MONITORING OF ACID

WATERS. PHASE 1

INDICATOR POPULATIONS

R&D Progress Report P2/090/1
for the period 1st October 1997
to 31st December 1997

M T Furse
K L Symes

Institute of Freshwater Ecology
River Laboratory
East Stoke
WAREHAM BH20 6BB

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1 TECHNICAL PROGRESS

The project was originally planned to begin on 1st October 1996 but the start was delayed by administrative processes. At the time of writing there is still no formal contract in place between the Environment Agency (the Agency) and the Natural Environment Research Council (NERC).

Following negotiations between Mike Furse (IFE Project Leader) and Rob Atkins (Environment Agency Contract Development Officer) a revised budget for the project was agreed. This was based on a new start date of 1st October 1997, as agreed between Mike Furse and John Steel (Environment Agency Project Manager) during discussions at a meeting of the Organising Committee of the RIVPACS International Workshop.

A letter of intent to contract the work to the NERC's Institute of Freshwater Ecology (IFE) was issued by Rob Atkins on 30th July 1997. This letter was accepted by IFE. Following further discussions with between Mike Furse and John Steel at the RIVPACS Workshop in September 1997 the commencement date of the project was re-affirmed as 1st October 1997.

This progress report covers the first three months of the work programme from 1st October 1997 to 31st December 1997.

1.1 Objectives

The overall objective of the full research programme is:

- To produce a standard methodology that enables the Environment Agency to assess the extent of ecological damage caused by acidification in controlled surface waters in order that they can make considered comment on short and longer term effects and on the likely effects of changes in land use.

The specific objectives are as follows:

- To produce an algorithm to differentiate biological communities into groups which reflect the effects of acidification on their environment.

- To test the algorithm using field data

- To propose monitoring guidelines for applying the algorithm nationally.

- To produce an R&D Technical Report and Project Record in accordance with the Environment Agency's Guidelines to Reporting.

- To use the project output to produce a paper for publication in a relevant scientific journal.

1.2 Work Programme and Timetable for the R&D Project

The targets and timescales for the R&D programme were set out in IFE's tender bid, as accepted by the Environment Agency.
In the light of the delayed start it is proposed that all target dates and timescales are extended by

the duration of that delay, which is twelve months. A Gantt chart shows the revised timetable (Appendix 1).

1.3   Work Programme for the Reporting Period

The work programme for the first three months comprised two elements:

- Commencing data acquisition

- Commencing data review

- Discussion with Environment Agency staff about the effectiveness and national applicability of the algorithm developed by Graham Rutt, Neil Weatherley and Steve Ormerod for the detection and evaluation of the impact of acidification using aquatic macro-invertebrates (Rutt *et al.* 1990). This algorithm is known as "the University of Wales system" in the contract documentation.

- Commencing data transfer

- Commencing data-logging

2   INTERIM RESULTS

2.1   Data Acquisition, Review, Transfer and Logging

Data acquisition has concentrated on macro-invertebrates in the first instance. This is because there are contractual reasons for doing so (Schedule II: Specification - Background, Paragraph 5 and Detailed Methodology, tasks a) and b)) and a requirement for field sampling of macro-invertebrates at 15 sites (Schedule II: Specification - Background, Paragraph 5). Macro-invertebrate data are also collected in a relatively standard manner on a nationwide basis.

Four data-sources are currently being considered:

- Species data to be acquired by IFE through further analysis of samples they held in store from the 1990 River Quality Survey

- Species level data held by the Agency and collected by them using RIVPACS compatible methodologies

- Species data held by IFE

- Family level data collected by the Agency and its predecessors during national surveys

It is probable that the algorithm to be developed will require species level data for many major

macro-invertebrate groups. However, the availability of the extensive national survey data from 1990 and 1995 will provide the opportunity to see if schemes developed at species level are transferable, at an acceptable level of reliability, to family level.

