TORRIDGE DATA REPORT

BIOLOGICAL MONITORING OF ORGANIC INPUTS TO THE STUDY CATCHMENTS USING RAPID BIOLOGICAL ASSESSMENT KEYS

RDALLEN/COVERS (TORRIDGE.DRW)

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<u>Circulation</u>

Torridge Project Steering Group Members only

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1. Introduction

The Rapid Biological Assessment Key (RBAK), developed by WRc/NRA Welsh Region to identify organic farm pollution in watercourses (NRA Project Nos A3.001/A3.012), was used in the four study catchments during winter/early spring 1992 (March-May).

The RBAK (Figure 1) provides a means of identifying organic farm pollution, and classifying its severity (Table 1), using a number of indicator macro-invertebrate taxa and the presence/absence of sewage fungus. The key was specifically developed for use in Wales, however a modified version specifically for use in Devon has also been produced (Figure 2). Both Keys are applicable in the S.W. (pers. comm. G.Rutt) and since the Devon method was untested in the field both methods were employed in this study.

Table 1. Rapid Biological Assessment Key site classification according to severity of organic input and the effect on fauna.

Devon Method

GROUP	INPUT	EFFECT ON FAUNA
1a	Unpolluted	None
1b	Mild organic input	Minor impact
2	Moderate/severe pollution	Impact on fauna

Welsh Method

GROUP	INPUT	EFFECT ON FAUNA
1	Unpolluted	None
2a	Mild input	None
2b	Moderate/historic pollution	Impact on fauna
2c	" " "	Serious
3	Gross pollution	Serious

