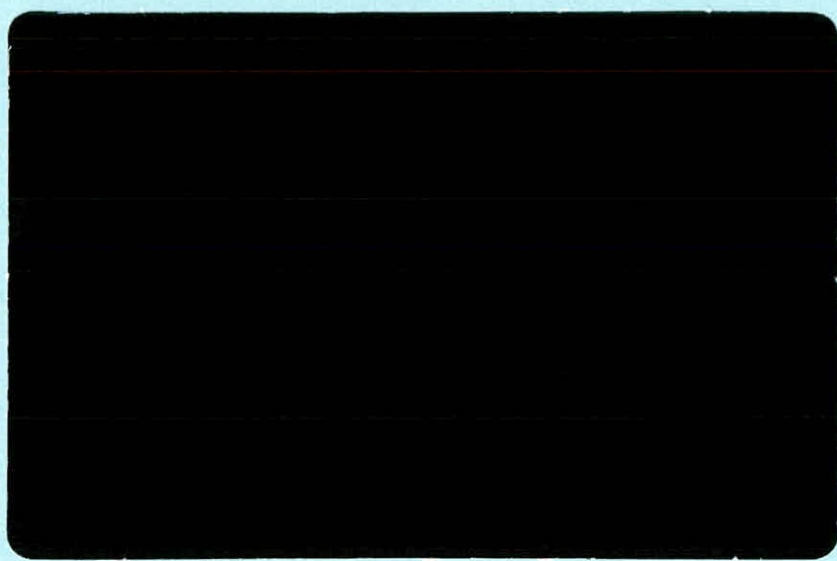


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An audit of performance in the
analysis of biological samples in 1997
Environment Agency: Primary Audit

Institute of Freshwater Ecology

IFE Report Ref: RL/T04071R7/08

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Research Contractor:
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IFE Report Ref: RL/T04071R7/08

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Statement of Use

Information in this document is to help biologists in the Agency to identify where analytical errors occur so that they can be reduced or eliminated. Data in the tables provide measures of the accuracy of primary data produced in accordance with the standard methods for the River Invertebrate Prediction and Classification System (RIVPACS) and analysed to the level required for the Biological Monitoring Working Party (BMWP)-score system, including General Quality Assessment. Information in this report may be used to determine statistical confidence limits and the statistical significances of differences between biological samples. This includes comparisons of Observed/Expected (O/E) values and quality bands made by the compare module of RIVPACS III+ and the statistical routine CONCLASS used for GQA surveys.

Research Contractor

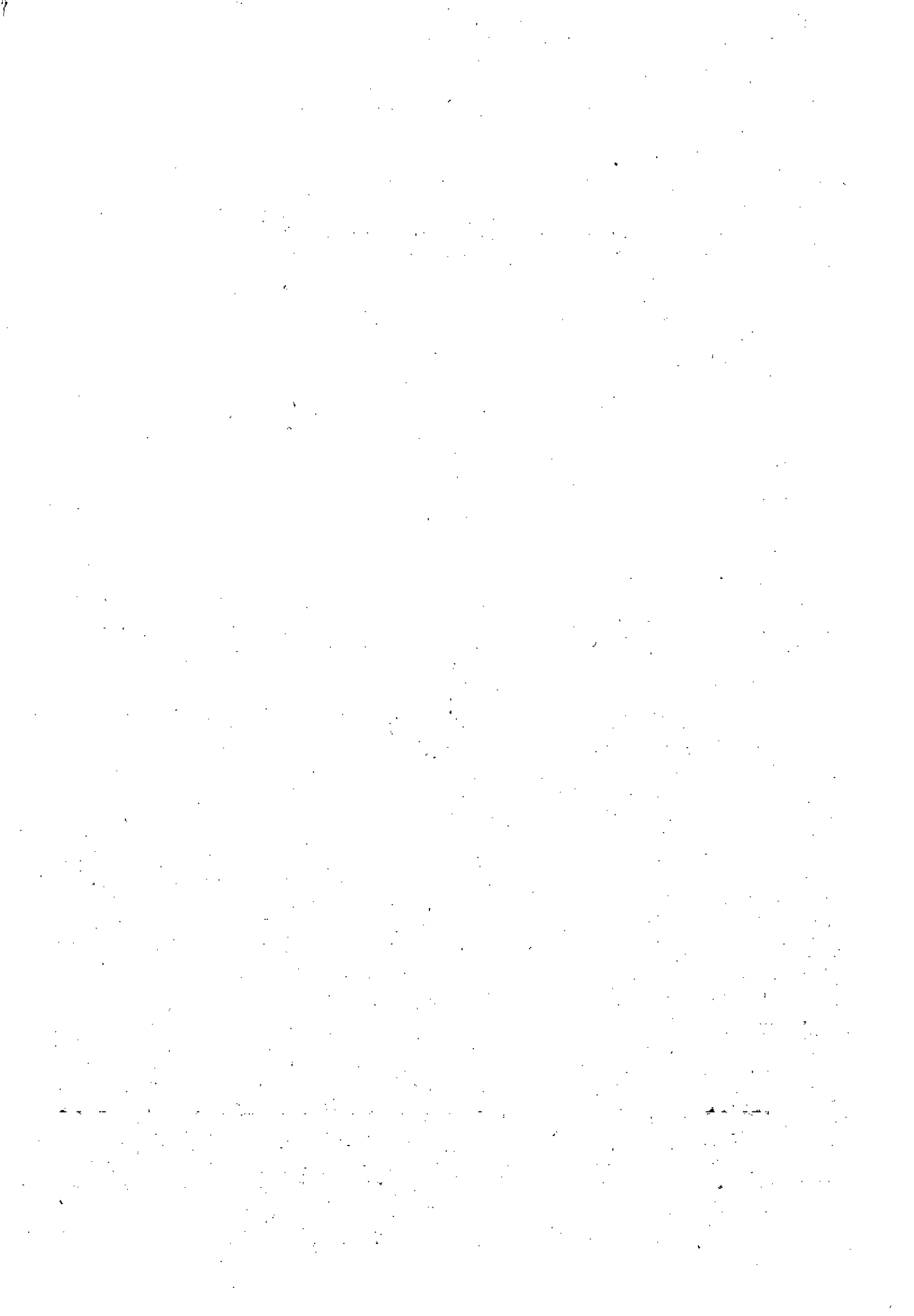
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Environment Agency's Project Manager

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1. INTRODUCTION

In 1997 the sampling of aquatic macro-invertebrates for the biological assessment of river quality was carried out throughout the United Kingdom. This task was undertaken by the Environment Agency (The Agency) in England and Wales, the Scottish Environment Protection Agency (SEPA) in Scotland and the Industrial Research and Technology Unit (IRTU) undertook the work in Northern Ireland.

Each organisation employed standard collection procedures as used in the 1995 General Quality Assessment (GQA) Survey. The sampling strategy was therefore compatible with RIVPACS (River InVertebrate Prediction And Classification System), a computer model developed by the Institute of Freshwater Ecology (IFE). Samples were sorted for the families of macro-invertebrates included in the Biological Monitoring Working Party (BMWP) system. Taxa present were recorded on site data sheets. Although attempts had been made to standardise sample processing and recording techniques, these did vary somewhat from Region to Region.

In view of the number of staff involved and the variability of sample processing techniques, it was recognised that a quality assurance exercise was necessary to minimise and quantify errors. Each laboratory appointed at least one experienced analyst to act as an internal analytical quality control (AQC) inspector. These inspectors re-sorted 10% of the laboratory's samples, those samples chosen for re-sorting being selected randomly. In addition, IFE was contracted to undertake an independent, external audit of the quality of the laboratory analysis of biological samples for each Agency and SEPA region and for IRTU. This commission was consistent with the audit performed by IFE for the National River Quality Surveys in 1990 and 1995 and for the routine biological monitoring of river sites each year between 1991 and 1994 and again in 1996. The audit for the Agency comprised two elements: The AQC Audit provided a measure of the quality of performance of the AQC inspectors. The Primary Audit provided an independent assessment of the quality of the data, since this was not adjusted for errors identified by either of the other quality assurance procedures.

This report presents the results of the audit of 483 samples that were sorted and identified by the Agency's primary analysts. The results of the AQC Audit, detailing the quality of the Agency's internal AQC inspections of 426 samples, are reported separately (Gunn *et al.*, 1998).

2. SAMPLE SELECTION

Samples for audit were selected internally by each of the organisations being monitored. The method of selection used by the Agency is described in Environment Agency (1996). The number of samples selected for audit varied between laboratories and the biologists processing these samples had no prior knowledge of which samples were to be audited. Laboratories were instructed to send to IFE samples that had been processed twice (once for primary analysis and once for internal AQC inspection). Those which analysed an insufficient number of samples throughout the year to provide the requisite number of AQC-inspected samples for the audit sent as many AQC-inspected samples as they could and made up the number with samples which had been analysed just once. The manner of sample selection, which biologists would be monitored and the number of audit samples from each season, were left to the discretion of the organisation, within the limits of the total number of samples that IFE was contracted to audit.

3. SAMPLE PROCESSING

The normal protocol for Agency, SEPA and IRTU biologists was to sort their samples within the laboratory and to select examples of each scoring taxon within the BMWP system. The invertebrates were placed in a vial of preservative (4% formaldehyde solution or 70% industrial alcohol) and the BMWP taxa were listed on a data sheet. The vial of animals and the sorted material were then returned to the sample container and preservative added. Samples for internal AQC analysis should have been sorted in the same manner as the primary analysis. The AQC inspector's task included confirming the identification of the contents of the vial and the correctness of the data sheet. Any additional taxa found at AQC were to be placed in a separate vial without altering the contents of the primary analyst's vial, although this instruction was not always followed.

Each sample available to IFE for audit should have included:

- i) a data sheet containing a list of the BMWP families found in the sample.
- ii) a vial or vials containing representatives from each family.
- iii) the preserved sample.

When these three elements were present, the sequence of operations at IFE was as follows:

- a) The remainder of the sample was sorted, without reference to the data sheet or to the vials of animals, and the BMWP families identified.
- b) The families contained within the vials were identified.
- c) A comparison was made between the listing of families and those found in the sample by IFE.
- d) A comparison was made between the listing of families and those identified from the vials by IFE.
- e) "Losses" or "gains" from the original listing of families were noted. In the case of "gains", each additional family was identified, where possible, to species level, in order to clarify any specific repetitive errors. Single representatives of a "gained" taxon were noted as such.
- f) An error code, selected from a list on the result sheet, was assigned by the IFE auditor for each "loss" or "gain".

Occasionally a sample did not include a vial containing representative examples of the families listed on the data sheet, while some arrived with the vial damaged in transit such that the representative specimens were no longer separated. For these samples, only operations a), c), e) and f) above were appropriate.

Several directives were issued to IFE relating to the treatment of BMWP taxa. Every taxon recorded on the data sheet must be supported by a voucher specimen of that family in the vial (or, for very large specimens, left in the sample). The only exceptions to this rule were the native crayfish, *Austropotamobius pallipes*, the medicinal leech, *Hirudo medicinalis* and the pearl mussel, *Margaritifera margaritifera* (which does not belong to a BMWP family), all of which are protected species. Where possible, IFE gave the benefit of doubt to the analyst in cases of the "loss" of Planariidae, specimens of which have been known to disintegrate in preservative. Animals deemed to have been dead at the time of sampling, cast insect skins, pupal exuviae and empty mollusc shells were to be excluded from the listing of families present. Isolated posterior ends of "living"

specimens were not acceptable as records of a taxon. In these cases, thorax plus abdomen was deemed acceptable but abdomen only was deemed unacceptable. Terrestrial representatives of BMWP scoring families were also to be excluded from the audit. For this reason, Clambidae, Chrysomelidae and Curculionidae, which appear in the BMWP list, were excluded for the purposes of the audit since most representatives of these families are, at best, only semi-aquatic. Trichopteran pupae, although not routinely identified by many biologists, were to be included in the listing of families.

4. REPORTING

The results of each sample audit were recorded on a standard report form and sent to the appropriate Regional Biologist. Examples for Primary and AQC Audits of the same site are shown in Figures 1 & 2. IFE were instructed not to include copies of these forms in the report but that each region would keep their own forms as an appendix to this report. For audit samples where a vial of animals was included, the comparison between the listing of families and the taxa found in the vial by IFE was shown in the section of the report form headed "VIAL". Discrepancies could be due to carelessness, misidentifications or errors in completing the data sheet listing the families present. Families not on the listing but found by IFE in the remainder of the sample were entered in the section of the report form headed "SAMPLE" under "Additional BMWP taxa found by IFE". This section also included taxa added by the internal AQC analyst. Taxa recorded here represent families missed by the analyst(s) on sorting the sample. When the families listed as "losses" in the first section of the report form were compared with the full list of families recorded in the sample by IFE, some apparent losses from the vial were offset by the presence of those families in the remainder of the sample. These taxa were therefore listed both as "losses" from the vial and as "gains" from the sample and were neither a net loss nor a net gain. In these cases, the families were marked with an asterisk in both boxes. Such errors are noted as "omissions".

Species identifications, state of development (eg adult or larval coleopterans) and the presence of a single representative of a family within the remainder of the sample were recorded in the centre section of the report form under "species name".

IFE was asked to interpret each error to provide a possible cause. An error code, selected from a list of options at the foot of each result sheet, was entered against each taxon in the column headed "Presumed cause of error".

For those samples in which the vial of animals was damaged or missing, the "VIAL" sections of the report form were not applicable (N/a). Families not on the list but present in the sample were entered in the section under "SAMPLE" : "Additional taxa" as before. Families recorded on the list but not found by IFE were indicated in the section above this. If the vial of animals was retained by the sorter, entries in this box could include the sole representative of a family which was removed, a family seen at the site which escaped or was released (without mention being made on the data sheet), inaccurate identification or the wrong family box being ticked on the data sheet.

The final section of the result sheet summarises the audit, giving details of the numbers of "losses", "gains" and "omissions", together with the net effects on BMWP score and the number of scoring taxa.

Figure 1. An example of a Primary Audit result sheet

EXTERNAL AUDIT OF BIOLOGICAL SAMPLES

REGION: Example	LABORATORY: Example	DATE: 01/04/97
WATER-COURSE: Beautiful River	PRIMARY ANALYST: XX	AQC ANALYST: YY
SITE: Utopia	CODE: 0001/AQC01	SORT/AQC METHOD: Preserved/Preserved

RESULTS OF PRIMARY AUDIT

Family name	Presumed cause of error (see footnotes)
<u>VIAL</u>	
<u>BMWP taxa not found in vial</u>	
Planorbidae	12
Terrestrial snail in vial	
Baetidae *	1
Limnephilidae	7
<u>Additional BMWP taxa found in vial</u>	
Lepidostomatidae	7
Lepidostoma hirtum (Fabricius)	
<u>SAMPLE</u>	
<u>BMWP taxa not found in sample</u> (for samples where vial is broken or absent)	
N/a	
<u>Additional BMWP taxa found in sample</u>	
Baetidae *	1
Baetis rhodani (Pictet)	
Hydrophilidae (incl. Hydraenidae)	9
Hydraena gracilis Germar (a) 1 only	
Hydroptilidae	11
Hydroptila sp. (p)	
Psychomyiidae (incl. Ecnomidae)	11
Psychomyia pusilla (Fabricius) 1 only	

SUMMARY OF AUDIT

LOSSES: 2 GAINS: 4 OMISSIONS: 1

NET EFFECTS:
ON BMWP SCORE 19
ON NO. OF TAXA 2

- | | | |
|--|--|--|
| 1 No representative of family in vial | 5 Specimen dead at time of sampling | 9 Taxon missed in sorting |
| 2 Alternative terrestrial specimen in vial | 6 Taxon in vial but not recorded | 10 Unexplained error |
| 3 Posterior end only in vial | 7 Mis-identification | 11 Taxon added in internal AQC |
| 4 Empty shell or case or cast skin in vial | 8 Typographical error - wrong box ticked | 12 Recorded taxon that was rejected by AQC analyst |

Omission (*) = Recorded, not in vial but found by IFE in sample (no net loss or gain)

Figure 2. An example of an AQC Audit result sheet

EXTERNAL AUDIT OF BIOLOGICAL SAMPLES

REGION: Example	LABORATORY: Example	DATE: 01/04/97
WATER-COURSE: Beautiful River	PRIMARY ANALYST: XX	AQC ANALYST: YY
SITE: Utopia	CODE: 0001/AQC01	SORT/AQC METHOD: Preserved/Preserved

RESULTS OF AQC AUDIT

Family name	Presumed cause of error (see footnotes)
<u>VIAL</u>	
<u>BMWP taxa not found in vial</u>	
Baetidae *	1
Limnephilidae	7
<u>Additional BMWP taxa found in vial</u>	
Lepidostomatidae	7
Lepidostoma hirtum (Fabricius)	
<u>SAMPLE</u>	
<u>BMWP taxa not found in sample</u> (for samples where vial is broken or absent)	
N/a	
<u>Additional BMWP taxa found in sample</u>	
Baetidae *	1
Baetis rhodani (Pictet)	9
Hydrophilidae (incl. Hydraenidae)	
Hydraena gracilis Germar (a) 1 only	

SUMMARY OF AUDIT

LOSSES: 1 GAINS: 2 OMISSIONS: 1

**NET EFFECTS:
ON BMWP SCORE 8
ON NO. OF TAXA 1**

- 1 No representative of family in vial
- 2 Alternative terrestrial specimen in vial
- 3 Posterior end only in vial
- 4 Empty shell or case or cast skin in vial

- 5 Specimen dead at time of sampling
- 6 Taxon in vial but not recorded
- 7 Mis-identification
- 8 Typographical error - wrong box ticked

- 9 Taxon missed in sorting
- 10 Unexplained error
- 11 Taxon added in internal AQC
- 12 Recorded taxon that was rejected by AQC analyst

Omission (*) = Recorded, not in vial but found by IFE in sample (no net loss or gain)

5. RESULTS

The results of the Primary Audit for 1997 for all Agency Regions are presented, Region by Region, in Tables 1 to 56. A summary of the basic audit results in terms of losses, gains and omissions is followed by the statistics of these regional audit results centered around the target of acceptability of no more than two missed taxa per sample. These data are presented for each analyst, for their Area Laboratories and for the Region as a whole. Then follows information on the net effects of the Primary Audit on the BMWP score and number of taxa for the Region's data. These results are again based on the target of no more than two missed taxa per sample. The figure of 13 for an acceptable underestimate of BMWP score is based on twice the average score of all taxa in the BMWP listing (excluding Clambidae, Chrysomelidae and Curculionidae, which are excluded from the audit). This average score is 6.57. Following this are listings for the Region of the taxa missed at family and species levels in the 1997 audit. Tables 57 and 58 summarise the statistics and effects of the 1997 Primary Audit for the whole of the Agency. Tables 59 and 60 give listings of all taxa, at family and species levels respectively, missed in sorting by the Agency's primary analysts and Tables 61 and 62 give similar listings for all samples audited in 1997 for the whole of the United Kingdom (Primary and AQC Audits for Agency Regions plus single Audit for other organisations). Data for the AQC Audit is presented in a separate report (Gunn *et al*, 1998).