Other taxonomic groups which have been used successfully to indicate changes in acidity are diatoms and macrophytes. Neither of these groups are extensively sampled by the Environment Agency on a routine or standard basis and are hence less likely to provide a short-term source of a national algorithm. However the suitability of these groups and the availability of data will be evaluated during the course of the project and reported upon at its completion.

2.1.1 Species level data held by IFE

IFE's species level macro-invertebrate data are held in a MSAccess relational data-base. Macro-invertebrate and environmental data are held on approximately 1600 United Kingdom sites. All sites were sampled in a RIVPACS compatible manner and identified to the same consistently high standard.

Data held on approximately another 400 sites have been prepared for addition to the data-base. The data are held on a parallel data-base and will be transferred to the main data-base once data-entry has been fully validated. This will extend the information available for examining the feasibility of a national macro-invertebrate algorithm for identification of acidification effects.

The sites in, or about to be added to the IFE data-base cover a wide range of alkalinity conditions throughout the United Kingdom. However, because of the nature of the projects for which IFE's data were collected, environmentally stressed sites are poorly represented. Thus, few rivers subject to acidification effects are included in the data-base.

These IFE data form a broad range of reference sites but need to be extended by the addition of sites where artificial acidification effects are operating. Thus additional site data must be sought from the Environment Agency and from samples held in store from the 1990 River Quality Survey.

2.1.2 Environment Agency species data

The National Rivers Authority and the Environment Agency have collected species data for a variety of special purposes, although less regularly for routine monitoring. There appears to be an increasing tendency within the Agency to identify to this more precise level and consideration is being given to the role of species identification in national surveys.

A letter was sent to all Regional and most Area Biologists in December 1997 requesting information on the species level data held by the Agency (Table 2.1).

Table 2.1   **Circulation list for the letter requesting information on macro-invertebrate**

species level holdings within the Environment Agency

Anglian	**Southern**
Sarah Chadd	Bob Dines
Terry Clough	Phil Smith
Chris Extence	Shelagh Wilson
Julia Stansfield	

North West	**South West**
Elaine Fisher	George Green
David Holland	Jeanette Collet
Ed Mycock	Trevor Renals
Ray Prigg	Andy Hicklin

North East	**Thames**
Brian Hemsley-Flint	Paul Logan
Graham Bird	John Steel
Liz Chalk	Les Ruse
Anne Lewis	Myles Thomas

Midlands	**Welsh**
Shelley Howard	Frank Jones
Gary Fretwell	Graham Rutt
Alan George	Nicky Gough
Phil Harding	Iwan Thomas
Helen Webb	Neil Weatherley

The following extract from the letter sets out the request for information on species level data.

"My first request of you is therefore to know whether you feel you have any useful species level data that you can contribute to the R&D programme. You will see from the enclosed documentation that the first specific objective is:

To produce an algorithm to differentiate biological communities into groups which reflect the effects of acidification of their environment.

We intend to use species data for this purpose and we already hold an extensive range data from minimally impacted sites collected during the RIVPACS and other contracts. We now need to supplement this with data on naturally acidic and those sites perceived to be subject to varying degrees of acidification. I fully appreciate that these categories are both overlapping and difficult to segregate. However, we hope that you may hold species data for sites in both categories which will be helpful to us.
Ideally the data would be collected using RIVPACS-style methodology, be taken in at least two seasons during a twelve month period and be from sites where other complicating stress effects

(eg organic pollution) are minimal.

This is a tall order, I know, so I don't wish to be too prescriptive at present. I would thus welcome information on any reliable species data which you currently hold, even if it fails to meet all the preferred criteria. One thing that is important, however, is that good chemical data are held for the sites.

Data collected in a single twelve months period will be useful in developing the algorithm but IFE also need to test it on time series of data in order to test its effectiveness. Hopefully, the data would cover a period of at least five and preferably at least ten years. Whilst annual data would be preferable, information on sites that have been sampled less frequently (even twice only) over a similar timescale would still be valuable. Chemical data are again very important too.

