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A biological investigation
of the effects of
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A BIOLOGICAL INVESTIGATION OF THE AFFECTS OF DISCHARGES FROM MELDON QUARRY
ON THE WEST OKEMENT RIVER - 8/09/89 AND 20/09/89

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SUMMARY

5 sites on the West Okement and Okement rivers were sampled before and after drought of 1989 broke. The discharge of Meldon Quarry stream was found to cause a severe reduction in both numbers and diversity of the aquatic fauna before and after the drought broke. There is no evidence that severe acid conditions occurred at any of the other sites investigated.

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INTRODUCTION

A biological investigation of the effects of acidic flushes in the West Okement and Okement rivers was requested by the Water Quality Planner (B.Milford). These rivers had previously been subject to acidic metal-rich flushes following rainfall at the end of long drought periods.

METHODS

Samples were taken using a 3 minute kick method with a 1.0 mm mesh pond net. Samples were taken in a riffle area at each site and preserved on site with formaldehyde. The initial samples were taken on the 8/9/89 while the river was still experiencing drought conditions. The drought broke on the 13/9/89 and further survey was carried out on the 20/9/89. The samples were sent up to Queen Mary College, London where they were sorted and identified by the Centre for Research in Aquatic Biology (CRAB).

RESULTS

Macroinvertebrate sampling sites are shown in figure 1. A more detailed map of the West Okement sites is given in figure 2. Species of macroinvertebrates obtained during both surveys is shown in tables 1 (8/9/89) and 2 (20/9/89).

DISCUSSION

Site 1 - West Okement downstream of Meldon Viaduct

This site was located just below Meldon Viaduct (NGR SX56439240) above any of the main quarry discharges. The substrate was found to be clear of any iron deposits and consisted mainly of cobbles/pebbles with some gravel and silt. The river was shallow, fast flowing and clear. Sampling on the 8/9/89, while the river was still in drought conditions, produced a typical moorland macroinvertebrate fauna with moderate numbers of Baetis rhodani, Ecdyonurus sp., Perlodes microcephala, Dinocras cephalotes, Rhyacophila dorsalis and Lumbriculidae. None of the taxa indicated severe acid conditions. Sampling on the 20/9/89, 7 days after spate conditions, found no great changes in numbers or diversity.

Site 2 - West Okement upstream of Meldon Quarry pipe

This site was located about 100 metres above the Quarry pipe (NGR SX56489383). Substrate and flow conditions were as for site 1. Sampling on the 8/9/89 revealed a broadly similar macroinvertebrate fauna to site 1. Leuctra fusca and Hydropsyche siltalai were the only common taxa found which were absent from site 1. Sampling on the 20/9/89 found a reduction in species but no great effect on numbers. However as many of the taxa found are known to be sensitive to very acid conditions it would be more probable that the spate rather than acidity was responsible for the observed changes.

Site 3 - West Okement downstream of Meldon Quarry pipe

This site was located about 30 metres downstream of the Quarry pipe and about 30 metres above the road drain which carries the Meldon Quarry stream discharge (NGR SX56489399). Substrate was similar to site 1 except for a heavy deposition of iron together with some algae. Sampling on the

8/9/89 revealed a similar fauna to site 1. Several acid sensitive taxa such as Baetis rhodani and Ecdyonurus sp. were found in moderate numbers. Resampling on the 20/9/89 revealed a slight drop in numbers of species although Baetis rhodani was still present. There is no significant indication that severe acid problems occurred here. Slight effects are indicated but this is more likely to be due to the substrate conditions.

