Fly Assemblages of Sandy Exposed Riverine Sediment

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Summary

This report describes surveys of flies at sandy exposed riverine sediment and forms part of a series of projects based on the flies included in the Biodiversity Action Plan.

Eighteen rivers in England, Wales and Scotland were selected for survey on the basis of their supporting populations of the BPS-listed *Spiriverpa lunulata*, *Cliorismia rustica* or *Rhabdomastix 'laeta'*, or whose sandy aspect suggested that high potential for these species. Therevids were sought during unstructured searches lasting for about an hour. The assemblage of flies using ERS was sampled using timed sweep-netting at 284 points and suction sampling at 136 of these. Sampling was targeted at ERS rather than other riverine habitats. Species in all well represented families except sphaerocerids were identified.

Records of therevids were patchy. New sites were found for *Cliorismia* on the Wey, Rother and Tay, and a previously known Rother population was found to be thriving. New records for *Spiriverpa* were from the Lune, Coquet, Till and Breamish. *Cliorismia* was found new to Scotland at two locations on the Tay and *Spiriverpa* was found to be widespread and locally numerous on both the Spey and the Tay (including several apparently new populations). Welsh sightings of both species duplicated previously known records.

A total of nearly 850 species were identified from the assemblage survey. The total for each river ranged from 101 to 303 species on different rivers. Dolichopodids and ephydrids were the dominant families in terms of both most species overall and mean species richness per sample; about half the British fauna of these families was recorded. Hybotids, empids and limoniids were also species-rich overall but limoniids had low mean species richness. This was partly explained by having targeted sampling at ERS rather than better-vegetated riverine habitat.

32 rare and 55 nationally scarce species were recorded, and another 11 ephydrids were allocated provisionally to these statuses. Six were new to Britain: *Hilara aartseni*, *H. tenella* (Empididae), *Asyndetus latifrons* and *Rhaphium suave* (Dolichopodidae), *Meonura anceps* (Carnidae) and *Rhabdomastix eugeni* (Limoniidae). A scatopsid in *Rhegmoclemina* is new to science. Several clearly 'new' species of ephydrid were recognised, as were several *Platypalpus*. Two species found at several sites had been added to the British list only recently from other ERS surveys (*Hoplolabis yezoana*, *Tachydromia edenensis*).

Species were allocated to ERS fidelity classes. Eleven species had total fidelity, 20 had strong fidelity and 54 had moderate fidelity. The Welsh and Northumberland rivers supported most species in the top classes, and the Lune, Spey, Rother, Wey and Weaver supported the fewest ERS species.

Classification was made using TWINSPAN on 238 sweep-net samples containing 475 species that occurred more than once (and excluding some minor families). Three ecologically meaningful groups were distinguished, and these were present on all but one or two small rivers. Proximity to the water's edge, vegetation cover and shade were the main factors operating on the assemblages. Substratum composition appeared to have less impact. Wet ERS at the river's edge was rich in ERS specialists and included most occurrences of several species with total ERS fidelity. It was characterised by large numbers of individuals of common shoreflies, which made the group distinctive in the field. Mean species-richness was lower than other groups. Wet but more structurally varied ERS was richest in both ERS specialists (but not those with total fidelity) and in uncommon species. It had the highest average species-richness of all species and particularly of wetland species. Dry, often vegetated sediment was relatively poor in ERS specialists but

usually as rich in uncommon and all species as the wet 'rich' ERS group. It represented the transition to dry habitat. Further divisions of the classification were almost entirely based on geographic location, thus highlighting the ecological reality of the first major divisions based on habitat features.

Ordination was carried out using 238 sweep-net samples and 475 species that occurred more than once (and excluding some minor families). Unconstrained ordination suggested that geographic locality may be a strong factor influencing the result, and could swamp effects attributable to measured variables. Constrained ordination showed the main trends were related to substrate particle size and the size of the ERS system, and shade. Other apparently less important factors were vegetation cover and wetness of the substrate, but some of these effects were contradictory. Overall, ordination was disappointingly unhelpful in interpreting the data.

The effectiveness of sweep-netting and suction sampling was compared using data from rivers sampled in 2005. The methods caught similar mean numbers of species on the Wey, Rother and Lune but sweep-netting was better on the Welsh rivers. A delay in getting the Welsh samples into a freezer for preservation was partly to blame, but inconsistencies between families suggested this was only part of the explanation. Slightly fewer ERS specialist were collected by suction sampling than by sweep-netting but the proportion of these species was higher in suction samples. The most serious under-sampling by netting was a few species that are reluctant to fly, as these included the ERS specialists *Tachydromia* and *Lonchoptera meijeri*. Most other species with moderate to high ERS fidelity were collected more consistently by netting. Despite suction sampling collecting a few ERS species more effectively than netting, its use represented considerable additional effort that did not add markedly to the conclusions drawn from sweep-netting alone.

Trampling appeared to have only a very slight and statistically non-significant impact on ERS specialists and uncommon species, although the survey was not designed to test the effects of trampling and samples were not taken at markedly disturbed places. The conclusion is at variance with the experience of some of the authors would need to be tested to establish the true relationship of ERS Diptera populations and trampling.

A few species showed clear preferences for well shaded places, notably craneflies and species of *Hilara*, and these included a few with high or moderate ERS fidelity. Another small suite of species was almost never found at shaded places, and these included several species with total ERS fidelity.

It is suggested that the term Exposed Riverine Sediment should be used more carefully when referring to river margin habitat of most value to flies, since high interest is not confined to 'exposed' sediment.

Contents

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Introduction

The study was initiated to take forward actions for three flies listed in the UK Biodiversity Action Plan (BAP). The stiletto flies *Cliorismia rustica* and *Spiriverpa lunulata* (Therevidae) have full plans and the cranefly *Rhabdomastix laeta* (Limoniidae) has a species statement (UK Biodiversity Group, 1999a, b). These species, together with several beetles, were added to BAP not only because they are under threat but as flagship species for exposed riverine sediments (ERS). Buglife therefore took the opportunity to broaden the scope to investigate the wider importance of ERS to flies of other families, especially those of sandy rivers. The study was divided into four projects:

Project 1. Survey of BAP-listed flies and fly assemblages using ERS

Project 2. Identification of therevid larvae

Project 3. Ecology of the BAP therevids

Project 4. Ecology of *Rhabdomastix laeta*

This report covers Project 1. The other projects are reported separately by Drake (2007) and Godfrey (2007).

Before the project began, *Cliorismia rustica* had been recorded from a few widely scattered sites but mostly from the middle reaches of the rivers Usk and Monnow in Gwent. Other sites were the River Ely in Gwent, the rivers Bolin and Etherow in Cheshire, the River Wey in Surrey, River Rother in West Sussex, River Rye in Yorkshire and the rivers Irthing and Eden in Cumbria. Godfrey (2006) lists some unconfirmed records in Yorkshire from Cloughton where there is only a small stream (although with larger rivers with ERS nearby) and Skipwith Common which he thinks is an unlikely site for *Cliorismia.* During the course of the project, work funded by other agencies led to the discovery of populations on the River Dane in Cheshire (Bates *et al*., 2006), and further sites in Cumbria (Hewitt *et al*., 2005). These riverine sites share a sandy geology, often where the rivers reach the lowlands abruptly as they emerge from hilly country and hence shed their sediment load (Stubbs & Drake, 2001). This is a relatively scarce habitat within the geographic range of *Cliorismia*.

Spiriverpa lunulata has a slightly wider distribution, especially in Scotland. There are scattered populations on the rivers Usk, Tywi, Rheidol and Ystwyth in Wales, and the Swale, Wharfe, Rye and Nidd/Ouse confluence in Yorkshire. It has recently been found at several rivers in Cumbria (Hewitt *et al*., 2000, 2005). Autecological studies undertaken on the Usk and Monnow populations showed that the larvae of both species were found in dry sand, often well away from the river, but not in damp ground (Drake, 2004a).

Recent work targeted at ERS flies has shown the fauna to be particularly rich, and included scarce or rare species that appear to show strong fidelity to river sediments (Sadler *et al*., 2002; Bell *et al.*, 2004, Godfrey, 2006; Hewitt *et al*., 2005). Unlike previous work on rivers with extensive ERS (e.g. Stubbs, 1991; Rotheray & Robertson, 1993), these surveys concentrated on the actual ERS rather than the wider range of habitats within the river corridor, and therefore identified a more ERS-specific suite of species. Two useful results followed from these surveys. Firstly, following the lead by coleopterists, each fly's fidelity to ERS has been quantified by allocating scores, and this has allowed detailed analysis of the results. The review of flies associated with ERS by Godfrey (1999) provided a basis for initial scores. Secondly, the flies were shown to form distinct assemblages that use different parts of the ERS and adjacent habitats (Bell *et al.*, 2004). The habitat is therefore not amorphous, and there appear to be elements where more specialised species are found.

The aims of the survey for assemblages of flies at sandy ERS were therefore two-fold. It provided the first opportunity to gather information on a wider geographic scale than previously, and permitted confirmation of initial results that showed that the habitat supported several distinct assemblages. It also gave the opportunity to try a sampling method additional to sweep-netting which was the only method used consistently in previous studies. Sweep netting is well established as a versatile and productive method of sampling flies but is known to miss small species with secretive habitats and are reluctant to fly (Drake, 2004b). Suction sampling was chosen to collect such flies. The hybotid genus *Tachydromia* was the principal target since it includes several rare species associated with river shingles.

Methods

Field work

Site selection

All three BAP-listed flies are associated with sandy rivers, and this requirement limits their distribution to areas where sand is deposited or is present in floodplain deposits (UK Biodiversity Group, 1999a, b). A shortlist was drawn up of sites that either had records of at least one of the three BAP-listed flies or well developed sandy sediments. In discussion with Buglife, five rivers were chosen for work in 2005 and another six rivers in 2006. The 2006 list was modified to include tributaries of the Till, and on the Exe access problems prevented a sensible series so five separate rivers were chosen instead (Table 1). Some short-listed rivers in Cheshire and Yorkshire were the subject of other ERS-fly projects in 2005 (Bates *et al*., 2006; Godfrey, 2006.). The distribution of the rivers is shown in Figure 1, and the approximate location of each sampling point in Figures 4-12.

Four to six sites were visited on each river. The choice of sites was guided by recommendations from a range of sources including the Environment Agency, SEPA, Countryside Council for Wales, Scottish Natural Heritage, fishing syndicates, other entomologists and personal knowledge. Sampling points were not randomly selected as their position and extent was dictated by access permissions and the actual availability of ERS that could be located.

Sampling was targeted at ERS rather than other riverine habitats. Once at a site, the river was walked until a patch of ERS was located and which was considered large enough to have at least two contrasting micro-habitats within its extent. The two principal micro-habitats that were sought at each point were bare wet margin and drier, higher deposited material with sparse ruderal vegetation. Other micro-habitats that were sampled either deliberately or because there was little else available was more densely vegetated deposits or the actual river banks, any obvious variations in particle size (sand, pebbles, organic silt), position on large bars (upstream, edge, downstream, by backwater channels), and isolated ponds within the river's channel. Sampling was restricted within each such patch in order to collect a sample most representative of that micro-habitat. Sometimes the patches of ERS were too small to make distinctions or to sweep-net within discrete microhabitats, especially on the Wey, Rother and Weaver. Clearly only a few of these variations could be included in the samples taken at any site; the number of samples per site is given in Table 1. An idea of what each sampling point comprised can be gained from the very brief description of each sampling point (Table 44).

Examples of how samples were taken are shown in the field sketches and the corresponding photographs of two sites, where three microhabitats were distinguished on one bar on the Monnow, and five on a larger expanse of predominantly sandy deposit by the Coquet (Figures 2 and 3).

Finding suitable ERS was a major issue on the Rother, Wey and Weaver where it was scarcely evident. Samples here were taken mainly on small to tiny patches of exposed shore that would not be regarded as ERS as conventionally understood. The Wey and Rother had not flooded the previous winter so that nearly all deposits were densely vegetated, whereas some exposed sand drifts had been present in recent years (Jonty Denton, pers. com.). However, these rivers run through sandy floodplains so eroding dry exposed sand was sometimes plentiful along the banks. ERS bars were plentiful on most other rivers although bars with large amounts of sand were usually rare or absent, especially so on the Lune, Breamish and parts of the Coquet.

Sampling methods

The rivers were visited in fine weather in both years although in 2006 some afternoons were hotter than ideal for fly survey.

At each site, field work was divided into structured sampling to collect the broad assemblage of flies, and casual sweeping and direct searching for the therevids.

Structured sampling at each sampling point consisted of sweep-netting for 10 minutes, during which time flies were removed frequently from the net using a pooter. This was followed by a 2 minute suction sample covering the same ground. Suction samples were omitted if the patch was too small to warrant sampling and on many sites on the Wey, Rother and Weaver where the exposed sand was limited to a narrow wet strip of shore with no stones under which small flies could hide. MD's machine stopped working during field work in Northumberland. The catches in 2005 were put into polythene bags and stored in deep freeze but in 2006 the live sample was placed into the sweep-net where the flies were removed as if it was a sweep-net sample. *Tachydromia* species, which were the main target for suction sampling, ran so fast that they sometimes escaped from the net.

The habitat at each sampling point was described on a field form (Appendix 1). Grid references of each sampling point are given in Appendix 3.

The sampling points were photographed and the better examples from each location are shown in the site accounts. A representative patch of sediment was also photographed in a standard way that was hoped would allow visual comparison between sites and perhaps measurement of its composition. This picture was taken with the camera pointing vertically downwards. Included in the frame was a rule extended to 50cm to provide scale and the site code on a piece of paper. Two problems with this method are that, subsequent to the survey, it was learnt that such pictures cannot be used as a reliable method of estimating sediment composition, and the site code written in pencil provided insufficient contrast to be visible to the digital camera, although was clear through the viewfinder.

Table 1. Sites visited and the number of sampling points at each.
See Appendix 3 for grid references.

County	River	Site	Number of samples	Date
W. Sussex, Hants	Rother	Adhurst	6	19-22 July 2005
		Petersfield	1	"
		Habin	7	"
		Woolbeding	3	"
		Cowdray	2	"
		Shopham	5	"
Surrey, Hants	Wey	Bordon	4	19-22 July 2005
		Tilford	7	"
		Frensham	5	"
		Thundry Meadows	3	"
		Eashing	4	"
Gwent	Monnow	Alltyrynys	7	7-8 July 2005
		Maerdy	5	"
		Kentchurch	5	"
		Monmouth Cap	2	"
		Skenfrith	6	"
Gwent, Powys	Ysgir	Ynys-gyfarch	3	7-8 July 2005
	Usk	Scethrog	8	7-8 July 2005
		Great Hardwick	8	"
		Llanvihangel Gobion	8	"
				21 July 2005
Lancashire	Lune	Higher Broomfield	3	18-20 July 2006
		Arkholme	2	"
		Gressingham	1	"
Cheshire	Weaver	Batherton Hall	8	26-27 July 2006
		Coole Hall	6	"
		Dairy Farm	9	"
		Mile End Farm	8	"
Devon	Bray	Bradbury Barton	8	22 July 2006
	Coly	Heathayne	6	7 July 2006
	Exe	Thorverton Weir	5	24 July 2006
	Mole	Meethe	9	22 July 2006
	Yarty	Bowditch Farm	12	9 July 2006
Northumberland	Breamish	Brandon	12	13 14 July 2006
	Coquet	Thropton	9	"
		Hepple	6	"
		Ryehill	8	"
		Healey	2	"
		Sharperton	9	"
	Glen	Akeld	6	"
	Till	Doddington	12	"
		Bewick Bridge	8	"
Perthshire	Tay	Westhaugh	5	15 July 2006

County	River	Site	Number of samples	Date
		Kercock	5	"
		Ballinluig Shingle Island		"
		Ballinluig	5	16 July 2006
		Dalguise		"
Highland	Spey	Fochabers	5	22 July 2006
		Dorback Burn	5	"
		Feshie Fan	5	"
		Inverdruie	6	23 July 2006

Figure 1. Location of rivers

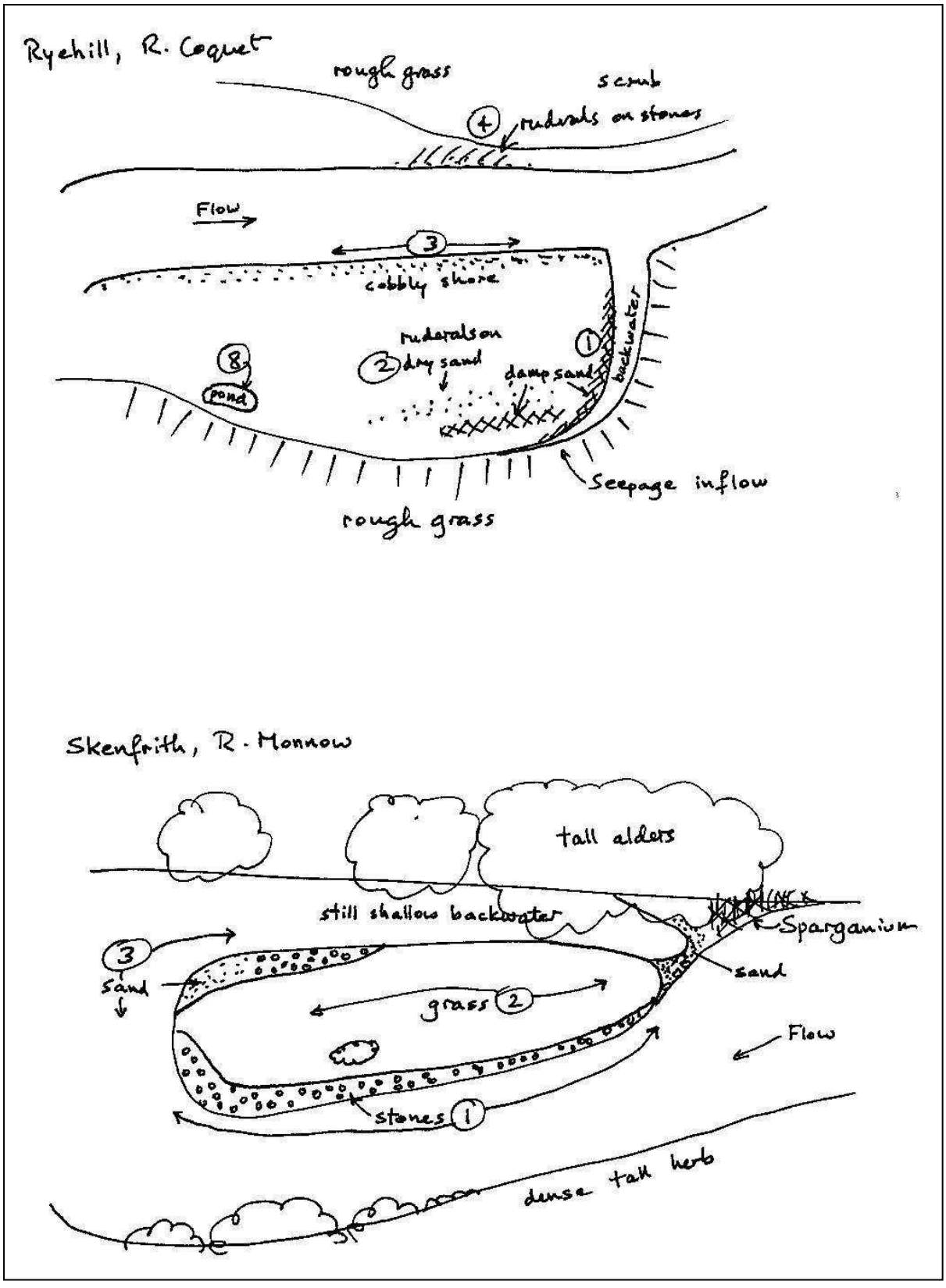


Figure 2. Example of field sheet sketches to show how samples were selected.

Figure 3. The sites shown in the sketches (Figure 2).

Skenfrith 1 and 2 (top left) and 3 (top right), Ryehill 1 and 2 (middle left), 3 (middle right), 4 (bottom left) and 8 (bottom right).

Therevid searches

Searching for the therevids involved sweeping and direct searching along stretches of bank wherever the habitat looked suitable and where brambles and fencing did not interfere (these were major constraints). Sweeping continued for approximately one hour, except at some sites on the Monnow and Usk where previous work had shown good populations of either species. The length of bank searched varied widely between sites and depended upon access constraints.

Laboratory methods

Several families were selected to represent the core of species to identify (craneflies, dolichopodids, empids *sensu lato*, ephydrids) but other families were included. Conspicuous species in groups other than flies were also occasionally identified, particularly those known to be nationally scarce. Identified specimens were bulked for each site and dried for storage. Representatives of uncommon species were pinned or stored in alcohol. Specimens not identified in 2005 samples (apart from numerous sphaerocerids) were bulked for each site and preserved in 70% alcohol. Unidentified and identified specimens in 2006 samples were stored together. Nomenclature followed Chandler (1998).

The number of identified and unidentified individuals were estimated by crude subsampling (except for samples from the Spey, Tay and Lune). The flies were gently shaken in a Petri dish to scatter them evenly, and a quarter or an eighth of these was counted. Complete counts were made of Lune samples identified by AG.

Suction samples preserved in the freezer were passed gently through a series of sieves and each fraction sorted, the finest of which was sorted under low magnification.

Analysis

Rarity, Habitat Affinity and Fidelity

Conservation statuses were obtained from the conservation reviews of the Nature Conservancy Council and Joint Nature Conservation Committee (Falk, 1991; Falk & Crossley, 2005; Falk & Chandler, 2005; Falk & Ismay, in prep.). Rarity was estimated for species not covered by JNCC reviews, although these values are clearly open to question since they are based only on Martin Drake's experience. These species were new or relatively new to the British list, and most shore flies.

Each species was allocated a score representing its fidelity to ERS, following the definitions used in Sadler & Petts (2000) and using some of their scores. Species not found in previous surveys were allocated scores using the literature as a guide, notably Godfrey (1999) and the reviews listed in the previous paragraph. Scores for ephydrids were based mainly on Martin Drake's experience. Fidelity classes were:

1 – total or virtual total fidelity to ERS
2 – high fidelity (mostly found on ERS)
3 – moderate fidelity (frequently but not necessarily found mostly on ERS)
4 – low fidelity (not expected on ERS but found more frequently in other habitats). These were taken to include wetland species not necessarily associated with rivers.
5 – vagrant, occurrence on ERS is accidental, called 'tourists' in this report.

Sadler & Bell (2002) used an ERS quality index for ERS beetles based on a system developed for dead wood beetles (Fowles, 1997). This method was used for flies on ERS in Cumbria by Hewitt *et al*. (2005) but is not used here because it relies on fairly accurate rarity assessments. These could be deduced for beetles and for flies at a local level using local

BRC information, but this information is not available at a national level for most of the key families of flies covered in the present survey.

Abundance

Abundance data, as input into Recorder, were converted to four categories corresponding to:

1 recorded only as present, or up to 9 counted individuals
2 recorded as 'several' or 10-19 individuals
3 recorded as 'frequent' or 20-50 individuals
4 recorded as 'numerous' or 'abundant' (more than 50 individuals were counted only by Andy Godfrey).

Median and mean values

Values such as the numbers of species in different families or status classes were expressed as medians with the upper and lower quartiles (i.e. the range that encompasses the middle half of values). Values were compared using a Mann-Whitney test for two values and Kruskal-Wallis test for more than two values. Parametric tests to compare mean values were used on a few occasions where the underlying assumption of normality in the data may be met.

Ordination and Classification

Samples and sites were classified by using Two Way Species Indicator Analysis (TWINSPAN) (Hill, 1979a). The technique classifies data into groups by the similarity of their species composition and divides the dataset into two based on the most pronounced break in the similarity of samples. Furthermore, indicator species are created each time a sample is allocated into a particular group. Each of these first divisions is treated in the same way, forming the next pair of groups, and so on until the groups contain too few samples divide or the program is instructed to halt divisions. The result is a dichotomously branched set of groups. Common sense and an understanding of the organisms being classified are applied to recognise when the algorithm is 'inventing' groups that have no ecological reality; the earlier divisions have the greatest chance of being genuine ecological entities. As the program is based on matrix algebra, the significance of the divisions can also be measured using eigenvalues so there is a mathematical check to confirm ecological hunches.

The potential environmental relationships were inferred using detrended correspondence analysis (DCA) in the version DECORANA, a well-used analysis tool when interpreting large invertebrate datasets (Hill, 1979b; Hill & Gauch, 1980). Samples are ordered along an axis according to the similarity of the component species, so that samples with most species in common are placed close together. Environmental factors can be correlated with this ordering and thus help explain why the samples are so ordered; for instance, this first ordering may correlate with percentage of sand in the ERS. Ordination continues with another examination of the data and orders it along a second axis in such a way that the position of samples bears as little relationship as possible to the their position on the first axis, but nevertheless groups similar samples as close as possible. This second axis may be correlated with another obvious environmental variable, such as the proximity of the sample from the water's edge. The distribution of the samples along the two axes can be displayed as a graph, so that similar samples lie close to one another, and the direction of environmental influences can be envisaged (as well as tested by statistical correlation). The process is repeated on further axes, although the higher the axis the less reality there is to the ordering of samples, and there is usually little point in investigating more than the first two axes in small datasets. As with TWINSPAN, ordination can order the species as well as the samples to provide axis scores that allow graphical representation of the closeness of species.

A second ordination was carried out using canonical correspondence analysis (CCA) which seeks patterns in the species data that are related to the main trends in the environmental data. The strength and direction of the trend in environmental data is shown graphically by a vector, and the sample and species data are shown as points, as in DCA. Samples and species lying in the area to which a variable's vector points are assumed to be most influenced by that variable.

Ordination was carried out in two stages, first using DECORANA for an unconstrained ordination, then using CCA for a constrained ordination. The use of both is recommended by Leps & Smilauer (2003) as the unconstrained ordination seeks any pattern in the species data, whereas the constrained ordination looks for patterns that are related to (constrained by) the environmental variables. If the actual key variables had not been recognised, it would still be possible to show relationships that had no ecological meaning, but using the unconstrained ordination provides a safety-net since it will show pattern in the species data if it exists.

Together, these techniques provide a powerful method of displaying a mass of data in a readily understood form, and of analysing the complete dataset free of preconceived ideas of the importance of particular species. They have been used consistently in invertebrate studies. Pisces (2003, 2004) software was used for these analyses.

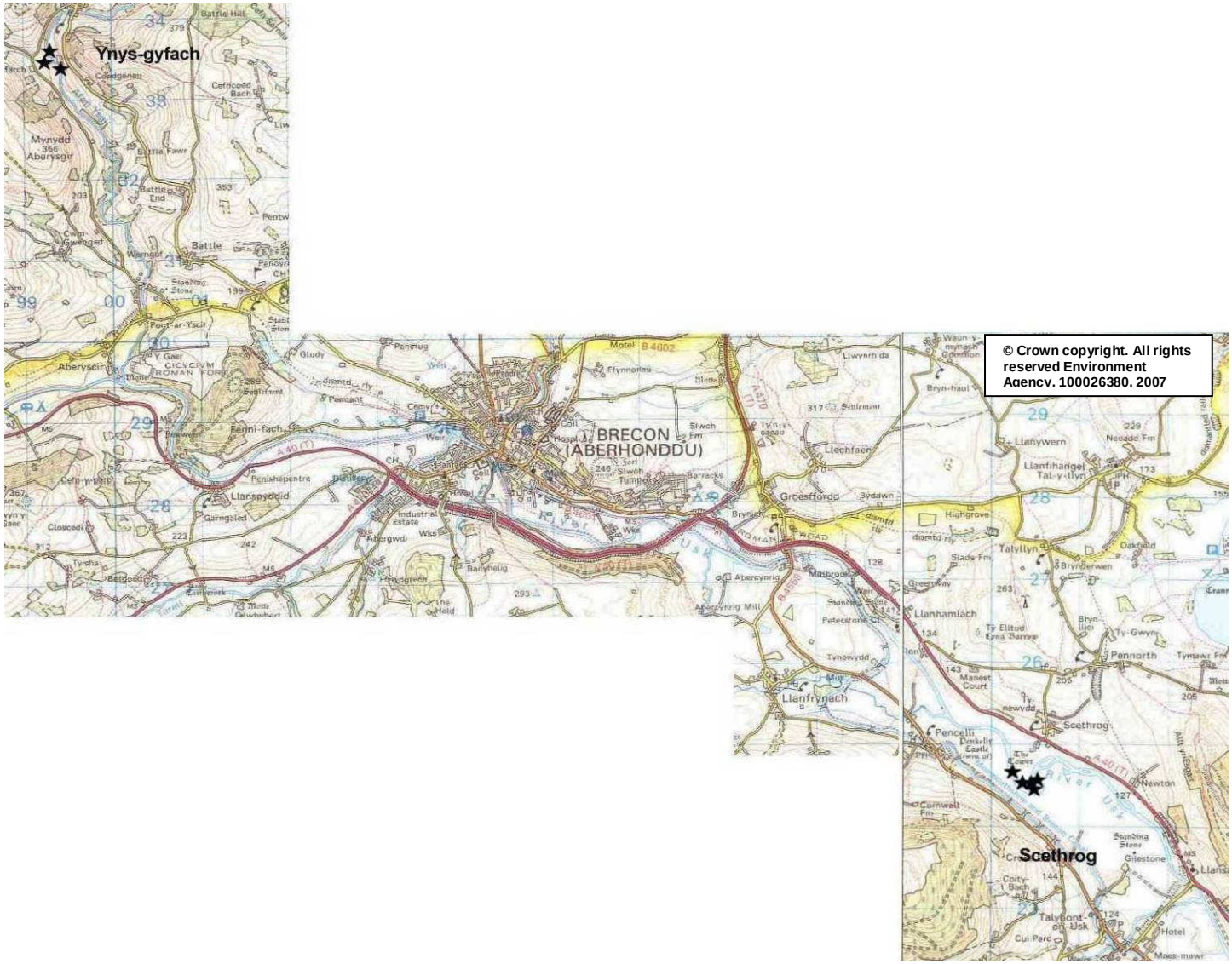
Data storage

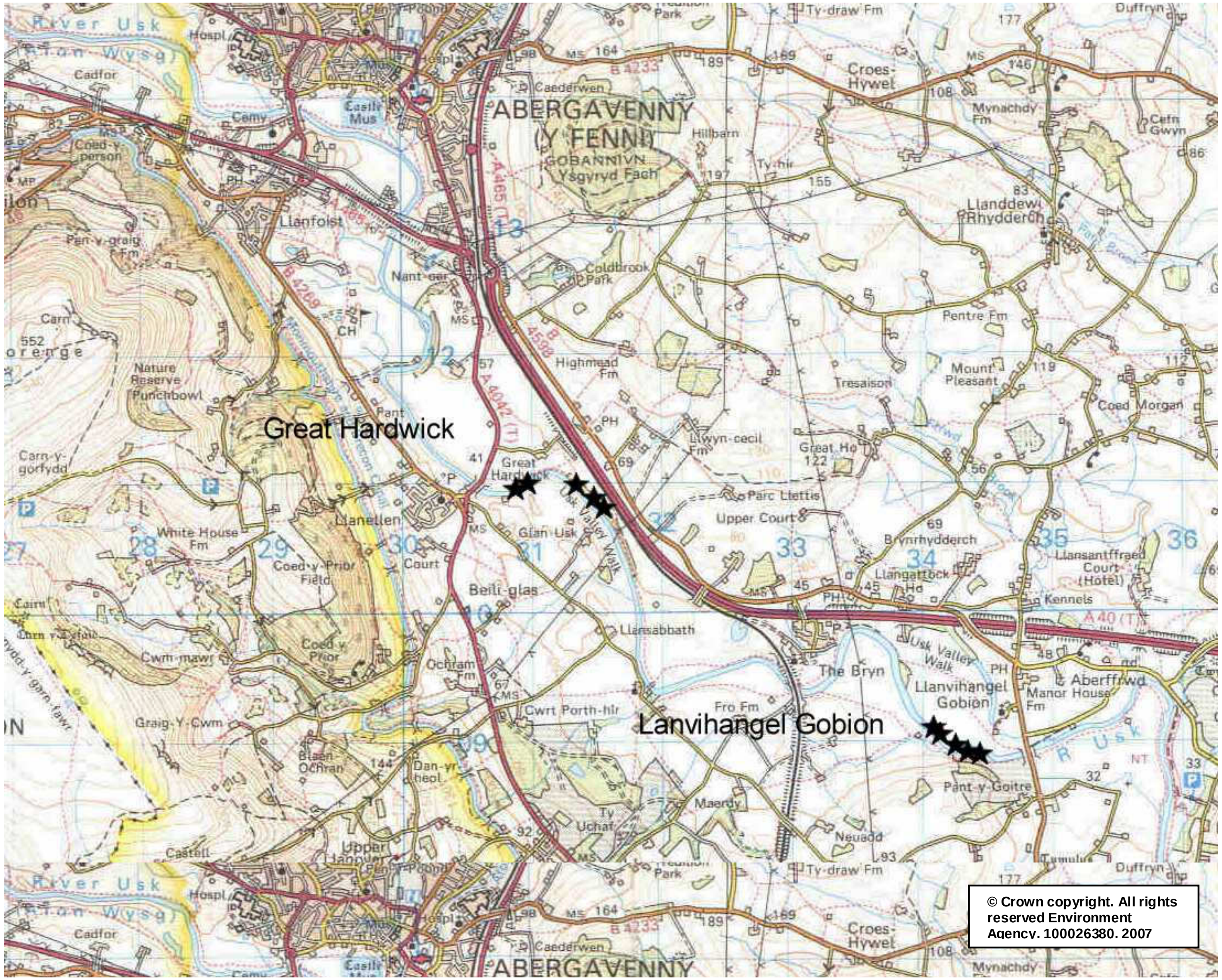
All the identification by MD were input into Recorder 3.3 except species recognised in Britain after 1997. The complete raw data are on an Excel 2000 spreadsheet. Photographs are cross-referenced by an Excel spreadsheet linking image numbers to sites and dates. All these are deposited with Buglife.

Environmental variables

Variables measured on a continuous scale (e.g. length of ERS patches) was summarise by its median with lower and upper quartiles, and ordinal values (present = 1, absent = 0) were summarised as the percentage of samples with the feature (e.g. 10 of 15 samples with sand substrate was 66%). Current was expressed as the mean of the score on the scale 1 = slow, 2 = medium, 3 = fast, 3.5 = riffle.

Figure 4. Usk and Ysgir sampling points

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© Crown copyright. All rights reserved Environment Agency. 100026380. 2007

Figure 5. Monnow sampling points

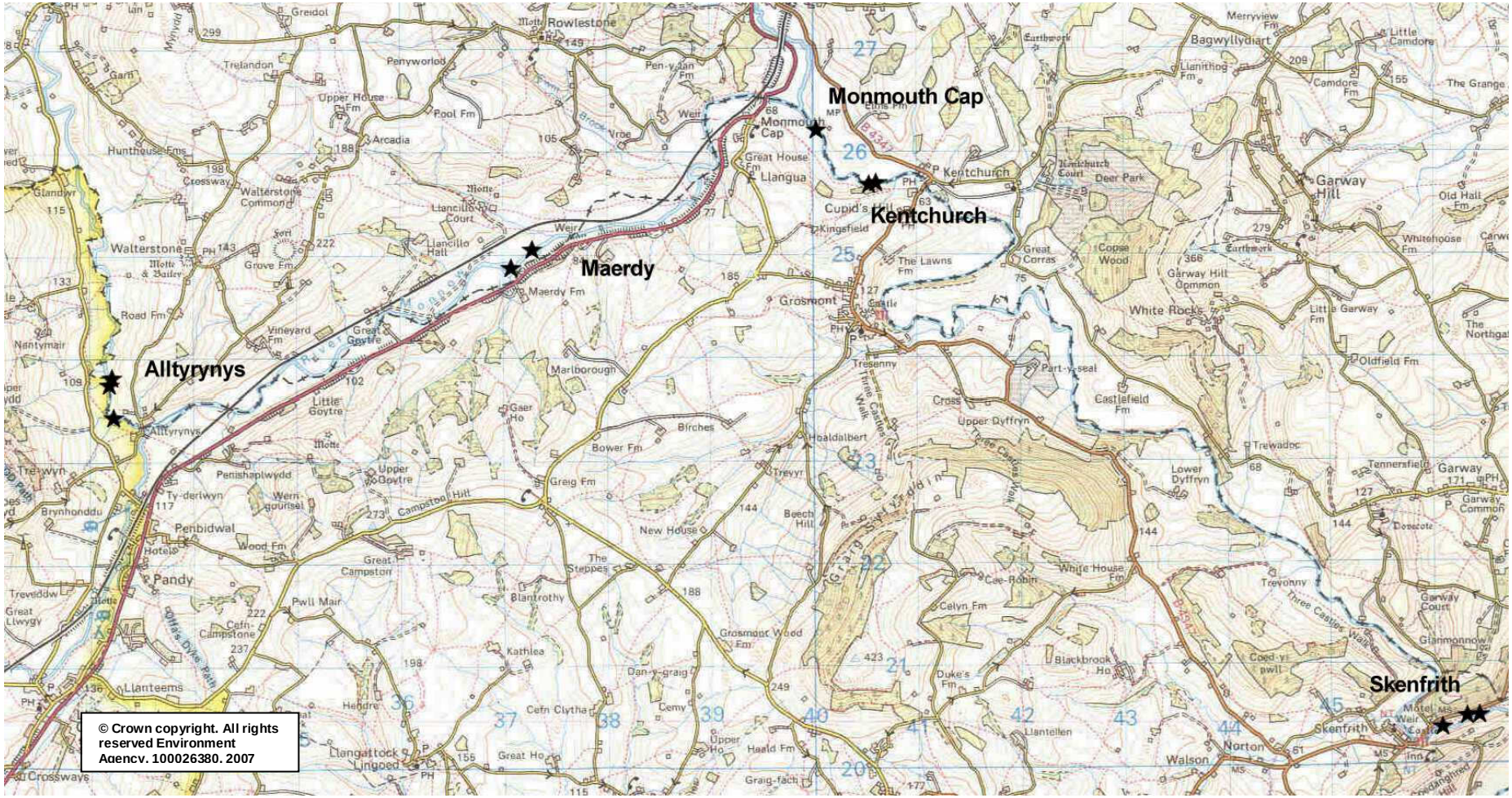


Figure 6. Lune sampling points

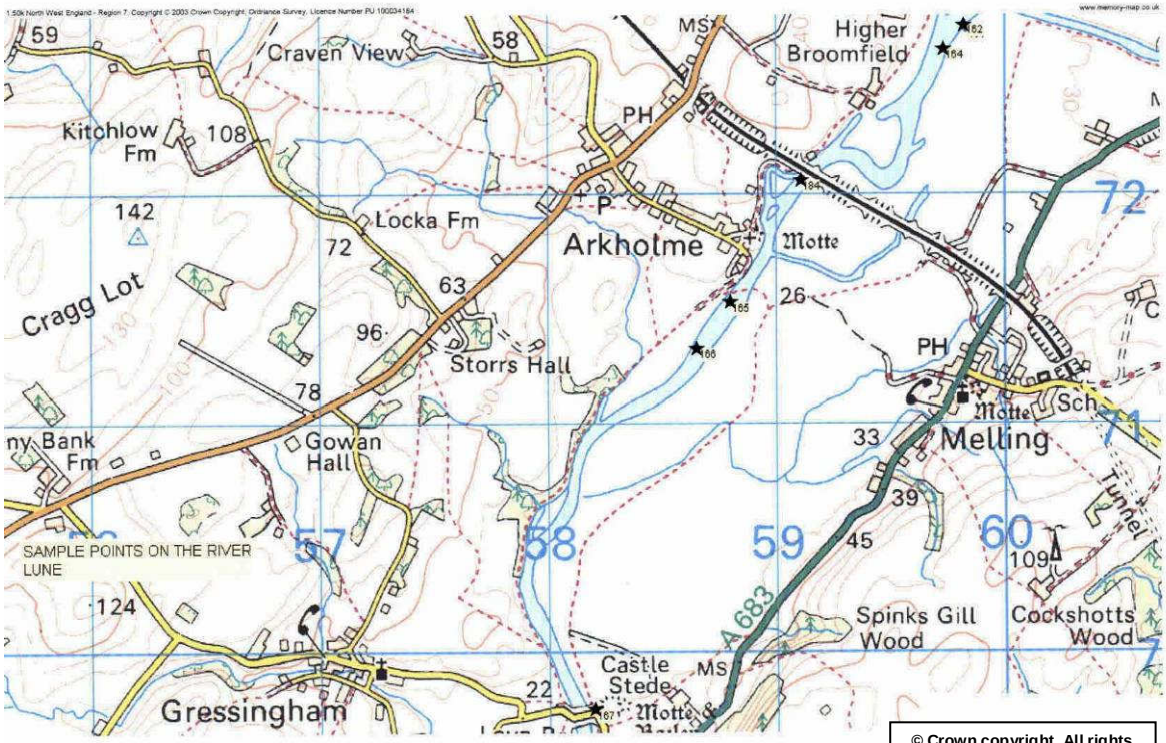


Figure 7. Wey sampling points

Arrows show all records of *Cliorismia rustica* (approximate for Charterhouse in the east)

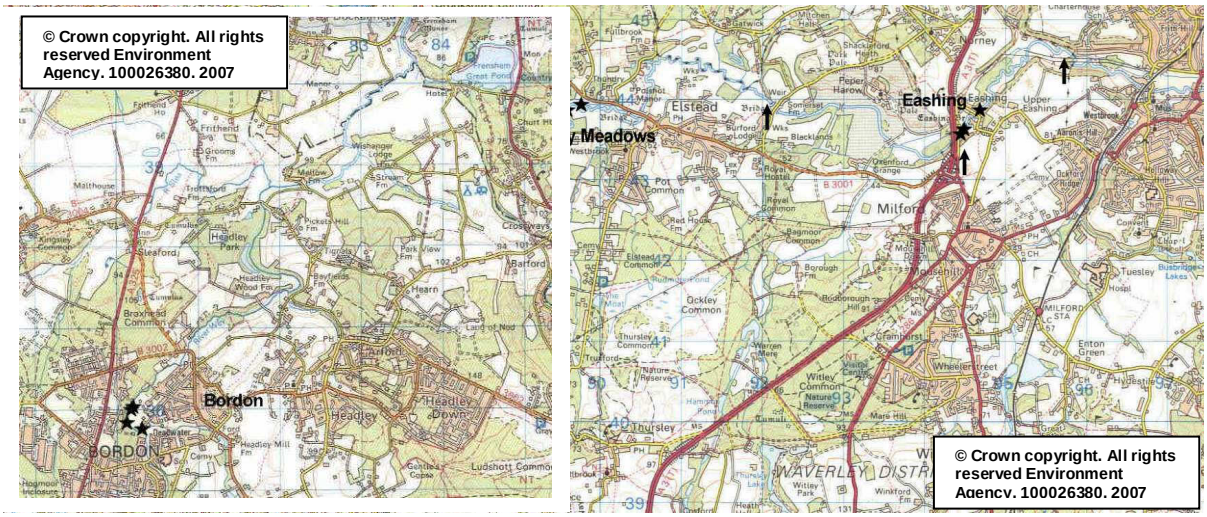


Figure 8. Rother sampling points

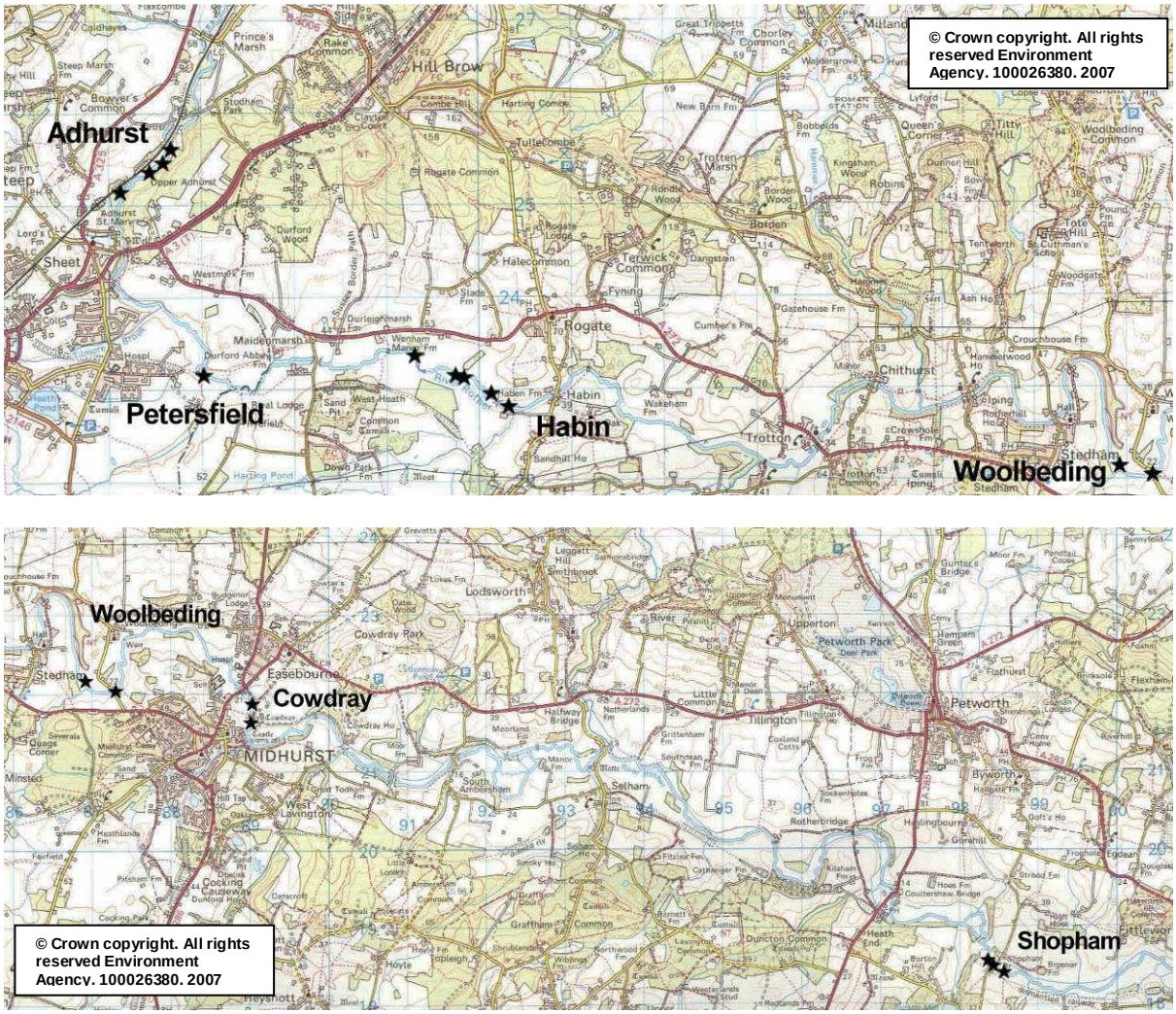


Figure 9. Coquet sampling points

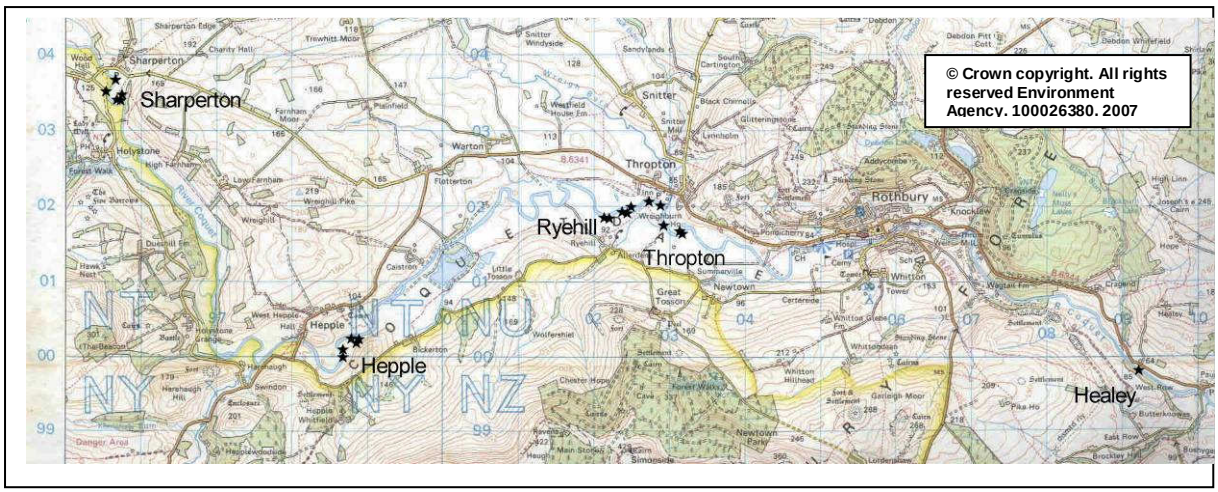
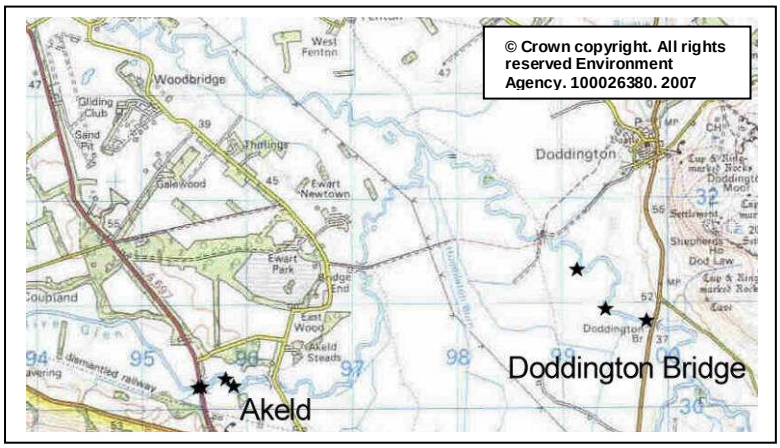
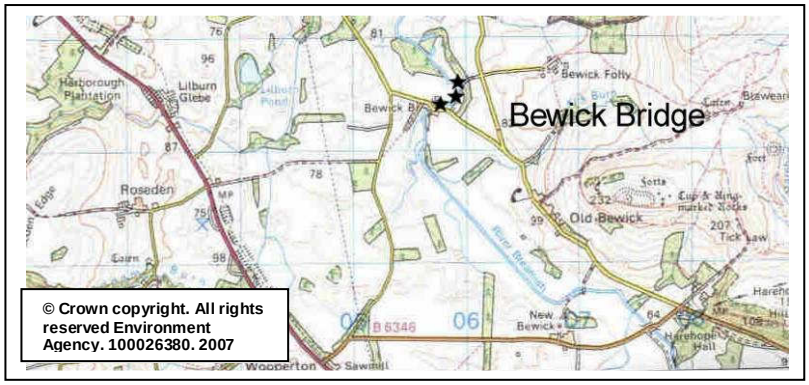


Figure 10. Till, Breamish and Glen sampling points





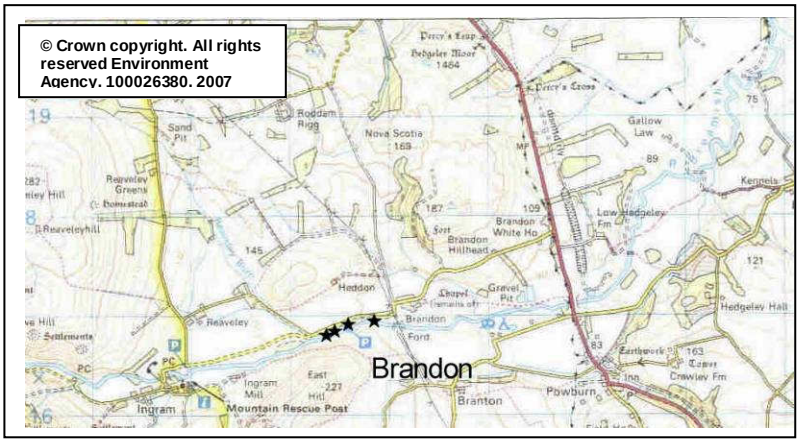


Figure 11. Weaver sampling points

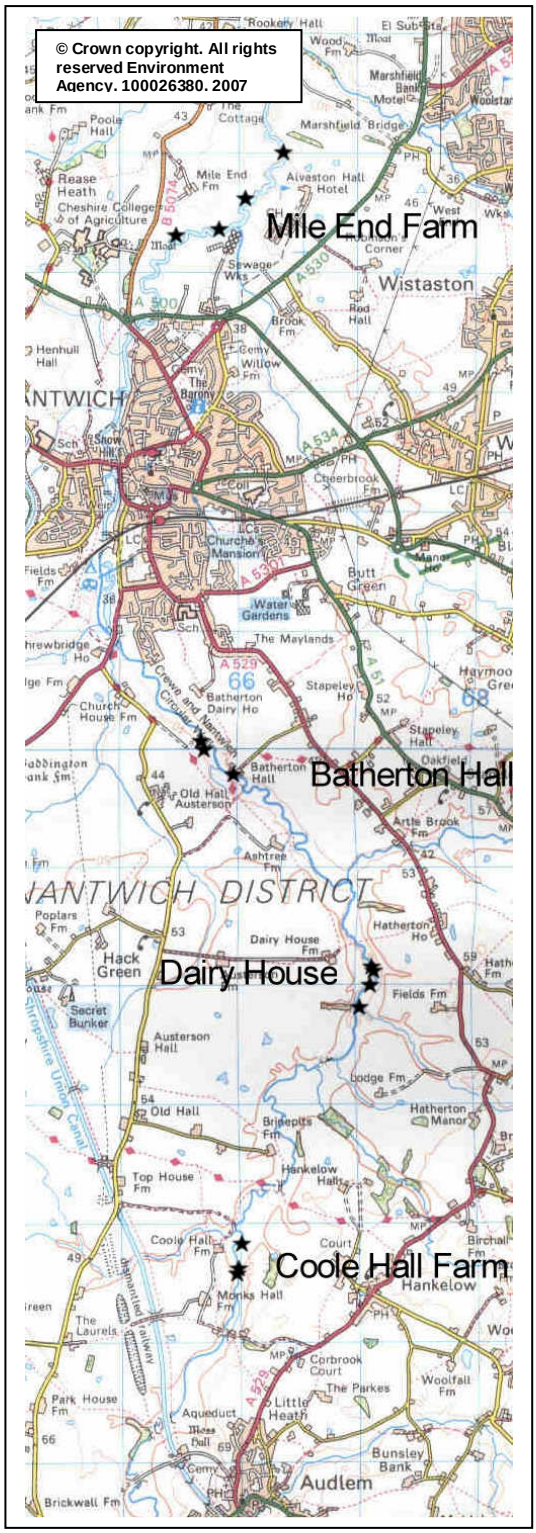
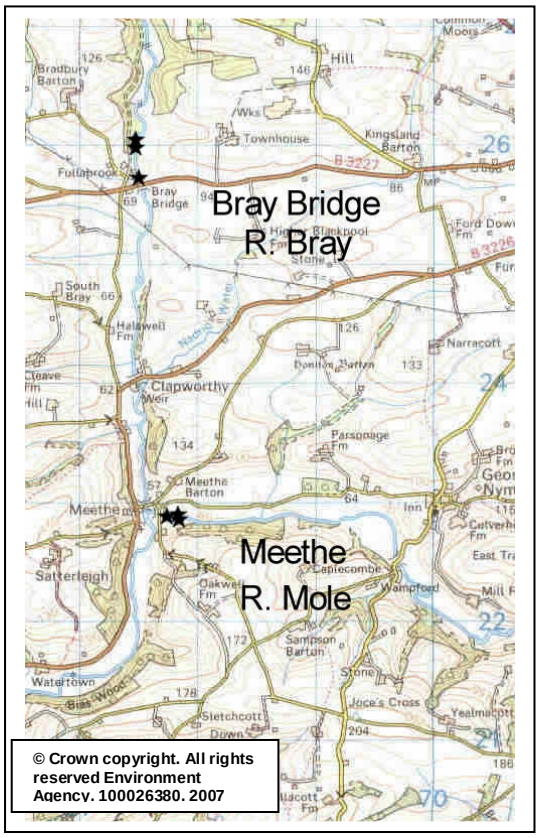
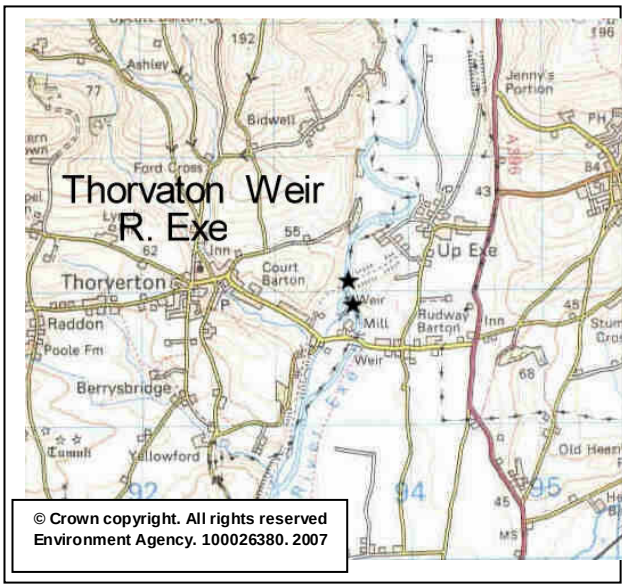
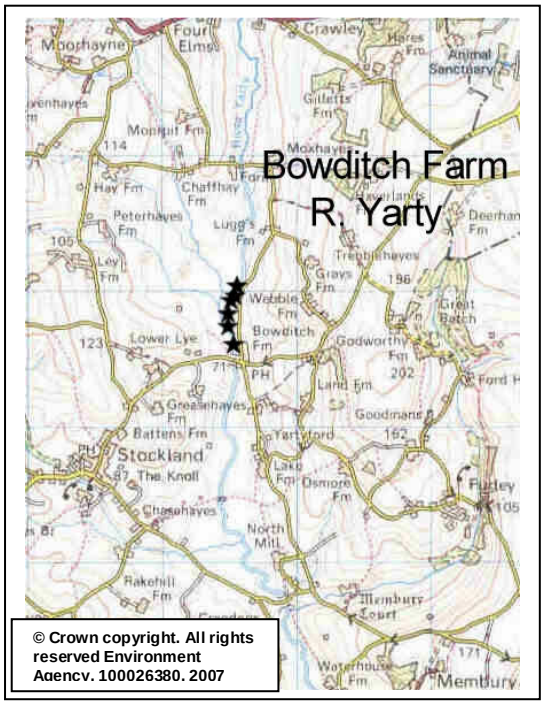
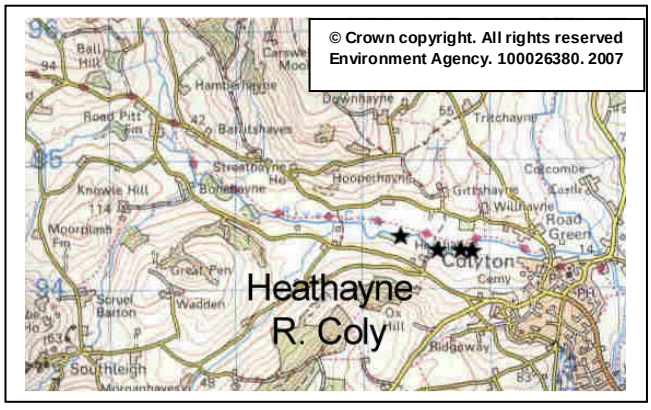


Figure 12. Devon river sampling points









Results

Stiletto flies

Cliorismia rustica

Cliorismia was seen infrequently. The most interesting discovery was first records of the species in Scotland. One female was found at Kercock on the Tay, and the situation in which the adult was found – loose, dry sand deposited well up on the riverbank – corresponded to the larval habitat of this species in Cumbria (Hewitt & Parker in prep.). A male was swept from a small, vegetated, sandy spit at Ballinluig Shingle Island, also on the Tay.

