

Craig Goch Report No. 15

Macroinvertebrates of the River Wye

Sampling Strategy

Introduction

Except for a single summer survey in 1970 (Radcliffe 1977) no significant investigations of the invertebrate fauna of the R. Wye have been undertaken. The objectives of the present study are to determine a sampling strategy which will provide a description of the distribution and relative abundance of aquatic macroinvertebrates in the R. Wye and those tributaries associated with proposals to regulate flow in the river system. In addition to fulfilling basic biological objectives, such as the description of community diversity and the incidence of taxa of particular significance, because of their rarity or usefulness as 'indicator' species, such a strategy must take account of operational preferences. Such preferences will be governed by river flow, the availability of support staff and the temporal stability of macroinvertebrate communities. This report considers the efficiency and efficacy of the timing of general surveys in 1975 and 1976 and the usefulness of certain survey sites.

Methods and Sampling Sites

All benthic samples were collected from riffles using a cylinder sampler (area 0.05m²; net aperture 440m) modified after Neill (1938). Four cylinder samples were taken across the width of each riffle at several sites along the length of the R. Wye and two tributaries (Table 1, Fig. 1) in March and September 1975 and July and September 1976. In addition, at two sites in the upper reaches of the R. Wye samples were collected more frequently (as often as weekly in the summer months) during 1975 (W2 and W3) and 1976 (W2 and W5). Organisms were identified to a variety of taxonomic levels (E.g. species, species groups) which are referred to as taxa.

Results

Pooled collections from W2 and W5 (1976) always yielded more taxa than those from W2 and W3 (1975). The highest number of taxa collected on a single collection date in 1975 was in August (55 taxa) while in 1976 the highest number (71) was collected in both June and August. Comparison of different combinations of two sampling dates in 1975 indicate that the greatest number of taxa (69) were collected either in June/September or in August/August samples and generally a combination of two summer sampling dates yielded high numbers of taxa. In 1976 the April/September combination collected the greatest number of taxa (94): other combinations which yielded high numbers of taxa included April/July, April/August, July/September and August/September.

The four general surveys of the whole river system showed a similar spatial pattern with fewer taxa and lower macroinvertebrate densities in the upper catchment (W1-W5) compared with the lower reaches (W6-W13) (Table 2). The greatest number of organisms and taxa were collected in July 1976 (excluding D1 and D2, Tables 2 and 3). The 152 taxa collected at this time represented 76% of the total collected during all surveys and included 24 taxa unique to this collection. Fewest taxa, 85, were collected in March 1975

at a time when average densities were relatively low and when only 10 sites were sampled (Tables 2 and 3). A direct comparison between years was possible using the September data: 21 more taxa were collected from 13 sites (excluding D1 and D2) in September 1976 compared with September 1975 although the total density of organisms collected at sites was similar (Tables 2 and 3). Consideration of all survey data indicated that 65 taxa, of which 17 were Chironomidae, were found in 1976 but not in 1975.

The inclusion of sites D1 and D2 in surveys in 1976 added little to the information, in terms of taxa collected (Table 3).

Of the combinations of general surveys, July 1976 and September 1976 (excluding D1 and D2) collected the greatest number of taxa, 178, compared with the 141 taxa collected in March and September 1975 (Tables 2 and 3). These differences were reflected in the unique taxa collected by these sampling combinations, 60 in July 1976 and September 1976 and 23 in March 1975 and September 1975. Even if only 10 sites (W1-W10) are compared July and September 1976 still collected the greatest number of taxa (47) compared with the 125 collected in March and September 1975.

In general then from available survey data September samples are likely to collect more taxa than March samples but less than July samples. Furthermore, July or September samples are likely to contain more unique taxa than March samples and these taxa are generally more important numerically (Table 4).

The proportional representation of major groups at different sampling times indicated that, in general, the upper sites (W1-W6) were dominated in terms of density by Plecoptera in March 1975, with Ephemeroptera, Trichoptera and Diptera (Chironomidae) being relatively more abundant during the summer months (Table 5). The lower sites (W8-W13) were more variable with Oligochaeta, Ephemeroptera, Trichoptera, Coleoptera and Diptera (Chironomidae and Simuliidae) all being relatively abundant at certain sites and times. Generally the March 1975 survey was dominated by Plecoptera, September 1975 and 1976 by Trichoptera and July 1976 by Diptera (Chironomidae).