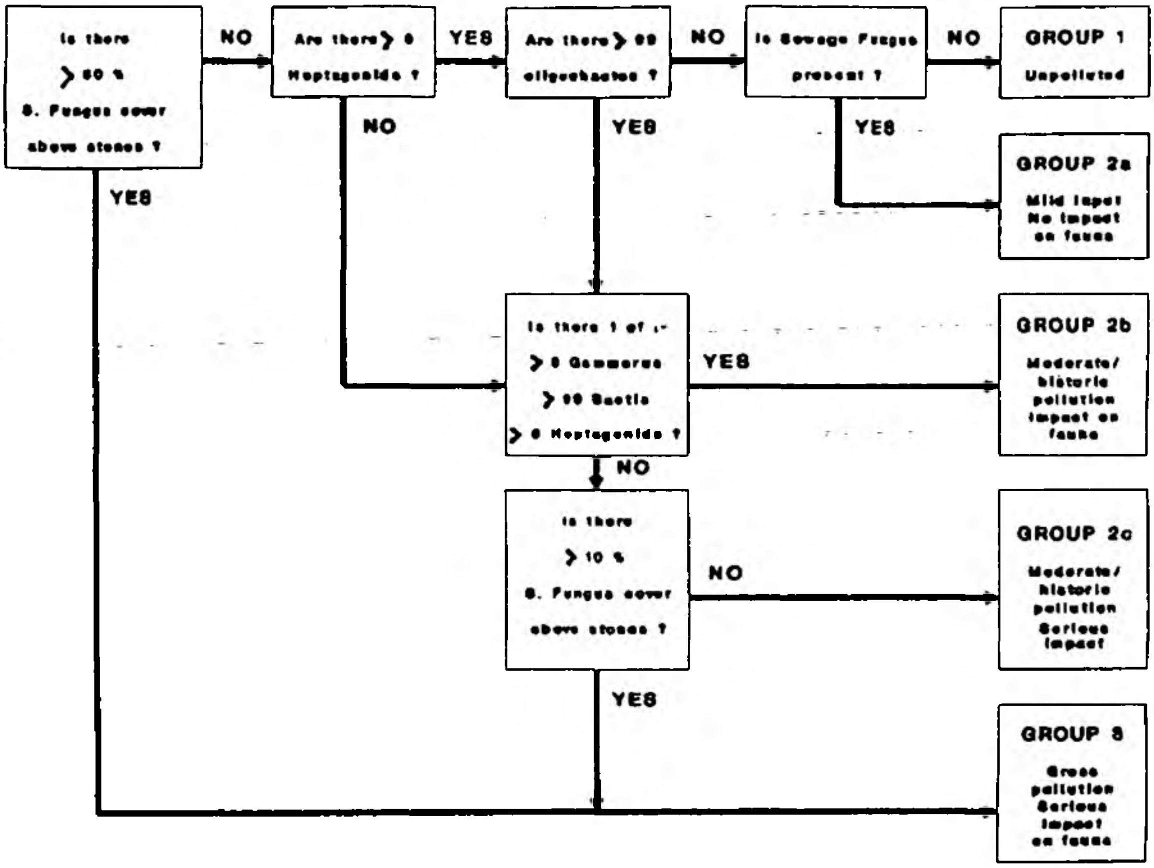

Figure 1. The Rapid Biological Assessment Key, Welsh method.

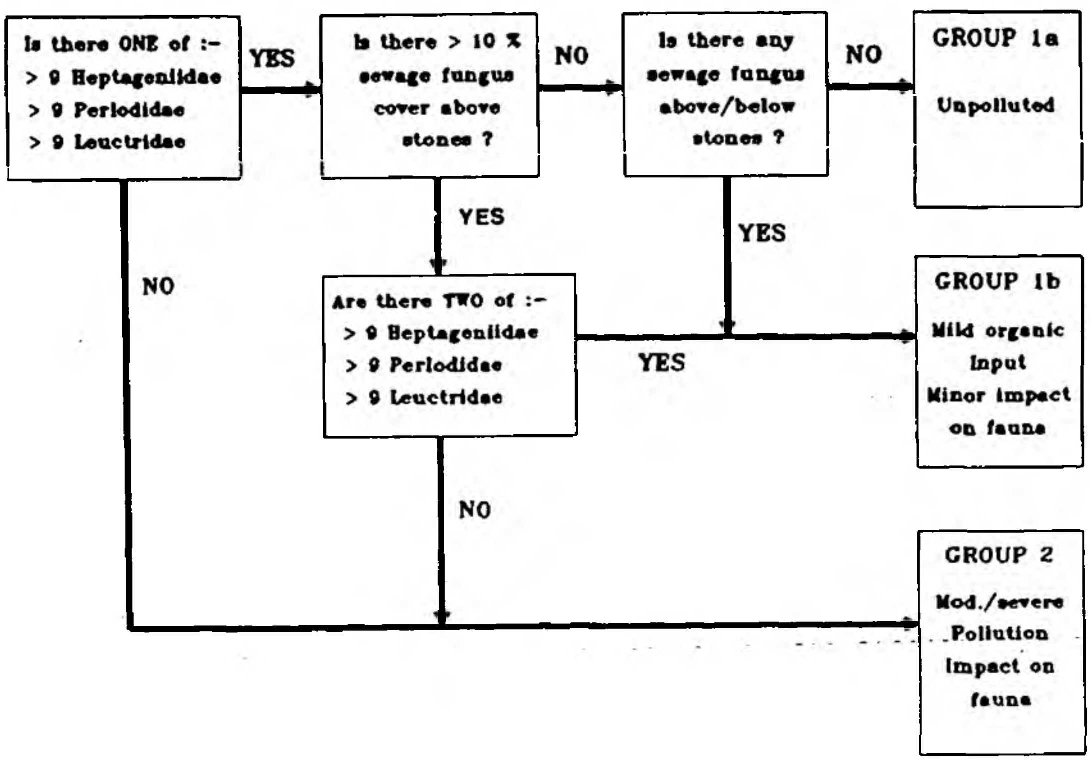

Figure 2. The Rapid Biological Assessment Key, Devon method.

Sewage Fungus

Sewage fungus comprises a community of bacteria, fungi and protozoa. These are normal inhabitants of rivers but form macroscopic slimes on the bed when the water is significantly polluted.

Sewage fungus is a sensitive indicator of organic pollution in flowing waters and can form slimy cotton wool like plumes which rapidly colonise submerged surfaces. Outbreaks can be massive and can severely damage the normal river biota by smothering the substrate and benthic fauna, and causing deoxygenation (in addition to the effects of the pollutant itself). The presence of sewage fungus is not always detrimental and growths can appear and subsequently die or be wasted away, having had no discernable effects on either the biota or water quality (Gray 1982).

