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Enhancement of RIVPACS for biological assessment of the quality of Scottish rivers

A progress report for the period November 1992 to October 1993

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1. INTRODUCTION

RIVPACS (River InVertebrate Classification and Prediction System) is a software package devised by the Institute of Freshwater Ecology (IFE). It has applications in the biological classification of running-water sites and the assessment of their biological quality. RIVPACS produces site-specific predictions of the macro-invertebrate fauna to be expected, in the absence of stress, at sites of known environmental characteristics. Site quality is evaluated by the degree to which the fauna captured at a site conforms with the taxa predicted to occur. The system was used in the 1990 River Quality Survey of Scotland, England and Wales.

Underpinning RIVPACS is a data-base containing species identifications and environmental information for 438 running-water sites in Britain. Of these, 102 (23%) are from Scotland and the remainder from England and Wales. These data are used to provide predictions by a process of comparison-by-analogy between the sites in the data-base and the sites being assessed. The reliability of a new site prediction is dependent upon there being adequate representation, in RIVPACS, of sites with comparable physical and chemical characteristics.

IFE recently reviewed the effectiveness of RIVPACS (Wright *et al.*, 1991) and is now seeking to enhance the system by rectifying its deficiencies. The overall performance of RIVPACS, in the 1990 River Quality Survey, appears to have been generally good. However, IFE's review has shown scope for improvement in certain river types (eg headwaters and chalk streams) and geographic areas (eg south-west English moorlands). The River Purification Boards (RPBs) have also suggested that the reliability of RIVPACS predictions would be improved by the addition of extra Scottish sites.

Since the construction of RIVPACS in 1988, a further 103 sites have become available for inclusion in a future version as a result of surveys undertaken for what was the Nature Conservancy Council. Of these only 17 (16.5%) are from Scotland. The NRA-funded Headwater Stream project will add approximately 50 sites in England and Wales and the NRA project entitled *Testing and Further Development of RIVPACS* will result in the addition of a further 55 sites in England and Wales. It is expected that the inclusion of these extra samples will overcome most of the weaknesses of the current system for England and Wales.

The current contract allows for a minimum of 30 new sites in Scotland although in practice 36 sites are being processed. By March 1994 approximately 682 sites will be available in Great Britain of which 155 (23%) will be in Scotland. It should be pointed out that before any of these GB sites are included in the analyses leading to RIVPACS III, they will be screened to ensure that they are of an acceptably high standard. On present evidence, this will result in the removal of a very small number of the sites from England, Wales and Scotland. Nevertheless, this contract will ensure that the level of representation of sites in Scotland will be maintained in the next version of the system.

2. OBJECTIVES

The primary objective is as follows:

- to increase the number of Scottish sites in the extended version of RIVPACS and thereby improve the reliability of biological quality assessment for Scottish rivers.

In addition, there are two subsidiary objectives:

- to provide a detailed and reliable data-base of the biological condition of selected, good quality sites in Scotland as reference against which to assess ecological response to potential future environmental stress (eg climatic change, acidification, land-use change etc)
- to increase knowledge of the distribution of individual species and species assemblages of macro-invertebrates in Scotland, with particular reference to their environmental ranges, and thereby provide information of assistance in the formulation of conservation strategies.

3. PROGRESS BETWEEN NOVEMBER 1992 AND OCTOBER 1993

3.1 Site selection

The previous report (Wright *et al.*, 1992) details the basis on which new sites were selected in order to overcome some of the limitations of the RIVPACS II data-set. Essentially this meant achieving better geographical coverage across Scotland, adding more lowland and coastal burns and also more low alkalinity sites in Highland RPB. Headwater sites were not considered a high priority area by RPB biologists. The results of the Water Quality Survey of Scotland 1990 (The Scottish Office, 1992) demonstrated some shortcomings of RIVPACS II in the interpretation of the biological quality at acidified sites, but it was agreed, after consultation with SOEnD that acidification problems were best identified using alternative techniques.

With the exception of just two sites on the R. Urr in Solway RPB, biologists undertook new sampling in 1992, or where necessary, in 1993. In the previous report, 34 high priority sites, involving 7 RPB regions were listed in Appendix I.

