Interim Report R&D Project 424

Occurrence of Cryptosporidium oocysts in river water

WRc plc

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R&D 424/5/T

OCCURRENCE OF CRYPTOSPORIDIUM OOCYSTS IN RIVER WATER

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EXECUTIVE SUMMARY

During Spring 1993 the lower reaches of four subcatchments of the River Torridge together with the upper, mid and lower reaches of the main river were sampled on three occasions. Comparisons of the levels of Cryptosporidium oocysts observed were made with water quality analyses made at the same time and data from automatic recording stations. No correlations between oocysts and other parameters were established although there was a possible relationship between presence of oocysts and recent animal pollution or storm events.

This study will continue after discussions between the participants has taken place to determine the future programme.

KEY WORDS

Cryptosporidia, surface waters, pollution

1. INTRODUCTION

Cryptosporidia, an intestinal protozoan parasite, has only been recognised as a pathogen of animals and humans during the last decade. In humans cryptosporidiosis usually takes the form of an acute self-limiting diarrhoea, but in the immuno-suppressed the disease may be far more serious. The disease is widespread in farmed animals. Infected animals, and humans excrete large numbers of oocysts, the environmentally resistant form, during the course of the disease. Thus it is likely that agricultural pollution incidents, land run-off or sewage effluents may contaminate surface waters. The size and nature of the oocyst, which is resistant to disinfection give the potential for small numbers to pass through treatment systems and enter potable water supplies.

The recommendations of the group of experts under the chairmanship of Sir John Badenoch, set up by the Government following the waterborne outbreak in Swindon and Oxfordshire in 1989 included (Recommendation 4) "Research should be undertaken to determine the levels of oocysts occurring in different types of water sources in the UK including groundwater and to seek to determine the origin of these oocysts" (Department of the Environment and Department of Health 1990).

The National Cryptosporidium Survey, funded in part by the NRA, as R&D Project 151, has addressed the occurrence of oocysts in surface waters and groundwaters in relation to the presence of oocysts in potable waters (Miller and Carrington 1992; National Cryptosporidium Survey Group 1992). This current study will provide the link between farming practices and the occurrence of oocysts in surface waters. The choice of sites and methodology used has been described in the earlier interim report (Report 424/2/T). The scope of the study has subsequently been extended to attempt to determine any relationship between levels of oocysts and water quality parameters, particularly particle size distribution.

Liaison has been established and will be maintained with the Institute for Grassland and Environmental Research (IGER) who are main contractors for a MAFF funded study which is investigating the portioning, between the liquid and solid fractions of farm wastes, of a number of pathogens including cryptosporidia.

2. EXTENSION OF THE STUDY

A study by Le Chevelier *et al.* (1991) suggested a possible correlation between the presence of oocysts and particle size distribution. Arising from a meeting between NRA, WRc, Drinking Water Inspectorate (DWI), IGER and South West Water Ltd, DWI agreed to fund particle size distribution analyses on water samples collected at the time of sampling for Cryptosporidia together with other analyses of water quality. These arrangements were in place for the second and third sampling exercises (29 March and 5 May 1993). DWI would also fund additional sampling in the Dalton Stream area on up to two occasions in the event of South Western NRA identifying a pollution incident or cases of cryptosporidiosis in animals occurring in that subcatchment being identified to or by IGER.

3. SAMPLING SITES

3.1 Water samples

The rationale for choosing the sites and the site descriptions were outlined in the previous interim report (424/2/T). These are shown as circles on Figure 3.1. They are:

Site 1.	Torridge at Gidcott Mill	Grid Reference 422094
Site 2.	R. Walden at Thornbury	Grid Reference 415080
Site 3.	R. Torridge at Sheepwash	Grid Reference 486057
Site 4.	R. Lew at Strawbridge	Grid Reference 533054
Site 5.	R. Okement at Week	Grid Reference 467058
Site 6.	Dalton Stream at Leekshill	Grid Reference 560117
Site 7.	R. Torridge at Town Mills, Torridge	Grid Reference 499184.

In the event of an incident in the Dalton Stream area, samples would be taken at Sites 6 and 7 and at Site 6a, River Torridge at New Bridge (Grid Reference 548112).

3.2 Flow measurement

River flow measurements are taken at each site at the time of sampling and South Western NRA has made available data from automatic monitoring stations. The location of these are indicated on Figure 3.1 as triangles. They are numbered in relation to the water sampling points as follows:

Site 3.	Torridge at Rockhay Bridge	Grid Reference 506069
Site 5b.	R. Okement at Jacobstone	Grid Reference 591019
Site 7.	R. Torridge at Torrington	Grid Reference 499184

3.3 Rainfall measurements

Data from a number of rainfall gauges has been made available. Their location is indicated on Figure 3.1 by squares and they are numbered in relation to the water sampling points as follows:

Site 2.	North Trew Farm, Highampton	Grid Reference 474042
Site 5a	Okehampton Pleasure Gardens	Grid Reference 610015
Site 5c	West Park, Iddlesleigh	Grid Reference 563080
Site 7a	Torridge Vale Sewage Works	Grid Reference 482191
Site 8	Hallsannery, Bideford	Grid Reference 457246