Estimating sample biases for the compare module of RIVPACS III+

The underestimation of the number of BMWP-scoring taxa is termed bias for the purpose of the compare module of RIVPACS III+. An estimate of bias is provided by the net gains (number of gains minus number of losses). The average net gains for each laboratory, Region and the Agency as a whole are listed in Table 58 in the column "mean net effect on no. of taxa". These values may be used directly for RIVPACS. To estimate the bias over a different period to that covered by this audit, it is necessary to refer to the Primary Audit result sheets for individual samples. Note that estimates of bias should be based on the results of at least 20 audited samples. Further instructions are given in Clarke *et al*. (1997).

6. ACKNOWLEDGEMENTS

Grateful thanks to the Agency's project leader, John Murray-Bligh of Thames Region, who contributed to the development and implementation of improved methodology and who provided helpful advice throughout the period of the audit

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AUDIT OF ANGLIAN REGION'S PRIMARY ANALYSTS

Table 1 The 20 samples audited for Central Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Fancott Brook	Cranford Bridge	AK	0	4	1
Sapiston	Bardwell Bridge	CLQ	0	1	0
Nar	Castle Acre Bridge	CLQ	0	3	1
Cam	Littlebury Bridge	CLQ	0	1	1
Ivel	Broom Mill	CLQ	0	2	0
Flit	Shefford North Bridge	CLQ	2	3	0
Old Bedford	Welmore Sluice	CLQ	1	3	1
Wendon Brook	B1383 Bridge	LJS	0	2	0
Granta	Hildersham Ford	LJS	0	1	2
Flood Relief Channel	Downham Bridge	LJS	0	0	0
Rhee	Haslingfield Road Bridge	LJS	1	3	0
Ely Ouse	Ely High Bridge	LJS	1	1	0
Mill Basin	Mill Basin PS	LJS	0	2	1
Tove	Capenham Bridge	LJS	0	1	0
Tove	Bozenham Mill	LJS	0	6	0
Clipstone Brook	Leighton Buzzard	LJS	0	1	2
Ouse	Harrold Bridge	LJS	0	6	0
Gadder	Oxborough Bridge	SEH	1	4	2
Little Ouse	Brandon Road Bridge	SEH	1	1	0
Ouse	Brackley	SJH	0	2	1

Table 2 The 20 samples audited for Eastern Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Laverham Brook	Lower Road Ford	CSA	2	1	0
Holland Brook	Holland Main Road Bridge	CSA	0	0	0
Chainbridge Tributary	Chainbridge Farm	CSA	0	1	0
Wang	Wangford Bridge	CSA	0	3	0
Colne	Earls Colne Bridge	CSA	2	2	0
Pant	Codham Mill Ford	CSA	0	3	0
Bure	Buxton Mill	CSA	0	3	0
Chelmer	Paper Mills	CSA	0	2	0
Colne	Middle Mill	CW	0	0	0
Rattlesden	u/s Confluence ICI	EJB	0	0	0
Gipping	Sproughton Mill	JHS	0	1	0
Brett	Layham Mill	JHS	0	3	0
Rattlesden	Burford Bridge	JHS	0	2	0
Dove	Thorndon Bridge	JMG	0	0	0
Wensum	Great Ryburgh Bridge	JMG	0	0	0
Starston Beck	Redenhall	JMG	0	2	0
Yare	Strumpshaw	LKH	0	4	0
Chilton Brook	Folly Road Bridge	LKH	0	2	0
Blyth	Rectory Street	LKH	0	3	0
Brett	Scripscross Bridge	LSM	0	6	0

Table 3 The 20 samples audited for Northern Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Skellingthorpe Main Drain	u/s Skellingthorpe STW	CAE	0	1	0
Wootton Brook	Milton Malsor Road Bridge	DMB	0	4	0
Caistor Canal	Westfield Farm	DMB	0	3	0
Slade Brook	Glendon Hall Wood	DMB	0	2	0
Welland	Rockingham	DMB	1	4	1
Upper Witham	Easton Park	IMC	0	1	0
Whaplode	Whaplode Marsh	IMC	0	2	0
Willow Brook (South)	Lodge Farm	IMC	0	0	0
Willow Brook	Apethorpe	IMC	0	2	0
Brant	Blackmoor Bridge	IMC	0	4	0
Werrington Brook	Cuckoos Hollow Lake inlet	IMC	0	0	1
Woldgrift Drain	Washdyke Bridge	IMC	0	0	0
Ise	d/s Rushton STW	IMC	1	2	1
Nene	Duston Mill	IMC	0	2	0
Ise	Rushton	IMC	0	2	0
West Glen	Little Bytham	RPC	0	6	0
East Halton Beck	College Bridge	RPC	0	0	0
Rase	Bishopbridge	RPC	0	1	0
Rase	Bully Hill	RPC	0	1	0
Chater	Ketton	RPC	0	0	0

Table 4 Statistics of the 1997 Primary Audit for Anglian Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Central	20	2.35	0.37	8	40.00	6	3.30	0.42
AK	1	4.00	n/a	1	100.00	4	5.00	n/a
CLQ	6	2.17	0.40	3	50.00	3	3.17	0.70
LJS	10	2.30	0.67	3	30.00	6	3.00	0.61
SEH	2	2.50	1.50	1	50.00	4	4.50	2.50
SJH	1	2.00	n/a	0	0.00	2	3.00	n/a
Eastern	20	1.90	0.35	7	35.00	6	2.10	0.37
CSA	8	1.88	0.40	3	37.50	3	2.38	0.46
CW	1	0	n/a	0	0	0	0	n/a
EJB	1	0	n/a	0	0	0	0	n/a
JHS	3	2.00	0.58	1	33.33	3	2.00	0.58
JMG	3	0.67	0.67	0	0	2	0.67	0.67
LKH	3	3.00	0.58	2	66.67	4	3.00	0.58
LSM	1	6.00	n/a	1	100.00	6	6.00	n/a
Northern	20	1.85	0.37	5	25.00	6	2.10	0.42
CAE	1	1.00	n/a	0	0	1	1.00	n/a
DMB	4	3.25	0.48	3	75.00	4	3.75	0.85
IMC	10	1.50	0.40	1	10.00	4	1.80	0.44
RPC	5	1.60	1.12	1	20.00	6	1.60	1.12
Anglian Region	60	2.03	0.21	20	33.33	6	2.50	0.24

Table 5 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Anglian Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Central	20	10.80	30.00	42	2.00	25.00	6
AK	1	20.00	100.00	20	4.00	100.00	4
CLQ	6	8.00	16.67	16	1.67	16.67	3
LJS	10	11.80	30.00	42	2.10	20.00	6
SEH	2	6.50	0	10	1.50	50.00	3
SJH	1	17.00	100.00	17	2.00	0	2
Eastern	20	10.05	35.00	37	1.70	35.00	6
CSA	8	8.13	37.50	17	1.38	37.50	3
CW	1	0	0	0	0	0	0
EJB	1	0	0	0	0	0	0
JHS	3	14.67	33.33	25	2.00	33.33	3
JMG	3	3.00	0	9	0.67	0	2
LKH	3	15.33	66.67	24	3.00	66.67	4
LSM	1	37.00	100.00	37	6.00	100.00	6
Northern	20	9.90	25.00	41	1.75	25.00	6
CAE	1	3.00	0	3	1.00	0	1
DMB	4	15.75	75.00	21	3.00	75.00	4
IMC	10	7.60	10.00	24	1.40	10.00	4
RPC	5	11.20	20.00	41	1.60	20.00	6
Anglian Region	60	10.25	30.00	42	1.82	28.33	6

Table 6 The families missed by Anglian Region's primary analysts

Family	n	% of Anglian Region's missed families in Primary Audit
Hydroptilidae	14	12.17
Haliplidae	7	6.09
Limnephilidae	7	6.09
Planariidae (incl. Dugesiidae)	6	5.22
Elmidae	6	5.22
Valvatidae	5	4.35
Simuliidae	5	4.35
Psychomyiidae (incl. Ecnomidae)	4	3.48
Caenidae	4	3.48
Coenagriidae	4	3.48
Ancylidae (incl. Acroloxidae)	4	3.48
Hydrobiidae (incl. Bithyniidae)	4	3.48
Physidae	3	2.61
Hydrophilidae (incl. Hydraenidae)	3	2.61
Polycentropodidae	3	2.61
Hydropsychidae	3	2.61
Leptophlebiidae	2	1.74
Corixidae	2	1.74
Goeridae	2	1.74
Leptoceridae	2	1.74
Baetidae	2	1.74
Sphaeriidae	2	1.74
Lymnaeidae	2	1.74
Unionidae	1	0.87
Nepidae	1	0.87
Rhyacophilidae (incl. Glossosomatidae)	1	0.87
Planorbidae	1	0.87
Notonectidae	1	0.87
Sialidae	1	0.87
Dendrocoelidae	1	0.87
Asellidae	1	0.87
Beraeidae	1	0.87
Libellulidae	1	0.87
Chironomidae	1	0.87
Nemouridae	1	0.87
Dytiscidae (incl. Noteridae)	1	0.87
Gammaridae (incl. Crangonyctidae)	1	0.87
Gyrinidae	1	0.87
Hydrometridae	1	0.87
Lepidostomatidae	1	0.87
Leuctridae	1	0.87
Calopterygidae	1	0.87
Total	115	100

Table 7 The species missed by Anglian Region's primary analysts

Species	n	% of Anglian Region's missed species in Primary Audit
Hydroptila sp.	12	9.45
Haliphus sp.	6	4.72
Limnephilidae indet	5	3.94
Ancylus fluviatilis Muller	4	3.15
Polycelis nigra group	4	3.15
Oulimnius tuberculatus (Muller)	3	2.36
Valvata piscinalis (Muller)	3	2.36
Coenagriidae indet	3	2.36
Physa fontinalis (L.)	3	2.36
Potamopyrgus jenkinsi (Smith)	3	2.36
Goera pilosa (Fabricius)	2	1.57
Hydropsyche angustipennis (Curtis)	2	1.57
Lymnaea peregra (Muller)	2	1.57
Dugesia tigrina (Girard)	2	1.57
Oulimnius sp.	2	1.57
Pisidium sp.	2	1.57
Sigara (Sigara) sp.	2	1.57
Simulium (Simulium) ornatum group	2	1.57
Tinodes waeneri (L.)	2	1.57
Valvata cristata Muller	2	1.57
Mystacides azurea (L.)	2	1.57
Agraylea multipunctata Curtis	2	1.57
Caenis horaria (L.)	2	1.57
Athripsodes aterrimus (Stephens)	2	1.57
Caenis luctuosa group	2	1.57
Athripsodes cinereus (Curtis)	1	0.79
Nemurella picteti Klapalek	1	0.79
Nepa cinerea L.	1	0.79
Notonecta sp.	1	0.79
Ochthebius minimus (Fabricius)	1	0.79
Orectochilus villosus (Muller)	1	0.79
Orthoclaadiinae	1	0.79
Bithynia tentaculata (L.)	1	0.79
Oxyethira sp.	1	0.79
Paraleptophlebia sp.	1	0.79
Baetis rhodani (Pictet)	1	0.79
Platambus maculatus (L.)	1	0.79
Polycentropus sp.	1	0.79
Simulium (Boophthora) erythrocephalum (de Geer)	1	0.79
Simulium (Eusimulium) aureum group	1	0.79
Asellus aquaticus (L.)	1	0.79
Simulium sp.	1	0.79

Table 7 continued

Species	n	% of Anglian Region's missed species in Primary Audit
Tanypodinae	1	0.79
Anodonta cygnea (L.)	1	0.79
Anacaena bipustulata (Marshall)	1	0.79
Dugesia polychroa group	1	0.79
Agapetus sp.	1	0.79
Sialis lutaria (L.)	1	0.79
Beraea maurus (Curtis)	1	0.79
Glyphotaelius pellucidus (Retzius)	1	0.79
Ecnomus tenellus (Rambur)	1	0.79
Polycentropodidae indet	1	0.79
Gammarus pulex (L.)	1	0.79
Lype sp.	1	0.79
Diamesinae	1	0.79
Gyraulus albus (Muller)	1	0.79
Habrophlebia fusca (Curtis)	1	0.79
Haliplidae indet	1	0.79
Dendrocoelum lacteum (Muller)	1	0.79
Hippeutis complanatus (L.)	1	0.79
Hydraena riparia Kugelann	1	0.79
Hydrometra stagnorum (L.)	1	0.79
Cyrnus trimaculatus (Curtis)	1	0.79
Libellulidae indet	1	0.79
Elmis aenea (Muller)	1	0.79
Calopteryx splendens (Harris)	1	0.79
Chironomini	1	0.79
Leuctra geniculata (Stephens)	1	0.79
Leuctra fusca (L.)	1	0.79
Lepidostoma hirtum (Fabricius)	1	0.79
Ithytrichia sp.	1	0.79
Cloeon dipterum (L.)	1	0.79
Hydropsyche siltalai Dohler	1	0.79
Hydropsyche pellucidula (Curtis)	1	0.79
Limnephilus sp.	1	0.79
Ischnura elegans (Van der Linden)	1	0.79
Total	127	100

AUDIT OF MIDLANDS REGION'S PRIMARY ANALYSTS

Table 8 The 20 samples audited for Upper Severn Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Vyrnwy	Llanymynech	ADG	0	1	0
Cain	Llanfyllin	ADG	0	1	0
Stour	Caunsall	ADG	0	1	0
Luttley Gutter West	Wassel Grove	ADG	0	1	0
Hoo Brook	u/s Offmore	ADG	0	0	0
Gallows Brook	u/s Hagley	LM	0	1	0
Blakedown Brook	Churchill	LM	0	1	0
Minsterley Brook	Hogstow	LM	0	1	0
Clun	u/s Teme	LM	0	3	0
Vyrnwy	Llanymynech	LM	0	2	0
Severn	Dolwen	LM	0	1	0
Staffs/Worcs Canal	Kidderminster	PW	0	1	0
Afon Biga	d/s Lime	PW	0	1	0
Ledwyche Brook	Henley	PW	0	3	0
Laughen Brook	A4013	PW	0	1	0
Worfe	Confluence	PW	0	1	0
Vyrnwy	Melverley	PW	0	4	0
Cerist	Fan Bridge	PW	1	1	1
Stratford Brook	d/s Pattingham	PW	0	3	0
Tanat	Pedair Ford	PW	0	5	0

Table 9 The 20 samples audited for Lower Severn Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Pool Brook	Upton on Severn	ADC	0	5	0
Shorn Brook	Hardwicke	ADC	0	0	0
Cannop - The Cut	u/s Cromptons	ADC	1	3	0
Leadon	Wedderburn Bridge	ADC	1	3	0
Leadon	Newton Bridge	ADC	0	1	0
Avon	Stare Bridge	ADC	0	1	0
Swilgate	Tewkesbury	ADC	0	1	1
Carisbrook	d/s Rank Xerox	ADC	0	1	0
Cannop Brook	New Mills	ADC	1	1	0
Yelvertoft Brook	Lilbourne	HJW	0	0	0
Longhope Brook	u/s Court Farm	HJW	0	1	0
Cinderford Brook	d/s Englehards	HJW	0	1	0
Nailsworth Stream	d/s Avening WRW	PCG	1	0	0
Itchen	Marton	PCG	0	4	1
Alne	Millhouse	PCG	0	1	0
Leadon	Uplands Bridge	PCG	0	1	1
Cowhoneybourne Brook	Clayfields Barn	PCG	0	2	0
Avon	Warwick	PCG	0	2	0
Piddle Brook	Wyre Mill	PCG	1	1	1
Daniels Brook	Brookthorpe	PCG	0	0	0

Table 10 The 20 samples audited for Upper Trent Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Trent	Hanford	CAS	0	0	0
Mease	Croxall	EL	0	5	0
Darklands Brook	Drakelow	GF	0	1	0
Bil Brook	Pendeford	GF	0	1	0
Spitalhill Brook	Ashbourne	GF	0	2	0
Henmore Brook	Atlow	GF	0	4	0
Dove	Sudbury	GF	1	4	0
Sow	u/s Cop Mere	GF	0	2	0
Manifold	Hulme End	GF	0	2	0
Blake Brook	Bridgend	GF	0	2	0
Churnet	Churnet Mouth	LCB	0	3	1
Doye	Mayfield	LCB	0	2	0
Doxey Brook	Doxey	LCB	0	0	1
Mease	Measham	LCB	1	3	0
Footherley Brook	Footherley Hall	LTT	0	3	0
Brereton Brook	Ash Lagoon Channel	LTT	0	3	0
Sibson Brook	Sibson	LTT	0	4	1
Blithe	Cookshill	LTT	0	2	0
Trent & Mersey Canal	Copp Lane	LTT	0	1	0
Tame	Chetwynd	LTT	1	2	0

Table 11 The 20 samples audited for Lower Trent Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Bullwell Hall Stream	Lake inlet	AR	0	2	0
Derwent	Darley Dale Bridge	AR	0	7	0
Sookholme Brook	d/s Coal Tip Tributary	AR	0	6	0
Cuttle Brook	Sinfin Golf Course	CM	0	1	0
Chesterfield Canal	Retford	PH	0	2	1
Braunstone Tributary	u/s Lubbesthorpe Brook	PH	0	0	0
Trent	d/s FGD Plant	PH	0	1	0
Bottle Brook	Lumb Farm	PH	0	1	0
Erewash	Stanton Gate	PH	0	1	0
Nethergreen Brook	Eastwood	PH	0	2	1
Rothley Brook	Ratby	PH	0	1	0
Bradford Brook	Alport	PS	0	6	0
Eau	Scotton	PS	0	3	0
Poulter	Cuckney	PS	0	2	0
Bottesford Beck	Brigg Road	PS	0	1	0
Stainforth & Keadby Canal	Keadby	PS	0	1	0
Countesthorpe Brook	Sence confluence	TP	0	0	1
Bradwell Brook	Brough	TP	0	5	0
Tideswell Brook	Tideswell Dale	TP	0	1	0
Shire Brook	Confluence Sookholme Brook	TP	0	2	0

Table 12 Statistics of the 1997 Primary Audit for Midlands Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Upper Severn	20	1.65	0.28	5	25.00	5	1.75	0.29
ADG	5	0.80	0.20	0	0	1	0.80	0.20
LM	6	1.50	0.34	1	16.67	3	1.50	0.34
PW	9	2.22	0.52	4	44.44	5	2.44	0.50
Lower Severn	20	1.45	0.30	4	20.00	5	1.90	0.35
ADC	9	1.78	0.52	3	33.33	5	2.22	0.57
HJW	3	0.67	0.33	0	0	1	0.67	0.33
PCG	8	1.38	0.46	1	12.50	4	2.00	0.53
Upper Trent	20	2.30	0.30	8	40.00	5	2.60	0.34
CAS	1	0	n/a	0	0	0	0	n/a
EL	1	5.00	n/a	1	100.00	5	5.00	n/a
GF	8	2.25	0.41	2	25.00	4	2.38	0.50
LCB	4	2.00	0.71	2	50.00	3	2.75	0.75
LTT	6	2.50	0.43	3	50.00	4	2.83	0.54
Lower Trent	20	2.25	0.46	5	25.00	7	2.40	0.46
AR	3	5.00	1.53	2	66.67	7	5.00	1.53
CM	1	1.00	n/a	0	0	1	1.00	n/a
PH	7	1.14	0.26	0	0	2	1.43	0.43
PS	5	2.60	0.93	2	40.00	6	2.60	0.93
TP	4	2.00	1.08	1	25.00	5	2.25	0.95
Midlands Region	80	1.91	0.17	22	27.50	7	2.16	0.18