A number of changes and additions have been made in the last 12 months and the revised list of 36 sites is given in Appendix I of this report. The changes are detailed below.

Highland RPB

R. Treig at Fersit has now been rejected on the advice of Dr J. Hunter as a result of low flows due to hydro-electric generation.

R. Arkaig at Strathan, R. Meig at Bridgend and R. Conon at Moy Bridge have all been added because efficient sorting and identification of samples generated additional time within the contract.

North East RPB

R. Ythan upstream of Auchterless and at Ardlethen dropped following problems in sample collection in 1992 due to bad weather conditions in summer and autumn.

R. Carron at Tewel Ford and Stonehaven being sampled to replace the two previous sites.

3.2 Sample collection

Some problems were encountered in sample collection in 1992, but all have been dealt with by repeat sampling in 1993. Again, the details are listed below.

Clyde RPB

Difficulties were encountered in sampling the two sites on the R. Ayr in summer 1992, but the samples were successfully taken in summer 1993.

Highland RPB

Repeat samples for autumn 1993 were taken on the Spean at Corrie Coille and the Arkaig at Strathan following comments by Dr J. Hunter that the autumn 1992 samples may have been poor due to high flows. An autumn 1993 sample was also taken on the Meig at Bridgend to complete the three season sampling sequence, following the decision to include this site in the programme.

North East RPB

The late 'spring' sampling dates for the two sites on the R. Lossie (10 June 1992) led to a request for new samples which were willingly retaken by North-East RPB biologists on 14 April 1993.

Solway RPB

Prolonged high flows on the Southwick Burn in autumn 1992 curtailed sampling but a sample was successfully obtained in autumn 1993.

Tweed RPB

Problems with the provision of a summer 1992 sample for the Biggar Water at Biggar Public Park were overcome by sampling in summer 1993.

Hence all 108 samples (36 sites x 3 seasons) have been taken and in fact all but one sample from the Southwick Burn have already been delivered to the River Laboratory.

3.3 Sample processing

Of the 107 samples at the River Laboratory, 104 have been sorted and the fauna identified to 'species' level. This procedure includes identification of the Oligochaeta and Chironomidae to the best achievable level. In addition, for each sample the abundance of each family (as a logarithmic category) is also recorded. Three autumn 1993 samples from Highland RPB have just been delivered. The sample from the Meig will be processed in the next few days but the autumn 1992 macroinvertebrate species lists for the Spean and Arkaig will be examined prior to deciding on the merit of replacing them with the autumn 1993 samples.

3.4 Collation of biological and environmental data

At the time of writing, 'species' level macroinvertebrate data for 90 of the 108 samples has been coded on computer. Family level data awaits coding. Verification of all the biological data will take place once all the sample data have been coded.

Some of the environmental data for the 36 sites has been provided by River Purification Board biologists on field data sheets which were completed at the time of sampling. Additional environmental information is currently being obtained from maps by IFE staff or, in the case of chemical data, will be requested from RPB chemists. Once the environmental data-set is complete this information will also be transferred to computer and verified.

4. FUTURE WORK

The major cost within this contract is the sorting and identification of the fauna in the 108 samples, and the collation and computer coding of both the biological and environmental data for the sites. This work is well on schedule and will be complete before the end of this financial year.

Full taxonomic lists of the macroinvertebrates recorded in each sample at each site will be made available to the appropriate River Purification Boards. In addition, the Scottish Office will receive a final report with full listings of the taxa recorded at all sites sampled within the contract.

Major new analyses leading to RIVPACS III are scheduled for early in the next financial year (1994/95) to ensure that RIVPACS III is available for the 1995 River Quality Survey. The Scottish Office and each River Purification Board will be supplied with the software for RIVPACS III and also the supporting documentation.

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APPENDIX I. Listing of the 36 running-water sites for which samples are being taken in three seasons. Dates indicate that samples have been taken and also delivered to the River Laboratory.