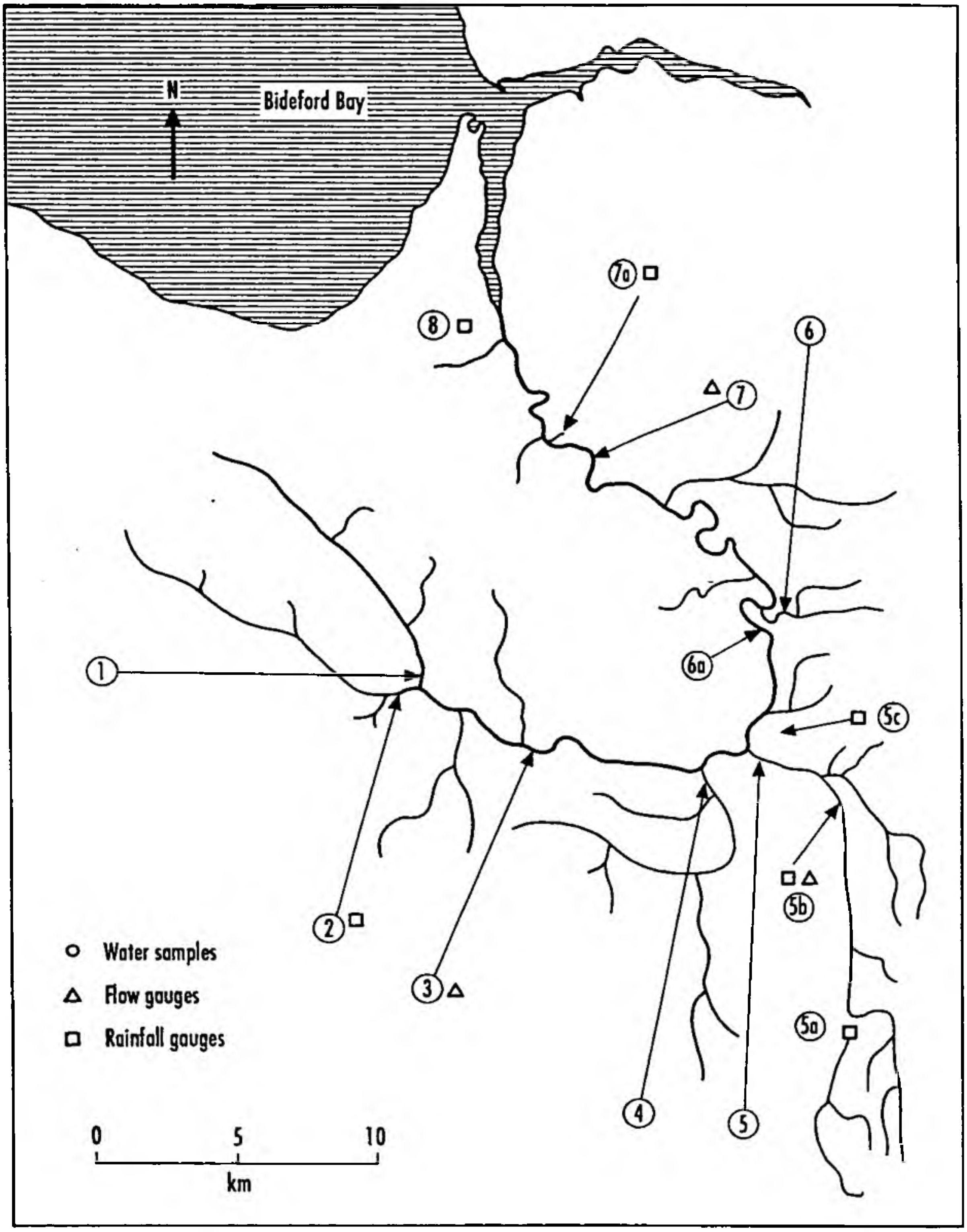


Figure 3.1 Torridge catchment showing sampling points

4. ANALYSES

4.1 Water sampling

The sampling for cryptosporidia is carried out on behalf of WRc by Hallsannery Field Centre (HFC) using techniques based on those proposed by the Standing Committee of Analysts (SCA) (1990). The arguments for using these techniques were presented in Report 424/2/T. The samples are despatched by overnight courier to WRc where the filters are processed and cryptosporidia oocysts identified and enumerated by techniques proposed by SCA.

4.2 Water quality measurements

The determinands and the operators carrying out the tests are listed in Table 4.1. South Western NRA have provided data for conductivity, dissolved oxygen, temperature, pH, turbidity and ammonia from their automatic monitoring stations at Sheepwash, Grid Reference 487057 (Site 3) and Cockshilhay, (Grid Reference 497183), Torrington.

4.3 Particle size distribution analyses

Le Chevelier and his colleagues (1991) suggested that a relationship may exist between the presence of oocysts and the pattern of distribution of particle sizes within the water body. Consequently, these analyses were made on the March and May samplings. The water supply company originally approached to carry the analyses was, at a late stage, unable to complete the arrangements. The March samples were examined at University College, London using an Elzone 280 PC particle counter fitted with a 38 μm orifice tube. May samples were examined by WRc using Kratel Portoscope Model F.

4.4 Quality assurance of examination for oocysts

As a quality assurance check on each occasion, the filter from Site 7 was quartered and opposite corners processed and examined independently by two technicians.

