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Grazing marsh assemblages and site classification using invertebrates

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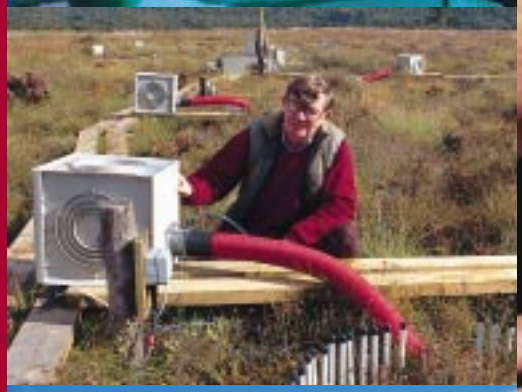

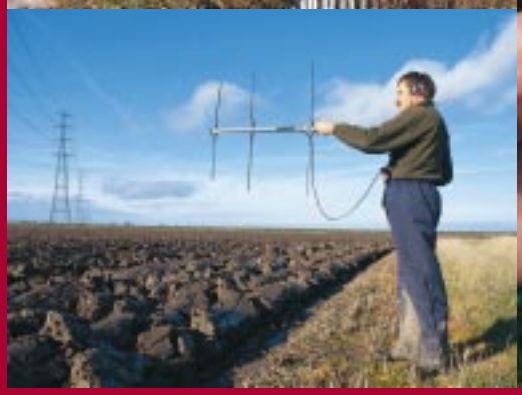

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Summary

1. A literature review highlights some of the most important outcomes of many unpublished surveys as well as those in formal publications.

2. 295 species showing high constancy in 41 of surveys aquatic fauna and 31 surveys of 'terrestrial' wetland species are given fidelity scores on a three-point scale.

3. Over 180 grazing marshes are ranked for their importance for the grazing marsh assemblage using the importance categories of county, regional, national, or of less than county importance. Ranking is based on the representation of nationally rare and scarce species, Species Quality Score for water beetles, and the proposed fidelity scores.

4. The return for effort using different sampling methods in aquatic surveys are investigated. These suggest that netting time must be greater than 30 seconds and perhaps as much as 3 minute, and that bank-sorting must be much longer than 10 minutes and probably about 30 minutes.

5. Methods are suggested for aquatic and terrestrial surveys (but not for monitoring).

Contents

1. Introduction

Britain has two natural assets that should place it high in Europe's league of wetlands – high rainfall and a long, low-lying coast. Mires have long been recognised as having international importance, but other wetlands subject to centuries of man's interference were for too long rated rather low. Among these are grazing marshes, which are mostly the sad remnants of former floodplain or coastal swamps. Their importance of even these highly managed systems begun to be recognised in the late 1979s and early 1980s as agricultural improvement began to dent traditional and relatively benign management. Since this time, many grazing marshes have been surveyed for birds, plants and invertebrates, and the clear importance of the habitat is now recognised by its inclusion as a priority habitat in the UK Biodiversity Action Plan.

This report brings together some of the information on the more important invertebrates. Two main aspects are covered. The first is the suite of species that most clearly define the grazing marsh 'assemblage', and the second is a rating of surveyed sites. It is hoped that this will enable those involved in site assessment to place their sites in a national context, thus enabling decisions about protection and management.

A set of defined assemblages would put conservation entomologists on equal footing with botanists whose NVC has provided rigour and simplification to site assessment. With easily ten times as many invertebrate species as plants, far fewer entomologists than botanists, and no standard sampling methodologies, this is an unobtainable goal. The next best approach is to define the fidelity of species to particular habitats. To make this task manageable, it is restricted to uncommon species but not just national rarities, and in this way it moves forward from the historical approach centred on rarity alone. Lott (2003) provides an excellent discussion on this issue and it need not be repeated here.

To move towards a workable system for assessing the invertebrate interest of grazing marshes, this contract provides the following outputs:

1 Lists uncommon species with low to high fidelity to grazing marshes.

2 A rating of grazing marshes on the basis of the invertebrate recorded.

3 A method for survey.

As grazing marsh is a landscape type rather than a habitat, the scope of this report includes the wetland types of coastal level grasslands, semi-natural floodplain grassland and washland, in all cases with ditch systems. Hazy borders with other habitats are brackish pools and upper saltmarsh, grazed fen and traditionally managed water meadows; information on these habitats is not included here.

2. Literature review

2.1 Range of available information

Few publications, as distinct from unpublished reports, have appeared on the fauna of grazing marshes. These usually cover aspects of grazing marsh ecology and conservation, such as the effects of land management or the relationship of assemblages to the environment, and so their relevance extends beyond the marsh where the study was undertaken. Considerably more information is contained in unpublished reports originating from a wide range of organisations, but probably mostly from the Nature Conservancy Council and English Nature. Understandably, most of these deal with sites of high value and which still retain large areas of semi-improved pasture rather than arable areas. Many of these reports discuss little more than the rare species found and attempt little ecological analysis. The results of such work have contributed to site notification, and on these areas invertebrates are recognised as interest features. The bibliography in this report brings together a large number of these surveys, although it is known to be incomplete.

A number of species lists from marshes have appeared in formal publications, notably water beetles which are the best documented group. There seem to be rather few papers on dragonflies and molluscs, considering their popularity, and these include Belden (1987) for the Pevensey Levels, Drake (1987) for the Gwent Levels and Painter (1998) for Wicken Fen ditches, and Hingley (1979) for molluscs on the Pevensey Levels; Willing (2000) summarises the state of aquatic molluscs generally and includes grazing marshes in his overview. Other groups have been covered less thoroughly. They include mayflies and stoneflies at several marshes (Drake, 1991), flies on the Gwent levels (Drake, 1988) and north Kent (Clemons, 1982, 1984, 1995) and corixids in south Lincolnshire fen ditches (Kirby, 1983). Many more unpublished reports exist for these groups.

Rare species have stimulated a range of studies on grazing marshes. Much of this was sponsored by English Nature's Species Recovery Programme, and later by more organisations under the banner of the Biodiversity Action Plan. Table 1 lists some of this work. It does not include articles about little-known species or those recorded as new to Britain such as *Scirtes* spp. and *Meromyza hispanica* (Drake, 1987a, b). BAP species found frequently or only rarely on grazing marsh are listed in Appendix 4. Species given protection under the Wildlife and Countryside Act are Desmoulin's whorl snail *Vertigo moulinsiana*, fen raft spider *Dolomedes plantarius*, Norfolk aeshna *Aeshna isosceles*, lesser silver water beetle *Hydrochara caraboides* and marsh fritillary *Eurodryas aurinia*.

Attempts to synthesise data on grazing marsh invertebrates appear in Davidson *et al* (1991), Drake (1998) and Godfrey (2003). The first of these may be seen as a precursor to the present report. Drake (1998) used data from English nature's Invertebrate Site Register to select rare and scarce species with apparently strong associations with lowland wet grasslands (including both ditches and swards), and herbivores requiring specific food plants. The sample of 942 nationally scarce or rare species from 24 sites were categorised according to their main habitat type. As might be expected, species characteristic of fens, water margins and standing water accounted for between one- and two-thirds of uncommon species on coastal marshes and more than this on floodplain sites. However, the remaining species comprised those characteristic of many habitat types, including a moderate number of dry grasslands, isolated bushes, hedges and trees (especially at inland marshes) and saltmarsh. Only small numbers were associated with reedbeds, flowing water and, surprisingly, wet

grassland. Godfrey (2003) brought together much information on the ecology and habitat requirements of individual species recorded from Kentish grazing marshes and, since much of the information relates to species, it has wider geographic application, especially the associations with particular species of wetland plants.

A large amount of information is held by recording schemes, local records centres and the Invertebrate Site Register but these sources have not been tapped for this report since the scope is too wide. In his collation of English sites of lowland wet grassland, Dargie (1995) notes sites with information on invertebrates, based largely on the Invertebrate Site Register and reports listed by Driscoll (1991) in his bibliography of ditch surveys. Dargie's work shows that numerous sites have some information on invertebrates but it was beyond the scope of that project to do more than note the source. His more detailed inventory of wet grassland in Essex and Norfolk summarises the number of species of each rarity status, the NCC's Invertebrate Index and sometimes a list of Red Data Book species and a brief appraisal (Dargie, 1995). The sites mapped by Dargie are available on GIS so the inventory information could be accessed through this route rather than laboriously leafing through nearly 10cm of reports.

