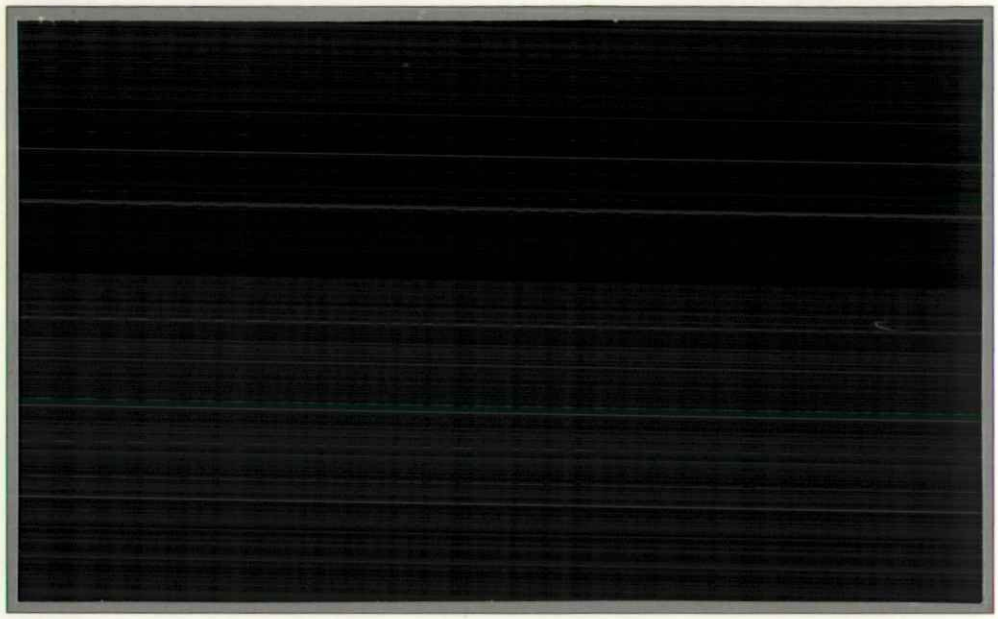

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The faunal richness of headwater streams.
A progress report for the period
1st October - 31st December 1990.

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Project leader: M.T. Furse
Report date: January 1991
Report to: National Rivers Authority
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The Institute of Freshwater Ecology is part of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council.

INSTITUTE OF FRESHWATER ECOLOGY

THE FAUNAL RICHNESS OF HEADWATER STREAMS.

A PROGRESS REPORT FOR THE PERIOD 1st OCTOBER 1990 - 31st DECEMBER 1990.

INTRODUCTION.

This report covers the first three months of a project scheduled for the total period 1st October 1990 to 31st January 1995. The complete work programme comprises four sequential stages, the first of which is of five months duration.

The objectives of Stage 1 are detailed in the Project Investment Appraisal (PIA) which Schedule 2 of the Memorandum of Agreement for Research Contract (ref:54015000) between the National Rivers Authority (NRA) and the Institute of Freshwater Ecology (IFE).

These objectives may be summarised as follows:

a) Undertake a comprehensive search for existing macro-invertebrate data and planned surveys on headwater streams.

b) Compile a report which collates and analyses the information obtained.

c) Use the results of the foregoing analyses, in consultation with the project leader, to select catchments and sites to fulfil the objectives of the subsequent stages of the project.

The following text is sectioned in accordance with Schedule 1 of the research contract.

SECTION 1. TECHNICAL PROGRESS.

Progress to date has been directed towards objective a), data aquisition.

1.1 Biological Data

In order to construct a suitable data-base for analysis it is essential that the results used shall meet consistently high standards of accuracy. In addition, wherever possible, most or all of the major taxonomic groups should be identified to species level. This is important in providing a balanced picture of the species diversity of each site in the data-base.

The primary source of information of this quality is internal to IFE. It comprises the results of a series of studies undertaken by the "River Communities" group at the River Laboratory, Dorset. Many of these results are currently incorporated in the computer package RIVPACS (River InVertebrate Prediction and Classification System) which is being used to assist interpretation of NRA's 1990 River Quality Survey.

RIVPACS contains 438 sites for which all taxa, from each of three seasonally distinct samples, have been consistently identified to species or the nearest achievable level. Sampling procedures for these sites were as standardised as practicable.

In addition the IFE team already hold species level data on a further 400+ "sites" and anticipate this figure rising by over 400 in 1991.