Cluster analyses, using the Jaccard similarity coefficient and average linkage sorting (UWIST 1976) indicated the variable nature of the spatial pattern of taxonomic assemblages at different sampling times (Fig. 2). In general tributary sites (W4, W7) were associated with nearby main river sites (Fig. 1) and except in September 1976, W1 was faunistically different from other sites. D2 (sampled only in 1976) and the adjacent site, W10, were always closely associated when both sites were sampled.

The spatial distribution of macroinvertebrates which develops principally during the winter, e.g. Plecoptera, was most fully described from the March survey (Fig 3). However, high flows at this time prevented any description of those taxa restricted to the lower reaches of the river.

Discussion

The present survey programme is intended to provide a description of the spatial distribution and relative abundance of aquatic invertebrates in the R. Wye and tributaries. The major part of this information is in terms of taxa or species-groups and the frequency and timing of sampling methods must be selected to optimise the collection of such

information. Preliminary analysis of data collected from key sites in 1975 suggested that the optimum combination of two sampling dates was July-September. Subsequent analysis of 1975 and 1976 data indicated great variability in the optimum sampling combination at two sites in the upper reaches though two summer sampling dates generally yielded high numbers of taxa. However, the issue is further complicated by the meteorological and hydrological conditions which were prevalent over the period of study.

Consideration of the general surveys undertaken indicates that notwithstanding the limited number of sites sampled in March 1975 (Table 1), only a small proportion (42%) of the total taxa of aquatic macroinvertebrates was collected during this month. Moreover, the practical difficulties of sampling the full length of a large river like the R. Wye are likely to be severe at this time and are likely to restrict description of fauna in the lower reaches (see Fig. 3). Further information collected at this time of the year is likely to be less relevant to the present strategy of summer regulation of the R. Wye than information collected later in the year. Intuitively, many biologists would consider that the composition of macro-invertebrate assemblages collected in March is likely to be more stable from year to year than summer collections because of the types of life cycle of many of the species involved. Such stability has not been established however.

For a single collection, a summer survey is generally likely to provide the greatest amount of information. However, the rapid turnover of benthic populations during the summer months makes the timing of any single survey critical. The problems associated with such lability are probably best overcome by undertaking two invertebrate surveys during the period June – September. The penalty for such additional data is the redundant information in the form of taxa common to both sampling dates (see Table 3). Sampling during this period is unlikely to be constrained by high flows, is of more direct relevance to the proposals to regulate the R. Wye during low flow conditions and allows the best use to be made of support staff.

The inclusion of sites D1 and D2 in July and September 1976 added little new information (2% in terms of taxa) to the description of the R. Wye. D2 is spatially and taxonomically close to W10 (Table 1, Fig. 3) and its inclusion in the survey was of little value. The location of D1, however, is strategically important in relation to possible regulation flows from the R. Elan and merits inclusion in future surveys.

Conclusions

1. General surveys of the R. Wye should be undertaken at two sampling dates during the summer period e.g. July and September.
2. If sampling is to be restricted to a single occasion July would probably be suitable although inter-year variation may be substantial because of rapid biological changes at this time of the year.
3. D1 should be retained as a sampling site but D2 should be omitted from future surveys.

References

Neill, R.M. (1938). The food and feeding of brown trout (*Salmo trutta* L.) in relation to the organic environment. *Trans. R. Soc. Edinburgh*. **59**, 481-520.

Radcliffe, D. (1977). A nature conservation review. **Vol. 2**. Site accounts. Cambridge University Press. 320pp.

UWIST (1976). Invertebrates: R. Wye. Craig Goch Field Surveys Group Meeting, Malvern. February, 1976. **UWIST Paper 4**.

Figures

Fig 1. Location of sampling sites in the Wye catchment.

Fig 2. Average linkage cluster of Jaccard Index, Wye catchment.