This review covers almost exclusively publications and reports for English sites and the Gwent Levels. The Dutch have undertaken considerably more in-depth studies of ditch invertebrates but no attempt has been made to cover this. The bibliography includes a few that I have seen (papers by Beltman, Higler, Rietveld, Scheffer, Verdonschott). We could learn much about the ecology and factors controlling assemblages in the Dutch output.

Table 1. Rare species studied on grazing marshes

Species	Reference
Anisus vorticulus	Killeen, 1999; Willing, 1999; Killeen & Willing, 1997; Willing & Killeen, 1998, 1999; Watson & Ormerod, 2004a, b
Brachytron pratense	Perrin, 1999
Dolomedes plantarius	Jones, 1992; Beale & Doberski, 2002
Emus hirtus	Williams, 1999
Hirudo medicinalis	Nixon, 1998; McConnell, 2000; Ausden *et al*, 2002
Hydraecia osseola	Clancy, 2000, 2001; Waring, 1994, 1999
Hydrochara caraboides	Boyce, 2003
Laccophilus poecilus	Hodge, 2000, 2001, 2003
Lestes dryas	Moore, 1980; Drake, 1990, 1991; Ellison, 1998
Segmentina nitida	Killeen & Willing, 1997; Killeen, 200l; Watson & Ormerod, 2004a, b
Valvata macrostoma	Hill-Cottingham, 1998; Willing, 1999, 2001, 2002; Watson & Ormerod, 2004a, b
Vertigo moulinsiana	Killeen, 2000

2.2 Land use

As the conservation importance of marshes became apparent, studies became more concerned with how land use and ditch management affect aquatic assemblages. Palmer (1987) showed that ditches in arable land of Romney Marsh supported markedly fewer aquatic species than those in pasture and, although she found scarcely any difference at Pevensey Levels, two rare snails failed to colonise ditches in arable land (Palmer 1986) and many fen-relict water

beetles here were restricted to the old pasture (Carr, 1983). Driscoll (1986a, b) tracked changes in the aquatic fauna of ditches as pasture was converted to arable land near the Norfolk coast where the fauna, already impoverished by slightly saline water, lost rather more species, notably flatworms, leaches and some molluscs. Increased saline seepage resulting from the changed drainage pattern exacerbated these effects. Abraham *et al* (1997) recorded noticeably greater species richness of molluscs in ditches bordering pasture or hay fields compared to those next to arable or silage fields or improved pasture. The only apparent support for ditches in arable areas having any value comes from a survey of water beetles in the predominantly arable ditches of The Fens, where a remarkably large number of uncommon species survive, although the quality of the fauna in most ditches is poor (Foster *et al*, 1990). Thus although the published evidence is not in complete accord, it can be concluded that ditches in arable land (including frequently reseeded pasture) are definitely poorer in scarcer species and often in total species to those in permanent grassland.

2.3 Hydrosere and ditch management

Using classification and sometimes ordination, several studies have shown that assemblages of aquatic invertebrates, especially water beetles, are associated with hydroseral stage or equivalently the intensity of management. Accurate information on the 'age' of ditches (years since cleaning) is rare but the hydroseral stage can be estimated using surrogate features such as vegetation structure which is often measured as percentage cover of the floating, submerged and emergent components. Maximum water depth and bank profile may also be correlated with 'age'. Classification usually shows a major division into early and late ditches, and strong correlations of the first or second ordination axes with variables that can be directly related to ditch age (Clare & Edwards, 1983; Drake *et al*, 1984, Drake 1985, 2002, 2003; Foster *et al*, 1990; Painter 1999, Painter & Friday 1999). Other environmental variables such as salinity and water flow usually clearly separate small groups of ditches atypical of the still field ditches of most freshwater marshes.

Species richness often varies with seral stage, with the very early stage and latest, choked stage having fewer species than the middle stage. Aquatic molluscs at Amberley Wildbrooks were more species-rich in well vegetated and less frequently cleared ditches, and the richest had not been cleaned for at least five years. Frequently cleaned ditches lacked scarce species such as *Anisus vorticulus* and *Pisidium pseudosphaerium* which were frequent in the marshes.

Scarce species are sometimes associated with different seral conditions, so that no stage in the ditch cleaning cycle can be singled out as being of greatest value to invertebrates as a whole. For instance, five rare molluscs in Norfolk ditches in the Yare valley were scattered across almost the entire site ordination, rather than clustering in one area in a way that may have indicated certain preferences. Both Painter & Friday (1999) and Drake (2003) found the water beetles to have slightly higher quality (as measured by the Species Quality Index) in older ditches than young ones. Species repeatedly shown to prefer early stage, botanically rich ditches with high cover of submerged plants are the aquatic larvae of the large soldierfly *Odontomyia ornata* and the water beetle *Peltodytes caesus*, and those consistently preferring later stages, or at least densely vegetated shallow margins, are *Odontomyia tigrina* and the diving beetles *Rhantus grapii* and *Hydaticus transversalis* (Drake *et al* 1984, Drake 1985, 2002, 2003; Godfrey 1999, 2000). The strong preference of *Segmentina nitida* for late hydroseral conditions is probably the best known and well documented (eg Killeen & Willing, 1997; Jackson & Howlett, 1999, Drake 2002). Godfrey (2000) concluded that there

were no uncommon species associated with the early, open-water stage in Somerset ditches and that the important stages were mid to late successional. Hingley (1979) studied how molluscs re-invaded cleaned ditches and found that some species now regarded as uncommon (eg *Segmentina nitida*, *Anisus vorticulus*, *Aplexa hypnorum*) fared slightly worse than the bulk of rather common species in newly cleaned ditches, suggesting a poorer ability to colonise new ditches.

Non-aquatic wetland species also appear to become more abundant in late-stage swamp conditions compared to early ones, so the loss of open-water aquatic species is replaced by equally interesting wetland species (Drake *et al*, 1984). Although this is a rather obvious conclusion, it does not fit comfortably with a botanical view of ditch systems, in which early successional stages are markedly more valuable than late-stage, choked ditches.

Most uncommon species show a frustrating lack of correlation with measured environmental variables. Their occurrence in particular ditches or marshes may be partly explained by historical 'accident' (such as land use in earlier decades, or saline incursions), as this seemed to be the only reason for the patchy distribution of a number of beetles and snails in Norfolk ditches (Drake, 2002, 2003), and for the clumped distribution of the snail *Valvata macrostoma* on West Sedgemoor in Somerset (Willing, 2002). Part of the problem with trying to find environmental correlations is that many species probably have wide tolerances provided the water quality is high but more likely is that the variables measured are inappropriate. For example, those measured in all my own surveys are based on macroscopic variables devised by botanists and may be irrelevant to tiny insects.

2.4 Vegetation

As there is a marked change in assemblages with hydroseral stage, it is not surprising that some studies have found animal assemblages to correlate in some way with plants. This was clear in a Wicken Fen (Painter, 1999) and in a Dutch study (Scheffer *et al*, 1984). However, little correlation was found between groupings of ditches based on beetles compared to molluscs (Drake, 2002), even though a few distinct and recognisable groups were found for each taxon separately. This may partly be explained by the rapid hydroseral changes between botanical and invertebrate surveys, but it could not explain the still poor correlation found using plant and invertebrate data collected at the same time in Norfolk.

Aquatic vegetation clearly influences the habitat structure and the invertebrates living there, but teasing out the any single commonly measured factor has usually failed to help predict invertebrate assemblages or species richness. For example, significant correlation between the species-richness of aquatic plants and invertebrates have been found for several marshes, both freshwater and brackish but the predictive power of the correlation is usually so low as to be of no practical help (Palmer, 1980; Drake *et al*, 1984; Drake, 1985). Both positive and negative relationships were found when the numbers of invertebrates were plotted against either submerged plants species (positive) or emergent species (negative), or when brackish water or freshwater invertebrate were plotted against plant species-richness (freshwater – positive, brackish water – negative). Clearly this type of analysis is too simplistic.

A variable proposed by Higler *et al* (1986) to encompass the structural complexity of the habitat was its 'tangledness', which they did not define. It was applied in a purely sujective manner using a three-point scale to Norfolk ditches where it produced strong correlations

with the first two ordination axes scores, total species and SQI for water beetles, although not for molluscs, and was a better predictor than many conventional measurement (Drake, 2003).