Table 4.1 Physical, chemical and microbiological examinations

Determinand	Operator
<u>Physical</u>	
River flow	Hallsannery Field Centre and automatic stations
Rainfall	Automatic stations
Temperature	Hallsannery Field Centre and automatic stations
Turbidity	NRA Exeter and automatic stations
Colour	NRA Exeter
Particle Size Distribution	WRc or University College London
Suspended Solids	NRA Exeter
Conductivity	Automatic stations
<u>Chemical</u>	
pH	NRA Exeter and automatic stations
Dissolved Oxygen	Hallsannery Field Centre and automatic stations
BOD	NRA Exeter
COD	NRA Exeter
Total Organic Carbon	NRA Exeter
Ammonia	NRA Exeter and automatic stations
Total Oxidise Nitrogen	NRA Exeter
Nitrate	NRA Exeter
Nitrite	NRA Exeter
Chlorides	NRA Exeter
Ortho Phosphate	NRA Exeter
<u>Microbiological</u>	
Cryptosporidium	WRc
Total Viable Bacteria	NRA Exeter
Faecal Streptococci	NRA Exeter
Coliform Bacteria	NRA Exeter
E. coli	NRA Exeter

5. RESULTS

5.1 Levels of oocysts

Sampling exercises were carried out on 25 February, 29 March and 5 May. During the February exercise samples of approximately 100 l were taken over a period of 60-90 min. A high level of debris in the samples reduced the sensitivity of the examination for cryptosporidia. Consequently, during subsequent exercises the sample size was increased to approximately 400 l taken over a 90-min period. The results are presented in Table 5.1 and are also shown graphically and geographically in Figure 5.1.

Table 5.1 Levels of oocysts observed in the Torridge catchment expressed as oocysts l^{-1}

	Sampling Date		
	25 Feb	29 Mar	5 May
Site 1*	4.69	0.11	ND (<0.07)
Site 2	ND (<0.36)	1.14	0.23
Site 3	ND (<5.36)	0.11	ND (<0.05)
Site 4	3.75	0.20	ND (<0.09)
Site 5	ND (<1.79)	0.10	0.41
Site 6	ND (<1.14)	0.71	ND (<0.93)
Site 7**	5.56	1.33	0.17
	2.28	0.40	ND (<0.27)

ND Not detected, figures in brackets indicate levels equivalent to the detection of one oocyst

* See Section 3.1 and Figure 3.1 for details of sites

** Two sets of figures represent duplicate analysis

5.2 Relationship between oocysts and observations at time of sampling

At the time of sampling, staff from Hallsannery Field Centre also measure the river flow, temperature and dissolved oxygen as well as making a visual assessment of the site.

The data is shown graphically, together with levels of oocysts, in Figure 5.2 The river flow measurements are taken at the site of sampling. At Sites 1, 2, 4, 6 and 7 the highest levels of oocysts were recorded where animals had access or what appeared to be storm-run off was present. The highest levels of oocysts occurred during the storm conditions in February.