Site 4 - West Okement downstream of Meldon Quarry stream

This site was located 200 metres below the A30 road bridge (NGR SX56599321) approximately 800 metres below site 1. Between these two sites both the Quarry effluent pipe and drainage from the A30 road bridge enter the river. The substrate and flow conditions were similar to site 1 except large deposits of iron from the Quarry effluent pipe were infilling the substrate. Some algae was present found amongst the deposits. Sampling on the 8/9/89 found low numbers of Lumbriculidae only. Resampling on the 20/9/89 found single examples of Leuctra fusca, Lumbriculidae and Glossoscolecidae. On this occasion most of the iron deposition had been flushed from the site by the higher flows. The entry of the two effluents had a marked effect on the macroinvertebrate fauna before and after the breaking of the drought. As a consequence little change occurred immediately below the inputs as an impoverished invertebrate fauna already existed.

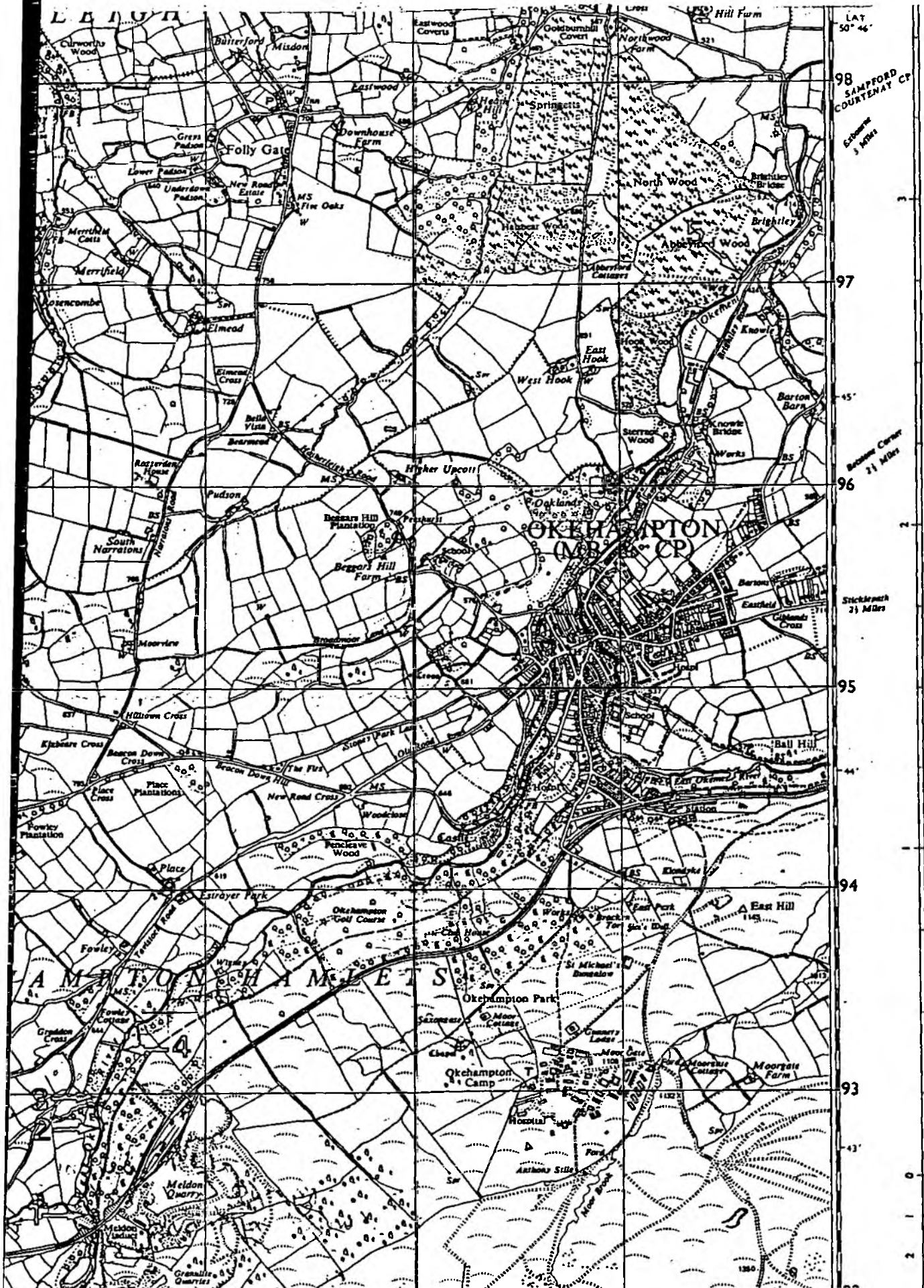
Site 5 - Okement upstream of Brightley stream