Fig 3. The distribution of major taxa (except Chironomidae) in the R. Wye

Table 1

Sampling Sites, Wye Catchment

Sites		Distance from source (km)	Sampling times			
			M	S ₁	J	S ₂
W1	Pant Mawr (SN 843827)	7	√	√	√	√
W2	Deep Pool (SN 921739)	20	√	√	√	√
W3	Rhayader (SN 961695)	34	√	√	√	√
W4	R. Elan (SN 939661)	-	√	√	√	√
D1	Llanwrthwl (SN 640796)		-	-	√	√
W5	Newbridge (SO 015582)	48	√	√	√	√
W6	Builth Wells (SO 043513)	60	√	√	√	√
W7	R. Irfon (SO 032510)	-	√	√	√	√
W8	Erwood (SO 115414)	70	√	√	√	√
W9	Glasbury (SO 180394)	85	√	√	√	√
D2	Boat Inn (SO 269473)		-	-	√	√
W10	Bredwardine (SO 336447)	117	√	√	√	√
W11	Ross (ST 588241)	183	√	√	√	√
W12	Symonds Yat (ST 508182)	202	√	√	√	√
W13	Redbrook (ST 535101)	220	√	√	√	√

M = March 1975

S₁ = September 1975

J = July 1976

S₂ = September 1976

Table 2

The number of taxa and estimated mean density (No/m²) of macroinvertebrates collected from the Wye catchment

Site	No. of Taxa				Mean density			
	M	S ₁	J	S ₂	M	S ₁	J	S ₂
W1	24	19	35	28	945	635	2445	1165
W2	22	39	42	32	1285	1895	3310	1195
W3	29	36	50	29	1360	1110	3030	655
W4	21	28	43	36	1710	935	2255	835
D1	-	-	57	42	-	-	5110	1685
W5	33	43	42	46	2730	1705	1700	3570
W6	37	42	63	51	4765	12035	15335	6495
W7	33	45	47	49	1940	8280	4685	9800
W8	36	41	67	58	3270	2995	7480	13385
W9	33	46	64	50	1460	4395	8635	8190
D2	-	-	43	58	-	-	9055	14315
W10	29	44	49	67	983	3645	5465	6115
W11	-	44	65	29	-	15660	9805	4870
W12	-	51	70	45	-	6355	22375	5075
W13	-	52	55	50	-	2830	3370	3390

M = March 1975

S₁ = September 1975

J = July 1976

S₂ = September 1976

Table 3

Numbers and proportions of taxa captured by various survey combinations.

Figures in parentheses exclude D1 and D2

	March* 1975	Sept 1975	July 1976	Sept 1976	Mar '75 & Sept '75	Mar '75 & Jul '76	Mar '75 & Sept '76	Sept '75 & Jul '76	Sep '75 & Sep '76	Sep '76 & Jul '76	Mar '75, Jul '76 & Sep '75	Mar '75, Jul '76 & Sep '76	Mar '75, Sep '75 & Sep '76	Sep '75, Jul '76 & Sep '76	All
No. of Taxa collected	85	123	156 (152)	145 (144)	141	172 (169)	162 (161)	175 (172)	168 (168)	181 (178)	186 (183)	192 (189)	177 (177)	196 (193)	204 (201)
% of total taxa	41.7	60.3	76.5	71.1	69.1	84.3	79.4	85.7	82.3	88.7	91.2	94.1	86.8	96.1	100
Number of unique taxa collected	8	12	27 (24)	18 (18)	23	36 (33)	29 (29)	42 (40)	32 (32)	63 (60)	59 (57)	81 (78)	48 (49)	119 (116)	-
Unique taxa as % of total collected	3.9	5.9	13.2	8.8	11.3	17.6	14.2	20.6	15.7	30.9	28.9	39.7	23.5	58.3	-
Taxa common to combinations of survey dates					68	69	70	104	100	119	63	64	62	97	60

* 10 sites only

Table 4

Numbers and densities (No./m²) of organisms and unique taxa collected during surveys. Figures in parentheses exclude D1 and D2

	Time of survey			
	March 1975*	Sept 1975	July 1976	Sept. 1976
Total number of organisms	20,463	68,110	104,230 (90,067)	80,755 (64,757)
Average density at all sites	2,046	5,239	6,949 (6,928)	5,384 (4,981)
Density of unique taxa	11	277	477	25
Contribution of unique taxa to total density %	0.5	5.3	6.9	0.4

* 10 sites only

Table 5
Proportional (% of total taxa) representation of macroinvertebrate fauna. R. Wye Catchment