RIVER	SITE	NGR	SPRING	SUMMER	AUTUMN
<u>Clyde RPB</u>					
Ayr	Nether Wellwood	NS 659262	19 May 92	7 Jul 93	13 Oct 92
Ayr	Mainholm Ford	NS 363215	19 May 92	7 Jul 93	13 Oct 92
Falloch	Keilator	NN 370237	12 May 92	18 Aug 92	17 Nov 92
Falloch	Beinglas	NN 319187	12 May 92	18 Aug 92	17 Nov 92
<u>Forth RPB</u>					
Cocklemill Burn	Kill Conquhar Mill	NO 482025	13 May 92	25 Aug 92	25 Nov 92
Crail Burn	A917 Rd. Br.	NO 611079	13 May 92	25 Aug 92	25 Nov 92
Keil Burn	Pitcruvie Castle	NO 413045	13 May 92	25 Aug 92	25 Nov 92
<u>Highland RPB</u>					
Finnan	Glen Finnan	NM 907808	5 May 92	24 Jul 92	31 Oct 92
Foyers	Dalcrag	NH 495187	5 May 92	28 Jul 92	8 Oct 92
Killin	Killin Lodge	NH 530093	5 May 92	29 Jul 92	8 Oct 92
Spean	Corrie Coille	NN 252808	12 May 92	24 Jul 92	5 Dec 92
Ailort	Mon	NM 774830	5 May 92	24 Jul 92	31 Oct 92
Ailort	Craig Ghobhair	NM 853817	5 May 92	24 Jul 92	31 Oct 92
Shiel	Shiel Bridge	NG 935188	14 May 92	30 Jul 92	26 Oct 92
Arkaig	Strathan	NM 979913	14 May 92	28 Jul 92	31 Oct 92
Meig	Bridgend	NH 323549	15 May 92	29 Jul 92	19 Oct 93
Conon	Moy Bridge	NH 477547	15 May 92	29 Jul 92	8 Oct 92
<u>North East RPB</u>					
Lossie	Cloddach	NJ 203584	14 Apr 93	4 Aug 92	7 Dec 92
Lossie	D/S Blackburn	NJ 185620	14 Apr 93	4 Aug 92	7 Dec 92
Bervie	Inverbervie G.S.	NO 824735	15 Apr 92	28 Jul 92	11 Nov 92
Carron	Tewel Ford	NO 828853	28 May 92	30 Jul 92	11 Nov 92
Carron	Stonehaven	NO 874858	28 May 92	30 Jul 92	11 Nov 92
<u>Solway RPB</u>					
Urr	Corsock	NX 766757	2 May 90	20 Aug 90	20 Nov 90
Urr	Haugh of Urr	NX 806660	8 May 90	20 Aug 90	20 Nov 90
Southwick Burn	Nr Southwick House	NX 929574	14 May 92	30 Jul 92	12 Oct 92
<u>Tay RPB</u>					
Earn	Forteviot	NO 048184	19 May 92	29 Jul 92	20 Oct 92
Isla	Wester Cardean	NO 294466	20 May 92	29 Jul 92	20 Oct 92
South Esk	Stannochoy Bridge	NO 584592	28 May 92	6 Aug 92	20 Oct 92
Braan	U/S Tay confluence	NO 023423	18 May 92	5 Aug 92	20 Oct 92
Prosen Water	Prosen Bridge	NO 394586	20 May 92	6 Aug 92	20 Oct 92
Vinny Water	Pitmuies	NO 568496	20 May 92	5 Aug 92	21 Oct 92
Elliot Water	Elliot	NO 620394	20 May 92	30 Jul 92	21 Oct 92
Kenly Water	Stravithie	NO 537112	27 May 92	30 Jul 92	21 Oct 92
<u>Tweed RPB</u>					
Biggar Water	Biggar Public Park	NT 047371	18 May 92	30 Jun 93	15 Oct 92
Tarth Water	Tarth Water Foot	NT 165429	22 Apr 92	29 Jul 92	22 Oct 92
Eden Burn	A6089 Bridge	NT 627451	29 May 92	5 Aug 92	10 Nov 92

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