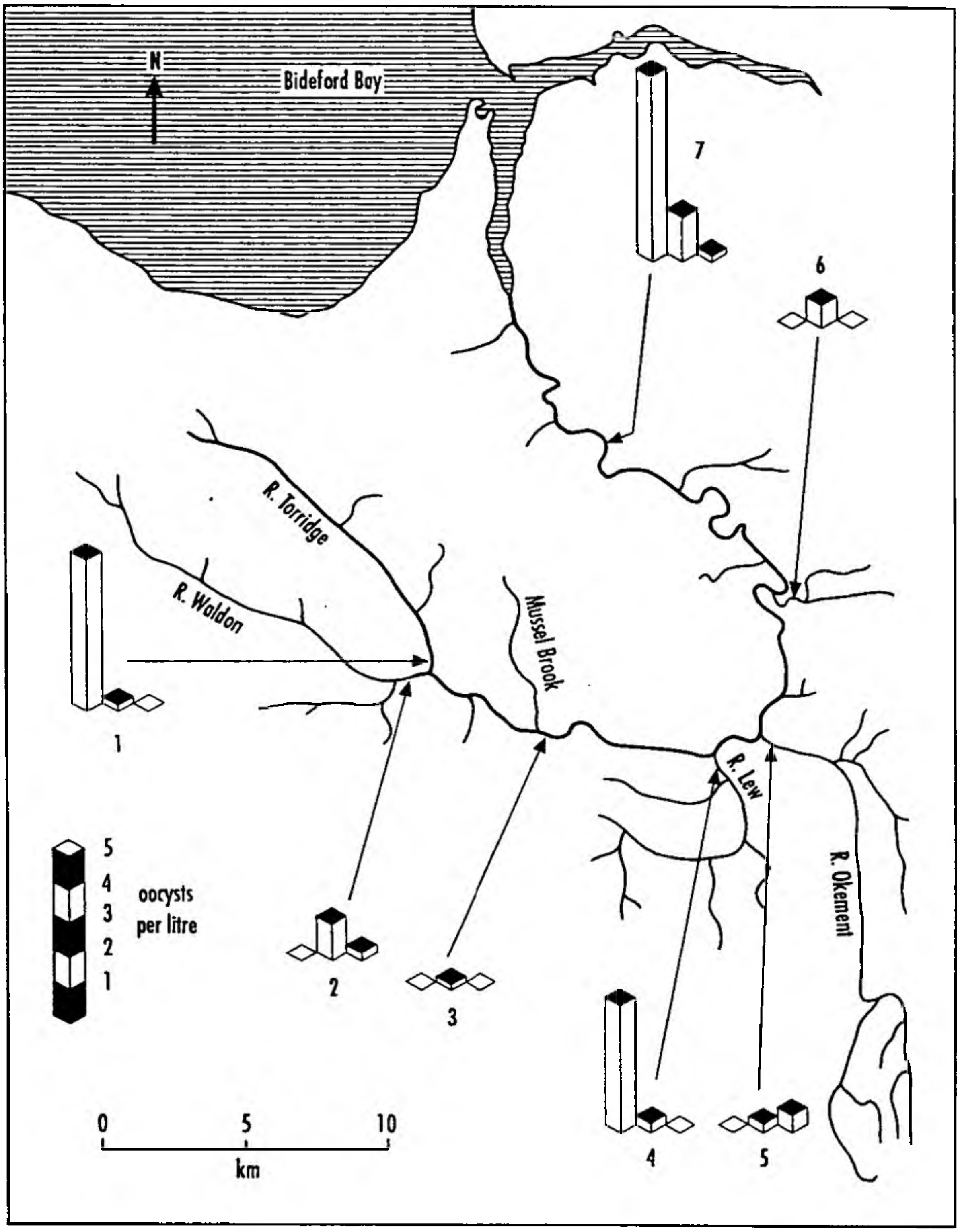


Figure 5.1 Levels of oocysts observed

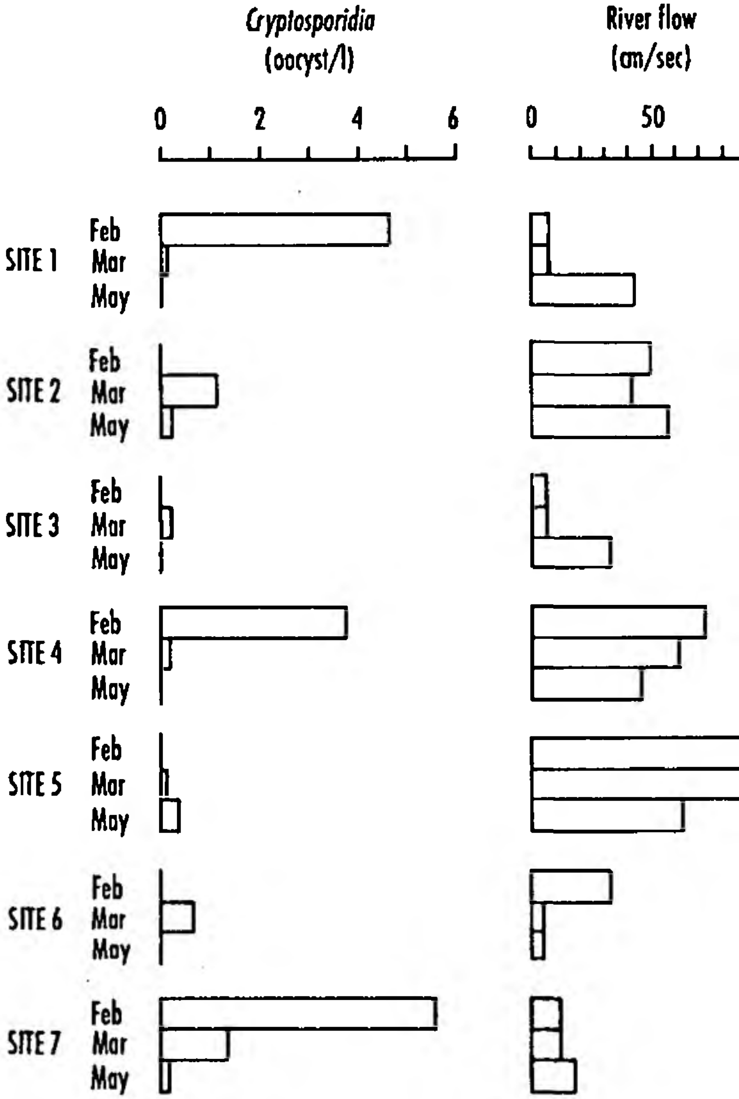
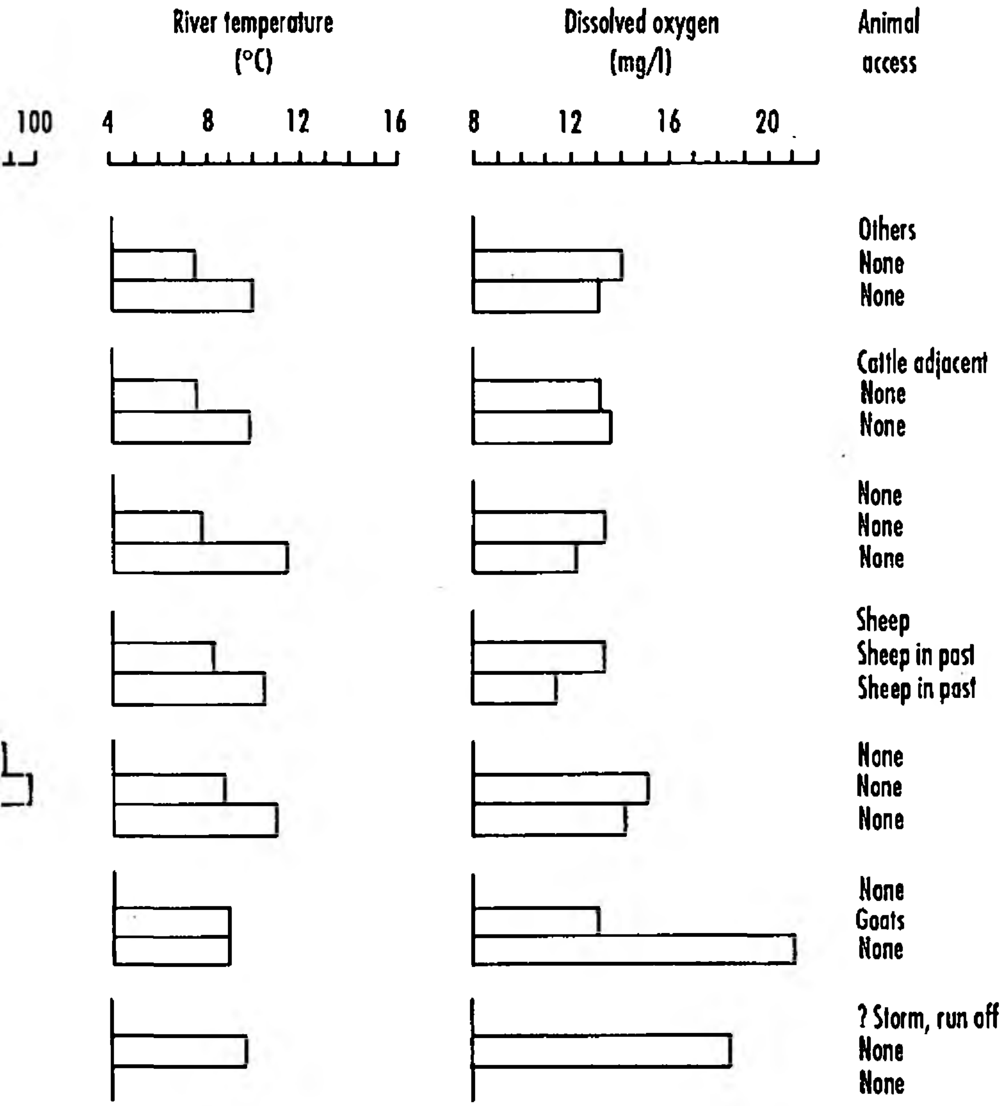