Groups	Platyhelminthes				Oligochaeta				Hirudinea				Plecoptera				Ephemeroptera				Trichoptera				Coleoptera			
	Dates	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J
W1	4	<1	<1	17	3	3	5	12	0	0	0	0	40	5	15	36	0	3	36	13	0	9	0	5	2	<1	2	5
W2	19	2	<1	9	<1	2	13	14	0	0	0	0	61	4	6	2	11	30	30	47	3	34	6	5	2	3	14	6
W3	0	<1	<1	5	3	5	10	28	0	0	0	0	39	11	15	22	20	14	5	21	8	41	14	7	24	3	25	4
W4	3	3	3	1	11	34	17	18	2	2	<1	1	78	8	13	11	1	11	22	17	1	7	1	14	<1	0	<1	2
D1			3	4			12	18			<1	<1			19	12			20	24			2	10			13	7
W5	0	0	<1	2	9	21	17	20	<1	<1	<1	<1	23	9	35	6	43	8	15	6	8	21	4	35	5	6	9	8
W6	<1	0	0	0	16	6	<1	4	<1	1	0	<1	18	13	9	4	50	16	16	18	1	7	2	23	7	2	2	10
W7	<1	<1	0	<1	32	6	10	4	<1	0	<1	<1	6	9	28	<1	27	15	10	11	1	29	3	35	5	11	9	9
W8	<1	0	0	<1	16	9	6	6	<1	<1	<1	<1	6	5	8	1	32	21	19	38	4	31	24	27	18	20	11	10
W9	0	0	<1	0	9	6	6	4	<1	<1	0	<1	6	5	19	<1	69	19	11	16	2	35	32	42	5	11	8	19
D2			0	<1			17	3			5	2			7	<1			20	14			13	46			18	17
W10	0	1	4	5	15	35	14	27	1	1	<1	<1	5	4	16	2	28	28	23	27	7	6	5	3	19	7	20	11
W11		11	6	11		11	41	27		0	<1	1		<1	2	0		4	5	10		26	2	<1		13	13	44
W12		1	6	2		24	26	16		<1	<1	<1		<1	<1	0		5	2	<1		19	3	<1		27	3	10
W13		<1	2	0		7	7	36		4	1	2		<1	<1	0		14	11	3		17	2	3		13	11	35

M = March 1975
 S1 = September 1975
 J = July 1976
 S2 = September 1976

<1 = less than 1%
 Blank space = not sampled
 All % rounded

Crustacea				Chironomidae				Simuliidae				Mollusca				Others			
M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2	M	S1	J	S2
0	0	0	0	25	65	7	4	25	5	34	20	0	0	0	0	2	10	2	3
0	0	0	0	3	14	22	9	0	7	2	5	0	<1	<1	<1	1	5	7	3
0	0	0	0	2	15	22	11	0	1	0	2	0	<1	0	0	3	8	9	2
0	0	<1	0	3	25	29	40	0	1	2	3	0	0	0	0	2	9	2	3
		0	<1			21	7			<1	<1			2	10			8	8
0	0	0	0	10	22	10	14	0	<1	6	<1	0	12	4	5	4	<1	<1	2
0	0	0	0	5	16	23	23	<1	31	45	6	0	0	0	<1	1	<1	1	2
0	<1	3	1	13	11	30	7	5	3	3	6	0	0	<1	1	9	15	3	15
0	<1	0	<1	32	12	25	14	0	0	<1	<1	0	0	2	<1	1	2	3	2
0	<1	<1	0	5	16	9	12	0	3	7	2	0	4	7	3	4	<1	<1	<1
		3	<1			16	9			0	<1			<1	4			2	2
13	11	<1	<1	4	41	14	22	0	0	<1	0	0	2	<1	<1	7	<1	3	3
	7	2	<1		18	11	<1		26	17	0		3	1	6		4	<1	1
	<1	<1	<1		9	57	15		0	0	<1		9	1	4		5	2	1
	6	<1	<1		16	57	2		0	<1	0		16	2	14		8	6	<1