2.5 Detrimental plants

Another effect detrimental to the fauna is dense cover of floating duckweed (*Lemna* spp). Dense carpets can result from eutrophication from farming practice or from frequent ditch cleaning, so here is a direct link between poor practice and decline in invertebrate interest. Clare & Edwards (1983) showed experimentally that 100% *Lemna* cover in the absence of submerged plants depressed benthic species markedly and also several taxa living on plants compared to a 'natural' control stretch with incomplete *Lemna* cover and submerged plants. Oxygen was virtually absent on the bed through the summer in both stretches, but conditions were slightly less stressful in the control section, and this was considered to be the mechanism operating on the fauna.

A weak effect of floating *Lemna* spp and *L. trisulca* on invertebrate richness was found in Norfolk ditches (Drake, 2002). Here, the Species Quality Index for molluscs was strongly depressed and that for beetles slightly depressed when floating *Lemna* was dominant, whereas *L. trisulca* affected only molluscs. This index should have countered the effects of poorer sampling efficiency in dense *Lemna* spp, and it was concluded that solid carpets of floating *Lemna* had a real if small effect. Water fern (*Azolla filiculoides*) also forms solid carpets under which few invertebrates survive (eg Abraham *et al*, 1997).

In contrast, a study by the Environment Agency (2003) suggested that the non-native invasive floating pennywort (*Hydrocotyle ranunculoides*) in the Pevensey Levels has no apparent effect on the numbers of all or just rare species of invertebrates. Another study by the Environment Agency looking at the effect of herbicide treatment to control *Hydrocotyle* confirmed that the plant appeared to have no impact on the macro-invertebrates (Sussex Area Biology Team, 2000). New Zealand swamp stonecrop (*Crassula helmsii*) has not been recorded as a problem on grazing marshes but a summary of observation by Denton (2001) on water beetles in infested shallow heathland ponds and two lakes in Hampshire and Surrey suggest that this invasive plant has no obvious impact, except perhaps on species with pelagic larvae such as *Acilius* and *Graphoderus*. The conclusions of these two studies suggest that a re-think is needed on the impact of plant monocultures on the aquatic fauna. This proposition is tentative since there is overwhelming evidence that both these invasive species (and *Azolla*) have a deleterious effect on native plants.

2.6 Poaching

By trampling a ditch's margings, cattle convert the channel cross-section from trapezoidal to saucer-shaped, and unwittingly increase the amount of shallow water to the benefit of wetland invertebrates. Several surveys have shown that poaching by cattle increases the interest. The effect is not great but ditches with poached margins have more species, especially of water beetles, than ditches without poaching (Drake, 1985, 1988, 2002, 2003), and a few rare molluscs are more frequent at ditches with a submerged shelf formed by previous poaching than those without a shelf (Jackson & Howlett, 1999). A similar effect has been reported in other surveys of aquatic invertebrates (Abraham *et al*, 1997; Painter, 2000).

2.7 Soil type

Soil type appears to have only a small influence on the assemblages of aquatic species, even though clay, alluvium and peat have such different properties. The Somerset Levels and Moors cover a wide range of soil types and although species richness of aquatic samples was unaffected by the soil type, samples richer in uncommon species tended to be from peat and the least rich from clay. Among the uncommon species that preferred peat soils were the corixid bug *Sigara semistriata* and the lesser silver water beetle (*Hydrochara caraboides*) which occurs only on the acid (Turbury) peat in the Somerset Moors. In a tiny patch of peat on the Gwent Levels (Magor Marsh), water spider was numerous but virtually absent elsewhere on the clay although this apparent preference was not noted at other grazing marshes. No obvious restrictions to peat or clay were noted in ditches in Norfolk (Drake 2002, 2003).

2.8 Water requirements and depth

Water requirements of the fauna of grazing marshes has received remarkably little attention considering the vulnerability of many marshes, especially those in the east, to water shortage. Maximum water depth has often been measured in aquatic surveys and it is assumed that this reflects the average condition of the ditch. The number of aquatic species shows no real decline with increasingly shallow water until it is shallower than about 30cm for freshwater marshes and about 15cm for brackish marshes (Drake, unpublished). No detailed information has been obtained for individual rare species. Godfrey (2003), for instance, could not give any hard information on the water level requirements of rare species in Kent marshes. Framing the question of requirements in terms of water depth may be nonsense for ditch species. Nearly all aquatic species of grazing marshes live in permanent water and, although some can survive short periods of drought, specialists of temporary water are not part of the typical fauna. It is likely that all the typical species would survive without stress in water that became no shallower that about 30cm. If ditches remain as wet as this, the entire wetland component of the ditch margins is automatically safeguarded.

'Freeboard' (bank top to water surface) may be more important than water depth to most species, both aquatic and wetland. Water level close to bank top is often accompanied by shallow water at the margins, as the top is usually rounded (although not in peat systems where banks are usually vertical), greater poaching at water level since animals can reach and the ground is softened, and little shading by the bank. These are all positive attributes since most ditch species live close to the water's margin or surface. Evidence for this is shown by molluscs and beetle assemblages in Norfolk ditches being more strongly influenced by low freeboard than by water depth, and by the number of species of water beetles and their Species Quality Score being significantly correlated with bank depth but not with water depth (Drake, 2002, 2003). An equivocal result was obtained by Gibbs (1994) for West Sedgemoor, Somerset, in a comparison of ditches with raised water levels and those not raised. Raising levels in this case was part of the ESA prescription for wet grassland. He found no real differences in the number of all species and rare species between the two treatments, and rather more uncommon species in the non-raised ditches. He concluded that water level relative to field level is not an important factor in the survival of ditch invertebrates, although recognised that other variables such as ditch profile, vegetation structure and cattle grazing (and poaching) may have obscured any effect caused by raised water levels. As these other factors are often improved by soft, wet margins, the value of raising levels should not be under-estimated.

Raising water levels in ditches is considered good practice, and winter flooding clearly causes no harm to the very rich fauna of the Somerset Levels and washlands of the Ouse, Nene and Derwent which may be under several feet of water for many weeks. However, summer flooding and flooding areas with no recent history of submersion is more controversial. Grasslands with no recent history of flooding have their terrestrial fauna reduced until wetland species colonise, but the fauna of wet grasslands suffer little or not at all from more prolonged winter flooding (Ausden, 1997). This is reassuring since the terrestrial fauna of dry marshes appears to be of low interest (usually) compared to that of wetter sites. Summer flooding is usually considered disastrous for wetland and aquatic invertebrates since it causes severe deoxygenation as vegetation decays. A study of Somerset Moors following such an event in 1997 showed this well (Hill-Cottingham & Smith, 1998); aquatic molluscs suffered particularly badly and water beetles, which may have been expected to escape, were also affected but to a lesser extent. A year later, the fauna appeared to have recovered, so the effects were short-lived although probably ameliorated by the setting of the these moors in the largest area of grazing marsh in Britain.

2.9 Brackish water

The influence of brackish water on aquatic assemblages has received some attention. Coastal grazing marsh bordering saltmarsh and estuaries, such as many of Essex, Thames estuary and north Kent, often have naturally and longstanding brackish ditches. These support a range of coastal species that are absent or scarce on inland marshes, and often nationally scarce because of the limited extent of brackish habitat. The importance of this suite of species, even as part of a relatively species-poor community, and the need to maintain such conditions has been highlighted for the marshes in Kent (Palmer, 1980, 1987; Charman *et al*, 1985), Inner Thames (Leeming, 1998) and Essex (Drake, 1988). The condition of ditches with a large proportion of brackish-water specialists may not be most appealing to botanists, for example they are often shallow, temporary, dominated by single-species stands of common sedges, club rush or grasses. Species frequently associated with brackish condition on grazing marshes are indicated in Appendix 1.