This site is located 100 metres upstream of the entry point of the Brightley stream into the Okement river. The substrate was found to be similar to site 1 with the addition of some areas of bedrock. No deposits of iron were apparent on the substrate but thick growths of algae were found in the pools and slack areas. The macroinvertebrate fauna on the 8/09/89 was similar to that found at sites 1 and 2. Resampling on the 20/09/89 found little change except several of the taxa were present in lower numbers. There was no significant indication of severe acid conditions at this site.

CONCLUSIONS

1. The entry of the Meldon Quarry pipe between sites 2 and 3 had no major impact on the macroinvertebrate fauna. Although a large amount of iron had been deposited on the stream bed downstream of the tunnel there was no evidence that severe acid conditions had occurred downstream of the discharge pipe.
2. The entry of the Meldon Quarry stream between sites 3 and 4 was found to cause a severe reduction in both numbers and the diversity of the macroinvertebrate fauna. This effect was present before the drought broke. No effect of the breaking of the drought could be detected at this site as a very poor fauna already existed.
3. The river Okement prior to the Brightley stream produced a similar fauna to that recorded above the discharges from Meldon Quarry. There was no evidence to suggest severe acid conditions had occurred at this site either before or after the drought broke.

FIGURE 1. MACROINVERTEBRATE SAMPLING SITES ON THE WEST OKEMENT AND OKEMENT RIVERS



SITES

- SITE 1 - WEST OKEMENT DOWNSTREAM OF MELDON VIADUCT (SX56409240)
- SITE 2 - WEST OKEMENT UPSTREAM OF MELDON QUARRY PIPE (SX56409280)
- SITE 3 - WEST OKEMENT DOWNSTREAM OF MELDON QUARRY PIPE (SX56509290)
- SITE 4 - WEST OKEMENT DOWNSTREAM OF MELDON QUARRY STREAM (SX5660932)
- SITE 5 - OKEMENT UPSTREAM OF BRIGHTLEY STREAM (SX59609710)