Figure 1

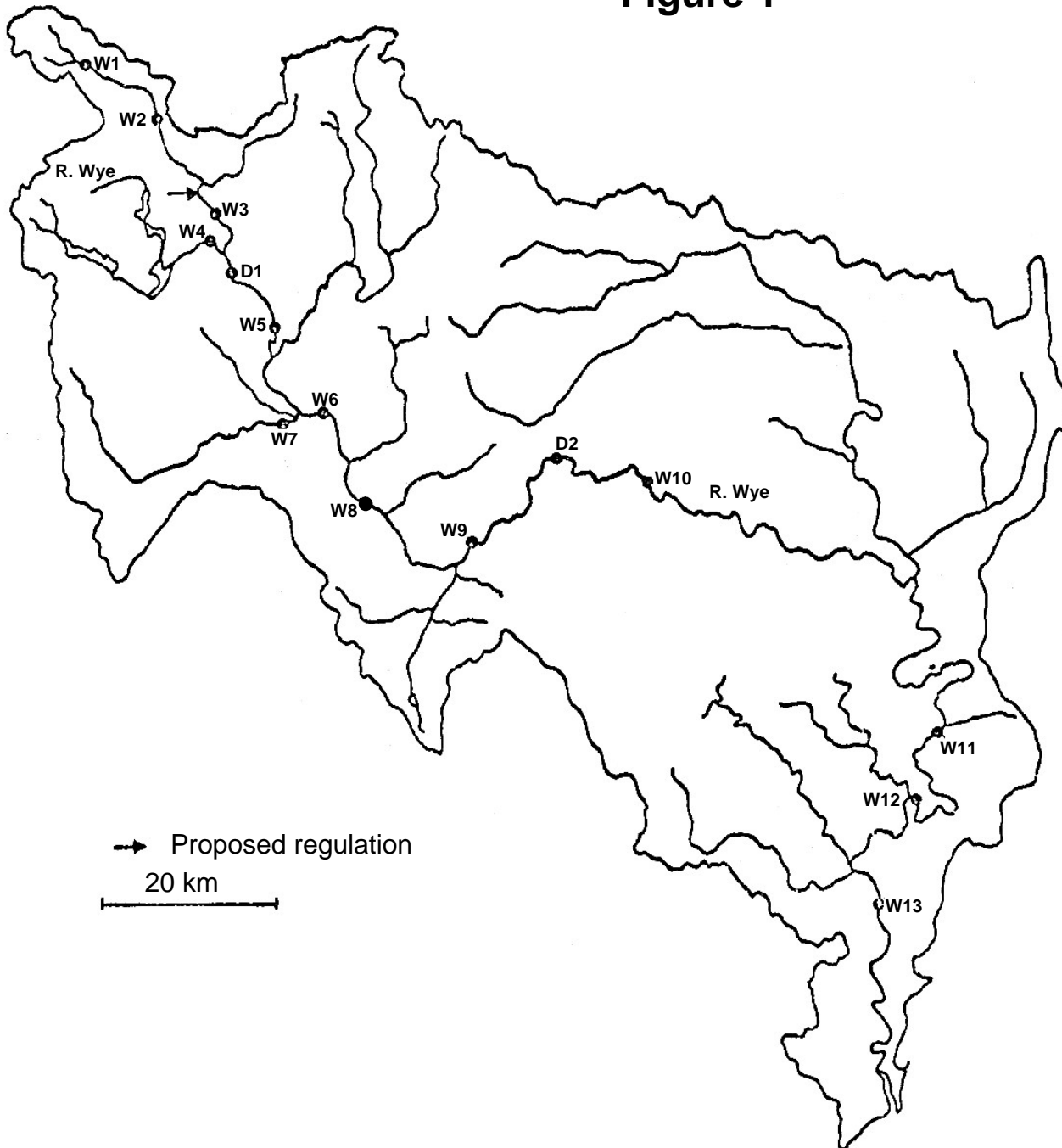
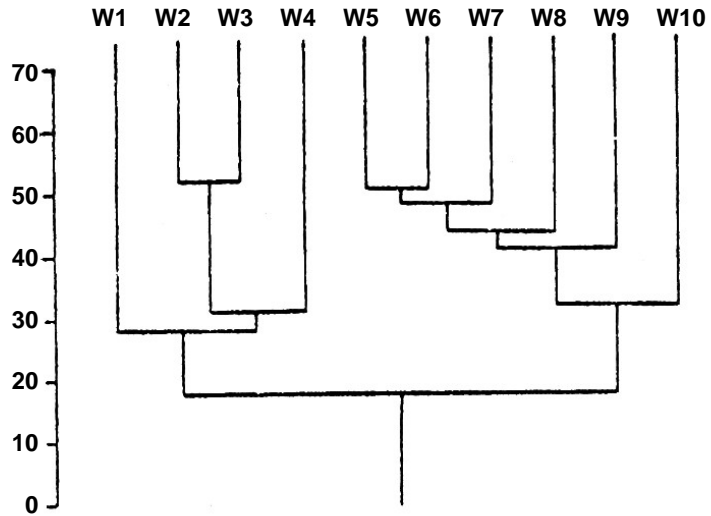
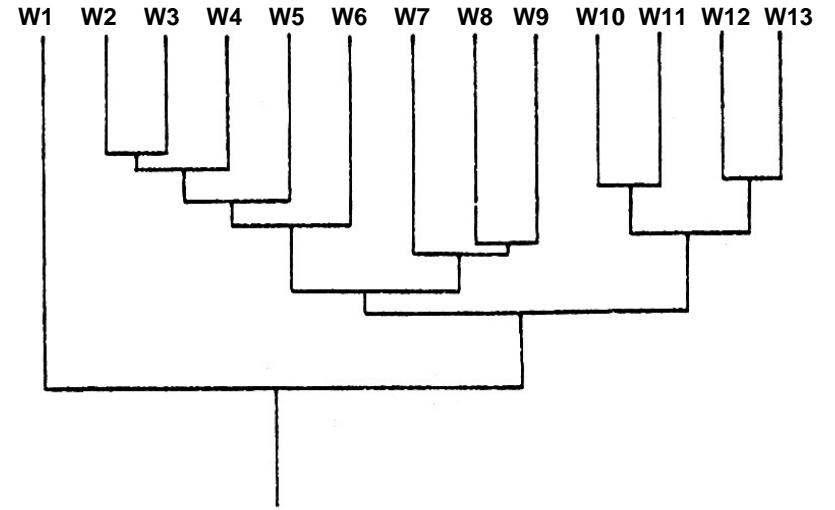