Table 13 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Midlands Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Upper Severn	20	9.25	20.00	33	1.60	25.00	5
ADG	5	3.80	0	5	0.80	0	1
LM	6	8.83	16.67	18	1.50	16.67	3
PW	9	12.56	33.33	33	2.11	44.44	5
Lower Severn	20	7.35	15.00	23	1.20	10.00	5
ADC	9	8.44	22.22	23	1.44	11.11	5
HJW	3	4.00	0	7	0.67	0	1
PCG	8	7.38	12.50	22	1.13	12.50	4
Upper Trent	20	11.00	40.00	31	2.15	35.00	5
CAS	1	0	0	0	0	0	0
EL	1	22.00	100.00	22	5.00	100.00	5
GF	8	10.88	25.00	31	2.13	25.00	4
LCB	4	8.75	25.00	15	1.75	25.00	3
LTT	6	12.67	66.67	20	2.33	50.00	4
Lower Trent	20	11.85	30.00	36	2.25	25.00	7
AR	3	25.33	66.67	36	5.00	66.67	7
CM	1	3.00	0	3	1.00	0	1
PH	7	6.57	14.29	17	1.14	0	2
PS	5	14.80	40.00	34	2.60	40.00	6
TP	4	9.50	25.00	25	2.00	25.00	5
Midlands Region	80	9.86	26.25	36	1.80	23.75	7

Table 14 The families missed by Midland Region's primary analysts

Family	n	% of Midlands Region's missed families in Primary Audit
Elmidae	8	5.71
Planariidae (incl. Dugesiidae)	8	5.71
Hydrophilidae (incl. Hydraenidae)	8	5.71
Hydroptilidae	7	5.00
Leptoceridae	7	5.00
Tipulidae	6	4.29
Haliplidae	6	4.29
Caenidae	5	3.57
Lymnaeidae	5	3.57
Hydrobiidae (incl. Bithyniidae)	5	3.57
Valvatidae	4	2.86
Sphaeriidae	4	2.86
Simuliidae	4	2.86
Limnephilidae	4	2.86
Hydropsychidae	4	2.86
Gyrinidae	4	2.86
Asellidae	3	2.14
Planorbidae	3	2.14
Oligochaeta	3	2.14
Nemouridae	3	2.14
Chironomidae	3	2.14
Coenagriidae	2	1.43
Piscicolidae	2	1.43
Chloroperlidae	2	1.43
Psychomyiidae (incl. Ecnomidae)	2	1.43
Dytiscidae (incl. Noteridae)	2	1.43
Physidae	2	1.43
Perlodidae	2	1.43
Erpobdellidae	2	1.43
Gerridae	2	1.43
Gammaridae (incl. Crangonyctidae)	2	1.43
Ancylidae (incl. Acroloxidae)	2	1.43
Lepidostomatidae	1	0.71
Taeniopterygidae	1	0.71
Goeridae	1	0.71
Heptageniidae	1	0.71
Calopterygidae	1	0.71
Corixidae	1	0.71
Sialidae	1	0.71
EphemereUidae	1	0.71

Table 14 continued

Family	n	% of Midlands Region's missed families in Primary Audit
Brachycentridae	1	0.71
Ephemeridae	1	0.71
Scirtidae	1	0.71
Leptophlebiidae	1	0.71
Baetidae	1	0.71
Rhyacophilidae (incl. Glossosomatidae)	1	0.71
Total	140	100

Table 15 The species missed by Midlands Region's primary analysts

Species	n	% of Midlands Region's missed species in Primary Audit
<i>Elmis aenea</i> (Muller)	6	3.95
<i>Caenis rivulorum</i> Eaton	5	3.29
<i>Pisidium</i> sp.	4	2.63
<i>Potamopyrgus jenkinsi</i> (Smith)	4	2.63
<i>Orectochilus villosus</i> (Muller)	4	2.63
<i>Polycelis nigra</i> group	4	2.63
<i>Hydroptila</i> sp.	4	2.63
<i>Haliphus</i> sp.	4	2.63
<i>Hydraena gracilis</i> Germar	4	2.63
<i>Oulimnius tuberculatus</i> (Muller)	3	1.97
<i>Athripsodes bilineatus</i> (L.)	3	1.97
<i>Ithytrichia</i> sp.	3	1.97
<i>Oulimnius</i> sp.	3	1.97
<i>Asellus aquaticus</i> (L.)	3	1.97
<i>Lymnaea peregra</i> (Muller)	3	1.97
<i>Valvata piscinalis</i> (Muller)	3	1.97
<i>Isoperla grammatica</i> (Poda)	2	1.32
<i>Hydropsyche angustipennis</i> (Curtis)	2	1.32
<i>Physa fontinalis</i> (L.)	2	1.32
<i>Piscicola geometra</i> (L.)	2	1.32
<i>Nemurella picteti</i> Klapalek	2	1.32
<i>Polycelis felina</i> (Dalyell)	2	1.32
<i>Lymnaea truncatula</i> (Muller)	2	1.32
<i>Gerris</i> (<i>Gerris</i>) <i>lacustris</i> (L.)	2	1.32
<i>Gammarus pulex</i> (L.)	2	1.32
Orthocladiinae	2	1.32
<i>Dugesia polychroa</i> group	2	1.32
<i>Chloroperla torrentium</i> (Pictet)	2	1.32
<i>Dicranota</i> sp.	2	1.32
Tubificidae	2	1.32
<i>Antocha vitripennis</i> (Meigen)	2	1.32
<i>Acroloxus lacustris</i> (L.)	2	1.32
<i>Mystacides azurea</i> (L.)	2	1.32
<i>Limnius volckmari</i> (Panzer)	2	1.32
Coenagriidae indet	2	1.32
<i>Nemoura avicularis</i> Morton	1	0.66
<i>Mystacides nigra/longicornis</i>	1	0.66
<i>Simulium</i> (<i>Eusimulium</i>) <i>aureum</i> group	1	0.66
<i>Taeniopteryx nebulosa</i> (L.)	1	0.66
<i>Oreodytes sanmarkii</i> (Sahlberg)	1	0.66
<i>Tipula</i> (<i>Yamatotipula</i>) <i>montium</i> group	1	0.66
Tanypodinae	1	0.66

Table 15 continued

Species	n	% of Midlands Region's missed species in Primary Audit
Valvata cristata Muller	1	0.66
Simulium (Simulium) argyreatum group	1	0.66
Potamophylax rotundipennis (Brauer)	1	0.66
Paraleptophlebia submarginata (Stephens)	1	0.66
Simulium (Boophthora) erythrocephalum (de Geer)	1	0.66
Planaria torva (Muller)	1	0.66
Platambus maculatus (L.)	1	0.66
Silo pallipes (Fabricius)	1	0.66
Sigara sp.	1	0.66
Sialis lutaria (L.)	1	0.66
Riolus subviolaceus (Muller)	1	0.66
Psychomyia pusilla (Fabricius)	1	0.66
Simulium (Simulium) ornatum group	1	0.66
Brychius elevatus (Panzer)	1	0.66
Ephemerella ignita (Poda)	1	0.66
Ephemera danica Muller	1	0.66
Enchytraeidae	1	0.66
Elodes sp.	1	0.66
Ecclisopteryx guttulata (Pictet)	1	0.66
Erpobdella octoculata (L.)	1	0.66
Calopteryx splendens (Harris)	1	0.66
Bithynia leachii (Sheppard)	1	0.66
Brachycentrus subnubilus Curtis	1	0.66
Bathyomphalus contortus (L.)	1	0.66
Armiger crista (L.)	1	0.66
Agapetus sp.	1	0.66
Adicella reducta (Mclachlan)	1	0.66
Lumbriculidae	1	0.66
Lype sp.	1	0.66
Chloroperla tripunctata (Scopoli)	1	0.66
Lepidostoma hirtum (Fabricius)	1	0.66
Lumbricidae	1	0.66
Baetis vernus Curtis	1	0.66
Erpobdellidae indet	1	0.66
Limnephilidae indet	1	0.66
Laccobius sp.	1	0.66
Laccobius (Macrolaccobius) sinuatus/striatulus	1	0.66
Hydropsyche sp.	1	0.66
Helius sp.	1	0.66
Hydrophilidae indet	1	0.66
Hydraena riparia Kugelann	1	0.66
Heptagenia sulphurea (Muller)	1	0.66

Table 15 continued

Species	n	% of Midlands Region's missed species in Primary Audit
Gyraulus albus (Muller)	1	0.66
Helophorus (Meghelophorus) grandis Illiger	1	0.66
Haliphus wehnckeii (Gerhardt)	1	0.66
Hydropsyche siltalai Dohler	1	0.66
Limnephilus lunatus Curtis	1	0.66
Total	152	100

AUDIT OF NORTH EAST REGION'S PRIMARY ANALYSTS

Table 16 The 20 samples audited for Dales Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Esk	d/s Murk Esk	AG	0	1	0
May Beck	Sneaton High Moor	AG	0	2	0
Ruthmoor Beck	Middle Rigg	AG	0	1	0
Tutt	Boroughbridge	AG	1	0	0
Ure	Aysgarth	AG	0	1	0
Ouse	Acaster Malbis	AG	0	5	0
Wharfe	Burnsall	AG	0	2	0
Wharfe	Kettlewell	AG	0	1	0
Ure	Wensley	AG	1	3	0
Wharfe	Hubberholme	JR	0	2	0
Wharfe	d/s Burley Weir	JR	0	0	0
Skirfare	Hawkswick	JR	0	0	0
Washburn	Leathley Bridge	JR	0	0	0
Wharfe	Addingham	JR	0	0	0
Ure	West Tanfield	JR	0	2	0
Ure	Aldwark Toll Bridge	JR	0	5	0
Derwent	Forge Valley	SJL	1	3	0
Rye	Nunnington	SJL	0	1	0
Great Fryup Beck	Street	SW	0	4	0
Mickleby Beck	Sandsend	SW	0	0	0

Table 17 The 20 samples audited for Northumbria Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Wansbeck	Morpeth	EC	0	0	0
Hazon Burn	Whittle Colliery	EC	1	3	1
Alwin	Alwinton	EC	1	1	0
Font	d/s Font Burn	EC	0	5	1
Wear	u/s Gaunless	FC	0	3	0
Rookhope Burn	Rookhope	FC	0	0	0
Wear	u/s Vinovium STW	FC	0	2	0
Gore Burn	u/s Confluence	FC	0	0	0
Gaunless	Bishops Palace	FC	0	1	1
Gaunless	Butterknowle	FC	1	2	0
Wear	Shincliffe	FC	0	3	0
Wear	u/s Vinovium STW	FC	0	2	0
Twizell Burn	B6313 Bridge	FC	0	1	0
Rookhope Burn	Rookhope	JH	0	1	0
Gaunless	Fylands d/s CSO	JH	0	0	0
Team	u/s Rowletch Burn	VW	0	0	0
Lewis Burn	u/s Picnic d/s FB	VW	0	2	0
South Tyne	Warden	VW	0	2	0
North Tyne	u/s Kielder	VW	0	0	0
Derwent	Ebchester	VW	0	1	0

Table 18 The 20 samples audited for Ridings Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Dearne	d/s Hinchcliffes Mill	FC	0	5	0
Smithy Brook	d/s Old Minewater adit	FC	0	0	0
Doe Lea	Doe Lea Bridge	LBS	0	2	0
Aire	Saltaire	LBS	0	2	1
Moss	Pipworth Lane	LBS	0	2	0
Rother	Canklow	LBS	0	0	0
Handley Brook	u/s R.Rother	LBS	1	1	0
Midgram Beck	Spring Farm Lane	LBS	1	0	0
Toftshaw Beck	d/s CSO 314	LBS	0	0	0
Worth	d/s North Beck	LFM	0	0	0
Dearne	Adj. to Wetland scheme	LFM	0	0	0
Aire	E.Riddlesden Hall	LFM	0	2	0
Sheaf	Queens Road	LFM	0	0	0
Colne	Colne Bridge	LFM	0	2	0
Brook Dike	d/s Station Road	LFM	0	1	0
Red Beck	d/s Brookfoot Dyeworks	MR	0	2	0
Calder	Sowerby Bridge	MR	0	2	0
Holme	d/s New Mill Dyke	PL	0	0	0
Hebble Brook	d/s Ogden Reservoir (S3)	PL	0	2	0
Old Howe	Frodingham Bridge	RJJ	0	5	0

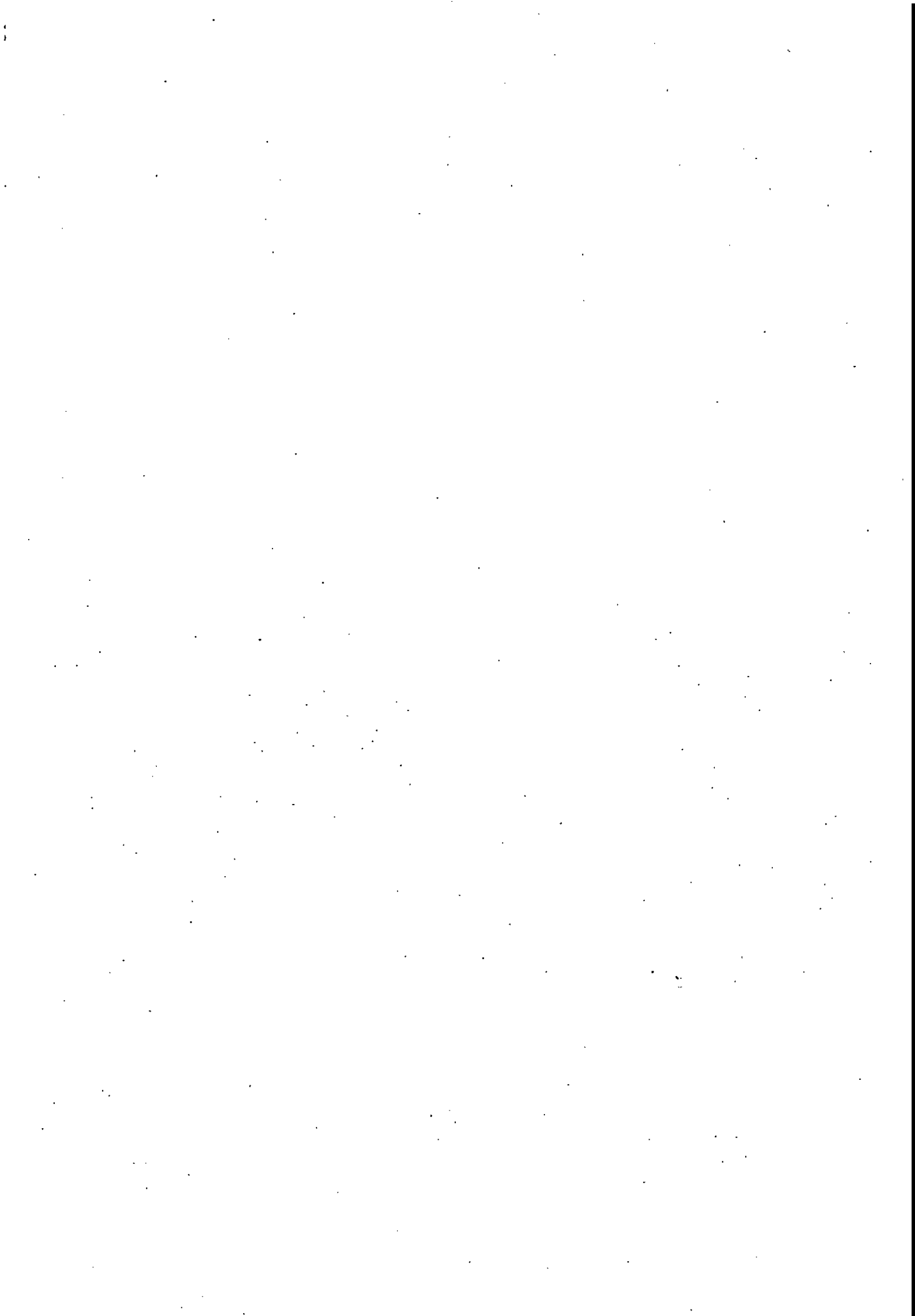


Table 19 Statistics of the 1997 Primary Audit for North East Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (H+g+o)	Standard error
Dales	20	1.65	0.36	5	25.00	5	1.80	0.38
AG	9	1.78	0.49	2	22.22	5	2.00	0.50
JR	7	1.29	0.71	1	14.29	5	1.29	0.71
SJL	2	2.00	1.00	1	50.00	3	2.50	1.50
SW	2	2.00	2.00	1	50.00	4	2.00	2.00
Northumbria	20	1.45	0.30	4	20.00	5	1.75	0.38
EC	4	2.25	1.11	2	50.00	5	3.25	1.38
FC	9	1.56	0.38	2	22.22	3	1.78	0.40
JH	2	0.50	0.50	0	0	1	0.50	0.50
VW	5	1.00	0.45	0	0	2	1.00	0.45
Ridings	20	1.40	0.34	2	10.00	5	1.55	0.34
FC	2	2.50	2.50	1	50.00	5	2.50	2.50
LBS	7	1.00	0.38	0	0	2	1.43	0.43
LFM	6	0.83	0.40	0	0	2	0.83	0.40
MR	2	2.00	0	0	0	2	2.00	0
PL	2	1.00	1.00	0	0	2	1.00	1.00
RJJ	1	5.00	n/a	1	100.00	5	5.00	n/a
North East Region	60	1.50	0.19	11	18.33	5	1.70	0.21

Table 20 Net effects of the Primary Audit on BMWP score and number of scoring taxa for North East Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Dales	20	9.45	20.00	35	1.50	15.00	5
AG	9	8.22	22.22	28	1.56	11.11	5
JR	7	8.57	14.29	34	1.29	14.29	5
SJL	2	10.00	0	10	1.50	0	2
SW	2	17.50	50.00	35	2.00	50.00	4
Northumbria	20	7.65	15.00	31	1.30	15.00	5
EC	4	9.25	25.00	31	1.75	25.00	5
FC	9	9.22	22.22	20	1.44	22.22	3
JH	2	3.50	0	7	0.50	0	1
VW	5	5.20	0	12	1.00	0	2
Ridings	20	6.85	15.00	30	1.30	10.00	5
FC	2	13.50	50.00	27	2.50	50.00	5
LBS	7	3.57	0	9	0.71	0	2
LFM	6	4.67	16.67	14	0.83	0	2
MR	2	8.50	0	9	2.00	0	2
PL	2	5.00	0	10	1.00	0	2
RJJ	1	30.00	100.00	30	5.00	100.00	5
N. East Region	60	7.98	16.67	35	1.37	13.33	5