Sewage fungus organisms are dependent for growth on a continuing supply of nutrients. Cleaning up an effluent and removing pollution usually has a rapid beneficial effect and sewage fungus organisms are reduced to negligible numbers (Curtis 1969)

2. Methods

Suitability of study catchments for application of RBAKs

The suitability of the study catchments for applying the RBAKs was assessed using the RIVPACS II invertebrate prediction model (NRA R&D Project 243). This predicts the probability of each invertebrate taxon being found in a watercourse under unpolluted conditions, based on the site's physical and geographical characteristics. The probability of RBAK indicator species being present is shown in Table 2 and demonstrates the high probability of these taxa being present in each study catchment.

Table 2. RIVPACS prediction of the probability (%) of RBAK invertebrate taxa being present in study catchments.

Taxa	Common Name	Hookmoor Brook	Medland Brook	Cookbury Stream	River E. Okement
HEPTAGENIDAE	Mayflies	99.0	98.8	97.2	88.3
LEUTRIDAE	Stoneflies	99.3	99.0	97.8	99.9
PERLODIDAE	Stoneflies	91.3	89.3	89.3	84.6
GAMMARIDAE	FW Shrimp	94.2	95.4	95.4	63.8
BAETIDAE	Mayflies	100	100	100	91.2
OLIGOCHAETAE	Worms	100	100	100	100

Choice of sampling points

Sampling sites were identified, with the aid of the WRc team that developed the keys, in relation to confluence points and the distribution of farms (Figures 3,4 & 5) in each study catchment.

Field techniques

Sampling was mainly carried out on days of stable low flow when the channel bed was easily visible. One minute kick samples were taken from suitable riffle areas at each site and the live invertebrates were sorted and identified on the bank. Sewage fungus organisms were identified by the microscopic examination of samples scraped from stones, in the field and the laboratory.

3. Results

Almost without exception, the sites in each study catchment registered as unpolluted according to invertebrate fauna, however trace amounts of sewage fungus (generally <5%) were found at many sites, indicating mild organic contamination.

Two types of sewage fungus organism were identified: Carchaesium polypinum a colonial protozoa often found to be dominant in recovery zones and the bacterium Zooglea, which forms gelatinous matrices. Carchaesium was present at all the sites where sewage fungus was observed whilst small quantities of zooglea were found at one site in the Medland Brook and two sites in the Cookbury Stream.

River East Okement

The results from the River East Okement (Figure 3) inferred that the main River and its moorland tributaries were Class 1a/1 (Devon method/Welsh method) and sewage fungus was absent. This indicates that these sites were unpolluted. Site 3, situated 200 m below a beef/sheep farm on the unnamed tributary from Belstone, was however Class 2/2b, with a 5% sewage fungus cover beneath the stones indicating moderate or historical pollution. The tributary was however Class 1a/1 at its confluence with the E.Okement (Site 2) and above the farm (Site 4) indicating a localised effect around the farm.

Cookbury Stream

The quality of the invertebrate population in the Cookbury Stream was good, however small quantities of sewage fungus were found on the underside of stones at several sites (Figure 3) making these Class 1b/2a, indicating mild organic inputs.