Other interesting records were from the Wey and Rother where it was previously known from only one or two sites on each river. On the Wey, it was found at Eashing, and had been recorded at Somerset Bridge by David Baldock in June 2005. These two sites are about 4.5km and 1.5 km upstream of Charterhouse where it was first seen in 1989 (Stubbs & Drake, 2001). In each case, only one individual was seen so although the population was still present, it may not have been particularly large.

On the Rother, it had been recorded in 1974 (Chandler, 1975) at Habin where it was found again in 2005 at three points along the banks. Another 1974 record was from Ambersham Common (SU906213) about 2.5km downstream of Midhurst (Alan Stubbs, pers. comm.), and it was found in 2005 at Woolbeding, immediately upstream of Midhurst. The known distribution therefore extends about 10km (rather more along the winding course of the river) from approximately Rogate to South Ambersham. Conditions appeared very suitable just downstream of Petersfield, and it is likely that *Cliorismia* has a wider distribution along the Rother.

Cliorismia was found at a few sites on the Monnow and Usk but only where it had already been recorded.

Details of these records are:

- Eashing 3, R. Wey north bank, at SU94474358 (50m downstream of the new A3 road bridge), 20 July 2005. 1 female. In taller riverside vegetation, mainly reed sweet-grass (*Glyceria maxima*) with some Himalayan balsam (*Impatiens glandulifera*), on a sunny, open bank next to short-grazed horse pasture with extensive rabbit scrapes and exposed patches of soil. The low river banks were eroding and trampled near the point of capture but such exposed sand on the bank was otherwise scarce. The soil was slightly earthy sand at the river margin but pure sand 10m inland at a large rabbit scrape.
- Habin at SU7936 2328, R. Rother, 21 July 2005. 1 male. On the north bank of the river by semi-improved pasture, electric fencing along the bank top below which the bank was a 2m cliff falling away into a narrow strip of loose sandy soil, then rank ruderal vegetation (mugwort (*Artemisia vulgaris*), yarrow (*Achillea ptarmica*), false oat grass (*Arrhenatherum elatius*), alder (*Alnus glutinosus*) saplings) occupying the lower 3m to the river's edge where Himalayan balsam was dominant.
- Habin 8 at SU7971 2319, R. Rother, 21 July 2005. 1 male. Swept from rank vegetation (mainly mugwort, nettle (*Urtica dioica*), false oat grass, creeping thistle (*Cirsium arvense*), hogweed (*Heracleum sphondylium*)) on moderately stabilised soil but with an eroding cliff nearby.
- Habin at SU8056 2284, R. Rother, 21 July 2005. 1 female. On a bank with seepages, but with a dry eroding slope nearby.

- Woolbeding 4, R. Rother, at SU8693 2210, 21 July 2005. 1 female. Next to sheep pasture. The sheep had grazed taller vegetation, other than nettles and burdock (*Arctium*), to leave trampled bare sand on a steep bank with was partly eroding at the top, and below which was tall rank vegetation (Himalayan balsam, bur-reed (*Sparganium erectum*)) inaccessible to sheep.
- Great Hardwick 4, SO31431086, R. Usk,16 July 2005. 1 male sitting on wet stones of a narrow unshaded shore at the water's edge next to a fast riffle, in an area otherwise almost devoid of flies. This was close to a cobbly island with dense scrub of small willows and alders and a small patch of rank ruderal vegetation (sampling point 5). The opposite (south) bank was next to pasture but the sampled bank was a high (c. 40m), steep and wooded bluff.
- Maerdy Farm 1, SO370247, R. Monnow, 8 July 2005. 1 female sitting on low vegetation on a narrow stony peninsular in the light shade of tall trees.
- Kercock NO1238, T. Tay, 15 July 2006. 1 female swept from tall herbs and grasses around an open patch of loose sand..
- Ballinluig Shingle Island, NN9753, R. Tay, on the evening of 15 July 2006. 1 male swept from vegetation fringing a small, sandy spit.

The habitat on the Wey and Rother where *Cliorismia* was recorded was often seen at other sites along both rivers, and it seemed likely that the fly could be present along much of both rivers. The key feature appeared to be eroding sandy banks of the type favoured by aculeates, and also other dry areas scuffed by grazing animals to expose sand. Very little deposited sand was seen, but this may be a moderately recent condition since there used to be exposed sand drifts at Charterhouse (at least) which have become stabilised and vegetated-over following river canalisation to reduce flooding at Godalming. Thus *Cliorismia* may now rely on loose sand derived from eroding conditions rather than depositing ones.

A reason for the scarcity of previous sighting on these rivers is probably the difficulty of access, as nearly all the land along both rivers is in private ownership and there are very few public paths alongside them. Its absence from the readily accessible Thundry Meadows reserve may be due to the floodplain being too wet as the river is exceptionally close to the top of the bank, or because river canalisation stops sand drifts forming, or simply that tall herb and riverside trees are scarce here.

Terrain apparently suitable for *Cliorismia* was present at some Northumberland sites, notably at Doddington Bridge on the Till where the eroding sandy banks resembled those at the Usk. Sandy banks with some sparse vegetation, or even eroding faces, were also a feature of other Northumberland sites including Brandon on the Breamish and Thropton and Ryehill on the Coquet. However, the preference of *Cliorismia* for sandy banks with nearby tall vegetation such as herbs or even low willow scrub was not often found, since most sites tended to be heavily grazed close to the bank top. When tall herb was present, the ground was often more stony than sandy, for example at Brandon on the Breamish and Sharperton on the Coquet.

None of the Devon sites visited in 2006 appeared to have conditions suitable for *Cliorismia*, even though the Yarty and Coly ran through moderately sandy floodplains. Far more promising sites were surveyed unsuccessfully in 2004 (Bell *et al*., 2004).

Of the sites on the Weaver in Cheshire, apparently suitable habitat was occasionally seen between Dairy House Farm and Batherton Hall Farm upstream of Nantwich, but most of this narrow river was steep-sided and with an abrupt interface between intensively farmed pasture and the river, which left little room for the semi-natural transition used by *Cliorismia*. However, the appearance of *Cliorismia* at shaded gravelly sections of the nearby Dane should make one cautious about speculating on unsuitability (Bates *et al*., 2006).

Spiriverpa lunulata

Spiriverpa was recorded at several sites, including new county records for Northumberland and Lancashire.

At the Welsh sites, *Spiriverpa* seen in 2005 by Andy Godfrey at one of its main sites on the Usk (Llanvihangel Gobion), but not by Martin Drake who searched mainly close to the river rather than across the huge sand plain where its larvae were numerous in 2002 and 2003 (Drake, 2004a). No larvae were found on this sandy plain in 2006, although a few adults were reared from larvae collected in 2006 on the Usk banks downstream of here (see Project 3). It was present at Scethrog on the Usk, and this record extended its known range 20km upstream of Llanwenarth where a good population was known (Skidmore, 2001).

Spiriverpa was widespread and locally frequent on the Tay and the Spey in Scotland. It occurred, usually in numbers, at all sites on the Tay and at all but one site on the Spey. The occurrence of several adult *Spiriverpa*, including 'leking' males, at a sand quarry well above the river at Kercock is note worthy as *Spiriverpa* is not known to breed away from in-channel ERS deposits. Further survey for larvae is required to establish the true situation in this case.

Spiriverpa was found at several of the Northumberland sites, although only in very small numbers at each. It was usually seen at or swept from dry unshaded sandy to cobbly ground with sparse vegetation, usually several to many metres from the river's edge. There were sometimes trees nearby but, unlike *Cliorismia*, it seemed to prefer much more open areas.

- Llanvihangel Gobion, 2005. (Andy Godfrey).
- Scethrog 6, R. Usk at SO1066 2437, 15 July 2005. 1 male. The site is an extensive sandy loop of the Usk. The vegetation where the fly was seen was a mix of low pioneer vegetation (creeping thistle, great willowherb (*Epilobium hirsutum*), willow saplings) and tall dense Himalayan balsam (70% of the area) on almost pure sand.
- Doddington Bridge 10 & 12, R. Till, NU037169, 16 July 2006, two males on a small island bar with a scrubby middle and pebbly shore.
- Bewick Bridge 7, R. Till, NU059225, 15 July 2006, a 'swarm' of four males. These were flying 1-2m above an exposed gently sloping sandy bank about 40x x10m in area, along a tree-sheltered stretch of river. The banks was lightly trampled by sheep, leaving sparse nettles and thistles, and the flies were swarming over 50cm-tall thistles stems on bare sand about half-way up the bank. They flew to-and-fro fairly quickly and erratically in their own zone about 5m across, and chased or investigated other insects (and each other) flying into this zone. The weather was hot and sunny but moderately windy. They were still flying about an hour after first being seen in mid afternoon.
- Brandon, R. Breamish 11, NU037169, 15 July 2006, one male, swept from pebbly ERS with pioneer vegetation.
- Sharperton 4 and 8, R. Coquet, NT956033 one female & NT957036 two females, 14 July 2006, and pupal exuviae collected by suction sampling at both these locations. *Spiriverpa* was probably quite frequent since several exuviae were collected. The locations were 10-40m from the river in a large expanse of nearly bare pebbly to gravelly ERS lightly grazed by cattle.
- Ryehill 7, R. Coquet, NU022018, one male at sparse pioneer vegetation on dry pebbly ERS.
- Thropton 2 & 5, R. Coquet, NU029018 & NU0290198, 13 July 2006, two females in sparse pioneer vegetation on dry pebbly ERS and close to the wet edge.

- Lower Broomfield 1, 3, & 5, R. Lune, SD598727 (sites 1 & 3) & SD596725, 20 July 2006, 7 adults swept and one taken by suction sampling. None were seen at the Lune sites in July 2005.
- Westhaugh, R. Tay, NO146396, 15 July 2006. Extensive shingle and sand banks. A sand quarry above the river here also had a number of adult *Spiriverpa lunulata*, with males performing 'leking' behaviour. This is interesting in that it may indicate a departure from the normal in-channel ERS deposits in which the larvae of this species are known to develop.
- Kercock, R. Tay, NO1238, 15 July 2006. Shingle and sand banks. Several adults swept from thin vegetation and leks towards the top of the ERS bank with areas of bare sand.
- Ballinluig, R. Tay, NN9752, 16 July 2006. Extensive shingle and sand banks. Several adults swept from thin vegetation and leks towards the top of the ERS bank with areas of bare sand.
- Dalguise, R. Tay, NN999477, 16 July 2006. Two or three on coarse shingle with only small areas of sand present.
- Fochabers, R. Spey, NJ3460, 22 July 2006. Several adults swept from thin vegetation and leks towards the top of the ERS bank with areas of bare sand.
- Inverdruie, R. Spey, NH8911, 23 July 2006. Single adult swept from the top of the ERS bank with areas of bare sand.
- Feshie Fan, R. Spey, NH8305, 22 July 2006. Large numbers of adults present with male 'leks' centred on areas of bare, loose, dry, sand.

Other therevids

Very few records were made of other therevids. *Thereva nobilitata* was seen at one site on each of the Rother, Weaver and Till and two sites on the Wey and Coquet. Skidmore (2001) also noted the scarcity of *Thereva* in his survey of the Usk and Monnow banks. *Cliorismia* and *Spiriverpa* are therefore more frequently seen than common Thereva on sandy to stony river banks.

Summary

- Records of therevids were patchy and disappointing. New sites were found for *Cliorismia* on the Wey, Rother and Tay, and a previously known Rother population was found to be thriving. New records for *Spiriverpa* were from the Lune, Coquet, Till and Breamish, but Welsh and Scottish sightings of both species duplicated previously known records.
- *Spiriverpa* was more often found at deposited sand or sometimes cobbles usually well away from the water's edge, and in open sunny places. *Cliorismia* adults occurred mainly at sites with eroding or slumped sand banks and with often with tall herbs, but circumstantial evidence from the Wey and Rother suggests that it may have used deposited sand that no longer occurs here as a result of river canalisation.

Assemblages

Species richness

Nearly 850 species of flies were identified from 284 sampling points on 18 rivers (Table 2). The samples collected by MD on 15 of the rivers contained about 135,500 identified individuals in sweep samples and about 24,000 individuals in suction samples. The number of species recorded at each river vary widely since the sampling effort was uneven, as indicated by the number of sampling points in Table 2, and ranged from 101 to 313. Timed sweep samples were taken at all sampling points (two additional sites on the Tay were searched casually), and suction samples were taken at 136 points. The species total for the Tay and Spey includes casual collecting as well as timed sweep and suction sampling, but all other are just for timed sweep and suction sampling. Some of the difference between rivers is due to different surveyors recording additional families, but, except for muscids and chloropids, the families in Table 2 were identified at all sites.

The dominant families in terms of total species richness were dolichopodids, ephydrids, empids, hybotids and limoniid craneflies. Dolichopodids were by far the best represented family overall with 128 species, compared to the next best-represented family, the ephydrids, with 79 species (Table 2). The families are listed here in their rank richness for all sites combined, although the ranking varied slightly between rivers. On all rivers except the Exe, dolichopodids were the most speciose family, followed in most cases by ephydrids, although on the northern rivers (Till, Breamish, Tay, Spey) empids were more species-rich than ephydrids. Had sphaerocerids been included, they would probably have ranked highly since they were abundant in most samples and, where identified to species on the Lune, were the most species-rich family.

No other family approached these in total richness, although the syrphids were intermediate between these very species-rich families and the remainder that made only a small contribution. It seems likely that nearly all syrphids were vagrants to ERS as the most frequent were widespread aphid predators, and wetland species occurred sporadically and usually when there were ponds nearby. Groups that are often useful as indicators in wetlands, such as stratiomyids and sciomyzids, were insignificant members of the ERS fauna.

The importance of the riverine habitat to several families is also indicated by the proportion of the British fauna that was recorded in the project (Table 2). About half the British dolichopodid and ephydrids, and about one third of empids, hybotids and limoniids were recorded. A larger proportion of the small families of lonchopterids and sepsids was found.

The species richness for a whole site disguised the relative importance of families in individual samples. The median number of species in each of the major families gave a different rank order of the important families. This is significant because, for nearly all rivers, ephydrids and dolichopodids had similarly high median species-richness, rather than dolichopodids being well ahead in terms of richness. These two major families are nearly always followed in importance by empids or sometimes hybotids in third place and usually with only about half the median numbers of dolichopodids and ephydrids (Table 3) This result is illustrated in Figure 13 for a selection of rivers. This shows the median and interquartile range for the five most speciose families and for sepsids as a example of one of the better represented small families. While there is a little variation between rivers, the pattern remains constant over most of the geographic range. Thus, in terms of species richness per sample, ephydrids and dolichopodids together were the dominant families of sandy ERS despite there being considerably more dolichopodid species overall. This indicates that more species of ephydrids than dolichopodids or empids are more predictably associated with this habitat.

Several large families with many species overall in the dataset, such as limoniids and syrphids, were relatively scarce in each sample. For craneflies, this may be partly explained by their preference for well vegetated shaded areas usually found on the banks, and these were not often sampled since they are not ERS. By comparison, apparently insignificant families such as lonchopterids, sepsids and opomyzids were surprisingly well and consistently represented even though they are not necessarily associated with ERS or even with rivers.

Summary

- A total of nearly 850 species were identified from the assemblage survey. The total for each river ranged from 101 to 303 species on different rivers.
- Dolichopodids and ephydrids were the dominant families in terms of both most species overall and median species richness per sample; about half the British fauna of these families was recorded.
- Hybotids, empids and craneflies were also species-rich overall but craneflies had consistently low median species richness. This was partly explained by having targeted sampling at ERS rather than better-vegetated riverine habitat.

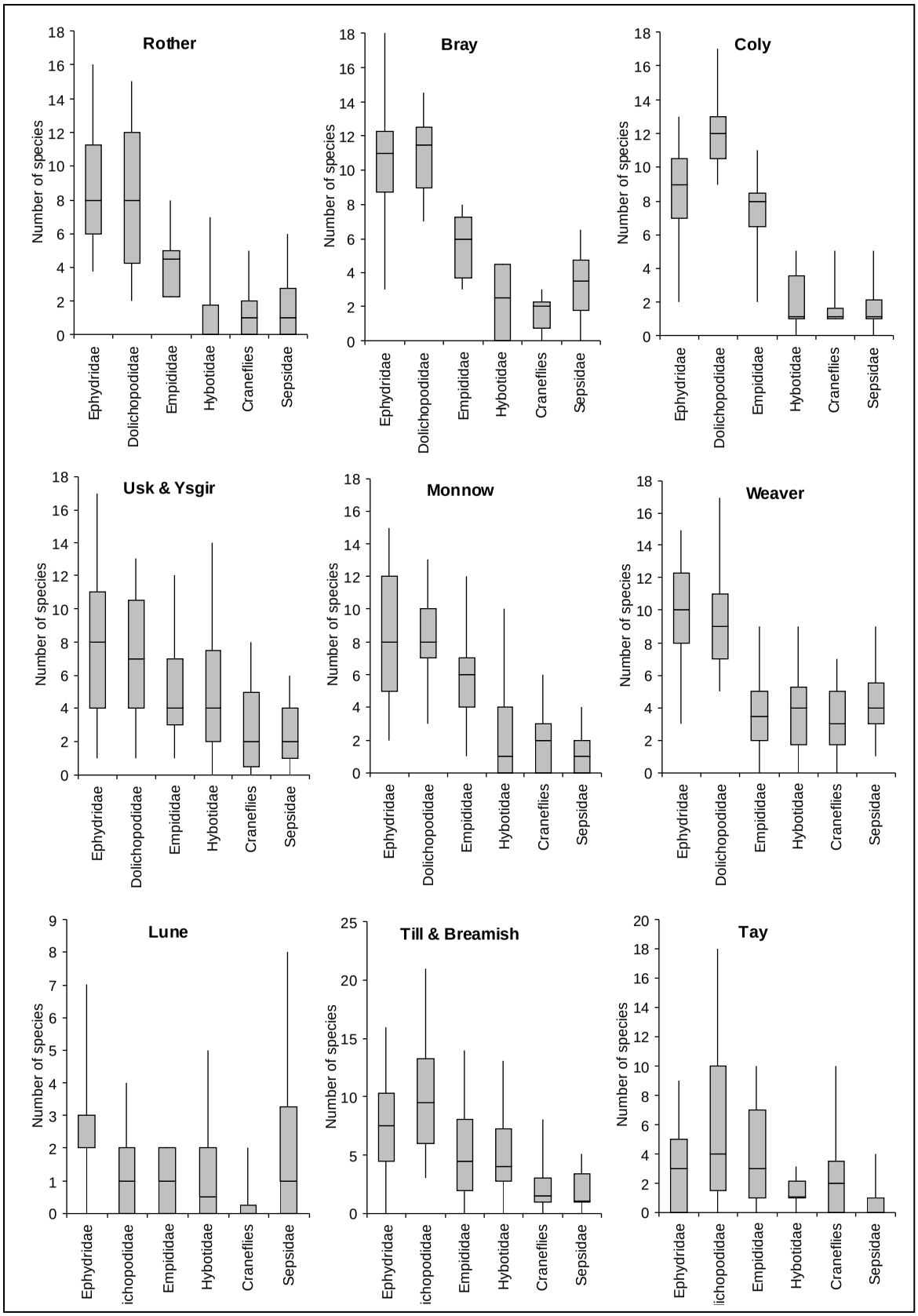


Figure 13. Median number of species in major families in some rivers. The grey box encloses the lower to upper quartiles; the bar gives the minimum and maximum range. Values from Table 3.

Table 2. Number of species in major families at each river.

	All Sites	% GB Fauna	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune 2006	Coquet	Till & Breamish	Glen	Tay	Spey
Samples	284		22	23	8	9	5	6	12	27	25	29	20	34	32	6	17	21
All flies[1]	848		238	263	156	155	101	144	171	303	280	254	137	279	313	99	140	143
Chloropidae	27	15	9	10	4	10	8	6	4	9	7	7	7	15	8	8		
Dolichopodidae	128	45	50	54	32	26	10	27	35	51	45	44	14	53	52	20	38	37
Empididae	72	35	24	18	14	13	6	16	20	32	31	19	6	15	35	7	22	20
Ephydridae	79	53	35	38	24	22	15	16	27	40	42	35	9	36	31	18	16	13
Hybotidae	66	38	15	17	11	10	8	13	13	33	32	20	9	24	31	8	8	14
Lauxaniidae	23	43	6	9	7	5	1	4	6	5	8	5	1	3	7	0		
Limoniidae	66	31	12	19	8	5	3	2	11	22	19	15	2	13	16	2	13	15
Lonchopteridae	6	86	5	4	3	5	3	3	3	5	5	3	1	4	4	3	2	2
Muscidae	34	12	3	2	7	6	5	7	8	9	7	12	9	13	15	5		
Opomyzidae	7	41	6	6	4	2	2	3	3	4	5	4	1	2	3	2	0	1
Sciomyzidae	23	34	5	10	0	0	0	2	3	6	6	9		10	10	2	1	6
Sepsidae	18	64	12	8	12	11	7	6	8	12	11	14	12	17	10	7	8	1
Stratiomyidae	16	33	6	4	1	0	0	4	3	7	4	7	5	7	6	1		
Syrphidae	55	20	11	14	7	8	11	9	4	12	12	16	9	15	19	2	3	4
Tephritidae	21	28	4	7	0	4	2	2	0	6	3	2	2	4	3	1	5	2
Tipulidae	17	20	4	6	3	3	3	4	5	7	5	6	3	5	8	4	8	6

Table 2 continued

	All Sites	% GB Fauna	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune 2006	Coquet	Till & Breamish	Glen	Tay	Spey
Status																		
New[2]	13		3	3	1	2	1	1	1	2	2	5	3	3	2	1	0	0
Rare	41		6	5	4	2	0	2	4	15	11	7	2	10	10	3	9	7
Scarce	63		14	10	9	12	8	6	9	22	17	15	3	15	21	5	8	12
Local	285		72	86	52	51	32	49	57	89	75	82	22	82	102	35	47	43
Common	396		141	157	84	83	55	81	95	173	172	136	81	147	167	52	74	68
Unknown	50		2	2	5	5	5	5	5	2	3	9	26	12	12	3	2	13
ERS Fidelity																		
1 (total)	12		2	1	1	1	2	1	1	6	6	1	3	8	9	2	5	4
2 (high)	23		6	6	2	3	3	4	3	11	8	5	3	5	7	1	6	5
3 (moderate)	53		17	13	14	16	10	12	22	26	25	19	6	16	23	7	12	15
4 (wetland)	367		127	147	75	63	37	62	93	135	124	124	48	128	140	53	76	74
5 (tourist)	387		86	96	64	71	49	65	52	125	117	105	76	110	132	36	39	32

Notes: 1 – includes a few duplicated at genus level. 2 – Nine species definitely new to Britain.

Table 3. Median number (with lower and upper quartiles) of species in major families, rarity and ERS fidelity classes at each river (timed sweep samples only).

Scarce occurrences appear as "0 (0-0)" since they will be in the bottom quartile which is not given; empty cells are true absences.

	Rother		**Wey**		**Bray**		**Mole**		**Exe**		**Coly**		**Yarty**		**Usk & Ysgir**	
Number of samples	22		23		8		9		5		7		12		27	
All Diptera	37	(26-43.5)	38	(33.5-42.5)	48.5	(36-60.8)	35	(28-38)	29	(28-45)	46	(41-56)	44	(28-53)	41	(27.5-47.5)
Chloropidae	1	(1-2)	1	(1-2.5)	0	(0-1.3)	2	(1-4)	4	(3-4)	0	(0-2)	0	(0-1)	0	(0-1)
Dolichopodidae	8	(4.3-12)	8	(4-11.5)	11.5	(9-12.5)	6	(4-8)	4	(2-5)	12	(10.5-13)	10.5	(8.3-14.3)	7	(4-10.5)
Empididae	4.5	(2.3-5)	3	(2-4)	6	(3.8-7.3)	3	(2-4)	4	(2-4)	8	(6.5-8.5)	4.5	(1.8-7)	4	(3-7)
Ephydridae	8	(6-11.3)	8	(5.5-11.5)	11	(8.8-12.3)	9	(4-11)	7	(3-8)	9	(7-10.5)	10.5	(6-12)	8	(4-11)
Hybotidae	0	(0-1.8)	1	(0-2)	2.5	(0-4.5)	1	(0-3)	2	(1-4)	1	(1-3.5)	0.5	(0-3.5)	4	(2-7.5)
Lauxaniidae	0.5	(0-1)	1	(1-1.5)	0	(0-0.5)	0	(0-1)	0	(0-0)	1	(0-1.5)	0	(0-0)	0	(0-0)
Lonchopteridae	2	(1-2)	2	(2-2)	2	(1-2)	1	(0-2)	1	(0-1)	1	(1-1)	1	(0-1.3)	0	(0-1)
Muscidae	0	(0-0)	0	(0-0)	2.5	(2-3)	1	(1-3)	2	(1-2)	2	(1-2)	1	(1-2)	1	(0-2)
Opomyzidae	1.5	(1-2)	1	(0.5-2.5)	0.5	(0-2.3)	0	(0-1)	1	(0-1)	1	(0-1)	0.5	(0-1.3)	0	(0-1)
Sciomyzidae	0	(0-0)	0	(0-1.5)							0	(0-0.5)	0	(0-0.3)	0	(0-0)
Sepsidae	1	(0-2.8)	1	(0-1)	3.5	(1.8-4.8)	3	(0-3)	3	(2-3)	1	(1-2)	3	(1.8-4)	2	(1-4)
Stratiomyidae	0	(0-0)	0	(0-1)	0	(0-0)					1	(0.5-1.5)	1	(0-1)	0	(0-1)
Syrphidae	0	(0-1)	1	(0-1.5)	1	(0-1.3)	2	(1-4)	3	(2-6)	1	(0.5-3.5)	0	(0-0)	0	(0-1)
Tephritidae	0	(0-0.8)	0	(0-1)			0	(0-0)	0	(0-1)	0	(0-0.5)			0	(0-1)
Craneflies	1	(0-2)	1	(0.5-2)	2	(0.8-2.3)	1	(0-2)	1	(0-2)	1	(1-1.5)	1	(0.8-4.3)	2	(0.5-5)
Status																
New	0.5	(0-1)	0	(0-1)	0	(0-0)	1	(0-1)			1	(0-1)	0.5	(0-1)	0	(0-0)
Rare	0.5	(0-1)	0	(0-0.5)			1	(0-1)	0	(0-1)			0	(0-1)	1	(0.5-2)
Scarce	1.5	(0-2)	1	(0-1)	2.5	(1.8-3)	2	(1-2)	2	(1-3)	2	(1-3)	1	(1-1.3)	3	(1-3)
Local	7	(5-11.8)	7	(6-10.5)	7.5	(7-9.5)	6	(2-8)	9	(7-9)	14	(10.5-15.5)	14	(5.5-19)	10	(6-14)
Common	22.5	(18.3-31)	28	(22.5-32)	34	(25.8-45)	28	(16-32)	18	(17-31)	31	(25.5-36.5)	26	(20.8-30.8)	24	(18-30.5)
Unknown	0	(0-0)	0	(0-0)	0	(0-0)	1	(0-1)	0	(0-0)	0	(0-0)	0	(0-0)	0	(0-0)
ERS Fidelity																
1 + 2 (total+high)	1	(0.3-1.8)	0	(0-1)	2	(1.8-2)	1	(0-2)	2	(1-2)	2	(1-2.5)	1	(0.8-1)	2	(2-3)
3 (moderate)	1.5	(1-3)	1	(0-3)	4	(3-7)	4	(3-5)	3	(2-3)	5	(3.5-5.5)	6	(2.5-8.3)	4	(3-6)
4 (wetland)	23	(16.3-26.5)	23	(20-25)	26	(24-28)	15	(13-25)	12	(12-16)	25	(23.5-28)	26	(21.8-30.3)	19	(11-22.5)
5 (tourist)	10	(6-15)	13	(9-19)	12	(7.5-22.8)	14	(4-23)	16	(9-22)	15	(8.5-22)	6	(3.8-13.3)	10	(8-14.5)

Table 3. Continued.

	Monnow		Weaver		Lune		Coquet		Till & Breamish		Glen		Tay		Spey	
Number of samples	25		28		20		34		32		6		15		21	
All Diptera	42	(35-47)	43.5	(37-60)	13	(8-20)	29	(19-41)	39.5	(28.8-59.5)	31.5	(24.8-39.8)	20	(8-27.5)	14	(8-17)
Chloropidae	0	(0-1)	1	(1-2)	1	(0-1.3)	0	(0-1)	1	(0-2.3)	2	(0.3-3)				
Dolichopodidae	8	(7-10)	9	(7-11)	1	(0-2)	6	(4.3-10.3)	9.5	(6-13.3)	10	(6.3-13)	4	(1.5-10)	3	(2-6)
Empididae	6	(4-7)	3.5	(2-5)	1	(0-2)	2.5	(2-3.8)	4.5	(2-8)	2.5	(2-3)	3	(1-7)	2	(1-3)
Ephydridae	8	(5-12)	10	(8-12.3)	3	(2-3)	6	(3-7.8)	7.5	(4.5-10.3)	6.5	(2.3-10)	3	(0-5)	1	(0-3)
Hybotidae	1	(0-4)	4	(1.8-5.3)	0.5	(0-2)	2.5	(1-4)	4	(2.8-7.3)	2.5	(2-3.8)	1	(1-2)	2	(1-2)
Lauxaniidae	1	(0-1)	0	(0-1.3)	0	(0-0)	0	(0-0)	0	(0-1)						
Lonchopteridae	1	(1-2)	1	(1-2)	0	(0-0)	0	(0-1)	1	(0-1.3)	0.5	(0-1)	0	(0-0)	0	(0-0)
Muscidae	1	(0-1)	1	(1-3)	1	(0-1.3)	2	(1-3)	2	(1-4)	1	(0.3-1.8)				
Opomyzidae	0	(0-1)	1	(0.8-2)	0	(0-0)	0	(0-0)	0	(0-1)	0	(0-0.8)			0	(0-0)
Sciomyzidae	0	(0-1)	0	(0-1)			0	(0-0)	0	(0-1)	0	(0-0.8)	0	(0-0)	0	(0-1)
Sepsidae	1	(0-2)	4	(3-5.5)	1	(0-3.3)	2	(1-3.8)	1	(1-3.3)	1.5	(0.3-2.8)	1	(0-1)	0	(0-0)
Stratiomyidae	1	(0-1)	0	(0-1.3)	0	(0-1)	0	(0-1)	0	(0-1)	0	(0-0)				
Syrphidae	0	(0-1)	1	(0-3)	0.5	(0-1)	0	(0-1)	1	(0-2)	0	(0-0.8)	0	(0-0)	0	(0-0)
Tephritidae	0	(0-0)	0	(0-0)	0	(0-0)	0	(0-0)	0	(0-0)	0	(0-0)	0	(0-0.5)	0	(0-0)
Craneflies	2	(0-3)	3	(1.8-5)	0	(0-0.3)	2	(0-3)	1.5	(1-3)	1.5	(0.3-2)	2	(0-3.5)	2	(0-2)
Status																
New	0	(0-1)	1	(0-1)	0	(0-1)	0	(0-0)	0	(0-1)						
Rare	1	(0-1)	0	(0-1)	0	(0-0)	0	(0-1)	1	(0-1)	0	(0-0)	0	(0-1)	0	(0-1)
Scarce	3	(2-3)	1	(1-2)	0	(0-1)	1	(1-1)	2	(1-3)	0.5	(0-1)	1	(0-1)	0	(0-1)
Local	11	(9-13)	9.5	(6.8-12.3)	1	(1-3.3)	7	(5.3-9.8)	11	(7-15)	6.5	(5-9.5)	6	(3-9.5)	3	(1-6)
Common	25	(20-28)	34.5	(26.8-47)	8.5	(7.3-15)	18.5	(11.3-30.5)	27.5	(18-40.3)	24.5	(22.3-26.8)	11	(4.5-17)	9	(4-11)
Unknown	0	(0-0)	0	(0-0)	1	(0-3)	0	(0-1)	0	(0-1)	0	(0-0)	0	(0-0)	0	(0-0)
ERS Fidelity																
1 + 2 (total+high)	2	(1-2)	1	(0.8-2)	1	(0-1)	1	(0.3-2)	2	(1-2)	0.5	(0-1.8)	1	(0-1.5)	0	(0-1)
3 (moderate)	6	(5-7)	3	(2-5.3)	0	(0-1)	3	(2-4)	5	(3-6.3)	2	(1.3-2.8)	2	(1-3)	1	(0-2)
4 (wetland)	21	(18-22)	24.5	(20.8-28.5)	7.5	(4.8-11)	13	(9.3-26.8)	20.5	(14.8-33)	20.5	(10.3-27)	10	(4.5-18)	7	(4-13)
5 (tourist)	9	(7-21)	16	(10.3-26.8)	4	(1-8.8)	9.5	(2-14.8)	13.5	(7.8-20.5)	11.5	(5.3-15.5)	5	(1-6.5)	2	(2-4)

Rare and scarce species

A surprisingly large number of species of conservation concern were recorded. Among these were at least eight new to Britain, 40 Red Data Book or probably equivalent status, and 64 nationally scarce (Table 4). The key findings are summarised here; generalised species accounts are given in Appendix 1.

Six species new to Britain and one new to science appear to be correctly identified and can be named. These are the limoniid cranefly *Rhabdomastix eugeni* (Lune: Caton), empids *Hilara aartseni* Chvála (Wey, Rother, widespread) and *Hilara tenella* Chvála (Wey: Tilford), the dolichopodids *Asyndetus latifrons* Loew (Lune: Lower Broomfield; Coquet: Hepple) and *Rhaphium suave* (Loew) (Usk: Great Hardwick; Till: Doddington Bridge) and the carnid *Meonura anceps* (Lune: Lower Broomfield). A scatopsid in the genus *Rhegmoclemina* is new to science and will be described in due course (Lune: Lower Broomfield, Caton).

Species whose identities are uncertain but which appear to be new to Britain or undescribed are ephydrids and hybotids. Five species are recorded as British in the genus ephydrid genus *Ditrichophora* but one very clearly different species (perhaps *bezzi* Becker) and another two or three were distinguished. European literature is of little help since the different species are best confirmed using genitalia but published illustrations do not exist. The large hybotid genus *Platypalpus* includes some species that are difficult to identify. At least four species that may not be on the British list were distinguished. One appeared to be the species *P. biapicalis* Weber added by Drake (1989) on the basis of a single female, but closer examination of several specimens from the Breamish (Brandon) suggests that this is not *biapicalis* of European literature but a possibly undescribed species. Another specimen could be *velocipes* (Frey). These species have been retained in the analysis but they make little difference to the overall conclusions about the value of ERS or particular rivers. Two *Ditrichophora* could not be ignored in the analysis since they were widespread and sometimes numerous.

Two species recognised as British only very recently were recorded at several sites. The tiny hybotid *Tachydromia edenensis* was described from specimens collected in 2000 on ERS on the Eden in Cumbria (Hewitt & Chvála, 2002); it was found on the Coquet (Hepple), Till (Doddington Bridge), Lune (Caton) and Tay (Westhaugh). The limoniid cranefly *Hoplolabis yezoana* was recorded from the Kingwater river and River Irthing in Cumbria in 2004 (Parker, 2006); it was found on the Usk (Llanvihangel Gobion, Great Hardwick, Scethrog), the Coquet (Ryehill), Till (Doddington Bridge) and Tay (Kercock).

Thirty two species with published or proposed Red Data Book status were identified. One of these, the dolichopodid *Melanostolus melancholicus*, has been demoted to Nationally Scarce in the recent review using IUCN classification (Falk & Crossley, 2005). The dolichopodid *Hydrophorus viridis* was a single female but appeared to be correctly identified. Another five ephydrids have been given RDB status based on the author's experience, and some of these may in future be shown to be over-rated.

Fifty-five species have the published status of Nationally Scarce, and another six ephydrids have been given this status here.

Over half of the Red Data Book species are particularly relevant to ERS, either because they are thought to have moderate to high affinity with the habitats (ERS fidelity classes 1 – 3), or because they were sufficiently frequent in the survey to suggest that they were riverine species, and perhaps closely tied with sandy substrates. This suite of species will be discussed under habitat fidelity. The remaining RDB species were 11 wetland species (ERS fidelity class 4) that rarely occurred at more than two sampling points, and five non-wetland species (ERS fidelity class 5).

Most of the Nationally Scarce species were wetland specialists, and of these 14 have total to moderate fidelity to ERS (ERS fidelity classes 1 – 3). Another 38 species are general wetland species or riverine species with a fairly wide tolerance of conditions, and of these only *Melanochaeta pubescens*, *Gymnoclasiopa cinerella*, *G. plumosa*, *Platypalpus articulatus*, *P. subtilis*, *Eleophila apicata* and *Hilara media* occurred several times. The two *Gymnoclasiopa* species and *Platypalpus articulatus* may be more closely tied to ERS than suggested by their score given here. There were only nine scarce 'tourists' to sandy ERS.

Thus the bulk of the more frequently occurring rare and scarce species have moderate to strong affinity with ERS or sandy river conditions, and nearly all non-ERS specialists were poorly represented and infrequent. This suggests that the habitat provides fairly stringent living conditions.

All three species listed on the BAP were recorded, although with the complication that *Rhabdomastix laeta* of the BAP literature was found, in the course of this and related work, to comprise three species: *R. laeta*, *R. japonica*, *R. eugeni* (Project 4: see Godfrey, 2007).

Summary

- 32 rare and 55 nationally scarce species were recorded, and another 11 ephydrids were allocated provisionally to these statuses.
- Six species were new to Britain: *Hilara aartseni*, *H. tenella* (Empididae), *Asyndetus latifrons* and *Rhaphium suave* (Dolichopodidae), *Meonura anceps* (Carnidae) and *Rhabdomastix eugeni* (Limoniidae). A scatopsid in *Rhegmoclemina* is new to science.
- Several clearly 'new' species of ephydrid were recognised, as were several *Platypalpus*.
- Two species found at several sites had been added to the British list only recently from other ERS surveys (*Hoplolabis yezoana*, *Tachydromia edenensis*).
- Over half of the Red Data Book species were related to ERS or sandy substrates.
- Most Nationally Scarce species were wetland specialists

Table 4. Species of conservation concern

The number of sampling points containing the species is given. Species are ordered alphabetically within family for each of the three main rarity statuses (new to Britain, RDB, Notable).

Species	Family	JNCC Status	IUCN Status	ERS Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Meonura anceps	Carniidae	New		5											1					
Asyndetus latifrons	Dolichopodidae	New		4											2	1				
Rhaphium suave	Dolichopodidae	New		2								1					1			
Hilara aartseni	Empididae	New		4	11	8														
Hilara tenella	Empididae	New		4		1														
Rhegmoclemina sp.nov.	Scatopsidae	New		4											1					
Rhabdomastix eugeni	Limoniidae	New		2											1					
Ditrichophora sp A (?bezzi)	Ephydridae	New		3	6	6						1	8							
Ditrichophora sp B of 2005	Ephydridae	?New		4	1															
Ditrichophora sp B of 2006	Ephydridae	?New		3			1	5		4	6			20		1	13			
Ditrichophora sp C of 2006	Ephydridae	?New		3										1						
Platypalpus ?biapicalis	Hybotidae	RDBK?		0													1	1		
Platypalpus ?velocipes	Hybotidae	?New		5									2							
Platypalpus near *annulipes*	Hybotidae	?New		0				1												
Platypalpus near *flaviventris*	Hybotidae	?New		0										1						
Platypalpus near *pallidiventris*	Hybotidae	?New		0												1				
Eutolmus rufibarbis	Asilidae	pRDB3		5		1														
Dioctria cothurnata	Asilidae	RDB3		5															1	
Laphria flava	Asilidae	RDB3		5																1
Diaphorus hoffmannseggii	Dolichopodidae	RDB I	LRnt	2	10	3							1							
Hydrophorus ?viridis female	Dolichopodidae	RDB3	LRnt	4								1								
Melanostolus melancholicus	Dolichopodidae	pRDB3	LRns	3				5			1		3							
Rhaphium penicillatum	Dolichopodidae	pRDB3	LRnt	3				1			1			2						
Heleodromia irwini	Empididae	pRDB1	DD	4																2
Wiedemannia phantasma	Empididae	pRDB3	LRnt	3																1

Species	Family	JNCC Status	IUCN Status	ERS Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Athyroglossa ordinata	Ephydridae	pRDB1		1					2			13	1							
Ditrichophora nectens	Ephydridae	RDBK?		4								1	1							
Hecamedoides unispinosus	Ephydridae	RDB2?		1								7				5	1			
Hyadina scutellata	Ephydridae	RDB2?		4								1								
Polytrichophora duplosetosa	Ephydridae	RDB3?		3	2	3		3	1		2	7	3	6						
Scatella obsoleta	Ephydridae	pRDB2		1												3	9	1	1	3
Scatophila unicornis	Ephydridae	RDBK?		4								2								
Platypalpus melancholicus	Hybotidae	pRDB3	LRnt	3	1							4	3							
Tachydromia costalis	Hybotidae	pRDB3	LRnt	1	1	1							5			1	1			
Tachydromia edenensis	Hybotidae	RDBK		1								2			1	1	1		1	
Tachydromia woodi	Hybotidae	RDB I	LRnt	2								2					2			
Homoneura limnea	Lauxaniidae	RDB2		4								2								
Arctoconopa melampodia	Limoniidae	RDB2		4													1			
Dicranomyia omissinervis	Limoniidae	RDB2		4															4	
Hoplolabis yezoana	Limoniidae	RDBK		2								6				2	3		1	
Limnophila pictipennis	Limoniidae	pRDB2		4									1							
Ormosia ruficauda	Limoniidae	?RDBK		5																1
Rhabdomastix inclinata	Limoniidae	RDB2		3																1
Rhabdomastix japonica	Limoniidae			4															1	5
Rhabomastix laeta	Limoniidae			1													1			
Cosmetopus dentimanus	Scathophagidae	RDB1		3									1							
Themira biloba	Sepsidae	pRDBK		4												1		1		
Oxycera terminata	Stratiomyidae	RDB2		1								1	12							
Parhelophilus consimilis	Syrphidae	RDB2		4													1			
Gymnosoma rotundatum	Tachinidae	pRDB3		5	1															
Cliorismia rustica	Therevidae	RDB3		2	2	1						1	1						1	
Spiriverpa lunulata	Therevidae	RDB3		1								1			3	5	4		3	1
Anagnota bicolor	Anthomyzidae	Notable		4									2	3						
Dioctria oelandica	Asilidae	Notable		5															1	
Melanochaeta pubescens	Chloropidae	Notable		4	10	9			1											

Species	Family	JNCC Status	IUCN Status	ERS Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Diogma glabrata	Cylindrotomidae	Notable		4															1	
Argyra auricollis	Dolichopodidae	Notable	LRns	5													1			
Campsicnemus pumilio	Dolichopodidae	Notable	LRns	4	1	1						1								
Dolichopus argyrotarsis	Dolichopodidae	Notable	LRns	3																3
Hercostomus plagiatus	Dolichopodidae	Notable	LRns	4		1									1					
Rhaphium fractum	Dolichopodidae	Notable	LRns	3								1	1				3		1	1
Rhaphium micans	Dolichopodidae	Notable	LRns	4					2											
Rhaphium rivale	Dolichopodidae	Notable	LRns	3								1			1					
Stegana nigrithorax	Drosophilidae	Notable		5	1															
Chelifera concinnicauda	Empididae	Notable	LRns	3																1
Hilara albiventris	Empididae	Notable	LRns	3	6		3					8	10	4		1	2			
Hilara biseta	Empididae	Notable	LRns	2	4		3	1		2		7	5	5						
Hilara diversipes	Empididae	Notable	LRns	4													2			
Hilara media	Empididae	Notable	LRns	4						1	1	1	2							
Hilara pseudochorica	Empididae	Notable	LRns	3	2		8	9	5	7	10	24	22	5			10		2	1
Rhamphomyia lamellata	Empididae	Notable	LRns	4									1						3	
Gymnoclasiopa collini	Ephydridae	Notable		4									1							
Gymnoclasiopa plumosa	Ephydridae	Notable		4	5	2								7						
Scatophila noctula	Ephydridae	Notable		4								1	2							
Diclasiopa lacteipennis	Ephydridae	Notable?		4				1						4						
Gymnoclasiopa cinerella	Ephydridae	Notable?		4												1	2			
Scatella silacea	Ephydridae	Notable?		4			1							2						
Platypalpus articulatoides	Hybotidae	Notable	LRns	4									3							
Platypalpus articulatus	Hybotidae	Notable	LRns	4	1							5	2			1	7	1		
Platypalpus luteolus	Hybotidae	Notable	LRns	4								1	2							
Platypalpus subtilis	Hybotidae	Notable	LRns	4								3	7				3			
Tachydromia halidayi	Hybotidae	Notable	LRns	1								4	1		6	5			1	1
Homoneura thalhammeri	Lauxaniidae	Notable		4	1															
Sapromyza albiceps	Lauxaniidae	Notable		5										1						
Sapromyza opaca	Lauxaniidae	Notable		5												1	1			

Species	Family	JNCC Status	IUCN Status	ERS Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Cheilotrichia imbuta	Limoniidae	Notable		4			1					1	3	1						
Dicranomyia ventralis	Limoniidae	Notable		4																1
Eloeophila apicata	Limoniidae	Notable		4													1		1	4
Eloeophila mundata	Limoniidae	Notable		5								1								
Gonomyia bifida	Limoniidae	Notable		4								1								
Limonia trivittata	Limoniidae	Notable		4		2														
Pilaria fuscipennis	Limoniidae	Notable		4								1								
Pilaria meridiana	Limoniidae	Notable		4																1
Lonchoptera meijeri	Lonchopteridae	Notable		3	4			1	1			5	13				1			1
Lonchoptera nigrociliata	Lonchopteridae	Notable		1	5		4	2		3	3	6	14	1		1	5	1		
Lonchoptera scutellata	Lonchopteridae	Notable		4		1														
Micropeza lateralis	Micropezidae	Notable		5															1	1
Limnophora scrupulosa	Muscidae	Notable		3												25	16	1		
Lispocephala spuria	Muscidae	Notable		4													3			
Conisternum decipiens	Scathophagidae	Notable		5										7						
Colobaea bifasciella	Sciomyzidae	Notable		4								1								
Colobaea punctata	Sciomyzidae	Notable		4								1								
Pherbellia brunnipes	Sciomyzidae	Notable		4													1			
Pherbellia nana	Sciomyzidae	Notable		4		1														
Psacadina verbekei	Sciomyzidae	Notable		4		2														
Tetanocera punctifrons	Sciomyzidae	Notable		4										1						
Themira gracilis	Sepsidae	Notable		3	1												1			
Oxycera morrisii	Stratiomyidae	Notable		4	1															
Neoascia geniculata	Syrphidae	Notable		4		1														
Tabanus cordiger	Tabanidae	Notable		2					1											1
Campiglossa absinthii	Tephritidae	Notable		5								2								
Dioxyna bidentis	Tephritidae	Notable		4	3	2														
Nephrotoma dorsalis	Tipulidae	Notable		2					1	1		3								1
Percentage of total list					9.7	6.8	9.0	10.3	8.9	6.3	8.2	12.9	10.7	10.6	5.8	10	10.5	9.1	13	14

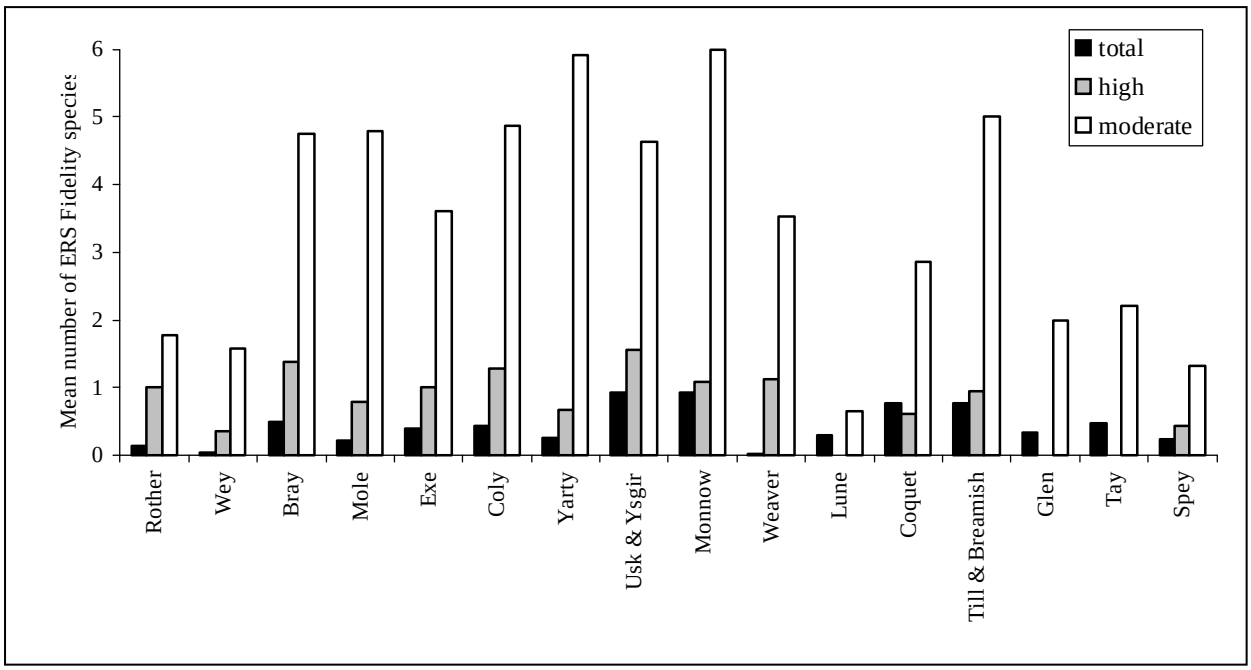
Affinity to ERS

The classes allocated to some species need comment. In order to allow comparison with earlier surveys, few changes have been made to the scores first allocated for the survey of Devon rivers (Bell *et al*., 2004). The species new to Britain, *Rhaphium suave* and *Ditrichophora* sp A and B, have been given scores on the basis of where the species where found in several ERS surveys. *Rhaphium suave* was also found in 2005 at sandy ERS on the River Dane in the week previous to the Usk visit (Bates *et al*., 2006), and in a very similar situation that suggested that bare wet sandy shore close to vegetation was the preferred habitat. *Ditrichophora* sp A and B were nearly as widespread as *D. palliditarsis*, and have clearly been confused with this species in the past, so it seems appropriate to give them a similar rating. *Hoplolabis yezoana* was added to the British list in 2005 based on specimens from Cumbrian ERS (Hewitt *et al*., 2005; Parker, 2006), and was frequent on the sandy ERS of the Dane and Bollin in Cheshire in 2005 (Bates *et al.*, 2006); these occurrences suggest that the species is as strongly tied to sandy rivers as the two commoner *Hoplolabis* species. Some species, such as *Hilara pseudochorica*, *Campsicnemus marginatus*, *Dolichopus longicornis* and *Melanostolus melancholichus*, are reputedly closely associated with ERS but are also occasionally found in different habitats, hence are given only moderate rating (class 3); however, their consistent occurrence at river margins in recent surveys suggests that some of them could perhaps be placed in class 2. Class 3 also includes some common species such as *Dixa* species whose larval habitat makes them obviously associated with water margins, although not necessarily with ERS.

Eighty-four species fell into fidelity classes with total (1) to moderate (3) affinity with ESR (Tables 2 and 5). Eleven had total affinity, and these were predominantly from the Welsh and Northumberland rivers which supported 6-9 of these species. The Spey and Tay had 4-5 such species, the Lune three and the remaining rivers only 1-2 species. Even when the five Devon rivers were treated as a single unit, they supported were only three species with total fidelity. By comparison, there was a smaller disparity between rivers in the number of species with high or moderate affinity (classes 2 and 3), although the Welsh rivers and Till/Breamish were still the most outstanding.

