The timing and extent of the biological response to mitigation measures

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Background

Robust evidence of the cost-effectiveness of the mitigation measures is needed both to engender support and uptake from the farmers and other stakeholders.

DTC aims to determine how measures of Ecological Quality respond to mitigation of diffuse pollution from agriculture. Such information is needed to develop plans for achieving WFD targets.

Understanding the extent and timing of the biological response is key to understanding the cost-effectiveness of measures. The detailed hydro-chemical and biological data collected by the DTC programme has enabled us to explore the links between hydrochemistry and biology in depth. This information will be used to inform model development (Figure 1).

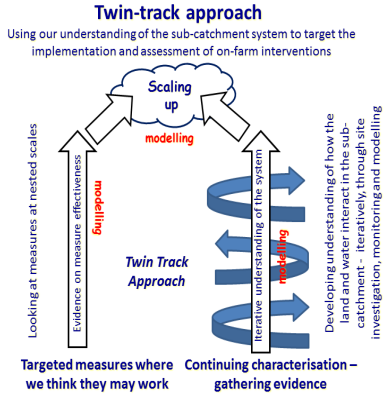

Figure 1. The twin track approach used by DTC to gather evidence of the effectiveness of interventions

Approach

Here we have summarised variation in hydro-chemical variables in a number of ways (average, variation, distribution) over varying time periods (1 to 90 days) prior to the collection of biological samples. Then we determined which summary variables best described the biological response, using indices such as ASPT (Average BMWP Score Per Taxon), a measure of the invertebrate assemblage used to classify the ecological quality of sites under the Water Framework Directive.

Variation in ASPT was best described by the Q_5 of % oxygen saturation (a measure of the lowest oxygen saturation observed), rather than the average or variation of % oxygen saturation (Figure 2 a). Furthermore, the best explanatory variable was Q_5 of % oxygen saturation determined over the 10 days prior to the biological sample being collected (Figure 2a). The invertebrates responded to events in the recent past, with events happening prior to this time having less influence: in effect, invertebrate communities appear to be recovering from low oxygen events that happened more than 10 days before the biological sample was collected.

Having identified which variable best explained variation in ASPT, the strength of the relationship (Figure 2b) and the factors influencing uncertainty in the relationship (Figure 2c) could be determined. Q_5 oxygen saturation over 10 days explained about 65% of the variation in ASPT, with spatial differences (both between and within sites) explaining most (about 25%) of the remaining variation.

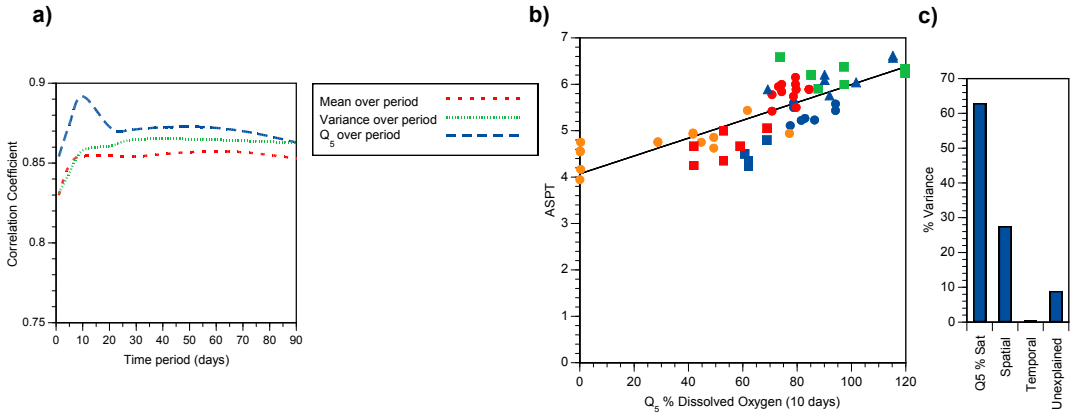

Figure 2. Exploring the relationship between the invertebrate index ASPT and dissolved oxygen, a) variation in the strength of correlation between ASPT and different measures of oxygen calculated over varying time periods before sampling the invertebrates, b) relationship between ASPT and Q_5 percentage dissolved oxygen (different symbols indicate different sub-catchments), and c) proportion of variance in ASPT explained by Q5 of % DO, spatial, temporal and unexplained factors.

Conclusion

The invertebrate community responds to periods of low oxygen: mitigation measures that improve the oxygen conditions (i.e. those that reduce inputs of organic matter such as improvements to manure management) should produce a marked improvement in this measure of ecological quality. The invertebrate communities appear to have some ability to recover over a very short time scale. Further improvements are likely to occur over longer time-scales as new species colonise.

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