Table 21 The families missed by North East Region's primary analysts

Family	n	% of North East Region's missed families in Primary Audit
Hydroptilidae	6	7.23
Elmidae	6	7.23
Lymnaeidae	4	4.82
Sphaeriidae	4	4.82
Asellidae	4	4.82
Hydrobiidae (incl. Bithyniidae)	4	4.82
Leptoceridae	4	4.82
Planorbidae	4	4.82
Hydrophilidae (incl. Hydraenidae)	4	4.82
Lepidostomatidae	3	3.61
Nemouridae	3	3.61
Planariidae (incl. Dugesiidae)	3	3.61
Caenidae	3	3.61
Ancylidae (incl. Acroloxidae)	3	3.61
Simuliidae	3	3.61
Limnephilidae	2	2.41
Rhyacophilidae (incl. Glossosomatidae)	2	2.41
Scirtidae	2	2.41
Baetidae	2	2.41
Dytiscidae (incl. Noteridae)	2	2.41
Tipulidae	1	1.20
Beraeidae	1	1.20
Sericostomatidae	1	1.20
Hydropsychidae	1	1.20
Calopterygidae	1	1.20
Coenagriidae	1	1.20
Psychomyiidae (incl. Ecnomidae)	1	1.20
Piscicolidae	1	1.20
Erpobdellidae	1	1.20
Gammaridae (incl. Crangonyctidae)	1	1.20
Goeridae	1	1.20
Leuctridae	1	1.20
Gyrinidae	1	1.20
Haliplidae	1	1.20
Ephemerellidae	1	1.20
Total	83	100

Table 22 The species missed by North East Region's primary analysts

Species	n	% of North East Region's missed species in Primary Audit
<i>Lymnaea peregra</i> (Muller)	4	4.60
<i>Potamopyrgus jenkinsi</i> (Smith)	4	4.60
<i>Asellus aquaticus</i> (L.)	4	4.60
<i>Hydroptila</i> sp.	4	4.60
<i>Caenis rivulorum</i> Eaton	3	3.45
<i>Lepidostoma hirtum</i> (Fabricius)	3	3.45
<i>Ancyclus fluviatilis</i> Muller	3	3.45
<i>Elodes</i> sp.	2	2.30
<i>Hydraena gracilis</i> Germar	2	2.30
<i>Limnius volckmari</i> (Panzer)	2	2.30
<i>Pisidium</i> sp.	2	2.30
<i>Elmis aenea</i> (Muller)	2	2.30
<i>Mystacides azurea</i> (L.)	2	2.30
Sphaeriidae indet	2	2.30
<i>Armiger crista</i> (L.)	2	2.30
<i>Orectochilus villosus</i> (Muller)	1	1.15
<i>Oecetis lacustris</i> (Pictet)	1	1.15
<i>Ochthebius bicolon</i> Germar	1	1.15
<i>Oreodytes sanmarkii</i> (Sahlberg)	1	1.15
<i>Nemurella picteti</i> Klapalek	1	1.15
<i>Oulimnius</i> sp.	1	1.15
<i>Oreodytes septentrionalis</i> (Sahlberg)	1	1.15
<i>Oxyethira</i> sp.	1	1.15
<i>Piscicola geometra</i> (L.)	1	1.15
<i>Polycelis felina</i> (Dalyell)	1	1.15
<i>Polycelis nigra</i> group	1	1.15
<i>Protonemura praecox</i> (Morton)	1	1.15
<i>Psychomyia pusilla</i> (Fabricius)	1	1.15
<i>Rhyacophila dorsalis</i> (Curtis)	1	1.15
<i>Riolus subviolaceus</i> (Muller)	1	1.15
<i>Sericostoma personatum</i> (Spence)	1	1.15
<i>Silo pallipes</i> (Fabricius)	1	1.15
<i>Simulium</i> (Nevermannia) <i>cryophilum</i> group	1	1.15
<i>Simulium</i> (Wilhelmia) sp.	1	1.15
<i>Tipula</i> sp.	1	1.15
<i>Simulium</i> (Simulium) <i>ornatum</i> group	1	1.15
<i>Athripsodes aterrimus</i> (Stephens)	1	1.15
<i>Ithytrichia</i> sp.	1	1.15
<i>Nemoura cambrica</i> group	1	1.15
<i>Agraylea multipunctata</i> Curtis	1	1.15
<i>Anisus vortex</i> (L.)	1	1.15
<i>Baetis scambus</i> group	1	1.15

Table 22 continued

Species	n	% of North East Region's missed species in Primary Audit
Baetis vernus Curtis	1	1.15
Bathyomphalus contortus (L.)	1	1.15
Beraea maurus (Curtis)	1	1.15
Calopteryx splendens (Harris)	1	1.15
Ceraclea dissimilis (Stephens)	1	1.15
Crangonyx pseudogracilis Bousfield	1	1.15
Ischnura elegans (Van der Linden)	1	1.15
Amphinemura sulcicollis (Stephens)	1	1.15
Dugesia polychroa group	1	1.15
Limnephilidae indet	1	1.15
Leuctra fusca (L.)	1	1.15
Limnephilus lunatus Curtis	1	1.15
Hydropsyche sp.	1	1.15
Helophorus (Atracthelophorus) brevipalpis Bedel	1	1.15
Haliphus fluviatilis Aube	1	1.15
Glossosoma sp.	1	1.15
Erpobdellidae indet	1	1.15
Ephemerella ignita (Poda)	1	1.15
Dugesia tigrina (Girard)	1	1.15
Total	87	100

AUDIT OF NORTH WEST REGION'S PRIMARY ANALYSTS

Table 23 The 20 samples audited for Central Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Crossens	Fine Jane Brook	AM	0	1	0
Alt	Alt Bridge	AM	0	1	0
Douglas	Smithy Brook	EIG	0	0	0
Darwen	u/s Hardman Way	EIG	0	1	0
Alt	u/s Fazakerley ETW	EIG	0	0	0
Ribble	Mearly Brook	FD	2	2	0
Lune	Deep Gill	FD	0	3	0
Lune	R.Roeburn	HFH	1	1	0
Ribble	u/s R. Calder	HFH	1	2	0
Bashall Brook	u/s Waddington STW	HFH	0	3	0
Calder	Barden Clough	HFH	0	1	0
Calder	Inghams Farm	HFH	1	2	0
Crossens	The Sluice PS	HFH	1	2	0
Ribble	Site 249	KCh	0	1	1
Lune	Killington	KCh	0	1	0
Calder	R.Brun	KCh	0	1	0
Hyndburn Brook	Tinker Brook	KCh	0	3	0
Yarrow	Tanyard Brook	KCo	0	5	0
Alt	Bull Bridge	KCo	0	0	0
Wyre	Hillylaid Pool	KCo	0	0	0

Table 24 The 20 samples audited for Northern Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Ellen	Uldale	AJ	1	0	0
Derwent	u/s Ouse Bridge	AJ	0	1	0
Whit Beck	NY 156 249	AJ	0	1	0
Gill Gooden	NY 157 412	AJ	1	0	0
Wiza Beck	Dockray	AJ	0	1	0
Summerground Gill	NY 442 309	AJ	0	1	0
Glenridding	Glenridding Bridge	DS	0	3	0
Cald Beck	d/s Caldbeck Church	DS	0	5	0
Deep Meadows Beck	u/s Tidal Doors	HFH	0	1	0
Sour Milk Gill	ptc Far Easedale Beck	HFH	0	1	0
Murton Beck	d/s Murton West STW	KR	1	1	0
Annas	Bootle	KR	1	1	0
Kirk Beck	ptc R. Ehen	KR	0	1	0
Eea	d/s Cartmel STW	KR	0	2	0
Eden	d/s Grinsdale Church	KR	0	0	0
Worm Gill	ptc R. Calder	NTC	0	1	0
Irt	Forest Bridge	NTC	0	1	0
Annas	A595 Bridge	NTC	0	1	0
Kinmont Beck	Near Bootle	NTC	0	1	0
Ehen	Braystones	NTC	0	1	0

Table 25 The 10 samples audited for Southern Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Bollin	Warburton Mill	AT	3	1	2
Dean	u/s Rainow ETW	AT	0	6	0
Roch	ptc Irwell	LCB	0	3	1
Scoineshore Brook	u/s Industrial Estate	MW	0	4	0
Tame	ptc Goyt	RJO	0	0	0
Gowy	Bunbury	RJO	1	2	0
Etherow	Compstall Bridge	RJO	0	6	0
Hornsmill Brook	u/s A56	RMM	0	3	0
Milton Brook	Milton Brook Bridge	RMM	0	1	1
Barrow Brook	Little Barrow	RMM	0	2	0

Table 26 Statistics of the 1997 Primary Audit for North West Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Central	20	1.50	0.29	4	20.00	5	1.85	0.33
AM	2	1.00	0.00	0	0	1	1.00	0
EIG	3	0.33	0.33	0	0	1	0.33	0.33
FD	2	2.50	0.50	1	50.00	3	3.50	0.50
HFH	6	1.83	0.31	1	16.67	3	2.50	0.34
KCh	4	1.50	0.50	1	25.00	3	1.75	0.48
KCo	3	1.67	1.67	1	33.33	5	1.67	1.67
Northern	20	1.20	0.25	2	10.00	5	1.40	0.23
AJ	6	0.67	0.21	0	0	1	1.00	0
DS	2	4.00	1.00	2	100.00	5	4.00	1.00
HFH	2	1.00	0	0	0	1	1.00	0
KR	5	1.00	0.32	0	0	2	1.40	0.40
NTC	5	1.00	0	0	0	1	1.00	0.00
Southern	10	2.80	0.65	5	50.00	6	3.60	0.64
AT	2	3.50	2.50	1	50.00	6	6.00	0.00
LCB	1	3.00	n/a	1	100.00	3	4.00	n/a
MW	1	4.00	n/a	1	100.00	4	4.00	n/a
RJO	3	2.67	1.76	1	33.33	6	3.00	1.73
RMM	3	2.00	0.58	1	33.33	3	2.33	0.33
North West Region	50	1.64	0.21	11	22.00	6	2.02	0.23

Table 27 Net effects of the Primary Audit on BMWP score and number of scoring taxa for North West Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Central	20	6.40	15.00	40	1.20	20.00	5
AM	2	2.50	0	3	1.00	0	1
EIG	3	1.67	0	5	0.33	0	1
FD	2	13.50	50.00	20	1.50	50.00	3
HFH	6	4.67	16.67	19	1.17	16.67	3
KCh	4	5.75	0	12	1.50	25.00	3
KCo	3	13.33	33.33	40	1.67	33.33	5
Northern	20	5.95	10.00	33	1.00	10.00	5
AJ	6	2.83	0	10	0.33	0	1
DS	2	23.50	100.00	33	4.00	100.00	5
HFH	2	4.00	0	5	1.00	0	1
KR	5	2.80	0	10	0.60	0	2
NTC	5	6.60	0	10	1.00	0	1
Southern	10	11.20	40.00	38	2.40	50.00	6
AT	2	13.50	50.00	38	2.00	50.00	6
LCB	1	16.00	100.00	16	3.00	100.00	3
MW	1	17.00	100.00	17	4.00	100.00	4
RJO	3	7.67	33.33	23	2.33	33.33	6
RMM	3	9.67	0	12	2.00	33.33	3
N. West Region	50	7.18	18.00	40	1.36	22.00	6

Table 28 The families missed by North West Region's primary analysts

Family	n	% of North West Region's missed families in Primary Audit
Elmidae	7	11.11
Chironomidae	5	7.94
Hydrobiidae (incl. Bithyniidae)	4	6.35
Nemouridae	4	6.35
Planorbidae	4	6.35
Sphaeriidae	3	4.76
Hydrophilidae (incl. Hydraenidae)	3	4.76
Planariidae (incl. Dugesiidae)	3	4.76
Asellidae	3	4.76
Ancylidae (incl. Acroloxidae)	2	3.17
Oligochaeta	2	3.17
Psychomyiidae (incl. Ecnomidae)	2	3.17
Heptageniidae	2	3.17
Rhyacophilidae (incl. Glossosomatidae)	2	3.17
Lymnaeidae	2	3.17
Hydroptilidae	2	3.17
Gammaridae (incl. Crangonyctidae)	2	3.17
Odontoceridae	1	1.59
Caenidae	1	1.59
Leptoceridae	1	1.59
Perlodidae	1	1.59
Hydropsychidae	1	1.59
Ephemerellidae	1	1.59
Erpobdellidae	1	1.59
Goeridae	1	1.59
Glossiphoniidae	1	1.59
Piscicolidae	1	1.59
Leuctridae	1	1.59
Total	63	100

Table 29 The species missed by North West Region's primary analysts

Species	n	% of North West Region's missed species in Primary Audit
Orthoclaadiinae	5	7.25
Potamopyrgus jenkinsi (Smith)	4	5.80
Elmis aenea (Muller)	4	5.80
Gyraulus albus (Muller)	3	4.35
Pisidium sp.	3	4.35
Polycelis felina (Dalyell)	3	4.35
Asellus aquaticus (L.)	3	4.35
Limnius volckmari (Panzer)	3	4.35
Hydraena gracilis Germar	3	4.35
Esolus parallelepipedus (Muller)	2	2.90
Hydroptila sp.	2	2.90
Tubificidae	2	2.90
Glossiphonia complanata (L.)	1	1.45
Gammarus sp.	1	1.45
Erpobdella octoculata (L.)	1	1.45
Heptagenia lateralis (Curtis)	1	1.45
Ephemerella ignita (Poda)	1	1.45
Crangonyx pseudogracilis Bousfield	1	1.45
Chironomini	1	1.45
Caenis rivulorum Eaton	1	1.45
Athripsodes sp.	1	1.45
Anisus vortex (L.)	1	1.45
Ancylus fluviatilis Muller	1	1.45
Amphinemura sulcicollis (Stephens)	1	1.45
Ancylidae indet	1	1.45
Tinodes waeneri (L.)	1	1.45
Hydropsyche siltalai Dohler	1	1.45
Tinodes assimilis/machlachlani	1	1.45
Tanypodinae	1	1.45
Silo sp.	1	1.45
Rhyacophila sp.	1	1.45
Rhyacophila dorsalis (Curtis)	1	1.45
Rhithrogena sp.	1	1.45
Protonemura meyeri (Pictet)	1	1.45
Prodiamesinae	1	1.45
Leuctra hippopus (Kempny)	1	1.45
Odontocerum albicorne (Scopoli)	1	1.45
Nemurella picteti Klapalek	1	1.45
Nemoura avicularis Morton	1	1.45
Lype sp.	1	1.45

Table 29 continued

Species	n	% of North West Region's missed species in Primary Audit
Lymnaea truncatula (Muller)	1	1.45
Lymnaea peregra (Muller)	1	1.45
Isoperla grammatica (Poda)	1	1.45
Piscicola geometra (L.)	1	1.45
Total	69	100

AUDIT OF SOUTHERN REGION'S PRIMARY ANALYSTS

Table 30 The 26 samples audited for the Kent Area of Southern Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Ouse	d/s Abstraction	E2	0	2	0
Ouse	u/s Weir	E2	2	1	1
Great Stour	Shalmsford Street	E4	0	1	0
Great Stour	Vauxhall Bridge	E4	0	1	0
Len Tributary	d/s Leeds STW	E11	0	0	0
Brede	u/s Rye Harbour	E19	0	1	0
Hexden Channel	Maytham Wharfe	E19	0	1	0
Great Stour	Vauxhall	E21	0	0	0
Line Tributary	u/s Netherfield	E26	2	6	0
Darent	Bridge Cottage	E28	0	1	0
Bough Beech Stream	d/s Reservoir	E28	0	2	1
Great Stour	Bucksford	E28	1	1	0
Eridge Stream	Ham Bridge	E28	0	2	0
Eden Vale Stream	d/s Lake	E29	0	4	0
Cuckmere	Arlington Intake	E29	0	3	0
Darent	d/s Augmentation	E31	0	3	0
Darent	Shoreham Village	E31	1	0	1
North End Stream	North End	E32	0	2	0
Darent	Farningham	E32	0	4	0
West Hoathly Stream	Blackland Wood	E32	0	3	0
North Stream	Old Dawns Farm	E32	0	3	0
Wingham	Wingham	E33	1	2	0
Medway	d/s Hampsted Canal	E33	0	3	0
Great Stour	d/s Lenham	E33	0	0	0
Eridge Stream	d/s Redgate Mill STW	E33	0	4	0
Dour	Kearsney	E34	0	3	0

Table 31 The 29 samples audited for the Hampshire & Sussex Areas of Southern Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Itchen	Vernal Farm	W9	0	0	0
Boldings Brook	Gunbarn Bridge	W13	0	1	0
Shawfords Lake	A5051 Bridge	W13	0	1	0
Warblington Stream	Brook Farm	W13	0	0	0
Warblington Stream No 3	Church Path	W13	0	3	1
Hammer Stream	Hammer Lane	W13	0	0	0
Curbridge Stream	Ridge Farm	W13	0	0	0
Sowley Stream West	East End	W15	1	1	0
Fairbourne Stream	Brook Farm	W15	0	0	0
Itchen	Easton	W15	0	4	0
Ober Water	Aldridge Hill	W15	0	0	0
Arle	u/s Manor FF	W15	0	0	0
Black Ditch	Lyminster	W19	0	0	0
Arun	Amiesmill Farm	W19	0	1	1
Bourne Rivulet	Hurstbourne Priors	W19	0	0	0
Pillhill Brook	u/s Anna Valley FF	W19	0	0	0
Arreton Stream	u/s Hasely Coombe	W21	0	0	0
Aldingbourne Rife	Lidsey Tip	W21	0	0	0
Cadland Stream	Calor Site	W21	1	2	0
Brightstone Stream	Brightstone Mill	W21	0	0	0
Whiteparish Stream	Chadwell Farm	W21	0	1	0
Adur East	Hookers Farm	W21	0	1	0
Test	Wherwell	W26	0	1	0
Kird	Kirdford Bridge	W26	0	2	1
Shawfords Lake	A3051 Bridge	W29	0	0	0
Dun	Dunbridge	W29	0	0	0
Nuns Walk Stream	Abbotts Barton	W29	0	0	0
Whiteparish Stream	Chadwell Farm	W30	0	1	0
Plaitford Stream	u/s Plaitford	W30	1	0	0