FIGURE 2. MACROINVERTEBRATE SAMPLING SITES ON THE WEST OKEMENT SHOWING POSITION IN RELATION TO MELDON QUARRY DISCHARGES

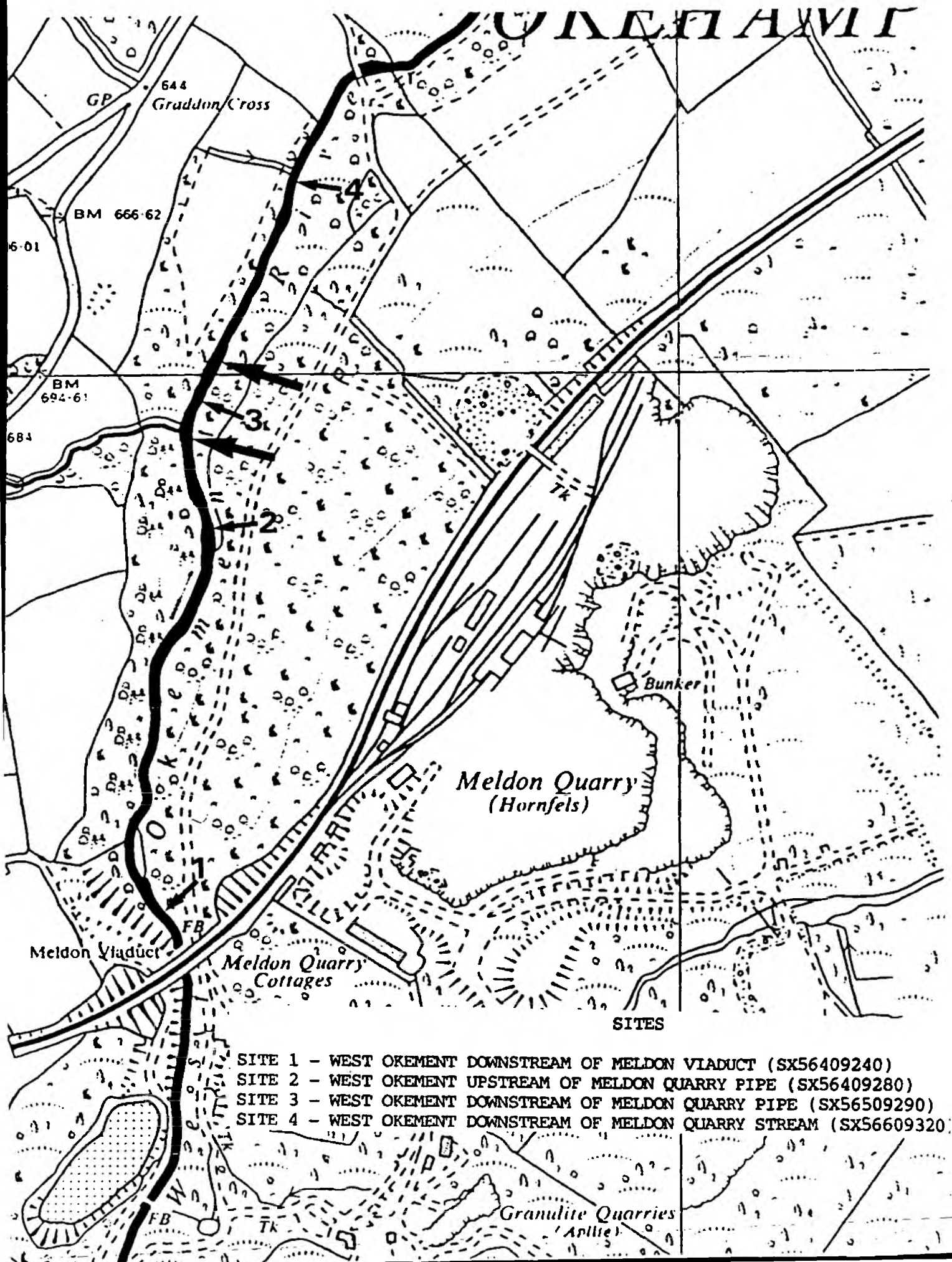


TABLE 1. MACROINVERTEBRATE RAW DATA - 8/09/89

SITE NUMBER (SEE MAP)	1	2	3	4	5
SAMPLING OFFICER	TRG	TRG	TRG	TRG	TRG
DATE SAMPLED	8/9/89	8/9/89	8/9/89	8/9/89	8/9/89
IDENTIFYING OFFICER	CRAB	CRAB	CRAB	CRAB	CRAB