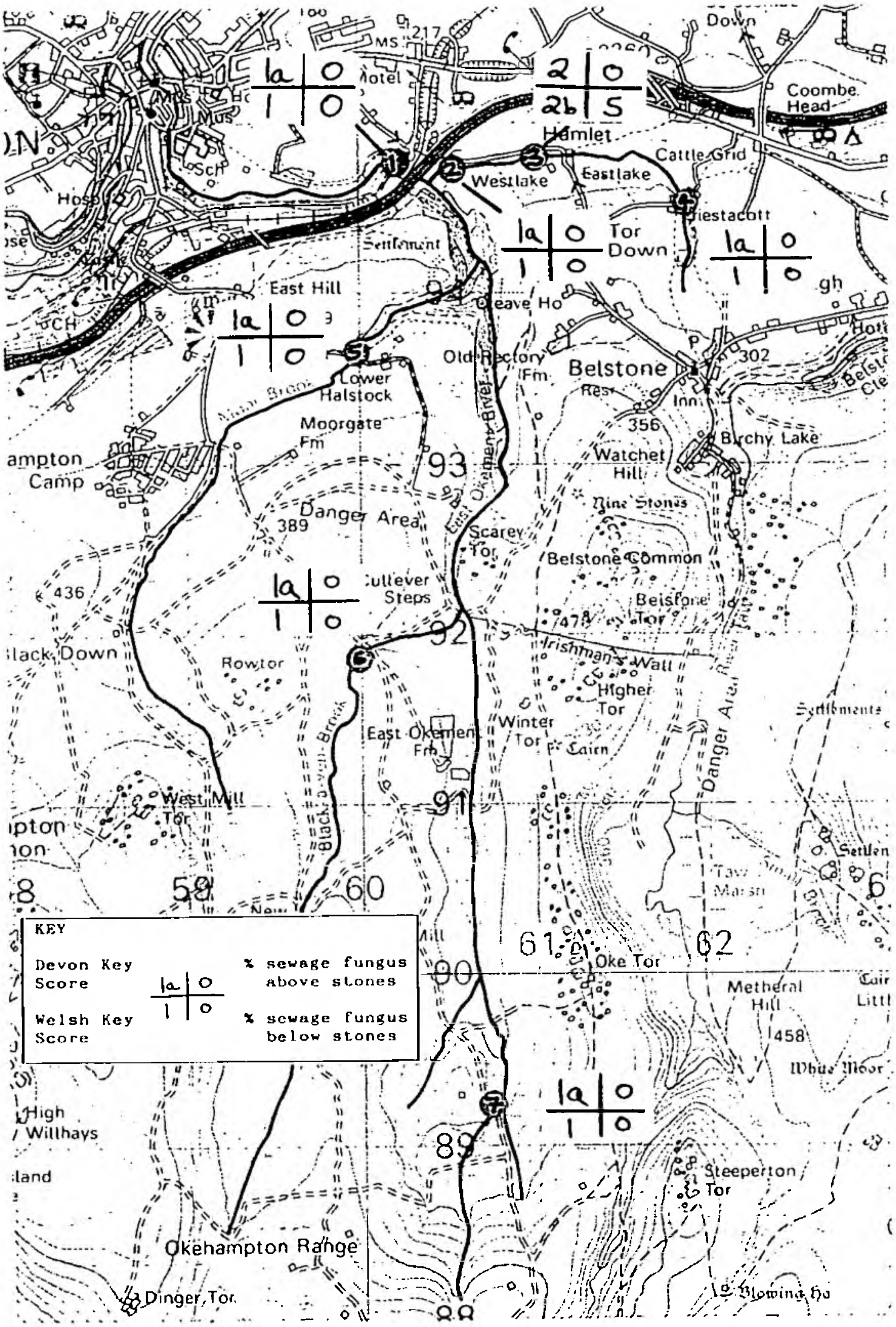

Figure 3. Map of the River East Okement showing Rapid Biological Assessment Key sites and results.