Freshwater marshes that suffer infrequent saline incursions present an opposite view of the value of brackish water. Norfolk marshes along the low-lying rivers, for instance, have a natural freshwater fauna apparently lacking coastal elements, and this fauna would not benefit from the rivers over-topping their banks on high tides. Driscoll (1986) showed a deterioration in the fauna of an area of ditches in north Norfolk following conversion to arable and a consequent increase in salinity due to greater saline seepage. He also showed a significant negative correlation between the number of species of invertebrates (including some fish) and chloride ion concentration, and interpreted this as evidence for the detrimental effect of saline influence on the fauna (Driscoll, 1975). However, in view of later work on brackish marshes showing a small but characteristic fauna of uncommon species, Driscoll's interpretation may be over-cautious, although his marsh did show a deterioration as saline seepage increased following conversion to arable. A converse view was given by Palmer (1976) who was concerned that underdrainage installed when pasture was converted to arable land would lead to a loss of its unusual brackish-water invertebrate assemblage as the drains allowed greater leaching of salt. Care is therefore needed in interpreting whether saline influence is likely to be good or bad. If it is natural in origin (leaky sluices, residual salt in the soil), it is likely to be accompanied by an interesting invertebrate fauna, but if it has resulted from drainage and an increase in various solutes (not just sea water) and ocre

deposition, then it is likely to be poor for invertebrates. Part of the problem in making this decision may stem from the frequent use of conductivity as a surrogate measure of salinity; fertiliser run-off can produce conductivity readings similar to those found in slightly brackish ditches.

Brackish-water species are one of the more intersting aspects of grazing marsh assemblages and therefore are listed in Appendix 5.

2.10 Cleaning methods

Few studies have investigated how invertebrates are affected by the method used to clean ditches. At Romney Marsh in Kent, the effects of applying the herbicide Dalapon were compared with mechanical removal using a Bradshaw bucket (Nature Conservancy Council & Southern Water, 1989), Marshall (1984) investigated the effect of Diquat in a ditch on the Gwent Levels, and Brooker (1976) compared hand cleaning with application of Dalapon and 2,4-D herbicides. No study found that using herbicides had a permanent effect on the species composition of invertebrates.

2.11 Factors influencing 'terrestrial' invertebrates

In comparison to the analysis to be found in reports on aquatic surveys, there is a dearth of analysis in reports of wetland and terrestrial species. The conclusions presented in a survey of North Kent marshes appear to be a mixture of wider experience and conclusions drawn from the actual survey, although the results showed a rather poor reed-associated fauna and more scarce and rare species being recorded beside ditches and banks with a stronger saline influence (Stubbs *et al*, 1982). Results from the Somerset Levels and Moors showed that terrestrial invertebrates (mainly Diptera) were favoured by ditches with shallow, trampled banks supporting mixed *Juncus*-dominated vegetation in permanent pasture, and that heavy grazing and improved grassland decreased species richness (Drake *et al*, 1984). Uncommon species were more frequent at sites in permanent pasture and with grazed or trampled shallow banks, but no other factors could be shown to be important. On the Gwent Levels, the most species-rich samples were from the most flowery sites and those with a higher proportion of emergent vegetation, although the results were not statistically significant, but ditches on peat did support significantly more species than those on clay (Drake, 1985). Other variables that appeared to have no influence on the species-richness of terrestrial insects were the species-richness of bankside plants, the steepness of the bank or the presence of tracks. There was no convincing correlation between the terrestrial and aquatic faunas, so one suite of species is no guide to the quality of the other. Poaching was the only factor that clearly improved both suites of species.

2.12 Analysis of results

When analysing the results of surveys, every author has used the common measures of total species and rarity defined by NCC or JNCC. Several use the Species Quality Score of Foster *et al* (1990) although with different scores allocated to each species so that results are inconsistent between surveys (sometimes even between those by the same author). It would have helped if Foster & Eyre (1992) had published the score for all regions that they covered in their classification and ranking as there then would be no excuse for applying different scores. A more complex measure, the Community Conservation Index, was proposed by Extence & Chadd (1996) which combines rarity with elements of the BMWP system for

measuring water quality. This has been applied in at least one survey of Crayford Marshes but, with no other sites to compare, its wider utility for evaluating grazing marshes cannot be assessed (Leeming, 1997). Killeen (1998) compared indices for molluscs specifically of grazing marshes, using an adaptation of the method of Extence & Chadd. He allocated scores to each species based on his own experience in surveys of several marshes in southern and eastern England, then calculated the total score, average score per taxon, a third index multiplying the previous one by the score for the highest-scoring species, and an index multiplying the scores by a geometric abundance categories to take account of numerical abundance. These produce a range of values that will need greater testing to discover their properties and limits (for instance, what value suggests a 'good' ditch?). The more involved systems of Extence & Chadd (1996) and Killeen (1998) may find a role in monitoring where the analysis must detect small differences over time, but perhaps they are too involved for site assessment.

2.13 Management advice

Recent publications giving management advice for lowland wet grassland often recognise that invertebrates are an important interest but do not include recommendations specific to invertebrates (Benstead *et al*, 1997, 1999). However, this is rarely a concern since the predominantly bird-orientated advice often agrees with good practice for invertebrates too. Advice specific to ditch invertebrates is given by Kirby (1992). Several reports on individual sites give management recommendations (too many to list here) and Godfrey (2003) summarises the management recommendations given in reports of surveys undertaken in Kent, and brings this information together as a series of points. Much of this supports and occasionally adds to guidance in *The Wet Grassland Guide* (Benstead *et al*, 1997).

3. Fidelity

3.1 Methods

3.1.1 Fidelity classes

Fidelity classes were defined by Lott (2003) for wetland ground beetles and rove beetles, and were followed by Alexander (2003) for calcareous grasslands. However, these were felt to be not directly applicable, even with suitable modification, to grazing marshes. To make the point, their definitions are first given, followed by the version I have used.

A Species routinely recorded from wetlands [calcareous grassland]. They may also be recorded to a greater or lesser degree from artificial habitats such as arable fields or compost heaps [open habitats on freely draining soils] but it is likely that they are mainly dependent on wetlands [calcareous grasslands] to sustain viable populations.

B Species routinely recorded from wetlands [calcareous grasslands], but also from semi-natural terrestrial habitats [open habitats on freely draining soils] over all or part of their geographical area of distribution. Also included here are wetland species that are recorded predominantly from artificial terrestrial habitat in part of their area of distribution.

C Species frequently recorded in numbers from wetlands [calcareous grasslands] but predominantly terrestrial habitats [other types of open habitats] over all their British

area of distribution. Wetland records may be due to vagrants or ephemeral breeding populations.

These criteria cannot be applied since grazing marsh is a landscape type, not a habitat with a semi-natural counterpart. It is a composite of artificial and natural habitats resulting from intensive intervention and lacking the clear-cut physico-chemical characteristics that allow wetlands to be distinguished from dry habitats, and calcareous grassland from other grasslands. Wet ditches are just long thin ponds subjected to routine, traumatic devastation every few years; the water may be fresh, brackish or even saline; the underlying soil may be clay, peat or alluvium. Trying to apply fidelity classes as envisaged by Lott and Alexander fails. Therefore, the following definitions are used.

A Species almost restricted to grazing marshes and without which would be unlikely to sustain viable populations.

B Species frequent on grazing marshes and therefore form part of the characteristic fauna of these marshes. They may be frequent in other wetlands or grasslands.

C Species occurring usually at low frequencies on grazing marshes and whose presence depends upon the habitat characteristics (eg water margins, flooded grassland) but which are not particularly frequent here in comparison with their geographic range.

To make the list manageable, it is restricted to species regarded as 'local' or scarcer, otherwise species allocated a fidelity of 'B' or 'C' would include several hundred common wetland species. A few 'common' species were included as they were mentined by some workers as being scarce outside marshes. As a starting point, the statuses used in Recorder 3.3 are used, but species were added or dropped if subsequent atlases, unpublished reviews or survey data provided grounds for doing so.

3.1.2 Datasets

The 'aquatic' versus 'terrestrial' dichotomy in entomological survey is merely a practical convenience that bear no relationship to the reality of wetland communities. It has led to a disparity in the data available for these two essentially continuous 'habitats', and two approaches therefore had to be used in the following analysis of fidelity.

For conventionally recognised aquatic species, many systematic surveys have been made using a fairly similar approach of pond netting at each sampling point, which yields data for discrete points (far smaller than the length of single ditches). The groups covered vary between surveys, but each group is treated more-or-less consistently in every case. Thus 'water beetles' and 'water bugs' cover the same suite of families traditionally recognised in these groups, and among aquatic molluscs only *Pisidium* pea mussels and amphibious Succineidae snails introduce some inconsistency between surveys.