Data on three types of sites are required; sites that have been consistently (naturally and/or artificially) acidic over the full period of sampling, sites that you feel have become gradually more acidic over the time period and sites which have been neither naturally nor artificially acidic.

I will come back for more detailed information later, if necessary, but for the present I would welcome a succinct list of the various data-sets you hold which might be helpful to IFE. I would also be grateful if, for each data-set, you could indicate, briefly:

- a short data-set title
- the approximate number of sites involved
- the time period covered by the samples
- the rough average of the number, or range, of samples per site per year
- the sampling methodology
- how the data are held (paper, ASCII file, spreadsheet (which?) or data-base (which?))
- the general availability of supporting chemical data

Again, I stress that these need only be back of envelope estimates at present. Please do not spend a lot of time on precise details. I will follow up the more interesting data-sets in detail later."

2.1.3   Provision of new species level data

The majority of samples collected during the 1990 RQS are held in long-term storage near the IFE River Laboratory in Dorset. These are available for species level identification. Recent access to stored samples showed that their condition remained adequate for the full identification of most taxonomic groups. An exception is likely to be species level identification of Sphaeriidae whose shells tend to degenerate during storage, particularly at acidic sites. It is thought unlikely that individual species of Sphaeriidae would be recommended as key indicators in any algorithm because of the limited number of biologists with the ability to identify this family to species.

A request for information and recommendations on the best samples to sort and identify to species was sent out to each of the biologists circulated under section 2.1.1 (see Table 2.1). The letter contained a full list of the sites sampled in the 1990 RQS in the relevant region for each recipient biologist. These lists were to help those recipients identify and annotate the sites they recommend for further analysis.

Instructions issued in the letter were as follows:

"..... in relation to species data, IFE *[propose]* to identify, to species level, 100 of the 1990 RQS samples which we still hold in store. We would like to select a set of sites subject to a range of low to high acidity which we can build into our classification model. Preferably, the acidity of some of these sites should, in your opinion, have been enhanced (i.e increased) by acid precipitation or other artificial causes.

I have enclosed a list of the samples collected from your Region as part of the 1990 survey. Could the person who is co-ordinating the response to my letter *[in each region]* please return this list with around 30 sites indicated as suitable for identification. Could these sites be marked with a single letter, indicating L (low, pH >6.0 -≤7.0), M (moderate, >5.3 - 6.0) or H (High, ≤5.3) levels of acidity. Not all categories will be present in all Agency Regions but I would still like a list of thirty sites from the categories present please. If you consider it feasible, please could you also mark with an asterisk any of the selected sites which you believe had their acidity enhanced prior to 1990 due to artificial causes. We would like some enhanced sites in each of the three acidity categories if possible."

2.1.4   Family level data from national surveys

The biological and environmental results of the 1990 RQS and 1995 GQA for England and Wales have been acquired from central data-base of the Thames Region of the Environment Agency. These data are also required for use in another Agency R&D project being undertaken by the IFE (EMA 036: Analysis of 1995 biological survey data and RIVPACS update. Phase 2. Post-survey appraisal).

Substantial time, shared between the two projects, has been spent in validating and standardising the data, especially site and sample coding and cross referencing the biological and environmental data. An MSAccess data-base has been developed to hold the national survey data for both 1990 and 1995. It is compatible with the data-base used by IFE to store their own data (see 2.1.3).

Data are held for 19,849 samples from 6,734 sites for the 1995 General Quality Assessment (GQA). Similarly, data are held for 7,700 sites for the 1990 River Quality Survey (RQS) and 4121 of these sites are common to both survey years. Data from common sites may be useful in examining contemporary change in macro-invertebrate assemblages and acidification status if an effective family level algorithm can be devised.