Figure 5.2 Observations at the time of sampling



River temperature
(°C)
Dissolved oxygen
(mg/l)
Animal
access
100
4
8
12
16
8
12
16
20
Others
None
None
Cattle adjacent
None
None
None
None
None
Sheep
Sheep in past
Sheep in past
None
None
None
None
Goats
None
? Storm, run off
None
None

5.3 Relationship between oocysts, rainfall and river flow

Data from the automatic river gauging stations and rainfall data for the period of seven days prior to and the morning after sampling is presented in Figure 5.3, together with the levels of oocysts.

The river reacts very quickly to rainfall. Compared to the long-term average rainfall, February was a very dry month with only about $^1/_3$ of the average rainfall. However, half the rainfall of the month fell on the 25th day of sampling. At both Sheepwash (Site 3) and Torrington (Site 7) the lowest daily mean flow for the month occurred on 24 February and the highest daily mean flow occurred on 26 February.

From Figure 5.3 it is apparent that there is a close relationship between rainfall and river flow and a strong suggestion of a relationship between levels of oocysts and river flow. However, Site 1, where a high level of oocysts was observed, sampling was initiated before the rain started. At Sites 2 and 3 no oocysts were observed although, because of difficulties with the timers on the sampling pumps, these sites were not sampled until late afternoon after considerable rain and the river flow was rapidly increasing. Site 7 was sampled between 1355 and 1455. The river at this point started rising at 1230. Lower levels of oocysts were observed during the March sampling but at more sites. The level of the river had changed little during the preceding 4 - 5 days. Very few oocysts were observed during the May sampling. This was preceded by a week with no rainfall and the river level was decreasing.

5.4 Relationship between oocysts and data from water quality monitoring stations

Measurements of conductivity, dissolved oxygen, pH, temperature, turbidity and ammonia are made every 30 minutes at two points on the River Torridge, Sheepwash (Site 3) and Cockshilhay, (upstream of Site 7). The maximum, minimum, average and Standard Deviation derived from the available data for the seven days prior to sampling and the day of sampling are listed in Table 5.2. Despite the differing flow patterns there is little difference for these between the periods examined. Occasional relatively high temperatures were observed lasting up to one hour but not at a consistent time of day. The possibility of a thermal discharge is being investigated.

A pH value of 10 was recorded at Cockshilhay during the March exercise. The possibility of a pollution slug has been considered but unfortunately at that time the ammonia probe at that site was not functioning.

5.5 Relationship between Cryptosporidia and water quality at the time of sampling

The results of the water quality analyses of samples taken at the time of sampling for cryptosporidia oocysts are shown in Table 5.2, together with the correlation between these results and the level of oocysts. No relationships were observed, however, the numbers of oocysts were low in March and irregular in May. It is a little surprising that the correlation between oocysts and faecal bacteria appears to have a negative slope.