In surveys of 'terrestrial' species, the methodology and groups covered vary hugely and are treated inconsistently. For instance, beetles may include all chrysomelid leaf beetles or just donacine reed beetles, and flies may include many acalyptrate families or just sciomyzid snail-killing flies. Samples are taken using sweep nets along single ditches or across swathes of marsh, or collected incidentally during pond netting. The outcome is that aquatic species,

especially water beetles, bugs and snails, could be analysed more rigorous than remaining groups.

Forty-one surveys were consulted for aquatic groups, in which 2442 ditches had been sampled for water beetles and 971 for water bugs. For 'terrestrial' groups, 31 surveys covering 1199 ditches were consulted. Reports where the data were not tabulated in a way that allowed the information to be rapidly extracted from tables were not used, even though these included some good surveys.

Some 30,000 records from my own surveys undertaken between 1983 and 1990 were re-entered on Recorder (the original data having been 'lost' through the inability of modern IT to read old tapes). A copy of these and another c. 10,000 records already input from my recent surveys has been lodged with English Nature and data submitted to national recording schemes.

Surveys used in this analysis:

Carr 1984, 1986, 2000; Clemons, 1995; Drake 1986, 1986, 1988, 1988, 1989, 1989, 1990, 2002, 2003, 2003; Drake *et al* 1984; Edwards & Hodge 2000; Edwards 2001; Godfrey 1999, 2000; Hodge 1987, 1988, 1991, 1992, 1992, 1995; Hodge in prep. (two reports); Kirby 1991 1993, 1995a, b; Leeming , Leeming 1998; Mallard 1990; McLean 1982; Palmer 1980, 1982, 1984; Philp 1994; Plant 1992, 1993, 1997, 2002; Pond Action 1992; Somerset Ecology Consultants Ltd. 1991.

3.1.3 Procedure used to allocate fidelity classes

Three approaches were taken to score each species.

Water beetles and water bugs

The fidelity class was arrived at using the following routine:

- A list of species with rarity scores of local or scarcer was produced from Recorder.
- From the sample of 41surveys, the number of ditches in which each species occurred was totalled and the percentage representation calculated. Species occurring in fewer than 1% of the sample of ditches were excluded unless they were rare species which the literature suggested were found on marshes.
- A judgement was made to which fidelity class was most appropriate by comparing the national distribution and literature comments with the species' representation in the surveys, taking into account its rarity and the likelihood of it being dependent upon traditional grazing marsh management. Literature consulted included distribution atlases, national reviews and sometimes comments from survey reports.

Thus, although some hard data were obtained on distribution, the decision was not made on the basis of applying a set of rules. Among the reasons for abandoning rigid criteria were the large geographic variation in representation of most species (eg common in the east, rare in the west) and the sometimes-suspect national statuses. There were also discrepancies in the surveys that appeared to be due to systematic errors in identification and to some low catches suggesting inexperienced surveyors.

Regional variation in the representation of species is shown by the percentage of each water beetle in six groups of counties. Species at the brink of inclusion on the basis of their national representation were included if they were well represented in one region. This is particularly important in the case of species that are a small but consistent component of brackish marsh or relict fenland.

Molluscs and Odonata

Although data available for aquatic molluscs and, to a lesser extent, for dragonflies are similar to those for beetles and bugs, the same approach was not used because there is a large gulf between the high abundance of common and 'local' species (eg *Bathyomphalus contortus*, *Hippeutis complanata*) and the extremely localised occurrence of genuinely scarce species (eg *Segmentina nitida*, *Oxyloma sarsi*). In any case, the literature is sufficiently explicit for these well worked groups that there was no need to use survey data to support allocation the fidelity scores.

Remaining groups

Included here are mainly several families of beetles and flies: Carabidae, Staphylinidae in part, Coccinellidae, Chrysomelidae, Curculionidae, Scirtidae, the families of craneflies and empids, Dixidae, Culicidae, Dolichopodidae, Sciomyzidae, Stratiomyidae, Tabanidae, Syrphidae and occasional representatives of other families. A few representatives of wetland Hemiptera, *Chalcis sispes* in Hymenoptera and water spider were also included. Other species in these groups, and other major taxa, were not included because they have been scantily surveyed.

Data from the sample of 31 surveys were tabulated similarly for water beetles but based on an initial list of uncommon species produced by searching national reviews and other literature for those occurring on grazing marsh. This initial search was unsatisfactory since the terms and concept used to describe grazing marsh vary between authors, not surprisingly in view of the landscape nature of the 'habitat'. Therefore, when survey data was scanned, species were constantly added to the list so the reason for inclusion in the final list cannot be justified by having met particular criteria.

The clear over-representation of some species can be demonstrated by their percentage occurrence in the surveys (as for water beetles and bugs), although this figure is rarely precise owing to the variation in groups covered between surveys. The best estimate of percentage representation was obtained for each group by including in the denominator only surveys that covered the taxa, so for example staphylinids and donacines were recorded in 25 surveys (not necessarily the same 25) so the proportions of *Stenus* and *Donacia* are probably reliable lowest values, although for any other genus in these two groups an estimate would be grossly misleading.

A previous attempt to define uncommon species that occur widely on grazing marshes was based on the occurrence of records in English Nature's Invertebrate Site Register (Drake, 1998, and repeated in Benstead *et al* 1997). A few of the species included there have been excluded from the present analysis owing to their low representation in surveys. Whether to include species that are widespread in other habitats will be a source of argument until all habitats are covered in a similar way, when realistic allocations of fidelity should become

more apparent. The excluded species are a large number of Lepidoptera which were not included in the present analysis because they are almost never covered in specific surveys, carabids *Bembidion clarki* and *Pterostichus anthracinus*, staphylinids *Paederus fuscipes* and *Gabrius bishopi*, stratiomyid *Vanoyia tenuicornis*, syrphid *Neoascia geniculata*, lauxanid *Sapromyza opaca*, and sciomyzids *Pherbellia brunnipes*, *P. grisescens* and *Sciomyza simplex*.

3.2 Results

Species and their fidelity scores are given in Appendix 1. The breakdown within major groups is shown in Table 2.

Table 2. Number of species in each fidelity category

Group	Fidelity			total
	A	B	C	
Aquatic Coleoptera	6	30	41	77
'Terrestrial' Coleoptera	1	21	44	66
Aquatic Hemiptera		6	10	16
'Terrestrial' Hemiptera		1	2	3
Diptera	7	41	62	110
Odonata	1	4	1	6
Ephemeroptera			1	1
Hymenoptera	1			1
Arachnida	1		1	2
Mollusca	3	1	9	13
total	20	104	171	295

3.2.1 Properties of the index

Sufficient is known about water beetles, and enough comparable data collected, to allow some basic testing of the usefulness of the fidelity scores. As with any scoring system based on accumulating points, the result for a site depends upon sampling effort. This can be corrected by dividing by the number of species in the sample to provide a mean value, as proposed by Foster *et al* (1990) in their Species Quality Index for water beetles, and followed using variations on this procedure, for example Fowles *et al* (1997) in the saproxylic index for dead-wood beetles. The same approach is used here for fidelity.

Proliferation of indices to measure the quality of different habitats is not recommended. The original SQI of Foster *et al* (1990) has universal application and has shown to be useful when assessing sites. It would be preferable to use only this method until a more robust method has been demonstrated. The method's main weakness is the accuracy of the categories to which species are allocated, which Foster & Eyre (1992) overcome by using regionally based scores derived from recording scheme data. A second weakness lies in the geometric progression of points so that very rare species found in small samples can distort the index, although casual perusal of the raw data can 'correct' for these extremes when assessing sites. Further problems have been introduced by mixing taxa whose statuses have been allocated by different authorities (eg 'rare' bugs are difficult to find compared to 'rare' water beetles), and by using different geometric scores for each rarity status. For instance, some authors (eg Fowles *et al* 1997) allocate the score 4 to regionally notable species whereas others skip this

category and allocate 4 to nationally notable species since there is little available information on regionally notable species; and Godfrey (2000) allocates 16, 32 and 64 to each of the three Red Data Book category, which produces 'interesting' results. Even for water beetles, there are published regional scores for only two areas. Additional confusion is occasionally introduced by naming any average score a 'Species Quality Index', for example Plant (1993) sums points proposed in the guidelines for the selection of biological SSSI (NCC, 1989) (100 for RDB species, 40 or 50 for notables, etc) and divides by the total number of species, thus giving SQI scores that bear no relation to those using the geometric system.