To take account of difference in sampling effort, the mean numbers of these species per sample were calculated and shown graphically for clarity (Table 3, Figure 14). The results for species with total fidelity were similar to those based on total numbers of species in each river, that is, the Welsh and larger Northumberland rivers were notably richer than the others, and the small sandy rivers (Rother, Wey, Weaver) were exceptionally poor in these species. The mean numbers of species with high fidelity were somewhat erratic, and no sensible generalisations are possible. For species with moderate fidelity, the Rother and Wey were clearly rather poorer than other rivers sampled by Martin Drake but there were only rather small differences (except for the Coquet) between the other rivers. Low numbers in the Lune, Tay and Spey may reflect differences in sampling technique used by the other surveyors since the mean numbers are far below what would be expected from such rivers; even the Glen bettered the Spey on this criterion, which is clearly ridiculous. However, the timing of the survey work, late in the season, exacerbated by exceptionally hot weather, was probably the significant factor effecting the low numbers of Diptera found on the extensive sun-baked ERS deposits of the big Scottish rivers.

Figure 14. Mean number of species in ERS fidelity classes 1 (total) to 3 (moderate) in each river.



Summary

- Species were allocated to ERS fidelity classes. Eleven species had total fidelity, 20 had strong fidelity and 54 had moderate fidelity.
- Welsh and Northumberland rivers supported most species in the top classes, and the Lune, Spey, Rother, Wey and Weaver supported the fewest ERS species.
- The average numbers per sample reflected the totals per river; Welsh and Northumberland rivers were richest in ERS specialists, and small sandy rivers (Rother, Wey, Weaver) were exceptionally poor.
- Differences in sampling technique between surveyors may explain low numbers on the Lune, Tay and Spey compared to other large rivers.

Table 5. Species with strong to moderate affinity with ERS.

Values are the number of sampling points with a species. For each fidelity classes, species are ordered alphabetically within family.

Species	Family	JNCC Status	IUCN Status	Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Ephydridae	*Athyroglossa ordinata*	pRDB2		1					2			13	1							
Ephydridae	*Hecamedoides unispinosus*	RDB2?		1								7				5	1			
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	5		4	2		3	3	6	14	1		2	5	1		
Stratiomyidae	*Oxycera terminata*	RDB2		1								1	12							
Limoniidae	*Rhabomastix laeta*	RDB?		1													1			
Ephydridae	*Scatella obsoleta*	pRDB1		1												3	9	1	1	3
Therevidae	*Spiriverpa lunulata*	RDB3		1								1			3	5	4		4	2
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	1	1							5			1	1			
Hybotidae	[*Tachydromia costalis* group]	RDB3		1												2	1			
Hybotidae	*Tachydromia edenensis*	RDBK		1								2			1	1	1		1	
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1								4	1		6	6			1	3
Hybotidae	*Tachydromia morio*	Local		1					1				2			5	2		1	2
Dolichopodidae	*Asyndetus latifrons*	New		2											2	1				
Ephydridae	*Athyroglossa glabra*	Local		2	5	3	8	4	3	5	6	18	15	13	8	14	19	3	3	3
Therevidae	*Cliorismia rustica*	RDB3		2	2	1						1	1						2	
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	1	3							1							
Limoniidae	*Hexatoma bicolor*	Local		2													1			
Limoniidae	*Hexatoma fuscipennis*	Local		2												3				
Empididae	*Hilara biseta*	Notable	LRns	2	4		3	1		2		7	5	5						
Limoniidae	*Hoplolabis areolata*	Local		2	3			2				6	3	14			2			
Limoniidae	*Hoplolabis* female	Unknown		2		2							3							
Limoniidae	*Hoplolabis vicina*	Local		2	2	1							1	1			3			
Limoniidae	*Hoplolabis yeozana*	RDBK?		2								6				2	3		1	
Tipulidae	*Nephrotoma analis*	Local		2		1				1	1	3		1					1	
Tipulidae	*Nephrotoma dorsalis*	Notable		2					1	1		3								1
Limoniidae	*Rhabdomastix edwardsi*	Local		2							1	1	1			2				1
Limoniidae	*Rhabdomastix eugeni*	New		2											1					

Species	Family	JNCC Status	IUCN Status	Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Limoniidae	*Rhabdomastix japonica*	RDBK?		2															2	5
Dolichopodidae	*Rhaphium elegantulum*	Local		2															1	1
Dolichopodidae	*Rhaphium nasutum*	Local		2															2	
Dolichopodidae	*Rhaphium suave*	New		2								1					1			
Tabanidae	*Tabanus cordiger*	Notable		2					1											1
Hybotidae	*Tachydromia woodi*	RDB I	LRnt	2								2					2			
Limoniidae	*Antocha vitripennis*	Local		3	1		1		2			3	6			1				
Dolichopodidae	*Campsicnemus marginatus*	Local		3				1		1	3	13	14	6		15	13	2	5	1
Empididae	*Chelifera concinnicauda*	Notable	LRns	3																1
Empididae	*Chelifera precatoria* group	Common		3							1			1						
Empididae	*Chelifera stigmatica*	Local		3								1					1			
Empididae	*Chelifera trapezina*	Local		3													1			
Scathophagidae	*Cosmetopus dentimanus*	RDB1		3									1							
Ephydridae	*Ditrichophora albifrons* var. of Collin	Unknown		3																
Ephydridae	*Ditrichophora palliditarsis*	Local		3	6	2				2	4	8	15							
Ephydridae	*Ditrichophora* sp A (?*bezzi*)	New		3	6	6						1	8							
Ephydridae	*Ditrichophora* sp B	New		3			1	5		4	6			2		1	13			
Ephydridae	*Ditrichophora* sp C	New		3										1						
Dixidae	*Dixa dilatata*	Common		3			1													
Dixidae	*Dixa nebulosa*	Common		3									1							
Dixidae	*Dixa nubilipennis*	Common		3								2								
Dixidae	*Dixa puberula*	Common		3								2								
Dixidae	*Dixella martinii*	Local		3																
Dolichopodidae	*Dolichopus argyrotarsis*	Notable	LRns	3																3
Dolichopodidae	*Dolichopus longicornis*	Local		3	4	3		1	2		1	12	3	15	3	11	18	2	11	9
Empididae	*Hemerodromia oratoria*	Local		3		1	1					5			1		1	2	1	2
Empididae	*Hemerodromia unilineata*	Local		3	1	3					3	2	11	5			3			
Dolichopodidae	*Hercostomus nanus*	Local		3		1				1	4		1	2						
Empididae	*Hilara albiventris*	Notable	LRns	3	6		3					8	1	4		1	2			

Species	Family	JNCC Status	IUCN Status	Fidelity	Rother	Wey	Bray	Mole	Exe	Coly	Yarty	Usk & Ysgir	Monnow	Weaver	Lune	Coquet	Till & Breamish	Glen	Tay	Spey
Empididae	*Hilara apta*	Local		3							1	2	8	1		1	5			
Empididae	*Hilara pseudochorica*	Notable	LRns	3	2		8	9	5	7	1	24	22	5			1		2	1
Athericidae	*Ibisia marginata*	Local		3			1													
Muscidae	*Limnophora exuta*	Local		3								1								
Muscidae	*Limnophora maculosa*	Local		3													1			
Muscidae	*Limnophora riparia*	Local		3			4	2	2	2	3		5	5	3	5	11			
Muscidae	*Limnophora scrupulosa*	Notable		3												25	16	1		
Muscidae	*Limnophora triangula*	Local		3			6	3	1	2	3			9						
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	4			1	1			5	13				1			1
Dolichopodidae	*Melanostolus melancholicus*	pRDB3	LRns	3				5			1		3							
Tipulidae	*Nephrotoma guestfalica*	Local		3							3	3	6	1		1	3		3	
Hybotidae	*Platypalpus interstinctus*	Local		3	3	1	2	2	3	1	4	15	6	7	7	4	12		2	1
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	1							4	3							
Hybotidae	*Platypalpus niger*	Local		3	2	2				2	4	11	3		(1)					
Ephydridae	*Polytrichophora duplosetosa*	RDB3?		3	2	3		3	1		2	7	3	6						
Limoniidae	*Rhabdomastix inclinata*	RDB2		3																1
Empididae	*Rhamphomyia lamellata*	Notable	LRns	3															3	
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3								1	1			1	3		1	1
Dolichopodidae	*Rhaphium penicillatum*	pRDB3	LRnt	3				1			1			2						
Dolichopodidae	*Rhaphium rivale*	Notable	LRns	3								1			1					
Dolichopodidae	*Teucophorus calcaratus*	Local		3	2	5	2	2	1	3	6	5	16	13		3	4			
Dolichopodidae	*Teucophorus monacanthus*	Local		3			4	1	1	5	4			1		2	13			1
Dolichopodidae	*Teucophorus simplex*	Local		3	7	8														
Sepsidae	*Themira gracilis*	Notable		3	1												1			
Therevidae	*Thereva handlirschi*	RDB3		3												1				
Tipulidae	*Tipula couckei*	Local		3	2	3	1	2		4	3	7	11	2	3	18	18	2	4	3
Tipulidae	*Tipula montium*	Common		3	4	3	3	5			3	6	9			7	5	2	2	3
Empididae	*Wiedemannia bistigma*	Local		3							1	1	1			1		1	1	2
Empididae	*Wiedemannia phantasma*	pRDB3	LRnt	3																1
Empididae	*Wiedemannia rhynchops*	Local		3													1			

Comments on habitat preferences of ERS and rare species

There were clear differences in the types of places where some of the species were collected. The key features are summarised here by comparing the values for variables in samples supporting the species with values for the whole dataset. Assessing the summary descriptions of each sampling point where the species was found was also useful (Table 44 gives most of these). The measure of these values were medians for continuous variables (e.g. channel width, percentage composition of sediments) or percentage occurrence (e.g. for type of ERS). These comparisons cannot be statistically compared owing to the non-random sampling and mixing of very different conditions on each river. The comments are therefore almost entirely qualitative. Only a few species were recorded often enough to allow conclusive deductions, but in view of the scarcity of information on most uncommon species, some infrequently occurring flies are mentioned here.

Athyroglossa glabra (Ephydridae) was almost always found on bare, wet unshaded ERS, usually close to the water's edge and not more than 2m away. For a widespread species, it is one of the best 'high fidelity' indicators.

Athyroglossa ordinata (Ephydridae) showed a marked preference for sites by wide channels and slow flows, where it was nearly always found on wet bare substrate close to the water's edge (although up to 10m away on one occasion), occasionally with sparse ruderal vegetation but not where there was continuous sand or tall herbs. The sites were always unshaded. There appeared to be no preference for substrate type.

Campsicnemus marginatus (Dolichopodidae) was nearly always found on flat, simple bare ERS that was nearly always wet, and close to the water (4m maximum). It was markedly scarce in the shade. The substrate was more cobbly and less sandy than average.

Diaphorus hoffmannseggii (Dolichopodidae). All but two specimens were females so the preferences relate mainly to this sex; males presumably normally live in the canopy. They were found on predominantly sandy shores that were nearly always wet, often in the shade of trees but sometimes in the open. There appeared to be no preference for the type of vegetation cover.

Diclasiopa lacteipennis (Ephydridae). Although this shore fly was very infrequently found, it may have a weak association with riverine habitat. The records were from fine sediments (sand, silt) that were bare or partially vegetated, or sometimes with taller marginal vegetation.

Ditrichophora palliditarsis (Ephydridae) was found on flat, simple sediments, a little more often than expected at the downstream end of bars and shores, and nearly always on wet substrate close to the water, and not more than 2m away from the water's edge. The ERS was most often bare or sometimes with continuous short sward but rarely dense tall herbs.

Ditrichophora sp A (Ephydridae) was absent next to fast flowing water and was notably more prevalent on small patches of sediment next to small channels. This was partly due to most samples coming from the Wey and Rother, where shores were small, but many Usk and Monnow samples followed this trend. It was found mostly on flat, wet ERS very close to the water's edge (no more than 1m distant), on bare sediment that sometimes had sparse ruderal vegetation but rarely any tall herbs. Most sites were shaded by trees.

Dolichopus longicornis (Dolichopodidae) was found mainly by slower flowing water of slightly larger channels. It was more often present away from the water's edge on often dry sediments, and more often in vegetated areas than on bare ground. The sites were usually unshaded.

Gymnoclasiopa plumosa (Ephydridae). The sites were on the Weaver, Rother and Wey which suggests a preference for these smaller rivers in sandy floodplains. The clear preference was for lightly shaded shores, that were usually sandy and bare or only sparsely vegetated.

Hecamedoides unispinosus (Ephydridae). Nearly all occurrences were at the water's edge on almost entirely bare, moderately sandy sediments. Several of the Northumberland records were of wet sandy shores by pools or slow backwaters where it was frequent, and this suggests that the species seeks fine sediment in areas where the ERS is predominantly stony, as at Hepple on the Coquet. Two individuals were taken from the stony ERS of the river's margin, and another was taken several metres inland of the river, but these were exceptions to the apparently preferred habitat.

Hilara aartseni (Empididae). All records were from the Wey and Rother where the samples were taken from wet, flat sandy shores with simple topography, and always at the water's edge. Most sites were shaded by trees. There appeared to be no preference for vegetation types, so there was no indication that the fly was associated with the bare substrate.

Hilara albiventris (Empididae). There were no clear preferences apart from the well known requirement for tree shade.

Hilara apta (Empididae) showed no obvious preferences although many sites were in the shade of trees and very few were sandy.

Hilara biseta (Empididae). This empid was found in several rivers with widely varying characteristics, and it showed no strong preference for substrate type, wetness or vegetation density, although it was taken rarely in well shaded areas, even when trees were present.

Hilara pseudochorica (Empididae). This empid was by far the most frequently occurring 'scarce' species, being found in over a third of samples and at most rivers (not the Lune or Wey). Although Plant (2004) suggested that this species is an obligate ERS species, the present results not suggest a preference for bare substrate, and was found as often as expected on sediments with all types of vegetation cover, and not confined to wet ERS or found markedly close to the water.

Hoplolabis areolata (Limoniidae) is given an ERS fidelity of 2 (high) but its occurrence was related more to vegetated shores and banks as to exposed ones. However, it was very closely associated with sand, with only one out of 36 sampling points being on other than sand or silt. The adults' preference for vegetation may therefore be a need for shelter, while the larvae may live in the wet sand at the river's edge.

Hoplolabis vicina (Limoniidae) was found far less often than *H. areolata*, and although several sites were on sand, some were from stony substrates. Although the sample is small, is appears to be less convincingly associated with sand than is *H. areolata*.

Hoplolabis yezoana (Limoniidae) was found at particularly sandy, but not necessarily silty, areas that were usually bare or had only sparse ruderal vegetation; one site was better vegetated.

Limnophora scrupulosa (Muscidae). This predatory muscid was not identified in 2005 samples so the summary of its preferences is abased on its widespread occurrence on the Northumberland rivers. Here is was most often found on wet stony edges but was not confined to the margin and was also found in the dry partially vegetated core of large areas of ERS. It was rare in the shade.

Lonchoptera meijeri (Lonchopteridae). Most of the records were from stony rather than sandy substrate, usually close to or at the shore, and mostly at bare or only lightly vegetated areas, although sometimes it was taken in dense tall herbs. It was rare in shaded areas.

Lonchoptera nigrociliata (Lonchopteridae). The results confirmed the known preference of this fly for shaded stony streams and small rivers (Drake, 1996, 2002).

Melanostolus melancholicus (Dolichopodidae). This small dolichopodid was infrequently found, but when present it appeared to have good populations, so that no clear preferences could be discerned apart from it occurring on wet shores. Particle size did not appear to influence its occurrence, which is surprising as the other habitat in which it is found is soft-rock cliffs; a preference for fine sediment would provide an ecological link between its river-edge and seepage habitats, but this does not seem to be the case.

Nephrotoma analis (Tipulidae) was infrequent but geographically widespread. It was only found in vegetated areas so was probably under-recorded. It showed no preference for sand or stones. Its ERS fidelity score of 2 may be too high.

Oxycera terminata (Stratiomyidae). This is the only soldierfly to show any affinity to river edges. It was confined to the Monnow where it was widespread. The sites were bare or nearly bare stony to cobbly shores. It was surprisingly faithful to this habitat where its larvae live in the shallow edges, and very few adults were taken in vegetated areas or on sandy or silty sediments.

Platypalpus articulatus (Hybotidae). This tiny hybotid appeared to show no obvious preferences, but perhaps being found more often on bare or sparsely vegetated areas than in dense vegetation.

Platypalpus interstinctus (Hybotidae). As with most other *Platypalpus*, this species was more frequent away from the water's edge and found more frequently in ruderal or dense herbaceous vegetation than on bare sediment. It may not have particularly high affinity to bare ERS but may only be associated with vegetation on disturbed ground.

Platypalpus melancholicus (Hybotidae) showed no clear pattern to its occurrence. It was found on average closer to the water's edge than other *Platypalpus* discussed in this section, so may be more closely associated with ERS than are others in the genus.

Platypalpus niger (Hybotidae) was more likely to be found away from the water's edge on dry substrate with ruderal or dense herbaceous vegetation, although sometimes also on bare wet substrate.

Platypalpus subtilis (Hybotidae) has been suggested as having moderate affinity with ERS. Like other *Platypalpus*, it was as likely to be found on dry substrate than on wet ground, and was notably frequent in continuous sward or dense tall vegetation, or even in scrub.

Polytrichophora duplosetosa (Ephydridae) was found at the water's edge on wet substrate which was more sandy or silty than usual, mainly or entirely bare or with some ruderal vegetation, and often, but not invariably, unshaded. It was rare on stony shores and in continuous swards and absent from dense tall herbaceous vegetation.

Rhaphium fractum (Dolichopodidae). The few records were all from bare unshaded wet shores of gravel or stones (not sand).

Scatella obsoleta (Ephydridae). The records for Northumberland rivers suggest a preference for finer substrate particles as it was particularly numerous on sandy or gravelly shores which were scarce here, although it was also present on pebbly and stony ERS. Nearly all the records at the wet river margin, and none was in the shade.

Tachydromia costalis (Hybotidae). As only males can be separated from *T. edenensis*, there were not many records to allow generalisations about habitat preference. The peak flight period of most *Tachydromia* is earlier than July when all rivers were sampled in the survey, so the genus was probably under-recorded. It appeared to prefer dry areas, usually on fine sediment, and usually partly or even densely vegetated.

Tachydromia halidayi (Hybotidae). This tiny fly was almost confined to stony and cobbly unshaded shores, usually close to the water's edge but sometimes on dry area with pioneer vegetation.

Teucophorus calcaratus (Dolichopodidae). This wetland dolichopodid is found in many habitats but occurs often by rivers. It was usually found quite close to the water's edge, although as far as 3m on occasions, and showed a preference for fine sediment, or when this was not obviously sand or silt, then on stone by quiet backwater or pools where there may be similar characteristics to the surface of the wet stones where the larvae presumably live. The sites were entirely bare or had some vegetation, and particularly marginal plants. It was a little more frequent in sites shaded by trees.

Teucophorus monacanthus (Dolichopodidae) was frequently found and showed a fairly strong preference for are wet margins composed of any particle size from sand to cobbles. It was rarely found on vegetated areas. This preference contrasts with that of *T. calcaratus*., and it may be a candidate for having a higher ERS fidelity score (i.e. raise to 2, 'high').

Teucophorus simplex (Dolichopodidae) was recorded at the water's edge on wet substrate that was usually bare or had sparse ruderal vegetation but only rarely dense tall vegetation. The sites were nearly all shaded by trees.

Tipula couckei (Tipulidae). There appeared to be no pattern to the occurrence of this widespread cranefly, and this may reflect the high activity of this large fly. However, it was often found on bare wet shores where other large craneflies were rarely found so an ERS fidelity of 2 may be justified. It was as frequent on sandy shores as stony ones.

Tipula montium (Tipulidae). In contrast to *T. couckei*, *T. montium* was almost never found on bare shores but only where there was vegetation.

Description of the fauna of each river

Wey: Surrey & Hampshire

The Wey originates in the Hampshire Downs and flows north-eastwards to join the Thames. All the sampled sites were on sand which comprised almost all the substratum at all but two sampling points, where gravel or pebbles dominated. Tall vegetation was characteristic of all sites and it squeezed the exposed sediment into narrow shores (0.5 – 2m wide, with two being 3m wide). Two thirds of sampling points, scattered throughout the river, had some form of disturbance, either by grazing animals or people (fishermen, dog-walkers, children), and these agencies were responsible for most of the exposed sand away from the wet water margin. There were few natural eroding sandy banks. The site was visited in 2005.

The principal difference between the sites and sampling points was due to shading by trees. Bordon, the most upstream, was the least similar to the others in being a small woodland stream with very tiny bare shores. Several Tilford and two Eashing sampling points were also heavily shaded by riverside trees. The river at Thundry Meadows was close to the bank tops so the soil was saturated enough for marsh vegetation to have developed at all areas that may otherwise have been ERS.

Although 18 rare and scarce species were found, only five of them have some affinity with ERS (Table 6). Most are wetland species with varying degrees of habitat specificity, but the asilid *Eutolmus rufibarbis* is a species of dry heathland with no connection to wetlands at all. Only two of the rare or scarce species were widespread along the river, and remarkably one of them, *Hilara aartseni*, is recorded new to Britain in this survey. It was found at all sites except Thundry Meadows where the small number of samples and lack of shade are probably the reasons for not finding it. The other widespread species was *Melanochaeta pubescens*, which appears to be far too common to warrant scarce status. The only other uncommon species at more than two sites was *Ditrichophora* sp A, which is also new to Britain but was found frequently in the survey and has been confused with the slightly more common *D. palliditarsis*.

Among the other rare or scarce species was *Hilara tenella* which is also new to Britain in this survey, recorded at Tilford at a shore with dense tall vegetation under the shade of riverside trees. *Polytrichophora duplosetosa* was unexpected at Bordon on the narrow tiny scraps of shore in woodland.

Only one species with moderate fidelity to ERS (class 3), *Teucophorus simplex*, was widespread, although *T. calcaratus*, *Dolichopus longicornis* and *Ditrichophora* sp A were present at three sites (Table 7). Most species with strong or total fidelity to ERS were found infrequently. The most interesting of these were *Cliorismia rustica* at Eashing and *Diaphorus hoffmannseggii*, of which a male was recorded among females at Bordon. The only males of *Hoplolabis* were of *vicina*, which is usually regarded as a northern species, although unidentified females were present at more sites; no males of the predominantly southern *areolata* were found.

Given the patchy occurrence of uncommon and ERS species, it is difficult to draw conclusions about which sites were most favourable to Diptera. The representation of uncommon and ERS species was approximately as expected for the sampling effort expended but with some unexplained variations. Thus, although at Bordon fewer species were recorded than expected for the effort, it still had a moderate number of scarce and ERS species, whereas at Tilford, where no suction samples were taken, there were notably fewer ERS species (Table 8). However, there seems little doubt that Frensham and Eashing supported the most interesting ERS fauna, followed unexpectedly closely by Bordon.

The Wey has been canalised in response to severe flooding in the 1960s and 1970s, particularly shortly upstream of Godalming. This appears to have had the effect of reducing the deposition of sand, so that old deposits have long since been stabilised and covered in vegetation. It is likely that this has reduced an ERS interest that may have been better developed in the past.


Bordon 2


Frensham 3


Tilford 1. Similar to Hilara tenella site


Eashing 3. Cliorismia site

Table 6. Rare and scarce species from the Wey.

Family	Species	Status		ERS Fidelity	Bordon	Frensham	Tilford	Thundry	Easing
		JNCC	IUCN						
Empididae	*Hilara aartseni*	New		4	3	1	2	-	2
Empididae	*Hilara tenella*	New		4	-	-	1	-	-
Ephydridae	*Ditrichophora* sp A	New		3	4	1	-	-	1
Asilidae	*Eutolmus rufibarbis*	pRDB3		5	-	1	-	-	-
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	3	-	-	-	-
Ephydridae	*Polytrichophora duplosetosa*	RDB3		3	3	-	-	-	-
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	-	-	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	-	-	-	1
Chloropidae	*Melanochaeta pubescens*	Notable		4	-	2	3	2	2
Dolichopodidae	*Campsicnemus pumilio*	Notable	LRns	4	-	1	-	-	-
Dolichopodidae	*Hercostomus plagiatus*	Notable	LRns	4	-	-	1	-	-
Ephydridae	*Gymnoclasiopa plumosa*	Notable		4	-	-	1	-	1
Limoniidae	*Limonia trivittata*	Notable		4	-	-	2	-	-
Lonchopteridae	*Lonchoptera scutellata*	Notable	LRns	4	-	-	1	-	-
Sciomyzidae	*Pherbellia nana*	Notable		4	-	1	-	-	-
Sciomyzidae	*Psacadina verbekei*	Notable		4	-	-	-	1	1
Syrphidae	*Neoascia geniculata*	Notable		4	-	-	-	-	1
Tephritidae	*Dioxyna bidentis*	Notable		4	-	2	-	-	-

Table 7. ERS species from the Wey.

Family	Species	Status		ERS Fidelity	Bordon	Frensham	Tilford	Thundry	Easing
		JNCC	IUCN						
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	-	-	-
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	3	-	-	-	-
Ephydridae	*Athyroglossa glabra*	Local		2	-	1	-	-	2
Limoniidae	*Hoplolabis* female	Unknown		2	-	1	-	-	1
Limoniidae	*Hoplolabis vicina*	Local		2	1	-	-	-	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	-	-	-	1
Tipulidae	*Nephrotoma analis*	Local		2	-	-	-	-	1
Dolichopodidae	*Dolichopus longicornis*	Local		3	-	1	-	1	1
Dolichopodidae	*Hercostomus nanus*	Local		3	-	-	1	-	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	1	-	2	-	2
Dolichopodidae	*Teucophorus simplex*	Local		3	4	1	1	-	2
Empididae	*Hemerodromia oratoria*	Local		3	-	1	-	-	-
Empididae	*Hemerodromia unilineata*	Local		3	1	1	-	-	1
Ephydridae	*Ditrichophora palliditarsis*	Local		3	-	-	-	-	2
Ephydridae	*Ditrichophora* sp A	New		3	4	1	-	-	1
Ephydridae	*Polytrichophora duplosetosa*	RDB3		3	3	-	-	-	-
Hybotidae	*Platypalpus interstinctus*	Local		3	-	-	-	-	1
Hybotidae	*Platypalpus niger*	Local		3	-	-	-	2	-
Tipulidae	*Tipula couckei*	Local		3	-	2	-	-	1

Family	Species	Status		ERS Fidelity					
		JNCC	IUCN		Bordon	Frensham	Tilford	Thundry	Easching
Tipulidae	*Tipula montium*	Common		3	-	3	-	-	-

Table 8. Summary of species variables for the Wey.

	Bordon	Frensham	Tilford	Thundry	Easching
Sampling points	4	5	7	3	5
Total flies	88	125	131	96	122
Major families					
Dolichopodidae	26	27	28	15	22
Empididae	11	10	11	6	8
Ephydridae	16	24	20	12	26
Hybotidae	2	7	6	8	6
Lauxaniidae	2	3	5	3	5
Limoniidae	6	1	6	6	5
Lonchopteridae	2	2	4	2	2
Sepsidae	2	6	5	1	1
Stratiomyidae	0	1	4	1	1
Syrphidae	1	7	3	3	8
Tipulidae	0	3	3	1	3
Status					
New	2	2	2	0	2
Rare	2	2	0	0	1
Scarce	0	4	5	2	4
Local	21	35	31	22	36
Common	63	81	93	71	77
Unknown	0	1	0	1	2
ERS Fidelity					
1 (total)	0	1	0	0	0
2 (high)	2	2	0	0	4
3 (moderate)	5	7	3	2	8
4 (wetland)	52	73	76	51	67
5 (tourist)	29	42	52	43	43

Rother: West Sussex & Hampshire

The Rother flows at its upstream end on gravel and clay of the Upper Greensand and Gault Clay which gives rise to a cobbly bed and pebbly or gravelly shores at the three upstream sites (Adhurst, Petersfield, Habin). Between Petersfield and Habin the floodplain is on Lower Greensand so that the river banks are sandy and, by the time the river reaches Habin, some of the shores are also moderately sandy. The three downstream sites (Woolbeding, Cowdray, Shopham) are on almost pure sand, with sandy shores and eroding sandy banks. A consequence of the sandy floodplain is that, from Petersfield, the river runs in a deep gully with steep and often eroding banks topped by a vertical cliff often 1-1.5m tall.

Patches of ERS were often narrow shores up to about 2m wide, and patches of drier vegetated sediment were often up to 5m wide or exceptionally 8m. The upstream site (Adhurst) ran through deciduous woodland or under heavily shading alders but the remaining sampling points, except for a few at Habin, were at most only lightly shaded. Many sampling points had a high proportion of bare sediment. Dense tall vegetation was a feature of drier sediment and banks on ground that may have been far more open after normal winter flooding. The transition through sparse ruderal vegetation that was a common feature of western rivers was rarely well developed.

Six sites were investigated but sampling effort was disparate owing to the difficulty of finding suitable locations for particular stretches of river. Only two points were sampled at Woolbeding and Cowdray Park, and one at Petersfield which was visited speculatively from a public path at the end of the field session. The river was visited in 2005.

About six of the 22 rare or scarce species were moderately widespread along the river, or at least occurred in several sampling points and thus suggested that they had good populations locally (Table 9). The four most widespread included *Hilara aartseni* which is new to Britain in this survey. It was similarly widespread on the Wey. *Diaphorus hoffmannseggii* was also widespread and locally frequent. All but one specimen were females, but were assumed to be this species based on the single male from Habin. *Melanochaeta pubescens* was also widespread but is thought to be too common to warrant scarce status. Less widespread but with locally frequent occurrence were *Ditrichophora* sp A, new to Britain in this survey, and *Hilara albiventris*.

Over half (12) of the rare or scarce species have moderate to total fidelity to ERS (Table 10). These include three of the few ERS species that may be considered widespread along the river (*Diaphorus hoffmannseggii*, *Hilara albiventris*, *H. biseta*). Others that were locally frequent, even if not particularly widespread, were *Lonchoptera nigrociliata* and *Teucophorus simplex* in shaded stretches, *Ditrichophora palliditarsis* and *Ditrichophora* sp A. Only one rare species, the tachinid *Gymnosoma rotundatum*, had no association with wetlands.

Other points of interest are the 'northern' species *Hoplolabis vicina* at the same site as the southern *H. areolata*, and the presence of *Cliorismia rustica* at Woolbeding which is a new site for it (*Cliorismia* records are discussed under *Stiletto flies* at the beginning of the results). Several other 'northern and western' species are mentioned in the Discussion. No Rhabdomastix were recorded in this survey but there is a record of *R.* '*hilaris*' from Fyning Moor just downstream of Haben, collected in 1974 (A.E. Stubbs).

The numbers of total species recorded was as expected for the sampling effort except at the most upstream site, Adhurst, which returned fewer than average (Table 11). Numbers of uncommon and ERS species were also approximately as expected for the effort, again with fewer at Adhurst and slightly fewer uncommon species at Shopham. There was relatively little variation in the representation of major families, although there were very few hybotids

at Adhurst and Shopham compared to Habin (all having similar high sampling effort), and relatively high numbers of ephydrids at Cowdray.

All the sites had good features for flies. The most upstream site, Adhurst, supported a moderate ERS fauna that was surprisingly good for a shaded stream with rather little ERS and almost no sand. The single patch of ERS sampled at Petersfield probably suffered from severe trampling by cattle, and this may have accounted for the rather uninteresting fauna here. The remaining four downstream sites showed most interest. Return for the widely varying effort suggested that these were similarly rich.


Habin 7


Woolbeding 2 Cliorismia site


Cowdray 2


Shopham 4

Table 9. Rare and scarce species from the Rother.

Family	Species	Status		ERS Fidelity	Adhurst	Petersfield	Habin	Woolbeding	Cowdray	Shopham
		JNCC	IUCN							
Empididae	*Hilara aartseni*	New		4	4	-	4	2	-	1
Ephydridae	*Ditrichophora* sp A	New		3	3	-	2	-	1	-
Ephydridae	*Ditrichophora* sp B	New		4	-	-	-	1	-	-
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	3	1	5	1	-	-
Ephydridae	*Polytrichophora duplosetosa*	RDB3		3	-	-	-	-	1	1
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	-	-	-	-	1	-
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	-	1	-	-	-
Tachinidae	*Gymnosoma rotundatum*	pRDB3		5	-	-	-	-	1	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	-	1	1	-	-
Chloropidae	*Melanochaeta pubescens*	Notable		4	-	-	4	1	2	3
Dolichopodidae	*Campsicnemus pumilio*	Notable	LRns	4	-	-	-	-	-	1
Drosophilidae	*Stegana nigrithorax*	Notable		5	1	-	-	-	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	3	-	2	-	1	-
Empididae	*Hilara biseta*	Notable	LRns	2	-	-	2	-	1	1
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	-	-	2	-
Ephydridae	*Gymnoclasiopa plumosa*	Notable		4	3	-	2	-	-	-
Hybotidae	*Platypalpus articulatus*	Notable	LRns	4	-	-	-	-	1	-
Lauxaniidae	*Homoneura thalhammeri*	Notable		4	-	-	-	1	-	-
Lonchopteridae	*Lonchoptera meijeri*	Notable	LRns	3	1	-	2	-	-	1
Lonchopteridae	*Lonchoptera nigrociliata*	Notable	LRns	1	4	-	1	-	-	-
Sepsidae	*Themira gracilis*	Notable		3	-	-	1	-	-	-
Stratiomyidae	*Oxycera morrisii*	Notable		4	-	-	1	-	-	-
Tephritidae	*Dioxyna bidentis*	Notable		4	-	-	-	-	-	3

Table 10. ERS species from the Rother.

Family	Species	Status		ERS Fidelity	Adhurst	Petersfield	Habin	Woolbeding	Cowdray	Shopham
		JNCC	IUCN							
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	-	1	-	-	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	4	-	1	-	-	-
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	3	1	5	1	-	-
Empididae	*Hilara biseta*	Notable	LRns	2	-	-	2	-	1	1
Ephydridae	*Athyroglossa glabra*	Local		2	-	-	3	-	-	2
Limoniidae	*Hoplolabis areolata*	Local		2	-	-	-	-	-	3
Limoniidae	*Hoplolabis vicina*	Local		2	-	-	1	-	1	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	-	1	1	-	-
Dolichopodidae	*Dolichopus longicornis*	Local		3	-	-	-	-	1	3
Dolichopodidae	*Teucophorus calcaratus*	Local		3	-	-	-	1	-	1
Dolichopodidae	*Teucophorus simplex*	Local		3	5	-	2	-	-	-
Empididae	*Hemerodromia unilineata*	Local		3	-	-	-	-	-	1
Empididae	*Hilara albiventris*	Notable	LRns	3	3	-	2	-	1	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	-	-	2	-
Ephydridae	*Ditrichophora palliditarsis*	Local		3	1	-	4	-	-	1
Ephydridae	*Ditrichophora* sp A	New		3	3	-	2	-	1	-
Ephydridae	*Polytrichophora duplosetosa*	RDB3		3	-	-	-	-	1	1
Hybotidae	*Platypalpus interstinctus*	Local		3	-	-	2	1	-	-
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	-	-	-	-	1	-
Hybotidae	*Platypalpus niger*	Local		3	-	-	1	-	-	1
Limoniidae	*Antocha vitripennis*	Local		3	-	-	-	-	-	1
Lonchopteridae	*Lonchoptera meijeri*	Notable	LRns	3	1	-	2	-	-	1
Sepsidae	*Themira gracilis*	Notable		3	-	-	1	-	-	-
Tipulidae	*Tipula couckei*	Local		3	-	-	-	-	-	2
Tipulidae	*Tipula montium*	Common		3	1	1	-	-	-	2

Table 11. Summary of species variables for the Rother.

	Adhurst	Petersfield	Habin	Woolbeding	Cowdray	Shopham
Sampling points	6	1	6	2	2	5
Total flies	95	47	134	60	75	118
Major families						
Dolichopodidae	24	9	30	12	11	21
Empididae	16	2	13	9	10	9
Ephydridae	18	14	21	7	16	25
Hybotidae	2	0	11	4	8	3
Limoniidae	3	2	5	0	3	8
Lonchopteridae	5	2	4	2	2	3
Sepsidae	2	4	6	2	5	9
Tipulidae	1	2	2	2	0	3
Status						
New	2	0	2	2	1	1
Rare	1	1	3	2	3	1
Scarce	5	0	8	2	5	5
Local	24	12	28	17	14	30
Common	62	34	93	36	52	81
Unknown	1	0	0	1	0	0
ERS Fidelity						
1 (total)	1	0	2	0	0	0
2 (high)	1	1	5	2	2	3
3 (moderate)	6	1	8	2	6	10
4 (wetland)	59	31	67	35	40	70
5 (tourist)	28	14	52	21	27	35

Devon rivers

In 2004 29 points on 13 rivers were surveyed for ERS beetles, and seven of them for flies (Bell *et al.*, 2004). The points sampled for flies had been selected from the most sandy sites since, as in the present study, the BAP flies associated with sandy rivers were a target of that survey. For the present study, more rivers were selected on the basis of having a good ERS beetle fauna and having sandy sediments. The original intention of selecting several sites along the Exe had to be abandoned on the advice of the Environment Agency who had problems with riparian owners and managers on this river. Thus there is likely to be greater variation in the Devon results than in those from other areas of Britain.

In comparison with the rives sampled in 2004, all the sites in the present study were more stony than sandy. The banks of the Yarty at Bowditch Farm and the Coly at Heathayne were predominantly sandy or at least shingly, and their shores were at least partly shingly, while the banks of the Bray at Bray Bridge and the Mole at Meethe were rather more shingly but their shores were stony. The Exe at Thorverton Weir was cobbly and almost devoid of fine sediments. All the sampling points were within alluvial floodplains of these rivers. All but the Exe are small rivers, mostly 3-5m wide and occasionally up to 8m at broad riffles. The Exe was 10m wide although still just shallow enough to cross in wellington boots. ERS size varied from narrow shores at the Bray to some broad shores at the Coly and Yarty, and large expanses at least 5m wide of stony ERS at the Mole and Exe. Adjacent land-use was pasture except for arable or rank grassland at the Exe. The Bray was mostly shaded by trees but the other sites were predominantly open.

Only three scarce species were widespread and sometimes frequent in samples: the empid *Hilara pseudochorica*, the shore-fly *Ditrichophora* sp B and *Lonchoptera nigrociliata* (Table 12). The last two were absent from the Exe; the lack of fine sediments is likely to be the reason for the absence of *Ditrichophora*. The shore-fly *Polytrichophora duplosetosa* was present at several places at the Mole and numerous in one sample here; and this was the first time this species has been recorded in such abundance. The dolichopodid *Melanostoma melancholichus* was also widespread at the Mole, although only found in small numbers. All other species were recorded infrequently and rare more abundantly than as a few individuals.

About two thirds (12 species) of the rare and scarce species have at least moderate fidelity to ERS, and nearly all the rest are wetland species.

Nearly all the rare and scarce species had been recorded in the survey of ERS flies of Devon rivers (Bell *et al*., 2004); additions are the empids *Hilara biseta*, *H. media* and the cranefly *Cheilotrichia imbuta*. Most species were about as abundant in that survey as in the present one, with the exception of the rare shore-fly *Athyroglossa ordinata* which was exceptionally frequent in 2004 but very scarce in the present survey.

Ten species had total or high fidelity to ERS (Table 13). Of these, only *Lonchoptera nigrociliata* and *Athyroglossa glabra* were widespread, but the remainder were too infrequent to draw conclusions about the value of these rivers for this suite of species. Several species with only moderate affinity to ERS were more often recorded, notably *Hilara pseudochorica* and *Polytrichophora duplosetosa*.

Species richness was probably similar for all sites. The apparently large spread of values in Table 14 is almost certainly due to uneven sampling effort from five samples on the Exe to 12 on the Yarty. Assuming this to be true, the Exe appears to support a slightly greater proportion of rare or scarce species (7.9%) than the other sites (4.1 – 5.8%), although the difference between sites is small and well within the variation expected in this type of survey.

The scarce sponge-fly *Sisyra dalii* (Neuroptera, Sisyridae) was recorded at the Yarty.

Table 12. Rare and scarce species from Devon rivers.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Bray	Mole	Coly	Yarty	Exe
Ephydridae	*Ditrichophora sp B*	New		3	1	5	4	6	-
Dolichopodidae	*Melanostolus melancholicus*	pRDB3	LRns	3	-	5	-	1	-
Dolichopodidae	*Rhaphium penicillatum*	pRDB3	LRnt	3	-	1	-	1	-
Ephydridae	*Athyroglossa ordinata*	pRDB1		1	-	-	-	-	2
Chloropidae	*Melanochaeta pubescens*	Notable		4	-	-	-	-	1
Dolichopodidae	*Rhaphium micans*	Notable	LRns	4	-	-	-	-	2
Empididae	*Hilara albiventris*	Notable	LRns	3	3	-	-	-	-
Empididae	*Hilara biseta*	Notable	LRns	2	3	1	2	-	-
Empididae	*Hilara media*	Notable	LRns	4	-	-	1	1	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	8	9	7	10	5
Ephydridae	*Diclasiopa lacteipennis*	Notable?		4	-	1	-	-	-
Ephydridae	*Polytrichophora duplosetosa*	Notable?		3	-	3	-	2	1
Ephydridae	*Scatella silacea*	Notable?		4	1	-	-	-	-
Limoniidae	*Cheilotrichia imbuta*	Notable		4	1	-	-	-	-
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	1	-	-	1
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	4	2	3	3	-
Tabanidae	*Tabanus cordiger*	Notable		2	-	-	-	-	1
Tipulidae	*Nephrotoma dorsalis*	Notable		2	-	-	1	-	1

Table 13. ERS species from Devon rivers.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Bray	Mole	Coly	Yarty	Exe
Hybotidae	*Tachydromia morio*	Unknown		1	-	-	-	-	1
Ephydridae	*Athyroglossa ordinata*	pRDB1		1	-	-	-	-	2
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	4	2	3	3	-
Empididae	*Hilara biseta*	Notable	LRns	2	3	1	2	-	-
Ephydridae	*Athyroglossa glabra*	Local		2	8	4	5	6	3
Limoniidae	*Hoplolabis areolata*	Local		2	-	2	-	-	-
Limoniidae	*Rhabdomastix edwardsi*	Local		2	-	-	-	1	-
Tabanidae	*Tabanus cordiger*	Notable		2	-	-	-	-	1
Tipulidae	*Nephrotoma analis*	Local		2	-	-	1	1	-
Tipulidae	*Nephrotoma dorsalis*	Notable		2	-	-	1	-	1
Athericidae	*Ibisia marginata*	Unknown		3	1	-	-	-	-
Dixidae	*Dixa dilatata*	Common		3	1	-	-	-	-
Dolichopodidae	*Campsicnemus marginatus*	Local		3	-	1	1	3	-
Dolichopodidae	*Dolichopus longicornis*	Local		3	-	1	-	1	2
Dolichopodidae	*Hercostomus nanus*	Local		3	-	-	1	4	-
Dolichopodidae	*Melanostolus melancholicus*	pRDB3	LRns	3	-	5	-	1	-
Dolichopodidae	*Rhaphium penicillatum*	pRDB3	LRnt	3	-	1	-	1	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	2	2	3	6	1
Dolichopodidae	*Teucophorus monacanthus*	Local		3	4	1	5	4	1
Empididae	*Chelifera precatoria group*	Common		3	-	-	-	1	-
Empididae	*Hemerodromia oratoria*	Unknown		3	1	1	-	-	-
Empididae	*Hemerodromia unilineata*	Local		3	-	-	-	3	-
Empididae	*Hilara albiventris*	Notable	LRns	3	3	-	-	-	-
Empididae	*Hilara apta*	Local		3	-	-	-	1	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	8	9	7	10	5
Empididae	*Wiedemannia bistigma*	Local		3	-	-	-	1	-
Ephydridae	*Ditrichophora palliditarsis*	Local		3	-	-	2	4	-
Ephydridae	*Ditrichophora sp B*	New		3	1	5	4	6	-
Ephydridae	*Polytrichophora duplosetosa*	Notable		3	-	3	-	2	1
Hybotidae	*Platypalpus interstinctus*	Local		3	2	2	1	4	3
Hybotidae	*Platypalpus niger*	Local		3	-	-	2	4	-
Limoniidae	*Antocha vitripennis*	Local		3	1	-	-	-	2
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	1	-	-	1
Muscidae	*Limnophora riparia*	Local		3	4	2	2	3	2
Muscidae	*Limnophora triangula*	Local		3	6	3	2	3	1
Tipulidae	*Nephrotoma guestfalica*	Local		3	-	-	-	3	-
Tipulidae	*Tipula couckei*	Local		3	1	2	4	3	-
Tipulidae	*Tipula montium*	Common		3	3	5	-	3	-

Table 14. Summary of species variables for Devon rivers.

River	Bray	Mole	Coly	Yarty	Exe
Site	**Bray Bridge**	**Meethe**	**Heathayne**	**Bowditch Farm**	**Thorverton Weir**
No. of sampling points	8	9	7	12	5
Total Diptera	156	155	144	171	101
Major Families					
Chloropidae	4	10	6	4	8
Dolichopodidae	32	26	27	35	10
Empididae	14	13	16	20	6
Ephydridae	24	22	16	27	15
Hybotidae	11	10	13	13	8
Lauxaniidae	7	5	4	6	1
Limoniidae	8	5	2	11	3
Lonchopteridae	3	5	3	3	3
Muscidae	7	6	7	8	5
Opomyzidae	4	2	3	3	2
Sciomyzidae	0	0	2	3	0
Sepsidae	12	11	6	8	7
Stratiomyidae	1	0	4	3	0
Syrphidae	7	8	9	4	11
Tephritidae	0	4	2	0	2
Tipulidae	3	3	4	5	3
Status					
New	1	1	1	1	0
Rare	0	2	0	2	1
Scarce	6	6	5	4	7
Local	32	35	46	54	28
Common	116	107	92	108	65
Unknown	1	4	0	2	0
ERS Fidelity					
1 (total)	1	1	1	1	2
2 (high)	2	3	4	3	3
3 (moderate)	14	16	12	22	10
4 (wetland)	75	63	62	93	37
5 (tourist)	64	71	65	52	49

Usk and Ysgir: Gwent & Powys

The four sampling points included Llanvihangel Gobion and Great Hardwick that have been well worked by dipterists, a broad sandy loop near Scethrog, and rather unsatisfactory sites upstream taken on the Ysgir and a nearby minor tributary at Ynys-gyfarch. They were surveyed in 2005.

Perhaps owing to their varied nature, only one scarce species (*Hilara albiventris*) was common to all four sites, whereas six other rare or scarce species were present at all three lower sites and may be regarded as the typical 'rarities' of the Usk (Table 15). *Hilara pseudochorica* was ubiquitous. *Hilara biseta*, *Athyroglossa ordinata*, *Polytrichophora duplosetosa* and *Hoplolabis yezoana* were present in several samples from at least one of the three sites. *Tachydromia halidayi* was present at three site but infrequent, and *Lonchoptera meijeri* was at the Ysgir and two downstream sites. More intensive sampling is likely to have shown that *Nephrotoma dorsalis*, *Platypalpus melancholicus*, *Lonchoptera nigrociliata* and *Hecamedoides unispinosus* to be more widespread as these were found in a few samples at two sites.

Widespread species with fidelity to ERS were *Athyroglossa ordinata* and *Tachydromia halidayi* (total fidelity), *Hilara biseta*, *Athyroglossa glabra* and *Hoplolabis yezoana* (high fidelity), and *Campsicnemus marginatus*, *Dolichopus longicornis*, *Hilara albiventris*, *H. apta*, *H. pseudochorica*, *Ditrichophora palliditarsis*, *Polytrichophora duplosetosa*, *Platypalpus interstinctus*, *P. melancholicus* and *P. niger* (Table 16). It is likely that *Tipula couckei* and *T. montium* should also be included in this group of widespread ERS species, but large craneflies were not often seen on exposed sites.

The Ysgir was not sampled at the point suggested by CCW at Pont-faen but at Ynys-gyfach a short distance downstream where there were small shores mostly shaded by tall trees. The samples were among the least typical of the whole survey as they included species not normally associated with larger streams and rivers, for example, the craneflies *Eleophila mundata* and *Pilaria fuscipennis*. The site supported an assemblage typical of woodland streams with numerous *Lonchoptera nigrociliata*, 12 species of *Hilara* (including *H. media* and *H. albiventris*) and common *Dixa* spp which have been included as ERS species with moderate fidelity, on the basis of their larval habitat. Dolichopodids and empids were well represented but there were markedly fewer species of ephydrids and hybotids than found at the three downstream sites, and no sepsids. An unusual species was *Scatophila unicornis*, which is probably rare and was otherwise recorded in the survey only at Great Hardwick. There were few ERS species, and no uncommon ones, apart from *L. nigrociliata*, were frequent. The value of having sampled this site lies in demonstrating that the ERS fauna is only weakly developed at the upper stony reaches of the river.

The sites at Scethrog and Llanvihangel were similar. Both had a wide hinterland of deposited sand although the river's edge was predominantly stony, with isolated patches of sand and silt, and small pond-like backwaters. The Scethrog site was fenced from adjacent sheep pasture and appeared to be ungrazed. Away from the river's edge, there was extensive ruderal vegetation on dry sand and gravel, comprising areas of short sparse and probably water-stressed vegetation, patches of tall Himalayan balsam and young willow scrub. Llanvihangel was heavily grazed and trampled so all the vegetation was low and sparse, even where not water-stressed.

The total number of species recorded at these two sites was high and, with the exception of fewer dolichopodids than expected at Scethrog, the representation of major families and of uncommon and ERS species was similar (Table 17). Species of interest that were more frequent at both sites than at Great Hardwick were *Hoplolabis yezoana*, *Platypalpus melancholicus, P. articulatus*, *Athyroglossa ordinata* and *Hecamedoides unispinosus*. This

suite of species appears to characterise sandier sections of rivers. *Athyroglossa ordinata* was particularly numerous and widespread at Llanvihangel, as was *H. unispinosus* at Scethrog. Apart from one record of *A. ordinata* from Dinefwr Deer Park (presumably from the Towy), Dyfed, neither species nor *Hoplolabis yezoana* has been recorded before in Wales. The ephydrid *Hyadina scutellata* was an interesting record as the species appears to be rare, but nothing is known of its habitat requirements.

Great Hardwick differed from Scethrog and Llanvihangel in being a more stony site, and was sampled on the side where the river ran against the bluff. Sampling points included unshaded shores trampled by sheep, and an island below a steep wooded slope where there was no access to grazing animals so that rank vegetation and scrub covered most of the ERS. It more resembled the Monnow sites. Species richness, representation of major families and the number of uncommon and ERS species were similar to those at Scethrog and Llanvihangel. The conspicuous differences were a far greater number of empids and slightly more dolichopodids than at these other two sites, and this may be explained by the proximity of shaded wet conditions under trees.

The most interesting species at Great Hardwick was *Rhaphium suave*, new to Britain. Five males were collected at the downstream end of the island on a partially shaded sandy patch at the water's edge. This was very similar to where the same species was collected on the River Dane in Cheshire only the previous week, and to its site at Doddington Bridge on the Till (in 2006). The occurrence of *Oxycera terminata* was among the features that made this site more similar to the Monnow where this stratiomyid is frequent. *Cliorismia* was recorded sitting on stones close to the water's edge next to a riffle in a place where scarcely any other flies were collected.

A few other species and genera from the Usk sites deserve highlighting. *Tachydromia* hybotids with fidelity to ERS were represented by three species, even if they were rather scarce and infrequent. *Tachydromia edenensis*, recently described new to science from specimens caught at Cumbrian ERS, was found at Great Hardwick and Llanvihangel (Hewitt & Chvála, 2002). Others were *T. woodi* and *T. halidayi*. No non-ERS *Tachydromia* were found. *Hilara* and *Platypalpus* were well represented, with 18 and 21 species, respectively, and both genera included four scarce or rare species. Their presence may have less to do with ERS rather than with riverside conditions, with a few exceptions listed in Table 16. *Platypalpus stabilis* may also belong the group with moderate affinity to ERS.

The ERS ladybird *Coccinella quinquepunctata* was found at Scethrog, Great Hardwick and Llanvihangel Gobion, the scarce ground beetles *Tachys parvulus* at Scethrog and *T. bistriata* and *Bembidion litorale* at Great Hardwick. The scarce hydrophilid water beetle *Georissus crenulatus* was captured frequently by suction sampling at the edges of the ERS at Scethrog and Llanvihangel Gobion.


Ysgir 1


Scethrog 1


Scethrog 5


Scethrog 7


Great hardwick - Rhaphium suave site


Great Hardwick 4

Table 15. Rare and scarce species from the Usk and Ysgir.

Family	Species	Status	IUCN status	ERS Fidelity	Ysgir	Scethrog	Great Hardwick	Llanvi-hangel
Dolichopodidae	*Rhaphium suave*	New		2	-	-	1	-
Ephydridae	*Ditrichophora sp A*	New		3	-	-	1	-
Dolichopodidae	*Hydrophorus ?viridis* female	RDB3	LRnt	4	-	-	-	1
Ephydridae	*Athyroglossa ordinata*	pRDB1		1	-	4	2	7
Ephydridae	*Ditrichophora nectens*	RDBK?		4	-	-	1	-
Ephydridae	*Hecamedoides unispinosus*	RDB2?		1	-	5	-	2
Ephydridae	*Hyadina scutellata*	RDB2?		4	-	-	-	1
Ephydridae	*Polytrichophora duplosetosa*	RDB3?		3	-	2	3	2
Ephydridae	*Scatophila unicornis*	RDBK?		4	1	-	1	-
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	-	2	-	2
Hybotidae	*Tachydromia edenensis*	RDBK		1	-	-	1	1
Hybotidae	*Tachydromia woodi*	RDB I	LRnt	2	-	1	-	1
Lauxaniidae	*Homoneura limnea*	RDB2		4	-	-	1	1
Limoniidae	*Hoplolabis yezoana*	RDBK		2		2	1	3
Stratiomyidae	*Oxycera terminata*	RDB2		1	-	-	1	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	-	1	-
Therevidae	*Spiriverpa lunulata*	RDB3		1	-	1	-	-
Dolichopodidae	*Campsicnemus pumilio*	Notable	LRns	4	-	1	-	-
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	-	1
Dolichopodidae	*Rhaphium rivale*	Notable	LRns	3	-	1	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	1	3	2	2
Empididae	*Hilara biseta*	Notable	LRns	2	-	2	4	1
Empididae	*Hilara media*	Notable	LRns	4	1	-	-	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	8	8	8
Ephydridae	*Scatophila noctula*	Notable		4	-	-	-	1
Hybotidae	*Platypalpus articulatus*	Notable	LRns	4	-	3	-	2
Hybotidae	*Platypalpus luteolus*	Notable	LRns	4	-	-	-	1
Hybotidae	*Platypalpus subtilis*	Notable	LRns	4	-	-	3	-
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	-	1	1	2
Limoniidae	*Cheilotrichia imbuta*	Notable		4	-	1	-	-
Limoniidae	*Eloeophila mundata*	Notable		5	1	-	-	
Limoniidae	*Gonomyia bifida*	Notable		4	-	-	-	1
Limoniidae	*Pilaria fuscipennis*	Notable		4	1	-	-	-
Lonchopteridae	*Lonchoptera meijeri*	Notable	LRns	3	1	-	1	3
Lonchopteridae	*Lonchoptera nigrociliata*	Notable	LRns	1	3	-	3	-
Sciomyzidae	*Colobaea bifasciella*	Notable		4	-	1	-	-
Sciomyzidae	*Colobaea punctata*	Notable		4	-	-	-	1
Tephritidae	*Campiglossa absinthii*	Notable		5	-	2	-	-
Tipulidae	*Nephrotoma dorsalis*	Notable		2	-	2	-	1

Table 16. ERS species from the Usk and Ysgir.