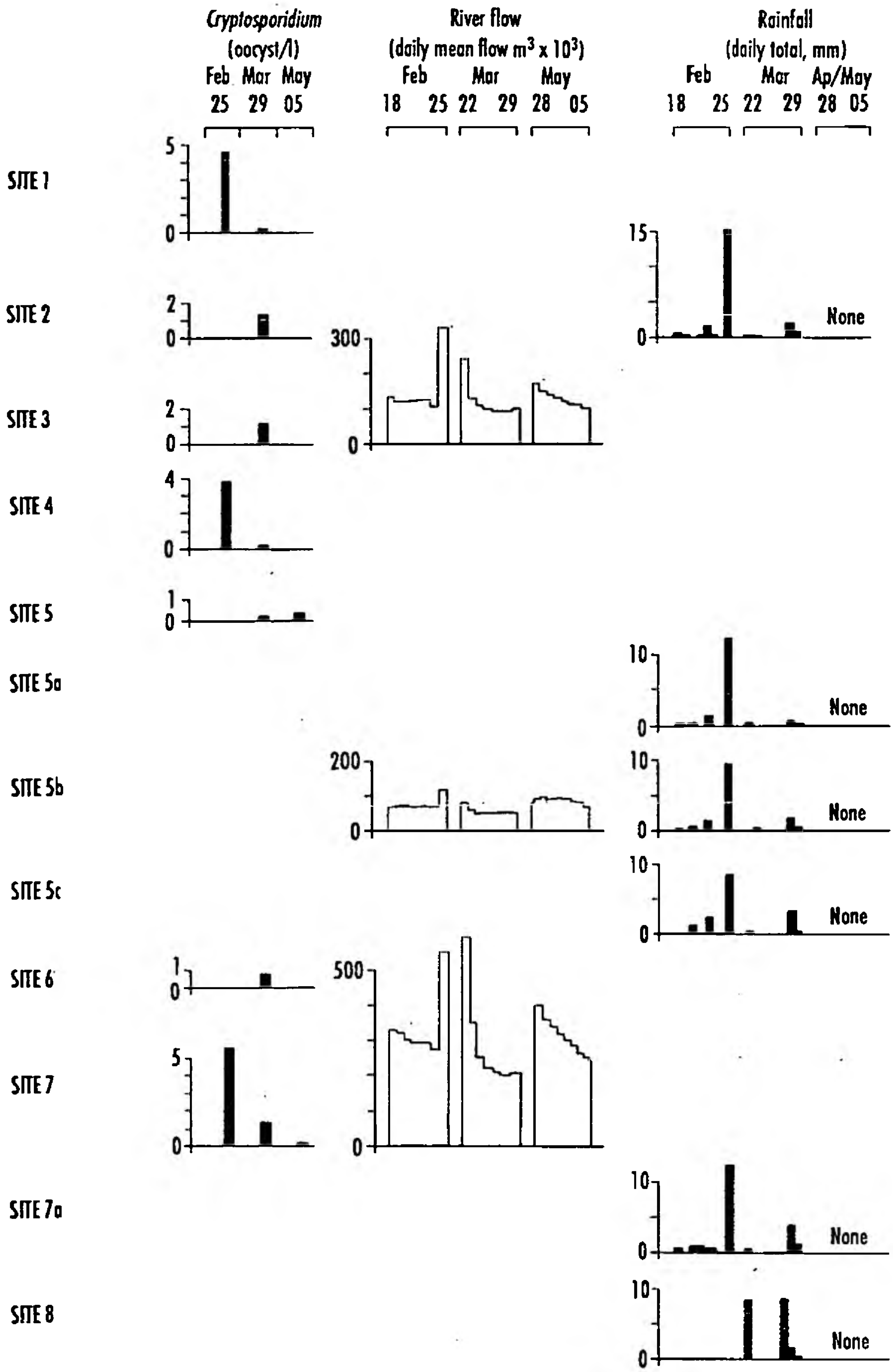


Figure 5.3 Levels of *Cryptosporidia*, river flow and rainfall

5.6 Relationship between oocysts and particle size distribution

The logarithm of the numbers of particles in bands of approximately 1 µm between 0.8 µm and 6 µm are shown in Table 5.3. The relationship between the numbers of particles in each band within a sample is similar for all samples, and in general, for each band size the difference between the highest and the lowest is only approximately 7-fold, however all samples had low levels of oocysts present ranging from 0.1 to 1.33 per litre.

The May samples were analysed to include larger sizes of particles. All samples were examined in 1 µm bands between 4 µm and 20 µm. These results are presented in Table 5.4. Some samples were also examined in 2 µm bands between 8 µm and 40 µm. The pattern of these results were similar to the smaller band width studies. The overall pattern is similar to the March samples. Oocysts were observed at low levels in three samples and not detected in four samples. There is no detectable relationship between the levels of oocysts and particle size distribution. The samples with the consistently highest and the lowest level of particles in all size bands both contained oocysts.

Table 5.2 Data from automatic water quality stations

	Conductivity US	Dissolved Oxygen % Saturation	pH	Temperature °C	Turbidity ftu	Ammonia mg l^{-1}
Cockshilhay 18 - 25 Feb 1993						
Maximum	180	107	7.8	9	8	0.0
Minimum	164	92	7.4	5	2	0.0
Average	175	97	7.6	7	5	0.0
SD	3	3	0.1	1	1	0.0
Sheepwash 18 - 25 Feb 1993						
Maximum	152	100	7.5	12	60	0.3
Minimum	136	88	7.2	4	8	0.0
Average	145	93	7.3	6	12	0.0
SD	4	2	0.1	1	5	0.0
Cockshilhay 22 - 29 Mar 1993						
Maximum	200	130	10.0	17	20	
Minimum	176	86	6.8	6	4	
Average	180	102	8.9	8	10	
SD	5	12	0.7	1	4	
Cockshilhay 26 Apr - 4 May 1993						
Maximum		125	8.5	20	12	0.8
Minimum		89	6.5	10	2	0.0
Average		104	7.4	13	5	0.2
SD		11	0.6	2	2	0.2
Sheepwash 4 - 5 May 1993						
Maximum	176	119	8.6	19	10	1.5
Minimum	160	53	6.8	10	2	0.0
Average	166	104	8.0	12	4	0.2
SD	5	11	0.6	1	2	0.3