Figure 2

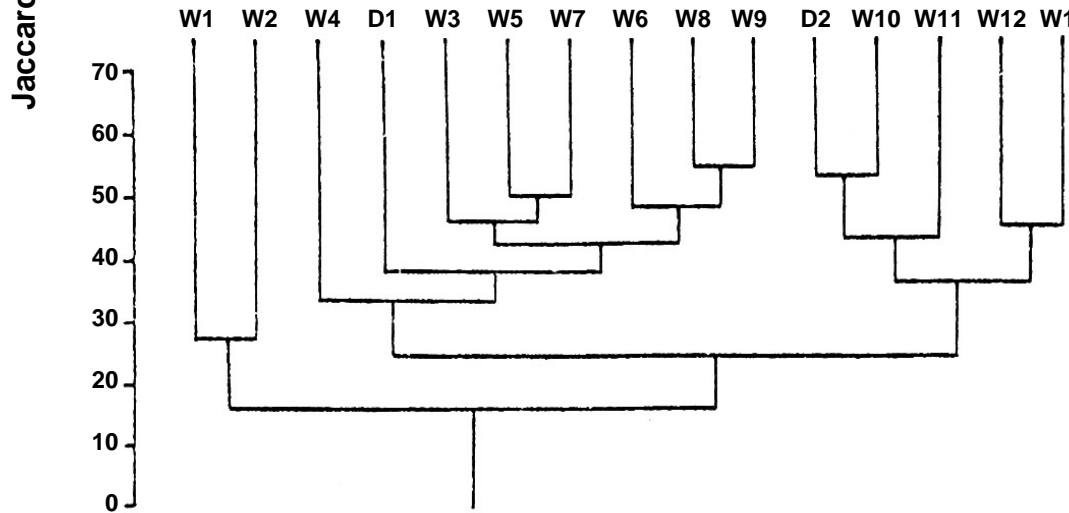
March 1975



September 1975