Family	Species	Status	ERS Fidelity	Ysgir	Scethrog	Great Hardwick	Llanvi-hangel
Ephydridae	*Athyroglossa ordinata*	pRDB1	1	-	4	2	7
Ephydridae	*Hecamedoides unispinosus*	RDB2?	1	-	5	-	2
Hybotidae	*Tachydromia edenensis*	RDBK	1	-	-	1	1
Hybotidae	*Tachydromia halidayi*	Notable	1	-	1	1	2
Lonchopteridae	*Lonchoptera nigrociliata*	Notable	1	3	-	3	-
Stratiomyidae	*Oxycera terminata*	RDB2	1	-	-	1	-
Therevidae	*Spiriverpa lunulata*	RDB3	1	-	1	-	-
Dolichopodidae	*Rhaphium suave*	New	2	-	-	1	-
Empididae	*Hilara biseta*	Notable	2	-	2	4	1
Ephydridae	*Athyroglossa glabra*	Local	2	1	5	7	5
Hybotidae	*Tachydromia woodi*	RDB I	2	-	1	-	1
Limoniidae	*Hoplolabis areolata*	Local	2	-	-	3	3
Limoniidae	*Hoplolabis yezoana*	RDBK	2	-	2	1	3
Limoniidae	*Rhabdomastix edwardsi*	Local	2	-	-	-	1
Therevidae	*Cliorismia rustica*	RDB3	2	-	-	1	-
Tipulidae	*Nephrotoma analis*	Local	2	-	-	-	3
Tipulidae	*Nephrotoma dorsalis*	Notable	2	-	2	-	1
Dixidae	*Dixa nubilipennis*	Common	3	2	-	-	-
Dixidae	*Dixa puberula*	Common	3	2	-	-	-
Dolichopodidae	*Campsicnemus marginatus*	Local	3	-	5	3	5
Dolichopodidae	*Dolichopus longicornis*	Local	3	-	4	3	5
Dolichopodidae	*Rhaphium fractum*	Notable	3	-	-	-	1
Dolichopodidae	*Rhaphium rivale*	Notable	3	-	1	-	-
Dolichopodidae	*Teucophorus calcaratus*	Local	3	-	-	2	3
Empididae	*Chelifera stigmatica*	Local	3	1	-	-	-
Empididae	*Hemerodromia oratoria*	Local	3	-	1	3	1
Empididae	*Hemerodromia unilineata*	Local	3	1	-	1	-
Empididae	*Hilara albiventris*	Notable	3	1	3	2	2
Empididae	*Hilara apta*	Local	3	-	-	2	-
Empididae	*Hilara pseudochorica*	Notable	3	-	8	8	8
Empididae	*Wiedemannia bistigma*	Local	3	-	-	1	-
Ephydridae	*Ditrichophora palliditarsis*	Local	3	-	1	5	2
Ephydridae	*Ditrichophora sp A*	New	3	-	-	1	-
Ephydridae	*Polytrichophora duplosetosa*	RDB3	3	-	2	3	2
Hybotidae	*Platypalpus interstinctus*	Local	3	-	4	6	5
Hybotidae	*Platypalpus melancholicus*	pRDB3	3	-	2	-	2
Hybotidae	*Platypalpus niger*	Local	3	-	5	3	3
Limoniidae	*Antocha vitripennis*	Local	3	1	-	2	-
Lonchopteridae	*Lonchoptera meijeri*	Notable	3	1	-	1	3
Muscidae	*Limnophora exuta*	Local	3	1	-	-	-
Tipulidae	*Nephrotoma guestfalica*	Local	3	-	1	-	2
Tipulidae	*Tipula couckei*	Local	3	-	3	-	4
Tipulidae	*Tipula montium*	Common	3	-	1	-	5

Table 17. Summary of species variables for the Usk and Ysgir.

River	Ysgir	Usk	Usk	Usk
Site	**Ynys-gyfarch**	**Scethrog**	**Great Hardwick**	**Llanvihangel**
Sampling points	3	8	8	8
Total species	83	147	168	169
Major Families				
Dolichopodidae	23	19	33	28
Empididae	21	13	19	11
Ephydridae	11	22	26	28
Hybotidae	5	18	21	21
Limoniidae	5	9	10	11
Lonchopteridae	4	2	3	3
Sepsidae	0	11	9	12
Tipulidae	0	5	1	5
Status				
New	0	0	2	0
Rare	1	7	9	10
Scarce	6	11	7	12
Local	24	35	54	43
Common	52	94	95	103
Unknown	0	0	1	1
ERS Fidelity				
1 (total)	1	4	5	4
2 (high)	1	5	6	8
3 (moderate)	8	14	16	16
4 (wetland)	48	60	74	75
5 (tourist)	25	64	67	66

Monnow: Gwent

Five sites were sampled on the Monnow in 2005. A variety of types of ERS were located at most sites so it is not possible to generalise about conditions at each sites, although Maerdy and Kentchurch were adjacent to woodland so a greater proportion of samples from these areas were shaded than at the other sites. Sand was more consistently present at Alltyrynys than at the remaining sites, although even here it formed only a small proportion of the sediment, and was almost absent from Maerdy sampling points. In comparison with the Usk sites, most patches of ERS were narrow; for example, gravely deposits (with fine particles) were rarely more than 5m wide.

Eight rare or scarce species were particularly widespread, some being absent only from the scantly sampled Monmouth Cap site (Table 18). *Hilara pseudochorica* was almost ubiquitous, and *Lonchoptera meijeri*, *L. nigrociliata* and *Oxycera terminata* (including larvae in suction samples) were sometimes plentiful. Others that were usually infrequent in samples were *Platypalpus subtilis*, *Tachydromia costalis*, *Hilara albiventris* and *Ditrichophora* sp A. More intensive sampling may have shown that *Hilara biseta* and perhaps *Platypalpus melancholicus* were more widespread.

Widespread species with affinity to ERS were *Tachydromia costalis*, *Lonchoptera nigrociliata* and *Oxycera terminata* (all total fidelity), *Athyroglossa glabra* (high fidelity), and *Campsicnemus marginatus*, *Teucophorus calcaratus*, *Hilara albiventris*, *H. pseudochorica*, *Ditrichophora palliditarsis*, *Ditrichophora* sp A, *Platypalpus interstinctus, Lonchoptera meijeri*, *Nephrotoma guestfalica*, *Tipula couckei* and *T. montium* (moderate fidelity) (Table 19).

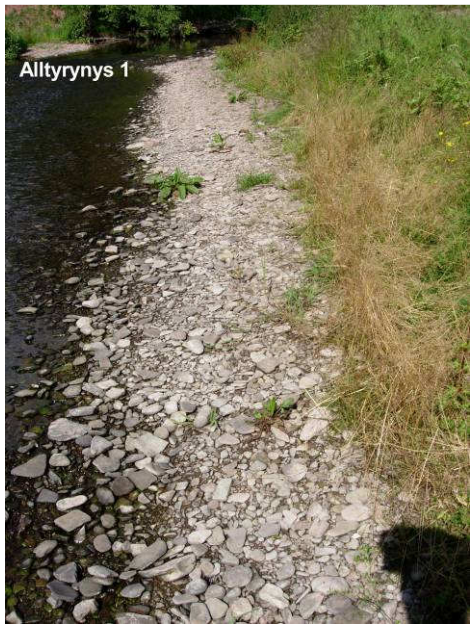
Alltyrynys was the most upstream site, bordering pasture with alders lining the bank although with plenty of unshaded patches of ERS scattered frequently along the river. Slightly more species were recorded here than at any downstream site (Table 20). The representation of each major family and ERS-faithful species was similar to other sites but the number of species ephydrids (31) was exceptionally high. The number of rare or scarce species was also notably higher than most other sites. *Athyroglossa ordinata* and *Tachydromia halidayi* were recorded only here and may reflect the slightly more sandy conditions that at other sites on the Monnow; both were more widespread on the sandier Usk.

Maerdy and Kentchurch (ignoring the intermediate Monmouth Cap site) were similar in most respects, and this is unsurprising given the similarity of much of the ERS and the more shaded conditions than at the other sites. Minor differences in the presence of rare or scarce species with affinity to ERS were *Cliorismia rustica* at Maerdy, where it was seen on lightly shaded vegetation growing on pebbles close to a riffle, and *Hilara biseta* at Kentchurch.

One small area of unshaded and gravely ERS disturbed by machinery was sampled at Monmouth Cap. Direct comparison of numbers with the other sites is not possible since there were only two sampling points on the same shore, but even this small sample included most of the widespread rare species of the Monnow.

Skenfrith sampling points differed from the upstream sites Maerdy and Kentchurch in being completely unshaded. Compared with these two sites, it was notably richer in rare and scarce species and had slightly fewer dolichopodids but was otherwise similar in the representation of major families and ERS-faithful species. This was the only site on the two Welsh rivers for *Diaphorus ?hoffmannseggii* (female),which has fairly strong affinity with ERS, and *Cosmetopus dentimanus*. The scathophagid is known from river sides, and this record may be the first for Wales.

The hydrophilid water beetle *Georissus crenulatus* was captured frequently by suction sampling at the edges of the ERS at Alltyrynys, Monmouth Cap and Maerdy Farm, and *Helophorus arvernicus* (Helophoridae) at Skenfrith.




Kentchurch 5


Monmouth Cap 1


Scenfrith 3

Table 18. Rare and scarce species from the Monnow.

Family	Species	Status		ERS Fidelity	Alltyrynys	Maerdy	Monmouth Cap	Kentchurch	Skenfrith
		JNCC	IUCN						
Ephydridae	*Ditrichophora* sp A	New		3	1	1	1	4	1
Hybotidae	*Platypalpus ?velocipes*	New		5	2	-	-	-	-
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	-	-	-	-	1
Dolichopodidae	*Melanostolus melancholicus*	pRDB3	LRns	3	2	-	1	-	-
Ephydridae	*Athyroglossa ordinata*	pRDB1		1	1	-	-	-	-
Ephydridae	*Ditrichophora nectens*	RDBK?		4	1	-	-	-	-
Ephydridae	*Polytrichophora duplosetosa*	RDB3?		3	2	-	-	-	1
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	-	-	1	-	2
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	1	1	2
Limoniidae	*Limnophila pictipennis*	pRDB2		4	-	1	-	-	-
Scathophagidae	*Cosmetopus dentimanus*	RDB1		4	-	-	-	-	1
Stratiomyidae	*Oxycera terminata*	RDB2		1	3	3	1	1	4
Therevidae	*Cliorismia rustica*	RDB3		2	-	1	-	-	-
Anthomyzidae	*Anagnota bicolor*	Notable		4	-	1	1	-	-
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	1	-	-	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	1	2	1	3	3
Empididae	*Hilara biseta*	Notable	LRns	2	-	-	-	3	2
Empididae	*Hilara media*	Notable	LRns	4	-	-	-	-	2
Empididae	*Hilara pseudochorica*	Notable	LRns	3	7	4	2	3	6
Empididae	*Rhamphomyia lamellata*	Notable	LRns	4	-	1	-	-	-
Ephydridae	*Gymnoclasiopa collini*	Notable		4	-	-	-	1	-
Ephydridae	*Scatophila noctula*	Notable		4	-	-	-	2	-
Hybotidae	*Platypalpus articulatoides*	Notable	LRns	4	1	1	-	-	1
Hybotidae	*Platypalpus articulatus*	Notable	LRns	4	1	-	-	-	1
Hybotidae	*Platypalpus luteolus*	Notable	LRns	4	2	-	-	-	-
Hybotidae	*Platypalpus subtilis*	Notable	LRns	4	1	1	-	1	4
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	-	-
Limoniidae	*Cheilotrichia imbuta*	Notable		4	-	-	-	-	3
Lonchopteridae	*Lonchoptera meijeri*	Notable	LRns	3	2	3	-	4	4
Lonchopteridae	*Lonchoptera nigrociliata*	Notable	LRns	1	2	3	-	4	5

Table 19. ERS species from the Monnow.

Family	Species	Status		ERS Fidelity	Alltyrynys	Maerdy	Monmouth Cap	Kentchurch	Skenfrith
		JNCC	IUCN						
Ephydridae	*Athyroglossa ordinata*	pRDB1		1	1	-	-	-	-
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	1	1	2
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	-	-
Hybotidae	*Tachydromia morio*	Local		1	-	1	-	-	1
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	2	3	-	4	5
Stratiomyidae	*Oxycera terminata*	RDB2		1	3	3	1	1	4
Dolichopodidae	*Diaphorus hoffmannseggii*	RDB I	LRnt	2	-	-	-	-	1
Empididae	*Hilara biseta*	Notable	LRns	2	-	-	-	3	2
Ephydridae	*Athyroglossa glabra*	Local		2	5	3	1	2	4
Limoniidae	*Hoplolabis areolata*	Local		2	2	-	-	1	-
Limoniidae	*Hoplolabis vicina*	Local		2	-	-	-	-	1
Limoniidae	*Hoplolabis* female	Unknown		2	1	1	-	1	-
Limoniidae	*Rhabdomastix edwardsi*	Local		2	-	1	-	-	-
Therevidae	*Cliorismia rustica*	RDB3		2	-	1	-	-	-
Dixidae	*Dixa nebulosa*	Common		3	-	1	-	-	-
Dolichopodidae	*Campsicnemus marginatus*	Local		3	3	2	1	4	4
Dolichopodidae	*Dolichopus longicornis*	Local		3	-	2	1	-	-
Dolichopodidae	*Hercostomus nanus*	Local		3	-	-	-	1	-
Dolichopodidae	*Melanostolus melancholicus*	pRDB3	LRns	3	2	-	1	-	-
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	1	-	-	-	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	4	4	2	5	1
Empididae	*Hemerodromia unilineata*	Local		3	1	-	1	4	5
Empididae	*Hilara albiventris*	Notable	LRns	3	1	2	1	3	3
Empididae	*Hilara apta*	Local		3	-	3	-	4	1
Empididae	*Hilara pseudochorica*	Notable	LRns	3	7	4	2	3	6
Empididae	*Wiedemannia bistigma*	Local		3	-	-	-	-	1
Ephydridae	*Ditrichophora palliditarsis*	Local		3	4	3	1	4	3
Ephydridae	*Ditrichophora sp A*	New		3	1	1	1	4	1
Ephydridae	*Polytrichophora duplosetosa*	RDB3		3	2	-	-	-	1
Hybotidae	*Platypalpus interstinctus*	Local		3	-	2	1	1	2
Hybotidae	*Platypalpus melancholicus*	pRDB3	LRnt	3	-	-	1	-	2
Hybotidae	*Platypalpus niger*	Local		3	1	1	-	-	1
Limoniidae	*Antocha vitripennis*	Local		3	-	1	1	1	3
Lonchopteridae	*Lonchoptera meijeri*	Notable	LRns	3	2	3	-	4	4
Muscidae	*Limnophora riparia*	Local		3	2	1	-	1	1
Tipulidae	*Nephrotoma guestfalica*	Local		3	1	3	-	1	1
Tipulidae	*Tipula couckei*	Local		3	5	1	1	1	3
Tipulidae	*Tipula montium*	Common		3	-	3	1	2	3

Table 20. Summary of species variables for the Monnow.

	Alltyrynys	Maerdy	Monmouth Cap	Kentchurch	Skenfrith
Sampling points	7	5	2	5	6
Total flies	152	137	85	134	135
Major families					
Dolichopodidae	27	27	14	20	15
Empididae	17	14	7	20	23
Ephydridae	31	18	18	21	19
Hybotidae	12	16	11	13	17
Limoniidae	8	7	1	10	6
Lonchopteridae	4	4	2	4	5
Opomyzidae	2	4	2	3	5
Sepsidae	7	4	3	1	5
Tipulidae	4	3	2	4	4
Status					
New	2	1	1	1	1
Rare	5	4	4	2	6
Scarce	10	8	3	8	10
Local	36	36	22	40	37
Common	97	87	55	81	81
Unknown	2	1	0	2	0
ERS Fidelity					
1 (total)	4	4	2	3	4
2 (high)	3	4	1	4	4
3 (moderate)	15	17	14	16	20
4 (wetland)	74	58	32	62	64
5 (tourist)	56	54	36	49	43

Weaver: Cheshire

Sites along the Weaver were selected from the visual survey of ERS by Bates (2005) who had assessed those chosen as having highest potential value as ERS-beetle habitat. These sites were not given as high ranking as those on the Dane and Bollin surveyed in 2005 (Bates *et al*., 2006). They lie along a 10km stretch of the river between the towns of Audlem to just north of Nantwich. This stretch of the Weaver's floodplain is on gently undulating river terrace deposits of sands and gravels overlying Triassic mudstones. The river's width was 4-8m and was mostly too deep to cross in wellington boots. It ran in an incised channel with steep sand banks that left little room for ERS. Nearly all the ERS was narrow sand shores, often with small stands of *Phalaris*. Land-use was cattle pasture at the upstream sites Coole Hall and Dairy House Farm, newly planted woodland at Batherton Hall, and sheep pasture with one arable field at Mile End. Trees lined most of the river although about half the samples were from unshaded or only lightly shaded shores.

With the exception of the ubiquitous and often numerous shore-fly *Ditrichophora* sp B, no rare or scarce species was either widespread or numerous (Table 21). *Hilara* species were more frequent along the shaded banks at Batherton Hall compared to other sites. Five scarce species are wetland specialists but not dependent upon the ERS or riverine habitat (*Anagnota bicolor*, *Diclasiopa lacteipennis*, *Gymnoclasiopa plumosa*, *Scatella silacea*, *Tetanocera punctifrons*), and *Sapromyza albiceps* and dung-fly *Coniosternum decipiens* are terrestrial. Thus less than half the rare or scarce species are dependent upon the ERS habitat, and all but one of these had small populations. The identity of shore fly *Ditrichophora* sp C needs checking, as it may be merely an odd variant of *Ditrichophora* sp B.

Lonchoptera nigrociliata was the only species with total fidelity to ERS, and was frequent at the only patch of ERS with gravel rather than just sand; this agrees with its known larval habitat of small stones at the edges of shaded streams. The shore-fly *Athyroglossa glabra* and the cranefly *Hoplolabis areolata*, with high fidelity to ERS, were both widespread although rarely represented by more than a few individuals (Table 22). Widespread and sometimes frequent species with moderate fidelity to ERS were *Dolichopus longicornis*, *Teucophorus calcaratus* and *Ditrichophora sp B.* There were moderate populations of the uncommon shore fly *Polytrichophora duplosetosa* at Dairy House Farm, and of the empids *Hilara biseta* and *H. pseudochorica* at Batherton Hall, but no other species of note was well represented.

The fauna of the four sites was moderately similar, and this reflected the underlying physical similarity of the sites (Table 23). The two upstream sites, Coole Hall and Dairy House Farm, were most similar in appearance and in their fauna. The most downstream site, Mile End Farm, was most dissimilar, having notably fewer species and somewhat fewer ERS species altogether. This may have reflected its predominantly open character with intense sheep grazing along most of the banks and scarcity of exposed shores. Despite its apparently lower interest, the number of wetland species (ERS class 4) was scarcely different to those at the other sites, and the lower overall species complement is seen to be due to a lower number and proportion of tourist species. This is thought to reflect the poor quality of the river's surroundings at Mile End Farm (sheep pasture, golf course, arable field) so the only refuge for species was the river itself. The other sites had less intensively farmed surroundings so non-riverine species were plentiful, notably sciomyzids at Batherton Hall which originated from a pond close to one of the sampling points.

The scarce ERS ground beetle *Bembidion litorale* (Carabidae) was recorded at Batherton.


Coole Hall 4
25.07.2006 17:30


Dairy Farm 4
26.07.2006 16:21


Batherton Hall 3
26.07.2006 10:29


Batherton Hall 5
26.07.2006 11:30


Mile End 3
27.07.2006 10:22


27.07.2006 13:41
Mile End 8

Table 21. Rare and scarce species from the Weaver.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Coole Hall	Dairy Farm	Batherton	Mile End
Ephydridae	*Ditrichophora* sp B	New		3	6	8	6	-
Ephydridae	*Ditrichophora* sp C	New		3	-	-	1	-
Dolichopodidae	*Rhaphium penicillatum*	pRDB3	LRnt	3	1	-	1	-
Anthomyzidae	*Anagnota bicolor*	Notable		4	1	2	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	1	2	1	-
Empididae	*Hilara biseta*	Notable	LRns	2	1	-	4	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	4	1
Ephydridae	*Diclasiopa lacteipennis*	?Notable		4	1	-	1	2
Ephydridae	*Gymnoclasiopa plumosa*	?Notable		4	3	3	-	1
Ephydridae	*Polytrichophora duplosetosa*	Notable		3	-	4	1	1
Ephydridae	*Scatella silacea*	?Notable		4	-	-	-	2
Lauxaniidae	*Sapromyza albiceps*	Notable		5	-	1	-	-
Limoniidae	*Cheilotrichia imbuta*	Notable		4	-	-	1	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	-	1	-	-
Scathophagidae	*Conisternum decipiens*	Notable		5	4	2	1	-
Sciomyzidae	*Tetanocera punctifrons*	Notable		4	-	-	-	1

Table 22. ERS species from the Weaver.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Coole Hall	Dairy Farm	Batherton	Mile End
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	-	1	-	-
Empididae	*Hilara biseta*	Notable	LRns	2	1	-	4	-
Ephydridae	*Athyroglossa glabra*	Local		2	3	3	4	3
Limoniidae	*Hoplolabis areolata*	Local		2	5	4	2	3
Limoniidae	*Hoplolabis vicina*	Local		2	-	-	1	-
Tipulidae	*Nephrotoma analis*	Local		2	-	1	-	-
Dolichopodidae	*Campsicnemus marginatus*	Local		3	-	2	2	2
Dolichopodidae	*Dolichopus longicornis*	Local		3	6	2	4	3
Dolichopodidae	*Hercostomus nanus*	Local		3	1	-	1	-
Dolichopodidae	*Rhaphium penicillatum*	pRDB3	LRnt	3	1	-	1	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	2	6	4	1
Dolichopodidae	*Teucophorus monacanthus*	Local		3	-	-	1	-
Empididae	*Chelifera precatoria group*	Common		3	-	1	-	-
Empididae	*Hemerodromia unilineata*	Local		3	3	1	1	-
Empididae	*Hilara albiventris*	Notable	LRns	3	1	2	1	-
Empididae	*Hilara apta*	Local		3	-	-	1	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	4	1
Ephydridae	*Ditrichophora sp B*	New		3	6	8	6	-
Ephydridae	*Ditrichophora sp C*	New		3	-	-	1	-
Ephydridae	*Polytrichophora duplosetosa*	Notable		3	-	4	1	1
Hybotidae	*Platypalpus interstinctus*	Local		3	3	1	3	-
Muscidae	*Limnophora riparia*	Local		3	-	1	4	-
Muscidae	*Limnophora triangula*	Local		3	-	5	4	-
Tipulidae	*Nephrotoma guestfalica*	Local		3	1	-	-	-
Tipulidae	*Tipula couckei*	Local		3	-	-	1	1

Table 23. Summary of species variables for the Weaver.

	Coole Hall	Dairy Farm	Batherton	Mile End
No. of sampling points	7	8	7	8
Total Diptera	149	144	154	117
Major Families				
Chloropidae	5	4	4	3
Dolichopodidae	25	23	31	26
Empididae	11	10	12	8
Ephydridae	20	22	21	25
Hybotidae	12	11	10	9
Lauxaniidae	2	5	2	2
Limoniidae	11	6	8	8
Lonchopteridae	2	3	2	2
Muscidae	5	7	7	3
Opomyzidae	3	3	2	4
Sciomyzidae	3	2	7	2
Sepsidae	12	7	12	10
Stratiomyidae	5	6	4	1
Syrphidae	9	10	7	2
Tephritidae	2	1	0	1
Tipulidae	3	3	2	2
Status				
New	1	1	2	0
Rare	1	0	1	0
Scarce	6	7	7	6
Local	32	32	38	30
Common	106	103	106	81
Unknown	2	1	0	0
ERS Fidelity				
1 (total)	0	1	0	0
2 (high)	3	3	4	2
3 (moderate)	9	11	17	6
4 (wetland)	69	65	81	70
5 (tourist)	68	64	52	39

Lune: Lancashire

The sites were on a 10km stretch of the lower reaches of the Lune where it is a broad river (20-25m wide) flowing in a broad alluvial floodplain at about 25m OD. The substrate was predominantly pebbly to cobbly, and finer sediment was present only at Gressingham where it was gravelly but rarely sandy. Land-use is pasture or occasionally scrub. All the sites were exposed and all but one sampling point lacked tree shade.

Andy Godfrey visited the site in 2005 and 2006. In the first year, the three sites from Lower Broomfield to Gressingham were sampled by general collecting and a few timed sweeps and suction samples at Lower Broomfield (three samples) and Arkholme (two samples). In 2006, five timed sweep and suction samples were taken at all four sites. More families were identified in these samples than at other rivers in this project, including agromyzids, anthomyids, scatopsids and sphaerocerids which together contributed 23% (29 species) of those identified.

Three species new to Britain and one new to science were found at the Lune. New to Britain were the dolichopodid *Asyndetus latifrons*, the limoniid cranefly *Rhabdomastix eugeni* and the carnid *Meonura anceps* (Table 24). *Asyndetus latifrons* was recorded in both years, and was also found at the Coquet in 2006 in similar stony ERS, so it seems likely that it is dependent upon at least the riverine habitat and possibly on stony ERS. *Rhabdomastix eugeni* is one of the '*laeta*' group. A scatopsid new to science in the genus *Rhegloclemina* was found at both Broomfield and Caton. The record for *Spiriverpa lunulata* is new for Lancashire. The hybotid *Tachydromia halidayi* was widespread although caught in only small numbers.

Six species with high to total fidelity to ERS were recorded, although these included two species new to Britain whose habitat preferences for ERS are assumed rather than known for certain (Table 25). Several local species with high to moderate ERS fidelity were widespread.

In both years and using different collecting methods, relatively few species were recorded (Table 26). The number of species of the key target families (dolichopodids, empids, hybotids, ephydrids) were very low compared to other rivers surveyed in this project. The most speciose family was sphaerocerids with 13 species recorded in 2006. There were also rather few rare, scarce and ERS faithful species compared to numbers recorded at other rivers. It is therefore remarkable that four species new to Britain or to science were recorded among these. The same result was obtained in both years, and it suggests that dry stony ERS has rather different and species-poor fauna compared with that of the more sandy sediments of many other rivers surveyed in the project.

Lower Broomfield appeared to be the richest site with most species overall, proportionally more dolichopodids and ephydrids, and more ERS-faithful species than at the other sites (Table 26). Caton appeared to be similarly rich. The proportion of ERS 'tourists' (class 5) was greater than the general wetlands species (class 4), and this result differed from the four other rivers where tourists were notably less frequent than wetland species and often only about twice as frequent as the ERS species in classes 1-3 together. The same result was obtained from both timed samples restricted to the ERS and general sweeping, so there appears to be a real difference in the composition of the assemblage on the Lune compared to the other rivers.

Some other interesting records were obtained including the scarce spider *Arctosa cinerea* at Broomhill and Caton, and a hummingbird hawkmoth at Arkholme.

Table 24. Rare and scarce species from the Lune.

	Family	Species	Status	IUCN	Fidelity	Lower Broomfield	Arkholme	Gressingham	Caton
2006 data	Dolichopodidae	*Asyndetus latifrons*	New		2	2	-	-	-
	Limoniidae	*Rhabdomastix eugeni*	New		2	-	-	-	1
	Scatopsidae	*Rhegmoclemina* sp.nov	New		4	4	-	-	2
	Hybotidae	*Tachydromia edenensis*	RDB?		1	-	-	-	1
	Therevidae	*Spiriverpa lunulata*	RDB3		1	3	-	-	-
	Dolichopodidae	*Hercostomus plagiatus*	Notable	LRns	4	1	-	-	-
	Dolichopodidae	*Rhaphium rivale*	Notable	LRns	3	-	-	1	-
	Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	2	1	2
2005 data	Carnidae	*Meonura anceps*	New		5	1	1	-	
	Dolichopodidae	*Asyndetus latifrons*	New		4	1	-	-	
	Empididae	*Hilara albiventris*	Notable	LRns	3	1	-	-	
	Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	

Table 25. ERS species from the Lune.

	Family	Species	Status	IUCN	Fidelity	Lower Broomfield	Arkholme	Gressingham	Caton
2006 data	Hybotidae	*Tachydromia edenensis*	?RDB		1	-	-	-	1
	Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	2	1	2
	Therevidae	*Spiriverpa lunulata*	RDB3		1	3	-	-	-
	Dolichopodidae	*Asyndetus latifrons*	New		2	2	-	-	-
	Ephydridae	*Athyroglossa glabra*	Local		2	-	3	4	1
	Limoniidae	*Rhabdomastix eugeni*	New		2	-	-	-	1
	Dolichopodidae	*Dolichopus longicornis*	Local		3	-	1	1	1
	Dolichopodidae	*Rhaphium rivale*	Notable	LRns	3	-	-	1	-
	Empididae	*Hemerodromia oratoria*	Local		3	-	1	-	-
	Hybotidae	*Platypalpus interstinctus*	Local		3	2	2	2	1
	Muscidae	*Limnophora riparia*	Local		3	1	1	1	-
	Tipulidae	*Tipula couckei*	Local		3	1	1	-	1
2005 data	Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	
	Dixidae	*Dixella martinii*	Local		3	1	-	-	
	Dolichopodidae	*Teucophorus calcaratus*	Local		3	1	-	-	
	Empididae	*Hilara albiventris*	Notable	LRns	3	1	-	-	
	Ephydridae	*Ditrichophora albifrons* var. of Collin	Unknown		3	1	-	-	
	Hybotidae	*Platypalpus interstinctus*	Local		3	2	-	-	
	Hybotidae	*Platypalpus niger*	Local		3	0	1	-	

Table 26. Summary of species variables for the Lune.

	Lower Broomfield	Arkholme	Gressingham	Caton
2006 data				
No. of sampling points	5	5	5	5
Total Diptera	45	88	62	62
Major Families				
Chloropidae	4	3	4	3
Dolichopodidae	6	5	6	7
Empididae	2	5	3	3
Ephydridae	5	6	7	7
Hybotidae	3	8	3	4
Lauxaniidae	0	0	1	0
Limoniidae	1	0	0	2
Lonchopteridae	0	0	1	1
Muscidae	3	9	3	3
Opomyzidae	0	1	1	0
Sepsidae	6	9	9	5
Stratiomyidae	2	3	2	1
Syrphidae	1	7	6	2
Tephritidae	0	1	1	0
Tipulidae	1	3	0	1
Status				
New	2	0	0	2
Rare	1	0	0	1
Scarce	2	1	2	1
Local	7	15	7	10
Common	30	55	45	37
Unknown	4	17	8	13
ERS Fidelity				
1 (total)	2	1	1	2
2 (high)	1	1	1	2
3 (moderate)	3	5	4	3
4 (wetland)	24	26	23	28
5 (tourist)	15	54	33	27

2005 Data	**Lower Broomfield** [1]	**Arkholme** [1]	**Gressingham** [2]
No. of sampling points	3	2	1
Total Diptera	59	39	30
Major families			
Dolichopodidae	8	3	5
Empididae	5	4	2
Ephydridae	10	5	1
Hybotidae	6	6	1
Limoniidae	0	0	0
Lonchopteridae	1	1	0
Sepsidae	1	3	2
Tipulidae	0	0	2
Status			
New	2	1	0
Rare	0	0	0
Scarce	2	0	0

	Lower Broomfield	Arkholme	Gressingham	Caton
Local	13	6	5	
Common	39	30	25	
Unknown	3	2	0	
ERS Fidelity				
1 (total)	1	0	0	
2 (high)	0	0	0	
3 (moderate)	5	1	0	
4 (wetland)	20	14	11	
5 (tourist)	33	24	19	

1 Includes all samples (timed and general sweeps and suction samples).
2 No timed samples.

Coquet: Northumberland

Sites were selected on the same basis as for the Till group of rivers. There was no presumption that they were especially sandy. The most downstream site, Healey, was sampled speculatively; it was close to a lay-by on a fisherman's path. The most upstream site, Sharperton, and the most downstream site were separated by about 16km along the river. Ryehill and Thropton were contiguous.

The site at Sharperton was a large expanse several hundred metres long and about 100m wide of uncultivated ERS with large areas of bare or sparsely vegetated ERS, occasionally temporary or swampy pools, backwaters and cut-off channels. The ground was mainly stony or cobbly with small areas of fine gravel or sand, although fine sediments were confined to deposits far from the river's edge. Hepple was also a large expanse of uncultivated ERS, but with even larger areas of bare stones and almost no sand. Downstream at Ryehill and Thropton, the amount of fine material increased so that, although the shores were stony, there was dry shingle away from the river at Ryehill and sand at Thropton. All these sites were exposed, unshaded, and grazed by sheep or cattle except for Ryehill where the ERS was fenced off. The river was moderately similar in size at all these sites (7-15m wide) and could usually be crossed at riffles in wellington boots. The ERS at Healey was a narrow completely sandy shore with a few large boulders. It was partly shaded by large trees and grazed by cattle.

Rare species were well represented but by comparison there were relatively few scarce species (Table 27). The dolichopodid *Asyndetus latifrons* is new to Britain from specimens collected at Hepple and from the Lune. It seems likely, in view of the habitat where it was collected, that the species specialises in dry ERS habitat. *Spiriverpa lunulata* was found at three sites, and was probably frequent at Sharperton where several pupal exuviae were collected in suction samples. No other rare species occurred at more than two sites. The shore-fly *Hecamedoides unispinosus* was frequent on bare sand around pools at both Ryehill and Hepple, and *Scatella obsoleta* was present in small numbers at Ryehill and Sharperton. The cranefly *Hoplolabis yezoana* was present at several places at Ryehill but was especially frequent at the sandy margin of a backwater; this agrees with the habitat at other locations for the species which was recently added to the British list. The hybotid *Tachydromia halidayi* was widespread, and many were seen running over dry stones at Hepple, both close to and not far away from the river's edge. The muscid *Limnophora scrupulosa* was particularly widespread, as at the Till group of rivers.

Specialists with total or high fidelity to ERS were moderately well represented (Table 28). They included four *Tachydromia*. The more interesting species have already been mentioned above; no others need special mention.

Sharperton was clearly a more species-rich site than the others, and this was probably due to the greater range of habitats than found at the other sites (Table 29). This richness was not reflected in either the rare and scarce or ERS specialists, which were scarcer at Sharperton than at Hepple, Ryehill or Thropton. Hepple was genuinely rather species-poor, and its moderate total of species is due largely to a small pool with fringing marginal plants, but it still included a similar number of ERS to the more sandy Ryehill and Thropton sites. Thropton supported notably fewer species than the adjacent Ryehill (with clearly fewer dolichopodids and shore-flies) but despite this the number of rare and scarce species was similar; this was likely to be due to additional wetland species from backwaters and ponds at Ryehill. Thus, although the sandier sites (Ryehill, Thropton) were overall of greater interest, Hepple with its bleak expanse of stony and sparsely vegetated ERS was almost as valuable to the ERS species. It was not clear why Sharperton did not support such an interesting fauna since it had most of the necessary elements except wet sand.

The small plant hopper *Trigonocranus emmeae* (Cixiidae) was found at Thropton. It is restricted to dry places. There are only about a dozen British records, with this one being the most northerly by some distance, the nearest being Burdale in SE Yorkshire (Dr Alan Stewart, pers. com.). The large wolf spider *Arctosa cinerea* (Lycosidae) was seen several times on the cobbly shore at Hepple.


Ryehill 1 - Hoplolabis yezoana
13 07 2006 14 12


Ryehill 2
13 07 2006 14 35


13 07 2006 08 54
Thropton 1


Thropton 5
13 07 2006 11 05

Table 27. Rare and scarce species from the Coquet.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Sharperton	Hepple	Ryehill	Thropton	Healey
Dolichopodidae	*Asyndetus latifrons*	New		2	-	1	-	-	-
Ephydridae	*Ditrichophora* sp B	New		3	-	-	-	-	1
Ephydridae	*Hecamedoides unispinosus*	pRDBK		1	-	2	3	-	-
Ephydridae	*Scatella obsoleta*	pRDB2		1	2	-	1	-	-
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	1	-	-
Hybotidae	*Tachydromia costalis* group ♀	pRDB3		1	-	-	(1)	1	-
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	1	-	-	-
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	-	2	-	-
Sepsidae	*Themira biloba*	pRDBK		4	-	-	-	1	-
Therevidae	*Spiriverpa lunulata*	RDB3		1	2	-	1	2	-
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	1	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	-	-	-	-	1
Ephydridae	*Gymnoclasiopa cinerella*	Notable?		4	-	-	-	-	1
Hybotidae	*Platypalpus articulatus*	Notable	LRns	4	-	-	1	-	-
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	3	1	1	1	-
Lauxaniidae	*Sapromyza opaca*	Notable		5	-	-	-	1	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	-	-	-	1	1
Muscidae	*Limnophora scrupulosa*	Notable		3	6	5	8	6	-

Table 28. ERS species from the Coquet.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Sharperton	Hepple	Ryehill	Thropton	Healey
Ephydridae	*Hecamedoides unispinosus*	pRDBK		1	-	2	3	-	-
Ephydridae	*Scatella obsoleta*	pRDB2		1	2	-	1	-	-
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	1	-	-	-
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	1	-	-	-
Hybotidae	*Tachydromia costalis* group ♀	pRDB3		1	-	-	(1)	1	-
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	3	1	1	2	-
Hybotidae	*Tachydromia morio*	Unknown		1	2	1	2	-	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	-	-	-	1	1
Therevidae	*Spiriverpa lunulata*	RDB3		1	2	-	1	2	-
Dolichopodidae	*Asyndetus latifrons*	New		2	-	1	-	-	-
Ephydridae	*Athyroglossa glabra*	Local		2	6	3	3	2	-
Limoniidae	*Hexatoma fuscipennis*	Local		2	3	-	-	-	-
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	-	2	-	-
Limoniidae	*Rhabdomastix edwardsi*	Local		2	-	-	1	1	-
Dolichopodidae	*Campsicnemus marginatus*	Local		3	3	2	5	4	1
Dolichopodidae	*Dolichopus longicornis*	Local		3	2	-	4	3	2
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	1	-	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	-	1	2	-	-
Dolichopodidae	*Teucophorus monacanthus*	Local		3	1	1	-	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	-	-	-	-	1
Empididae	*Hilara apta*	Local		3	-	-	-	1	-
Empididae	*Wiedemannia bistigma*	Local		3	-	-	-	1	-
Ephydridae	*Ditrichophora* sp B	New		3	-	-	-	-	1
Hybotidae	*Platypalpus interstinctus*	Local		3	1	-	-	1	2
Limoniidae	*Antocha vitripennis*	Local		3	-	-	-	-	1
Muscidae	*Limnophora riparia*	Local		3	2	2	-	1	-
Muscidae	*Limnophora scrupulosa*	Notable		3	6	5	8	6	-
Tipulidae	*Nephrotoma guestfalica*	Local		3	-	-	-	1	-
Tipulidae	*Tipula couckei*	Local		3	5	2	7	4	-
Tipulidae	*Tipula montium*	Common		3	2	1	2	2	-

Table 29. Summary of species variables for the Coquet.

	Sharperton	Hepple	Ryehill	Thropton	Healey
No. of sampling points	9	6	8	9	2
Total Diptera	164	102	126	107	67
Major Families					
Chloropidae	5	2	8	9	1
Dolichopodidae	33	27	32	15	17
Empididae	6	4	9	9	10
Ephydridae	24	20	23	12	11
Hybotidae	16	10	10	10	6
Lauxaniidae	1	0	0	1	1
Limoniidae	6	1	6	3	1
Lonchopteridae	2	0	2	1	3
Muscidae	8	5	8	7	5
Opomyzidae	1	1	1	2	2
Sciomyzidae	7	2	2	2	0
Sepsidae	8	7	6	8	2
Stratiomyidae	4	3	2	2	1
Syrphidae	10	1	5	3	2
Tephritidae	2	0	0	2	0
Tipulidae	4	3	3	4	0
Status					
New	0	1	0	0	1
Rare	2	4	5	3	0
Scarce	2	2	4	4	3
Local	47	29	35	26	12
Common	111	62	80	72	51
Unknown	2	4	3	2	0
ERS Fidelity					
1 (total)	4	5	6	4	1
2 (high)	2	2	3	2	0
3 (moderate)	8	8	7	10	6
4 (wetland)	87	52	70	42	36
5 (tourist)	62	33	41	48	24

Till, Breamish and Glen: Northumberland

The sites were selected because their ERS beetles had been surveyed recently (Lott, 2005) and some were known to be sandy rivers. The choice of sampling locations had been made by the Environment Agency on the basis of known ERS deposits and a rapid visual survey from easily accessible points. The sites were therefore not selected for the sandiness of their deposits.

The Breamish and the Till are the same river, the Breamish being the upstream section with a more stony character. The floodplain where the Breamish was sampled at Brandon is wide, and its low banks are composed of cobbles and stones. The river is braided and runs in a broad uncultivated and frequently flooded channel (c. 100m wide) with small pools, bare expanses of stones, ruderal vegetation and low scrub. There is almost no sand here. It is classic stony ERS.

The Till at Bewick Bridge, although not far downstream from Brandon, is a far quieter river in gently undulating countryside. The ERS is in small bars and islands, and although the shores are mainly stony, the banks are mainly shingle with sand at the top. Some samples could therefore be taken on mainly sandy substrate. Trees cast moderate shade in parts of this site, unlike the others in this group of rivers. The wide floodplain of the Till at Doddington Bridge is particularly sandy, and the river here flows in a deep channel with nearly vertical sand banks. The banks clearly erode rapidly here, although deposited material was not as extensive as had been expected. This is an exposed site with few trees and arable fields or rather bleak pasture; the conservation interest away from the river is low. The Glen is a small tributary joining the Till near Doddington Bridge and is on the Till's floodplain where is was sampled at Akeld. The river had more algae than seen at most sites, and it may be more affected by nutrient input than the large Till.

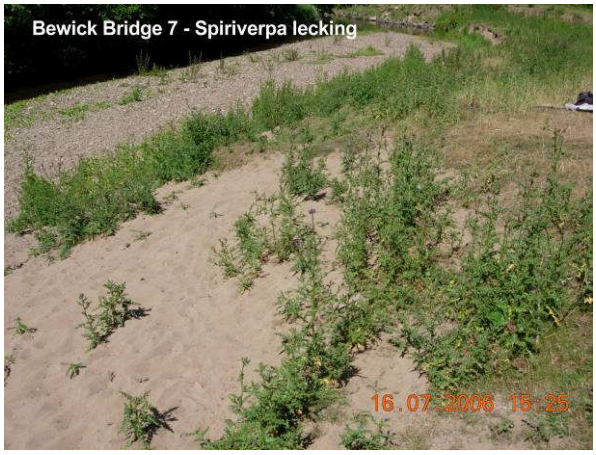
The rivers supported an exceptional number of rare and scarce species (Table 30). *Rhaphium suave* was recorded as new to Britain in 2005 from sandy ERS on the Usk (this project) and Dane (Bates *et al*., 2006); a single male was recorded at Doddington Bridge at a wet sand shore next to still water. The shore fly *Scatella obsoleta* was found at all four sites, and was widespread and sometimes numerous at Doddington Bridge where it sometimes outnumbered the common *S. paludum* and *S. tenuicosta*. These are the first records for England; it was previously known only from Speyside. The final widespread rare species was *Spiriverpa lunulata* which was recorded at the Breamish and Till sites; these are new county records.

Few scarce species were widespread. *Lonchoptera nigrociliata* and the aquatic muscid *Limnophora scrupulosa* were found at all four sites, and the muscid was particularly frequent although rarely numerous. *Platypalpus articulatus* was at three sites but only widespread at Doddington Bridge. The remaining species were infrequently found, except for *Hilara pseudochorica* at Doddington Bridge. The BAP-listed *Rhabdomastix laeta* was found only once at Doddington Bridge.

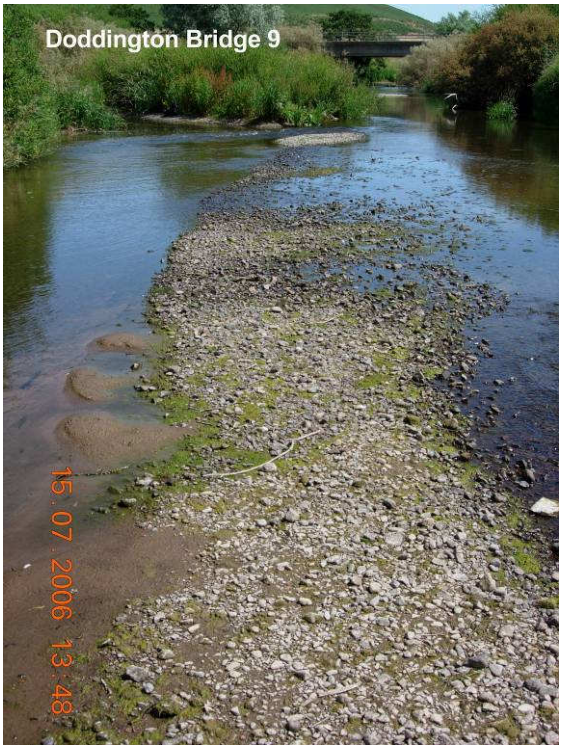
ERS species were well represented with eight having total fidelity and seven with high fidelity species, making these among the highest totals in the project. Almost all of these were found at Doddington Bridge, so this sandy stretch of river was clearly of more value to the ERS species than the gravelly or stony sites. The cranefly *Hextoma bicolor* was missing from Doddington Bridge but present on the stony Brandon site, which fits with its known preference for stony ERS. The presence of all three British *Hoplolabis* craneflies at Doddington Bridge was of interest, especially as *H. areolata* is regarded as a southern species.

The total species richness was similar for the Breamish and Till sites, despite considerable difference in sampling effort (Table 32). The low numbers at the Glen reflect low sampling effort as well as a genuinely poorer fauna which is particularly noticeable in the small numbers of empids and hybotids. Doddington Bridge stands out in many ways. For the effort expended, the total numbers of species are slightly less than at Brandon and Bewick Bridge but most of the key families are proportionally better represented, notably limoniid craneflies and muscids. More rare and scarce species were found here - 19 (11.7%) in all compared to 9 (4.8%) and 15 (8.5%) at Brandon and Bewick Bridge, respectively, including ten RDB species and the obviously uncommon dolichopodid *Rhaphium suave* new to Britain. Doddington Bridge also supported a high number of species with total or high ERS fidelity – 14 species compared to 6 species at Brandon and Bewick Bridge, although similar numbers of wetland species (ERS fidelity class 4). As the river flows through an intensively farmed floodplain at Doddington (by comparison to the other sites), the proportion of tourist species is low. Among the rare species here, special mention is made of the shore-fly *Hecamedoides unispinosus*, which was also present at the Coquet and some Devon rivers (but not found in the rivers surveyed in this project), the craneflies *Hoplolabis yezoana* and *Rhabdomastix laeta* (two males), and three species of *Tachydromia*; all these species are apparently closely associated with sandy rivers or with ERS, and nearly all were unique to this site. The shore-fly *Ditrichophora* sp B was ubiquitous here are often frequent or numerous in samples; this was in strong contrast to its near-absence elsewhere in this group of rivers.

Bewick Bridge supported a moderately interesting fauna, although not matching that of Doddington Bridge. The proportion of rare or scarce species found here (8.5%) is high, but the representation of ERS species no greater than at many other sites surveyed.




Bewick Bridge 1 & 2
16.07.2006 14:16


Doddington Bridge 9
15.07.2006 13:48


Doddington 2 - Rhaphium suave
15.07.2006 12:41


Doddington Bridge near 7
15.07.2006 12:35


Doddington Bridge 8-12
15.07.2006 14:53


Akeld 3 & 4
15.07.2006 16:12

Table 30. Rare and scarce species from the Till, Breamish and Glen.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Brandon	Bewick Bridge	Doddington Bridge	Akeld
Dolichopodidae	*Rhaphium suave*	New		2	-	-	1	-
Ephydridae	*Ditrichophora* sp B	New		3	-	2	11	-
Ephydridae	*Hecamedoides unispinosus*	pRDBK		1	-	-	1	-
Ephydridae	*Scatella obsoleta*	pRDB2		1	1	1	7	1
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	-	1	-
Hybotidae	*Tachydromia costalis* group ♀	pRDB		1	-	-	(1)	-
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	-	1	-
Hybotidae	*Tachydromia umbrarum*	RDBI		5	-	1	-	-
Hybotidae	*Tachydromia woodi*	RDB?	LRnt	2	-	1	1	-
Limoniidae	*Arctoconopa melampodia*	RDB2		4	-	-	1	-
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	-	3	-
Limoniidae	*Rhabdomastix laeta*	RDB?		1	-	-	1	-
Sepsidae	*Themira biloba*	pRDBK		4	-	-	-	1
Syrphidae	*Parhelophilus consimilis*	RDB2		4	-	1	-	-
Therevidae	*Spiriverpa lunulata*	RDB3		1	1	1	2	-
Dolichopodidae	*Argyra auricollis*	Notable	LRns	5	-	1	-	-
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	3	-
Empididae	*Hilara albiventris*	Notable	LRns	3	-	2	-	-
Empididae	*Hilara diversipes*	Notable	LRns	4	-	1	1	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	10	-
Ephydridae	*Gymnoclasiopa cinerella*	Notable?		4	-	-	2	-
Hybotidae	*Platypalpus articulatus*	Notable	LRns	4	-	1	6	1
Hybotidae	*Platypalpus subtilis*	Notable	LRns	4	-	3	-	-
Lauxaniidae	*Sapromyza opaca*	Notable		5	1	-	-	-
Limoniidae	*Eloeophila apicata*	Notable		4	1	-	-	-
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	-	1	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	3	1	1	1
Muscidae	*Limnophora scrupulosa*	Notable		3	6	1	9	1
Muscidae	*Lispocephala spuria*	Notable		4	3	-	-	-
Sciomyzidae	*Pherbellia brunnipes*	Notable		4	-	1	-	-
Sepsidae	*Themira gracilis*	Notable		3	-	1	-	-
Syrphidae	*?Meligramma trianguliferum*	Notable		5	1	-	-	-

Table 31. ERS species from the Till, Breamish and Glen.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Brandon	Bewick Bridge	Doddington Bridge	Akeld
Ephydridae	*Hecamedoides unispinosus*	pRDBK		1	-	-	1	-
Ephydridae	*Scatella obsoleta*	pRDB2		1	1	1	7	1
Hybotidae	*Tachydromia costalis*	pRDB3	LRnt	1	-	-	1	-
Hybotidae	*Tachydromia costalis* group ♀	pRDB		1	-	-	(1)	-
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	-	1	-
Hybotidae	*Tachydromia morio*	Unknown		1	1	-	1	-
Limoniidae	*Rhabdomastix laeta*	Unknown		1	-	-	1	-
Lonchopteridae	*Lonchoptera nigrociliata*	Notable		1	3	1	1	1
Therevidae	*Spiriverpa lunulata*	RDB3/I		1	1	1	2	-
Dolichopodidae	*Rhaphium suave*	New		2	-	-	1	-
Ephydridae	*Athyroglossa glabra*	Local		2	7	6	6	3
Hybotidae	*Tachydromia woodi*	Unknown	LRnt	2	-	1	1	-
Limoniidae	*Hexatoma bicolor*	Local		2	1	-	-	-
Limoniidae	*Hoplolabis areolata*	Local		2	-	1	1	-
Limoniidae	*Hoplolabis vicina*	Local		2	-	-	3	-
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	-	3	-
Dolichopodidae	*Campsicnemus marginatus*	Local		3	4	3	6	2
Dolichopodidae	*Dolichopus longicornis*	Local		3	4	5	9	2
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	3	-
Dolichopodidae	*Teucophorus calcaratus*	Local		3	-	-	4	-
Dolichopodidae	*Teucophorus monacanthus*	Local		3	6	5	2	-
Empididae	*Chelifera stigmatica*	Unknown		3	1	-	-	-
Empididae	*Chelifera trapezina*	Local		3	1	-	-	-
Empididae	*Hemerodromia oratoria*	Unknown		3	3	3	4	2
Empididae	*Hemerodromia unilineata*	Local		3	-	3	-	-
Empididae	*Hilara albiventris*	Notable	LRns	3	-	2	-	-
Empididae	*Hilara apta*	Local		3	3	-	2	-
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	10	-
Empididae	*Wiedemannia bistigma*	Local		3	-	-	-	1
Empididae	*Wiedemannia rhynchops*	Local		3	-	-	1	-
Ephydridae	*Ditrichophora sp B*	New		3	-	2	11	-
Hybotidae	*Platypalpus interstinctus*	Local		3	3	3	6	-
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	-	1	-
Muscidae	*Limnophora maculosa*	Local		3	-	-	1	-
Muscidae	*Limnophora riparia*	Local		3	7	2	2	-
Muscidae	*Limnophora scrupulosa*	Notable		3	6	1	9	1
Sepsidae	*Themira gracilis*	Notable		3	-	1	-	-
Tipulidae	*Nephrotoma guestfalica*	Local		3	1	1	1	-
Tipulidae	*Tipula couckei*	Local		3	6	5	7	2
Tipulidae	*Tipula montium*	Common		3	2	2	1	2

Table 32. Summary of species variables for the Till, Breamish and Glen.

River	Breamish	Till	Till	Glen
Site	Brandon	Bewick Bridge	Doddington Bridge	Akeld
No. of sampling points	13	8	12	6
Total Diptera	187	176	162	99
Major Families				
Chloropidae	7	6	7	8
Dolichopodidae	34	34	27	20
Empididae	21	21	16	7
Ephydridae	22	19	24	18
Hybotidae	15	17	20	8
Lauxaniidae	6	3	1	0
Limoniidae	8	3	10	2
Lonchopteridae	3	3	4	3
Muscidae	6	8	13	5
Opomyzidae	2	3	1	2
Sciomyzidae	4	6	3	2
Sepsidae	6	7	8	7
Stratiomyidae	4	5	4	1
Syrphidae	12	6	5	2
Tephritidae	2	2	0	1
Tipulidae	5	6	4	4
Status				
New	0	1	2	0
Rare	2	5	9	2
Scarce	7	9	8	3
Local	50	39	43	23
Common	125	119	96	71
Unknown	3	3	4	0
ERS Fidelity				
1 (total)	4	3	7	2
2 (high)	2	3	7	1
3 (moderate)	13	14	18	7
4 (wetland)	86	85	76	53
5 (tourist)	80	71	53	36

Scottish rivers

Survey work on the Scottish rivers was only agreed in mid-July. Due to the late stage of the season by this time there was concern that some ERS species would be coming to the end of their flight period. However, despite this, it was decided that the target UK BAP species (therevids and *Rhabdomastix* '*laeta*') should still be on the wing and to go ahead with the fieldwork on the Tay and the Spey in 2006. Arrangements were hastily made and fieldwork conducted as soon as possible in July.

The initial concerns over the lateness in the season were born out by the results with low numbers of ERS species and low numbers of individual flies recorded on these rivers. The very hot and sunny weather in the survey period exacerbated the problems. The extensive unshaded shingle banks of these big spate rivers became very hot and dry, bringing the flies' season to a rapid end or driving them off the shingle to seek shelter in vegetated habitats not targeted in this survey.