In the context of these additional samples, the term "sites" is more loosely applied than in RIVPACS where each site is almost invariably a separate geographical location. Amongst the additional sites particular locations may be sampled in more than one calender year and each year-set is regarded as a separate "site". Similarly more than one set of samples may have been taken from the same location in a given calender year. Each sample-set is also regarded as a separate site for the purposes of subsequent analyses.

In general taxa from the additional sites have been identified to the same level as in the RIVPACS data-base but with the frequent exception of two groups, Oligochaeta (worms) and Chironomidae (non-biting midges). The identification of these groups is particularly time consuming.

Approximately half of the 400+ non-RIVPACS sites were sampled in three separate seasons during a twelve month period. The principal exceptions are sites sampled in the land-use study programmes jointly funded by NERC and the Department of the Environment (DoE).

Data from all RIVPACS and additional IFE sites are all held on the same VAX mainframe computer. However, because of the different purposes for which they were collected and the different analyses to which they were subjected, the biological data were not always stored in a directly compatible manner. The same degree of incompatibility existed amongst files containing locational data and other environmental information.

The first stage in the utilisation of internal data has been to standardise the format of as many of the existing data-sets as practicable.

This has provided a master data-base, for analysis, of 748 "sites". These include all samples (30) currently identified to species from the 1988 land-use programme "Impact of Land-use Change on Aquatic Communities".

Shortly to be added to the data-base and available for anayses will be a further 92 samples that have currently been identified to species from the 1990 land-use programme "Countryside Survey 1990". These will be mainly first or second stream order.

Also likely to be added are a variety of mainly one off samples collected during other minor contracts but identified to the same high standard. These could contribute up to an extra 21 sites which are again mainly low stream-order.

The total data-base available for analysis in mid-January could therefore comprise 861 sites.

A secondary source of data is the NRA regions. At a meeting of NRA biologists held in December 1990 the project leader requested that the regional biologists make available, to IFE, any such relevant information on headwaters as could be easily extracted.

A letter from IFE, re-iterating this request and defining the nature and extent of data required, will be circulated to each NRA and River Purification Board (RPB) Region in early January 1990. Correspondents will also be asked to identify any specific headwater study programmes that have been, or will be, undertaken in their regions.

A tertiary source of information could be published data in the public domain. No effort has yet been made to carry out a literature search. Such a search is not thought likely to be cost-effective for the reasons outlined later in Section 6.

1.2 Environmental Data.

For the purposes of this study headwater streams have been contractually defined as those of first or second stream order. First order streams are those that have no tributaries. Second order streams are those which have only first order tributaries.

No stream order information was held for any of the IFE sites and the values had to be determined for each of them before the biological data could be examined on this basis. Orders were calculated using all of the watercourses marked on the Ordnance Survey 1:50,000 "Landranger" series of maps.

The complexity of the stream network for particular catchments varies markedly according to topography and geology. For example upland streams on igneous rock have highly bifurcate networks with large numbers of very short first order tributaries. Thus rivers in landscapes of this sort rapidly reach fourth or fifth order although they may still have low discharge and be very near the source. In contrast lowland chalkstreams have extremely few tributaries and may become quite substantial watercourses when still only second order.

It is therefore proposed to examine the macro-invertebrate data in relation to two additional criteria, distance from source and annual mean flow. Values of each of these variables were held for the majority (700+) of the IFE sites. Missing values are being determined.

For ease of interpretation values of annual mean flow and distance from source are best divided into a series of categories. Annual mean flow values were already held as categories but distance from source values are currently being converted from absolute measurements.

The annual mean flow categories adopted correspond to those shown on the River Pollution Survey of England and Wales, 1975 Chemical Classification maps as issued by DoE Water Data Unit. These are as follows:-

CATEGORY	VALUE RANGE (Cubic metres per second)
1	0.31 or less
2	> 0.31 - 0.62
3	> 0.62 - 1.25
4	> 1.25 - 2.50
5	> 2.50 - 5.00
6	> 5.00 - 10.00
7	> 10.00 - 20.00
8	> 20.00 - 40.00
9	> 40.00 - 80.00
10	> 80.00

The distance from source categories adopted were as follows:-

CATEGORY	VALUE RANGE (Kilometres)
1	> 0 - 1.2
2	1.3 - 2.5
3	2.6 - 5.0
4	5.1 - 10.0
5	10.1 - 20.0
6	20.1 - 40.0
7	40.1 - 80.0
8	80.1 - 160.0
9	> 160.0

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8	80.1 - 160.0
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SECTION 2 INTERIM RESULTS.

2.1 Biological data

No detailed analyses of biological data are currently available. Analyses can only be undertaken once all the environmental data have been obtained and transferred to computer.