Table 5.3 Results of water quality analyses

29 March 1993	Site 1	2	3	4	5	6	7	Correlation with Cryptosporidia
Cryptosporidia oocysts l^{-1}	0.11	1.14	0.11	0.2	0.1	0.71	1.33	
pH	7.2	7.5	7.7	7.7	8.6	7.9	9.6	0.48
Turbidity ftu	10	11	6	5	2	5	2	0.00
Colour	23	16	20	21	9	15	18	-0.12
BOD mg l^{-1}	1.3	1.3	1.4	1.6	3.1	1.1	2.7	0.07
Chemical Oxygen Demand mg l^{-1}	0	0	0	19	0	16	0	-0.12
Total Organic Carbon mg l^{-1}	2.5	2.3	2.8	3.9	1.8	2.8	2.9	-0.02
Ammonia mg l^{-1} N	0.08	0.04	0	0	0.02	0.02	0	-0.15
Total Oxidised Nitrogen mg l^{-1} N	2.2	2.2	2	1.1	1.8	2.9	1.4	0.05
Nitrate mg l^{-1} N	2.18	2.19	1.99	1.09	1.79	2.87	1.39	0.06
Nitrite mg l^{-1} N	0.02	0.01	0.01	1.01	0.01	0.03	0.01	-0.27
Suspended Solids mg l^{-1}	5.7	36	3	2.1	0	3.4	0	0.45
Chloride Ion mg l^{-1} Cl	24	22	23	23	18	28	23	0.22
Orthophosphate mg l^{-1} P	0	0	0	0.06	0.11	0.19	0	-0.14
Colony Count 37 °C								
1 day No. ml	370	700	480	600	870	290	520	-0.05
Faecal Streptococci								
No. 100 ml	10	20	20	190	50	40	0	-0.37
Coliform bacteria								
No. 100 ml	3600	3500	7000	20000	47000	29000	80	-0.43
E. coli (presumptive)								
No. 100 ml	450	220	280	1800	450	450	0	-0.47

Table 5.3 Continued...../2

5 May 1993	Site 1	2	3	4	5	6	7	Correlation with Cryptosporidia
Cryptosporidia oocysts l^{-1}	0	0.23	0	0	0.41	0	0.17	
pH	7.4	7.7	8	7.8	7.7	7.7	8.4	0.09
Turbidity ftu	25	10	10	5	7	10	6	-0.35
Colour	19	14	17	18	9	11	13	-0.71
BOD mg l^{-1}	2.2	1.6	1.4	1.8	1.5	2.5	1.9	-0.49
Chemical Oxygen Demand mg l^{-1}	20	0	16	0	0	16	0	-0.66
Total Organic Carbon mg l^{-1}	3.2	2.6	2.9	3.3	1.8	3	2.6	-0.95
Ammonia mg l^{-1} N	0.02	0	0	0.02	0	0.04	0	-0.61
Total Oxidised Nitrogen mg l^{-1} N	2.4	2.6	2.3	1.2	1	3.3	1.5	-0.48
Nitrate mg l^{-1} N	2.38	2.58	2.29	1.18	0.99	3.27	1.49	-0.48
Nitrite mg l^{-1} N	0.02	0.02	0.01	0.02	0.01	0.03	0.01	-0.48
Suspended Solids mg l^{-1}	6	8.2	7.3	3.1	2.1	9.2	2.9	-0.45
Chloride Ion mg l^{-1} Cl	24	22	22	22	16	26	22	-0.83
Orthophosphate mg l^{-1} P	0	0	0	0.08	0.11	0.22	0	-0.03
Colony Count 37 °C 1 day No. ml	670	800	1170	2180	380	7200	340	-0.45
Faecal Streptococci No. 100 ml	30	150	70	60	10	110	0	-0.21
Coliform bacteria No. 100 ml	1700	3100	170	10000	1800	5300	190	-0.32
E. coli (presumptive) No. 100 ml	340	2800	1300	900	200	2400	20	-0.18

Table 5.4 Particle size distribution for March sampling*

Size range (µm)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Oocysts	0.11	1.14	0.11	0.2	0.1	0.71	1.33
0.8 - 1	6.43 (6.74)	6.42 (6.69)	6.11 (6.34)	5.91 (6.11)	6.26 (6.43)	6.31 (6.56)	6.52 (6.78)
1 - 2	6.42 (6.44)	6.33 (6.35)	5.93 (5.96)	5.67 (5.69)	5.91 (5.92)	6.19 (6.20)	6.41 (6.42)
2 - 3	4.90 (5.07)	4.77 (4.96)	4.69 (4.87)	4.24 (4.46)	4.19 (4.33)	4.37 (4.52)	4.71 (4.80)
3 - 4	4.26 (4.57)	4.21 (4.51)	4.16 (4.41)	3.72 (4.05)	3.37 (3.76)	3.62 (3.98)	3.92 (4.08)
4 - 5	3.95 (4.27)	3.87 (4.20)	3.76 (4.05)	3.49 (3.77)	3.07 (3.53)	3.37 (3.70)	3.29 (3.56)
5 - 6	3.89 (4.00)	3.75 (3.93)	3.50 (3.73)	3.28 (3.45)	3.21 (3.34)	3.28 (3.49)	3.13 (3.22)
6 -	3.64 (3.34)	3.44 (3.44)	3.34 (3.34)	2.95 (2.95)	2.77 (2.77)	3.07 (3.07)	2.48 (2.48)

* Particles expressed as logarithms of number/ml for indicated size range, figures in parenthesis indicate the cumulative number/ml in excess of that size. Oocysts are express as number/litre

Table 5.5 Particle size distribution for May sampling*

Size range (µm)	1
Oocysts	ND
4 - 5	5.12 (6.00)
5 - 6	5.04 (5.94)
6 - 7	4.57 (5.88)
7 - 8	4.91 (5.84)
8 - 9	4.81 (5.78)
9 - 10	4.64 (5.73)
10 - 11	4.70 (5.70)
11 - 12	4.56 (5.65)