Tay: Perthshire

The Tay is one of the largest rivers in Britain with a length of 193 km and a mean flow of 168 cubic metres per second. It draws its water from a wide catchment from Ben Lui, south of Tyndrum, Rannoch Moor (R. Tummel) and the southern Cairngorms (R. Gary). In the upper reaches these dynamic rivers give rise to very coarse cobbly and bouldery substrate. South of Pitlochry the Tummel, which now includes the waters of the Gary slows and large areas of shingle and lenses of sand are deposited. The extensive shingle deposits of Ballinluig Shingle Island have been visited by entomologists over many years and were visited in this survey. However, much of the bare, sandy ERS was found to have gone from this site and area of ERS immediately downstream was chosen to sample instead. The Tummel joins the Tay just south of Ballinluig and flows south. At Dalguise no suitable sandy shingle areas could be found to sample, although collecting on the shingle and riverbank recorded some notable species. At Dunkeld, the Tay passes across the Highland Boundary Fault and into the lowlands where it again slows and extensive areas of mixed-grade ERS are deposited around the Bloody Inches at Kercock and Westhaugh.

Fourteen rare or scarce species were recorded in timed sweep and suction samples, and another four were found by casual collecting (Table 33). None of the species was widespread except for *Spiriverpa lunulata* which was found at all four sites. The most interesting records were a single female of *Cliorismia rustica* at Kercock and a single male at Ballinluig Shingle Island; these are the first records of the species in Scotland. Ballinluig Shingle Island was found to have largely vegetated over since a previous visit some years ago, with some of the margins of the ERS bank having been washed out and with very little sand. Although *Rhabdomastix* '*hilaris*' was also recorded at this site, an alternative area of ERS downstream just above the road bridge was chosen for detailed sampling. Kercock supported all three BAP flies (both therevids and *Rhabdomastix 'hilaris'*).

Of the ten species with total or high fidelity to ERS, only *Spiriverpa lunulata* was recorded at the three sites with timed sampling, and most others were infrequently recorded at each site (Table 34).

Despite the otherwise low numbers of Diptera recorded, the numbers of dolichopodids, empids and shore-flies is similar to those recorded at other rivers, and the number of limoniid craneflies is slightly higher (Table 35).

Tachydromia were few in numbers and species. The ERS specialist *T. edenensis*, only recently described from Cumbria, was an interesting discovery at Westhaugh. This is only the second Scottish locality for this species, having been found on the R. Nith in

Dumfriesshire in 2005 (Hewitt in prep). Otherwise only a few of the relatively common *T. morio* and a single specimen of the late season *T. halidayi* were found at Westhaugh and Ballinluig respectively.

Ballinuig appeared to be the most species rich site but the complement of rare, scarce and ERS-faithful species was little different from the other two sites. Its high species richness is due largely to a higher representation of ERS tourists; when this is taken into account, there is little difference in the interest at Ballinuig and Kercock. Westhaugh is slightly less interesting in terms of rare, scarce and ERS faithful species.

Other flies of conservation concern included the cranefly *Dicranomyia omissinervis* RDB2 at Ballinluig and the robberfly *Dioctria cothurnata* pRDB3 apparently new to Perthshire at Dalguise. The following noteworthy non-dipteran ERS-specialists were recorded. The Nationally Scarce 5-spot Ladybird was present at all sites visited on the Tay and was present in numbers at Kercock, Westhaugh and Ballinluig. These records appear to be the first on the Tay away from Ballinluig Shingle Island. The Nationally Scarce shorebug *Saldula fucicola* was noted at Westhaugh.

Table 33. Rare and scarce species from the Tay.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Ballinluig	Kercock	Westhaugh	Dalguise
Timed sweep & suction								
Ephydridae	*Scatella obsoleta*	pRDB2		1	-	1	-	
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	-	1	
Limoniidae	*Dicranomyia omissinervis*	RDB2		4	2	2	-	
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	1	-	
Limoniidae	*Rhabdomastix hilaris (=japonica)*	RDB3		4	-	1	-	
Therevidae	*Spiriverpa lunulata*	RDB3		1	1	1	1	
Cylindrotomidae	*Diogma glabrata*	Notable		4	1	-	-	
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	1	
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	2	
Empididae	*Rhamphomyia lamellata*	Notable	LRns	3	1	2	-	
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	
Limoniidae	*Eloeophila apicata*	Notable		4	1	-	-	
Micropezidae	*Micropeza lateralis*	Notable		5	1	-	-	
General collecting only								
Asilidae	*Dioctria oelandica*	Notable		5	1	-	-	-
Asilidae	*Dioctria cothurnata*	pRDB3		5	-	-	-	1
Therevidae	*Cliorismia rustica*	RDB3		2	1	1	-	-
Therevidae	*Spiriverpa lunulata*	RDB3		1				1
Micropezidae	*Micropeza lateralis*	Notable		5	-	1	-	-

Table 34. ERS species from the Tay.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Ballinluig	Kercock	Westhaugh	Dalguise
Timed sweep & suction								
Ephydridae	*Scatella obsoleta*	pRDB2		1	-	1	-	
Hybotidae	*Tachydromia edenensis*	RDB?		1	-	-	1	
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	1	-	-	
Hybotidae	*Tachydromia morio*	Local		1	-	-	1	
Therevidae	*Spiriverpa lunulata*	RDB3		1	1	1	1	
Dolichopodidae	*Rhaphium elegantulum*	Local		2	-	-	1	
Dolichopodidae	*Rhaphium nasutum*	Local		2	-	2	-	
Ephydridae	*Athyroglossa glabra*	Local		2	2	1	-	
Limoniidae	*Hoplolabis yezoana*	RDB?		2	-	1	-	
Tipulidae	*Nephrotoma analis*	Local		2	1	-	-	
Dolichopodidae	*Campsicnemus marginatus*	Local		3	1	1	3	
Dolichopodidae	*Dolichopus longicornis*	Local		3	4	2	5	
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	1	
Empididae	*Hemerodromia oratoria*	Local		3	-	-	1	
Empididae	*Hilara apta*	Local		3	-	-	1	
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	2	
Empididae	*Rhamphomyia lamellata*	Notable	LRns	3	1	2	-	
Empididae	*Wiedemannia bistigma*	Local		3	-	-	1	
Hybotidae	*Platypalpus interstinctus*	Local		3	-	1	1	
Tipulidae	*Nephrotoma guestfalica*	Local		3	2	-	1	
Tipulidae	*Tipula couckei*	Local		3	1	-	3	
Tipulidae	*Tipula montium*	Common		3	2	-	-	
General collecting only								
Therevidae	*Cliorismia rustica*	RDB3		2	1	1	-	-
Therevidae	*Spiriverpa lunulata*	RDB3						1

Table 35. Summary of species variables for the Tay (timed sweep and suction samples).

	Ballinluig	Kercock	Westhaugh
No. of sampling points	5	5	5
Total Diptera	86	44	56
Major Families			
Dolichopodidae	28	14	20
Empididae	15	11	11
Ephydridae	12	7	8
Hybotidae	4	4	5
Limoniidae	10	6	1
Lonchopteridae	2	0	1
Syrphidae	0	0	1
Tephritidae	3	1	2
Tipulidae	8	0	4
Status			
New	0	0	0
Rare	3	5	2
Scarce	5	1	2
Local	27	14	23
Common	51	24	29
Unknown	0	0	0
ERS Fidelity			
1 (total)	2	2	3
2 (high)	2	3	1
3 (moderate)	7	4	9
4 (wetland)	56	27	32
5 (tourist)	19	8	11

Spey: Highland

The River Spey is one of the largest rivers in Scotland with a length of 160 km and mean flow of 64 cubic metres per second. Draining from the Cairngorms massif it is a highly dynamic river and is considered of national importance for nature conservation for its plant, bird and invertebrate communities as well as its diversity of fluvial geomorphological features. In the high-energy regime of the Spey, the rocks of the Cairngorrns weather to develop a variety of substrate grades, from cobbles and boulders through shingle to gravels and fine sands.

Sample sites were chosen at various points on the catchment to sample different ERS deposit types. Upstream, the River Feshie is very active with well developed braided channels, sand and shingle bars and, at the confluence with the Spey, the extensive mosaic of ERS deposits of the Feshie Fan form the most important fluvial geomorphology site in Scotland. The River Druie is an excellent example of a mountain torrent with coarse-grained bed material. The confluence with the Spey at Inverdruie has a variety of extensive sand and shingle banks. The Dorbach Burn, with its adjacent 'inland sand dunes' is a well-known entomological locality and is the type location for the Red-listed ERS specialist Hybotid fly *Tachydromia acklandi*. The burn itself is some 3 m. wide and drains a broad upland basin on the north western slops of the Cairngorms. There is a mix of in-channel sediments from medium-coarse to fine-grained. Old shingle terraces have become vegetated. Downstream at Fochabers, the Spey is still a fast-flowing spatey river some 40m wide. Here extensive areas of sediment include open medium-coarse shingle, some areas of sand and silty margins at the toe and backwaters of the deposits.

Nineteen rare or scarce species were recorded (Table 36). This is a low number considering the Spey's reputation for its value to Diptera. Many of the rare and specialist species were absent due to the late-timing of the fieldwork and the extremely hot and sunny conditions during the survey. Numbers of specimens were also low; nearly all were recorded at only one site, although some were found at more than one sampling point and these species may have had moderate populations locally (e.g. *Scatella obsoleta* at Fochabers). *Rhabdomastix japonica* was notably found at all four sites, and *Spiriverpa lunulata* at three.

Species with total or high fidelity to ERS were similarly poorly represented, with only three species in each of these classes (Table 37). Even the species with moderate fidelity (class 3) were sporadically represented. Among the ERS-specialist *Tachydromia* (Hybotidae), only the late season *T. halidayi and T. morio* were found – and these in very low numbers. *Tachydromia acklandi*, which is a northern ERS specialist recorded from the Spey catchment in the past and widely on the Eden catchment in Cumbria, has a generally earlier season and was not found during this survey. Among the ERS-specialist Dolichopodids, *Rhaphium* numbers were similarly low. Northern species such as *R. gravipes*, largely restricted to Scotland but also occurring widely on Cumbrian rivers in early summer, was not found at all. Adults of the ERS robberfly *Rhadiurgus variabilis* were observed by the surveyor on a casual visit to the R. Feshie on 8 July, but were not recorded by the time of the survey on 23 July. Other flies of northern rivers included the second British record of the cranefly *Ormosia ruficauda*, from Inverdruie; *Heleodromia irwini* pRDB1, found at Dorbach Burn, *Rhabdomastix inclinata* pRDB2 at Feshie Fan and *Wiedemannia phantasma*, recorded at Fochabers. The Nationally Scarce ERS horse-fly *Tabanus cordiger* was also found on the Feshie Fan.

Total numbers of species were much lower than recorded at other rivers, even in the target families, with the exception of results for Inverdruie, which notably is a heavily wooded and shaded site in contrast to the others on the Spey (Table 38). Nevertheless, the proportion of rare and scarce species is high for all sites, in the range 9.8 – 14.6% for the timed sweep and suction samples.

Other flies of note in the survey include the RDB3 dead-wood specialist robber-fly *Laphria flava* at Feshie Fan. The following Nationally Scarce non-dipteran ERS-species were recorded casually during the survey: the shorebug *Saldula fucicola* at Fochabers and Inverdruie; the wolf-spider *Arctosa cinerea* at Fochabers; the ground beetle *Bembidion litorale* at Fochabers, Dorbach Burn, Feshie Fan; the click-beetle *Fleutiaxellus maritimus* at Dorbach Burn and the 5-spot Ladybird in numbers at Fochabers, Dorbach Burn, Feshie Fan and Inverdruie.

Table 36. Rare and scarce species from the Spey.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Dorbach Burn	Feshie Fan	Fochabers	Inverdruie
Timed sweep & suction								
Empididae	*Heleodromia irwini*	pRDB1	DD	4	2	-	-	-
Empididae	*Wiedemannia phantasma*	pRDB3	LRnt	3	-	-	1	-
Limoniidae	*Rhabdomastix inclinata*	RDB2		3	-	1	-	-
Ephydridae	*Scatella obsoleta*	pRDB2		1	-	-	3	-
Limoniidae	*Rhabdomastix hilaris (=japonica)*	RDB3		4	1	1	1	2
Therevidae	*Spiriverpa lunulata*	RDB3		1	-	-	1	-
Dolichopodidae	*Dolichopus argyrotarsis*	Notable	LRns	3	-	3	-	-
Empididae	*Chelifera concinnicauda*	Notable	LRns	3	-	1	-	-
Limoniidae	*Pilaria meridiana*	Notable		4	-	-	-	1
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	-	1	-
Tipulidae	*Nephrotoma dorsalis*	Notable		2	-	-	-	1
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	-	1
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	-	1
Limoniidae	*Eloeophila apicata*	Notable		4	1	2	-	1
Micropezidae	*Micropeza lateralis*	Notable		5	-	1	-	-
General collecting only								
Asilidae	*Laphria flava*	RDB3		5	-	1	-	-
Therevidae	*Spiriverpa lunulata*	RDB3		1	-	1	-	-
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	-	1	1	-
Limoniidae	*Dicranomyia ventralis*	Notable		4	1	-	-	-
Tabanidae	*Tabanus cordiger*	Notable		2	-	1	-	-

Table 37. ERS species from the Spey.

Family	Species	JNCC Status	IUCN Status	ERS Fidelity	Dorbach Burn	Feshie Fan	Fochabers	Inverdruie
Timed sweep & suction								
Ephydridae	*Scatella obsoleta*	pRDB2		1	-	-	3	-
Hybotidae	*Tachydromia morio*	Local		1	-	-	1	-
Therevidae	*Spiriverpa lunulata*	RDB3		1	-	-	1	-
Dolichopodidae	*Rhaphium elegantulum*	Local		2	-	1	-	-
Ephydridae	*Athyroglossa glabra*	Local		2	-	-	1	2
Tipulidae	*Nephrotoma dorsalis*	Notable		2	-	-	-	1
Dolichopodidae	*Campsicnemus marginatus*	Local		3	1	-	-	-
Dolichopodidae	*Dolichopus argyrotarsis*	Notable	LRns	3	-	3	-	-
Dolichopodidae	*Dolichopus longicornis*	Local		3	-	1	4	4
Dolichopodidae	*Rhaphium fractum*	Notable	LRns	3	-	-	-	1
Dolichopodidae	*Teucophorus monacanthus*	Local		3	1	-	-	-
Empididae	*Chelifera concinnicauda*	Notable	LRns	3	-	1	-	-
Empididae	*Hemerodromia oratoria*	Local		3	-	-	-	2
Empididae	*Hilara pseudochorica*	Notable	LRns	3	-	-	-	1
Empididae	*Wiedemannia bistigma*	Local		3	1	-	1	-
Empididae	*Wiedemannia phantasma*	pRDB3	LRnt	3	-	-	1	-
Hybotidae	*Platypalpus interstinctus*	Local		3	-	-	1	-
Limoniidae	*Rhabdomastix inclinata*	RDB2		3	-	1	-	-
Lonchopteridae	*Lonchoptera meijeri*	Notable		3	-	-	1	-
Tipulidae	*Tipula couckei*	Local		3	-	2	1	-
Tipulidae	*Tipula montium*	Common		3	1	-	-	2
General collecting only								
Hybotidae	*Tachydromia halidayi*	Notable	LRns	1	-	1	1	-
Limoniidae	*Rhabdomastix edwardsi*	Local		2	-	-	1	-
Tabanidae	*Tabanus cordiger*	Notable		2	-	1	-	-

Table 38. Summary of species variables for the Spey (timed sweep and suction samples).

	Dorbach Burn	Feshie Fan	Fochabers	Inverdruie
No. of sampling points	5	5	5	6
Total Diptera	30	41	36	61
Major Families				
Chloropidae				
Dolichopodidae	10	12	10	20
Empididae	5	5	4	15
Ephydridae	4	4	8	9
Hybotidae	4	6	6	6
Limoniidae	4	7	1	5
Lonchopteridae	0	0	2	0
Opomyzidae	1	0	0	1
Syrphidae	0	0	1	1
Tephritidae	0	1	0	0
Tipulidae	2	3	2	2
Status				
New	0	0	0	0
Rare	2	2	4	1
Scarce	1	4	1	5
Local	10	14	12	20
Common	17	21	19	35
Unknown	0	0	0	0
ERS Fidelity				
1 (total)	0	0	3	0
2 (high)	0	1	1	2
3 (moderate)	4	5	6	5
4 (wetland)	21	24	21	37
5 (tourist)	5	11	5	17

Ordination

The size of the database from this project (c. 850 species, nearly 300 sampling points) precluded including all sites in the ordination and classification, since the Excel spreadsheet has a limit of 256 columns (used for samples in the present analysis). The option of using the subset of the c. 250 most frequent species was not followed since 'stitching together' disparate spreadsheet data, transposing rows and columns to fit the spreadsheet, and then manipulating environmental data to match the results was considered far too time consuming. Another 84 samples taken using the same standard sweep-sampling in previous surveys of other Devon and Cheshire rivers also had to be excluded (Bell *et al*., 2004; Bates *et al*., 2006).

It was decided to use only the 238 sweep-net samples collected by MD since these suffered least from sampling effects caused by different surveyors. Suction samples were not combined with sweep samples since they were taken at only about half the sampling points. The number of species had to fit the limit of 500 species in the Pisces software used for TWINSPAN (although there is a far larger limit for running CCA). Excluded species were those recorded only once, and those in a families inconsistently recorded between years (mainly muscids) and a few minor families of no relevance to riverine habitat. The final list included 475 species. No downweighting was used for species that were rare in the dataset.

The use of a linear abundance scale is likely to have affected the ordination scores but was useful in TWINSPAN where the scale of 1 to 4 can be used directly.

DECORANA produced eigenvalues of 0.291, 0.285 and 0.207 for axes 1 to 3, respectively. The similarity of the first two, and the not much smaller value of that of the third axis, suggested that it may be possible to distinguish clear trends along at least the first two axes and possibly the third too.

A plot of the first two DECORANA axes was made to show the distribution of rivers in ordination space (Figure 15). Geographic location influenced the assemblages since samples on the left and top of the ordination are mainly from Northumberland (squares), those on the lower right are from the Wey and Rother (diamonds), and the Devon and Cheshire (Weaver) rivers fall in the middle. Thus there appears to be a lowlands-uplands trend across the ordination. This was likely to partly override the explanatory power of environmental variables.

Constrained ordination was first carried out using the environmental variables that were thought most likely to be important. A number of these variables were removed for various reasons and using a variety of selection procedures. Some showed considerable multicolinearity, that is, they were strongly correlated with each other, notably suites of variables such as percentage substrate or vegetation cover that summed to 100%. The initial CCA plots of the first three axes suggested that some closely related variables were showing the same trend on three-dimensional ordination space (which can be shown here only by plotting axis 1 scores against axis 2 and 3 scores separately – Figure 16). Finally, variables that explained the largest proportion of variance in the species data and which ought to be retained were search for using correspondence analysis. The results of this test suggested that 'disturbance – recreation', 'size – length' (of ERS patch) and 'channel width' were the three most important variables. However, common sense suggested that, since 'disturbance – recreation' was greatest at the Wey and Rother where fishermen used the few available patches of ERS, this analysis merely picked out sites on the Wey and Rother which cluster to one end of the ordination.

The final selection included 16 environmental variables. The results were disappointing as the variance in species data explained by these variables was extremely small, amounting to

1.14% by the first canonical axis (which would normally account for a moderate proportion of the variance) and only 4.6% by the first five axes. This suggested that the wrong variables were measured, or that the species data is far too variable to be explained simply. Nevertheless, the Monte Carlo test suggested that the first three axes were explained significantly by the selected variables, with a chance of obtaining the result by chance being less than p=0.001. The variables are shown in ordination space as vectors (Figure 17). The scores for species and variables are recalculated every time a variable is excluded, and this sometimes results in them appearing upside-down in the plots, as in this case with axis 3 (lower graphs in Figures 19 and 20).

The following conclusion were drawn:

Geographic location influenced the assemblages, and this effect may swamp any due to the measured variables in the constrained ordination.

Constrained ordination suggested that gross substrate type was the most important variable. Figures of both the initial run using many variables and the shortened version with just 16 variables have long vectors for substrate type measured as percentage composition at the sampling point (coded as, e.g., 'substrate – sand') and for the cruder categories at the shore (e.g. 'shore – sand') and half-way up the bank (e.g. bank – sand'). Sand and shingle lie at the opposite end to and pebbles (or cobbles) and indicate a main trend associated largely with the first axis.

The assemblages are related to the size of the system. ERS patch size shows a strong trend with both the first and second axes, and channel width with the third axis. The flies are presumably not responding to patch size but to other factors associated with this; for instance, patch size is strongly correlated with particle size, so that stony patches of ERS are much more likely to be large, and sandy ones small.

Shade has a strong influence, and the trend is approximately in an opposite direction to ERS size and channel width. This is partly an artifact since trees cannot grow on large patches of ERS, whereas narrow sandy shores of many rivers a far more likely to be shaded. However, it is also likely that species such as many *Hilara* will be more numerous in shaded sites, so there are some species that will affect the ordination due to their behavioral preference for shade or exposed sites.

Vegetation explains less of the species variation than these gross physical features. Tall herb and shade follow a similar trend, for the simple reason that many samples taken in tall herb were also up on the banks and into the 'tree zone'. Bare shore and those with pioneer vegetation are at opposite ends of a trend that shows up well on the third axis, although this trend is weak. It is confounded by the apparently inverse trend indicated by wetness of the ERS ('surface – wet') and distance to the river edge ('metres from water') – it was expected that bare shores and wetness would have a similar impact on the assemblage, and be opposite to distance from the river. This confusion was disappointing since samples from bare wet edges have one of the most distinct assemblages and contain some of the most characteristic ERS species.

The final factors that appear to have an influence are disturbance, either by people or by grazing animals. Disturbance by people is thought to be misleading as an important factor, as explained above, but its vector is similar to that for animals, so there may be some similarity in the effects. As trampling is known to be detrimental to the ERS beetle fauna, it is investigated later in the report.

Thus the CCA suggests that there is a major trend associated with the physical size of the systems, (encompassing channel width, ERS patch size and particle size), but which

perhaps splits between the first and second axes; and smaller but perhaps more confused effects due to the small-scale distribution of vegetation types and proximity to the water's edge. Overlapping with these trends are those due to disturbance and shade which cannot be so readily interpreted.

Summary

- Ordination was carried out using 238 sweep-net samples and 475 species that occurred more than once (and excluding some minor families).
- Unconstrained ordination suggested that geographic locality may be a strong factor influencing the result, and could swamp effects attributable to measured variables.
- Constrained ordination showed the main trends were related to substrate particle size and the size of the ERS system, and shade.
- Other apparently less important factors were vegetation cover and wetness of the substrate, but some of these effects were contradictory.
- Ordination was disappointingly unhelpful in interpreting the data.

Figure 15. Unconstrained ordination showing the distribution of rivers.

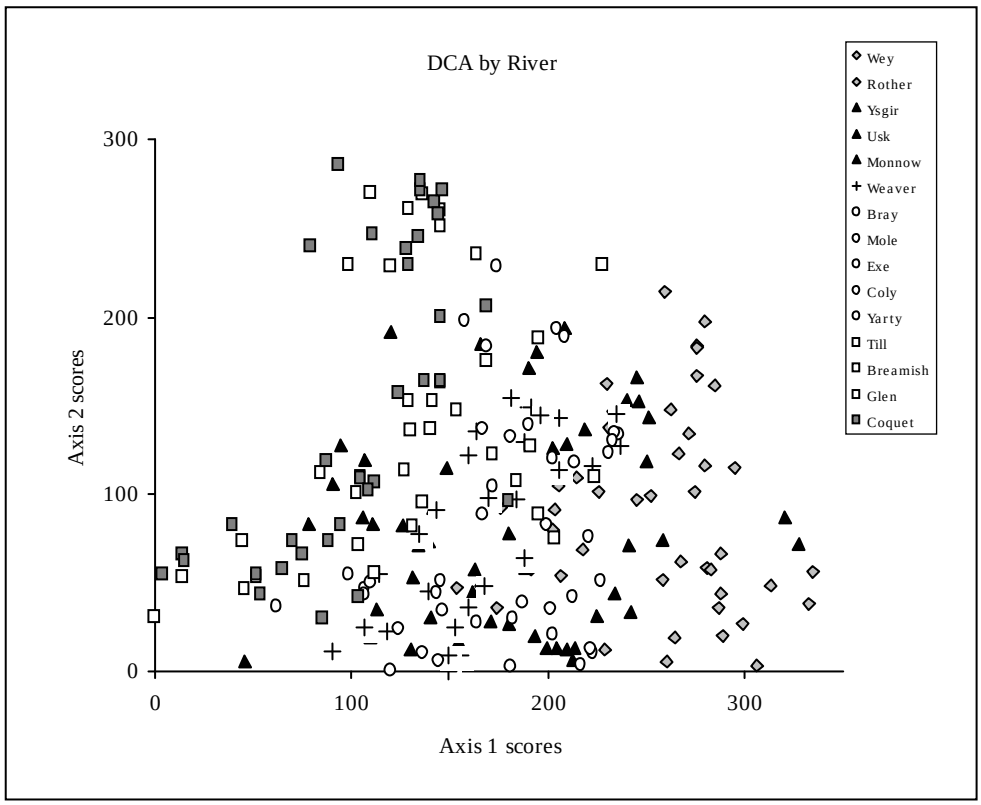


Figure 16. Constrained ordination biplot showing all environmental variables.

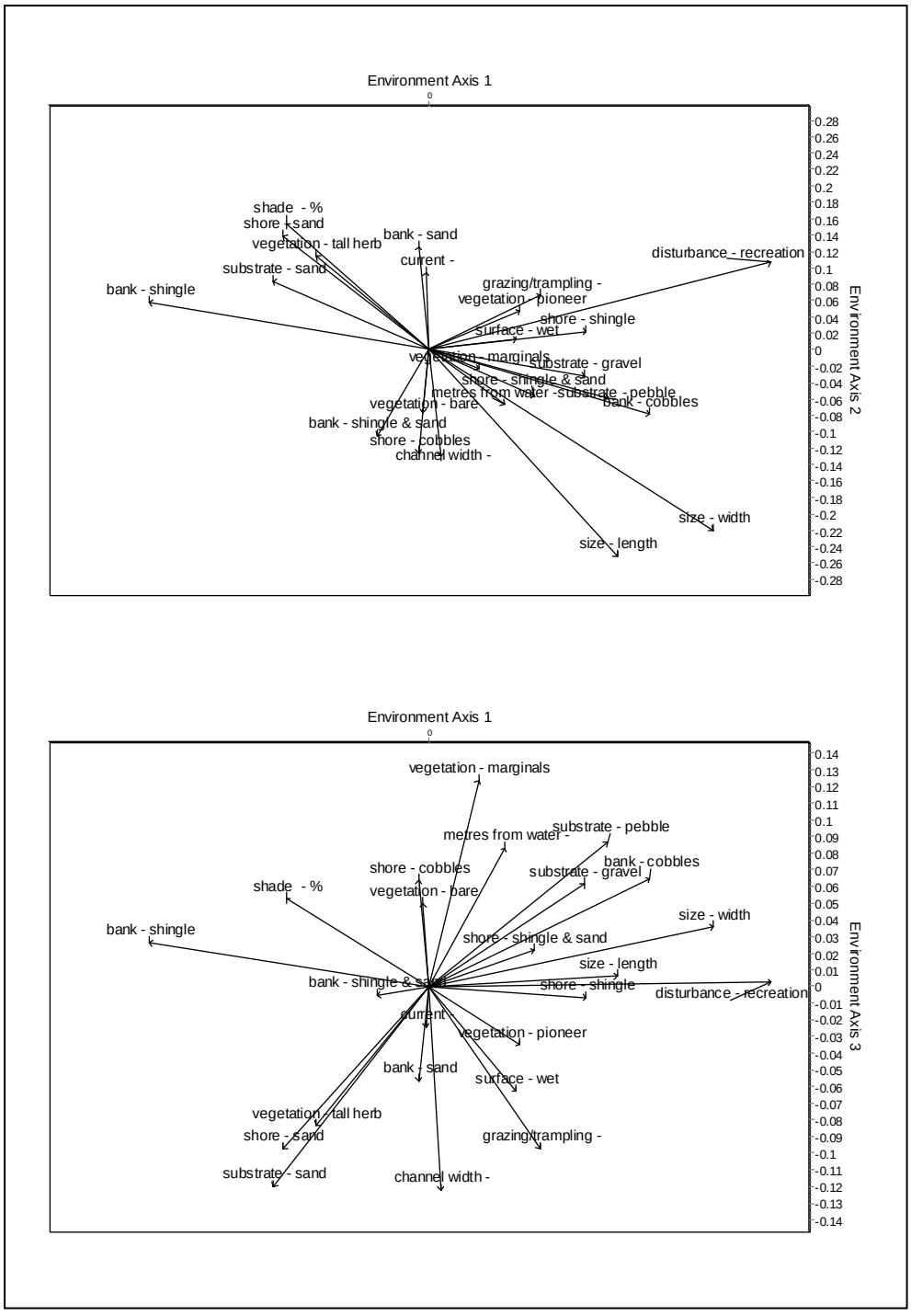
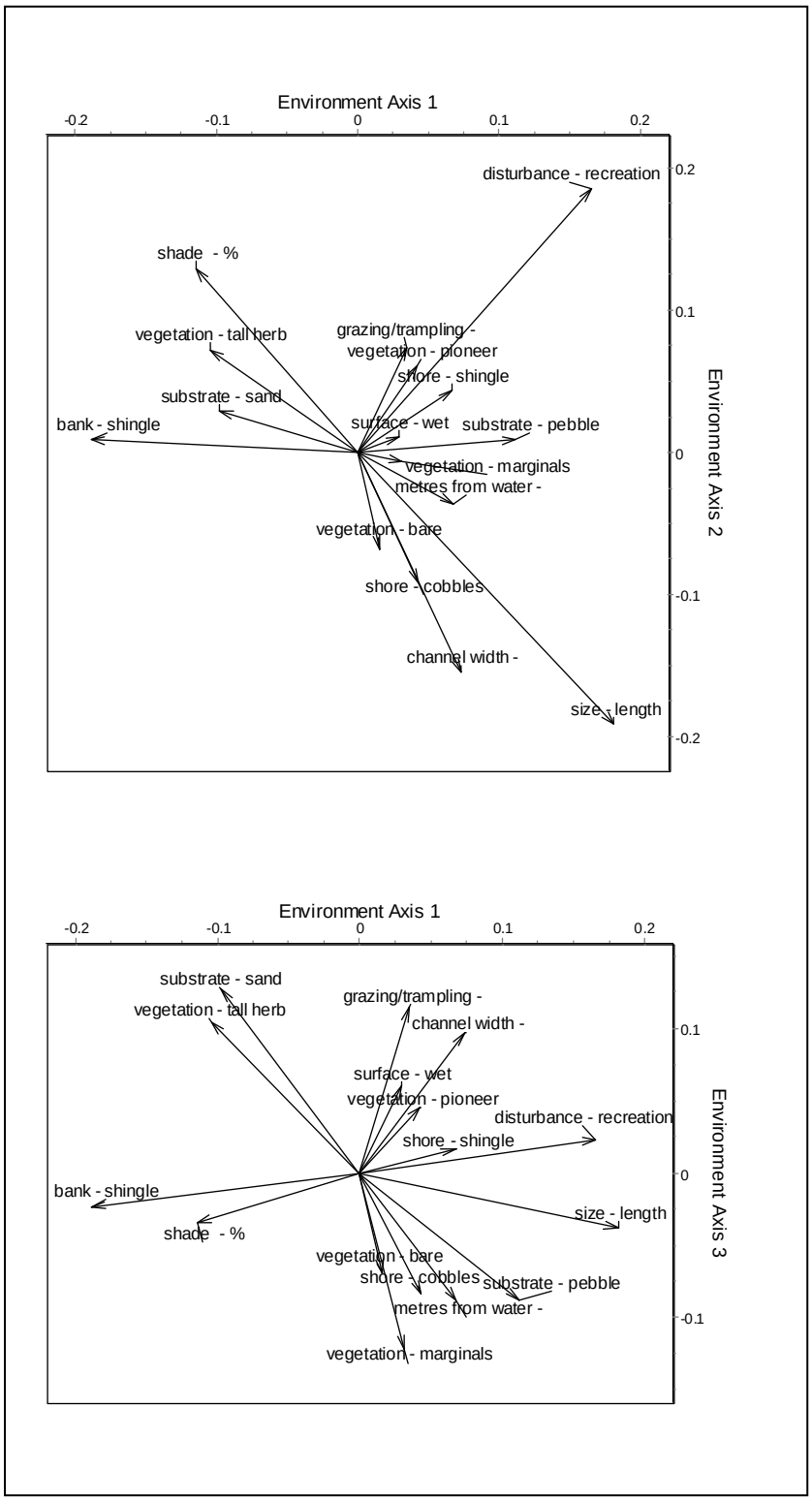


Figure 17. Constrained ordination biplot showing the final selection of 16 environmental variables.



Classification

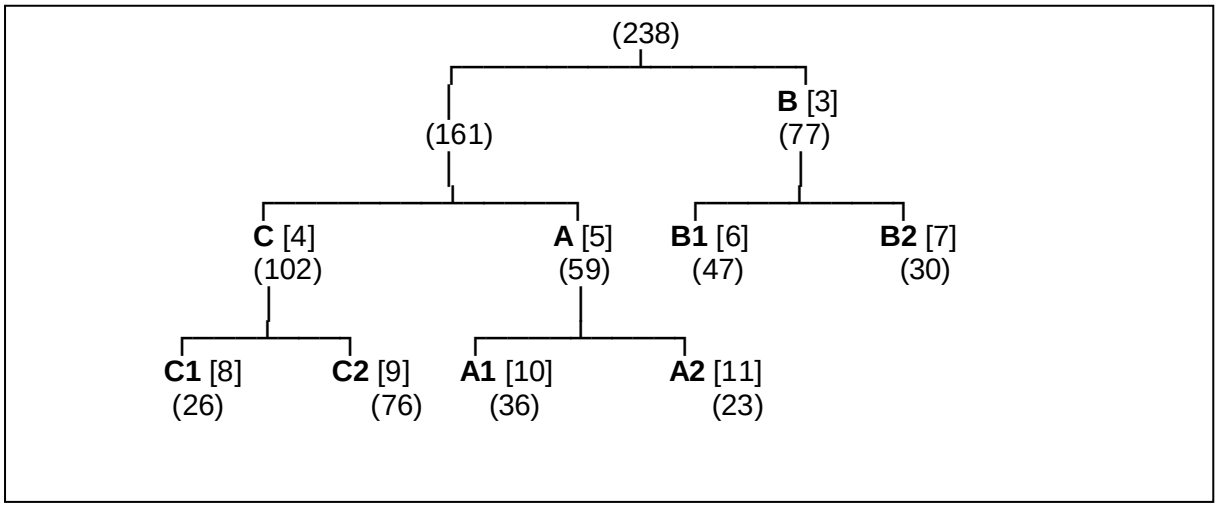
Three basal groups appear to real ecological entities that could be easily recognised. These are a species-poor water's edge group with some key ERS species, a species-rich wetland group of most interest, and a non-wetland group of low interest representing over-spill from the surrounding dry habitat. These three large groups contained samples from all regions and nearly all rivers, so habitat features override geographic location at this level. However, the next divisions of these three basic types were based largely on geographic location and no differences could be detected in assemblage composition based on an understanding of the flies' ecology. Some of these subgroups are mentioned when they show how the assemblage may be responding to grossly different habitat conditions found across the country.

The TWINSPAN groups are shown on the DECORANA ordination of axes 1 against axes 2 and 3 which helps to visualise the relationship of the samples in the groups (Figure 19). They are also shown on the CCA plots which have corresponding vector plots that indication trends in environmental conditions (Figures 17 and 20). The distribution of samples differs between the two methods of ordination but each shows a similar clustering of samples in each TWINSPAN group, as would be expected if there are real groupings in the data. This is clearest for the axis 1 by axis 2 plots (in which axis 2 is inverted in figures 13 and 14). It was expected that the trends illustrated by the CCA vector plots can therefore be used to interpret those in the DECORANA plots, and help to explain the basis of the TWINSPAN groups. In practice, this failed to help, and often the trends suggested by the vectors were opposite to the clear indications given by the disposition of samples on the CCA plots, giving little faith in the outcomes of the CCA ordination.

The groups were labeled along with the corresponding TWINSPAN group number which shows the relationship between groups (Figure 18). Several variables that help characterise and describe each group are tabulated: species characteristic of each group are the TWINSPAN preferentials (Table 40), rare and scarce species (Table 41), median numbers of species in different taxa, rarity and ERS fidelity classes (Table 42), environmental features (Table 43) and a short verbal description of each sampling point (Table 44).

One-way ANOVA of the mean number of species in each ERS fidelity class and in the rarity categories rare and scarce showed significant differences between the three main groups, with the exception of ERS fidelity 2 (high). When species with high and total fidelity were lumped, the differences were again significant. Thus there appears to be a real difference in richness in rarity and fidelity across the three groups, and confirms the differences discussed below.

Figure 18. TWINSPAN divisions showing group names, TWINSPAN group number [ ] and the number of samples in each group ( ).



Summary of Groups shown in Figure 12

Group A Bare wet substrate at or very close to water edge: quite sandy.
About half of sites shaded. Patch size small (c. 25 m long, 3 m wide).
High in ERS fidelity. Rich in rare species.
Large suit of wetland species. Few tourists.

A1 Wales, Devon

A2 Western Weald. Seemingly less rich that western rivers.

Group B Usually more stony rivers: bare unshaded water edge.
Few species confined to group, although a few with high fidelity.
Less species-rich but numbers of individuals high.

B1 All regions.
Small to moderate sized rivers.

B2 Mainly Northumberland.
Usually larger stonier rivers with a poor water edge fauna.
Best fauna of *Tachydromia*, including some of high fidelity.
Otherwise poor in fidelity, rare species and species-richness.

Group C Transition from water's edge to drier banks. Wet and dry samples.
Greater vegetation cover (provides cover for flies)
Many common and widespread grassland species as tourists from nearby.
Species rich, including many scarce and rare species.
Few ERS species: fidelity low.

C1 Northumberland.
Large rivers.
Large patches of exposed dry and stony ERS with little fly habitat.

C2 All regions.
Usually small to moderate sized rivers.
Shelter, and often shade, provided by herbage, scrub or trees.

Figure 19. Unconstrained ordination (DECORANA) showing the distribution of samples by TWINSPAN group; axes 1 and 2 above, axes 1 and 3 below.

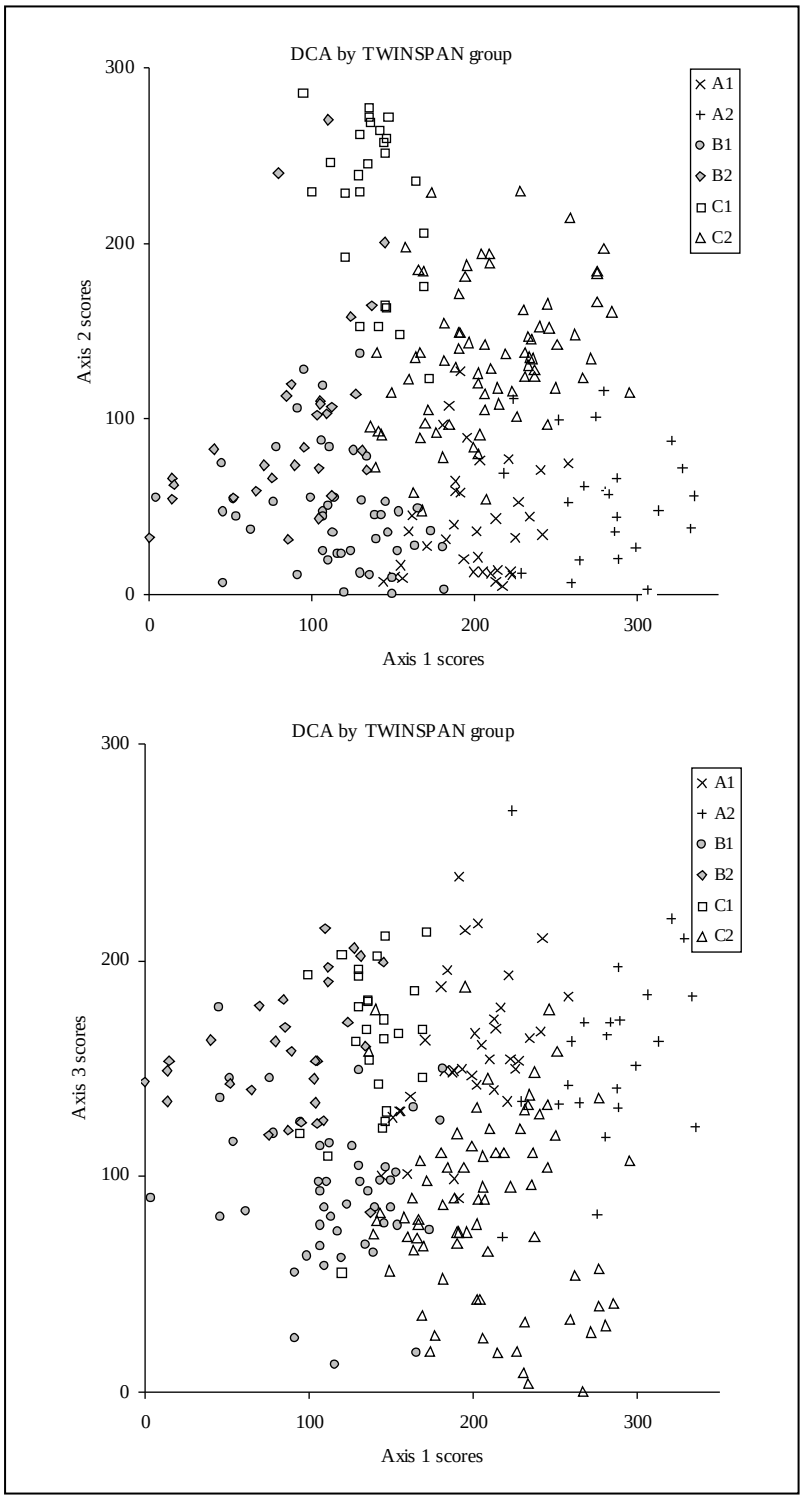
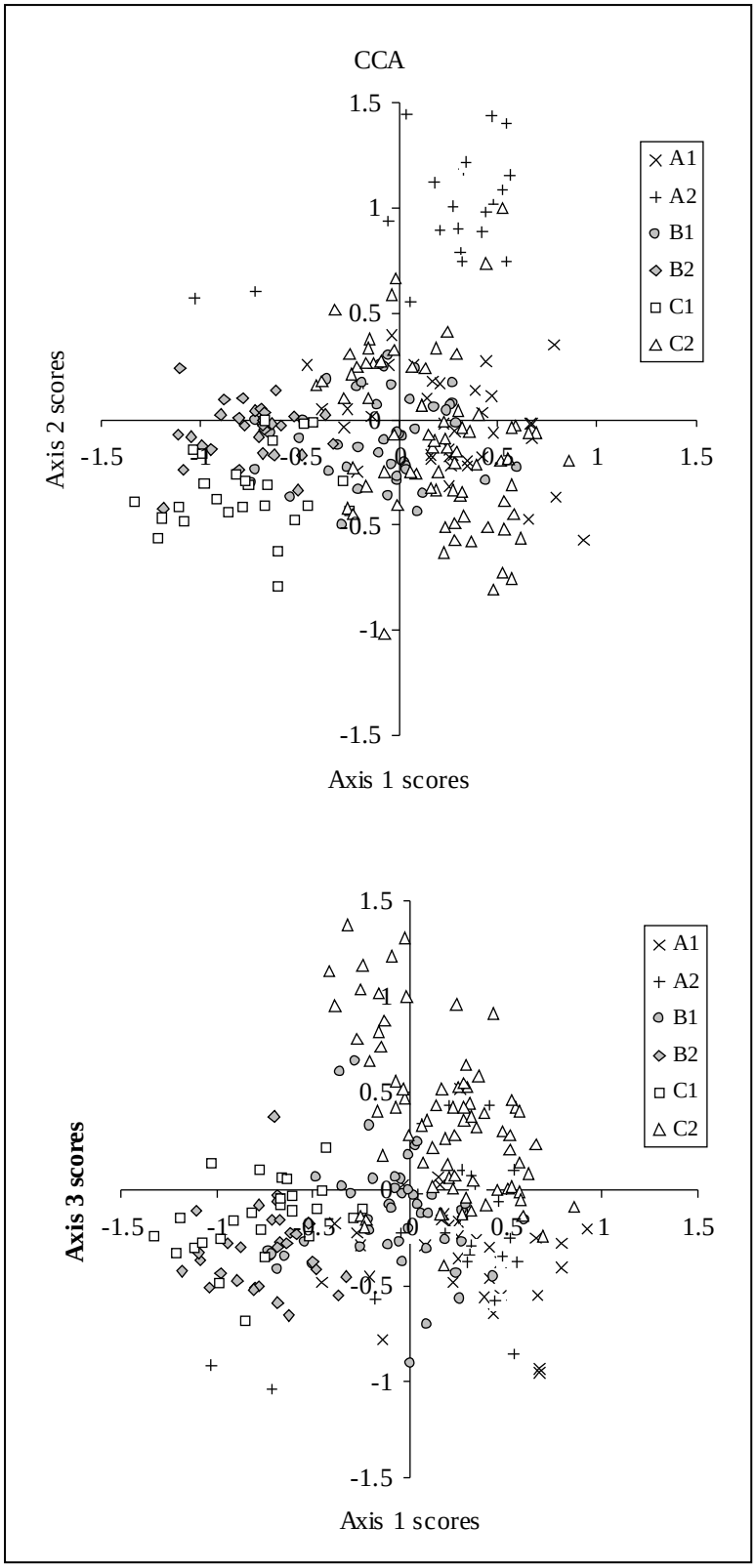


Figure 20. Constrained ordination showing the distribution of samples by TWINSPAN group; axes 1 and 2 above, axes 1 and 3 below.



Group A

Thirteen rivers contributed 59 samples to this group. It is clearly characterised by a large suite entirely of wetland species, often with large numbers of the shore fly *Parydra coarctata*, and usually with many of the dolichopodid *Campsicnemus curvipes*. The shoreflies *Ditrichophora calceata*, *D. fuscella* and *Athyroglossa glabra* were often frequent. A few common species that were frequent in this group of samples (in more than two-thirds of the samples) were infrequent in other groups, including the shore flies *Ditrichophora calceata*, the empid *Dolichocephala irrorata* and the dolichopodid *Teucophorus monacanthus*. Of more interest were uncommon characteristics of this group but which were scarce elsewhere: the shore fly *Ditrichophora* sp A (*?bezzi*) (95% of all occurrences), the dolichopodids *Diaphorus hoffmannseggii* (86%) and *Rhaphium brevicorne* (89%) and the empid *Hilara aartseni* (94%). Other more widespread scarce species characteristic of the group were *Lonchoptera meijeri*, *L. nigrociliata* and *Hilara albiventris*.

Altogether, 41 rare or scarce species were found in this group (Table 41). Among species that were nearly confined to it were *Hilara aartseni*, *Ditrichophora* sp A, *Diaphorus hoffmannseggii* and *Hilara media*, and several were fairly frequent here although quite well represented in other groups too (*Ditrichophora* sp B, *Polytrichophora duplosetosa*, *Oxycera terminata*, *Hilara albiventris*, *H. biseta*, *H. pseudochorica*, *Gymnoclasiopa plumosa*, *Lonchoptera meijeri* and *L. nigrociliata*).

Only five species with total fidelity to ERS occurred in this group, and of these the moderately widespread *Lonchoptera nigrociliata* and *Oxycera terminata* occurred several times. There was only one occurrence (of a total of ten in the whole dataset) of *Spiriverpa lunulata*, and two out of eight occurrences of the hybotid *Tachydromia costalis*, which suggested that this was not their preferred habitat. Another 11 species had high ERS fidelity and the rare or scarce among that were frequent in the group were *Diaphorus hoffmannseggii* and *Hilara biseta*. Thirty-four species had moderate ERS fidelity, of which some that were frequent in the group but were also frequent in one other group so were not highlighted as characteristic by TWINSPAN. These include *Campsicnemus marginatus*, *Teuchophorus calcaratus*, *T. simplex* (exclusive to this group), *Hilara albiventris*, *H. apta*, *Ditrichophora palliditarsis*, *Lonchoptera meijeri*, *Limnophora riparia* and *L triangula*.

The group had high average species-richness compared to other groups and particularly high median numbers of the predominantly wetland families of empids, dolichopodids and shore-flies (Figure 21). It was also rich in rare species, with the interquartile range being between 2 and 4 rare, scarce or new-to-Britain species (Figure 22). The median number of 2 species with total or high ERS fidelity was also high, and the median of 5 species with moderate fidelity and wetland species were higher than in any other group (Table 42). Conversely, ERS-tourists formed a low proportion (about a quarter) of the total. The median number of individuals (608) was higher than in either other group.

The size of the ERS patch in this group was not especially large, being on average about 15m by 2m. Nearly all samples were from wet substrate at or very close to the water's edge (which included backwaters and pools). The cover of vegetation was low, particularly tall herb and continuous sward, leaving most sites bare or nearly so. Median shade cover was 50%, and about half the sites were adjacent to woodland or patches of trees, both these values being considerably higher than in other groups. The substrate was rather varied and no one type predominated.

As with other group, the next division of this group was based on geographic location, since one sub-group was composed of samples mainly from Welsh and Devon rivers (A1) and the other mainly from the Wey and Rother (A2) which form an outlying cluster at one end of the first axis of the DCA plot. Uncommon species with a strong western and northern

distribution were characteristic and often considerably more frequent in the first subgroup, including the empids *Hilara apta*, and *H. pseudochorica*, the shore fly *Ditrichophora* sp B, the soldierfly *Oxycera terminata*, *Lonchoptera nigrociliata* and *L. meijeri*. Uncommon species that may be regionally restricted and which were more characteristic of the Wey and Rother samples were *Diaphorus hoffmannseggii* and *Hilara aartseni*. These two assemblages were rather more distinct than suggested merely by the occurrence of these uncommon and locally restricted species, and it is quite likely that the Wey and Rother group is genuinely less rich in riverine specialists than the western rivers group.

It is possible that this group represented a river-shore assemblage that would be found in the absence of large areas of ERS. This idea may need to be tested by including more rivers with predominantly stony ERS in which this assemblage may not be well represented.

Group B

The 77 samples comprising this basal group of the first division were taken from 14 rivers from all regions. It is a very distinct group found at bare unshaded water's edge, usually on more stony than sandy shores. It is dominated by the common shore flies *Scatella paludum* which was often abundant, *S. tenuicosta*, *S. stagnalis* and *Discocerina obscurella* which were also often found in large numbers but not matching the profusion of *S. paludum*, and the dolichopodid *Campsicnemus marginatus* which was often moderately numerous. The sepsids *Themira minor* and *T. superba* were also characteristic and common species on wet margins. Less frequent overall but still characteristic of this group were the predatory muscid *Lispe tentaculata*, and a few other species that were clearly regionally restricted (e.g. *Themira pusilla*, *Dolichopus vitripennis*).

Altogether, 43 rare or scarce species occurred in this group (Table 41). It is highly significant that the few species that were almost confined to this group also had the greatest fidelity to ERS: the shore flies *Athyroglossa ordinata*, *Hecamedoides unispinosus* and *Scatella obsoleta* and the hybotid *Tachydromia halidayi*. Others occurred several times in Group B but were also found in other groups: the shore-flies *Ditrichophora* sp B and *Polytrichophora duplosetosa*, the cranefly *Hoplolabis yezoana*, *Spiriverpa lunulata*, the empid *Hilara pseudochorica*, the hybotid *Platypalpus articulatus*, *Lonchoptera nigrociliata* and the muscid *Limnophora scrupulosa* (identified only in 2006 samples). *Rhaphium fractum* and *Diclasiopa lacteipennis* were not found often but were almost confined to this group. Some of these species may deserve a greater ERS fidelity score than given here.

Ten species with total fidelity to ERS occurred in this group. Four almost confined to this group have just been mentioned; others were *Tachydromia costalis*, *T. edenensis*, *T. morio*, *Oxycera terminata*, *Spiriverpa lunulata* and *Lonchoptera nigrociliata*, none of which were confined to this group. Another 14 species had high ERS fidelity but none of these showed an obvious preference for this group, except for *Athyroglossa glabra* which was present in 55 samples in this group (71%); it was therefore a particularly notable species of this water's edge assemblage, even though not characteristic in the sense of being relatively scarce in other groups. Twenty-eight species with moderate ERS fidelity were in the group, and the more frequent of these that have not been mentioned above were *Dolichopus longicornis*, *Teucophorus calcaratus*, *T. monacanthus*, *Tipula couckei* and *Limnophora riparia*.

The group was notably less species-rich than other groups, but the median numbers of shore flies and sepsids were no different to those in the species-rich Group A. All other key families were somewhat less well represented than in other TWINSPAN groups.

Despite fewer species, the interquartile range of the number of rare, scarce and new-to-Britain species was 1-3 species. These and local species formed a greater proportion of the total than was the case in the other two groups. Those with total or high ERS fidelity and, to

a lesser extent, wetland species were as well represented as in the species-rich Group A. Notably there were few ERS tourists which made up only about one fifth of the species. There were fewer scarce species and those with moderate ERS fidelity than in group A. Numbers of individuals were almost as high as in group A, and higher than in the 'dry' group C. Thus this assemblage is rather small but includes species with the most fastidious habitat preferences.

Most samples were taken at the water's edge of the river or pools and backwaters, although a few falling into this 'water edge' group were from dry ERS, and may have been mis-classified by TWINSPAN. The range of substrates varied widely and the distribution was similar to that of group A samples but with more samples from pebbly rather than sandy shores. The cover of different vegetation classes 'bare' and 'pioneer' were almost identical to that of group A, but there were more samples from areas with marginal wetland vegetation but far fewer from tall herb (on dry ground). The greatest difference from group A in the physical make-up was the near-absence of shade and trees (compared to half of group A samples coming from shaded patches). This group does appear to be a genuine assemblage of ERS and not just of shore-lines.

The next division of this group separated 30 samples nearly all from Northumberland rivers (B2) from 47 samples from rivers from all other regions (B1). There was no difference in species-richness of all flies or any family between the subgroups, but the Northumberland subgroup was noticeably poorer in rare and scarce species and those with moderate to high ERS fidelity. Slightly more species with total ERS fidelity occurred in the Northumberland subgroup, and these are the additional *Tachydromia* species that were rather scarcer on other rivers. The physical characteristics differed markedly since the Northumberland ERS patches were usually far larger and stonier than on other rivers. This appears to indicate that stony ERS supports a poorer water's edge assemblage than found on finer sediments.

Group C (TWINSPAN group 4)

This large group of 102 samples were from all rivers except the Ysgir where only three samples were taken from this small shaded stony stream. The groups was characterised mostly by common and widespread grassland species whose presence is merely the over-spill from adjacent land. These include species such as grass-feeding opomyzids and chloropids, sepsids and scathophagid dung flies, the grassland aphid-feeding *Melanostoma* hoverflies, frequent *Lonchoptera bifurcata* and often large numbers of the dolichopodid *Chrysotus gramineus*. Such an assemblage could be found across much of lowland Britain's grasslands.

A few riverine species also characterised the group and their prevalence in this 'dry' group rather than in either of the main 'wet' groups is attributed to their need for cover. This applies especially to the large craneflies *Tipula couckei* and *T. montium* and probably to the smaller cranefly *Symplecta hybrida* and the dolichopodid *Dolichopus longicornis*, as all four are associated with river banks with fine sediments. Common wetland species such as the shore fly *Parydra coarctata* and the dolichopodid *Campsicnemus curvipes* were also often as frequent as in this group as in the 'wet' groups, but the four riverine species that characterised the group were far out-numbered by the generalist grassland species.