2.2 Environmental data.

By the end of the reporting period a total of 748 sites had stream order, discharge and distance from source data available. The values for the remaining sites to be included in the data-base will be determined in early January.

The number of sites, out of 748, in each category for each environmental variable is as follows:

CATEGORY	STREAM ORDER	ANNUAL MEAN FLOW	DISTANCE FROM SOURCE
1	49	187	32
2	81	80	43
3	189	75	88
4	222	119	108
5	136	98	171
6	60	69	172
7	8	71	95
8	0	29	30
9	0	16	6
10	0	1	0
UNCLASSIFIED	3	3	3
TOTAL	748	748	748

In addition to the variables listed above, the county and hydrometric area in which each site is situated were also computer coded, as were the 1:50,000 OS maps on which each site occurred. This information will be of value on examining taxon diversity within individual catchments or geographic areas and in selection of study catchments for subsequent stages of the project.

Output of analyses will show the comparative frequency of each taxon in each stream order and each discharge and distance from source category. Results will be presented both for the whole data-base and for a limited series of selected catchments.

Appropriate procedures for defining taxa with a statistically significant affinity with headwater streams are being discussed with NERC statisticians. It is anticipated that any ensuing results will also be included in the Stage 1 report.

3. COST OF WORK DURING THE REPORTING PERIOD

A financial statement of the costs incurred during the reporting period has been requested from the IFE Finance Officer.

Such details normally take six weeks, from the completion of the period of interest, before they become available. This inevitable delay has been discussed with the NRA project leader.

The required information will be made available to NRA at the earliest opportunity.

4. ESTIMATE OF TOTAL COST OF WORKS

The estimated total cost of the works under each category of expenditure remain as listed in Section 10 of the PIA and Schedule 8 of the project contract

It should be noted that the listed figures are given on a cost increase basis with a base date of 1990-91.

Additional information is now available on the staffing of the project works.

The IFE Scientific Officer signified by a + on the third page of Schedule 4 of the project contract is J.M.Winder B.Sc. The IFE Assistant Scientific Officer signified by a + on the fourth page of the schedule is K.L.Symes.

The Resource Input figures given on the fourth page of Schedule 4 are incorrect. The input for Symes (+) should read 202 and not 6, as stated. The input for D.Morton (not Norton, as stated) should read 8 and not 17. The duration of input for Symes should be amended to read 12.90 - 3.94.

5.ESTIMATE OF COSTS FOR THE NEXT REPORTING PERIOD.

The work is fully on schedule. It is anticipated that the cost of work for the period 1-1-91 to 31-3-90 will be the difference between the figure given in Schedule 8 of the contract and the costs incurred in the current reporting period (see Section 3 of this report and the figures to be provided shortly).

6. FACTORS LIKELY TO AFFECT THE SATISFACTORY COMPLETION OF THE WORK.

There are no current budgetary problems associated with the completion of the work.

The data-base immediately available for anaysis within IFE is substantial (>850 "sites") and is of a consistently high accuracy. However other sources of data which are of potential importance will probably not be available within the reporting period for Stage 1 of the contract.

For example, the two existing NERC/DoE funded land-use studies undertaken by IFE will yield approximately 500 running-water macro-invertebrate samples, collected throughout Great Britain during 1988 and 1990. These will all be identified to species in due course and will be of particular value in the context of the headwater study.

Progress with the identification of these samples is dependant on the annual funding available. Thus, to date, only 123 of the samples have been identified and incorporated in the data-base for the current project. Most of the remaining, approximately 400, samples will become available for analyses during the 1991-1992 reporting year. Most of these are expected to be from first or second order streams within 3km of the source.

Information requested from NRA regions may also provide interesting insights. However it is uncertain when and how much data will be made available to IFE. Furthermore the formats in which the data will be provided are unknown but are likely to be very variable. It may take quite some time to make them compatible with the internal IFE data-base and therefore be of value in analyses.

Finally, literature searches for information on headwater streams are likely to be very time consuming and the compatibility and accuracy of data could each be extra sources of complication. For these reasons it has been considered neither cost nor time-effective to search the literature at this stage.

Therefore, whilst the size and quality of the existing data-base is considered perfectly adequate for the purposes of this study, more extensive data will come "on-stream" during 1991-92. A supplement to, or revision of, parts of the Stage 1 report may provide a mechanism for making this wider data-base available.

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(To be completed by all Project Leaders completing commissioned research project reports. Please bind a copy of this distribution sheet as the final page in all internal (IFE) copies of the report.)

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