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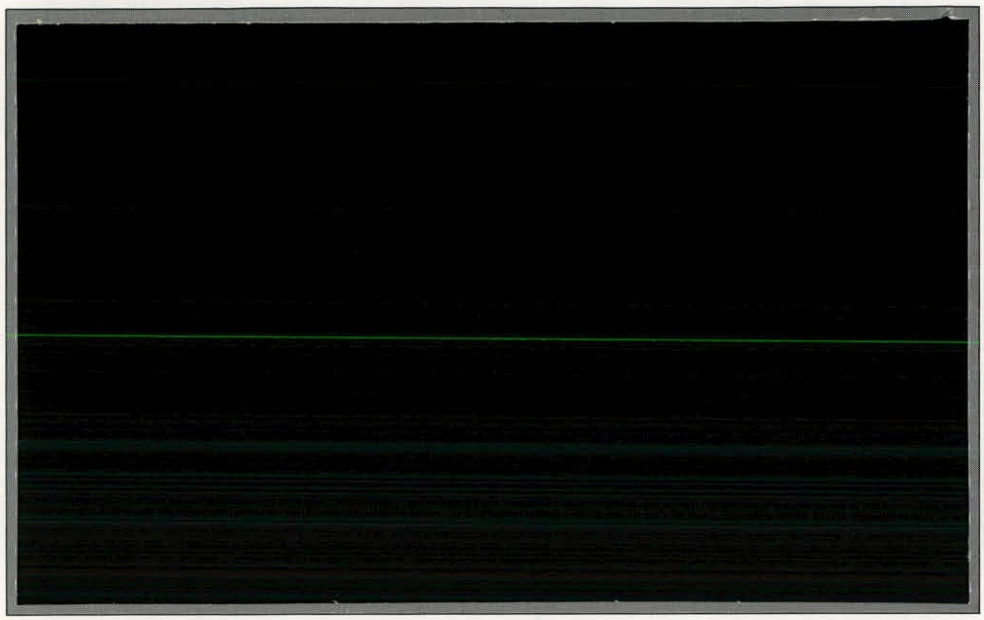

Natural Environment Research Council

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Testing and further development of RIVPACS.
A progress report for the period
1st October - 31st December 1990.

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INSTITUTE OF FRESHWATER ECOLOGY

TESTING AND FURTHER DEVELOPMENT OF RIVPACS

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

1. INTRODUCTION

This research project is in two phases. In Phase 1 (October 1990-March 1991) there are two specific objectives.

a) To undertake a comprehensive testing exercise of RIVPACS II to check its robustness and find the best possible combination of environmental features for use in assessing the 1990 River Quality Survey data.

b) To formulate a series of bands to express river quality in biological terms based upon the 'observed/predicted' ratio obtained from RIVPACS. The bands will be used to describe the results of the 1990 River Quality Survey and future biological surveys.

In Phase 2 (April 1991 onwards) the general objectives are

c) to undertake a comprehensive examination of the 1990 River Quality Survey data, and

d) to undertake future development of RIVPACS.

Note that the details of the research programme for Phase 2 are to be formulated after consultation with the NRA in the near future.

The emphasis of the work in the first three months of Phase 1 has been on objective a) and details of technical progress are given below.

2. TECHNICAL PROGRESS

The prediction system used in RIVPACS II depends upon the use of environmental features to discriminate between site groupings based on the fauna. The current system offers a choice of six different sets of environmental features from which predictions may be made.

Each of the six environmental options has a core group of eight variables in common:

LATITUDE (degrees)	ALTITUDE (m)
LONGITUDE (degrees)	DISTANCE FROM SOURCE (km)
WATER WIDTH (m)	SUBSTRATUM COMPOSITION (% cover)
WATER DEPTH (cm)	DISCHARGE CATEGORY

together with further environmental variables which then characterise the six separate options:

1. ALKALINITY, SLOPE, MEAN AIR TEMPERATURE, ANNUAL AIR TEMPERATURE RANGE
2. ALKALINITY, MEAN AIR TEMPERATURE, ANNUAL AIR TEMPERATURE RANGE
3. SLOPE, MEAN AIR TEMPERATURE, ANNUAL AIR TEMPERATURE RANGE
4. ALKALINITY, SLOPE
5. MEAN AIR TEMPERATURE, ANNUAL AIR TEMPERATURE RANGE
6. ALKALINITY, SLOPE, CHLORIDE

The testing exercise involves prediction of the fauna and various biological indices at each of the 438 sites used to construct the system, using the six environmental options. The observed fauna and biological indices at a given site can then be compared with the predictions. This provides a method of determining which set of environmental variables give the most accurate predictions on this internal test. In addition, the detailed assessment of the results will highlight the strengths and deficiencies of the current prediction system and should provide valuable lessons for further improvements in the future.

A comprehensive comparison between the observed and predicted fauna (and biological indices) at BMWP family level (3 seasons combined) has been carried out. For each of the six environmental options, printouts have been prepared giving observed/expected ratios for the following indices:

number of BMWP families
BMWP score
Average Score per Taxon (ASPT)

for each of the 438 sites.

The relative merits of the six environmental options have been explored by plotting histograms of the range of observed/expected ratios for each index and correlating the observed with the expected values for each index.

Summarising printouts which list the observed/expected ratios for number of BMWP families, BMWP score and ASPT for all six environmental options and all 438 sites have also been prepared. These have been used to highlight, for detailed examination, all sites which exhibit either high or low observed/expected ratios.