Two surprisingly frequent species in this 'grassland' group were the cranefly *Hoplolabis areolata* and the lauxaniid *Calliopum elisae*. *Hoplolabis areolata* is characteristic of sandy river banks so its occurrence away from the river in better vegetated ground probably reflects its need for shelter; the same reason probably explains the occurrence of other riverine craneflies *Nephrotoma dorsalis* and *N. analis* in this group. *Calliopum elisae* was once regarded as a scarce species, although is moderately widespread, and its high occurrence in this survey suggests a slight preference for riverine habitat.

The total list of 74 rare and scarce species well exceeded that found in Groups A and B but many more samples were included in Group C. Nevertheless, considering that the samples were often deliberately taken from patches that were not prime ERS, the list is surprising. However, among species caught at least a few times, only two species, both of which are terrestrial (the chloropid *Melanochaeta pubescens* and the dung fly *Conisternum decipiens*) were nearly confined to the group. Species occurring frequently in the group but also elsewhere were the shore flies *Ditrichophora* sp B and *Polytrichophora duplosetosa*, the empids *Hilara albiventris*, *H. biseta* and *H. pseudochorica*, the hybotids *Platypalpus articulatus* and *P. subtilis*, *Lonchoptera meijeri* and the muscid *Limnophora scrupulosa*

Eleven species with total fidelity to ERS were present in the group. Of these, *Athyroglossa ordinata*, *Tachydromia costalis*, *T. morio*, *Oxycera terminata*, *Spiriverpa lunulata* and *Lonchoptera nigrociliata* occurred in 4-5 samples. Eleven species had high ERS fidelity and of these *Athyroglossa glabra*, *Hoplolabis yezoana*, *Hilara biseta* occurred several times. In general, there appeared to be relatively low preference by most ERS specialists for this habitat. Finally, 35 species with moderate ERS fidelity were present, of which a number were found in 10-20% of samples in this group, so were far from characteristic of the group (*Teucophorus calcaratus*, *T. monacanthus*, the empids *Hemerodromia oratoria*, *H. unilineata*, *Hilara albiventris*, *Ditrichophora* sp B, *Platypalpus interstinctus*, *P. niger* and three species of *Limnophora*). Thus although ERS species appeared to be well represented, few were in a large proportion of the samples, and some, like craneflies, may well have been responding to the additional vegetation cover rather than to the dry conditions.

This group occupied the transition from river to dry terrestrial habitats, and the inclusion of species with preferences for either habitat probably explained the high average species-richness. The samples also included the largest individual catch taken in the survey with 86 species. Although the wetland families of shore-flies, dolichopodids and empids were less speciose than in wetland groups, this was compensated for by higher mean numbers of families with mostly non-wetland species, such as lauxaniids, opomyzids, sepsids, hoverflies and tephritids, leading to far higher mean numbers of ERS-tourists. Despite the apparently non-riverine bias to the group's composition, the average numbers of wetland species and ERS species were not strikingly lower than in the rich wetland group A, although the differences were significant for total-fidelity and wetland species.

Half the samples were taken away from the water's edge, and mostly over dry sediment. Pioneer vegetation and continuous low sward was the characteristic vegetation type, and bare ground usually formed a small proportion of the ground area. Many were examples of the better vegetated river bank rather than flat sediments, so tall herbs were far more frequent than in other groups, although only a small proportion of samples were tree-shaded. Perhaps also because a fair proportion of samples were of the banks, the amount of sand in the sediment was higher than in the other two groups (although still a small proportion overall), since sand is scoured from many ERS at river level on the faster northern and western rivers, even when they flow through sandy floodplains.

The next division of this group split 26 samples from Northumberland rivers (C1) from 76 samples from many rivers in the remaining regions (C2), which in turn split samples from the Wey and Rother from the remaining mix of rivers. Differences in the characteristic species differentiating the sub-groups did not seem to be ecologically meaningful and may have reflected regional differences in the local abundance of the species, such as more *Dolichopus vitripennis* and *Bicellaria spuria* in the Northumberland assemblage and more *Hilara pseudochorica* and *Hoplolabis areolata* in the southern and western rivers. Part of the explanation for splitting the species-poor and small Northumberland samples is merely a feature of ordination which usually places species-poor samples to one end of the axes, but

there was probably also a real difference resulting from collecting from large patches of dry and stony ERS with little habitat usually thought of as attractive to flies.

Summary

- Classification was made using TWINSPAN on 238 sweep-net samples containing 475 species that occurred more than once (and excluding some minor families).
- Three ecologically meaningful groups were distinguished, and these were present on all but one or two small rivers. Proximity to the water's edge, vegetation cover and shade were the main factors operating on the assemblages. Substratum composition appeared to have less impact.
- Wet ERS at the river's edge was rich in ERS specialists and included most occurrences of several species with total ERS fidelity. It was characterised by large numbers of individuals of common shoreflies, which made the group distinctive in the field. Mean species-richness was lower than other groups.
- Wet but more structurally varied ERS was richest in both ERS specialists (but not those with total fidelity) and in uncommon species. It had the highest average species-richness of all species and particularly of wetland species.
- Dry, often vegetated sediment was relatively poor in ERS specialists but usually as rich in uncommon and all species as the wet 'rich' ERS group. It represented the transition to dry habitat.
- Further divisions of the classification were almost entirely based on geographic location, thus highlighting the ecological reality of the first major divisions based on habitat features.

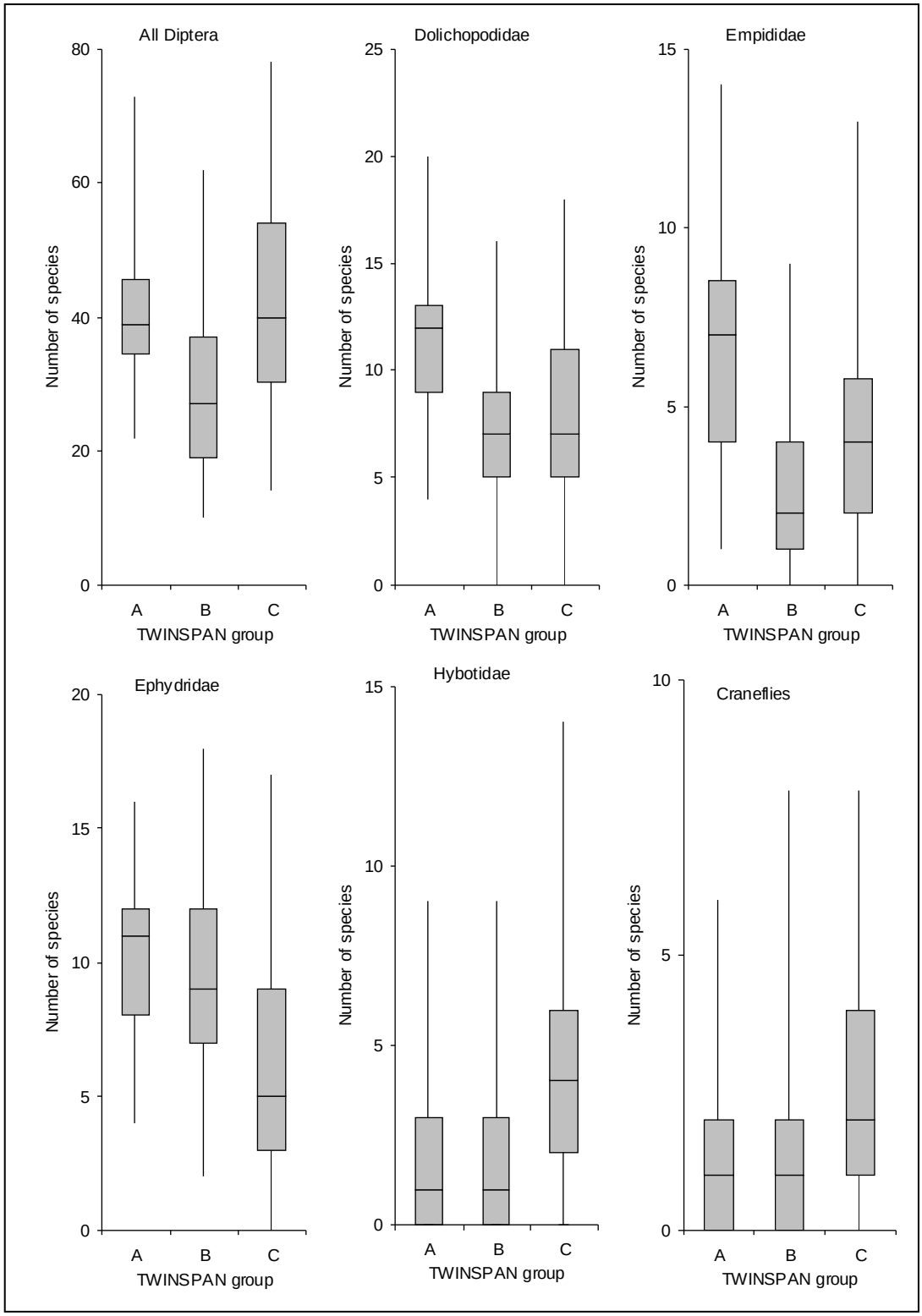


Figure 21. Median number of species of all Diptera and those in major families in the three basal classification groups. The grey box encloses the lower to upper quartiles; the bar gives the minimum and maximum range. Values from Table 42.

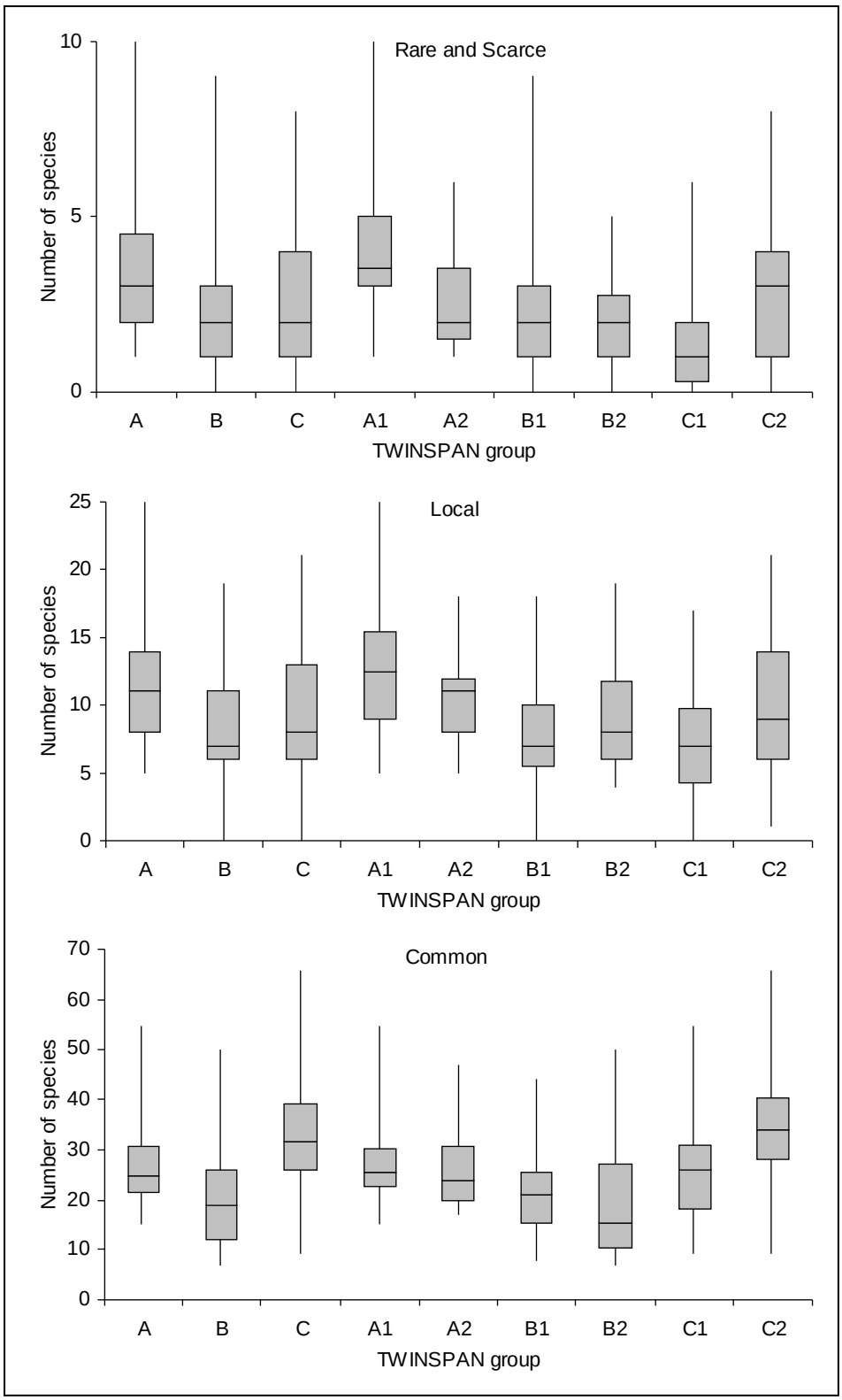


Figure 22. Median number of species in rarity status classes in each classification group.

Groups A1 and A2 are subgroups of A, and so on. Note the different scales. The grey box encloses the lower to upper quartiles; the bar gives the minimum and maximum range. Values from Table 42.

Table 40. Characteristic species in each TWINSPAN group.

Note: TWINSPAN treats species at different abundance levels as separate pseudospecies, so the same name can appear for one group, but will be at different abundances (1 = present to 4 = numerous).

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Group B (3)							
Scatella stagnalis	1	69	66	90	51	Common	4
Scatella paludum	1	70	58	91	55	Common	4
Themira minor	1	59	37	77	61	Common	4
Campsicnemus marginatus	1	44	24	57	65	Local	3
Themira superba	1	39	25	51	61	Local	4
Notiphila cinerea	1	28	19	36	60	Common	4
Dolichopus vitripennis	1	25	13	32	66	Local	4
Lispe tentaculata	1	20	9	26	69	Common	4
Themira pusilla	1	20	9	26	69	Local	4
Meonura lamellata	1	16	2	21	89	Unknown	4
Scatella tenuicosta	2	36	25	47	24	Common	4
Scatella stagnalis	2	19	9	25	14	Common	4
Scatella paludum	2	56	16	73	44	Common	4
Discocerina obscurella	2	24	24	31	19	Common	4
Campsicnemus marginatus	2	19	3	25	28	Local	3
Scatella tenuicosta	3	21	15	27	14	Common	4
Scatella paludum	3	45	11	58	35	Common	4
Discocerina obscurella	3	18	17	23	15	Common	4
Scatella paludum	4	35	5	45	27	Common	4
Group C (4)							
Scathophaga stercoraria	1	58	12	57	69	Common	5
Tipula couckei	1	33	8	32	45	Local	3
Dolichopus longicornis	1	53	6	52	74	Local	3
Opomyza florum	1	53	14	52	74	Common	5
Chrysotus cilipes	1	41	9	40	63	Common	4
Empis livida	1	43	3	42	74	Common	5
Sepsis punctum	1	33	9	32	57	Common	5
Sepsis cynipsea	1	37	2	36	76	Common	5
Tipula montium	1	35	6	34	74	Common	3
Thaumatomyia notata	1	28	3	27	62	Common	5
Cetema neglectum	1	34	3	33	79	Common	5
Dolichopus trivialis	1	34	2	33	81	Common	4
Opomyza petrei	1	35	6	34	83	Common	5
Symplecta hybrida	1	21	1	21	54	Local	4
Sepsis fulgens	1	29	2	28	78	Common	5
Syritta pipiens	1	29	0	28	78	Common	5
Tipula lateralis	1	24	6	24	65	Common	4
Geomyza tripunctata	1	31	5	30	86	Common	5
Dicranomyia modesta	1	24	6	24	69	Common	4
Melanostoma mellinum	1	26	2	25	81	Common	5

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Norellisoma spinimanum	1	26	3	25	87	Common	5
Themira annulipes	1	21	2	21	72	Common	4
Dolichopus festivus	1	22	2	22	92	Common	4
Chrysotus gramineus	2	33	6	32	18	Common	5
Lonchoptera bifurcata	2	23	5	23	24	Common	5
Chrysotus gramineus	3	21	3	21	11	Common	5
Group A (5)							
Anepsiomyia flaviventris	1	19	2	32	90	Local	4
Campsicnemus loripes	1	21	6	36	68	Common	4
Campsicnemus marginatus	1	17	7	29	25	Local	3
Campsicnemus scambus	1	17	4	29	74	Common	4
Clinocera stagnalis	1	19	4	32	51	Common	4
Diaphorus hoffmannseggii	1	12	1	20	86	RDB	2
Ditrichophora calceata	1	40	8	68	78	Common	4
Ditrichophora fuscella	1	36	25	61	48	Common	4
Ditrichophora palliditarsis	1	23	6	39	62	Local	3
Ditrichophora sp A	1	19	1	32	95	New	3
Dolichocephala irrorata	1	37	21	63	49	Common	4
Gymnopternus aerosus	1	27	5	46	79	Common	4
Gymnopternus brevicornis	1	12	2	20	75	Local	4
Gymnopternus celer	1	28	11	47	53	Local	4
Hilara aartseni	1	15	1	25	94	New	4
Hilara albiventris	1	19	14	32	56	Scarce	3
Hilara fuscipes	1	17	9	29	59	Local	4
Hilara manicata	1	34	15	58	61	Common	4
Hilara nigrina	1	31	10	53	69	Local	4
Hilara rejecta	1	25	11	42	66	Local	4
Lonchoptera meijeri	1	14	9	24	58	Scarce	3
Lonchoptera nigrociliata	1	34	5	58	76	Scarce	1
Paranthomyza nitida	1	19	9	32	68	Common	4
Parydra aquila	1	18	15	31	29	Local	4
Parydra littoralis	1	30	6	51	83	Common	4
Parydra quadripunctata	1	20	6	34	61	Common	4
Poecilobothrus nobilitatus	1	27	16	46	49	Common	4
Rhaphium brevicorne	1	16	0	27	89	Local	4
Scatella paludum	1	32	26	54	25	Common	4
Sybistroma obscurellum	1	26	2	44	90	Common	5
Syntormon denticulatum	1	27	18	46	45	Local	4
Teucophorus calcaratus	1	28	23	47	45	Local	3
Teucophorus monacanthus	1	40	11	68	63	Local	3
Teucophorus simplex	1	15	0	25	100	Local	3
Parydra coarctata	2	41	31	69	24	Common	4
Scatella tenuicosta	2	15	10	25	10	Common	4
Campsicnemus curvipes	2	25	8	42	17	Common	4
Athyroglossa glabra	2	13	3	22	11	Local	2
Ditrichophora fuscella	2	12	3	20	16	Common	4
Teucophorus monacanthus	2	12	0	20	19	Local	3
Ditrichophora calceata	2	14	2	24	27	Common	4

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Parydra coarctata	3	27	18	46	16	Common	4
Campsicnemus curvipes	3	15	4	25	10	Common	4
Group B1 (6)							
Discocerina obscurella	1	39	8	83	31	Common	4
Hilara pseudochorica	1	32	1	68	31	Scarce	3
Dolichocephala irrorata	1	17	1	36	22	Common	4
Ditrichophora fuscella	1	14	0	30	19	Common	4
Platypalpus longiseta	1	12	0	26	16	Common	5
Dolichopus longicornis	1	10	3	21	14	Local	3
Syntormon denticulatum	1	13	2	28	22	Local	4
Sepsis punctum	1	14	2	30	24	Common	5
Poecilobothrus nobilitatus	1	12	0	26	22	Common	4
Ditrichophora Sp B	1	14	2	30	26	New	3
Thaumatomyia notata	1	12	2	26	27	Common	5
Symplecta hybrida	1	13	4	28	33	Local	4
Athyroglossa ordinata	1	11	0	23	69	RDB	1
Chrysotus suave	1	11	0	23	79	Local	5
Parydra coarctata	2	22	6	47	13	Common	4
Discocerina obscurella	2	23	1	49	19	Common	4
Hilara pseudochorica	2	12	0	26	12	Scarce	3
Themira minor	2	10	2	21	10	Common	4
Parydra coarctata	3	19	1	40	11	Common	4
Discocerina obscurella	3	17	1	36	14	Common	4
Parydra coarctata	4	12	0	26	7	Common	4
Discocerina obscurella	4	12	0	26	10	Common	4
Group B2 (7)							
Platypalpus pallidiventris	1	19	14	63	14	Common	5
Hilara chorica	1	27	14	90	21	Common	4
Dolichopus plumipes	1	18	14	60	16	Common	4
Scathophaga stercoraria	1	9	5	30	11	Common	5
Empis livida	1	11	1	37	19	Common	5
Dolichopus vitripennis	1	19	6	63	50	Local	4
Hydrophorus balticus	1	12	6	40	32	Local	4
Dolichopus simplex	1	7	1	23	23	Common	4
Themira pusilla	1	15	5	50	52	Local	4
Syntormon pumilum	1	8	2	27	47	Local	4
Hydrellia subalbiceps	1	7	3	23	47	Common	4
Hydrophorus praecox	1	11	3	37	73	Local	4
Scatella obsoleta	1	8	4	27	62	RDB	1
Hilara obscura	2	7	5	23	4	Local	4
Hilara chorica	2	12	3	40	9	Common	4
Sympycnus desoutteri	2	9	4	30	9	Common	4
Themira lucida	2	8	4	27	9	Common	4
Hilara obscura	3	7	1	23	4	Local	4
Sympycnus desoutteri	3	7	0	23	7	Common	4
Group C1 (8)							
Sympycnus desoutteri	1	22	22	85	22	Common	4
Empis livida	1	23	20	88	40	Common	5
Dolichopus subpennatus	1	13	9	50	28	Common	4
Dolichopus vitripennis	1	9	2	35	24	Local	4
Platypalpus minutus	1	11	11	42	33	Common	5

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Dolichopus simplex	1	12	5	46	40	Common	4
Empis aestiva	1	8	6	31	28	Common	5
Trichina clavipes	1	9	3	35	38	Common	5
Medetera truncorum	1	7	3	27	41	Common	5
Hybos culiciformis	1	6	5	23	46	Common	5
Pollenia pediculata	1	6	1	23	46	Common	5
Bellardia vulgaris	1	8	2	31	67	Common	5
Dicraeus vagans	1	9	1	35	75	Common	5
Meromyza femorata	1	6	4	23	55	Common	5
Nephrotoma submaculosa	1	7	0	27	64	Local	4
Minettia plumicornis	1	7	2	27	78	Common	4
Bicellaria spuria	1	6	0	23	86	Local	5
Platypalpus pallidiventris	2	9	8	35	7	Common	5
Hilara chorica	2	12	1	46	9	Common	4
Sympycnus desoutteri	2	11	7	42	11	Common	4
Platypalpus pallidiventris	3	7	3	27	5	Common	5
Hilara chorica	3	9	1	35	7	Common	4
Sympycnus desoutteri	3	6	3	23	6	Common	4
Group C2 (9)							
Hydrellia maura	1	61	10	80	33	Common	4
Parydra coarctata	1	60	6	79	35	Common	4
Hydrellia griseola	1	59	9	78	36	Common	4
Campsicnemus curvipes	1	43	7	57	29	Common	4
Lonchoptera lutea	1	63	6	83	50	Common	5
Discocerina obscurella	1	39	1	51	31	Common	4
Scaptomyza pallida	1	56	6	74	53	Common	5
Hilara pseudochorica	1	39	5	51	38	Scarce	3
Themira minor	1	24	2	32	25	Common	4
Themira lucida	1	25	1	33	28	Common	4
Dolichocephala irrorata	1	21	0	28	28	Common	4
Ditrichophora fuscella	1	25	0	33	33	Common	4
Opomyza florum	1	47	6	62	65	Common	5
Opomyza germinationis	1	36	6	47	53	Common	5
Themira superba	1	16	2	21	25	Local	4
Teucophorus calcaratus	1	21	2	28	34	Local	3
Syntormon denticulatum	1	17	1	22	28	Local	4
Platypalpus calceatus	1	31	5	41	53	Common	5
Sepsis punctum	1	30	3	39	52	Common	5
Poecilobothrus nobilitatus	1	16	0	21	29	Common	4
Ditrichophora Sp B	1	19	3	25	36	New	3
Calliopum elisae	1	33	2	43	65	Common	4
Chrysotimus molliculus	1	23	0	30	46	Local	4
Scathophaga furcata	1	23	1	30	49	Common	5
Drosophila andalusiaca	1	27	1	36	60	Common	5
Elachiptera megaspis	1	32	0	42	71	Local	4
Thaumatomyia notata	1	24	4	32	53	Common	5
Opomyza petrei	1	35	0	46	83	Common	5
Rhaphium caliginosum	1	20	0	26	51	Common	4
Beris vallata	1	18	3	24	49	Common	5
Sepsis fulgens	1	26	3	34	70	Common	5
Asteia amoena	1	24	0	32	67	Common	5

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Chrysopilus asiliformis	1	19	0	25	53	Common	5
Geomyza tripunctata	1	28	3	37	78	Common	5
Dicranomyia modesta	1	23	1	30	66	Common	4
Melanostoma scalare	1	23	1	30	70	Common	5
Melanostoma mellinum	1	25	1	33	78	Common	5
Norellisoma spinimanum	1	23	3	30	77	Common	5
Symplecta stictica	1	19	0	25	63	Common	4
Hoplolabis areolata	1	17	0	22	59	Local	2
Themira annulipes	1	18	3	24	62	Common	4
Themira putris	1	19	0	25	66	Common	4
Episyrphus balteatus	1	19	1	25	68	Common	5
Dolichopus festivus	1	21	1	28	88	Common	4
Sepsis flavimana	1	18	0	24	82	Common	5
Melanochaeta pubescens	1	16	0	21	80	Scarce	4
Parydra coarctata	2	29	2	38	17	Common	4
Hydrellia griseola	2	19	2	25	12	Common	4
Lonchoptera lutea	2	28	0	37	22	Common	5
Lonchoptera bifurcata	2	21	2	28	22	Common	5
Chrysotus gramineus	3	18	3	24	10	Common	5
Hydrellia maura	3	20	2	26	11	Common	4
Parydra coarctata	3	18	0	24	11	Common	4
Lonchoptera lutea	3	16	0	21	13	Common	5
Lonchoptera bifurcata	3	16	0	21	16	Common	5
Group A1 (10)							
Athyroglossa glabra	1	27	4	75	23	Local	2
Hilara pseudochorica	1	25	0	69	25	Scarce	3
Themira minor	1	11	0	31	11	Common	4
Scathophaga stercoraria	1	10	2	28	12	Common	5
Campsicnemus marginatus	1	17	0	47	25	Local	3
Parydra aquila	1	15	3	42	24	Local	4
Teucophorus calcaratus	1	22	6	61	35	Local	3
Syntormon denticulatum	1	21	6	58	35	Local	4
Poecilobothrus nobilitatus	1	22	5	61	40	Common	4
Ditrichophora Sp B	1	15	0	42	28	New	3
Dolichopus subpennatus	1	10	1	28	22	Common	4
Lonchoptera nigrociliata	1	26	8	72	58	Scarce	1
Empis aestiva	1	10	1	28	34	Common	5
Hilara fuscipes	1	16	1	44	55	Local	4
Hemerodromia unilineata	1	11	3	31	39	Local	3
Parydra fossarum	1	9	0	25	32	Common	4
Lonchoptera meijeri	1	12	2	33	50	Scarce	3
Scathophaga inquinata	1	8	0	22	36	Common	5
Argyra argyria group	1	9	0	25	50	Common	4
Hilara apta	1	10	0	28	56	Local	3
Antocha vitripennis	1	8	0	22	57	Local	3
Oxycera terminata	1	8	0	22	62	RDB	1
Hydrellia maura	2	20	6	56	11	Common	4
Hilara obscura	2	26	4	72	14	Local	4
Athyroglossa glabra	2	13	0	36	11	Local	2
Hilara pseudochorica	2	9	0	25	9	Scarce	3

Species	Abund. level	No. of samples in group	No. of samples in sister group	% of samples in this group	% of all occurrences in whole dataset	Status	ERS Fidelity
Teucophorus monacanthus	2	10	2	28	16	Local	3
Hilara obscura	3	16	4	44	9	Local	4
Hilara obscura	4	8	1	22	4	Local	4
Group A2 (11)							
Opomyza florum	1	8	6	35	11	Common	5
Gymnopternus celer	1	17	11	74	32	Local	4
Calliopum elisae	1	9	6	39	18	Common	4
Drosophila andalusiaca	1	12	4	52	27	Common	5
Elachiptera megaspis	1	7	4	30	16	Local	4
Hilara rejecta	1	15	10	65	39	Local	4
Asteia amoena	1	8	4	35	22	Common	5
Parydra littoralis	1	19	11	83	53	Common	4
Gymnopternus aerosus	1	17	10	74	50	Common	4
Parydra quadripunctata	1	13	7	57	39	Common	4
Paranthomyza nitida	1	15	4	65	54	Common	4
Campsicnemus scambus	1	13	4	57	57	Common	4
Meiosimyza rorida	1	7	2	30	32	Common	5
Ditrichophora sp A	1	11	8	48	55	New	3
Hilara aartseni	1	15	0	65	94	New	4
Scaptomyza graminum	1	8	0	35	53	Common	5
Teucophorus simplex	1	15	0	65	100	Local	3
Diaphorus hoffmannseggii	1	11	1	48	79	RDB	2
Gymnoclasiopa plumosa	1	7	2	30	50	Scarce	4
Sciapus platypterus	1	9	1	39	69	Common	5
Lonchoptera tristis	1	9	2	39	82	Local	4
Teucophorus nigricosta	1	7	1	30	70	Local	4
Lonchoptera lutea	2	9	3	39	7	Common	5
Ditrichophora calceata	2	8	6	35	16	Common	4
Parydra littoralis	2	5	0	22	14	Common	4
Gymnopternus aerosus	2	5	1	22	15	Common	4
Parydra quadripunctata	2	7	2	30	21	Common	4
Ditrichophora sp A	2	5	3	22	25	New	3
Teucophorus simplex	2	7	0	30	47	Local	3
Lonchoptera lutea	3	8	1	35	6	Common	5
Parydra quadripunctata	3	5	1	22	15	Common	4

Table 41. Rare and scarce species in each main TWINSPAN group.

Group	Family	Rarity	ERS fidelity	A	A1	A2	All samples
Group A							
Rhaphium suave	Dolichopodidae	New	2	1	1	0	2
Hilara aartseni	Empididae	New	4	15	0	15	16
Ditrichophora sp A (*?bezzi*)	Ephydridae	New	3	19	8	11	20
Ditrichophora sp B	Ephydridae	New	3	15	15	0	53
Diaphorus hoffmannseggii	Dolichopodidae	RDB	2	12	1	11	14
Melanostolus melancholicus	Dolichopodidae	RDB	3	2	2	0	9
Polytrichophora duplosetosa	Ephydridae	RDB	3	10	7	3	27
Scatophila unicornis	Ephydridae	RDB	4	2	2	0	2
Platypalpus melancholicus	Hybotidae	RDB	3	2	2	0	8
Tachydromia costalis	Hybotidae	RDB	1	2	1	1	8
Tachydromia umbrarum	Hybotidae	RDB	5	1	1	0	1
Tachydromia woodi	Hybotidae	RDB	2	1	1	0	4
Hoplolabis yezoana	Limoniidae	RDB	2	1	1	0	10
Cosmetopus dentimanus	Scathophagidae	RDB	4	1	1	0	1
Oxycera terminata	Stratiomyidae	RDB	1	8	8	0	13
Cliorismia rustica	Therevidae	RDB	2	1	1	0	3
Spiriverpa lunulata	Therevidae	RDB	1	1	1	0	10
Argyra auricollis	Dolichopodidae	Scarce	5	1	1	0	1
Hilara albiventris	Empididae	Scarce	3	19	14	5	34
Hilara biseta	Empididae	Scarce	2	9	7	2	27
Hilara diversipes	Empididae	Scarce	4	1	1	0	2
Hilara media	Empididae	Scarce	4	4	4	0	5
Hilara pseudochorica	Empididae	Scarce	3	25	25	0	102
Gymnoclasiopa cinerella	Ephydridae	Scarce	4	1	1	0	3
Gymnoclasiopa collini	Ephydridae	Scarce	4	1	1	0	1
Gymnoclasiopa plumosa	Ephydridae	Scarce	4	9	2	7	14
Scatella silacea	Ephydridae	Scarce	4	1	1	0	3
Scatophila noctula	Ephydridae	Scarce	4	2	2	0	3
Platypalpus subtilis	Hybotidae	Scarce	4	4	4	0	13
Cheilotrichia imbuta	Limoniidae	Scarce	4	2	2	0	6
Eloeophila apicata	Limoniidae	Scarce	4	1	0	1	1
Eloeophila mundata	Limoniidae	Scarce	5	1	0	1	1
Pilaria fuscipennis	Limoniidae	Scarce	4	1	0	1	1
Lonchoptera meijeri	Lonchopteridae	Scarce	3	14	12	2	24
Lonchoptera nigrociliata	Lonchopteridae	Scarce	1	34	26	8	45
Themira gracilis	Sepsidae	Scarce	3	2	1	1	2
Oxycera morrisii	Stratiomyidae	Scarce	4	1	0	1	1
Melanochaeta pubescens	Chloropidae	Scarce	4	3	0	3	20
Stegana nigrithorax	Drosophilidae	Scarce	5	1	0	1	1
Lispocephala spuria	Muscidae	Scarce	4	1	0	1	3
Pherbellia brunnipes	Sciomyzidae	Scarce	4	1	1	0	1
Total				41	33	18	
Group B	**Family**	**Rarity**	**ERS fidelity**	**B**	**B1**	**B2**	**All samples**
Rhaphium suave	Dolichopodidae	New	2	1	1	0	2
Ditrichophora sp B	Ephydridae	New	3	16	14	2	53
Diaphorus hoffmannseggii	Dolichopodidae	RDB	2	1	1	0	14
Hydrophorus ?viridis ♀	Dolichopodidae	RDB	4	1	1	0	1
Melanostolus melancholicus	Dolichopodidae	RDB	3	2	2	0	9

Group	Family	Rarity	ERS fidelity	A	A1	A2	All samples
Rhaphium penicillatum	Dolichopodidae	RDB	3	2	2	0	3
Athyroglossa ordinata	Ephydridae	RDB	1	11	11	0	16
Ditrichophora nectens	Ephydridae	RDB	4	2	2	0	2
Hecamedoides unispinosus	Ephydridae	RDB	1	11	6	5	13
Polytrichophora duplosetosa	Ephydridae	RDB	3	8	8	0	27
Scatella obsoleta	Ephydridae	RDB	1	12	4	8	13
Platypalpus melancholicus	Hybotidae	RDB	3	3	3	0	8
Tachydromia costalis	Hybotidae	RDB	1	1	1	0	8
Tachydromia costalis group ♀	Hybotidae	RDB	1	1	1	0	1
Tachydromia edenensis	Hybotidae	RDB	1	1	1	0	2
Tachydromia woodi	Hybotidae	RDB	2	1	1	0	4
Hoplolabis yezoana	Limoniidae	RDB	2	4	2	2	10
Themira biloba	Sepsidae	RDB	4	2	1	1	2
Oxycera terminata	Stratiomyidae	RDB	1	1	1	0	13
Parhelophilus consimilis	Syrphidae	RDB	4	1	1	0	1
Cliorismia rustica	Therevidae	RDB	2	1	1	0	3
Spiriverpa lunulata	Therevidae	RDB	1	4	0	4	10
Campsicnemus pumilio	Dolichopodidae	Scarce	4	2	2	0	3
Rhaphium fractum	Dolichopodidae	Scarce	3	4	3	1	5
Rhaphium micans	Dolichopodidae	Scarce	4	1	1	0	2
Rhaphium rivale	Dolichopodidae	Scarce	3	1	1	0	1
Hilara albiventris	Empididae	Scarce	3	1	0	1	34
Hilara biseta	Empididae	Scarce	2	4	3	1	27
Hilara pseudochorica	Empididae	Scarce	3	33	32	1	102
Diclasiopa lacteipennis	Ephydridae	Scarce	4	5	5	0	5
Gymnoclasiopa plumosa	Ephydridae	Scarce	4	1	1	0	14
Scatella silacea	Ephydridae	Scarce	4	1	1	0	3
Platypalpus articulatus	Hybotidae	Scarce	4	5	3	2	17
Platypalpus subtilis	Hybotidae	Scarce	4	1	0	1	13
Tachydromia halidayi	Hybotidae	Scarce	1	9	5	4	10
Lonchoptera meijeri	Lonchopteridae	Scarce	3	1	1	0	24
Lonchoptera nigrociliata	Lonchopteridae	Scarce	1	6	4	2	45
Conisternum decipiens	Scathophagidae	Scarce	5	1	1	0	7
Tabanus cordiger	Tabanidae	Scarce	2	1	1	0	1
Nephrotoma dorsalis	Tipulidae	Scarce	2	1	1	0	5
Melanochaeta pubescens	Chloropidae	Scarce	4	1	1	0	20
Limnophora scrupulosa	Muscidae	Scarce	3	27	5	22	42
Tetanocera punctifrons	Sciomyzidae	Scarce	4	1	1	0	1
Total				44	41	15	

Group C	Family	Rarity	ERS fidelity	C	C1	C2	All samples
Asyndetus latifrons	Dolichopodidae	New	2	1	1	0	1
Hilara aartseni	Empididae	New	4	1	0	1	16
Hilara tenella	Empididae	New	4	1	0	1	1
Ditrichophora sp A (?*bezzi*)	Ephydridae	New	3	1	0	1	20
Ditrichophora sp B	Ephydridae	New	3	22	3	19	53
Ditrichophora sp C	Ephydridae	New	3	1	0	1	1
Platypalpus ?velocipes	Hybotidae	New	5	2	0	2	2
Diaphorus hoffmannseggii	Dolichopodidae	RDB	2	1	0	1	14
Melanostolus melancholicus	Dolichopodidae	RDB	3	5	0	5	9
Rhaphium penicillatum	Dolichopodidae	RDB	3	1	0	1	3
Athyroglossa ordinata	Ephydridae	RDB	1	5	0	5	16
Hecamedoides unispinosus	Ephydridae	RDB	1	2	0	2	13

Group	Family	Rarity	ERS fidelity	A	A1	A2	All samples
Hyadina scutellata	Ephydridae	RDB	4	1	0	1	1
Polytrichophora duplosetosa	Ephydridae	RDB	3	9	0	9	27
Scatella obsoleta	Ephydridae	RDB	1	1	1	0	13
Platypalpus melancholicus	Hybotidae	RDB	3	3	0	3	8
Platypalpus biapicalis?	Hybotidae	RDB	0	1	1	0	1
Tachydromia costalis	Hybotidae	RDB	1	5	0	5	8
Tachydromia edenensis	Hybotidae	RDB	1	1	1	0	2
Tachydromia woodi	Hybotidae	RDB	2	2	0	2	4
Arctoconopa melampodia	Limoniidae	RDB	4	1	0	1	1
Hoplolabis yezoana	Limoniidae	RDB	2	5	2	3	10
Limnophila pictipennis	Limoniidae	RDB	4	1	0	1	1
Rhabdomastix laeta	Limoniidae	RDB	1	1	1	0	1
Oxycera terminata	Stratiomyidae	RDB	1	4	0	4	13
Cliorismia rustica	Therevidae	RDB	2	1	0	1	3
Spiriverpa lunulata	Therevidae	RDB	1	5	4	1	10
Thereva handlirschi	Therevidae	RDB	3	1	1	0	1
Eutolmus rufibarbis	Asilidae	RDB	5	1	0	1	1
Piezura graminicola	Fanniidae	RDB	5	1	0	1	1
Homoneura limnea	Lauxaniidae	RDB	4	2	0	2	2
Gymnosoma rotundatum	Tachinidae	RDB	5	1	0	1	1
Campsicnemus pumilio	Dolichopodidae	Scarce	4	1	0	1	3
Hercostomus plagiatus	Dolichopodidae	Scarce	4	1	0	1	1
Rhaphium fractum	Dolichopodidae	Scarce	3	1	0	1	5
Rhaphium micans	Dolichopodidae	Scarce	4	1	0	1	2
Hilara albiventris	Empididae	Scarce	3	14	0	14	34
Hilara biseta	Empididae	Scarce	2	14	0	14	27
Hilara diversipes	Empididae	Scarce	4	1	1	0	2
Hilara media	Empididae	Scarce	4	1	0	1	5
Hilara pseudochorica	Empididae	Scarce	3	44	5	39	102
Rhamphomyia lamellata	Empididae	Scarce	3	1	0	1	1
Gymnoclasiopa cinerella	Ephydridae	Scarce	4	2	1	1	3
Gymnoclasiopa plumosa	Ephydridae	Scarce	4	4	0	4	14
Scatella silacea	Ephydridae	Scarce	4	1	0	1	3
Scatophila noctula	Ephydridae	Scarce	4	1	0	1	3
Platypalpus articulatoides	Hybotidae	Scarce	4	3	0	3	3
Platypalpus articulatus	Hybotidae	Scarce	4	12	5	7	17
Platypalpus luteolus	Hybotidae	Scarce	4	3	0	3	3
Platypalpus subtilis	Hybotidae	Scarce	4	8	0	8	13
Tachydromia halidayi	Hybotidae	Scarce	1	1	0	1	10
Cheilotrichia imbuta	Limoniidae	Scarce	4	4	0	4	6
Gonomyia bifida	Limoniidae	Scarce	4	1	0	1	1
Limonia trivittata	Limoniidae	Scarce	4	2	0	2	2
Lonchoptera meijeri	Lonchopteridae	Scarce	3	9	1	8	24
Lonchoptera nigrociliata	Lonchopteridae	Scarce	1	5	1	4	45
Lonchoptera scutellata	Lonchopteridae	Scarce	4	1	0	1	1
Conisternum decipiens	Scathophagidae	Scarce	5	6	0	6	7
Meligramma trianguliferum	Syrphidae	Scarce	5	1	1	0	1
Neoascia geniculata	Syrphidae	Scarce	4	1	0	1	1
Nephrotoma dorsalis	Tipulidae	Scarce	2	4	0	4	5
Anagnota bicolor	Anthomyzidae	Scarce	4	5	0	5	5
Melanochaeta pubescens	Chloropidae	Scarce	4	16	0	16	20
Homoneura thalhammeri	Lauxaniidae	Scarce	4	1	0	1	1

Group	Family	Rarity	ERS fidelity	A	A1	A2	All samples
Sapromyza albiceps	Lauxaniidae	Scarce	5	1	0	1	1
Sapromyza opaca	Lauxaniidae	Scarce	5	2	2	0	2
Limnophora scrupulosa	Muscidae	Scarce	3	15	13	2	42
Lispocephala spuria	Muscidae	Scarce	4	2	2	0	3
Colobaea bifasciella	Sciomyzidae	Scarce	4	1	0	1	1
Colobaea punctata	Sciomyzidae	Scarce	4	1	0	1	1
Pherbellia nana	Sciomyzidae	Scarce	4	1	0	1	1
Psacadina verbekei	Sciomyzidae	Scarce	4	2	0	2	2
Campiglossa absinthii	Tephritidae	Scarce	5	2	1	1	2
Dioxyna bidentis	Tephritidae	Scarce	4	5	0	5	5
Total				74	20	64	

Table 42. Median (lower and upper quartiles) of species in major families, and in status and ERS classes in TWINSPAN groups.

	Main groups			Sub-groups					
	A	B	C	A1	A2	B1	B2	C1	C2
Main group	5	3	4	5	5	3	3	4	4
Sub-group				10	11	6	7	8	9
Total Diptera	39 (35-46)	27 (19-37)	40 (30-54)	42 (35-50)	37 (34-41)	28 (223-37)	23 (16-39)	28 (21-37)	43 (36-56)
Chloropidae	0 (0-1)	0 (0-1)	2 (1-3)	0 (0-1)	1 (0-1)	0 (0-1)	0 (0-1)	1.5 (1-3)	2 (1-3)
Dolichopodidae	12 (9-13)	7 (5-9)	7 (5-11)	11 (8-14)	12 (9-13)	7 (4.5-9)	7 (5-13)	7 (5-11)	7 (5-11)
Empididae	7 (4-8.5)	2 (1-4)	4 (2-5.8)	8 (5-10)	5 (4-7)	2 (1-4)	2.5 (1.3-4)	3 (2-4)	4 (2-6)
Ephydridae	11 (8-12)	9 (7-12)	5 (3-9)	12 (9-13)	9 (6.5-11)	10 (8-12.5)	7 (5-11)	2 (1-7)	6.5 (4-9)
Hybotidae	1 (0-3)	1 (0-3)	4 (2-6)	2 (1-3.3)	1 (0-2)	1 (0-2)	2 (0.3-3)	4 (3-5)	4 (1-6)
Lauxaniidae	0 (0-1)	0 (0-0)	1 (0-2)	0 (0-0.3)	1 (0-1)	0 (0-0)	0 (0-0)	0 (0-1)	1 (0-2)
Lonchopteridae	2 (1-2)	0 (0-1)	1 (1-2)	2 (1-2)	2 (2-2)	0 (0-1)	0 (0-0.8)	0.5 (0-1)	2 (1-2)
Opomyzidae	1 (0-1)	0 (0-0)	1 (1-2)	0 (0-1)	1 (0-1.5)	0 (0-0)	0 (0-0)	0 (0-1)	2 (1-3)
Sciomyzidae	0 (0-0)	0 (0-0)	0 (0-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0.8)	0 (0-1)	0 (0-1)
Sepsidae	1 (0-2)	3 (1-4)	2 (1-4)	1 (0-2.3)	1 (0-1)	3 (2-4)	1.5 (1-4)	1 (0-2)	3 (1-4)
Syrphidae	0 (0-1)	0 (0-1)	1 (0.3-3)	0 (0-1)	0 (0-1)	0 (0-1)	0 (0-1)	1 (0-1)	2 (1-3)
Tephritidae	0 (0-0)	0 (0-0)	0 (0-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-1)
Craneflies	1 (0-2)	1 (0-2)	2 (1-4)	1 (0-2.3)	1 (0-1)	1 (0-2)	1 (0-2.8)	2 (1-3)	3 (1-5)
Status									
Rare and scarce	3 (2-4.5)	2 (1-3)	2 (1-4)	3.5 (3-5)	2 (1.5-3.5)	2 (1-3)	2 (1-2.8)	1 (0.3-2)	3 (1-4)
Local	11 (8-14)	7 (6-11)	8 (6-13)	12.5 (9-16)	11 (8-12)	7 (5.5-10)	8 (6-11.8)	7 (4.3-9.8)	9 (6-14)
Common	25 (22-31)	19 (12-26)	32 (26-39)	26 (23-30)	24 (20-31)	21 (16-26)	16 (10-27)	26 (18-31)	34 (28-40)
ERS Fidelity									
1 + 2 (total+high)	2 (1-2)	2 (1-2)	1 (0-2)	2 (1.8-3)	1 (0-1)	2 (1-2)	2 (1-2)	1 (0-2)	1 (0-2)
3 (moderate)	5 (3-6.5)	3 (2-4)	3 (1-5)	6 (5-8)	2 (1-3)	3 (2-5)	3 (2-4)	3 (2-4)	3 (1-6)
4 (wetland)	24 (21-29)	19 (13-26)	21 (12-27)	25 (21-29)	24 (21-27)	20 (14-25)	15 (12-29)	10 (8-19)	23 (14-27)
5 (tourist)	10 (8-13)	5 (3-9)	19 (14-25)	10 (8-13)	10 (7-13)	5 (3-8.5)	4 (2-9)	16 (13-19)	21 (15-28)
Individuals	608 (421-885)	495 (320-930)	290 (165-640)	800 (600-1000)	440 (300-565)	590 (318-960)	475 (329-896)	153 (73-284)	400 (198-693)

Table 43. Summary of environmental variables for each TWINSPAN group.

Continuous variables are given as median (lower and upper quartiles) and all other variables are expressed as the percentage occurrence of samples in the group.

TWINSPAN group		Main group			Sub-group					
		A	B	C	A1	A2	B1	B2	C1	C2
Variable	**Condition**									
Number of samples		59	77	102	36	23	47	30	26	76
flow conditions	normal	73	60	53	67	83	57	63	50	54
	low	27	39	45	33	17	43	33	46	45
current	converted to score	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	2 (1-2)	1 (1-2)	1 (0-1)	1 (1-2)	1 (1-2)
patch size A	length	15 (5-35)	40 (15-80)	25 (15-50)	28 (7-50)	5 (4.5-20)	25 (9-45)	100 (43-100)	75 (33-100)	20 (15-30)
	width	2 (1-3)	5 (2-20)	5 (2-10)	2 (2-5)	2 (0.5-3)	3 (2-5)	20 (6-65)	20 (6-88)	3 (2-5)
patch size B	length	5 (3-5.8)	6.5 (4.3-9.5)	6 (5-10)	5 (5-6)	3 (2-4)	6.5 (4.25-9.5)	(-)	40 (40-40)	5.5 (5-10)
	width	2 (1-2)	2 (1.3-2)	2 (1-2)	2 (2-2)	1 (1-1)	2 (1.25-2)	(-)	5 (5-5)	2 (1-2)
channel width		5 (4-7)	8 (5-10)	7 (5-10)	5 (4-8)	5 (3.5-5)	8 (4-15)	8 (7-10)	8 (6-10)	5 (5-10)
adjacent land use	arable	2	10	9	0	4	15	3	0	12
	pasture	80	74	76	86	70	70	80	69	79
	scrub	10	23	20	6	17	19	30	31	16
	woodland/trees	47	9	14	44	52	15	0	4	17
	rank herb	2	9	10	0	4	4	17	31	3
pollution	none	98	96	94	97	100	100	90	81	99
	abundant fil. alga	0	8	5	0	0	0	20	19	0
grazing/trampling	none	49	47	49	47	52	40	57	50	49
	slight	37	22	30	42	30	17	30	35	29
	much	14	30	21	11	17	43	10	19	21
stock	sheep	14	30	23	22	0	30	30	46	14
	cattle	22	21	24	33	4	26	13	8	29
	horse	3	1	2	0	9	2	0	0	3
	deer	2	0	0	0	4	0	0	0	0
	dog	5	4	6	6	4	6	0	0	8
	people	17	6	11	6	35	9	3	4	13

TWINSPAN group		Main group			Sub-group					
		A	B	C	A1	A2	B1	B2	C1	C2
	fence - electric	2	1	3	3	0	2	0	0	4
disturbance by people	recreation	24	22	20	14	39	17	30	31	16
	fishing	2	1	2	0	4	2	0	4	1
bar type	meander	2	8	2	3	0	4	13	8	0
	bank	75	74	69	69	83	79	67	65	70
	peninsular	8	0	3	14	0	0	0	0	4
	island	17	14	21	19	13	19	7	15	22
ERS profile	flat	83	84	51	92	70	83	87	77	42
	gentle	14	18	36	6	26	23	10	23	41
	steep	3	1	13	3	4	2	0	0	17
ERS topography	simple	93	94	82	97	87	91	97	96	78
	humped	3	1	10	0	9	2	0	4	12
position on bar	upstream	7	8	0	8	4	9	7	0	0
	side	88	75	48	86	91	79	70	38	51
	downstream	8	8	1	11	4	13	0	0	1
	inland	0	8	49	0	0	6	10	50	49
	whole island	3	0	2	3	4	0	0	0	3
wetness of ERS	wet surface visible	97	91	34	97	96	94	87	27	37
	dry	5	10	65	3	9	9	13	73	62
metres from water		0 (0-0)	0 (0-0)	1 (0-3)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	3 (2-5)	1 (0-2)
backwater, pools	slack / pools	8	14	4	14	0	11	20	4	4
	backwater with full flow	2	1	1	0	4	0	3	4	0
	backwater with minor flow	12	9	4	17	4	6	13	0	5
	backwater with dry bed	2	0	1	3	0	0	0	0	1
	stream or seepage	2	1	0	0	4	0	3	0	0
substrate	boulder	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
	cobble	5 (0-35)	0 (0-10)	0 (0-0.75)	10 (0-65)	0 (0-9)	0 (0-15)	1 (0-8.75)	0 (0-4.25)	0 (0-0)
	pebble	10 (0-50)	10 (0-83)	0 (0-50)	10 (5-42)	0 (0-60)	5 (0-55)	77 (3-90)	20 (5-90)	0 (0-32.5)
	gravel	0 (0-5)	0 (0-10)	0 (0-10)	3.5 (0-10)	0 (0-0)	0 (0-10)	1 (0-8.75)	5 (0-60)	0 (0-10)
	sand	10 (0-90)	2 (0-90)	20 (0-100)	5 (0-77)	80 (10-98)	5 (0-93)	0.5 (0-5)	5 (0-20)	80 (5-100)
	silt	0 (0-2)	0 (0-1)	0 (0-0)	0 (0-1.25)	0 (0-5)	0 (0-1.5)	0 (0-0)	0 (0-0)	0 (0-0)

TWINSPAN group		Main group			Sub-group					
		A	B	C	A1	A2	B1	B2	C1	C2
	organic	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
vegetation	bare or almost bare	90 (70-95)	95 (70-100)	5 (0-30)	93 (86-98)	70 (40-85)	95 (80-99)	95 (50-100)	20 (1-65)	2 (0-20)
	pioneer	5 (0-10)	2 (0-5)	10 (0-30)	2 (0-5)	10 (2-20)	2 (0-5)	0 (0-13)	20 (0-49)	10 (0-30)
	continuous short sward	0 (0-0)	0 (0-0)	0 (0-10)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-10)	0 (0-5)
	dense tall herb	0 (0-0)	0 (0-0)	5 (0-70)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-9)	15 (0-90)
	scrub	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
	tall trees	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
	marginal vegetation	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
shade	%	50 (10-100)	0 (0-0)	0 (0-20)	25 (5-90)	100 (50-100)	0 (0-0)	0 (0-0)	0 (0-0)	5 (0-50)
	tall herbs	2	0	5	3	0	0	0	0	7
	scrub	3	3	9	6	0	2	3	0	12
	trees	78	9	33	69	91	15	0	0	45
bed	cobbles	76	73	55	86	61	60	93	81	46
	shingle	8	10	12	6	13	13	7	15	11
	shingle & sand	7	0	2	3	13	0	0	0	3
	shingle & silt	0	0	0	0	0	0	0	0	0
	sand	17	19	28	14	22	30	3	0	38
shore	cobbles	68	62	51	78	52	51	80	73	43
	shingle	8	12	11	14	0	11	13	12	11
	shingle & sand	3	12	10	3	4	9	17	15	8
	shingle & silt	2	0	0	3	0	0	0	0	0
	sand	39	21	32	22	65	32	3	0	43
	silt	7	4	1	3	13	4	3	0	1
half-way up bank	cobbles	24	35	22	25	22	23	53	42	14
	shingle	22	17	18	36	0	26	3	0	24
	shingle & sand	14	19	18	22	0	11	33	35	12
	shingle & silt	3	0	2	0	9	0	0	0	3
	sand	51	32	46	31	83	45	13	31	51
	silt	3	3	1	6	0	2	3	0	1
top of bank	cobbles	12	23	16	11	13	9	47	42	7
	shingle	15	9	11	25	0	6	13	12	11
	shingle & sand	12	18	11	19	0	11	30	15	9
	shingle & silt	3	0	1	0	9	0	0	0	1

TWINSPAN group	Main group			Sub-group					
	A	B	C	A1	A2	B1	B2	C1	C2
sand	61	53	58	50	78	68	30	42	63
silt	2	1	2	3	0	2	0	0	3
alluvium	5	5	6	3	9	9	0	0	8

Table 44. Summary description of the sampling points in each TWINSPAN group.