The usefulness of fidelity scores for grazing marshes were compared with an SQI that is close to the original conception. The SQI scores are based on the national statuses in Recorder 3.3 and allocated following Ball (1990): 1 – common, 2 – local, 4 – Nb, 8 – Na, 16 – RDB3, 32 - RDB2 and RDB1. Curtailing the geometric series at 32 follows the practice of Foster & Eyre. The 'regionally notable' category is skipped. The values for two regions given in Foster & Eyre (1992) were not used since scores for the remaining regions would have to be based on Recorder statuses, thus introducing extra confusion. Status in Recorder 3.3 are known to be in need of updating, and while IUCN categories proposed by Foster (in prep.) could be used, these do not allow the distinction of common from local species. The resulting SQI are therefore not directly comparable with those in Foster & Eyre but sites are probably in a similar rank order as their scores would have produced. All species of water beetles recorded in these surveys have been included in calculating the SQI, so it includes not only those used to obtain fidelity scores but uncommon species that are not regular members of this habitat.

Fidelity scores for 73 marshes surveyed by myself (and Andy Foster in 1983) were converted to a more comparable figure by calculating the mean value, as done in most quality indices (category A species score 3 point, B score 2 points, C score 1 point, divided by the total number of water beetles recorded at a site). I am not proposing this as yet another quality index, but merely using it as a convenience to demonstrate its properties. The number of samples (ditches) varied widely between marshes, from 1 to 100, and the area of each marsh also varied widely. Summary data are given in Appendix 2.

The average fidelity score plotted against the SQI shows that they are closely related (Fig. 1). This is not surprising since almost all faithful species are at least local. The SQI of 70% of marshes was at least 2.0, which is Foster & Eyre's (1992) approximate threshold for a 'good' site (although my values may differ slightly from theirs). The mean fidelity score of 75% of sites was greater than 0.75. The top right-hand quadrangle contains the bulk of sites over which there would be little argument about their high value, for instance, nearly all the marshes in the Yare and Bure valleys in Norfolk, nearly all the Somerset Levels and Moors SSSI, the Gwent Levels, and many Essex marshes. Some of these are not 'pristine' grazing marsh but contain chunks of arable land; the ditch systems within these arable areas can sometimes be unexpectedly good.

Low-scoring sites on either axis give clues to the usefulness of the fidelity score. Most ditches on the Suffolk coast had low SQI; the outstanding site to the right is Orford Ness which was highly brackish but ungrazed marsh at the time of the survey, and on the borderline of 'grazing marsh' as both a landscape type and habitat. Despite their low SQI, half the remaining sites had a similar fidelity score to the large group of undoubtedly good sites. However, this cluster of apparently better Suffolk sites included those which, at the time of the survey, were rated moderately highly (eg Sizewell Belts, Tinkers Marsh, Shotley

Marshes) mixed with those rated decidedly poorly (eg Reydon Marsh). Two sites from south Cumbria clearly contain few species typical of southern marshes, despite samples being taken from a mix of peaty and brackish ditches.

Small sampling effort appears to influence the fidelity score, as many points in the lower part of the figure (scoring less than 0.75) are based on five or fewer samples, whereas most of those in the upper half are based on considerably more than this.

The trend shows a definite levelling-off once the fidelity score exceeds 0.75, despite the SQI continuing to rise markedly. This suggests that samples taken from most 'good' grazing marshes (SQI of 2 or more) have a good representation of grazing marsh specialists, and that there is no need to use another measure (such as a fidelity score) of whether the site has merit. There may be a need to look at the representation of such species if samples come from a predominantly arable landscape where the quality of the ditch fauna is being assessed for it potential in the event of a site's restoration to pasture.

In conclusion, there is uncertainty about whether the average fidelity score has much ecological meaning, in contrast to the clear meaning of SQI. The range of values would need comparing using a larger dataset that included other types of habitat, when it may become apparent that a score of 0.75 does represent a good and distinct assemblage of grazing marsh species rather than, say, one from any lowland pond.

4. Scoring surveyed grazing marshes

The present project requires grazing marshes to be rated as having local (county), regional, national or international importance for their invertebrate assemblages. This would help assess which sites should be retained as grazing marsh, and which could be sacrificed in the face of managed re-alignment of low-lying coasts.

Data for this assessment are based almost entirely on surveys, rather than records held by local records centres or national scheme organisers. This clearly omits a large amount of valuable information, but it is hoped that the approach taken here can be extended to other sites using such data, and of course to any other survey data not seen so far. The analysis concentrates on coastal sites where there is an immediate need for this information to assess how to select sites for managed re-alignment. Flood-plain marshes are covered only where information was readily to hand.

The most complete sets of data are for water beetles on which the analysis relies heavily. The reason is simply that these are surveyed consistently by all surveyors, whereas every other group is covered with varying degrees of thoroughness. Other groups are still taken into account in ranking sites.

Four categories of importance were suggested by English Nature: international, national, regional and local (county). The first was felt to be unworkable in the absence of comparable data from, say, The Netherlands or Belgium. No species, except for the snail *Vertigo moulinsiana*, listed in the Habitats and Species Directive is a typical inhabitant of grazing marshes, and the scarce occurrence of this snail does not seem good grounds for raising the status of sites to National importance; such a decision would be political and not ecological and I therefore leave it to others.

The categories used, with their meaning, were:

- Not classified - felt to be of less than county importance, but may still be a SINC.
- Local or County - candidate SSSI standard, assuming the Area of Search is the county.
- Regional - outstanding for its region.
- National (difficult to distinguish from Regional using firm criteria)

Grazing marshes with survey information are ranked according to the number of nationally rare and scarce species, the numbers of habitat-faithful species (using the results of the previous analysis) and Species Quality Index for water beetles, if available. Allocating sites to the four categories is courting disfavour and ridicule using the disparate data available, but it does provide a starting point for wetland invertebrates independently of any other conservation interest.

The project aims required different habitat elements of each site to be scored separately. Only three habitat categories of any importance were used: freshwater ditches, brackish water ditches and wetland. An early attempt to allocate species to different subdivisions, such as species of ponds, fens or dry ground, led to an unwieldy spreadsheet whose interpretation began to become increasingly subjective. Disentangling the species coming from each micro-habitat in an actual survey was also nearly impossible and, since nearly all surveys concentrated on ditches (and the occasional pond), the exercise became rather meaningless since most species, whatever their text-book preferences, where living in or by ditches. The general 'wetland' category is used as a blanket category to encompass species whose larvae may be amphibious or live in saturated ground, as well as genuine aquatic species.

As it is, the assessment of any site is still far from perfect as it relies mostly on the data available rather than any interpretation by the original surveyors (not often given!). This does lead to anomalous rankings, including that of sites surveyed by myself, but it was felt that the process would be more transparent if all data were treated on an equal footing.

No fast rules were used but, after the initial allocation of sites to each of four categories, the data were ordered by total fidelity score and SQI for water beetles, and anomalous allocations re-adjusted, taking other taxa into account. These two measures are plotted to show the spread of values for each of the categories of freshwater ditch assemblage (Figure 2) and the range of values for each category are given in Table 3, where it is obvious that single variables are of little help in placing sites. Some apparently anomalous outliers are for sites placed in different categories for their brackish or general wetland assemblages (notably Essex marshes).

If this approach is to be used more widely, every species needs to be assigned a fidelity score for every habitat and the data held in a database, not a spreadsheet. This would save many errors, a huge amount of time, and be available to anyone to 'play' with.

Marshes are identified using Dargie's (1993, 1995) codes for each block of lowland wet grassland as this will allow the information to be attached directly to English Nature's grazing marsh GIS.

The final allocation of sites and accompanying data are given in Appendix 2. Sites have then been ranked in order of national importance (Appendix 3). The ranking in appendix 3 sometimes differs slightly from those based on individual surveys in Appendix 2 and is an attempt to summarise the overall interest as grazing marsh habitat for invertebrates, therefore is more a value judgement than one based on numbers.