Site					
2	3	4	5	6	7
0.23	ND	ND	0.41	ND	0.17
5.32	5.25	5.00	4.74	5.09	4.92
(6.10)	(6.03)	(5.66)	(5.44)	(5.80)	5.52)
5.29	5.20	4.87	4.65	4.96	4.81
(6.02)	(5.95)	(5.55)	(5.34)	(5.70)	(5.39)
5.07	5.01	4.62	4.31	4.71	4.52
(5.93)	(5.86)	(5.45)	(5.25)	(5.62)	(5.26)
5.09	5.08	4.58	4.44	4.71	4.54
(5.86)	(5.80)	(5.38)	(5.19)	(5.56)	(5.17)
5.00	4.92	4.44	4.23	4.57	4.35
(5.79)	(5.70)	(5.30)	(5.11)	(5.49)	(5.06)
4.81	4.74	4.28	4.07	4.45	4.07
(5.71)	(5.63)	(5.24)	(5.05)	(5.44)	(4.96)
4.88	4.82	4.36	4.13	4.41	4.12
(5.65)	(5.56)	(5.19)	(5.00)	(5.39)	(4.90)
4.68	4.57	4.15	3.90	4.24	3.88
(5.57)	(5.48)	(5.12)	(4.93)	(5.34)	(4.82)

Table 5.5 Continued...../2

Size range (μm)	1	2
12 - 13	4.61 (5.61)	4.70 (5.51)
13 - 14	4.49 (5.57)	4.49 (5.44)
14 - 15	4.44 (5.53)	4.53 (5.39)
15 - 16	4.35 (5.50)	4.37 (5.32)
16 - 17	4.37 (5.46)	4.36 (5.22)
17 - 18	4.34 (5.43)	4.28 (5.21)
18 - 19	4.38 (5.39)	4.23 (5.16)
19 - 20	4.20 (5.34)	4.18 (5.11)

Site 3	4	5	6	7
4.57 (5.42)	4.16 (5.07)	3.85 (4.89)	4.06 (5.26)	3.98 (4.77)
4.43 (5.35)	3.92 (5.01)	3.72 (4.85)	4.19 (5.23)	3.88 (4.69)
4.45 (5.30)	3.97 (4.98)	3.76 (4.82)	3.98 (5.19)	3.82 (4.62)
4.30 (5.23)	3.83 (4.93)	3.65 (4.78)	3.92 (5.16)	3.63 (4.54)
4.18 (5.18)	3.83 (4.89)	3.60 (4.74)	3.92 5.14)	3.33 (4.49)
4.17 (5.13)	3.70 (4.86)	3.63 (4.71)	3.97 (5.11)	3.40 (4.46)
4.10 (5.08)	3.62 (4.82)	3.56 (4.67)	4.00 (5.11)	3.56 (4.42)
4.02 (5.03)	3.59 (4.80)	3.71 (4.64)	3.84 (5.07)	3.44 (4.35)

Table 5.5 Continued...../3

Size range (μm)	Site 1	2	3	4	5	6	7
20 -	5.31 (5.31)	5.05 (505)	4.99 (4.98)	4.77 (4.77)	4.58 (4.58)	5.05 (5.05)	4.30 (4.30)

* Particles expressed as logarithms of number/ml for indicated size range, figures in brackets indicate cumulative number/ml in excess of that size. Oocysts are expressed as number/l

ND Indicates no oocysts detected at that site

6. SEASONAL OCCURRENCE OF CRYPTOSPORIDIOSIS IN CATTLE

Data has been obtained from the MAFF, Central Veterinary Laboratory of the numbers of herds in England and Wales with reported cryptosporidiosis each month for 1989-1992. This is summarised in Table 6.1. The pattern is similar for each year. A sharp increase between February and March peaking in April with a slight decline in May. A sharp drop in diagnoses is reported in June with the level then remaining steady until August. The levels increase slowly between September and December, with January and February being similar to December.

Table 6.1 Reported occurrence of cryptosporidiosis in cattle herds

Month	Year			
	1989	1990	1991	1992
January	87	85	89	69
February	73	72	103	95
March	144	114	140	148
April	167	123	165	212
May	104	96	84	142
June	28	37	34	61
July	29	25	30	40
August	26	31	32	36
September	54	33	38	49
October	55	74	57	52
November	70	84	70	112
December	90	86	76	85

7. DISCUSSION

During Spring 1993 the lower reaches of four subcatchments of the R. Torridge together with the upper, mid and lower reaches of the main river were sampled on three occasions for the presence of cryptosporidia oocysts. A total of 21 samples. At the same time a number of water quality analyses were made. Data is also available from automatic water quality monitoring stations, river flow gauges and rainfall gauges from the period prior to sampling.

Three of the four highest levels of oocysts were observed at sites where recent animal access was noted or storm sewage was observed. The three highest levels of oocysts were observed on days of heavy rain, but one was taken before a storm and before the river started rising. Some samples taken after the river had risen were reported as being below the limits of detection of oocysts.

Although US studies have suggested a relationship between particle size distribution and the presence of oocysts this was not observed in this study. Surprisingly, there appeared to be a negative relationship between the presence of oocysts and the levels of faecal bacteria.

Data supplied by MAFF shows that although there is a slight increase in the level of Cryptosporidiosis in cattle in the Autumn by far the highest number of incidents are reported in March, April and May.

These results were discussed at a meeting between WRc and NRA in July 1993. It was apparent that insufficient data had been collected to draw conclusions. A further meeting of the interested parties, NRA, WRc, DWI, IGER and South West Water was arranged for September to consider whether to continue with the study as planned and carry out three sampling exercises in Autumn 1993, or whether to postpone these until the Spring when oocysts are more likely to be present and produce data that will be comparable to that already accumulated. Consideration would also be given to means of increasing sampling frequency or duration by additional funding.

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