River	Site	Sample	Group	summary description
Bray	Bray Bridge	2	A1	shaded and open bare sand shore
Bray	Bray Bridge	4	A1	bare stony margin
Bray	Bray Bridge	5	A1	wet sand patches
Breamish	Brandon	3	A1	tiny wet sand shores in vegetated matrix
Coly	Heathayne	3	A1	bare stony shore
Coly	Heathayne	6	A1	bare stony shore
Coly	Heathayne	7	A1	bare stony shore
Coquet	Healey	1	A1	wet shaded bare sand edge
Mole	Meethe	1	A1	stony unshaded bare shore
Mole	Meethe	2	A1	stony shore of partly shaded backwater
Monnow	Alltyrynys	5	A1	silty ponds in shade
Monnow	Alltyrynys	6	A1	nearly bare cobbly shore
Monnow	Kentchurch	1	A1	cobbly shore of still backwater
Monnow	Kentchurch	2	A1	partly vegetated sand and silt tail shore
Monnow	Kentchurch	3	A1	bare cobbly shore
Monnow	Kentchurch	5	A1	bare stony shaded shore, sand in one patch
Monnow	Maerdy	1	A1	bare stony shore
Monnow	Maerdy	3	A1	bare cobbly shore by riffle
Monnow	Maerdy	4	A1	nearly bare stony tail with some silt
Monnow	Skenfrith	1	A1	bare cobbly shore
Monnow	Skenfrith	3	A1	bare sand and stone shore of minor backwater
Monnow	Skenfrith	4	A1	dense herb with narrow cobble and gravel shore
Monnow	Skenfrith	5	A1	nearly bare cobble shore
Rother	Habin	7	A1	bare sand shore
Till	Bewick Bridge	3	A1	wet bare gravel shore
Till	Bewick Bridge	6	A1	wet shaded sand on bank
Till	Bewick Bridge	8	A1	wet shaded sand shore
Usk	Great Hardwick	1	A1	wet nearly bare sand tail
Usk	Great Hardwick	2	A1	sandy shaded backwater
Weaver	Dairy Farm	1	A1	long strip of shaded sandy shore
Weaver	Dairy Farm	3	A1	wet shaded bare sand shore
Weaver	Dairy Farm	5	A1	wet shaded sand shore
Yarty	Bowditch Farm	1	A1	partly shaded bare stony shore
Yarty	Bowditch Farm	6	A1	bare shore with some pioneer vegetation on pebbles and gravel
Yarty	Bowditch Farm	9	A1	shaded bare cobbly shore
Ysgir	Ysgir	2	A1	cobble shore
Breamish	Brandon	9	A2	shaded stony braid
Rother	Adhurst	1	A2	partly shaded bare stony bars
Rother	Adhurst	2	A2	lightly shaded bare stony bars
Rother	Adhurst	3	A2	lightly shaded bare stony and mossy bar
Rother	Adhurst	4	A2	mainly bare shaded cobbly shore
Rother	Adhurst	5	A2	shaded wet bare sand shore
Rother	Habin	1	A2	shaded lightly vegetated cobble shore
Rother	Habin	2	A2	shaded bare pebbly to gravely shore
Rother	Habin	3	A2	tall rank vegetation
Rother	Habin	6	A2	narrow pebbly bare wet shore
Rother	Woolbeding	2	A2	wet partly vegetated sand
Wey	Bordon	1	A2	shaded wet sand shore
Wey	Bordon	2	A2	shaded wet sand shore
Wey	Bordon	3	A2	shaded wet sand shore

River	Site	Sample	Group	summary description
Wey	Bordon	4	A2	shaded wet sand shore
Wey	Eashing	1	A2	bare wet sand shore
Wey	Eashing	2	A2	vegetated sand shore and bank
Wey	Frensham	1	A2	wet sand shore
Wey	Tilford	2	A2	bare wet shore in woodland
Wey	Tilford	6	A2	shaded narrow bare sand shore
Wey	Tilford	7	A2	lightly shaded wet thinly vegetated sand bank
Ysgir	Ysgir	1	A2	shaded cobbles
Ysgir	Ysgir	3	A2	shaded cobble & boulder shore
Bray	Bray Bridge	1	B1	stony bare unshaded shore
Bray	Bray Bridge	8	B1	bare wet stony shore
Coly	Heathayne	1	B1	bare gravelly shore
Coquet	Hepple	1	B1	wet stony edge
Coquet	Thropton	9	B1	wet bare sandy edge with some grass sward
Exe	Thorverton Weir	1	B1	bare unshaded stony shore
Exe	Thorverton Weir	4	B1	bare stony shore
Mole	Meethe	5	B1	bare stony shore
Mole	Meethe	7	B1	bare silt shore
Monnow	Alltyrynys	1	B1	bare stony shore, small amount sand
Monnow	Alltyrynys	4	B1	silty bay
Monnow	Monmouth Cap	1	B1	bare stony shore with tiny silt patches
Rother	Habin	4	B1	bare trampled sand shore
Rother	Shopham	1	B1	trampled bare sand bank & shore
Rother	Shopham	3	B1	narrow sand shore with dense marginal vegetation
Till	Bewick Bridge	2	B1	wet bare cobble & gravel shore
Till	Doddington Br.	2	B1	wet sand edge by still water
Till	Doddington Br.	4	B1	bare gravel bar away from water
Till	Doddington Br.	5	B1	damp sand at water's edge
Till	Doddington Br.	9	B1	wet gravel edge, exposed
Usk	Great Hardwick	3	B1	mainly bare dry cobbles
Usk	Great Hardwick	4	B1	bare cobbly shore
Usk	Great Hardwick	7	B1	bare stony shore
Usk	Llanvihangel	2	B1	bare wet trampled sandy silty tail
Usk	Llanvihangel	3	B1	wet bare algal-covered cobbles
Usk	Llanvihangel	5	B1	dry pioneer vegetation on cobble
Usk	Llanvihangel	7	B1	nearly bare cobble to sand shore
Usk	Scethrog	2	B1	bare cobble shore
Usk	Scethrog	4	B1	pioneer vegetation on pebbles
Usk	Scethrog	5	B1	nearly bare sand shore with backwater pool
Usk	Scethrog	8	B1	short dense vegetation by wet bare sand
Weaver	Batherton	3	B1	wet sand shore (tiny patches)
Weaver	Batherton	5	B1	wet bare sand shore & Sparganium
Weaver	Coole Hall	1	B1	sandy trampled shore and marginal vegetation
Weaver	Dairy Farm	8	B1	bare lightly shaded sand shore
Weaver	Mile End	1	B1	bare trampled sand shore
Weaver	Mile End	3	B1	part shaded silty shore
Weaver	Mile End	5	B1	wet silt shaded shore
Weaver	Mile End	7	B1	bare and partly vegetated sand shore, grazed, mixed microhabitats
Weaver	Mile End	8	B1	bare and partly vegetated sand shore, grazed, mixed microhabitats
Wey	Tilford	4	B1	bare trampled wet sand shore
Yarty	Bowditch Farm	2	B1	unshaded stony shore
Yarty	Bowditch Farm	3	B1	sparse grazed grass at margin

River	Site	Sample	Group	summary description
Yarty	Bowditch Farm	4	B1	unshaded stony shore
Yarty	Bowditch Farm	5	B1	grazed grass sward on sandy margin
Yarty	Bowditch Farm	10	B1	bare stony bar
Yarty	Bowditch Farm	11	B1	gravely shore with pioneer vegetation
Breamish	Brandon	1	B2	wet bare cobbly edge
Breamish	Brandon	10	B2	sunny stony edge
Breamish	Brandon	11	B2	pioneer vegetation
Breamish	Brandon	12	B2	wet pebbly edge with some sand
Coquet	Hepple	3	B2	pool in old channel with swamp areas
Coquet	Hepple	4	B2	wet stony edge
Coquet	Hepple	6	B2	wet stony edge
Coquet	Ryehill	1	B2	wet sand shore of sunny backwater with seepage inflow
Coquet	Ryehill	2	B2	damp sand and pioneer vegetation away from backwater edge
Coquet	Ryehill	3	B2	wet pebbly edge
Coquet	Ryehill	5	B2	pool on sand
Coquet	Ryehill	6	B2	wet pebbly edge
Coquet	Ryehill	8	B2	wet sand around pool
Coquet	Sharperton	1	B2	wet stony edge
Coquet	Sharperton	2	B2	pioneer vegetation on dry stones
Coquet	Sharperton	3	B2	pools on stones
Coquet	Sharperton	5	B2	cut-off channel silt shore
Coquet	Sharperton	6	B2	pools and swamp in old channel
Coquet	Sharperton	7	B2	wet stony edge
Coquet	Thropton	1	B2	wet pebbly edge
Coquet	Thropton	2	B2	dry pebble core with pioneer vegetation
Coquet	Thropton	5	B2	wet pebbly edge
Coquet	Thropton	7	B2	wet pebbly edge
Glen	Akeld	1	B2	wet sand shore
Glen	Akeld	3	B2	wet stony edge
Glen	Akeld	5	B2	wet bare stony edge
Till	Bewick Bridge	4	B2	wet bare pebbly edge
Till	Doddington Bridge	1	B2	gravel edge with wet stones
Till	Doddington Bridge	12	B2	wet gravel edge
Usk	Scethrog	3	B2	bare pebble shore by backwater
Breamish	Brandon	2	C1	pioneer (and older) vegetation
Breamish	Brandon	4	C1	lush vegetated backwater stream
Breamish	Brandon	5	C1	wet stony edge
Breamish	Brandon	6	C1	vegetation clumps at wet edge, & scrub
Breamish	Brandon	8	C1	pioneer vegetation on cobbles
Coquet	Healey	2	C1	pioneer vegetation and continuous sward on dry sand
Coquet	Hepple	2	C1	pioneer vegetation on dry cobbles
Coquet	Hepple	5	C1	pioneer vegetation on dry cobbles
Coquet	Ryehill	4	C1	pioneer vegetation on pebbly gravel
Coquet	Ryehill	7	C1	sparse pioneer vegetation on dry pebbles
Coquet	Sharperton	4	C1	pioneer vegetation on dry sand far from river
Coquet	Sharperton	8	C1	pioneer vegetation on dry cobbles
Coquet	Sharperton	9	C1	pool in old channel on stones
Coquet	Thropton	3	C1	dry sparse sandy grass
Coquet	Thropton	4	C1	grazed grass sward on dry sand
Coquet	Thropton	6	C1	dry nearly bare gravely core

River	Site	Sample	Group	summary description
Coquet	Thropton	8	C1	pioneer vegetation and grass sward on dry pebbles
Glen	Akeld	2	C1	pioneer vegetation on dry gravel
Glen	Akeld	4	C1	marginal vegetation
Glen	Akeld	6	C1	pioneer vegetation on stones
Till	Bewick Bridge	7	C1	sandy dry bank
Till	Doddington Bridge	6	C1	damp marginal vegetation
Till	Doddington Bridge	7	C1	dry core on sand or gravel
Till	Doddington Bridge	10	C1	dry scrubbed core
Till	Doddington Bridge	11	C1	vegetated edge
Usk	Scethrog	1	C1	pioneer vegetation on dry cobbles
Bray	Bray Bridge	3	C2	pioneer vegetation on gravel/sand
Bray	Bray Bridge	6	C2	pioneer and fringing vegetation
Bray	Bray Bridge	7	C2	dense tall herb on dry bank
Coly	Heathayne	2	C2	tall herb on dry bank
Coly	Heathayne	4	C2	pioneer & dense herb on stones
Coly	Heathayne	5	C2	pioneer and tall herb on dry channel bed
Exe	Thorverton Weir	2	C2	pioneer vegetation on dry stones
Exe	Thorverton Weir	3	C2	marginal vegetation and stony shore of backwater
Exe	Thorverton Weir	5	C2	ruderals and marginals
Mole	Meethe	3	C2	Phalaris stand on stones
Mole	Meethe	4	C2	wet sand shore fragments
Mole	Meethe	6	C2	pioneer vegetation on stones
Mole	Meethe	8	C2	tall herb on damp silt
Mole	Meethe	9	C2	marginal & pioneer vegetation on silty bank
Monnow	Alltyrynys	2	C2	mixed core vegetation pioneer to dense on pebbles
Monnow	Alltyrynys	3	C2	nearly bare mixed sediments at backwater
Monnow	Alltyrynys	7	C2	dense tall dry herb
Monnow	Kentchurch	4	C2	densely vegetated core on mixed sediments
Monnow	Maerdy	2	C2	shaded dense tall herb on stones
Monnow	Maerdy	5	C2	vegetated dry core
Monnow	Monmouth Cap	2	C2	mixed sparse to dense dry vegetation on gravel and sand
Monnow	Skenfrith	2	C2	short dry sward on pebbles
Monnow	Skenfrith	6	C2	grassy sand bank
Rother	Adhurst	6	C2	shaded dense herb on sand
Rother	Cowdray	1	C2	bare sand bank
Rother	Cowdray	2	C2	narrow wet bare sand shore
Rother	Habin	5	C2	dense tall herb on high bar
Rother	Petersfield	1	C2	gravel & pebble island with short trampled grass
Rother	Shopham	2	C2	lightly vegetated wet sand shore
Rother	Shopham	4	C2	sandy bank and shore with pioneer and marginal vegetation
Rother	Shopham	5	C2	
Rother	Woolbeding	3	C2	
Till	Bewick Bridge	1	C2	pioneer vegetation on dry core
Till	Bewick Bridge	5	C2	shaded backwater with Phalaris
Till	Doddington Bridge	3	C2	Phalaris & willow foliage and long grass in shade on sand bank
Till	Doddington Bridge	8	C2	wet gravel edge, quiet water
Usk	Great Hardwick	5	C2	dense dry herb on cobbles

River	Site	Sample	Group	summary description
Usk	Great Hardwick	6	C2	wet partly vegetated sand shore
Usk	Great Hardwick	8	C2	wet bare sand shore
Usk	Llanvihangel	1	C2	sandy silty backwater with some vegetation
Usk	Llanvihangel	4	C2	sand and cobbles with half pioneer vegetation
Usk	Llanvihangel	6	C2	willow scrub on dry cobble
Usk	Llanvihangel	8	C2	pioneer vegetation on dry pebbles
Usk	Scethrog	6	C2	pioneer and dense vegetation on dry sand
Usk	Scethrog	7	C2	tall willow scrub over balsam
Weaver	Batherton	1	C2	bare wet sand shore
Weaver	Batherton	2	C2	pioneer and marginal with tall herbs on bank
Weaver	Batherton	4	C2	fringing tall herb
Weaver	Batherton	6	C2	Phalaris on bank
Weaver	Coole Hall	2	C2	marginal vegetation
Weaver	Coole Hall	3	C2	wet lightly shaded sand margin
Weaver	Coole Hall	4	C2	pioneer and marginals on dry sand bank
Weaver	Coole Hall	5	C2	wet shaded shore & marginal vegetation
Weaver	Coole Hall	6	C2	shaded sand bank with pioneer & marginal vegetation
Weaver	Dairy Farm	2	C2	tall herb on dry bank
Weaver	Dairy Farm	4	C2	tall herb on dry bank
Weaver	Dairy Farm	6	C2	poor grazed nettle on shaded sand bank
Weaver	Dairy Farm	9	C2	ruderals and Phalaris on clayey sand bank
Weaver	Mile End	2	C2	tall herb around edge of "1" at steep dry edge
Weaver	Mile End	4	C2	ruderals and bank of nettle
Weaver	Mile End	6	C2	poor partly shaded nettles on bank
Wey	Eashing	3	C2	vegetated sand bank
Wey	Eashing	4	C2	pioneer on wet sand
Wey	Frensham	2	C2	balsam-dominated steep sandy bank
Wey	Frensham	3	C2	wet sandy shore and pioneer
Wey	Frensham	4	C2	wet sand island
Wey	Frensham	5	C2	vegetated slumped sand bank
Wey	Thundry	1	C2	vegetated sand bank
Wey	Thundry	2	C2	vegetated sand bank
Wey	Thundry	3	C2	Glyceria swamp
Wey	Tilford	1	C2	shaded bare sand shore
Wey	Tilford	3	C2	shaded vegetated bank
Wey	Tilford	5	C2	vegetated wet sand shore
Yarty	Bowditch Farm	7	C2	dense tall herb on gravel
Yarty	Bowditch Farm	8	C2	shaded stony shore with tall herb
Yarty	Bowditch Farm	12	C2	stony bar with pioneer vegetation

Effects of trampling

Disturbance by large grazing animals, people or vehicles has been shown to be detrimental to the ERS beetle fauna. Such an effect was sought in the present results. Constrained ordination had indicated that trampling was a minor factor but that human disturbance was important on the Wey and Rother (Figure 17). Taking a single variable in isolation cannot be expected to produce a significant result as many factors influence species numbers, but a pattern across many rivers may give an indication of an effect, even if it cannot be proven.

The effect of disturbance was examined by comparing the median numbers of species in rarity and ERS fidelity classes and for the numbers of three key families (dolichopodids, ephydrids, hybotids) for different levels of trampling, treating each river separately. Any medians that appeared obviously different were tested using the non-parametric Kruskal-Wallis test. Trampling was scored on the field sheet as none, slight or much, and human disturbance as present or absent. Trampling was converted to a nominal scale of 1, 2 or 3, and human disturbance was treated both as a separate factor and also added to the trampling score (so the maximum score could be 4). There was a fairly even spread of samples with none, slight or much trampling on most rivers; there were few or no samples with 'much' trampling on the Monnow, Tay and Spey.

Almost no median values differed between the three levels of trampling, and none at all with human disturbance (Table 45). Values for the three large families are not shown as they also showed no large or consistent differences. The few significant differences occurred on the Coquet, which was one of the more stony rivers at its upper end, and here trampling was associated with lower numbers of key species. The almost consistent lack of any effect suggested that trampling was not an important influence on the numbers of key ERS or rare and scarce species. Disturbance by people (mainly fishermen) had no effect on the median values for the Wey and Rother, despite this factor being strongly associated with samples from these rivers which had higher obvious usage by fishermen than seen at most other rivers.

The result runs counter to observations on Cumbrian ERS by one of the authors and of the consensus for beetles. There are several possible explanations for the current data not supporting these observations. Trampled sites were avoided in preference for sampling at non-trampled sites where possible. Trampling may not have been accurately recorded in the field. It is likely to have been more visible on sandy than on stony shores, as indicated perhaps by the positive correlation with sand substrate and negative with stony ones, and sometimes it was clear that cattle used the shore since there were cow-pats, but there were no clear signs of trampling. Some trampled shores had vast numbers of sphaerocerids. Had these been identified, a 'trampled' TWINSPAN subgroup characterised by this family may have been distinguished. Finally, and perhaps most importantly, badly damaged shores were not sampled since the survey was exploratory in nature, and the design had not attempted to investigate all aspects. Thus the scoring of 'much trampling' may represent a section at one end of a much wider spectrum of damage.

Summary
It was concluded from these limited data that trampling had a negligible effect on the richness of key groups of flies on ERS, but this needs closer analysis to demonstrate conclusively. The study was not designed to test such an effect, and it would be unwise to assume that trampling has no effect on Diptera associated with ERS, especially as observations on Cumbrian rivers suggest that trampling is detrimental.

Table 45. Median numbers of species in different status and ERS fidelity classes with three levels of trampling. Shaded values are significantly different at p < 0.05 (Kruskall-Wallis test).

	Degree of trampling	Wey	Rother	Usk & Ysgir	Monnow	Weaver	Devon	Coquet & Till group	Tay & Spey
Common	none	24.0	20.0	24.0	25.0	28.0	25.0	27.0	10.0
	slight	34.0	30.0	25.5	24.0	39.0	29.0	15.0	7.0
	much	29.5	21.0	22.5		34.0	27.5	24.0	
Local	none	6.0	7.0	9.0	13.0	9.0	7.0	10.0	5.5
	slight	7.0	12.0	11.5	9.0	10.0	12.5	6.0	3.0
	much	8.0	6.0	10.0		9.0	10.5	6.5	
Rare and Scarce	none	1.0	2.0	4.0	4.0	2.0	3.0	2.0	2.0
	slight	1.0	2.0	3.5	5.0	3.0	3.0	1.0	2.0
	much	2.0	1.0	4.5		2.0	1.5	1.5	
Total and high fidelity	none	0.0	1.0	2.0	2.0	2.0	1.0	2.0	0.5
	slight	0.0	1.0	2.5	2.0	1.0	2.0	1.0	1.0
	much	1.0	1.0	2.5		1.0	1.0	0.0	
Moderate fidelity	none	0.0	2.0	4.0	6.0	3.0	4.0	3.0	1.0
	slight	1.0	3.0	4.0	6.0	4.0	6.5	2.0	1.0
	much	2.5	1.0	5.0		2.0	3.5	3.5	
Wetland	none	21.0	23.0	16.0	22.0	22.0	16.0	23.0	10.0
	slight	24.5	25.0	24.0	19.0	26.0	26.0	12.0	5.5
	much	23.0	20.0	20.5		26.0	24.0	15.0	

Shade

A number of species are known to be strongly influenced by shade; these are not often found in exposed, sunny places but prefer the shade (and probably higher humidity) found in tall herbaceous vegetation or under trees. Shade appeared as a moderately strong variable explaining some of the variation in species composition in the CCA ordination. There was therefore reason to examine this factor in more detail.

Species characteristic of exposed ERS, such as *Tachydromia*, would not necessarily be expected to be found in shaded sites, whereas a few such as *Lonchoptera nigrociliata*, are confined to shaded stony shores. Knowing which uncommon species and those with higher fidelity to ERS prefer shaded conditions may help how to manage riverside trees and scrub.

The issue was examined by investigating species that were much more frequent than expected in shaded sites. Species preferring shade were arbitrarily defined as those occurring at least twice as often as expected in samples taken in the shade, using the proportion of all samples taken in the shade as the expected proportion. A cover or 70% was likely to encompass conspicuously shaded places. Of 289 samples where the percentage of shade had been recorded, 45 samples were taken in 70% or more shade, so the test examined a rather small proportion of the samples as shown by the distribution of

samples with increasing percentage of shade (Figure 23). This high degree of shade was recorded mainly when trees or scrub, but rarely tall herb, was the cause of the shade.

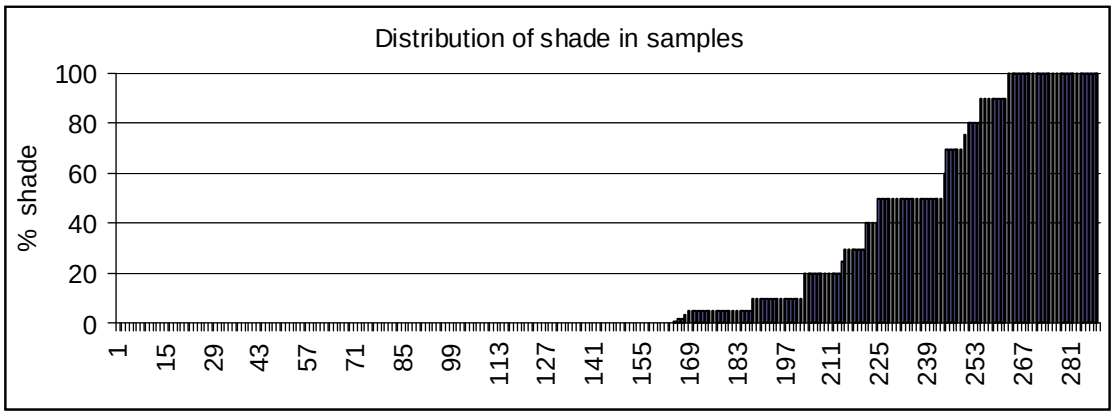


Figure 23. Distribution of percentage shade in samples from all rivers.

A quarter of all flies (205 species) were found twice as often as expected in 70% or more shade but many of these represented by only a few individuals, so their occurrence may have been due to chance. Nevertheless, they included those that would be expected in shade but not in the open, such as all seven species of *Argyra* found in the survey, 11 *Hilara* (out of 31 species) and 29 craneflies (out of 83 species). Among these were several species with high fidelity to ERS, although none was confined to heavily shaded places: *Diaphorus hoffmannseggii*, *Tachydromia woodi, Hoplolabis areolata*, *H. vicina*, *Rhabdomastix edwardsi*, *Nephrotoma analis* and *N. dorsalis*. Species with moderate ERS fidelity included the scarce species *Hilara albiventris*, *Rhamphomyia lamellata* and *Themira gracilis*, and the new ephydrid *Ditrichophora* sp A, as well as more common species.

When the stringency of the test was increased to include species occurring at least three times more often than expected in at least 70% shade, the species with moderate or high ERS fidelity showing clearest preference for shade were *Diaphorus hoffmannseggii, Nephrotoma analis, Teuchophorus simplex and Ditrichophora* sp A, and scarce or rare species were *Cheilotrichia imbuta*, *Gymnoclasiopa plumosa* and *Hilara aartseni*.

The obverse of a preference for shade was its avoidance. As many more samples were taken in unshaded places than shaded ones, and therefore many more species were present in the samples, only species occurring at least 10 times in the 289 samples were investigated. Of greatest interest was the c. 50 species not or very rarely found in places with at 50% or more shade (none or one occurrence out of at least 10 samples). These included six species with total ERS fidelity (*Athyroglossa ordinata*, *Hecamedoides unispinosus*, *Scatella obsoleta*, *Tachydromia halidayi*, *T. morio* and *Spiriverpa lunulata*) and one each with high or moderate ERS fidelity (*Hoplolabis yezoana* and *Limnophora scrupulosa*, respectively). These are also mostly rare or scarce species. This suggests that species with the highest dependence on ERS also have least tolerance to shade. This may be true for the adults but not necessarily for larvae, as that larva of *Spiriverpa lunulata* has been reared from larvae collected in both unshaded and shaded sediments.

As the number of species occurring several times in well shaded places increased, the numbers of craneflies rose only slowly, but notably included the frequent species *Symplecta hybrida* and *Nephrotoma submaculosa* appeared to show a preference for open sites. Other craneflies, including *Tipula couckei* and *T. montium* with moderate ERS fidelity, appeared to show no preference for open or shaded sites, and were all frequent regardless of conditions.

This analysis suggests that moderate to complete shade is important, or at least does not deter, a small number of ERS-specialists and scarce or rare species, whereas another suite of particularly specialised ERS species appear to be intolerant of shade. Shaded sediments may be the preferred habitat for many more commoner species, notably craneflies, some of which may be only loosely associated with streams and rivers.

Summary

A few species showed clear preferences for well shaded places, notably craneflies and species of Hilara, and these included a few with high or moderate ERS fidelity. Another small suite of species was almost never found at shaded places, and these included several species with total ERS fidelity.

Comparison of the methods

The estimated number of individuals altogether in 96 sweep net samples taken in 2005 from the Usk, Monnow, Wey and Rother was nearly 68,000, of which about 50,000 (74%) were identified to species. Fewer individuals were caught in 66 suction samples (over 46,000) but only slightly under half of these (c. 22,000) were identified to species. The remainder were mainly sphaerocerids. Thus a greater proportion of the target groups were taken by sweep netting, and this avoided having to sort through a much larger proportion of unidentified material. Ten-minute sweep samples collected on average about 1.5 times as many species as the 2 minute suction samples, and the mean numbers per sample were significantly different (Table 46). Thus sweep netting not only collected more material but a greater proportion of it contained useful species. If sphaerocerids were to be identified, the residue of unidentified material would be insignificant, consisting mainly of phorids, anthomyiids, ceratopogonids and psychodids, but usually in very small numbers.

Table 46. Number of individuals counted in samples from four rivers (Usk, Monnow, Wey, Rother) in sweep-net and suction samples.

Sweep-net Samples	mean	x÷95% CL	total
Identified	524	1.16	50,345
Not identified	181	1.24	17,390
Total	706	1.15	67,730
Suction Samples			
Identified	336	1.34	22,180
Not identified	370	1.51	24,425
Total	706	1.36	46,610

It was expected that the relationship between the number of species caught and the number of individuals would be a simple one and give a measure of the efficacy of the methods. However, regressions of these two variables for sweep-net samples (log-transformed) showed an unexpectedly weak relationship (Figure 24), and the proportion of variation in the number of species explained by the number of individuals was very small, even though the correlation was highly significant (Table 47). The result for the Monnow samples was even more difficult to explain since the relationship was negative – more species were caught with fewer individuals.

The relationship was more normal for the suction samples although the apparently most convincing results (for the Monnow) is partly an artefact of problems caused by large numbers of lycosids and *Bembidion* ground beetles eating the catch (a problem that was overcome in later samples from other rivers). The Wey and Rother suction samples have been combined since there were few Wey samples.

It was concluded that there is a poor relationship between species-richness and the abundance of individuals. Samples taken from the water's edge contained vast numbers of relatively few species, whereas those from more structurally diverse habitat often had greater species richness and variable abundances. The statistical result is therefore of little value in comparing the two methods.

Figure 24. Number of species against ln number of individuals in each river, for suction samples (above) and sweep-net samples.

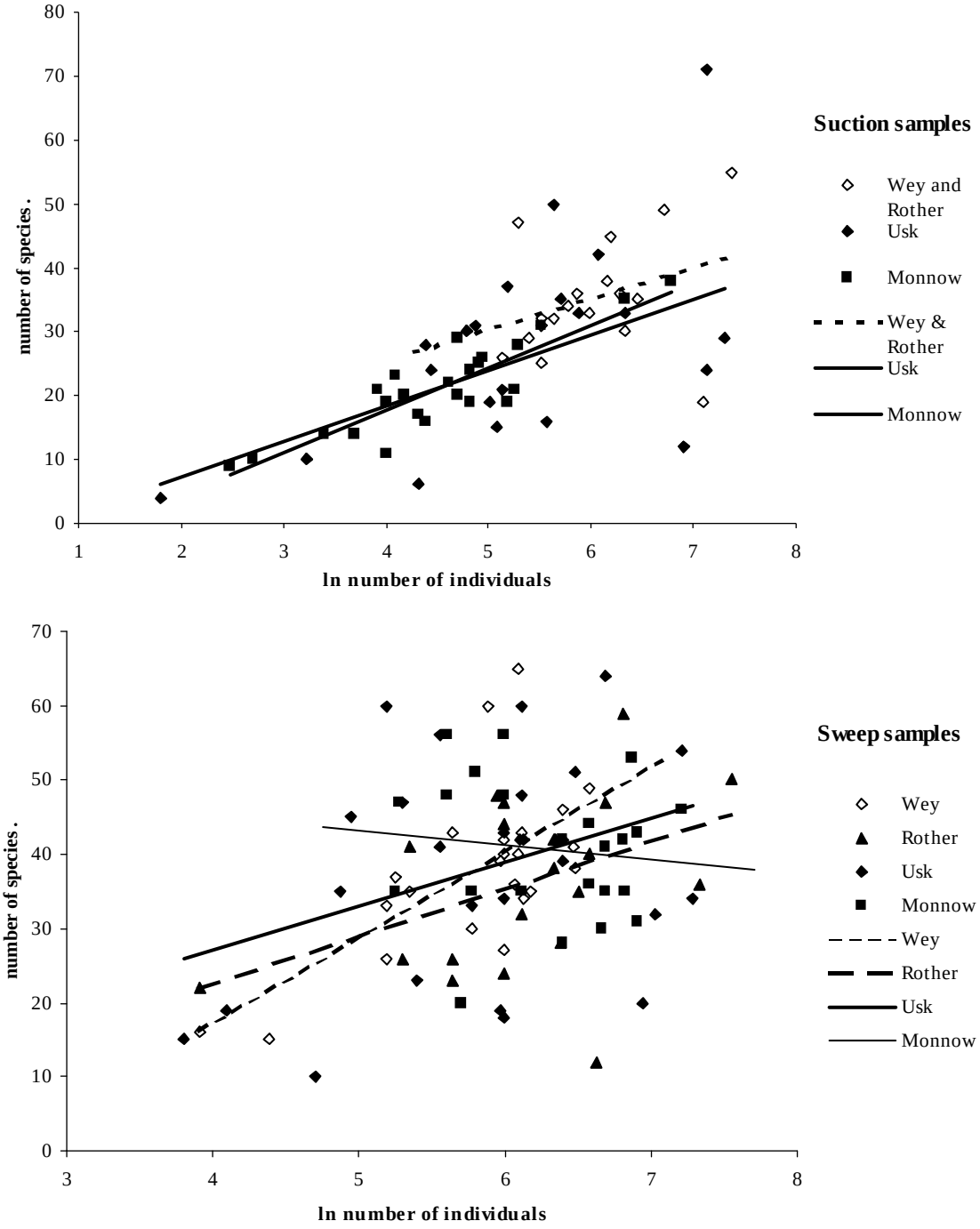


Table 47. Correlation coefficient and proportion of variance explained between the number of species and log-transformed number of individuals.

	Sweep		Suction	
	r	r^2	r	r^2
All	0.356***	0.127	0.643***	0.413
Wey	0.665***	0.443		
Rother	0.420***	0.177		
Wey & Rother			0.372***	0.138
Usk	0.348***	0.121	0.497***	0.247
Monnow	-0.124	0.015	0.883***	0.780

As the purpose of using suction sampling was to locate additional ERS species, the proportion of such species in suction and sweep samples provides a measure of its effectiveness. This is shown graphically in Figure 25 in which the number of ERS species in suction and sweep samples are shown as adjacent columns. Species with total, high or moderate fidelity to ERS (classes 1-3) form a higher percentage of the total catch of suction samples than of sweep samples for nearly all rivers (white column – suction samples – are higher for these ERS classes). Non-ERS species (classes 4 and 5) usually form a smaller proportion of suction samples. Thus although suction sampling may collect fewer species overall, especially on the stonier ERS of the Welsh rivers, it collects a higher proportion of species of most interest in the context of ERS. This may be the result of suction sampling being more targeted at species living close to the ground.

The same data were combined for all rivers to provide a value to express this difference in effectiveness (Table 48).

Figure 25. Percentage composition of species in ERS fidelity classes in four rivers collected by suction sampling and sweep-netting.

Each adjacent black and white pair of columns are sweep and suction samples from one river, in the order Wey, Rother, Usk then Monnow.

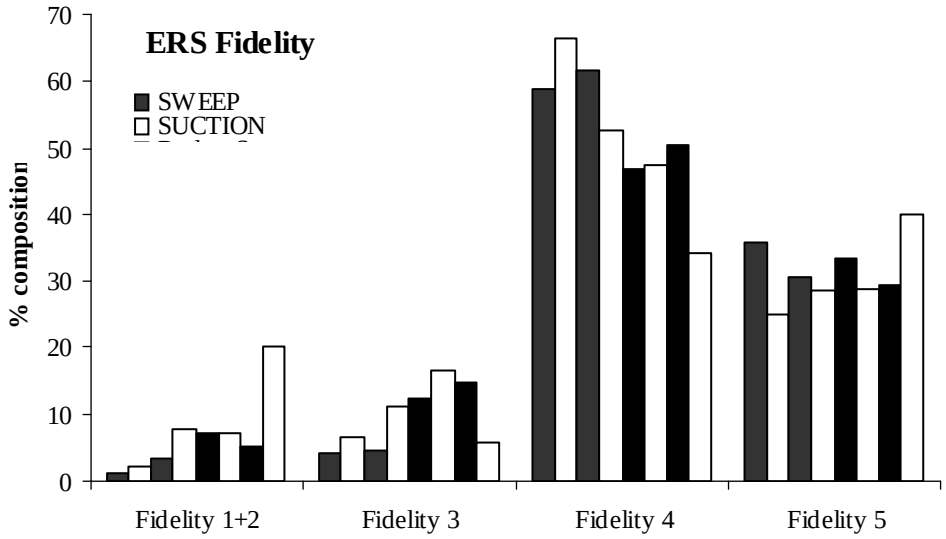


Table 48. Number of species (and percentage of all species) in each fidelity class in all sweep-net and suction samples combined.

ERS Fidelity Class	Sweep		Suction	
	number of species	%	number of species	%
1 & 2 (total & high)	18	1.1	14	2.6
3 (moderate)	28	6.1	26	9.7
4 (wetland)	219	47.7	141	52.4
5 (tourist)	194	42.3	88	32.7
total species	459		269	

Secretive flies are collected more effectively by suction sampling than by sweep netting. This was examined using the 71 sampling points where both types of samples were taken, concentrating on species in ERS fidelity classes 1-3. The ratio of occurrences was used as a measure of selectiveness of the devices. To avoid numerous instances of high ratios, the analysis was restricted to species that were collected at least ten times using either method.

Of the 509 species in the 71 samples, 54 were in fidelity class 1, 2 or 3, but only 22 of them were in 10 or more samples. Of these, sweep-netting collected one species in fidelity class 1, four in class 2 and six in class three twice as frequently as did suction sampling. Only one species in class 3 was collected more frequently by suction sampling (Table 49). The same result was obtained for more common wetland flies in class 4, of which very few were frequent in suction samples (only three species of the ephydrid *Hyadina* among frequently occurring species). Forty-four species were collected by suction sampling but not by sweep netting (in these 71 samples) but, had suction sampling not been used, their apparent absence would have made little difference to conclusions reached by netting alone since they have only weak affinity to ERS. Exceptions were *Tachydromia* (discussed below) and the rare species *Asyndetus latifrons* (new to Britain), *Hyadina scutellata*, *Scatophila noctula* and *Campsicnemus pumilio*.

Since many infrequently collected species were excluded from this analysis, it underestimates the usefulness of suction sampling for the group of flies for which it was chosen – *Tachydromia*. There were indeed more captures of these species using the suction sampler, although the numbers are too small to form firm conclusions (Table 50). However, it seems very likely that suction sampling is the better method for finding these flies.

Summary

- The effectiveness of sweep-netting and suction sampling was compared using data from rivers sampled in 2005.
- The methods caught similar mean numbers of species on the Wey, Rother and Lune but sweep-netting was better on the Welsh rivers. A delay in getting the Welsh samples into a freezer for preservation was partly to blame, but inconsistencies between families suggested this was only part of the explanation.
- Slightly fewer ERS specialist were collected by suction sampling than by sweep-netting but the proportion of these species was higher in suction samples. The most serious under-sampling by netting was a few species that are reluctant to fly, as these included the ERS specialists *Tachydromia* and *Lonchoptera meijeri*.
- Most other species with moderate to high ERS fidelity were collected more consistently by netting.
- Despite suction sampling collecting a few ERS species more effectively than netting, its use represented considerable additional effort that did not add markedly to the conclusions drawn from sweep-netting alone.

Table 49. Species collected preferentially by either sweep-netting or suction sampling.

Species	ERS fidelity class	Number of occurrences		Ratio sweep/suction
		sweep	suction	
Athyroglossa ordinata	1	14	6	2.3
Athyroglossa glabra	2	40	18	2.2
Diaphorus hoffmannseggii	2	12	3	4
Hilara biseta	2	15	3	5
Hoplolabis areolata	2	12	6	2
Ditrichophora sp A	3	20	10	2
Hemerodromia unilineata	3	13	6	2.2
Hilara pseudochorica	3	47	20	2.4
Polytrichophora duplosetosa	3	12	5	2.4
Tipula couckei	3	22	3	7.3
Tipula montium	3	21	2	10.5
Lonchoptera meijeri	3	5	20	0.3

Table 50. *Tachydromia* collected by sweep and suction sampling

	ERS fidelity class	Number of occurrences		Ratio sweep/suction
		sweep	suction	
Tachydromia aemula	5	4	7	0.6
Tachydromia arrogans	5	0	3	0
Tachydromia costalis	1	4	3	1.3
Tachydromia edenensis	1	0	2	0
Tachydromia halidayi	1	0	6	0
Tachydromia morio	1	0	2	0
Tachydromia woodi	2	2	0	∞

Discussion

Overall composition

The survey confirmed the high species richness of flies at riversides. Even while deliberately avoiding densely vegetated banks and concentrating on bare or recently vegetated ERS, the survey produced about 850 species. High species richness has been found in other surveys of ERS (Rotheray & Robertson, 1993; Bell *et al*., 2004; Hewitt *et al*., 2005; Bates *et al*., 2006; Godfrey, 2006). Riversides also support higher than average numbers of nationally scarce and rare species; in this survey, these species formed between 7 and 15% of the total lists on different rivers. Surveys of SSSIs usually find about 5% of the total species list is composed of rare or scarce species.

The survey also confirmed a previous result that the two dominant families are dolichopodids and ephydrids, and that hybotids and empids are also species-rich. Dolichopodids and ephydrids were not only represented by most species overall but their average species richness was consistently high. This result is not apparent in several previous surveys, although lack of effort on ephydrids is understandable since there are so few keys to the fauna.

Although many species were found in other families, their average species richness was low. Craneflies performed most disappointingly of these families, and the result deserves some discussion since high numbers are normally found at riversides. Several reasons may explain the low numbers recorded in the present survey. The approach taken in this survey, which was to concentrate on actual riverine sediments rather than the river banks, under-sampled dense and shaded vegetation where craneflies shelter. Craneflies show strong seasonality, so a single visit can miss emerging peaks; for comparison, Hewitt *et al*. (2005) surveyed Cumbrian ERS sites from May to September and recorded 79 craneflies, with a wide range of total from individuals sites but with most supporting over 15 species, whereas scarcely more (83 in all) were found in the present survey covering a far wider range of site but visited only in July. Higher numbers were found in surveys where sampling included more stabilised riverside habitats, for example woodland and swamp that was included in a survey of the Feshie Fan on the Spey where Stubbs (1991) recorded 39 species of cranefly, although rather few at ERS. Finally, the last few years have been rather poor for craneflies (but also for other families), so part of the low catches may reflect universally low abundances.

Syrphids, sciomyzids and stratiomyids that perform well as indicators of conditions in still wetlands are of little value for evaluating ERS. They appear to be almost entirely vagrants to the ERS habitat, except perhaps for those associated with pools. The most frequent species were not wetland species but those of grasslands, such as species of *Platycheirus*, *Melanostoma* and Syrphini.

This survey did not include sphaerocerids (except on the Lune) since previous work had shown them to be of little help in interpreting the results owing to the limited understanding of their conservation status (Bell *et al.*, 2004). They were one of the most numerous families in this survey, and detailed work in the future, when they are better understood, ought to include them.

Bare shore specialists and fidelity scores

ERS scores allocated to each species appear to have been about right. For instance, it was encouraging to see that several ephydrids first recognised as being ‘bare shore’ species in a survey of Devon rivers in 2004 were found on several more rivers in the same habitat. The most noteworthy of these are *Athyroglossa ordinata* and *Hecamedoides unispinosus* as two

of the most specialised indicators. *Ditrichophora palliditarsis*, *Ditrichophora* sp A and *Polytrichophora duplosetosa* are probably better indicators than their current scores suggest.

However, given the lack of knowledge of many of the scarcer species that make up the bulk of the two highest fidelity classes, it may be sensible to use fewer classes by amalgamating classes 1 (total fidelity) and 2 (high fidelity). Since the scores are not used here to produce an overall ERS quality score, as done by coleopterists, this change simplifies describing and ranking, and reduces the scope for open-ended discussion on exactly which class to allocate a species. There are several species in class 3 (moderate fidelity) that need revising (usually downwards), and a few more that appear to warrant raising to this class (*Dolichocephala irrorata*, *Platypalpus subtilis*, *Chrysotus suave*, *Gymnoclasiopa plumosa*).

Before moving species from class to class, it is worth redefining what the classes measure. To coleopterists, ERS is a clearly understood habitat with a well defined fauna. The recent surveys of flies have shown that coleopterists' ERS is not necessarily the habitat of most interest to most rare river-edge Diptera. Rather than the huge banks of pebbles, it seems that the wet shore is the focus of the most specialised flies, with the notable exception of several *Tachydromia* and the BAP therevids. These useful shores may be next to recently re-sorted ERS but are frequently found as narrow strips at the river bank. Dipterists therefore need to be careful about their use of the term, and may need to find a new one that describes the feature of greatest value to flies but does not detract from the clear importance of genuine ERS to beetles. The rather dull term 'riverine shores' best describes the habitat without the constraint of describing whether it is vegetated or not, and does not restrict attention to large expanses of ERS. As can be seen from the pictures of examples from different rivers, some ERS can be merely a narrow shoreline exposed during low summer flows.

The term 'riverine shores' takes account of the importance of sparse or nearby vegetation. Classification show that most specialised species (in ERS fidelity classes 1-3) were richest close to the water's edge on wet sediment, and that only a short distance away on dry sediments the interest fell away markedly. Proximity to a wet shore seemed to be a more important factor than the amount of vegetation cover, although this cover clearly affected the present assemblage classification. Unlike beetles, adult flies have more complex spatial behaviour than their larvae, and many require different habitat to their larvae. Most cranefly adults, even those like *Antocha* and *Dicranota* with completely aquatic riverine larvae, rest in shady places, and this probably accounts for their scarcity in the samples in this survey. Adult *Hilara*, on the contrary, appear to spend most time at and over water but their larvae may live well away from the river. Most *Platypalpus* are found high on foliage and tall vegetation. Therefore, this vegetational element of the riverside is integral to the lives of adults associated with river shores. These are generalisation about particularly large genera and families, and more painstaking work may show that adults of 'bare shore' species really do have little need for vegetation, but this seems unlikely except for ephydrids.

ERS assemblages

The ERS beetle fauna has been classified in several studies. Sadler & Petts (2000) classified rivers in Wales and the Pennines using TWINSPAN; their groups were related principally to particle size, and secondarily to elevation. Sadler & Bell (2002) classified rivers in southwest England, Wales and the Pennines; the groups were related principally to substrate size and the amount of vegetation. Eyre & Luff (2002) used fuzzy set classification of carabids at rivers in Scotland and northern England, and their study usefully gives the quality of each group in terms of ERS fidelity and site quality scores based on the usual score per taxon of geometric scores allocated to each rarity class. Sediment composition, wetness and vegetation cover are the main controlling factors. Groups with high ERS fidelity scores for carabids were nearly all from dry places which had a large proportion of sand,

although the sediments could be mixed. These groups may or may not have had high site quality scores, so some dry sites with low ERS interest still supported good assemblages of uncommon species. Sites with lower fidelity and site quality scores tended to be damp, often with larger particles and usually with more vegetation cover. Rove beetles were also classified for these rives but no link was made with the value of each group for rare or ERS-faithful species (Eyre *et al*., 2001).

Only one attempt has been made to classify the flies of ERS. A small study of seven Devon rivers by Bell *et al*. (2004) showed that there was a major division between a water's edge assemblage and that of the drier core, and with a further distinct assemblage in scrubby areas. The water's edge assemblage was further divided in this study but no environmental variables were collected to help support or explain the distinction.

The present study appears to be only the second attempt at defining fly assemblages and describing the factors that correlate best with their occurrence. Three convincing assemblages were recognised, corresponding to the extreme water margin, wet ERS with greater physical heterogeneity and to stabilised dry vegetated ERS or river banks. The bare water's edge assemblage was least species-rich but contained a high number of ERS specialists; the 'rich wet ERS' group could be very species-rich and also rich in rare species and ERS specialists. The 'dry stabilised vegetated ERS' group could also be species-rich but was poor in ERS specialists and had large numbers of ERS-tourists. It was also the least ecologically real assemblage as it represented the over-spill from adjacent terrestrial habitat. These divisions correspond with two of those found on the Devon rivers (the main wet – dry division). Both classifications show that the water's edge assemblages contain more ERS species although not necessarily more rare and scarce species (some subgroups are especially rich in rarities, others less so). Proximity to water is therefore the overriding factor affecting the ERS quality of fly assemblages. This effect must be strong since it is clear using even such a crude collecting method as sweep-netting.

This conclusion is based on samples from stony as well as sandy rivers, and it is therefore interesting that substrate type is not the most important factor as it is for beetles. Substrate may still play a role, as hinted at by the next divisions in the classification, but, since substrate type is strongly associated with the geographical location of rivers in this survey, it was not possible to be sure that regional variation in species' occurrences rather than substrate was the overriding factor. There was a small suite of species obviously more closely associated with dry stony rather than sandy ERS, of which several *Tachydromia* are principal members (*costalis*, *edenensis*, *halidayi*) and perhaps the newly discovered dolichopodid *Asyndetus latifrons.* Certainly *Tachydromia* appear to be more species-rich and certainly more obvious in the field on stony ERS in the north of Britain than in the south and in Wales. This group may be the dipteran equivalent of the larger suite of beetles associated with drier stones.

Also in contrast to the results presented for carabids by Eyre & Luff (2002) is the response to wetness of the substrate. Wet ERS was clearly of less value to carabids but of greater value to flies. The specialists of the two orders therefore appear to require rather different elements of the riverine habitat.

The collecting strategy used in all beetle studies differs markedly from that used in the present study, and this may affect comparisons. In all beetle studies, a single sample is taken (by combining pitfall-trap, hand searching and excavation samples) to represent a single patch of ERS, whereas separate fly samples were often taken in close proximity on what appeared to be very different habitat. Had all the fly samples for a single location been lumped, it is unlikely that a pattern other than geographic location would emerge. Thus conclusions based on carabid beetles may not be directly comparable with those based on flies.

Geographic outliers

Some unexpected records were made on the Wey and Rother. The reason for having included these rivers in the survey was the outlying occurrence of *Cliorismia rustica*, but finding several other northern and western species indicated that *Cliorismia's* presence here is not the anomaly that it first appears. More such species were found on the Rother than on the Wey. They are *Hoplolabis vicina*, *Hilara albiventris*, *H. biseta*, *H. pseudochorica*, *Platypalpus melancholicus*, *Diaphorus hoffmannseggii*, *Lonchoptera meijeri* and *L. nigrociliata*. The records for *Lonchoptera meijeri* are probably the most surprising and represent a huge extension of its range, especially as it was recorded at the two extreme and one intermediate site on the Rother, and so is clearly well established here. *Platypalpus melancholicus* and *Diaphorus hoffmannseggii* were thought for many years to be confined to the Monnow, and although now known to be a little more widespread, neither would have been predicted on the Wey or Rother.

Other outlying northern and western species have been recorded in the Weald, and these include both wetland and terrestrial species, so explanations for their presence must cover a range of habitats. The mid Weald has some high land and is not necessarily 'lowland' in character, and the western Weald has a wetter climate than much of south-east England. Nutrient status may be low and more similar to western rivers; this applies particularly to the Wey as it passes through agriculturally unproductive sands where modern agriculture has had less impact than in most of the lowlands. One factor pertinent to ERS species is the river's sandy substrate which is unusual for lowland south-east England. Finally, cool springs feeding the rivers keep water temperature low locally, and may account for such species as the ERS cranefly *Hexatoma fuscipennis* on the Wey (although not recorded in this survey).

The occurrence of *Cliorismia rustica* on the Tay also represented a large extension of its range, although this was perhaps less remarkable than western species appearing in the southern lowlands. Other very rare species whose range has been extended in this survey are the 'Speyside' shore-fly *Scatella obsoleta* now shown to have a large population on the Till and also present on other Northumberland rivers, and the 'Monnow' (and latterly Devon) shore fly *Hecamedoides unispinosus* now also found in Northumberland.

Comparison with previous work

Two surveys were conducted using almost identical sampling methodology at seven rivers in Devon and two in Cheshire (Bell *et al*., 2004; Bates *et al*., 2006). Other surveys of ERS have used unstructured collecting whose results cannot be directly compared with those of timed sweep-netting targeted at small patches of ERS. General collecting (sweep-netting, hand searching) was used by Stubbs (1991) and Rotheray & Robertson (1993) along the Spey, and by Hewitt *et al*. (2005) in Cumbria. Sadler *et al*. (2000) identified flies in pitfall traps on the Welsh Severn, and Sadler & Petts (2000) used flight interception and water traps on rivers in Wales and the Pennines. Eyre (2000) used water traps in northern England and Scotland. ERS was included as part of a wider survey of the upper Dee in Highland (Godfrey, 2000) but the results list only the rare species recorded. The surveys that produced large lists of flies (Stubbs, Rotheray & Robertson) were also more general in their scope and, judging from the species lists which include many hoverflies, appeared to include habitat outside the ERS or river channel. Few environmental variables were collected in these three surveys, so no association with the habitat can be made. The surveys in which environmental variables were collected had poor results from water and pitfall traps (Eyre, Sadler *et al*., Sadler & Petts). Therefore, comparisons with these surveys has to be anecdotal.

Comparisons for ERS beetles have been facilitated by using an ERS Quality Score base on that developed for dead wood (Fowles, 1997, Sadler & Petts, 2000). A single value can then be used to compare sites or rivers. It was adapted by Hewitt *et al*. (2005) to include non-beetle ERS taxa, including flies. While appealing, the score was not used here since it relies on a fairly accurate assessment of rarity and a universally accepted list of ERS specialists, corresponding to classes 1 (total) to 3 (moderate) ERS fidelity used in this study. This information has been developed in this study (e.g. ERS fidelity scores and suggested rarity statuses for shore flies), and this has proved useful in comparing samples and sites within the same surveys. But to then use these values, not yet recognised or tested by others, to produce an ERS index would compound any errors in the suggested rarity and ERS fidelity scores.

A comparison of the numbers of species was made with two previous surveys where Martin Drake was the surveyor (Bell *et al*., 2004; Bates *et al*., 2006) (Table 51). As species richness is strongly dependent upon sampling effort, some of the figures in Table 51 are shown as graphs of the values plotted against the number of samples (Figures 26 and 27). A logarithmic line was plotted through the points excluding the Lune, Tay and Spey for all species, and a linear regression line was plotted for RDB & 'new' species and for scarce species (without excluding any rivers), since there was no justification for applying a transformed regression line. With the exception of the Lune, Tay and Spey, which were sampled by different surveyors, there appears to be almost no difference between rivers in the numbers of species they support, once sampling effort has been taken into account (the points lie close to the regression line). However, for rare, new and scarce species there are some differences that may be real. The Usk and Monnow stand out as supporting the high numbers of all these species, and most unexpectedly the Weaver was not well below the regression line, where an intuitive assessment of this rather dull river would place it. The Teign was also rather poor considering its physical attributes and exceptional ERS beetle fauna. The Lune appears to be poor on all counts, whereas the Tay and Spey are no different from average, although perhaps lower than would be expected from their reputations for ERS species.

The numbers of ERS-faithful species show a similar distribution of specialist as in the rare and scarce species (Figure 27). ERS specialists are under-represented in the Weaver, Lune and Wey, and over-represented in the Usk, Monnow and Yarty.

What emerges from these graphs, but which is not apparent in the bald totals, is that there are relatively small differences between the rivers in terms of rarity and ERS fidelity, and also that there is a wide scatter of totals that would be obscured if these rather small figure were subsumed into a single ERS quality score. No further attempt is therefore made at trying to rank these rivers.

Management advice

The project was designed to obtain information on the assemblages and BAP species of sandy ERS by choosing sites with well developed ERS. It was therefore not easy to use the data to show how some activities may have damage the interest. When this was attempted for trampling, the result was contrary to received wisdom owing to the small range of potential damage that was encompassed. Nevertheless, some over-arching points are listed here, including some that could not be deduced from the results.

Negative influences were:

- Accumulations of silt whose supply from arable run-off exacerbates siltation.

Although some scarce species showed a preference for silty deposits, rather more preferred clean sand or stones.

- Reduction in the range of particle sizes along bars. Uncommon species often showed clear preferences for different particle sizes, ranging from the need by some *Tachydromia* for large stones to fine sand or even silt by some shore flies.
- Loss of deposited sediments. Larvae of the two BAP stiletto-flies, *Cliorismia* and *Spiriverpa*, require fine loose sand which is more often found in depositing situations than eroding ones (although *Cliorismia* larvae can be frequent on eroding banks).
- Colonisation of ERS by vegetation. More of the scarcest ERS-faithful species were associated with bare or sparsely vegetated shores than with closed growths of tall herbs. There is no substitute for unvegetated ERS.
- Loss of bankside vegetation by heavy grazing. This is not contrary to the issue of colonisation of ERS but refers to the need of several riverine species for vegetated areas for resting and feeding, notable craneflies. Their needs are often met by dense vegetation growing on the stable, uneroded banks in a separate zone to the unvegetated shoreline.
- Increased nutrients leading to algal-dominated water margins. This will probably encourage common and tolerant species at the expense of specialists of barer sediments at the water margin.
- Water-borne insecticides, notably sheep-dip. The sandy deposits that formed the selection of many of the rivers in this study often coincided with sheep-farming areas where cypermethrin may lead to killing aquatic and semi-aquatic larvae of ERS flies.