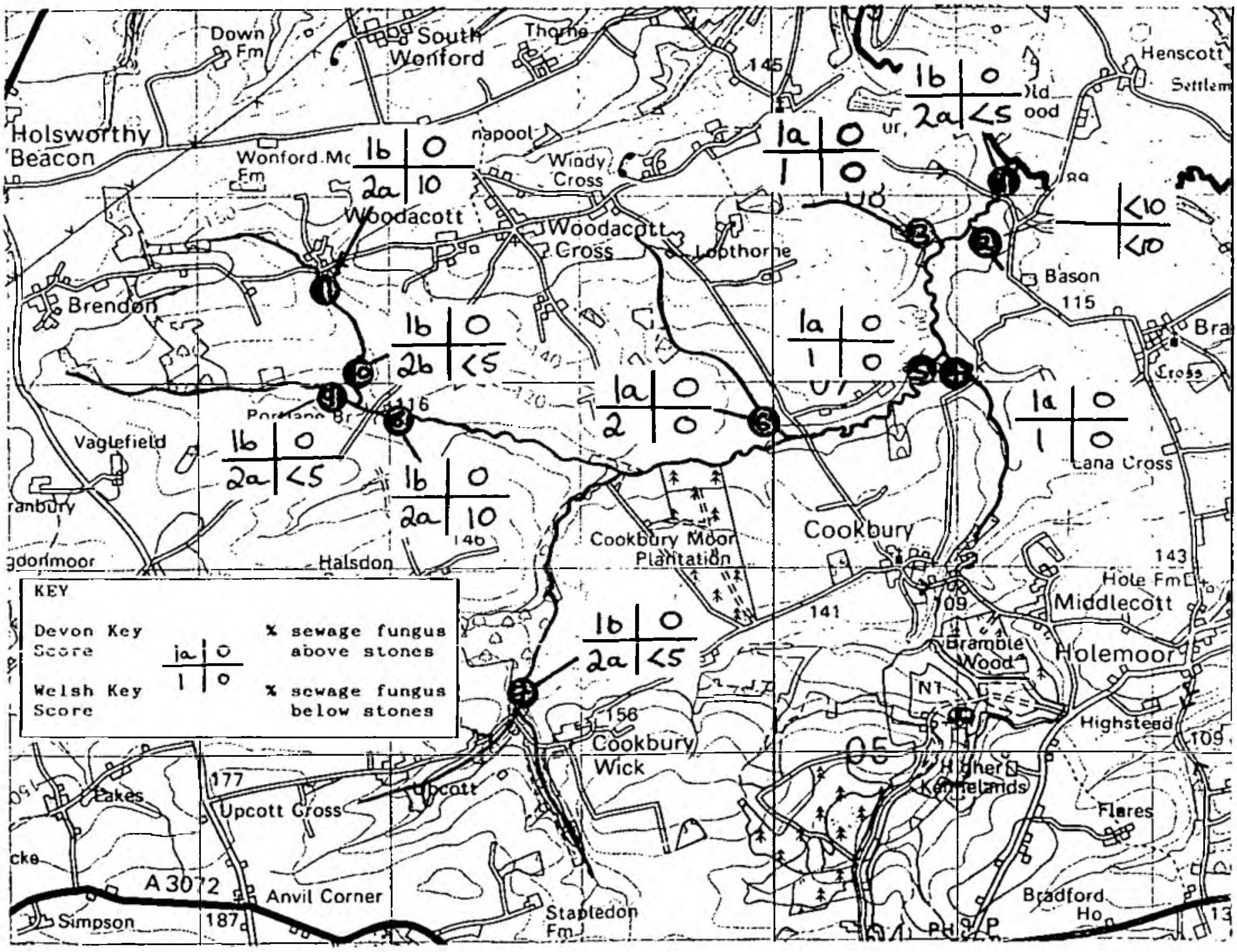

Figure 4. Map of the Cookbury Stream showing Rapid Biological Assessment Key sites and results.

The presence of traces of Carchaesium at site 1, the lowest site, may be caused by inputs from a farm drain (Site 2). This drain was too small to contain the representative invertebrate taxa but a 5-10% cover of Carchaesium was found above and below stones. Similarly at site 11 a 10% cover of Carchaesium, below the stones, was observed within 50m of a beef cattle overwintering barn. The invertebrate quality at this site was however good.

Hookmoor Brook

As in the Cookbury Stream, invertebrates scored highly at all of the sites in the Hookmoor Brook (Figure 5). Three ditches (Sites 2,7,9) running directly from farms however contained Carchaesium and approximately 50% sewage fungus cover was observed at Site 9. In each case samples from the main channel immediately downstream of the ditches showed that water from the ditches had no discernable impact on the Brook. This indicates that the quantities of organic material carried in the ditches were small and were diluted at the confluence of the main channel.

Medland Brook

Small quantities of Carchaesium were found at all sites on the Medland however as in the other study catchments the invertebrate population was good. All sites were classified as 1b/2a indicating minor organic enrichment.