March 1976



September 1976

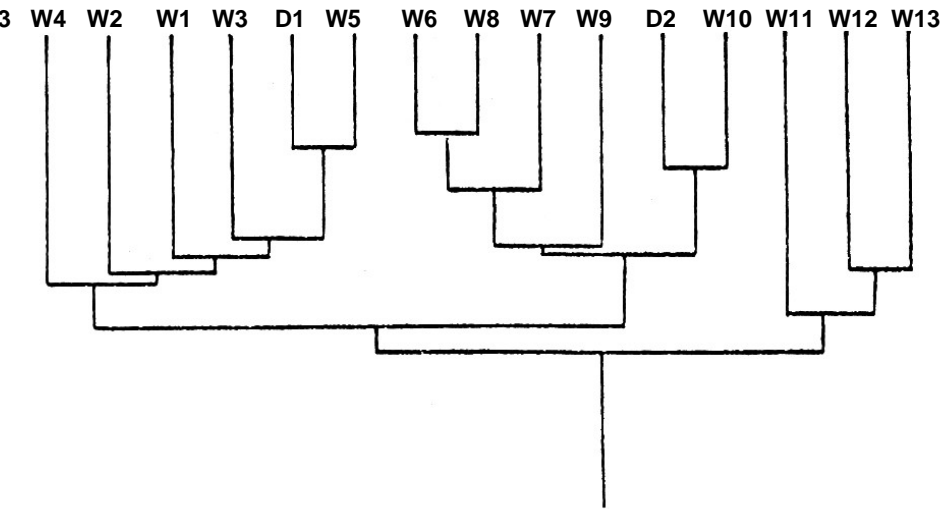
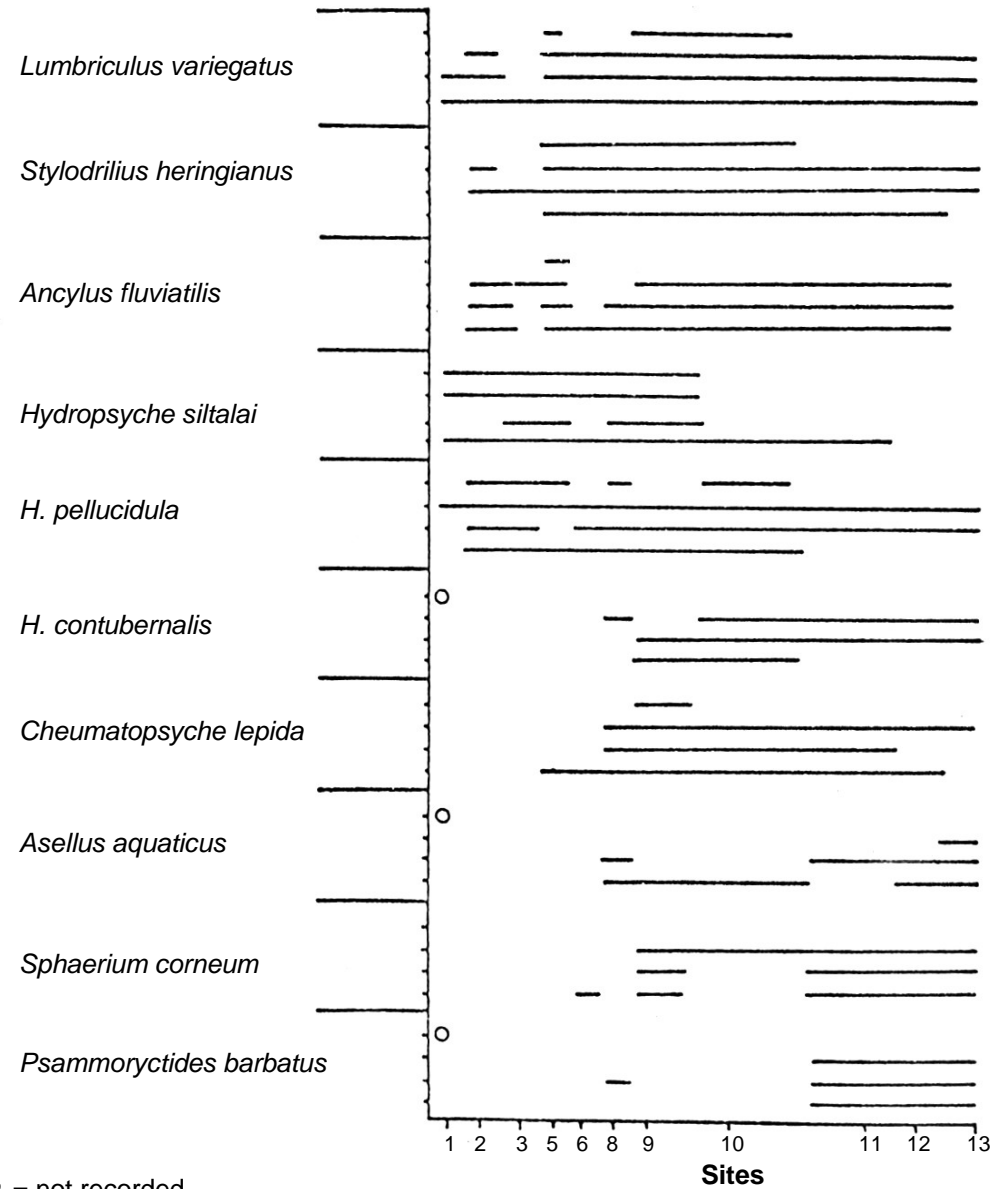