Table 3. Range of some variables for water beetles in four categories of site importance for freshwater ditch assemblages

Category of importance	Total fidelity score	Mean fidelity score	SQI	Species of conservation concern	
				Notable B	Notable A and RDB
Not classified	3 - 38	0.01 - 0.91	1.14 - 2.17	0 - 6	0 (1)
Local (= County)	12 - 79	0.40 - 1.11	1.81 - 2.91	4 - 21	0 - 5
Regional	18 - 77	(0.44) 0.60 – 0.95	2.33 – 3.46	8 - 21	2 – 6
National	31 - 81		2.27 – 3.89		

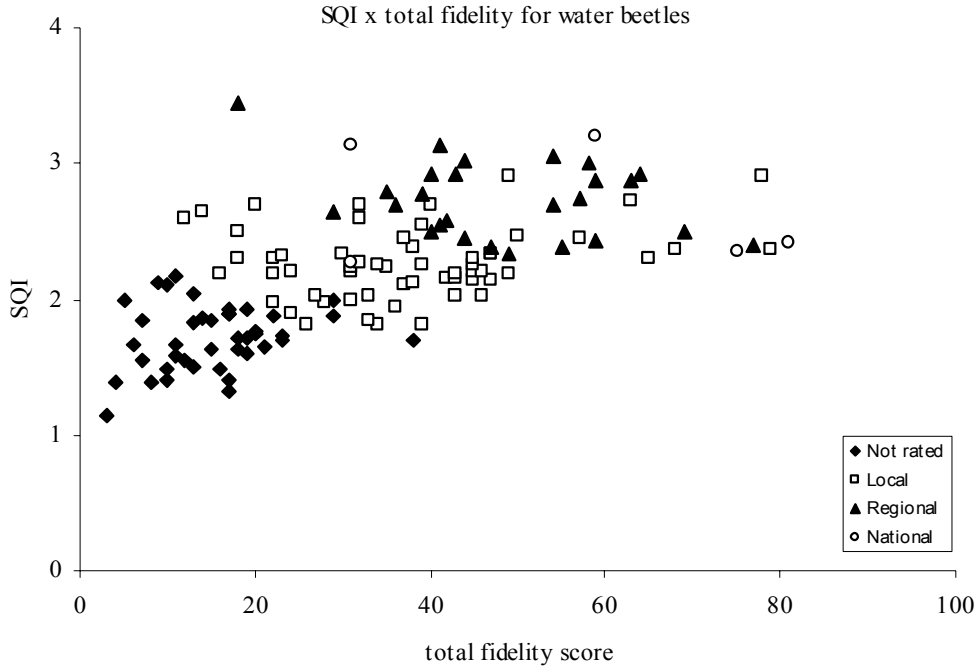

Figure 1. Species Quality Score against total fidelity score for water beetles in each importance class of grazing marsh (freshwater ditches only).

5. Sampling and survey methods for grazing marsh

5.1 Introduction

Methods for survey and monitoring invertebrates of wet grasslands are given in Benstead *et al* (1997) and are methods are reviewed by Jackson (1997) and Godfrey (2003), and so do not be repeated here. Additional background to methodologies is given below.

5.2 Aquatic fauna

5.2.1 Taxa to include

The range of aquatic taxa and their usefulness in evaluating grazing marshes is summarised in Table 3. This is meant as a guide and not to deter the enthusiastic from contributing to our understanding of the 'not worth the effort' groups. No assessment would be complete without water beetles, since this group is especially well known, has the best published comparable data for SQI, and is the most species-rich of the 'popular' groups in ditches. Molluscs and bugs can be disappointing in analyses since they lack a spread of rarity – they are nearly all common or local, and a few rarely encountered species have Red Data Book status, thus usually leaving a gap in the nationally scarce category. In brackish marshes, beetles and bugs remain useful, and large crustaceans (usually all common species) provide a very useful indication that a large suite of freshwater species will be missing.

Table 4. Aquatic taxa in grazing marsh surveys

Taxa	Most useful	Optional	Not worth the effort
Coleoptera	water beetles – the families keyed by Friday (1988)	weevils and chrysomelids with aquatic larvae; *Stenus* and *Paederus* within Staphylinidae	most larvae
Hemiptera	the families keyed by Savage (1989)	Saldidae	immature stages
Mollusca	the families keyed by Macan (1977); Succineidae *Sphaerium*	*Pisidium*, since they are difficult to identify accurately Amphibious taxa such as *Zonitoides*, *Vertigo*	
Odonata	all, although some separations are unreliable (eg *Coenagrion puella/ pulchellum*)		
Diptera larvae	Stratiomyidae (soldierflies)	Dixidae (meniscus midges) Culicidae (mosquitoes)	All other families, since keys are inadequate
Trichoptera larvae		Nearly all families, although few species are present	Hydroptilidae
Ephemeroptera larvae		All families, although few species are present	
Plecoptera		All families, although very few species are present	

Taxa	Most useful	Optional	Not worth the effort
Hirudinea		All, if done alive	rapidly preserved specimens
Crustacea	Isopods, amphipods and decapods (shrimps only) on brackish marshes	*Asellus*	Microcrustacea
Lepidoptera		aquatic Pyralidae	
Tricladida		All, if done alive	rapidly preserved specimens
Arachnida		*Argyroneta*, *Dolomedes*	
Annelida			all
Hydracharina			all

5.2.2 Effort needed

All the surveys examined for this report have used pond netting as the principal method, supplemented sometimes by direct searching or using a flour sieve or tea strainer at the water margin. Since pond netting is a qualitative method, the results obtained can vary hugely with the way it is used. Bratton (2000, 2001), motivated by the need to find a repeatable and reliable method of monitoring the Gwent Levels ditch fauna, reviewed some issues and made detailed and thorough comparisons of exisiting and new data, and it need not be repeated here. In brief, an important conclusion appears to be that it is probably not possible to specify a repeatable method as the variation between operators gives results that are as great as any caused by environmental changes. Differences occurred even between experienced and enthusiastic recorders working the same suite of sites (not necessarily the same ditches). With this as a background, the following is an attempt to recommend a method that will produce useful results for survey, even if it is less adequate for monitoring. I will assume that these surveys are being undertaken for nature conservation purposes, where there is an underlying sense of urgency in the face of destruction of the natural heritage and which requires the fullest picture of the fauna at any point. Maximising return for effort is the main priority, rather than perfecting reproducibility.

When evaluating sites using aquatic invertebrates, the following variables are often used:

- total species recorded at the site;
- total number of species in the following categories:
  - uncommon species (local, regionally or nationally scarce or rare, or on lists such as BAP, HSD or the Wildlife & Countryside Act);
  - species associated with important habitat features (eg brackish water, ponds);
- mean number of species per sample, or the mean of any of the above categories;
- scoring systems such as Species Quality Index or the proposed fidelity score.

Since total numbers recorded are proportional to sampling effort, variables that correct for this are better measures. Thus mean number per sample and scoring systems such as SQI are preferable to total numbers. For this reason, Appendix 2 (site ranking) gives the SQI and mean grazing marsh fidelity. The properties of SQI are fairly well understood, and the index gives reasonable results as long as there are more than about five beetles in the sample and ‘odd’ samples (eg a great rarity in a small sample) are viewed cautiously. The properties of

the new fidelity score are untested and may produce meaningless average values (as calculated here).

However, even mean (or median) values can depend upon sampling effort per sample, as the following data show, taken from surveys undertaken by myself using different sampling intensity.

- Samples from Gwent, Somerset, Essex and Suffolk were taken using the pond net to probe all the vegetation types in a stretch of about 10-60m of ditch, ignoring bottom sediments. After about 10-15 seconds of vigorous netting, the haul was tipped onto a polythene sheet and sorted until no 'new' species were found. The procedure was repeated for about 5-8 hauls, for a period of 40 minutes. Another 10 minutes was spent in a rapid search at the end to catch large fast diving beetles that may have escaped the previous more localised netting, and in searching the margins using a tea strainer or flour sieve. The exact times, number of net hauls and length of ditch searched varied a little since the first and last surveys were 20 years apart, but the effort was similar.
- Samples from the Yare valley, Norfolk, were taken using the method based on that proposed by Jackson & Howlett (1999), in an effort to use the same method for the whole of the Norfolk surveys sponsored by the Broads Authority. Samples consisted of three lots of 10 second netting taken 10m apart. The sample was lumped and excess vegetation removed before preserving the entire sample which was sorted dead in the laboratory. The was a misinterpretation the proposed methodology, and which was partially corrected in the following survey of the Bure.
- Bure (Norfolk) samples were collected in the same way but were sorted for ten minutes on the bank, as in the Somerset surveys. Five minutes, as proposed by Jackson & Howlett, was found to be completely inadequate.