NRA Routine Biological Monitoring of the study catchments

The lowest site on each catchment in this study (Sites 1 in Figures 3-5) were also NRA routine biological monitoring sites. These had been sampled in detail in April, June and September 1991 and the results have been analysed in relation to the NRAs Ecological Quality Index (EQI) and Biological Classification.

These classifications are based on the observed and predicted (RIVPACS II) Biological Monitoring Working Party Score (BMWP), number of taxa, and average score per taxon (ASPT). The predicted taxa list is compared with an aggregated taxa list from analysis of the three seasonal samples from each site.

The Environmental Quality Index (Scottish Office 1992) is derived by dividing the observed value for each of the three scores by their predicted values. The EQIs indicate the degree to which, over an annual period, a given site supports its expected range of macro-invertebrate taxa. The NRA Biological Classification uses EQI values derive four classes of biological quality (Table 3) graded from good to very poor. A site is classified by the ASPT EQI if that is the lowest of the three EQIs or by the modal class of all three EQIs if the ASPT EQI is not the lowest.

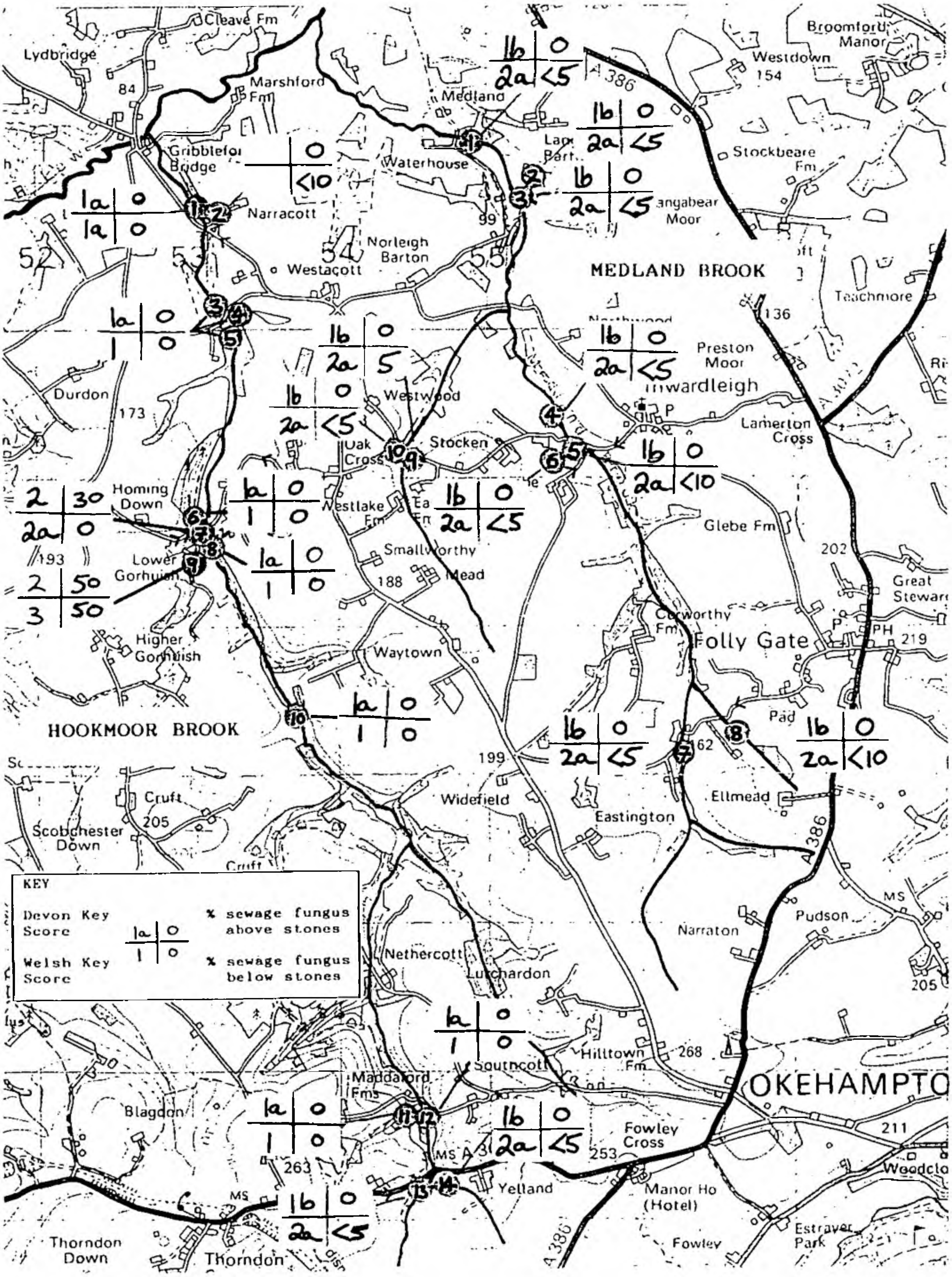

Figure 5. Map of the Hookmoor Brook and Medland Brook showing Rapid Biological Assessment Key sites and results.

Table 3. NRA Biological Classification

	A GOOD	B MODERATE	C POOR	D V.POOR
EQI BMWP	≥ 0.75	0.50-0.74	0.25-0.49	≤ 0.24
EQI taxa nos	≥ 0.79	0.58-0.78	0.37-0.57	≤ 0.36
EQI ASPT	≥ 0.89	0.77-0.88	0.66-0.76	≤ 0.65

The EQIs and Biological Classes for each study catchment are shown in Table 4.

Table 4. Environmental Quality Scores (EQIs) and Biological Classes derived for sites at the foot of each study catchment.

COOKBURY STREAM

	OBSERVED	PREDICTED	EQI	CLASS
BMWP	196	220.9	0.89	A
No. TAXA	31	34.6	0.90	A
ASPT	6.32	6.4	0.99	A

HOOKMOOR BROOK

	OBSERVED	PREDICTED	EQI	CLASS
BMWP	237	214.8	1.10	A
No. TAXA	35	33.4	1.05	A
ASPT	6.77	6.4	1.06	A

MEDLAND BROOK