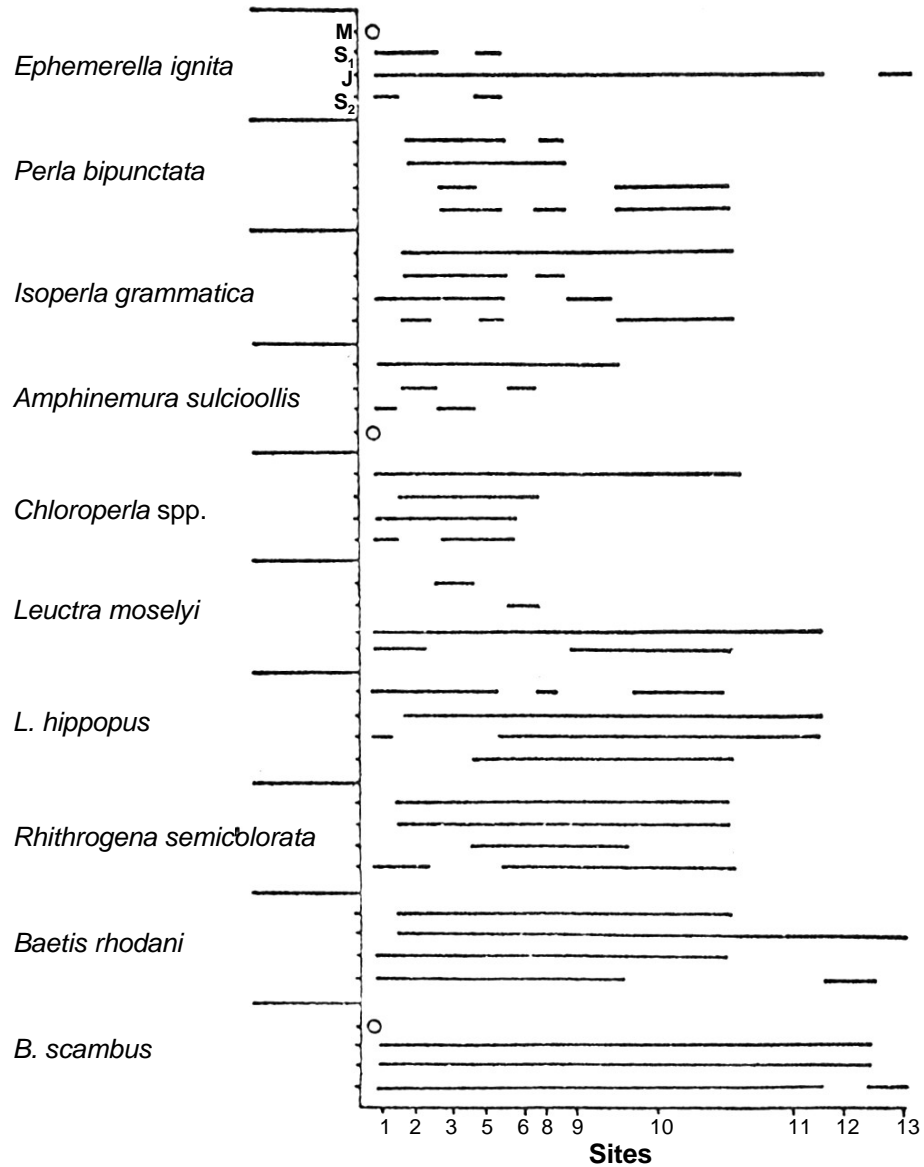


Figure 3



○ = not recorded