1 = 1, 2 = 2-10, 3 = 11-100, 4 = 101-1000, 5 = 1000+

HEMEROPTERA					
BAETIDAE					
Baetis rhodani	2	3	3		2
EPHEMERELLIDAE					
Ephemerella ignita		1			
HEPTAGENIIDAE					
Ecdyonurus sp.	2	3	1		3
LEPTOPHLEBIIDAE					
Paraleptophlebia cincta					2
ECOPTERA					
LEUCTRIDAE					
Leuctra fusca		3	3		3
PERLIDAE					
Dinocras cephalotes	2	1			
PERLODIDAE					
Perlodes microcephala	2	2	2		1
TRICHOPTERA					
GLOSSOSOMATIDAE					
Glossosoma sp.					1
HYDROPSYCHIDAE					
Hydropsyche pellucidula					
Hydropsyche siltalai		2			3
LIMNAPHILIDAE					
POLYCENTROPIDAE					
Plectrocnemia geniculata					
Polycentropus flavomaculatus	1	2	2		
RHYACOPHILIDAE					
Rhyacophila dorsalis	3	2	2		1
OLEOPTERA					
ELMIDAE					
Limnius volckmari					2
GYRINIDAE					
Orectochilus villosus		1	2		
DIPTERA					
ATHERICIDAE					
Atherix sp.		2			
CERATOPOGONIDAE					
Forcipomyia sp.					2
CHIRONOMIDAE					
	2	2	2		2
SIMULIIDAE					
		3			2
TIPULIDAE					
Dicranota sp.					
ACARI					
LIMNOCARIDAE					
CRUSTACEA					
ASELLIDAE					
Asellus aquaticus					
GAMMARIDAE					
Gammarus pulex					2
MOLUSCA					
OLIGOCHAETA					
GLOSSOSCOLECIDAE					
	1	2			
LUMBRICULIDAE					
	2	3	2	2	3
MOLLUSCA					
ANCYLIDAE					
Ancylus fluviatilis					
LYMNAEIDAE					
Lymnaea peregra					2
PLATYHELMINTHES					
PLANARIIDAE					
TOTAL NUMBER OF TAXA	9	15	9	1	15

TABLE 2. MACROINVERTEBRATE RAW DATA - 20/09/89

SITE NUMBER (SEE MAP)	1	2	3	4	5
SAMPLING OFFICER	TRG	TRG	TRG	TRG	TRG
DATE SAMPLED	20/9/89	20/9/89	20/9/89	20/9/89	20/9/89
IDENTIFYING OFFICER	CRAB	CRAB	CRAB	CRAB	CRAB

1 = 1, 2 = 2-10, 3 = 11-100, 4 = 101-1000, 5 = 1000+

HEMEROPTERA

BAETIDAE

Baetis rhodani 2 2 2 1

EPHEMERELLIDAE

Ephemerella ignita

HEPTAGENIIDAE

Ecdyonurus sp. 2 2 2

LEPTOPHLEBIIDAE

Paraleptophlebia cincta

ECOPTERA

LEUCTRIDAE

Leuctra fusca 2 2 2 1 2

PERLIDAE

Dinocras cephalotes 2

PERLODIDAE

Perlodes microcephala 2 2 1

TRICHOPTERA

GLOSSOSOMATIDAE

Glossosoma sp. 2

HYDROPSYCHIDAE

Hydropsyche pellucidula

Hydropsyche siltalai 1 1

LIMNAPHILIDAE

POLYCENTROPIDAE

Plectrocnemia geniculata 1

Polycentropus flavomaculatus 1 2 2

RHYACOPHILIDAE

Rhyacophila dorsalis 2 2

COLEOPTERA

ELMIDAE

Limnius volckmari

GYRINIDAE

Orectochilus villosus 1

DIPTERA

ATHERICIDAE

Atherix sp. 1 2

CERATOPOGONIDAE

Forcipomyia sp. 2 2 1

CHIRONOMIDAE

SIMULIIDAE

TIPULIDAE

Dicranota sp. 2 1

ACARI

LIMNOCARIDAE

1

CRUSTACEA

ASELLIDAE

Asellus aquaticus 1

GAMMARIDAE

Gammarus pulex

OLIGOCHETA

GLOSSOSCOLECIDAE

1 1 1 3

LUMBRICULIDAE

1 2 1 3

MOLLUSCA

ANCYLIDAE

Ancylus fluviatilis 1

LYMNAEIDAE

Lymnaea peregra 2

PLATYHELMINTHES

PLANARIIDAE

2

TOTAL NUMBER OF TAXA

11 10 6 3 14