Table 32 Statistics of the 1997 Primary Audit for Southern Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Kent	26	2.04	0.30	10	38.46	6	2.42	0.33
E2	2	1.50	0.50	0	0	2	3.00	1.00
E4	2	1.00	0	0	0	1	1.00	0
E11	1	0	n/a	0	0	0	0	n/a
E19	2	1.00	0	0	0	1	1.00	0
E21	1	0	n/a	0	0	0	0	n/a
E26	1	6.00	n/a	1	100.00	6	8.00	n/a
E28	4	1.50	0.29	0	0	2	2.00	0.41
E29	2	3.50	0.50	2	100.00	4	3.50	0.50
E31	2	1.50	1.50	1	50.00	3	2.50	0.50
E32	4	3.00	0.41	3	75.00	4	3.00	0.41
E33	4	2.25	0.85	2	50.00	4	2.50	0.87
E34	1	3.00	n/a	1	100.00	3	3.00	n/a
Hants & Sussex	29	0.66	0.19	2	6.90	4	0.86	0.23
W9	1	0	n/a	0	0	0	0	n/a
W13	6	0.83	0.48	1	16.67	3	1.00	0.63
W15	5	1.00	0.77	1	20.00	4	1.20	0.80
W19	4	0.25	0.25	0	0	1	0.50	0.50
W21	6	0.67	0.33	0	0	2	0.83	0.48
W26	2	1.50	0.50	0	0	2	2.00	1.00
W29	3	0	0	0	0	0	0	0
W30	2	0.50	0.50	0	0	1	1.00	0.00
Southern Region	55	1.31	0.19	12	21.82	6	1.60	0.22

Table 33 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Southern Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Kent	26	9.85	34.62	31	1.77	38.46	4
E2	2	-1.00	0	10	0.50	0	2
E4	2	5.50	0	8	1.00	0	1
E11	1	0	0	0	0	0	0
E19	2	8.00	0	10	1.00	0	1
E21	1	0	0	0	0	0	0
E26	1	18.00	100.00	18	4.00	100.00	4
E28	4	8.00	0	13	1.25	0	2
E29	2	18.00	100.00	20	3.50	100.00	4
E31	2	6.50	50.00	16	1.00	50.00	3
E32	4	16.00	50.00	23	3.00	75.00	4
E33	4	13.00	50.00	31	2.00	50.00	4
E34	1	16.00	100.00	16	3.00	100.00	3
Hants & Sussex	29	4.00	10.34	33	0.55	6.90	4
W9	1	0	0	0	0	0	0
W13	6	6.00	16.67	24	0.83	16.67	3
W15	5	7.20	20.00	33	0.80	20.00	4
W19	4	1.25	0	5	0.25	0	1
W21	6	3.33	0	12	0.50	0	1
W26	2	11.50	50.00	20	1.50	0	2
W29	3	0	0	0	0	0	0
W30	2	-2.00	0	4	0	0	1
Southern Region	55	6.76	21.82	33	1.13	21.82	4

Table 34 The families missed by Southern Region's primary analysts

Family	n	% of Southern Region's missed families in Primary Audit
Elmidae	5	7.58
Planariidae (incl. Dugesiidae)	5	7.58
Planorbidae	5	7.58
Hydrophilidae (incl. Hydraenidae)	4	6.06
Caenidae	3	4.55
Lymnaeidae	3	4.55
Leptoceridae	3	4.55
EphemereIIDae	3	4.55
Piscicolidae	2	3.03
Limnephilidae	2	3.03
Lepidostomatidae	2	3.03
Psychomyiidae (incl. Ecnomidae)	2	3.03
Goeridae	2	3.03
Valvatidae	2	3.03
Asellidae	2	3.03
Polycentropodidae	1	1.52
Tipulidae	1	1.52
Sphaeriidae	1	1.52
Simuliidae	1	1.52
Sialidae	1	1.52
Sericostomatidae	1	1.52
Leuctridae	1	1.52
Scirtidae	1	1.52
Hydrobiidae (incl. Bithyniidae)	1	1.52
Pleidae	1	1.52
Dryopidae	1	1.52
Hydroptilidae	1	1.52
Baetidae	1	1.52
Dendrocoelidae	1	1.52
Ancylidae (incl. Acroloxidae)	1	1.52
Corophiidae	1	1.52
Coenagriidae	1	1.52
Nemouridae	1	1.52
Odontoceridae	1	1.52
Phryganeidae	1	1.52
Beraeidae	1	1.52
Total	66	100

Table 35 The species missed by Southern Region's primary analysts

Species	n	% of Southern Region's missed species in Primary Audit
Ephemerella ignita (Poda)	3	4.35
Polycelis nigra group	3	4.35
Elmis aenea (Muller)	3	4.35
Caenis luctuosa group	2	2.90
Oulimnius tuberculatus (Muller)	2	2.90
Polycelis felina (Dalyell)	2	2.90
Asellus meridianus Racovitza	2	2.90
Valvata cristata Muller	2	2.90
Gyraulus albus (Muller)	2	2.90
Lymnaea peregra (Muller)	2	2.90
Piscicola geometra (L.)	2	2.90
Anisus vortex (L.)	2	2.90
Phryganea sp.	1	1.45
Odontocerum albicorne (Scopoli)	1	1.45
Nemurella picteti Klapalek	1	1.45
Mystacides azurea (L.)	1	1.45
Lymnaea sp.	1	1.45
Lype sp.	1	1.45
Pisidium sp.	1	1.45
Plea leachi Mcgregor & Kirkaldy	1	1.45
Potamopyrgus jenkinsi (Smith)	1	1.45
Pyrrhosoma nymphula (Sulzer)	1	1.45
Sericostoma personatum (Spence)	1	1.45
Sialis lutaria (L.)	1	1.45
Simulium (Boopthora) erythrocephalum (de Geer)	1	1.45
Simulium (Wilhelmia) sp.	1	1.45
Tinodes waeneri (L.)	1	1.45
Valvata piscinalis (Muller)	1	1.45
Limnius volckmari (Panzer)	1	1.45
Silo nigricornis (Pictet)	1	1.45
Caenis pusilla Navas	1	1.45
Limnephilus politus/rhombicus	1	1.45
Adicella reducta (Mclachlan)	1	1.45
Agraylea multipunctata Curtis	1	1.45
Ancylus fluviatilis Muller	1	1.45
Anisus sp.	1	1.45
Antocha vitripennis (Meigen)	1	1.45
Helophorus (Helophorus) obscurus Mulsant	1	1.45
Beraeodes minutus (L.)	1	1.45
Cloeon dipterum (L.)	1	1.45
Corophium lacustre Vanhoffen	1	1.45
Crunoecia irrorata (Curtis)	1	1.45

Table 35 continued

Species	n	% of Southern Region's missed species in Primary Audit
<i>Cyrnus trimaculatus</i> (Curtis)	1	1.45
<i>Lepidostoma hirtum</i> (Fabricius)	1	1.45
<i>Dryops</i> sp.	1	1.45
<i>Elodes</i> sp.	1	1.45
<i>Goera pilosa</i> (Fabricius)	1	1.45
<i>Limnephilus marmoratus</i> Curtis	1	1.45
<i>Helophorus</i> (<i>Atracthelophorus</i>) <i>brevipalpis</i> Bedel	1	1.45
<i>Hydraena gracilis</i> Germar	1	1.45
<i>Hydraena riparia</i> Kugelann	1	1.45
<i>Dendrocoelum lacteum</i> (Muller)	1	1.45
<i>Athripsodes cinereus</i> (Curtis)	1	1.45
<i>Leuctra geniculata</i> (Stephens)	1	1.45
Total	69	100

AUDIT OF SOUTH WEST REGION'S PRIMARY ANALYSTS

Table 36 The 2 samples audited for Cornwall Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Carnon	Devoran Bridge	KAI	0	0	0
Fal	Tregony GS	KAI	0	0	0

Table 37 The 20 samples audited for Devon Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Little Mere	u/s Petrookstowe STW	AA	0	0	1
West Okement	Okehampton Hospital	AA	0	0	0
Okement	Brightly Bridge	AA	0	0	0
Yeo	d/s West Anstey STW	AA	0	0	0
Okement	Woodhall Bridge	AA	0	0	0
Lew	Hatherleigh	AA	0	0	0
Torrige Tributary	d/s Little Torrington STW	AA	0	0	0
Dart	d/s Buckfastleigh STW	AA	0	3	0
Erme	Stowford Weir	AG	0	0	0
Torrige	New Bridge	AG	0	5	0
Dart	d/s Dart Bridge	AG	1	1	0
Dart	Dartington Hall	AG	0	1	0
Mole	North Molton Bridge	AH	0	0	0
Creedy Tributary	u/s Shute STW	AH	0	1	0
Coombe Raleigh Stream	d/s Discharge ditch	AH	0	1	0
Okement	Knowle Bridge	AH	0	0	0
Taw	Newnham Bridge	LK	0	1	0
Taw	Umberleigh	LK	0	1	0
Taw	Chenson	LK	0	0	0
Knighty Brook	u/s Yeo confluence	LK	0	4	0

Table 38 The 20 samples audited for North Wessex Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Langford Brook	Site 2	AB	1	0	0
Yeo	Goathill	AB	0	1	0
South Drain	Chilton Moor (E)	AB	0	0	0
South Drain	Shapwick Heath (E)	AB	0	0	0
South Drain	Shapwick	AB	0	0	0
Alham	Mill Farm	SG	0	2	0
Congresbury Yeo	u/s Town Bridge	SJH	0	3	0
Chew	d/s Chewton Mendip	SJH	0	0	0
South Drain	Chilton Moor (W)	SJH	1	0	0
Congresbury Yeo	d/s Reg Spring	SJH	0	1	0
Congresbury Yeo	d/s Village	SJH	0	2	0
Congresbury Yeo	d/s Reg Spring	SJH	0	1	0
Abberd Brook	u/s Housing Estate	WO	0	0	0
Siston Brook	u/s Storm overflow	WO	0	0	0
Tetbury Avon Tributary	Estcourt Farm	WO	0	1	0
Tetbury Avon	Shipton Mill	WO	0	0	0
Tetbury Avon	u/s Fosseyway	WO	0	0	0
Tetbury Avon	u/s Brokenborough	WO	0	0	0
Tetbury Avon	Back Bridge	WO	0	0	0
Tetbury Avon	Estcourt	WO	0	2	0

Table 39 The 16 samples audited for South Wessex Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Western Avon Tributary	d/s Wedhampton STW	AJK	0	0	0
Hooke	d/s Toller Porcorum	AJK	0	2	0
Ebblake	d/s Industrial Estate	AJK	0	0	0
Ebblake	u/s Industrial Estate	AJK	0	0	0
Holt Heath Stream	Holt Heath Crossing	AJK	0	0	0
Hampshire Avon	North End Farm	AJK	0	0	0
Clockhouse Brook	Burton	CEC	0	0	0
Nadder	Panthers Bridge	CEC	0	1	0
Rodden Stream	d/s Langton Herring	GPG	0	1	0
Fleet Stream	d/s Langton Herring	HY	0	1	0
Spetisbury StreamTrib	u/s Spetisbury Cress beds	HY	0	2	0
Teffont Brook	Teffont Manor	HY	0	0	0
Lodden	Gutchpool Farm	HY	0	1	0
Lodden	Lugmarsh Farm	PRH	0	1	0
Piddle	Piddletrenthide Church	PRH	0	2	0
Fern Brook	Kings Court Palace	PRH	0	0	0

Table 40 Statistics of the 1997 Primary Audit for South West Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Cornwall	2	0	0	0	0	0	0	0
KAI	2	0	0	0	0	0	0	0
Devon	20	0.90	0.32	3	15.00	5	1.00	0.32
AA	8	0.38	0.38	1	12.50	3	0.50	0.38
AG	4	1.75	1.11	1	25.00	5	2.00	1.08
AH	4	0.50	0.29	0	0	1	0.50	0.29
LK	4	1.50	0.87	1	25.00	4	1.50	0.87
North Wessex	20	0.65	0.21	1	5.00	3	0.75	0.20
AB	5	0.20	0.20	0	0	1	0.40	0.24
SG	1	2.00	n/a	0	0	2	2.00	n/a
SJH	6	1.17	0.48	1	16.67	3	1.33	0.42
WO	8	0.38	0.26	0	0	2	0.38	0.26
South Wessex	16	0.69	0.20	0	0	2	0.69	0.20
AJK	6	0.33	0.33	0	0	2	0.33	0.33
CEC	2	0.50	0.50	0	0	1	0.50	0.50
GPG	1	1.00	n/a	0	0	1	1.00	n/a
HY	4	1.00	0.41	0	0	2	1.00	0.41
PRH	3	1.00	0.58	0	0	2	1.00	0.58
South West Region	58	0.72	0.14	4	6.90	5	0.79	0.14

Table 41 Net effects of the Primary Audit on BMWP score and number of scoring taxa for South West Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Cornwall	2	0	0	0	0	0	0
KAI	2	0	0	0	0	0	0
Devon	20	5.05	15.00	28	0.85	15.00	5
AA	8	2.75	12.50	22	0.38	12.50	3
AG	4	8.50	25.00	28	1.50	25.00	5
AH	4	2.00	0	5	0.50	0	1
LK	4	9.25	25.00	24	1.50	25.00	4
North Wessex	20	3.05	10.00	20	0.55	5.00	3
AB	5	1.40	0	10	0.00	0	1
SG	1	6.00	0	6	2.00	0	2
SJH	6	5.67	33.33	20	1.00	16.67	3
WO	8	1.75	0	9	0.38	0	2
South Wessex	16	4.75	0	13	0.69	0	2
AJK	6	1.83	0	11	0.33	0	2
CEC	2	4.00	0	8	0.50	0	1
GPG	1	5.00	0	5	1.00	0	1
HY	4	8.25	0	13	1.00	0	2
PRH	3	6.33	0	10	1.00	0	2
S. West Region	58	4.10	8.62	28	0.67	6.90	5

Table 42 The families missed by South West Region's primary analysts

Family	n	% of South West Region's missed families in Primary Audit
Hydroptilidae	4	10.00
Hydrophilidae (incl. Hydraenidae)	3	7.50
Hydrobiidae (incl. Bithyniidae)	3	7.50
Leptoceridae	3	7.50
Planariidae (incl. Dugesiidae)	2	5.00
Asellidae	2	5.00
Ephemeridae	2	5.00
Taeniopterygidae	1	2.50
Odontoceridae	1	2.50
Polycentropodidae	1	2.50
Psychomyiidae (incl. Ecnomidae)	1	2.50
Sialidae	1	2.50
Simuliidae	1	2.50
Sphaeriidae	1	2.50
Tipulidae	1	2.50
Glossiphoniidae	1	2.50
Lymnaeidae	1	2.50
Leuctridae	1	2.50
Hydrometridae	1	2.50
Hydropsychidae	1	2.50
Baetidae	1	2.50
Calopterygidae	1	2.50
Chironomidae	1	2.50
Ephemerellidae	1	2.50
Erpobdellidae	1	2.50
Gerridae	1	2.50
Halplidae	1	2.50
Nemouridae	1	2.50
Total	40	100

Table 43 The species missed by South West Region's primary analysts

Species	n	% of South West Region's missed species in Primary Audit
Potamopyrgus jenkinsi (Smith)	3	7.32
Asellus aquaticus (L.)	2	4.88
Hydraena gracilis Germar	2	4.88
Mystacides azurea (L.)	2	4.88
Hydroptila sp.	2	4.88
Polycelis nigra group	2	4.88
Ithytrichia sp.	2	4.88
Leuctra fusca (L.)	1	2.44
Tanytarsini	1	2.44
Lymnaea peregra (Muller)	1	2.44
Odontocerum albicorne (Scopoli)	1	2.44
Polycentropus flavomaculatus (Pictet)	1	2.44
Protonemura meyeri (Pictet)	1	2.44
Simulium (Simulium) ornatum group	1	2.44
Tinodes waeneri (L.)	1	2.44
Tipula sp.	1	2.44
Sialis lutaria (L.)	1	2.44
Baetis rhodani (Pictet)	1	2.44
Pisidium sp.	1	2.44
Hydropsyche siltalai Dohler	1	2.44
Athripsodes albifrons/bilineatus	1	2.44
Brachyptera risi (Morton)	1	2.44
Calopteryx splendens (Harris)	1	2.44
Ephemera danica Muller	1	2.44
Ephemera sp.	1	2.44
Ephemerella ignita (Poda)	1	2.44
Hydrometra stagnorum (L.)	1	2.44
Gerris sp.	1	2.44
Glossiphonia complanata (L.)	1	2.44
Helophorus (Atracthelophorus) brevipalpis Bedel	1	2.44
Haliphus lineatocollis (Marsham)	1	2.44
Antocha vitripennis (Meigen)	1	2.44
Erpobdellidae indet	1	2.44
Total	41	100

AUDIT OF THAMES REGION'S PRIMARY ANALYSTS

Table 44 The 30 samples audited for the Fobney Mead Laboratory of Thames Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Thames	South Stoke	303	2	2	0
Veneymore Stream	d/s Trout Farm	303	2	1	4
Bear Brook	u/s R. Thame	309	0	5	0
Summerstown Ditch	d/s Marsh Gibbon STW	317	0	3	0
The Cut	Cannon Hill	317	0	2	0
Gainsbridge Brook	u/s Little Milton STW	317	0	2	0
Garsington Stream	B480	317	0	3	1
Bookham Brook	Bookham Road	317	0	0	0
Bletchington Brook	u/s Gallos Brook	317	0	3	0
Thames	MWD Walton	317	1	2	0
Blackwater	u/s Whitewater	317	0	2	0
Bourne	Englefield House	317	0	1	0
Thames	Donnington Bridge	317	1	0	1
Blue Brook	Swailsford Bridge	317	0	1	0
Stocklake Brook	u/s Bear Brook	317	0	0	0
Blackwater	Frimley Bridges	317	0	2	0
Glyme	Wootton	317	0	5	0
Marcham Brook	Fyfield	317	0	2	0
Horsenden Stream	Brook Road	317	0	4	0
Denton Brook	Denton	317	0	0	0
Lambourn	Newbury	317	0	2	0
Shalbourne Stream	Smitham Bridge	317	0	0	0
Moor Ditch	u/s Didcot STW	317	0	5	0
Bagpuize Brook	Swanney Brook	317	0	0	0
Shill Brook	u/s Carterton STW	317	0	0	0
Windrush	Newbridge	317	1	3	0
Childrey Brook	Mill Road	317	0	2	0
Cove Brook	u/s Blackwater	317	0	2	0
Burstow Stream	Shipley Bridge	317	0	0	0
Burstow Stream	Meathgreen Bridge	317	0	3	0