These detrimental influences result primarily from:
- Changes to the natural flow regime. Regulated flows, canalisation and dredging will reduce sediment supply, re-sorting of sediments and scouring of colonising vegetation.
- Heavy disturbance by trampling, people and vehicles.
- Inappropriate farming (nutrient enrichment, sheep-dip spills).

Table 51. Comparison of rivers surveyed using timed sweep sampling by numbers of species in families and in status and ERS fidelity classes.

River	County	Status			Fidelity					No. of samples	All flies	Family												
		New	Rare	Scarce	Total - 1	High - 2	Moderate - 3	Wetland - 4	Tourist - 5			Dolichopodid.	Empididae	Ephydridae	Hybotidae	Lauxaniidae	Limoniidae	Lonchopterid.	Sciomyzidae	Sepsidae	Stratiomyidae	Syrphidae	Tephritidae	Tipulidae
Rother	Sussex/Hants	3	6	14	2	6	17	127	86	22	238	50	24	35	15	6	12	5	5	12	6	11	4	4
Wey	Surrey	3	5	10	1	6	13	147	96	23	263	54	18	38	17	9	19	4	10	8	4	14	7	6
Avon	Devon	0	1	4	2	3	6	58	39	7	110	18	6	22	3	0	4	2	1	9	0	12	2	2
Bovey	Devon	0	1	8	2	1	10	64	48	5	127	21	14	22	7	8	6	4	2	3	0	5	3	2
Bray	Devon	1	4	9	1	2	14	75	64	8	156	32	14	24	11	7	8	3	0	12	1	7	0	3
Coly	Devon	1	2	6	1	4	12	62	65	6	144	27	16	16	13	4	2	3	2	6	4	9	2	4
Culm	Devon	0	2	7	2	5	14	82	59	7	164	34	13	21	15	4	15	4	4	7	0	6	2	6
Exe 2004	Devon	0	2	7	3	1	13	62	66	8	147	25	11	21	11	3	2	4	2	8	0	9	8	3
Exe 2006	Devon	1	0	8	2	3	10	37	49	5	101	10	6	15	8	1	3	3	0	7	0	11	2	3
Mole	Devon	2	2	12	1	3	16	63	71	9	155	26	13	22	10	5	5	5	0	11	0	8	4	3
Otter	Devon	0	1	11	4	5	16	89	90	14	206	31	22	31	12	8	10	4	4	9	0	13	5	7
Teign	Devon	0	2	4	3	3	8	73	96	11	185	26	13	27	12	9	9	2	0	9	0	13	10	4
Torridge	Devon	0	1	8	4	3	8	51	41	7	109	21	11	16	7	2	6	3	2	8	0	6	1	3
Yarty	Devon	1	4	9	1	3	22	93	52	12	171	35	20	27	13	6	11	3	3	8	3	4	0	5
Usk	Gwent	2	15	19	6	11	22	121	116	24	276	46	24	38	31	5	19	4	6	12	7	12	6	7
Ysgir	Gwent	0	1	6	1	1	8	48	25	3	83	23	21	11	5	1	5	4	0	0	1	1	0	0
Monnow	Gwent	2	11	17	6	8	25	124	117	25	280	45	31	42	32	8	19	5	6	11	4	12	3	5
Bollin	Cheshire	0	5	7	3	6	17	104	64	12	196	39	19	30	19	4	18	4	3	8	4	4	0	6
Dane	Cheshire	1	4	7	3	7	15	77	62	13	165	36	18	23	18	1	9	4	2	12	4	6	0	3
Weaver	Cheshire	5	7	15	1	5	19	124	105	29	254	44	19	35	20	5	15	3	9	14	7	16	2	6
Lune 2006	Lancashire	3	2	3	3	3	6	48	76	20	137	14	6	9	9	1	2	1	0	12	5	9	2	3
Coquet	Northumberland	3	10	15	8	5	16	128	110	34	279	53	15	36	24	3	13	4	10	17	7	15	4	5
Glen	Northumberland	1	3	5	2	1	7	53	36	6	99	20	7	18	8	0	2	3	2	7	1	2	1	4
Till & Breamish	Northumberland	2	10	21	9	7	23	140	132	32	313	52	35	31	31	7	16	4	10	10	6	19	3	8

River	County	Status			Fidelity					No. of samples	All flies	Family												
		New	Rare	Scarce	Total - 1	High - 2	Moderate - 3	Wetland - 4	Tourist - 5			Dolichopodid.	Empididae	Ephydridae	Hybotidae	Lauxaniidae	Limoniidae	Lonchopterid.	Sciomyzidae	Sepsidae	Stratiomyidae	Syrphidae	Tephritidae	Tipulidae
Tay	Perthshire	0	9	8	5	6	12	71	35	17	131	38	22	16	8		13	2				3	5	8
Spey	Highland	0	7	12	4	5	15	68	31	21	136	37	20	13	14		15	2				4	2	6

Figure 26. Number of species (all, rare or scarce) plotted against number of samples for each river.

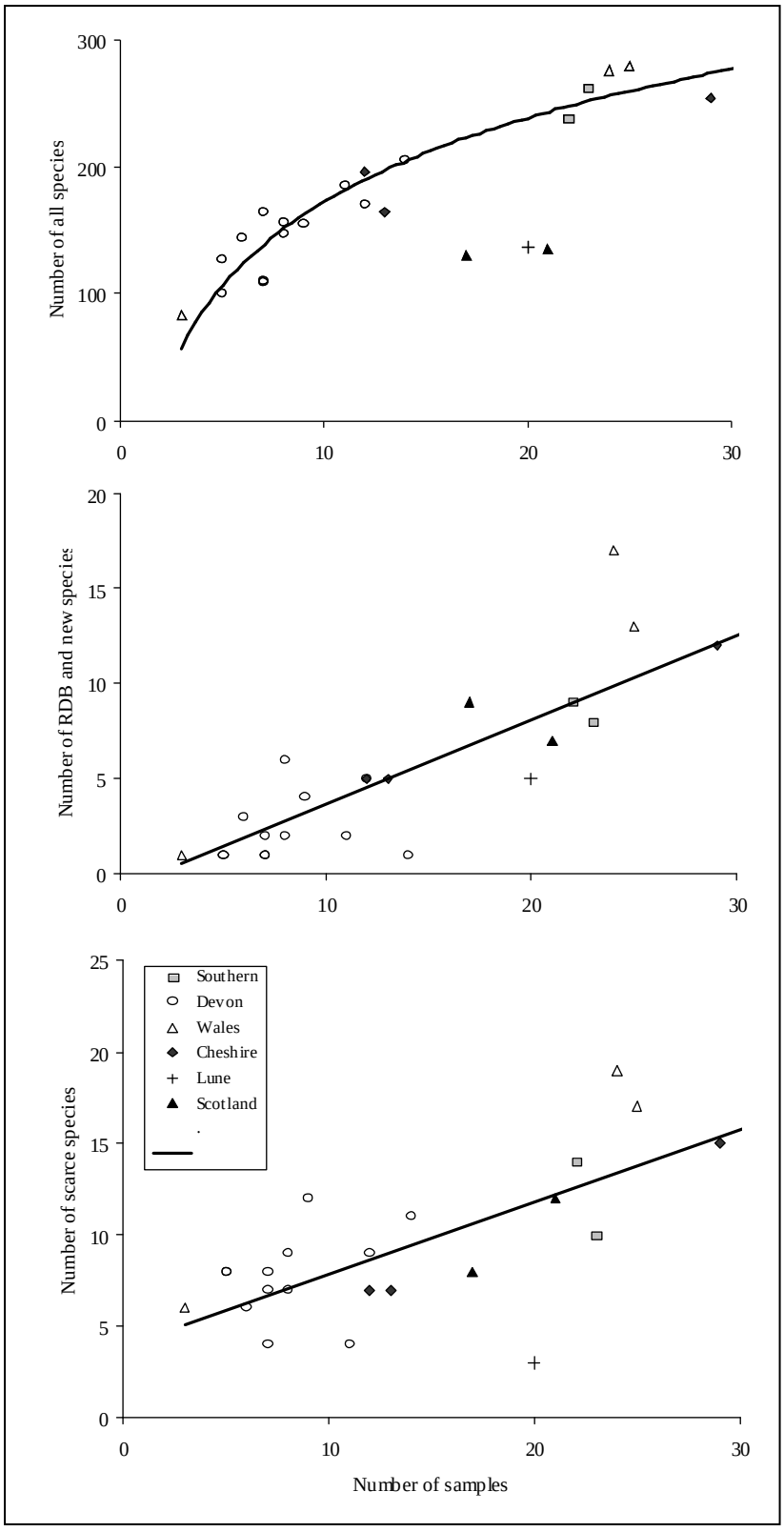
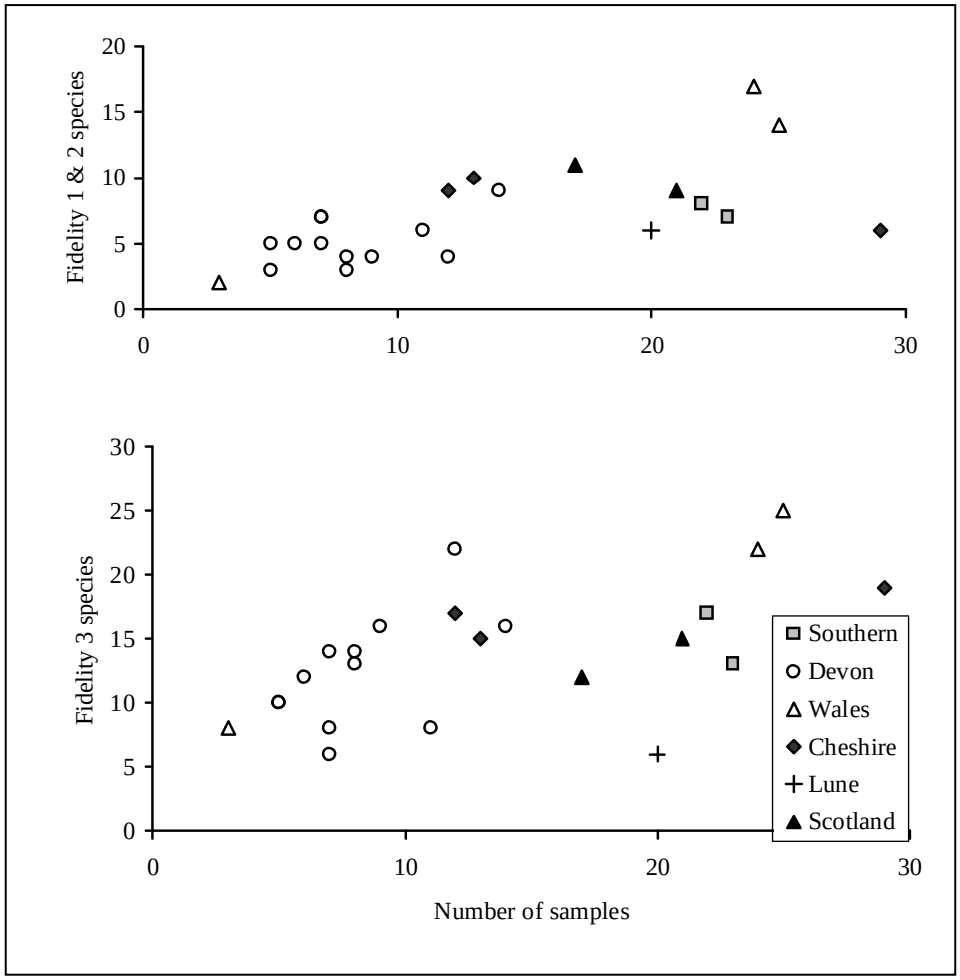


Figure 27. Number of species in ERS fidelity classes 1 + 2 and 3 plotted against number of samples for each river.



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Appendix 1. Field form used to describe each sampling point in Project 1.

Variable	Condition
Site	Sample
Grid	
Date	
Survey conditions	good OK poor sunny warm
Flow conditions	normal flow
	low flow
	in flood
	recent flooding
Current	slow medium fast
Patch size	ERS width x length
Size of river	channel width
Adjacent land use	arable pasture scrub woodland
Pollution	none abundant fil. alga
Grazing / trampling	none slight much
Stock	sheep cattle
Disturbance by people	none recreation boating
Bar type	meander bank peninsular island
ERS profile	flat gentle steep
ERS topography	simple humped complex
Position on bar	upstream side downstream 'inland'
Wetness of ERS	wet surfaces visible dry
Metres to water (min)	
Backwater and pools	slacks / pools
	backwater with full flow
	backwater with minor flow
	backwater with bed 'dry'
Substrate	boulder
	cobble
% cover	pebble
	gravel
	sand
	silt
	organic

continued

Form continued

Vegetation % cover	aquatic moss
	algae / diatoms
	bare or almost bare
	pioneer
	continuous short sward
	dense tall herb
	scrub
	tall trees
Shade % and cause	% tall herbs scrub trees
Dominant plants	

	cobbles	shingle	shingle & sand	shingle & silt	sand	silt	mud
bed							
shore							
½ up bank							
top of bank							

Appendix 2. Generalised accounts for scarce and rare species

Anagnota bicolor Diptera Anthomyzidae Notable
This is a small fly has a wide distribution in Britain where it is associated with stands of common reed (Phragmites) in marshes, and tussocks of Carex paniculata or grass away from reed (Falk & Ismay, in prep.). Its biology is uncertain but it may develop within stems or galls formed in reed and other large monocots.

Argyra auricollis Diptera Dolichopodidae Notable
A fly with a scattered distribution from central Scotland to Oxfordshire and including Wales. It is usually found in damp woodland or wooded upland valleys. It may be associated with marshy conditions.

Asyndetus latifrons Diptera Dolichopodidae New to Britain
A dolichopodid that was found in the present survey at the Lune and Coquet, in both cases on dry stony ERS.

Asyndetus latifrons Diptera Dolichopodidae New to Britain
A dolichopodid that was found in the present survey at the Lune and Coquet, in both cases on dry stony ERS.

Athyroglossa ordinata Diptera Ephydridae pRDB1
A small shore-fly recorded recently from Devon, Dyfed and Gwent and from old records in the Highlands. It has only been found at stony river margins and is has high fidelity to ERS. The larvae probably live as alga grazers at the water's edge.

Campiglossa absinthii Diptera Tephritidae Notable
A picture-wing fly recorded widely in England by more rarely in Wales and Scotland. It is usually found on saltmarshes where the larvae feed on the flower heads of sea wormwood (*Artemisia maritima*), but it also occurs inland feeding on mugwort (*A. vulgaris*). It has become more widespread recently.

Campiglossa absinthii Diptera Tephritidae Notable
This picture-winged fly is usually found on saltmarshes where the larvae feed on the flower heads of sea wormwood (*Artemisia maritima*), but it also occurs inland feeding on mugwort (A. vulgaris). It is widely distributed in England, including Wiltshire (Clemons, 1996).

Campsicnemus pumilio Diptera Dolichopodidae Notable
A small dolichopodid distributed sparsely by widely in southern England, but also found in Wales and Scotland. It is a wetland species but it preferences are unclear; habitats include river margins, pond margins and coastal sites.

Cheilotrichia imbuta Diptera Limoniidae Notable
A small cranefly mainly associated with Phalaris or Phragmites growing on river banks in sheltered situations, rarely in other wet habitats. The larvae are assumed to be semi-aquatic. Records are scattered in Britain. (Recorder, Falk, 1991).

Chelifera concinnicauda Diptera Empididae Notable
A small empid with a northern and western distribution in Britain. It is found mainly on the foliage of trees and shrubs in the vicinity of rivers and streams. The larvae may develop in mud or wet sand by the water's edge, or perhaps in wet moss.

Cliorismia rustica Diptera Therevidae RDB3
This large stiletto-fly is recorded from isolated sandy rivers in Surrey, Cheshire, Gwent and Cumbria. The larvae are predators in loose and lightly vegetated sand close to large rivers that have eroding banks or sand deposits.

Colobaea bifasciella Diptera Sciomyzidae Notable
A small snail killing fly of base-rich fens and ponds. Larvae are parasitic mainly on snails of the

family Succineidae, but in Europe it has been reared from Lymnaea palustris and L. truncatula exposed on mud. It complete 2-3 generations per year. Widespread in England and Wales but very scarce.

Colobaea punctata Diptera Sciomyzidae Notable
A small snail-killing fly whose larvae feed on aquatic snails, including Lymnaea peregra, Planorbis corneus and P. planorbis. Adults are found in lush marginal vegetation by rivers, lakes, ponds and ditches, especially those where the summer water levels drop, leaving their prey exposed on muddy shores (Falk, 1991). There are scattered records in England and Wales (Ball & McLean, 1986).

Cosmetopus dentimanus Diptera Scathophagidae RDB1
The few records of this 'dung fly' are from beside chalk rivers (Test, Itchen) in southern England. The biology is unknown but the larvae may mine within plants associated with the river margins.

Diaphorus hoffmannseggii Diptera Dolichopodidae RDB I
A moderately large dolichopodid recorded from rivers in eastern Wales and adjacent parts of England, and from isolated rivers in southern England (Wey, Rother, and in the New Forest). It is usually found at river margins with fringing alders and deposits of sand and gravels.

Diclasiopa lacteipennis Diptera Ephydridae Notable?
A small shorefly recorded in England from East Anglia to Cheshire. Most records are from river or stream margins with fine sediments but it has also been found on heathland (presumably by water). Oviposition sites are wet sand close to the water's edge.

Dicranomyia omissinervis Diptera Limoniidae RDB2
A cranefly recorded from the rivers Spey and Tay in eastern Scotland, and Wye (Worcestershire) and Usk (Gwent). It is found at sandy rivers banks within the shade of alders of willows.

Dicranomyia ventralis Diptera Limoniidae Notable
A cranefly widely distributed in Britain. Many records refer to brackish ditches on coastal grazing marshes, and inland records are from muddy, sparsely vegetated margins of lakes and ponds. Sparse emergent vegetation is probably a more necessary requirement than brackish condition. The larvae are aquatic in pools.

Dioctria cothurnata Diptera Asilidae RDB3
A robberfly recorded widely but sporadically from Dorset to the Scottish Highlands. Its habitats include glades in wet and dry woodland, and more exposed dry coastal habitats.

Dioctria oelandica Diptera Asilidae Notable
A robberfly recorded widely in Britain but absent from drier areas. It is strongly associated with oak woodland.

Diogma glabrata Diptera Cylindrotomidae Notable
A cranefly with a wide distribution, generally in the lowlands. It is usually associated with ancient deciduous damp woodlands where the larvae develop in moss.

Dioxyna bidentis Diptera Tephritidae Notable
This small picture-wing fly has a wide distribution in Britain but is recorded mostly from the southeast of England. Its larvae feed on the seedheads of Bidens tripartita (bur marigold) and can often be found whenever there are good stands of the plant.

Ditrichophora cinerella Diptera Ephydridae Notable?
A small shorefly whose distribution is unknown. It is found by rivers where the larvae may develop at the water's edge or in interstices within the gravels.

Ditrichophora longula Diptera Ephydridae Notable?
A small shorefly whose distribution is unknown but which is known from several sites in southern England and Wales. It is found in upper saltmarsh, washlands and riversides.

Ditrichophora nectens Diptera Ephydridae RDBK?

A small shore-fly recorded widely but sparsely in Britain, and may be more frequent in Scotland. It is a wetland species although its preferences are unclear. The larvae probably live as alga grazers at the water's edge.

Ditrichophora plumosa Diptera Ephydridae Notable?
A small shorefly recorded from sites in England from surrey to Cheshire. It is found in a wide variety of wetlands including sandy river margins, silty pond margins, by spring and seepages and sometimes in fens.

Ditrichophora sp A Diptera Ephydridae New to Britain
A small shore-fly recognised as new to Britain in 2005, recorded at several rivers (Wey, Rother, Monnow and Usk). It has been confused with D. palliditarsis and is probably more widespread. It appears to be associated with sandy and stony river margins, and probably has moderately high fidelity to ERS. The larvae probably live as alga grazers at the water's edge.

Ditrichophora sp B Diptera Ephydridae New to Britain

Dolichopus argyrotarsis Diptera Dolichopodidae Notable
A fly recorded mainly in Scotland but also from English counties southwards to Cornwall, and Wales. It is riparian and the larvae are probably semi-aquatic predators at water margins.

Eloeophila apicata Diptera Limoniidae Notable
A cranefly with a widespread but extremely local distribution with a southern and western bias. It is found by shaded streamsides. The larvae probably develop in stream sediments.

Eloeophila mundata Diptera Limoniidae Notable
A moderately large cranefly widely distributed in Scotland, northern England, Wales and the Welsh borders as far south as the Forest of Dean. It is found by streams in upland or hilly country, usually where partly shaded by alders, but sometimes by exposed streams. The larvae probably develop in stream sediments.

Eutolmus rufibarbis Diptera Asilidae pRDB3
A large robberfly confined to sandy heaths in the south-east of England in Surrey, West Sussex, the New Forest and the Weald in Hampshire and the Breck in East Anglia. There are sparse occasional records outside of these areas, including one in Oxfordshire where it was rediscovered after a long absence.

Eutolmus rufibarbis Diptera Asilidae pRDB3
A large robberfly confined to sandy heaths in the south-east of England in Surrey, West Sussex, the New Forest and the Weald in Hampshire and the Breck in East Anglia. There are sparse occasional records outside of these areas, including one in Oxfordshire where it was rediscovered after a long absence.

Gonomyia bifida Diptera Limoniidae Notable
This small cranefly is widely distributed in southern England, and with sparse records in Wales. It is found by small streams and seepages in wet usually calcareous woods. The larvae probably develop in wet soil beside streams and seepages.

Gymnoclasiopa collini Diptera Ephydridae Notable?
A small shore-fly recorded widely but sparsely in England and Wales. It is a wetland species but its habitat preferences are unclear. They include river margins in western Britain. The larvae probably live as alga grazers at the water's edge.

Gymnoclasiopa plumosa Diptera Ephydridae Notable?
A small shore-fly recorded widely but sparsely in England and Wales. It is a wetland species but its habitat preferences are unclear. They include sandy river margins in southern Britain. The larvae probably live as alga grazers at the water's edge.

Gymnosoma rotundatum Diptera Tachinidae pRDB3

Gymnosoma rotundatum Diptera Tachinidae pRDB3
A parasitic fly recorded in south-east England (Kent, Surrey, Sussex). The larvae parasitise the shield bug Palomena. It is found in dry sandy areas on downland and heathland with isolated shrubs.

Hecamedoides unispinosus Diptera Ephydridae RDB2?
A small shore-fly recorded recently from Devon and Gwent; the only previous records are from the R. Monnow. It has only been found at sandy and stony river margins, and is has high fidelity to ERS. The larvae probably live as alga grazers at the water's edge.

Heleodromia irwini Diptera Empididae RDB1
A small empid recorded from a few sites in Scotland Rivers (Spey, Dee and Lui, and Glen Derry). Adults are found around bare shingle and sand at the margins of fast-flowing streams. The adults may develop as predators in streamside sand, shingle or vegetation.

Hercostomus plagiatus Diptera Dolichopodidae Notable
A small, metallic green, predacious fly, recorded from a wide range of wetland habitats including fens, damp woods and coastal localities such as grazing marsh and cliff seepages. The larvae are probably semi-aquatic carnivores. Widespread but very local in southern England north to Yorkshire, Wales and southern Scotland.

Hilara aartseni Diptera Empididae New to Britain
This dance fly was recorded new to Britain from the River Rother and R. Wey in southern England in 2005. It was frequent and widely distributed on these rivers, which pass through sandy floodplains.

Hilara albiventris Diptera Empididae Notable
A dance fly widely distributed in Britain and found mainly in the west and north, with isolated occurrences in southern England. It is restricted to fast-flowing streams and rivers. The larvae are probably predators in wet sediment at the water's edge.

Hilara biseta Diptera Empididae Notable
Records are widely distributed in Britain. It is found mainly by river banks and may have affinity with exposed riverine sediment. The larvae are probably predatory in wet mud at the river's edge.

Hilara diversipes Diptera Empididae Notable
An empid with a northern and western distribution in Britain. It is found by rivers and streams in wooded valleys. The larvae may develop in damp mud or perhaps in wet moss.

Hilara media Diptera Empididae Notable
A small predatory dance fly. Most records are from the margins of streams or rivers with some shade or adjacent woodland. The larvae probably develop in damp mud beside such streams. The species has a typically northern and western distribution, including south-west England, Wales and western Scotland (Falk & Crossley, 2005).

Hilara pseudochorica Diptera Empididae Notable
An empid fly likely to be found swarming over water. It is widespread in Britain, mainly in the west and north but also from lowland England. Falk & Crossley (2005) give the habitat as river banks, field dykes or other types of waterways where overhanging foliage of trees or shrubs may be required by the adults for courtship and predation. Plant (2003) suggests that it has an obligatory association with stream and river gravels.

Hilara setosa Diptera Empididae RDB2
An empid recorded from several rivers in eastern Scotland and from Yorkshire and Durham. It appears to be associated with shaded streams and rivers. The larvae probably develop in mud beside flowing water.

Hilara tenella Diptera Empididae New to Britain
An empid recorded new to Britain from the R. Wey in 2005, and recorded the following year from a

pond within 1kilometre of the R. Rother.

Homoneura limnea Diptera Lauxaniidae RDB2
The records are confined to the Welsh borders (R. Monnow), eastern Wales (R. Usk) and dune sites in Wales. There may be an association with willows growing by water on sand, as records include this habitat at dune slacks and river margins. The larvae probably feed on decaying leaves.

Homoneura thalhammeri Diptera Lauxaniidae Notable
Records are scattered widely in England as far north as Yorkshire, south Wales and Skokholm Island, Pembrokeshire. Adults appear to show a preference for scrub of sallow and other Salix species on disturbed sites. The larvae probably feed on decaying leaves.

Hoplolabis yezoana Diptera Limoniidae RDBK
This yellow cranefly was recorded new to Britain in 2004 from Cumbria, and was found again on sandy rivers in Cheshire and Gwent in 2005. It appears to be associated with sandy and silty shores of riverine deposits.

Hyadina scutellata Diptera Ephydridae RDB2?
A small shore-fly that appears to be very rare, with no published recorded. It was recorded recently on sparsely vegetated sandy ERS by the River Usk, Gwent. Commoner species in the genus are found in damp places and wetlands.

Hydrophorus viridis Diptera Dolichopodidae RDB3
The records are widely scattered in the southern half of England. It is a wetland species but its preferences are unclear; site include coastal soft-rock seepages and a scrape in a gravel pit.

Laphria flava Diptera Asilidae RDB3
A large robberfly found in the Scottish Highlands, mainly in the Spey and Dee valleys and in Culbin Forest. Its larvae develop as predators in the decaying stumps of old Scots pines.

Limnophila pictipennis Diptera Limoniidae pRDB2
Limnophila pictipennis is an moderately large and attractively marked cranefly with a predominantly southern distribution from Devon to Cambridgeshire, and with isolated records to Yorkshire. Its habitats include coastal marshes and inland gravel pits and fens, and rich marginal vegetation next to ponds and ditches may be a requirement. The larvae are probably aquatic.

Limnop*hora scrupulosa* Diptera Muscidae Notable
A local muscid fly recorded widely in Britain. The larvae are predators probably inhabiting running water in a range of situations including woods, dunes, upland areas and in around old gravel pits.

Limonia trivittata Diptera Limoniidae Notable
A cranefly recorded widely in Britain. It is found in wet woodlands on calcareous soils, especially beside rivers. The larval biology is unknown but there seems to be a partial association with butterbur, Petasites hybridus, and the larvae may develop in petioles or rootstocks.

Lispocephala spuria Diptera Muscidae Notable
A muscid fly with a wide distribution in England and Wales, and more restricted in Scotland. It is found by deciduous woodland by running water. The larvae may develop in running water among mosses.

Lonchoptera meijeri Diptera Lonchopteridae Notable
It is recorded widely in upland areas from the central Highlands to Devon, with a marked western distribution. It was recently recorded on the Rother in West Sussex. It is closely associated with river margins and may have some affinity with vegetated river gravels.

Lonchoptera nigrociliata Diptera Lonchopteridae Notable
Records are widely distributed in Britain. It is found at shaded streams and river banks where the larvae develop under stones at the water's edge. It is clearly a species of exposed riverine sediment.

Lonchoptera scutellata Diptera Lonchopteridae Notable
This is a small yellow pointed-wing fly found in fens, swampy margins of ponds and rivers and other base-rich wetlands with abundant large Carex species. Its distribution is mainly in a band from Norfolk to Hampshire, following base-rich geology (as with *Vertigo moulinsiana*).

Melanochaeta pubescens Diptera Chloropidae Notable
A small fly found in brackish coastal levels and wetlands near the coast where Phragmites grows. Its biology is unknown, but it is probably phytophagous and seemingly with a requirement for Phragmites beds. It is mainly a coastal species of southern England, ranging from Cornwall to Kent, and also Carmarthenshire in Wales, but with a concentration of records in the Essex and Thames Estuary coastal marshes. There is a very old (1860) inland record for Chippenham Fen which requires confirmation.

Melanostolus melancholicus Diptera Dolichopodidae pRDB3
A small dolichopodid that appears to have undergone an expansion in range since 1970, and is now recorded from southern England, Wales and an isolated occurrence in Yorkshire. It appears to have two principal habitats, and is found mainly at coastal seepages or by stony rivers with exposed gravels and sands, although it has also been found at a gravel pit which shares the same microhabitat features.

Meonura anceps Diptera Carnidae New to Britain
A tiny fly recorded new to Britain in 2005 from specimens collected at the River Lune, Lancashire, on stony ERS.

Micropeza lateralis Diptera Micropezidae Notable
A stilt-fly recorded mainly in south-east England but also from Yorkshire and north-east Scotland. It is found mainly on heathland, usually preferring lush damper areas near trees and bushes or beside streams. It is occasionally found on chalk or fixed dunes. Several records suggest a close association with bushes of broom.

Neoascia geniculata Diptera Syrphidae Notable
This small hoverfly is widespread in Britain, occurring at the margins of ponds and ditches where there is lush vegetation such as Glyceria maxima. It seems to be too frequent to warrant Notable status.

Nephrotoma dorsalis Diptera Tipulidae Notable
A large cranefly recorded sparsely in southern and western England and Wales, but more widely in Scotland. Most records are from shaded sandy river banks.

Oxycera morrisii Diptera Stratiomyidae Notable
This soldierfly is widely distributed in lowland areas of England, Wales and southwest Scotland. It is found in a variety of wetlands but usually in seepages where its larvae live in the shallow film of water (Stubbs & Drake, 2001).

Oxycera terminata Diptera Stratiomyidae RDB2
This soldierfly is sparsely distributed in England from Dorset to Northamptonshire, but is most frequently found in the Monnow valley on the Gwent/Herefordshire border. Adults are found by lightly shaded streams and sandy rivers, and larvae are found under wet stones and in sediment at the water's edge where they live as amphibious detritivores.

Parhelophilus consimilis Diptera Syrphidae RDB2
A hoverfly recorded widely but patchily in Britain northwards to southern Scotland. Adults are associated with accumulations of wet decaying matter, particularly Typha, in eutrophic bogs and occasionally in fens. The larvae are aquatic.

Pherbellia brunnipes Diptera Sciomyzidae Notable
A snail-killing fly most frequently recorded from the highlands of Scotland and from the coastal marshes of the Thames and Severn Estuaries. It lives in marshy areas and temporary pools in a variety of wetlands including fens, acid bogs, dune slacks, coastal levels and damp woodland. The larvae are probably parasitoids of aquatic pulmonate snails.

Pherbellia nana Diptera Sciomyzidae Notable
A widely distributed snail-killing fly but with nearly all records from the eastern part of England. It has been recorded in Anglesey and Glamorganshire. Adults occur at a wide range of wetlands including open marshes, forest pools, lake margins and wet dune slacks. Both permanent and temporary water bodies are used but those that dry out in summer and have sparse reed appear to be preferred. The larvae are parasitoids of several water and wetland snails (Ball & McLean, 1986; Falk, 1991).

Pilaria fuscipennis Diptera Limoniidae Notable
A cranefly. Adults are associated with bare wet peat in alder carr and damp woods, especially around seepages. Its distribution is mainly in southern counties from Cornwall to Kent, with some sites in Wales, northern England, but it is rare in Scotland. Larvae live in saturated, humic mud.

Pilaria meridiana Diptera Limoniidae Notable
A cranefly with a northern and western distribution. It is found in alder carr and wet woodlands, and more rarely in the open. The larvae probably develop in wet mud or peat.

Platypalpus ?velocipes Diptera Hybotidae New to Britain

Platypalpus articulatoides Diptera Hybotidae Notable
A small hybotid recorded from several counties in eastern and northern England, and eastern Wales. It has been found in a range of dry and wet places and its habitat preferences are unclear.

Platypalpus articulatus Diptera Empididae Notable
Avery small predatory dance fly found rarely on ground vegetation and low bushes. Falk & Crossley (2005) give a wide British distribution. Most records are from wetlands, including fen and damp heathland.

Platypalpus biapicalis Diptera Hybotidae Notable
A small hybotid recorded only from a wet woodland in Dorset. There is uncertainty about the identity of this species which may be undescribed.

Platypalpus luteolus Diptera Empididae Notable
Falk & Crossley (2005) give a wide English distribution. Tree-fringed upland rivers and broadleaved woodlands appear to be the main habitats.

Platypalpus melancholicus Diptera Hybotidae pRDB3
A small hybotid recorded mainly from eastern Wales and adjacent England, and two rivers in north-east Scotland. There is one remarkable record from the Rother in West Sussex. Most records are from river banks, and the species possibly has affinity with exposed riverine sediments.

Platypalpus subtilis Diptera Hybotidae Notable
A small hybotid recorded almost exclusively from the English/Welsh border and from Yorkshire. Most records are from riverside localities but also from woodland ones away from rivers. It may have affinity with exposed riverine sediments.

Polytrichophora duplosetosa Diptera Ephydridae RDB3?
A small shore-fly recorded widely but sparsely in England and Wales. It appears to have at least moderate affinity to ERS or river margins, where many recent records have been made. The larvae probably live as alga grazers at the water's edge.

Psacadina verbekei Diptera Sciomyzidae Notable
This is a frequently encountered snail-killing fly of a range of wetlands such as swamps, fens and pond and river margins where its larvae feed on aquatic or amphibious snails (notably in the genus Lymnaea) (Falk, 1991). The species is widespread in England and Wales (Ball & McLean, 1986)

Rhabdomastix inclinata Diptera Limoniidae pRDB2
A cranefly recorded from Yorkshire, Radnorshire and Glen Quick near Cairngorm. The adults are

found at streamsides, possibly only under trees. The larvae are probably aquatic.

Rhamphomyia lamellata Diptera Empididae Notable
A small predatory fly, widely distributed but very local in England and Wales and perhaps associated with damp woodlands or wetlands. Falk & Crossley (2005) suggest that fens may be an important habitat for this species.

Rhaphium fractum Diptera Dolichopodidae Notable
A small fly found widely in Britain. Its habitats include river banks and river shingle.

Rhaphium micans Diptera Dolichopodidae Notable
Medium sized metallic fly. Mainly found in the south but records extend northwards to Dunbarton. Widespread but scarce.

Rhaphium rivale Diptera Dolichopodidae Notable
Medium sized metallic fly of northern riverbanks, known mainly from Scotland where it may be abundant.

Rhaphium sp Diptera Dolichopodidae New to Britain
This species was recorded new to Britain from single sites on the River Dane, Cheshire, and R. Usk, Gwent, in 2005. The habitat was wet sandy shore with adjacent dense vegetation.

Sapromyza albiceps Diptera Lauxaniidae Notable
A small yellow fly. Records are scattered widely in southern England north to Warwickshire and Norfolk, and with a few records in Wales and north to the top of Scotland. The habitat is damp broadleaved woodland but it has also been found in hedgerows and limestone scrub. The larvae of this family develop in decaying vegetable matter including fallen leaves.

Sapromyza opaca Diptera Lauxaniidae Notable
A fly widely distributed in southern England and Wales and with one Scottish record. Most records are associated with woodland or established scrub. The larvae probably develop in decaying leaves.

Scatella obsoleta Diptera Ephydridae RDB2
A small shorefly recorded from Rivers Spey and Tay in the Central Highlands of Scotland and in 2006 from the Till and Coquet in Northumberland. The habitat is sandy or cobbly shores. The larvae are probably amphibious at the water's edge or among interstices.

Scatella silacea Diptera Ephydridae Notable
A small shore-fly recorded widely in England (and probably more widespread). It is mostly found on brackish coastal sites and on soft sediments of stream and river banks. The status is provisionally allocated by C. M. Drake.

Scatophila noctula Diptera Ephydridae Notable?
A small shore-fly with no published British records and with an unknown distribution.

Scatophila unicornis Diptera Ephydridae RDBK?
A small shore-fly with few published British records and with an unknown distribution.

Spiriverpa lunulata Diptera Therevidae RDB3
This stiletto-fly is recorded mainly from rivers in the Scottish Highlands but also in western counties of England and Wales. It lives by larger stony or sandy rivers and larger streams, but also by moorland streams in Scotland. The larvae are predators in loose sediment deposited recently by the river.

Stegana nigrithorax Diptera Drosophilidae Notable
A small fly found in woodland, mainly beech woods, where it breeds in decaying bark bearing the fungus Hypoxylon fragiforme. Adults are usually found around decaying logs and stumps. Recorded mainly in southern England, with isolated northern records from Westmorland and Dunbartonshire (Falk & Ismay, in prep.).

Tabanus cordiger Diptera Tabanidae Notable
A large horsefly found throughout Britain. The larvae are aquatic in streams and rivers.

Tachydromia costalis Diptera Hybotidae pRDB3
A small hybotid recorded sparsely in England and Wales. It is usually associated with rivers, and may prefer partially vegetated sandy ERS or with dappled shade. The larvae are probably predators living in damp sediment.

Tachydromia edenensis Diptera Hybotidae RDBK
A small hybotid described new to science in 2005 from records made in Cumbria; it has since been found by the R. Usk, Gwent. It is strongly associated with the ERS of stony rivers. The larvae are probably predators living in damp sediment.

Tachydromia halidayi Diptera Hybotidae Notable
A small hybotid recorded sparsely in western Britain, but mainly in Scotland. It is associated with medium grade riverine shingle banks. The larvae are probably predators living in damp sediment.

Tachydromia woodi Diptera Hybotidae RDB I
A small hybotid recorded only from rivers in eastern Wales and adjacent parts of England, Yorkshire and from Scotland. It is associated with river shingle or sandy banks. The larvae are probably predators living in damp sediment.

Tetanocera punctifrons Diptera Sciomyzidae Notable
A snail-killing fly found in wetlands, often in damp woods near running water, riversides, damp heathland and coastal marshes. The larvae are most probably parasitoids of snails, but it is not known whether these are aquatic or terrestrial snails. The records are very widely distributed in Britain although records seem to be mainly southern (Ball & McLean 1986, Falk 1991).

Themira biloba Diptera Sepsidae pRDBK
A lesser dung fly recorded from East Anglia where it was associated with the guano of a coot's nest. It may be restricted to waterfowl droppings in which its larvae develop.

Themira gracilis Diptera Sepsidae Notable
A small black fly which has been found at riverside watering places where cattle trample dung into wet mud. Rare and possibly northern, but there is a single record from N. Hants. Falk & Ismay (in prep.) gave the habitat as grazed cattle marshes, cattle-trampled streams and *Sphagnum* moors.

Wiedemannia phantasma Diptera Empididae RDB3
An empid recorded only in eastern Scotland along the River Spey and its tributaries and from the River Blackwater and at Nairn. Its habitat is boulder-strewn rivers banks and shingle. The larvae are probably aquatic, living in wet moss.

Appendix 3. River, site, sample and grid reference.

River	Site	River number	Site number	Sample	Grid reference
Wey	Bordon	1	1	1	SU80313574
Wey	Bordon	1	1	2	SU80103579
Wey	Bordon	1	1	3	SU80173609
Wey	Bordon	1	1	4	SU80173612
Wey	Frensham	1	2	1	SU83814175
Wey	Frensham	1	2	2	SU83814175
Wey	Frensham	1	2	3	SU83934142
Wey	Frensham	1	2	4	SU83644106
Wey	Frensham	1	2	5	SU83764130
Wey	Tilford	1	3	1	SU87294378
Wey	Tilford	1	3	2	SU87034394
Wey	Tilford	1	3	3	SU86904421
Wey	Tilford	1	3	4	SU86884427
Wey	Tilford	1	3	5	SU86884427
Wey	Tilford	1	3	6	SU86984397
Wey	Tilford	1	3	7	SU86834288
Wey	Thundry	1	4	1	SU89454392
Wey	Thundry	1	4	2	SU89624384
Wey	Thundry	1	4	3	SU89784388
Wey	Eashing	1	5	1	SU947438
Wey	Eashing	1	5	2	SU947438
Wey	Eashing	1	5	3	SU94474358
Wey	Eashing	1	5	4	SU944435
Rother	Adhurst	2	1	1	SU76702562
Rother	Adhurst	2	1	2	SU76702555
Rother	Adhurst	2	1	3	SU76522540
Rother	Adhurst	2	1	4	SU764253
Rother	Adhurst	2	1	5	SU764253
Rother	Adhurst	2	1	6	SU764253
Rother	Petersfield	2	2	1	SU76912320
Rother	Habin	2	3	1	SU79842312
Rother	Habin	2	3	2	SU79352337
Rother	Habin	2	3	3	SU79352337
Rother	Habin	2	3	4	SU79952313
Rother	Habin	2	3	5	SU80312280
Rother	Habin	2	3	6	SU80312280
Rother	Habin	2	3	7	SU80472277
Rother	Habin	2	3	8	
Rother	Woolbeding	2	4	1	SU86812227
Rother	Woolbeding	2	4	2	SU873220
Rother	Woolbeding	2	4	3	
Rother	Woolbeding	2	4		
Rother	Cowdray	2	5	1	SU89102165
Rother	Cowdray	2	5	2	SU89132182
Rother	Shopham	2	6	1	SU98310883
Rother	Shopham	2	6	2	SU98310883
Rother	Shopham	2	6	3	SU98371858
Rother	Shopham	2	6	4	SU98501848

River	Site	River number	Site number	Sample	Grid reference
Rother	Shopham	2	6	5	***
Ysgir	Ysgir	3	1	1	SN99213349
Ysgir	Ysgir	3	1	2	SN99353351
Ysgir	Ysgir	3	1	3	SN99453338
Usk	Scethrog	4	2	1	SO10592433
Usk	Scethrog	4	2	2	SO10592433
Usk	Scethrog	4	2	3	SO10592433
Usk	Scethrog	4	2	4	SO10622434
Usk	Scethrog	4	2	5	SO10622434
Usk	Scethrog	4	2	6	SO10662437
Usk	Scethrog	4	2	7	SO10622434
Usk	Scethrog	4	2	8	SO10632443
Usk	Great Hardwick	4	3	1	SO31531076
Usk	Great Hardwick	4	3	2	SO31531076
Usk	Great Hardwick	4	3	3	SO31431086
Usk	Great Hardwick	4	3	4	SO31431086
Usk	Great Hardwick	4	3	5	SO31431086
Usk	Great Hardwick	4	3	6	SO31491080
Usk	Great Hardwick	4	3	7	SO30951096
Usk	Great Hardwick	4	3	8	SO30861094
Usk	Llanvihangel	4	4	1	SO34320893
Usk	Llanvihangel	4	4	2	SO34310895
Usk	Llanvihangel	4	4	3	SO34290892
Usk	Llanvihangel	4	4	4	SO34200892
Usk	Llanvihangel	4	4	5	SO34130902
Usk	Llanvihangel	4	4	6	SO34420890
Usk	Llanvihangel	4	4	7	SO34420890
Usk	Llanvihangel	4	4	8	SO34540888
Monnow	Alltyrynys	5	1	1	SO33172347
Monnow	Alltyrynys	5	1	2	SO33172347
Monnow	Alltyrynys	5	1	3	SO33172347
Monnow	Alltyrynys	5	1	4	SO33202376
Monnow	Alltyrynys	5	1	5	SO33202376
Monnow	Alltyrynys	5	1	6	SO33202369
Monnow	Alltyrynys	5	1	7	SO33202369
Monnow	Maerdy	5	2	1	SO370247
Monnow	Maerdy	5	2	2	SO370247
Monnow	Maerdy	5	2	3	SO37252497
Monnow	Maerdy	5	2	4	SO37252497
Monnow	Maerdy	5	2	5	SO37252497
Monnow	Monmouth Cap	5	3	1	SO40092614
Monnow	Monmouth Cap	5	3	2	SO40092614
Monnow	Kentchurch	5	4	1	SO40632567
Monnow	Kentchurch	5	4	2	SO40632567
Monnow	Kentchurch	5	4	3	SO40632567
Monnow	Kentchurch	5	4	4	SO40632567
Monnow	Kentchurch	5	4	5	SO40712571
Monnow	Skenfrith	5	5	1	SO46422048
Monnow	Skenfrith	5	5	2	SO46422048
Monnow	Skenfrith	5	5	3	SO46422048
Monnow	Skenfrith	5	5	4	SO46342044
Monnow	Skenfrith	5	5	5	SO46092038

River	Site	River number	Site number	Sample	Grid reference
Monnow	Skenfrith	5	5	6	SO46092038
Lune	Lower Broomfield	6	1	1	SD59827273
Lune	Lower Broomfield	6	1	2	SD59787268
Lune	Lower Broomfield	6	1	3	SD59847274
Lune	Lower Broomfield	6	1	4	SD59877272
Lune	Lower Broomfield	6	1	5	SD59677256
Lune	Arkholme	6	2	1	SD58847156
Lune	Arkholme	6	2	2	SD58857154
Lune	Arkholme	6	2	3	SD58697136
Lune	Arkholme	6	2	4	SD58697136
Lune	Arkholme	6	2	5	SD58577125
Lune	Gressingham	6	3	1	SD58126979
Lune	Gressingham	6	3	2	SD58136978
Lune	Gressingham	6	3	3	SD58126976
Lune	Gressingham	6	3	4	SD58106980
Lune	Gressingham	6	3	5	SD58116983
Lune	Caton	6	4	1	SD53996527
Lune	Caton	6	4	2	SD53996527
Lune	Caton	6	4	3	SD53916528
Lune	Caton	6	4	4	SD53936527
Lune	Caton	6	4	5	SD53866531
Weaver	Coole Hall	7	1	1	SJ66004579
Weaver	Coole Hall	7	1	2	SJ66004579
Weaver	Coole Hall	7	1	3	SJ65904579
Weaver	Coole Hall	7	1	4	SJ65904579
Weaver	Coole Hall	7	1	5	SJ65964596
Weaver	Coole Hall	7	1	6	SJ65964596
Weaver	Coole Hall	7	1	5&6	SJ65964596
Weaver	Dairy Farm	7	2	1	SJ67144814
Weaver	Dairy Farm	7	2	2	SJ67144814
Weaver	Dairy Farm	7	2	3	SJ67174805
Weaver	Dairy Farm	7	2	4	SJ67174805
Weaver	Dairy Farm	7	2	5	SJ67024758
Weaver	Dairy Farm	7	2	6	SJ67024758
Weaver	Dairy Farm	7	2	7	SJ66994778
Weaver	Dairy Farm	7	2	8	SJ67104844
Weaver	Dairy Farm	7	2	9	SJ67104844
Weaver	Batherton	7	3	1	SJ68685008
Weaver	Batherton	7	3	2	SJ68685008
Weaver	Batherton	7	3	3	SJ65714998
Weaver	Batherton	7	3	4	SJ65714998
Weaver	Batherton	7	3	5	SJ65884480
Weaver	Batherton	7	3	6	SJ65884480
Weaver	Batherton	7	3	7	SJ66354954
Weaver	Batherton	7	3	8	SJ66354954
Weaver	Mile End	7	4	1	SJ65795429
Weaver	Mile End	7	4	2	SJ65795429
Weaver	Mile End	7	4	3	SJ66045461
Weaver	Mile End	7	4	4	SJ66045461
Weaver	Mile End	7	4	5	SJ66345503
Weaver	Mile End	7	4	6	SJ66345503
Weaver	Mile End	7	4	7	SJ65545425

River	Site	River number	Site number	Sample	Grid reference
Weaver	Mile End	7	4	8	SJ65475423
Bray	Bray Bridge	8	1	1	SS67472607
Bray	Bray Bridge	8	1	2	SS67472607
Bray	Bray Bridge	8	1	3	SS67472607
Bray	Bray Bridge	8	1	4	SS67462597
Bray	Bray Bridge	8	1	5	SS67462597
Bray	Bray Bridge	8	1	6	SS67462597
Bray	Bray Bridge	8	1	7	SS67532571
Bray	Bray Bridge	8	1	8	SS67532571
Mole	Meethe	9	1	1	SS67702293
Mole	Meethe	9	1	2	SS67702293
Mole	Meethe	9	1	3	SS67702293
Mole	Meethe	9	1	4	SS67702293
Mole	Meethe	9	1	5	SS67822290
Mole	Meethe	9	1	6	SS67822290
Mole	Meethe	9	1	7	SS67822290
Mole	Meethe	9	1	8	SS67822290
Mole	Meethe	9	1	9	SS67822290
Exe	Thorverton Weir	10	1	1	SS935018
Exe	Thorverton Weir	10	1	2	SS935018
Exe	Thorverton Weir	10	1	3	SS935018
Exe	Thorverton Weir	10	1	4	SS93550204
Exe	Thorverton Weir	10	1	5	SS93550204
Coly	Heathayne	11	1	1	SY23899428
Coly	Heathayne	11	1	2	SY23899428
Coly	Heathayne	11	1	3	SY23809429
Coly	Heathayne	11	1	4	SY23809429
Coly	Heathayne	11	1	5	SY23669428
Coly	Heathayne	11	1	6	SY23669428
Coly	Heathayne	11	1	7	SY23339422
Yarty	Bowditch Farm	12	1	1	ST25560605
Yarty	Bowditch Farm	12	1	2	ST25520596
Yarty	Bowditch Farm	12	1	3	ST25520596
Yarty	Bowditch Farm	12	1	4	ST25460592
Yarty	Bowditch Farm	12	1	5	ST25460592
Yarty	Bowditch Farm	12	1	6	ST25420581
Yarty	Bowditch Farm	12	1	7	ST25420581
Yarty	Bowditch Farm	12	1	8	ST25490570
Yarty	Bowditch Farm	12	1	9	ST25490570
Yarty	Bowditch Farm	12	1	10	ST25540554
Yarty	Bowditch Farm	12	1	11	ST25540554
Yarty	Bowditch Farm	12	1	12	ST25540554
Till	Bewick Bridge	13	2	1	NU05732242
Till	Bewick Bridge	13	2	2	NU05732242
Till	Bewick Bridge	13	2	3	NU05732242
Till	Bewick Bridge	13	2	4	NU05802242
Till	Bewick Bridge	13	2	5	NU05802242
Till	Bewick Bridge	13	2	6	NU05802242
Till	Bewick Bridge	13	2	7	NU05942250
Till	Bewick Bridge	13	2	8	NU05942250
Till	Doddington Bridge	13	3	1	NT99443089
Till	Doddington Bridge	13	3	2	NT99443089

River	Site	River number	Site number	Sample	Grid reference
Till	Doddington Bridge	13	3	3	NT99443089
Till	Doddington Bridge	13	3	4	NT99443089
Till	Doddington Bridge	13	3	5	NT99173127
Till	Doddington Bridge	13	3	6	NT99173127
Till	Doddington Bridge	13	3	7	NT99173127
Till	Doddington Bridge	13	3	8	NT99813080
Till	Doddington Bridge	13	3	9	NT99813080
Till	Doddington Bridge	13	3	10	NT99813080
Till	Doddington Bridge	13	3	11	NT99813080
Till	Doddington Bridge	13	3	12	NT99813080
Breamish	Brandon	14	1	1	NU03491681
Breamish	Brandon	14	1	2	NU03491681
Breamish	Brandon	14	1	3	NU03551683
Breamish	Brandon	14	1	4	NU03621695
Breamish	Brandon	14	1	5	NU03611692
Breamish	Brandon	14	1	6	NU03611692
Breamish	Brandon	14	1	7	NU03601690
Breamish	Brandon	14	1	8	NU03601690
Breamish	Brandon	14	1	9	NU03621689
Breamish	Brandon	14	1	10	NU03651688
Breamish	Brandon	14	1	11	NU03741691
Breamish	Brandon	14	1	12	NU03741691
Glen	Akeld	15	1	1	NT95793031
Glen	Akeld	15	1	2	NT95793031
Glen	Akeld	15	1	3	NT95803028
Glen	Akeld	15	1	4	NT95803028
Glen	Akeld	15	1	5	NT95653025
Glen	Akeld	15	1	6	NT95653025
Coquet	Sharperton	16	1	1	NT95700335
Coquet	Sharperton	16	1	2	NT95700335
Coquet	Sharperton	16	1	3	NT95680338
Coquet	Sharperton	16	1	4	NT95680338
Coquet	Sharperton	16	1	5	NT9560333
Coquet	Sharperton	16	1	6	NT95760344
Coquet	Sharperton	16	1	7	NT95700361
Coquet	Sharperton	16	1	8	NT95700361
Coquet	Sharperton	16	1	9	NT95700361
Coquet	Hepple	16	2	1	NT98800035
Coquet	Hepple	16	2	2	NT98840033
Coquet	Hepple	16	2	3	ST98740025
Coquet	Hepple	16	2	4	NT98680019
Coquet	Hepple	16	2	5	NT98750006
Coquet	Hepple	16	2	6	NT98750006
Coquet	Ryehill	16	3	1	NU02500194
Coquet	Ryehill	16	3	2	NU02500194
Coquet	Ryehill	16	3	3	NU02500194
Coquet	Ryehill	16	3	4	NU02470198
Coquet	Ryehill	16	3	5	NU02380196
Coquet	Ryehill	16	3	6	NU02250189
Coquet	Ryehill	16	3	7	NU02250189
Coquet	Ryehill	16	3	8	NU02460194
Coquet	Thropton	16	4	1	NU02910184

River	Site	River number	Site number	Sample	Grid reference
Coquet	Thropton	16	4	2	NU02910184
Coquet	Thropton	16	4	3	NU02910184
Coquet	Thropton	16	4	4	NU02930172
Coquet	Thropton	16	4	5	NU20900198
Coquet	Thropton	16	4	6	NU20900198
Coquet	Thropton	16	4	7	NU02810206
Coquet	Thropton	16	4	8	NU02810206
Coquet	Thropton	16	4	9	NU02720206
Coquet	Healey	16	5	1	NU091000
Coquet	Healey	16	5	2	NU091000
Tay	Ballinluig	17	B	A-E	NN9752
Tay	Kercock	17	K	A-E	NO1238
Tay	Westhaugh	17	WH	A-E	NO1439
Spey	Dorback	18	D	A	NJ07261621
Spey	Dorback	18	D	B	NJ07351622
Spey	Dorback	18	D	C	NJ07521837
Spey	Dorback	18	D	D	NJ07541640
Spey	Dorback	18	D	E	NJ07581644
Spey	Inverdruie	18	D/S	A	NH89621192
Spey	Inverdruie	18	D/S	B,C	NH8911
Spey	Inverdruie	18	D/S	D	NH89521146
Spey	Inverdruie	18	D/S	E	NH89521126
Spey	Inverdruie	18	D/S	F	NH8911
Spey	Fochabers	18	F	A	NJ34238111
Spey	Fochabers	18	F	B	NJ34216107
Spey	Fochabers	18	F	C	NJ3410
Spey	Fochabers	18	F	D	NJ34306109
Spey	Fochabers	18	F	E	NJ34386115
Spey	Feshie Fan	18	FF	A	NH84370634
Spey	Feshie Fan	18	FF	B	NH8406
Spey	Feshie Fan	18	FF	C	NH84330617
Spey	Feshie Fan	18	FF	D	NH84170594
Spey	Feshie Fan	18	FF	E	NH84210590