** SC010080/S2

**Title:** The ecological classification of UK lakes using aquatic macrophytes

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