Table 45 The 30 samples audited for the Hatfield Laboratory of Thames Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Misbourne	Section 5, Site 3	DJL	0	2	0
Colne	Coppermill Lane	DJL	0	1	0
Rib	Westmill	DJL	0	0	0
Misbourne	u/s Gerards Cross STW	DJL	0	2	0
Ash (Lee)	North of Widford	DJL	0	2	0
Lee	u/s Luton STW	DJL	0	0	0
Gade	u/s Gade Bridge Lane	DJL	0	1	0
Gade	Croxley Green	DJL	0	5	0
Misbourne	Denham Country Park, Site 3	DJL	0	5	0
Misbourne	Denham Country Park, Site 5	DJL	0	1	0
Misbourne	Denham	JE	0	1	0
Crane	Crane Park	JE	0	0	0
Colne/GUC	u/s Maple Lodge STW	JE	0	2	0
Small Lee	d/s Ordnance Road	JE	0	0	0
Lee	u/s East Hyde Roadbridge	JE	0	0	0
Chess	u/s Colne	JE	0	2	0
Horton Brook	u/s Tan House Stream	JFM	1	3	1
Mad Bess Brook	Mad Bess Wood	JFM	0	0	0
Hogsmill	Surbiton Hill Park	JFM	0	3	0
Duke of Northumberlands	River Gardens	JFM	1	1	0
Duke of Northumberlands	Worton Road	JFM	0	3	0
Beverley Brook	Richmond Park	JFM	0	2	0
Friary Park Stream	Friary Park	LK	0	2	0
Quaggy	Mottingham Lane	LK	2	2	0
Colne	Waterfields Rec Ground	LK	1	2	0
Gade	d/s Cassiobury Park	RJC	0	5	0
Gade	Gade Water Nurseries	RJC	0	2	1
Lee	d/s Enfield Weir	RJC	2	2	0
Lee	Lea Valley Road	RJC	2	0	0
Navestock Brook	d/s Strawberry Wood	RJC	1	1	0

Table 46 Statistics of the 1997 Primary Audit for Thames Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Fobney Mead	30	1.90	0.29	9	30.00	5	2.33	0.34
303	2	1.50	0.50	0	0	2	5.50	1.50
309	1	5.00	n/a	1	100.00	5	5.00	n/a
317	27	1.81	0.29	8	29.63	5	2.00	0.30
Hatfield	30	1.73	0.27	6	20.00	5	2.13	0.29
DJL	10	1.90	0.57	2	20.00	5	1.90	0.57
JE	6	0.83	0.40	0	0	2	0.83	0.40
JFM	6	2.00	0.52	3	50.00	3	2.50	0.67
LK	3	2.00	0	0	0	2	3.00	0.58
RJC	5	2.00	0.84	1	20.00	5	3.20	0.58
Thames Region	60	1.82	0.19	15	25.00	5	2.23	0.22

Table 47 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Thames Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Fobney Mead	30	8.90	23.33	38	1.67	26.67	5
303	2	-0.50	0	1	-0.50	0	0
309	1	33.00	100.00	33	5.00	100.00	5
317	27	8.70	22.22	38	1.70	25.93	5
Hatfield	30	7.23	16.67	33	1.40	16.67	5
DJL	10	10.50	20.00	33	1.90	20.00	5
JE	6	5.17	0	12	0.83	0	2
JFM	6	8.83	33.33	18	1.67	33.33	3
LK	3	4.00	0	8	1.00	0	2
RJC	5	3.20	20.00	30	1.00	20.00	5
Thames Region	60	8.07	20.00	38	1.53	21.67	5

Table 48 The families missed by Thames Region's primary analysts

Family	n	% of Thames Region's missed families in Primary Audit
Planorbidae	7	6.73
Physidae	7	6.73
Elmidae	6	5.77
Lymnaeidae	5	4.81
Hydrobiidae (incl. Bithyniidae)	5	4.81
Haliplidae	5	4.81
Planariidae (incl. Dugesiidae)	5	4.81
Ancylidae (incl. Acroloxidae)	5	4.81
Psychomyiidae (incl. Ecnomidae)	4	3.85
Dytiscidae (incl. Noteridae)	4	3.85
Leptoceridae	4	3.85
Hydropsychidae	4	3.85
Hydroptilidae	4	3.85
Dendrocoelidae	3	2.88
Valvatidae	3	2.88
Tipulidae	3	2.88
Simuliidae	3	2.88
Glossiphoniidae	3	2.88
Sphaeriidae	2	1.92
Rhyacophilidae (incl. Glossosomatidae)	2	1.92
Caenidae	2	1.92
Gammaridae (incl. Crangonyctidae)	2	1.92
Goeridae	1	0.96
Polycentropodidae	1	0.96
Asellidae	1	0.96
Calopterygidae	1	0.96
Ephemerellidae	1	0.96
Erpobdellidae	1	0.96
Dryopidae	1	0.96
Scirtidae	1	0.96
Corixidae	1	0.96
Gyrinidae	1	0.96
Brachycentridae	1	0.96
Nemouridae	1	0.96
Molannidae	1	0.96
Coenagriidae	1	0.96
Leuctridae	1	0.96
Leptophlebiidae	1	0.96
Total	104	100

Table 49 The species missed by Thames Region's primary analysts

Species	n	% of Thames Region's missed species in Primary Audit
Potamopyrgus jenkinsi (Smith)	5	4.35
Lymnaea stagnalis (L.)	4	3.48
Polycelis nigra group	4	3.48
Elmis aenea (Muller)	4	3.48
Physa fontinalis (L.)	3	2.61
Mystacides azurea (L.)	3	2.61
Helobdella stagnalis (L.)	3	2.61
Hydroptila sp.	3	2.61
Armiger crista (L.)	3	2.61
Haliplus sp.	3	2.61
Dendrocoelum lacteum (Muller)	3	2.61
Tinodes waeneri (L.)	3	2.61
Simulium (Simulium) ornatum group	3	2.61
Tipula (Yamatotipula) montium group	3	2.61
Oulimnius sp.	2	1.74
Lymnaea peregra (Muller)	2	1.74
Hydropsyche siltalai Dohler	2	1.74
Acroloxus lacustris (L.)	2	1.74
Valvata cristata Muller	2	1.74
Haliplus fluviatilis Aube	2	1.74
Agabus sp.	2	1.74
Glossiphonia complanata (L.)	2	1.74
Physa acuta group	2	1.74
Ancylus fluviatilis Muller	2	1.74
Physa sp.	2	1.74
Bathyomphalus contortus (L.)	2	1.74
Agapetus sp.	2	1.74
Sphaerium sp.	1	0.87
Lymnaea palustris (Muller)	1	0.87
Polycentropus flavomaculatus (Pictet)	1	0.87
Lype sp.	1	0.87
Oxyethira sp.	1	0.87
Polycelis felina (Dalyell)	1	0.87
Platambus maculatus (L.)	1	0.87
Valvata piscinalis (Muller)	1	0.87
Nemoura cinerea (Retzius)	1	0.87
Orectochilus villosus (Muller)	1	0.87
Sigara (Sigara) sp.	1	0.87
Pisidium sp.	1	0.87
Paraleptophlebia sp.	1	0.87
Molanna angustata Curtis	1	0.87
Anisus vortex (L.)	1	0.87

Table 49 continued

Species	n	% of Thames Region's missed species in Primary Audit
<i>Leuctra fusca</i> (L.)	1	0.87
<i>Calopteryx splendens</i> (Harris)	1	0.87
<i>Agabus didymus</i> (Olivier)	1	0.87
<i>Anisus leucostoma</i> (Millet)	1	0.87
<i>Asellus aquaticus</i> (L.)	1	0.87
<i>Athripsodes albifrons</i> (L.)	1	0.87
<i>Athripsodes bilineatus</i> (L.)	1	0.87
<i>Athripsodes cinereus</i> (Curtis)	1	0.87
<i>Brachycentrus subnubilus</i> Curtis	1	0.87
<i>Caenis luctuosa</i> group	1	0.87
<i>Caenis rivulorum</i> Eaton	1	0.87
<i>Dryops</i> sp.	1	0.87
Dytiscidae indet	1	0.87
<i>Hydropsyche angustipennis</i> (Curtis)	1	0.87
Ancylidae indet	1	0.87
<i>Elodes</i> sp.	1	0.87
<i>Ithytrichia</i> sp.	1	0.87
<i>Ischnura elegans</i> (Van der Linden)	1	0.87
<i>Hippeutis complanatus</i> (L.)	1	0.87
<i>Gyraulus albus</i> (Muller)	1	0.87
<i>Goera pilosa</i> (Fabricius)	1	0.87
<i>Glossiphonia heteroclita</i> (L.)	1	0.87
<i>Gammarus</i> sp.	1	0.87
<i>Gammarus pulex</i> (L.)	1	0.87
Erpobdellidae indet	1	0.87
<i>Ephemerella ignita</i> (Poda)	1	0.87
Hydropsychidae indet	1	0.87
Total	115	100

AUDIT OF WELSH REGION'S PRIMARY ANALYSTS



Table 50 The 20 samples audited for Northern Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Alyn	Football Ground	353	1	0	0
Afon Tryweryn Tributary	d/s Rhyduchaf STW	353	0	1	0
Afon Wheeler	u/s Pant Gwyn	358	1	3	0
Afon Desach	Tain Lon	358	1	5	0
Afon Wheeler	d/s Pant Gwyn	359	0	2	0
Dwryrd	u/s Iron Bridge	376	0	3	0
Red Brook	Whitchurch STW d/s CSO	376	0	3	0
Afon Soch Tributary	u/s Llaniestyn STW	376	0	4	0
Coddington Brook	d/s Clutton STW	376	0	5	1
Afon Erch Tributary	u/s Llangybi STW	376	1	4	1
Afon Erch Tributary	d/s Llangybi STW	376	3	10	2
Afon Twrch	u/s Afon Groes	377	1	3	0
Afon Meddanen	d/s Llanfechall STW	377	0	2	0
Nant Sir Roger	d/s Whitford STW	377	1	2	1
Afon Geiran Tributary	d/s Dinas STW	377	1	6	0
Afon Hiraethlyn	d/s Eglwysbach STW	377	2	2	0
Afon Eitha	u/s Pen y cae WTW	377	0	1	0
Afon Glan Sais	d/s Teiryd WTW	377	0	3	0
Afon Nant Fach	Ty Mawr	377	0	3	0
Afon Alwen	d/s Alwen WTW	377	0	0	0

Table 51 The 20 samples audited for South Eastern Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Rhondda	d/s Gwyddon confluence	370	1	1	0
Ely	d/s Peterston-s-Ely	370	0	0	0
Tarrington Brook	d/s Tarrington STW	370	0	1	0
Nant Gledyr	Gypsy Lane	370	0	0	0
Rhymney	Pengam	370	0	0	0
Ebbw	Culvert opp Steelworks	372	0	4	0
Hindwell Brook	Nash Bridge	372	0	1	0
Cage Brook	u/s Clehonger STW	372	0	1	0
Un-named Tributary	u/s Cwrt Bleddyn	372	1	7	1
Usk	Llantrisant	375	0	2	0
Sirhowy	u/s Footbridge	375	0	2	0
Sirhowy	d/s Roadbridge	375	0	0	0
Ely	u/s St Fagans STW	375	1	3	0
Nant Llancarfan	d/s Bonvilston East STW	375	0	2	2
Un-named Tributary	u/s Trellech STW	375	3	0	0
Clyro Brook	u/s Clyro STW	375	0	1	0
Wye	d/s Builth Wells STW	375	0	2	0
Tedstone Brook	Bromyard	375	0	0	0
Cwm Brook	u/s Farm	375	0	1	0
Usk	d/s Llanfoist Bridge	375	0	2	0

Table 52 The 20 samples audited for South Western Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Gwili	u/s Crosshands STW	361	0	4	0
Afon Marlas Tributary	d/s Carmel & Pantillyn STW	361	0	3	0
Gwendraeth Fawr Tributary	d/s Carway STW	361	0	2	0
Rudbaxton Water Tributary	d/s Spittal STW	362	0	1	0
Dulais	d/s Llangybi STW	362	0	4	0
Cwmwaungron	d/s Bonfire	362	0	1	0
Nant Pant-yr-haidd	u/s Llanafan	362	0	0	0
Soden	d/s Pant Sod Farm	364	0	2	0
Nant Denys	d/s Silian PS	374	0	4	0
Wyre	u/s Llanrhystud STW	374	0	1	0
E.Cleddau	u/s Narbeth East STW	374	5	2	0
Afon Ffynnon Ddewi	u/s Llwynfydd	374	0	1	0
Sprinkle Pill	u/s Hook STW	374	0	3	0
Cartlett Brook	u/s Crundale PS	374	2	2	0
Cartlett Brook Tributary	d/s Crundale PS	374	0	0	0
Ritec	u/s St Florence STW	374	2	1	1
Un-named Watercourse	d/s Reynoldston STW	374	0	2	0
Castell	Site 5, u/s Ponterwyd STW	374	1	4	0
Nant-y-Bugael	d/s Fishponds	374	2	5	0
Lash	u/s Minewater discharge	374	0	4	0

Table 53 Statistics of the 1997 Primary Audit for Welsh Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Northern	20	3.10	0.51	12	60.00	10	3.95	0.72
353	2	0.50	0.50	0	0	1	1.00	0
358	2	4.00	1.00	2	100.00	5	5.00	1.00
359	1	2.00	n/a	0	0	2	2.00	n/a
376	6	4.83	1.08	6	100.00	10	6.17	1.85
377	9	2.44	0.56	4	44.44	6	3.11	0.68
South Eastern	20	1.50	0.38	3	15.00	7	1.95	0.48
370	5	0.40	0.24	0	0	1	0.60	0.40
372	4	3.25	1.44	2	50.00	7	3.75	1.89
375	11	1.36	0.31	1	9.09	3	1.91	0.41
South Western	20	2.30	0.33	8	40.00	5	2.95	0.46
361	3	3.00	0.58	2	66.67	4	3.00	0.58
362	4	1.50	0.87	1	25.00	4	1.50	0.87
364	1	2.00	n/a	0	0	2	2.00	n/a
374	12	2.42	0.45	5	41.67	5	3.50	0.65
Welsh Region	60	2.30	0.25	23	38.33	10	2.95	0.34

Table 54 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Welsh Region

Analyst/Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Northern	20	16.80	70.00	46	2.50	50.00	7
353	2	3.00	0	10	0	0	1
358	2	16.50	100.00	18	3.00	50.00	4
359	1	8.00	0	8	2.00	0	2
376	6	27.33	100.00	46	4.17	100.00	7
377	9	13.89	66.67	27	1.89	33.33	5
South Eastern	20	5.65	20.00	29	1.00	10.00	6
370	5	1.00	0	5	0.20	0	1
372	4	15.25	50.00	29	3.00	50.00	6
375	11	4.27	18.18	16	0.64	0	2
South Western	20	14.00	50.00	34	1.70	40.00	4
361	3	20.00	66.67	28	3.00	66.67	4
362	4	11.25	25.00	30	1.50	25.00	4
364	1	20.00	100.00	20	2.00	0	2
374	12	12.92	50.00	34	1.42	41.67	4
Welsh Region	60	12.15	46.67	46	1.73	33.33	7

Table 55 The families missed by Welsh Region's primary analysts

Family	n	% of Welsh Region's missed families in Primary Audit
Hydrophilidae (incl. Hydraenidae)	9	8.11
Scirtidae	7	6.31
Hydropsychidae	7	6.31
Ephemerellidae	6	5.41
Simuliidae	4	3.60
Nemouridae	4	3.60
Goeridae	4	3.60
Tipulidae	4	3.60
Limnephilidae	4	3.60
Lepidostomatidae	3	2.70
Hydroptilidae	3	2.70
Leuctridae	3	2.70
Ancylidae (incl. Acroloxidae)	3	2.70
Planariidae (incl. Dugesiidae)	3	2.70
Hydrobiidae (incl. Bithyniidae)	3	2.70
Elmidae	3	2.70
Psychomyiidae (incl. Ecnomidae)	3	2.70
Sphaeriidae	3	2.70
Leptoceridae	2	1.80
Odontoceridae	2	1.80
Heptageniidae	2	1.80
Rhyacophilidae (incl. Glossosomatidae)	2	1.80
Gerridae	2	1.80
Gammaridae (incl. Crangonyctidae)	2	1.80
Dryopidae	2	1.80
Lymnaeidae	2	1.80
Baetidae	2	1.80
Perlodidae	2	1.80
Sialidae	1	0.90
Sericostomatidae	1	0.90
Polycentropodidae	1	0.90
Philopotamidae	1	0.90
Leptophlebiidae	1	0.90
Hydrometridae	1	0.90
Haliplidae	1	0.90
Gyrinidae	1	0.90
Glossiphoniidae	1	0.90
Corixidae	1	0.90
Coenagriidae	1	0.90
Brachycentridae	1	0.90
Beraeidae	1	0.90
Asellidae	1	0.90
Dytiscidae (incl. Noteridae)	1	0.90
Total	111	100

Table 56 The species missed by Welsh Region's primary analysts

Species	n	% of Welsh Region's missed species in Primary Audit
<i>Ephemerella ignita</i> (Poda)	6	5.17
<i>Hydraena gracilis</i> Germar	6	5.17
<i>Elodes</i> sp.	5	4.31
<i>Hydropsyche</i> sp.	4	3.45
<i>Hydropsyche siltalai</i> Dohler	3	2.59
<i>Hydroptila</i> sp.	3	2.59
<i>Potamopyrgus jenkinsi</i> (Smith)	3	2.59
<i>Lype</i> sp.	3	2.59
<i>Ancylus fluviatilis</i> Muller	3	2.59
<i>Elmis aenea</i> (Muller)	3	2.59
Limnephilidae indet	3	2.59
<i>Gammarus pulex</i> (L.)	2	1.72
<i>Helophorus</i> (<i>Atracthelophorus</i>) <i>brevipalpis</i> Bedel	2	1.72
<i>Pisidium</i> sp.	2	1.72
<i>Odontocerum albicorne</i> (Scopoli)	2	1.72
<i>Lymnaea peregra</i> (Muller)	2	1.72
<i>Silo pallipes</i> (Fabricius)	2	1.72
<i>Perlodes microcephala</i> (Pictet)	2	1.72
<i>Nemoura avicularis</i> Morton	2	1.72
<i>Dryops</i> sp.	2	1.72
<i>Dicranota</i> sp.	2	1.72
<i>Ecdyonurus</i> sp.	2	1.72
Scirtidae indet	2	1.72
<i>Silo nigricornis</i> (Pictet)	2	1.72
<i>Simulium</i> (<i>Nevermannia</i>) <i>angustitarse</i> group	2	1.72
<i>Baetis rhodani</i> (Pictet)	2	1.72
<i>Simulium</i> (<i>Nevermannia</i>) <i>cryophilum</i> group	1	0.86
<i>Pedicia</i> (<i>Pedicia</i>) <i>rivosa</i> (L.)	1	0.86
<i>Simulium</i> (<i>Simulium</i>) <i>argyreatum</i> group	1	0.86
<i>Simulium</i> (<i>Wilhelmia</i>) <i>equinum</i> (L.)	1	0.86
Sphaeriidae indet	1	0.86
<i>Tipula</i> (<i>Acutipula</i>) <i>maxima/fulvipennis</i>	1	0.86
<i>Nemurella picteti</i> Klapalek	1	0.86
<i>Orectochilus villosus</i> (Muller)	1	0.86
<i>Sialis lutaria</i> (L.)	1	0.86
<i>Gerris</i> (<i>Gerris</i>) <i>gibbifer</i> Schummel	1	0.86
<i>Polycelis felina</i> (Dalyell)	1	0.86
<i>Polycentropus</i> sp.	1	0.86
<i>Potamophylax latipennis</i> (Curtis)	1	0.86
<i>Sericostoma personatum</i> (Spence)	1	0.86
<i>Protonemura</i> sp.	1	0.86
<i>Pyrrhosoma nymphula</i> (Sulzer)	1	0.86