	OBSERVED	PREDICTED	EQI	CLASS
BMWP	182	211.4	0.86	A
No. TAXA	28	33	0.85	A
ASPT	6.5	6.4	1.02	A

RIVER EAST OKEMENT

	OBSERVED	PREDICTED	EQI	CLASS
BMWP	191	175.5	1.09	A
No. TAXA	27	27.2	0.99	A
ASPT	7.07	7.02	1.01	A

All four sites were classified as Class A (good) for each of the three scores, showing that the observed macro-invertebrate population is very similar to that predicted by RIVPACS and indicating these are not subject to chronic organic pollution.

4. Discussion

Both the Welsh and Devon RBAKs gave similar results, with most sites in the intensively farmed study catchments (Cookbury, Hookmoor and Medland) being classified as 1b (mild organic input) using the Devon Key and 2a (mild organic input) using the Welsh Key. With the exception of one tributary, the River East Okement was classified as being unpolluted.

The presence of only small quantities of sewage fungus, mainly confined to the underside of stones, does not indicate the presence of chronic organic discharges affecting the watercourses. Farm ditches were highlighted as a source of organic input, however the evidence from sampling immediately downstream of their confluences showed that these were heavily diluted by main channel flows. Thus it appears that waste management within these farms was preventing chronic pollution but, as might reasonable be expected, some organic material did enter the farm drainage systems.

Sewage fungus normally comprises a community of many different micro-organisms extending downstream from a discharge, however in this survey only one species, the protozoa Carchaesium polypinum, was widespread. This stalked, colonial protozoa is normally found in areas of relatively high oxygen concentration at the lower end of sewage fungus zones, feeding on the bacteria present in organic effluent (Mason 1981). Its presence in small quantities in these streams was therefore indicative of a relatively low supply of prey bacteria.

5. DRAFT CONCLUSIONS

* There was no indication of gross organic pollution within the main channels of the study catchments.