Reasons for high or low ratios within the 438 site data set are now being sought. Three areas are under investigation.

a) Limitations of the current prediction system

   The prediction system draws on information from many sites in order to offer a prediction of the fauna to be expected at a site with given environmental features. Since the process depends upon averaging, the prediction will be of the fauna to be expected at an average site. Thus, sites characterised by a limited (or rich) fauna, for whatever reason, will tend to have a low (or high) observed/expected ratio.

b) Variation in the biological quality of the 438 sites

   Some of the sites may be slightly stressed with a reduced taxon richness, whilst others may be exceptionally taxon rich as a result of a combination of favourable conditions at the sites.

c) Variation in sampling effort at the 438 sites

   Despite the three seasons sampling programme to ensure a reasonably comprehensive listing of families for each site, some variation in sampling effort between biologists in the different regions could also be a factor. Examination of those sites sampled by the IFE team itself in various parts of the country may help to throw some light on this area.

The occurrence of low and high observed/expected ratios is also being assessed across each of the 25 TWINSPAN groups to determine whether any particular areas of the classification have a tendency to generate extreme ratios.

Further internal tests using the 438 sites and environmental option 1 will be undertaken in the near future. They are:-

1) A comparison between the observed and predicted fauna at species level (3 seasons combined).

2) A comparison between the observed and predicted number of BMWP families, BMWP score, Average Score per Taxon (ASPT) for each of spring, summer and autumn separately.

The various tests outlined above should provide valuable information on the strength and weaknesses of the current system and the relative merits of the different environmental options.

In addition to these internal assessments, it is also important to see how the system performs when predictions are made for new sites. To minimize complications in the interpretation of the results, the sites should be sampled using the standard procedures devised by the IFE, they should be of good biological quality and the data should be amenable to assessment at different taxonomic levels and different seasons if required.

Over the past few years the IFE have sampled 65 unpolluted sites on 20 river systems throughout Great Britain in a project funded by the Nature Conservancy Council. The sites, which include eight different NRA regions and the Highland RPB, will be used for an external test of RIVPACS II. All of the physical data required for the predictions is now available and further information on the most relevant alkalinity and chloride values for the sites is to be acquired via the 1990 RQS data currently being collated by NRA Thames region.

3. INTERIM RESULTS

Tests to assess the relative merits of the six environmental options and the robustness of the system are still in progress and it would be inappropriate to anticipate the results of all the tests outlined above. However, a brief statement is given below as a guide to the early results.

a) Comparative performance of the six environmental options

Initially, only a single set of environmental variables was offered for prediction, being those now termed option 6 (see previous section). These were judged to offer the best overall predictions after the testing of a range of different variables, all of which could be acquired with relative ease. However, there was a strong view amongst biologists within what is now the NRA, that it would be preferable to have several environmental options for prediction and that use of chloride was best avoided. Options 1-5 were therefore developed.

Criteria used to compare the options included:-
Ability to predict to the correct TWINSPAN group.
Similarity of observed to expected number of BMWP families, BMWP score and ASPT.
Number of observed/expected ratios which gave extreme values (both high and low).

The initial set of variables chosen (option 6) was in general the best but this has been discounted because of the need for chloride as a predictor.

Although the differences in performance between the remaining five options were relatively small, options 1 and 2 came out best, followed by option 4. Options 3 and 5, which were both characterised by the absence of alkalinity as a predictor, appeared to be less reliable.

As observed on a number of previous occasions, ability to predict ASPT is higher than ability to predict the number of BMWP families or BMWP score.

b) Robustness of the prediction system

Here the emphasis is on obtaining an understanding of the reasons for both high and low observed/expected ratios amongst the 438 sites within RIVPACS II. There are good reasons for expecting each of the three possibilities listed in section 2 to contribute towards this end product. Since each mechanism produces the same result, it is proving difficult to determine the relative contribution from each source. In considering the limitations of the current prediction system, new ideas are being generated on possible improvements to future versions of RIVPACS. Some evidence is accumulating that sites sampled by IFE tend to have a preponderance of high observed/expected ratios and fewer low observed/expected ratios in comparison with sites sampled by other agencies. Although this demonstrates a consistently high standard of sampling in the field by IFE staff it may also be, in part, a consequence of IFE choosing a series of consistently high quality sites for sampling.

4. FINANCIAL STATEMENTS

This information, which normally becomes available approximately six weeks after the completion of the period being reported on, will be made available by the IFE Finance Office in due course.

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

There are three items within the research programme which require access to information being accumulated by the NRA as part of the 1990 River Quality Survey. Only when these data are collated within the NRA and made available to the IFE can work on these items proceed.

1) External testing of RIVPACS

Information is required on the water chemistry (alkalinity and chloride) of the 20 river systems to be used in the external test of RIVPACS so that estimated values can be acquired for the 65 unpolluted sites. The predictions can then proceed as all the other environmental and biological data are available.

2) Banding

In order to develop an appropriate banding scheme for presentation of the 1990 RQS results, it will be necessary to have access to a reasonably comprehensive set of RIVPACS predictions (observed/expected ratios) from 1990 survey sites. They should include not only a wide geographical spread but also a wide range of biological quality.

3) Selection of sites for increasing the scope of RIVPACS

All the samples collated during the 1990 RQS are being catalogued and stored at the IFE River Laboratory. They represent an ideal source of material on which to draw in order to increase the scope of RIVPACS and fill in gaps where the system is currently deficient. In order to do this, selected sites on high quality rivers will have their invertebrate fauna identified to species level. Before selection can take place it is important for IFE to have access to the biological data, the environmental data and the predictions for the 1990 RQS sites. This will ensure that only sites of high biological quality and with specified environmental features are processed to species level.

The three blocks of data specified above would, we hope, start to become available during February. Work can then proceed.

J.F. Wright
15 January 1991

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