Table 56 continued

Species	n	% of Welsh Region's missed species in Primary Audit
<i>Rhyacophila dorsalis</i> (Curtis)	1	0.86
<i>Simulium</i> (<i>Eusimulium</i>) <i>aureum</i> group	1	0.86
<i>Crunoecia irrorata</i> (Curtis)	1	0.86
<i>Wormaldia</i> sp.	1	0.86
<i>Agabus</i> sp.	1	0.86
<i>Anacaena globulus</i> (Paykull)	1	0.86
<i>Asellus aquaticus</i> (L.)	1	0.86
<i>Athripsodes</i> sp.	1	0.86
<i>Beraea pullata</i> (Curtis)	1	0.86
<i>Brachycentrus subnubilus</i> Curtis	1	0.86
<i>Centroptilum luteolum</i> (Muller)	1	0.86
<i>Cloeon dipterum</i> (L.)	1	0.86
<i>Glossiphonia complanata</i> (L.)	1	0.86
<i>Crenobia alpina</i> (Dana)	1	0.86
<i>Mystacides azurea</i> (L.)	1	0.86
<i>Dugesia tigrina</i> (Girard)	1	0.86
<i>Gerris</i> (<i>Gerris</i>) sp.	1	0.86
<i>Glossosoma</i> sp.	1	0.86
<i>Gyrinus</i> sp.	1	0.86
<i>Habrophlebia fusca</i> (Curtis)	1	0.86
<i>Haliphus lineatocollis</i> (Marsham)	1	0.86
<i>Hydrometra stagnorum</i> (L.)	1	0.86
<i>Lasiocephala basalis</i> / <i>Lepidostoma hirtum</i>	1	0.86
<i>Lepidostoma hirtum</i> (Fabricius)	1	0.86
<i>Leuctra fusca</i> (L.)	1	0.86
<i>Leuctra geniculata</i> (Stephens)	1	0.86
<i>Leuctra</i> sp.	1	0.86
Corixidae indet	1	0.86
Total	116	100

SUMMARY OF PRIMARY AUDIT FOR ENVIRONMENT AGENCY

Table 57 Statistics of the 1997 Primary Audit for each Agency laboratory

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Anglian Region	60	2.03	0.21	20	33.33	6	2.50	0.24
Central	20	2.35	0.37	8	40.00	6	3.30	0.42
Eastern	20	1.90	0.35	7	35.00	6	2.10	0.37
Northern	20	1.85	0.37	5	25.00	6	2.10	0.42
Midlands Region	80	1.91	0.17	22	27.50	7	2.16	0.18
Upper Severn	20	1.65	0.28	5	25.00	5	1.75	0.29
Lower Severn	20	1.45	0.30	4	20.00	5	1.90	0.35
Upper Trent	20	2.30	0.30	8	40.00	5	2.60	0.34
Lower Trent	20	2.25	0.46	5	25.00	7	2.40	0.46
North East Region	60	1.50	0.19	11	18.33	5	1.70	0.21
Dales	20	1.65	0.36	5	25.00	5	1.80	0.38
Northumbria	20	1.45	0.30	4	20.00	5	1.75	0.38
Ridings	20	1.40	0.34	2	10.00	5	1.55	0.34
North West Region	50	1.64	0.21	11	22.00	6	2.02	0.23
Central	20	1.50	0.29	4	20.00	5	1.85	0.33
Northern	20	1.20	0.25	2	10.00	5	1.40	0.23
Southern	10	2.80	0.65	5	50.00	6	3.60	0.64
Southern Region	55	1.31	0.19	12	21.82	6	1.60	0.22
Kent	26	2.04	0.30	10	38.46	6	2.42	0.33
Hants & Sussex	29	0.66	0.19	2	6.90	4	0.86	0.23
South West Region	58	0.72	0.14	4	6.90	5	0.79	0.14
Cornwall	2	0	0	0	0	0	0	0
Devon	20	0.90	0.32	3	15.00	5	1.00	0.32
North Wessex	20	0.65	0.21	1	5.00	3	0.75	0.20
South Wessex	16	0.69	0.20	0	0	2	0.69	0.20
Thames Region	60	1.82	0.19	15	25.00	5	2.23	0.22
Fobney Mead	30	1.90	0.29	9	30.00	5	2.33	0.34
Hatfield	30	1.73	0.27	6	20.00	5	2.13	0.29
Welsh Region	60	2.30	0.25	23	38.33	10	2.95	0.34
Northern	20	3.10	0.51	12	60.00	10	3.95	0.72
South Eastern	20	1.50	0.38	3	15.00	7	1.95	0.48
South Western	20	2.30	0.33	8	40.00	5	2.95	0.46
Whole of Agency	483	1.67	0.07	119	24.64	10	2.01	0.08

Table 58 Net effects of the 1997 Primary Audit on BMWP score and number of scoring taxa for each Agency laboratory

Region	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Anglian	60	10.25	30.00	42	1.82	28.33	6
Central	20	10.80	30.00	42	2.00	25.00	6
Eastern	20	10.05	35.00	37	1.70	35.00	6
Northern	20	9.90	25.00	41	1.75	25.00	6
Midlands	80	9.86	26.25	36	1.80	23.75	7
Upper Severn	20	9.25	20.00	33	1.60	25.00	5
Lower Severn	20	7.35	15.00	23	1.20	10.00	5
Upper Trent	20	11.00	40.00	31	2.15	35.00	5
Lower Trent	20	11.85	30.00	36	2.25	25.00	7
North East	60	7.98	16.67	35	1.37	13.33	5
Dales	20	9.45	20.00	35	1.50	15.00	5
Northumbria	20	7.65	15.00	31	1.30	15.00	5
Ridings	20	6.85	15.00	30	1.30	10.00	5
North West	50	7.18	18.00	40	1.36	22.00	6
Central	20	6.40	15.00	40	1.20	20.00	5
Northern	20	5.95	10.00	33	1.00	10.00	5
Southern	10	11.20	40.00	38	2.40	50.00	6
Southern	55	6.76	21.82	33	1.13	21.82	4
Kent	26	9.85	34.62	31	1.77	38.46	4
Hants & Sussex	29	4.00	10.34	33	0.55	6.90	4
South West	58	4.10	8.62	28	0.67	6.90	5
Cornwall	2	0	0	0	0	0	0
Devon	20	5.05	15.00	28	0.85	15.00	5
North Wessex	20	3.05	10.00	20	0.55	5.00	3
South Wessex	16	4.75	0	13	0.69	0	2
Thames	60	8.07	20.00	38	1.53	21.67	5
Fobney Mead	30	8.90	23.33	38	1.67	26.67	5
Hatfield	30	7.23	16.67	33	1.40	16.67	5
Welsh	60	12.15	46.67	46	1.73	33.33	7
Northern	20	16.80	70.00	46	2.50	50.00	7
South Eastern	20	5.65	20.00	29	1.00	10.00	6
South Western	20	14.00	50.00	34	1.70	40.00	4
Whole of Agency	483	8.42	23.81	46	1.45	21.53	7

Table 59 The families missed by the Agency's Primary Analysts in the 1997 Audit

Family	n	% of Agency's missed families in Primary Audit
Hydroptilidae	41	5.68
Elmidae	41	5.68
Planariidae (incl. Dugesiidae)	35	4.85
Hydrophilidae (incl. Hydraenidae)	34	4.71
Hydrobiidae (incl. Bithyniidae)	29	4.02
Leptoceridae	26	3.60
Lymnaeidae	24	3.32
Planorbidae	24	3.32
Haliplidae	21	2.91
Hydropsychidae	21	2.91
Simuliidae	21	2.91
Sphaeriidae	20	2.77
Ancylidae (incl. Acroloxidae)	20	2.77
Limnephilidae	19	2.63
Psychomyiidae (incl. Ecnomidae)	19	2.63
Caenidae	18	2.49
Nemouridae	18	2.49
Asellidae	17	2.35
Tipulidae	16	2.22
Valvatidae	14	1.94
Ephemerellidae	14	1.94
Physidae	12	1.66
Goeridae	12	1.66
Scirtidae	12	1.66
Lepidostomatidae	10	1.39
Chironomidae	10	1.39
Gammaridae (incl. Crangonyctidae)	10	1.39
Coenagriidae	10	1.39
Rhyacophilidae (incl. Glossosomatidae)	10	1.39
Dytiscidae (incl. Noteridae)	10	1.39
Baetidae	9	1.25
Leuctridae	9	1.25
Gyrinidae	8	1.11
Polycentropodidae	7	0.97
Glossiphoniidae	6	0.83
Piscicolidae	6	0.83
Erpobdellidae	6	0.83
Calopterygidae	5	0.69
Dendrocoelidae	5	0.69
Corixidae	5	0.69
Gerridae	5	0.69
Oligochaeta	5	0.69

Table 59 continued

Family	n	% of Agency's missed families in Primary Audit
Sialidae	5	0.69
Leptophlebiidae	5	0.69
Heptageniidae	5	0.69
Perlodidae	5	0.69
Odontoceridae	5	0.69
Beraeidae	4	0.55
Dryopidae	4	0.55
Sericostomatidae	3	0.42
Ephemeridae	3	0.42
Hydrometridae	3	0.42
Brachycentridae	3	0.42
Taeniopterygidae	2	0.28
Chloroperlidae	2	0.28
Phryganeidae	1	0.14
Pleidae	1	0.14
Philopotamidae	1	0.14
Corophiidae	1	0.14
Nepidae	1	0.14
Molannidae	1	0.14
Unionidae	1	0.14
Libellulidae	1	0.14
Notonectidae	1	0.14
Total	722	100

Table 60 The species missed by the Agency's primary analysts

Species	n	% of Agency's missed species in Primary Audit
Hydroptila sp.	30	3.87
Potamopyrgus jenkinsi (Smith)	27	3.48
Elmis aenea (Muller)	23	2.96
Polycelis nigra group	18	2.32
Hydraena gracilis Germar	18	2.32
Lymnaea peregra (Muller)	17	2.19
Pisidium sp.	16	2.06
Asellus aquaticus (L.)	15	1.93
Ephemerella ignita (Poda)	14	1.80
Ancylus fluviatilis Muller	14	1.80
Mystacides azurea (L.)	13	1.68
Haliphus sp.	13	1.68
Elodes sp.	10	1.29
Caenis rivulorum Eaton	10	1.29
Polycelis felina (Dalyell)	10	1.29
Limnephilidae indet	10	1.29
Hydropsyche siltalai Dohler	9	1.16
Lype sp.	8	1.03
Orectochilus villosus (Muller)	8	1.03
Orthoclaadiinae	8	1.03
Oulimnius tuberculatus (Muller)	8	1.03
Physa fontinalis (L.)	8	1.03
Oulimnius sp.	8	1.03
Limnius volckmari (Panzer)	8	1.03
Ithytrichia sp.	8	1.03
Simulium (Simulium) ornatum group	8	1.03
Gyraulus albus (Muller)	8	1.03
Tinodes waeneri (L.)	8	1.03
Valvata piscinalis (Muller)	8	1.03
Nemurella picteti Klapalek	7	0.90
Valvata cristata Muller	7	0.90
Lepidostoma hirtum (Fabricius)	7	0.90
Hydropsyche sp.	6	0.77
Gammarus pulex (L.)	6	0.77
Piscicola geometra (L.)	6	0.77
Armiger crista (L.)	6	0.77
Sialis lutaria (L.)	5	0.64
Dendrocoelum lacteum (Muller)	5	0.64
Coenagriidae indet	5	0.64
Leuctra fusca (L.)	5	0.64
Anisus vortex (L.)	5	0.64
Calopteryx splendens (Harris)	5	0.64
Odontocerum albicorne (Scopoli)	5	0.64

Table 60 continued

Species	n	% of Agency's missed species in Primary Audit
<i>Hydropsyche angustipennis</i> (Curtis)	5	0.64
<i>Helophorus</i> (<i>Atracthelophorus</i>) <i>brevipalpis</i> Bedel	5	0.64
<i>Glossiphonia complanata</i> (L.)	5	0.64
<i>Caenis luctuosa</i> group	5	0.64
<i>Dugesia polychroa</i> group	4	0.52
<i>Dugesia tigrina</i> (Girard)	4	0.52
<i>Dryops</i> sp.	4	0.52
<i>Goera pilosa</i> (Fabricius)	4	0.52
<i>Acroloxus lacustris</i> (L.)	4	0.52
<i>Nemoura avicularis</i> Morton	4	0.52
<i>Lymnaea stagnalis</i> (L.)	4	0.52
<i>Silo pallipes</i> (Fabricius)	4	0.52
Erpobdellidae indet	4	0.52
<i>Tipula</i> (<i>Yamatotipula</i>) <i>montium</i> group	4	0.52
<i>Agapetus</i> sp.	4	0.52
<i>Agraylea multipunctata</i> Curtis	4	0.52
Tubificidae	4	0.52
<i>Antocha vitripennis</i> (Meigen)	4	0.52
<i>Dicranota</i> sp.	4	0.52
<i>Athripsodes bilineatus</i> (L.)	4	0.52
<i>Baetis rhodani</i> (Pictet)	4	0.52
<i>Bathyomphalus contortus</i> (L.)	4	0.52
<i>Ischnura elegans</i> (Van der Linden)	3	0.39
<i>Agabus</i> sp.	3	0.39
<i>Cloeon dipterum</i> (L.)	3	0.39
<i>Brachycentrus subnubilus</i> Curtis	3	0.39
<i>Simulium</i> (<i>Boophthora</i>) <i>erythrocephalum</i> (de Geer)	3	0.39
<i>Simulium</i> (<i>Eusimulium</i>) <i>aureum</i> group	3	0.39
<i>Leuctra geniculata</i> (Stephens)	3	0.39
<i>Athripsodes aterrimus</i> (Stephens)	3	0.39
<i>Isoperla grammatica</i> (Poda)	3	0.39
<i>Haliphus fluviatilis</i> Aube	3	0.39
Tanypodinae	3	0.39
<i>Lymnaea truncatula</i> (Muller)	3	0.39
<i>Hydrometra stagnorum</i> (L.)	3	0.39
<i>Hydraena riparia</i> Kugelann	3	0.39
<i>Helobdella stagnalis</i> (L.)	3	0.39
<i>Athripsodes cinereus</i> (Curtis)	3	0.39
Sphaeriidae indet	3	0.39
<i>Oxyethira</i> sp.	3	0.39
<i>Sigara</i> (<i>Sigara</i>) sp.	3	0.39
<i>Platambus maculatus</i> (L.)	3	0.39
<i>Sericostoma personatum</i> (Spence)	3	0.39

Table 60 continued

Species	n	% of Agency's missed species in Primary Audit
<i>Silo nigricornis</i> (Pictet)	3	0.39
<i>Rhyacophila dorsalis</i> (Curtis)	3	0.39
<i>Chloroperla torrentium</i> (Pictet)	2	0.26
<i>Simulium</i> (<i>Wilhelmia</i>) sp.	2	0.26
<i>Glossosoma</i> sp.	2	0.26
<i>Athripsodes</i> sp.	2	0.26
<i>Esolus parallelepipedus</i> (Muller)	2	0.26
<i>Baetis vernus</i> Curtis	2	0.26
<i>Oreodytes sanmarkii</i> (Sahlberg)	2	0.26
<i>Polycentropus</i> sp.	2	0.26
<i>Beraea maurus</i> (Curtis)	2	0.26
<i>Polycentropus flavomaculatus</i> (Pictet)	2	0.26
<i>Gammarus</i> sp.	2	0.26
<i>Ephemera danica</i> Muller	2	0.26
Chironomini	2	0.26
Scirtidae indet	2	0.26
<i>Gerris</i> (<i>Gerris</i>) <i>lacustris</i> (L.)	2	0.26
<i>Psychomyia pusilla</i> (Fabricius)	2	0.26
<i>Caenis horaria</i> (L.)	2	0.26
<i>Habrophlebia fusca</i> (Curtis)	2	0.26
<i>Paraleptophlebia</i> sp.	2	0.26
<i>Hippeutis complanatus</i> (L.)	2	0.26
<i>Ecdyonurus</i> sp.	2	0.26
<i>Adicella reducta</i> (Mclachlan)	2	0.26
<i>Physa acuta</i> group	2	0.26
<i>Physa</i> sp.	2	0.26
<i>Perlodes microcephala</i> (Pictet)	2	0.26
<i>Protonemura meyeri</i> (Pictet)	2	0.26
<i>Amphinemura sulcicollis</i> (Stephens)	2	0.26
<i>Cyrnus trimaculatus</i> (Curtis)	2	0.26
<i>Crunoecia irrorata</i> (Curtis)	2	0.26
<i>Erpobdella octoculata</i> (L.)	2	0.26
Ancylidae indet	2	0.26
<i>Limnephilus lunatus</i> Curtis	2	0.26
<i>Tipula</i> sp.	2	0.26
<i>Crangonyx pseudogracilis</i> Bousfield	2	0.26
<i>Pyrrhosoma nymphula</i> (Sulzer)	2	0.26
<i>Haliphus lineatocollis</i> (Marsham)	2	0.26
<i>Riolus subviolaceus</i> (Muller)	2	0.26
<i>Simulium</i> (<i>Simulium</i>) <i>argyreatum</i> group	2	0.26
<i>Simulium</i> (<i>Nevermannia</i>) <i>cryophilum</i> group	2	0.26
<i>Simulium</i> (<i>Nevermannia</i>) <i>angustitarse</i> group	2	0.26
<i>Asellus meridianus</i> Racovitza	2	0.26

Table 60 continued

Species	n	% of Agency's missed species in Primary Audit
Planaria torva (Muller)	1	0.13
Corixidae indet	1	0.13
Crenobia alpina (Dana)	1	0.13
Centroptilum luteolum (Muller)	1	0.13
Ceraclea dissimilis (Stephens)	1	0.13
Corophium lacustre Vanhoffen	1	0.13
Rhyacophila sp.	1	0.13
Chloroperla tripunctata (Scopoli)	1	0.13
Athripsodes albifrons (L.)	1	0.13
Agabus didymus (Olivier)	1	0.13
Protonemura sp.	1	0.13
Protonemura praecox (Morton)	1	0.13
Anacaena bipustulata (Marsham)	1	0.13
Anacaena globulus (Paykull)	1	0.13
Prodiamesinae	1	0.13
Anisus leucostoma (Millet)	1	0.13
Anisus sp.	1	0.13
Anodonta cygnea (L.)	1	0.13
Bithynia tentaculata (L.)	1	0.13
Potamophylax latipennis (Curtis)	1	0.13
Tipula (Acutipula) maxima/fulvipennis	1	0.13
Athripsodes albifrons/bilineatus	1	0.13
Polycentropodidae indet	1	0.13
Rhithrogena sp.	1	0.13
Baetis scambus group	1	0.13
Beraea pullata (Curtis)	1	0.13
Beraeodes minutus (L.)	1	0.13
Bithynia leachii (Sheppard)	1	0.13
Plea leachi Mcgregor & Kirkaldy	1	0.13
Brachyptera risi (Morton)	1	0.13
Brychius elevatus (Panzer)	1	0.13
Caenis pusilla Navas	1	0.13
Potamophylax rotundipennis (Brauer)	1	0.13
Leuctra hippopus (Kempny)	1	0.13
Tanytarsini	1	0.13
Oecetis lacustris (Pictet)	1	0.13
Hydropsyche pellucidula (Curtis)	1	0.13
Ochthebius minimus (Fabricius)	1	0.13
Wormaldia sp.	1	0.13
Simulium (Wilhelmia) equinum (L.)	1	0.13
Ochthebius bicolon Germar	1	0.13
Notonecta sp.	1	0.13
Laccobius (Macrolaccobius) sinuatus/striatulus	1	0.13