2.2   Evaluation of the University of Wales System

The letter circulated to Agency staff (section 2.1.2 and Table 2.1) contained a request for recipients to supply IFE with their views on the effectiveness of the University of Wales system in their region and how they thought any shortcomings might be dealt with. Each recipient was supplied with a copy of the published paper describing the system (Rutt, Weatherly and Ormerod, 1990).

The relevant section of the letter was as follows:

"In the "Background" section of the Agency's invitation to tender for the current contract they wrote:

The opinion of EA biologists is that the science behind the [University of Wales] *method is sound but it has its limitations, this being particularly evident after applying the method to data from the 1990 National Biological River Quality Survey.*

I don't know if you were one of the biologists who tried out the method on your 1990 RQS data. Either way, I would welcome hearing your views, practical or theoretical, on whether the method has worked effectively in, or would appear to be appropriate to all or parts of your Region. If you think the method was, or would be ineffective I would like to hear what problems you have encountered, or think you might encounter, in using the system and how you think these problems may be overcome.

In addition IFE (Mike Furse) attended the Welsh Acid Waters Symposium on 26th November 1997. Papers presented included one on the evaluation of whether detectable change had occurred in the fauna of 102 Welsh stream sites between 1984 and 1995 that might be attributable to changes in acidification status. The University of Wales system was extensively used in order to detect possible change. Brief conversations were held with both Graham Rutt and Steve Ormerod, originators of the system and the project documentation (Stevens, Ormerod and Reynolds, 1997) provides further useful information on the application of the system.

A further meeting has been arranged with Graham Rutt and Frank Jones (Environment Agency, Welsh Region) to discuss the existing system and the way forward with the current contract.

Another meeting has been provisionally arranged with biologists from the Agency's Midlands Region, who have some experience of applying the University of Wales system outside its region of origin, and comments on the system have also been received from a biologist in North East Region.

3 PLANS FOR THE NEXT REPORTING PERIOD

The next reporting period is from 1st January 1998 (month 4) to 31st March 1998 (month 6).

The following tasks are planned, as listed in Table 1:

- Completion of data acquisition

- Completion of data review

- Completion of discussions on the University of Wales system

- Continuation of data transfer

- Continuation of data-logging

- Selection of 1990 RQS samples for species identification

- Commencement of identification of RQS samples

- Commencement of preliminary analyses

Meetings will take place with all Environment Agency Regions who request them. Currently

meetings have been arranged with Welsh Region (16th February 1998) and Midlands Region (17th February - provisional date).

Mike Furse will attend the Environmental Change Research Centre (ECRC) symposium entitled "Surface Water Acidification: Prospects for Recovery" in January 1998.

4 FACTORS WHICH MAY AFFECT THE ATTAINMENT OF ANY TARGETS OR TIMESCALES

A combination of the delayed award of the contract, existing IFE commitments at the revised start date and staff changes at IFE have resulted in a slow start to the project which is approximately six weeks behind schedule.

Some existing commitments have now been cleared and one new, experienced staff member has been recruited. A second new recruitment will be made in mid-February 1998. The lost time will now be re-cooped over the first half of 1998.

5 FINANCE

The work conducted to date has been within the agreed budget.

A financial summary for the reporting period and end-of-year out-turn may be obtained from the IFE Finance Office approximately two months after the end of the period/financial year in question.

6 REASONS FOR ANY LIKELY UNDER OR OVERSPEND OF BUDGET

No under or overspend of the budget is currently anticipated.

7 OTHER MATTERS

None

8 REFERENCES

Rutt, G P, Weatherly, N S and Ormerod, S J (1990) Relationships between the physiochemistry and macroinvertebrates of British upland streams: the development of modelling and indicator systems for predicting fauna and detecting acidity. *Freshwater Biology*, **24**, 463-480.

Stevens, P A, Ormerod, S J and Reynolds, B (1997*) Final report on the Acid Waters Survey for Wales*. A report to the Environment Agency, Welsh Office, Countryside Council for Wales and Forestry Authority. Volume 1: 221pp. Volume 2: unpaginated.

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