* The small quantities of sewage fungus found at sites in the Cookbury Stream, Medland Brook and Hookmoor Brook and one site on the River E.Okement indicated a low level of organic input to these catchments.

* Farm ditches contained sewage fungus however, their effect on the main watercourses is minimised by dilution.

* The quality of the invertebrate fauna in the study catchments was high and there was little evidence of any impacts on the fauna.

6. DRAFT RECOMMENDATIONS

* This investigation supports the view that the education and enforcement policy initiated with the Torridge Farm Campaign has been effective in removing or reducing point sources of organic pollution from farms.

  Farm Campaigning should be used in catchments where point source agricultural pollution from farms is suspected to be contributing to declines in water quality and fish stocks.

* The RBAK system should be included as part of Farm Campaign programmes as it is easily applied by non-specialist biologists and indicates the actual impact of discharges on watercourses.

* Specific training in the macroscopic and microscopic identification of sewage fungus is essential for staff involved in farm campaigning and the application of RBAK.

* More detailed biological sampling by trained biologists should be applied where resources permit. This would allow watercourses to be compared with the routine biological monitoring data base being established by the NRA.

References

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21st August 1992

Dear Chris

TORRIDGE PROJECT DATA REPORTS

Please find enclosed the first of the Data Reports I am preparing in advance of the 12th October Steering Group Meeting.

This document reports the results of the use of the Rapid Biological Assessment Key (winter) for identifying organic farm pollution in the Study Catchments.

The exercise is currently being repeated using a 'Summer' Key and will be reported in due course. In addition the NRA SW Biology Section is undertaking a review of all historical Torridge invertebrate survey data on my behalf. This will assist in clarifying historical changes in water quality and provide an overview of current biological quality throughout Torridge, using the extensive survey data collected by the NRA since 1990.

FUTURE DATA REPORTS

I am working on a number of data reports covering two main areas; the results of the Project Work Programme and the production of clear definitions of 'the observed deterioration in both salmonid populations and water quality' (see Project Overall Objectives).

Individual reports will cover:

a) Project Work Programme

- Water Quality
- Land Use
- Juvenile Salmon Bioassay
- Egg Bioassay
- Juvenile Salmonid Surveys

Pesticides
Application of Rapid Biological Appraisal Keys

b) Observed Deterioration in Salmonid Populations and Water Quality

Rod & Net Catches
Spawning Distribution
Juvenile Salmonid Surveys
Water Quality
Biological Quality

INTERIM REPORT 1991/92

Jon Gulson will shortly be sending you a corrected bound copy of the Interim Report submitted at the last Steering Group Meeting.

PROGRESS - Field Work

Electric Fishing

The summer electric fishing survey has been finished this week, completing the study of temporal changes in wild stock density.

Stocking experiment on the Cookbury Stream

600 fed salmon fry (adipose fin clipped) were released in the Cookbury Stream in April (5 m-2). Sampling in July showed that these fish had dispersed upstream and downstream and that survival has been high. Sixty nine were recaptured in an 80 m section covering the release site whilst two sections 0.5 km above and below this point yielded 3 and 1 fish respectively. At each site small numbers of trout parr were taken but trout fry and non-stocked salmon were absent. The area is to be resurveyed in the autumn by the NRA.

Pesticide sampling

Sampling for pesticide residues is being undertaken using the facilities of the NRA SW Region Laboratory. Water samples are being screened for chemicals using a mass spectrometer. Samples of eels have been obtained in the course of electric fishing surveys and are to be analysed for pesticide residues.

External R & D

a) Land use change 1952 to date:

This report is due to be completed by the end of August.

b) Changes in sediment loading:

I have consulted the Geography Department of Exeter University regarding the studies on the R.Exe. The data that has been collected is however not suitable for the determination of trends in sediment loading. Consequently this external R&D work has not been commissioned.

I have therefore pursued this avenue through published literature and relevant work being undertaken by the NRA SW Region.
The River Tamar (adjacent to the Torridge) is currently the subject of an NRA SW Region in house research project, following a recent downgrading of parts of it to NWC Class 3, due to high suspended solid loadings.

Yours ye. Iain

Iain Naismith