Table 60 continued

Species	n	% of Agency's missed species in Primary Audit
Laccobius sp.	1	0.13
Sigara sp.	1	0.13
Nepa cinerea L.	1	0.13
Simulium sp.	1	0.13
Leuctra sp.	1	0.13
Libellulidae indet	1	0.13
Limnephilus marmoratus Curtis	1	0.13
Limnephilus politus/rhombicus	1	0.13
Limnephilus sp.	1	0.13
Nemoura cinerea (Retzius)	1	0.13
Lumbricidae	1	0.13
Lumbriculidae	1	0.13
Lymnaea palustris (Muller)	1	0.13
Nemoura cambrica group	1	0.13
Lymnaea sp.	1	0.13
Mystacides nigra/longicornis	1	0.13
Molanna angustata Curtis	1	0.13
Lasiocephala basalis/Lepidostoma hirtum	1	0.13
Gerris sp.	1	0.13
Phryganea sp.	1	0.13
Dytiscidae indet	1	0.13
Ecclisopteryx guttulata (Pictet)	1	0.13
Ecnomus tenellus (Rambur)	1	0.13
Tinodes assimilis/machlachlani	1	0.13
Enchytraeidae	1	0.13
Silo sp.	1	0.13
Ephemera sp.	1	0.13
Pedicia (Pedicia) rivosa (L.)	1	0.13
Paraleptophlebia submarginata (Stephens)	1	0.13
Taeniopteryx nebulosa (L.)	1	0.13
Hydrophilidae indet	1	0.13
Gerris (Gerris) sp.	1	0.13
Diamesinae	1	0.13
Glossiphonia heteroclita (L.)	1	0.13
Glyptotaelius pellucidus (Retzius)	1	0.13
Sphaerium sp.	1	0.13
Gyrinus sp.	1	0.13
Haliplidae indet	1	0.13
Hydropsychidae indet	1	0.13
Halplus wehnckeii (Gerhardt)	1	0.13
Helius sp.	1	0.13
Oreodytes septentrionalis (Sahlberg)	1	0.13
Helophorus (Helophorus) obscurus Mulsant	1	0.13

Table 60 continued

Species	n	% of Agency's missed species in Primary Audit
Helophorus (Meghelophorus) grandis Illiger	1	0.13
Heptagenia lateralis (Curtis)	1	0.13
Heptagenia sulphurea (Muller)	1	0.13
Gerris (Gerris) gibbifer Schummel	1	0.13
Total	776	100

MISSED TAXA FOR ALL SAMPLES IN THE 1997 AUDIT

Table 61 Missed families for all samples in the 1997 Audit

Family	n	% of missed families in 1997 audit
Hydroptilidae	68	5.75
Elmidae	66	5.58
Hydrophilidae (incl. Hydraenidae)	61	5.16
Planariidae (incl. Dugesiidae)	53	4.48
Leptoceridae	45	3.81
Hydrobiidae (incl. Bithyniidae)	43	3.64
Simuliidae	36	3.05
Lymnaeidae	36	3.05
Planorbidae	36	3.05
Sphaeriidae	34	2.88
Ancylidae (incl. Acroloxidae)	32	2.71
Hydropsychidae	32	2.71
Limnephilidae	32	2.71
Nemouridae	32	2.71
Caenidae	29	2.45
Haliplidae	28	2.37
Tipulidae	28	2.37
Psychomyiidae (incl. Ecnomidae)	28	2.37
Asellidae	25	2.12
Ephemerellidae	22	1.86
Lepidostomatidae	22	1.86
Rhyacophilidae (incl. Glossosomatidae)	20	1.69
Valvatidae	19	1.61
Goeridae	18	1.52
Physidae	18	1.52
Scirtidae	17	1.44
Dytiscidae (incl. Noteridae)	17	1.44
Coenagriidae	16	1.35
Leuctridae	16	1.35
Baetidae	15	1.27
Glossiphoniidae	15	1.27
Gammaridae (incl. Crangonyctidae)	13	1.10
Leptophlebiidae	13	1.10
Sericostomatidae	13	1.10
Chironomidae	12	1.02
Erpobdellidae	12	1.02
Heptageniidae	11	0.93
Gerridae	11	0.93
Polycentropodidae	11	0.93
Perlodidae	10	0.85
Gyrinidae	10	0.85
Dendrocoelidae	9	0.76
Piscicolidae	9	0.76

Table 61 continued

Family	n	% of missed families in 1997 audit
Taeniopterygidae	8	0.68
Corixidae	8	0.68
Odontoceridae	8	0.68
Beraeidae	7	0.59
Calopterygidae	7	0.59
Dryopidae	7	0.59
Sialidae	7	0.59
Oligochaeta	7	0.59
Hydrometridae	5	0.42
Chloroperlidae	5	0.42
Ephemeridae	4	0.34
Brachycentridae	4	0.34
Libellulidae	2	0.17
Notonectidae	2	0.17
Molannidae	2	0.17
Unionidae	1	0.08
Phryganeidae	1	0.08
Philopotamidae	1	0.08
Nepidae	1	0.08
Pleidae	1	0.08
Corophiidae	1	0.08
Total	1182	100

Table 62 Missed species for all samples in the 1997 Audit

Species	n	% of missed species in 1997 audit
Hydroptila sp.	49	3.90
Potamopyrgus jenkinsi (Smith)	40	3.18
Elmis aenea (Muller)	38	3.02
Hydraena gracilis Germar	34	2.70
Pisidium sp.	28	2.23
Polycelis nigra group	26	2.07
Lymnaea peregra (Muller)	26	2.07
Asellus aquaticus (L.)	23	1.83
Ephemerella ignita (Poda)	22	1.75
Ancylus fluviatilis Muller	22	1.75
Limnephilidae indet	19	1.51
Mystacides azurea (L.)	18	1.43
Caenis rivulorum Eaton	18	1.43
Lepidostoma hirtum (Fabricius)	18	1.43
Simulium (Simulium) ornatum group	18	1.43
Hydropsyche siltalai Dohler	17	1.35
Haliphus sp.	16	1.27
Limnius volckmari (Panzer)	15	1.19
Ithytrichia sp.	15	1.19
Polycelis felina (Dalyell)	14	1.11
Physa fontinalis (L.)	13	1.03
Sericostoma personatum (Spence)	13	1.03
Tinodes waeneri (L.)	13	1.03
Elodes sp.	13	1.03
Lype sp.	12	0.95
Gyraulus albus (Muller)	12	0.95
Valvata piscinalis (Muller)	12	0.95
Glossiphonia complanata (L.)	12	0.95
Oulimnius sp.	11	0.87
Orectochilus villosus (Muller)	10	0.79
Helophorus (Atracthelophorus) brevipalpis Bedel	10	0.79
Dendrocoelum lacteum (Muller)	9	0.72
Dicranota sp.	9	0.72
Piscicola geometra (L.)	9	0.72
Coenagriidae indet	9	0.72
Nemurella picteti Klapalek	9	0.72
Oulimnius tuberculatus (Muller)	9	0.72
Valvata cristata Muller	9	0.72
Bathyomphalus contortus (L.)	8	0.64
Odontocerum albicorne (Scopoli)	8	0.64
Orthocladiinae	8	0.64
Hydropsyche sp.	8	0.64
Isoperla grammatica (Poda)	8	0.64

Table 62 continued

Species	n	% of missed species in 1997 audit
Agapetus sp.	8	0.64
Anisus vortex (L.)	8	0.64
Goera pilosa (Fabricius)	7	0.56
Gammarus pulex (L.)	7	0.56
Erpobdellidae indet	7	0.56
Nemoura avicularis Morton	7	0.56
Caenis luctuosa group	7	0.56
Amphinemura sulcicollis (Stephens)	7	0.56
Dugesia polychroa group	7	0.56
Armiger crista (L.)	7	0.56
Dryops sp.	7	0.56
Sialis lutaria (L.)	7	0.56
Calopteryx splendens (Harris)	7	0.56
Rhyacophila dorsalis (Curtis)	7	0.56
Acroloxus lacustris (L.)	6	0.48
Baetis rhodani (Pictet)	6	0.48
Lymnaea truncatula (Muller)	6	0.48
Hydropsyche angustipennis (Curtis)	6	0.48
Agabus sp.	6	0.48
Athripsodes bilineatus (L.)	6	0.48
Helobdella stagnalis (L.)	6	0.48
Agraylea multipunctata Curtis	6	0.48
Dugesia tigrina (Girard)	6	0.48
Oxyethira sp.	6	0.48
Athripsodes aterrimus (Stephens)	5	0.40
Tipula (Yamatotipula) montium group	5	0.40
Athripsodes sp.	5	0.40
Erpobdella octoculata (L.)	5	0.40
Silo pallipes (Fabricius)	5	0.40
Oreodytes sanmarkii (Sahlberg)	5	0.40
Gerris (Gerris) lacustris (L.)	5	0.40
Sphaeriidae indet	5	0.40
Tipula sp.	5	0.40
Antocha vitripennis (Meigen)	5	0.40
Chloroperla torrentium (Pictet)	5	0.40
Leuctra fusca (L.)	5	0.40
Hydraena riparia Kugelann	5	0.40
Rhithrogena sp.	5	0.40
Paraleptophlebia sp.	5	0.40
Hydrometra stagnorum (L.)	5	0.40
Leuctra geniculata (Stephens)	4	0.32
Leuctra hippopus (Kempny)	4	0.32
Ischnura elegans (Van der Linden)	4	0.32

Table 62 continued

Species	n	% of missed species in 1997 audit
<i>Athripsodes cinereus</i> (Curtis)	4	0.32
<i>Baetis vernus</i> Curtis	4	0.32
Hydrophilidae indet	4	0.32
<i>Brachycentrus subnubilus</i> Curtis	4	0.32
<i>Brachyptera risi</i> (Morton)	4	0.32
<i>Haliplus fluviatilis</i> Aube	4	0.32
<i>Ceraclea dissimilis</i> (Stephens)	4	0.32
Ancylidae indet	4	0.32
<i>Ecdyonurus</i> sp.	4	0.32
<i>Beraea maurus</i> (Curtis)	4	0.32
<i>Sigara</i> (<i>Sigara</i>) sp.	4	0.32
Tubificidae	4	0.32
<i>Platambus maculatus</i> (L.)	4	0.32
Tanypodinae	4	0.32
<i>Taeniopteryx nebulosa</i> (L.)	4	0.32
<i>Polycentropus flavomaculatus</i> (Pictet)	4	0.32
<i>Psychomyia pusilla</i> (Fabricius)	4	0.32
<i>Simulium</i> (<i>Nevermannia</i>) <i>cryophilum</i> group	4	0.32
Scirtidae indet	4	0.32
<i>Lymnaea stagnalis</i> (L.)	4	0.32
<i>Silo nigricornis</i> (Pictet)	4	0.32
<i>Crangonyx pseudogracilis</i> Bousfield	3	0.24
<i>Caenis horaria</i> (L.)	3	0.24
<i>Helophorus</i> (<i>Helophorus</i>) <i>obscurus</i> Mulsant	3	0.24
<i>Pyrrhosoma nymphula</i> (Sulzer)	3	0.24
<i>Cloeon dipterum</i> (L.)	3	0.24
<i>Habrophlebia fusca</i> (Curtis)	3	0.24
<i>Crunoecia irrorata</i> (Curtis)	3	0.24
<i>Glossosoma</i> sp.	3	0.24
Polycentropodidae indet	3	0.24
<i>Ephemera danica</i> Muller	3	0.24
<i>Gammarus</i> sp.	3	0.24
<i>Physa</i> sp.	3	0.24
<i>Esolus parallelepipedus</i> (Muller)	3	0.24
<i>Haliplus lineatocollis</i> (Marsham)	3	0.24
<i>Simulium</i> (<i>Eusimulium</i>) <i>aureum</i> group	3	0.24
<i>Adicella reducta</i> (Mclachlan)	3	0.24
<i>Limnephilus lunatus</i> Curtis	3	0.24
Leptophlebiidae indet	3	0.24
<i>Leuctra</i> sp.	3	0.24
<i>Nemoura cambrica</i> group	3	0.24
<i>Simulium</i> (<i>Boophthora</i>) <i>erythrocephalum</i> (de Geer)	3	0.24
<i>Simulium</i> (<i>Wilhelmia</i>) sp.	3	0.24

Table 62 continued

Species	n	% of missed species in 1997 audit
<i>Athripsodes albifrons</i> (L.)	3	0.24
<i>Simulium</i> (<i>Simulium</i>) <i>argyreatum</i> group	3	0.24
<i>Cyrnus trimaculatus</i> (Curtis)	2	0.16
<i>Asellus meridianus</i> Racovitza	2	0.16
<i>Protonemura praecox</i> (Morton)	2	0.16
<i>Crenobia alpina</i> (Dana)	2	0.16
<i>Ecclisopteryx guttulata</i> (Pictet)	2	0.16
<i>Anisus</i> sp.	2	0.16
<i>Tanytarsini</i>	2	0.16
<i>Protonemura meyeri</i> (Pictet)	2	0.16
<i>Brychius elevatus</i> (Panzer)	2	0.16
Corixidae indet	2	0.16
<i>Beraeodes minutus</i> (L.)	2	0.16
<i>Protonemura</i> sp.	2	0.16
<i>Simulium</i> (<i>Wilhelmia</i>) <i>equinum</i> (L.)	2	0.16
<i>Simulium</i> (<i>Nevermannia</i>) <i>angustitarse</i> group	2	0.16
Chironomini	2	0.16
<i>Rhyacophila</i> sp.	2	0.16
<i>Baetis scambus</i> group	2	0.16
<i>Riolus subviolaceus</i> (Muller)	2	0.16
<i>Polycentropus</i> sp.	2	0.16
<i>Silo</i> sp.	2	0.16
<i>Sigara</i> sp.	2	0.16
<i>Bithynia tentaculata</i> (L.)	2	0.16
<i>Athripsodes albifrons/bilineatus</i>	2	0.16
<i>Ochthebius bicolon</i> Germar	2	0.16
Libellulidae indet	2	0.16
Lumbricidae	2	0.16
<i>Molanna angustata</i> Curtis	2	0.16
<i>Molophilus</i> sp.	2	0.16
<i>Mystacides nigra/longicornis</i>	2	0.16
Naididae	2	0.16
<i>Nemoura cinerea</i> (Retzius)	2	0.16
<i>Notonecta</i> sp.	2	0.16
<i>Hippeutis complanatus</i> (L.)	2	0.16
<i>Oecetis lacustris</i> (Pictet)	2	0.16
<i>Helius</i> sp.	2	0.16
<i>Haliphus wehnckeii</i> (Gerhardt)	2	0.16
<i>Paraleptophlebia submarginata</i> (Stephens)	2	0.16
<i>Perlodes microcephala</i> (Pictet)	2	0.16
<i>Gerris</i> (<i>Gerris</i>) sp.	2	0.16
<i>Gerris</i> (<i>Gerris</i>) <i>gibbifer</i> Schummel	2	0.16
<i>Physa acuta</i> group	2	0.16

Table 62 continued

Species	n	% of missed species in 1997 audit
Gerris sp.	2	0.16
Ephemera sp.	1	0.08
Enchytraeidae	1	0.08
Baetis sp.	1	0.08
Diamesinae	1	0.08
Laccobius (Macrolaccobius) sinuatus/striatulus	1	0.08
Laccobius sp.	1	0.08
Lasiocephala basalis/Lepidostoma hirtum	1	0.08
Lymnaea sp.	1	0.08
Lymnaea palustris (Muller)	1	0.08
Lumbriculidae	1	0.08
Simulium sp.	1	0.08
Phagocata vitta (Duges)	1	0.08
Anodonta cygnea (L.)	1	0.08
Ochthebius minimus (Fabricius)	1	0.08
Leuctra inermis Kempny	1	0.08
Anisus leucostoma (Millet)	1	0.08
Plea leachi Mcgregor & Kirkaldy	1	0.08
Limonia sp.	1	0.08
Anacaena globulus (Paykull)	1	0.08
Anacaena bipustulata (Marsham)	1	0.08
Anabolia nervosa (Curtis)	1	0.08
Tinodes assimilis/machlachlani	1	0.08
Tipula (Acutipula) maxima/fulvipennis	1	0.08
Tipula (Tipula) paludosa Meigen	1	0.08
Limnephilus marmoratus Curtis	1	0.08
Agabus didymus (Olivier)	1	0.08
Limnephilus politus/rhombicus	1	0.08
Sphaerium sp.	1	0.08
Helophorus (Meghelophorus) grandis Illiger	1	0.08
Drusus annulatus/Ecclisopteryx guttulata	1	0.08
Gyrinus sp.	1	0.08
Corophium lacustre Vanhoffen	1	0.08
Haliplidae indet	1	0.08
Pedicia (Pedicia) rivosa (L.)	1	0.08
Prodiamesinae	1	0.08
Chloroperla tripunctata (Scopoli)	1	0.08
Potamophylax rotundipennis (Brauer)	1	0.08
Potamophylax latipennis (Curtis)	1	0.08
Oreodytes septentrionalis (Sahlberg)	1	0.08
Wormaldia sp.	1	0.08
Hydropsychidae indet	1	0.08
Glossiphonia heteroclita (L.)	1	0.08

Table 62 continued

Species	n	% of missed species in 1997 audit
Caenis pusilla Navas	1	0.08
Heptagenia lateralis (Curtis)	1	0.08
Heptagenia sulphurea (Muller)	1	0.08
Glyptotaelius pellucidus (Retzius)	1	0.08
Planaria torva (Muller)	1	0.08
Limnephilus sp.	1	0.08
Dytiscidae indet	1	0.08
Bithynia leachii (Sheppard)	1	0.08
Nepa cinerea L.	1	0.08
Beraea pullata (Curtis)	1	0.08
Ecnomus tenellus (Rambur)	1	0.08
Hydropsyche pellucidula (Curtis)	1	0.08
Phryganea sp.	1	0.08
Centroptilum luteolum (Muller)	1	0.08
Total	1258	100