Two different sampling intensities were therefore used, one with at least 30 minutes bank sorting and another with only 10 minutes. Clearly the comparison is further complicated by being at different marshes, different years and decades, and different times of year (most in spring, but some Somerset sites in mid to late summer; all Norfolk surveys in late September to October).

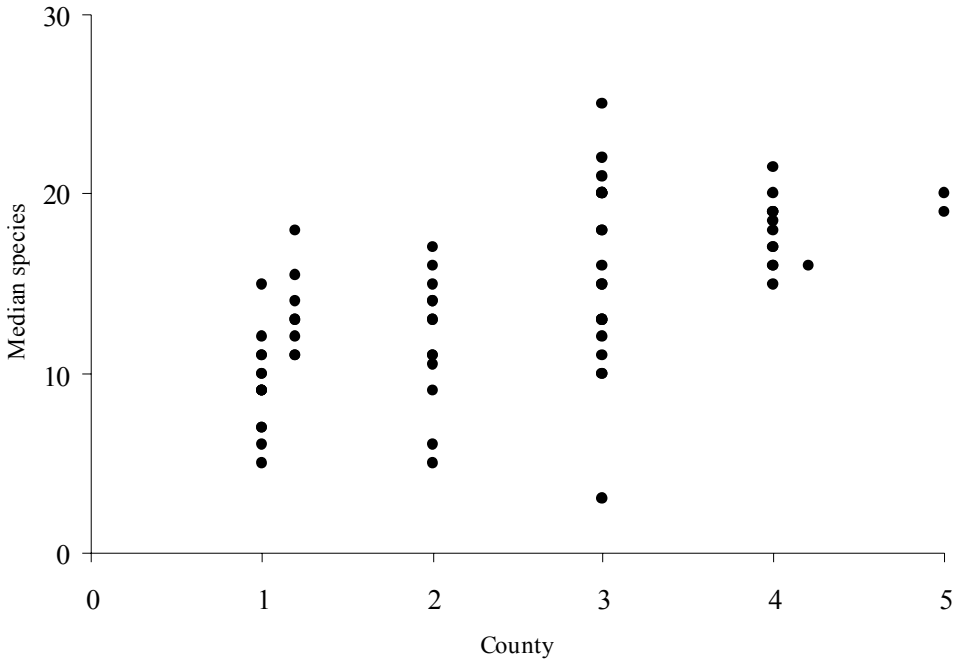

Figure 2. Median number of water beetles per sample from marshes in seven surveys from five counties. 1 – Norfolk (Yare then Bure), 2 – Suffolk, 3 – Essex; 4 – Somerset (Stert, 2003, to the right), 5 – Gwent.

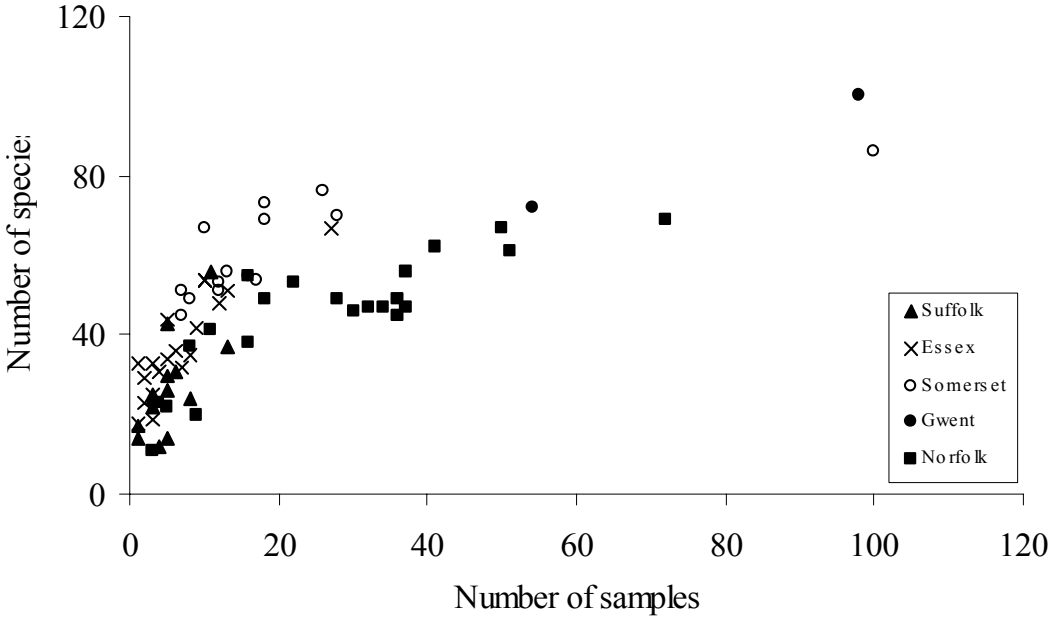

Figure 3. Number of species of water beetles against the number of samples for each marsh in seven surveys in five counties.

Total species may be used to compare sites if sampling effort can be taken into account. This was achieved by plotting the number of samples (= sampling effort) against the total number of water beetles in each marsh, for the same seven surveys used above for median species richness (Figure 3). Samples with markedly different methods, for example Somerset (O) and Essex (x) versus Norfolk (■) follow different curves. It is apparent that, with at least 30 seconds of netting and the 10 minutes of bank-sorting, about 20 samples would be needed to be fairly sure of collecting 50 species of beetles, whereas with less structured but longer netting time and at least 30 minutes bank-sorting, only about 10 samples would be needed. The figure of 50 species is taken from SSSI selection guidelines (NCC, 1989, p. 119) which states that 'To qualify for selection as an SSSI, a ditch system should normally contain a high diversity of invertebrates (eg after a thorough survey a list of over 50 species of water beetles …).'. Clearly, if sampling is intense, this level will be reached even on sites perhaps not meriting SSSI status, for example the extreme right-hand point in Figure 3 for Stert, Somerset, where 100 samples were taken.

Bratton (2001) showed that using a flour sieve collected more species of beetles but fewer water bugs than using a pond net. He used the sieve for 15 minutes per site, and of this time the sieve was 'working' for 65 seconds. Pond-netting consisted of six sweeps, each at right-angles to the bank and taken a few metres apart. His mean values for water beetles are rather lower than the medians shown in Figure 1, and this seems to show that a competent entomologist (Bratton) is merely hampered by the constraint of an inadequately standardised method that he was asked to follow.

Of more interest are Bratton's conclusions for variation through the year. He collected at two-monthly intervals from January to November, and showed relatively little consistent variation in both bugs and beetles through the year, although January collections were among the poorest for both beetles and bugs collected by either sieve or pond net. This suggests that survey can take place from March to November without missing an unduly large proportion of the fauna.

Bratton illustrated the problem, also seen in Figure 3, that even after several collecting sessions the accumulated species remain a long way from the probable maximum present at a site. Although he proposed 'stopping rules' by which a surveyor would know when a reasonable number of species had been collected, there is no practical method that can be applied during a session, nor one that would not lead to confusion about the sampling effort, and therefore how other workers may repeat a survey. It is likely that most experienced surveyors, such as those who undertook the surveys used for Appendix 2 (site ranking) in this report, worked until no obviously new species were found and a reasonable number of specimens of species-groups inseparable in the field had been collected for later examination. Clearly this method of working depends upon the surveyors being experienced.

Ditch vegetation is exceedingly varied. Most beetles hide within vegetation, and mostly in marginal vegetation, whereas plenty of snails and bugs can be collected in more open conditions in vegetation in the centre of a ditch, and corixids can be numerous over bare sediment. A single raft of vegetation or clump of submerged *Juncus* left after a ditch has been cleaned may contain a fair number of species, and conversely a dense tangle of *Lemna trisulca* will fill the net with weed before even a few species are found. Therefore, the way in which a net is used, and in sort of places that are probed, makes a large difference to the catch. Trying to take a standard sweep does not work. The effort must instead be standardised by working for a set period or until no new 'species' are recorded.

This brief review and analysis shows that the issues that a standard method needs to overcome are:

- sampling effort must involve more than 30 seconds netting, and perhaps as much as 3 minutes per sample;
- bank sorting, if undertaken in preference to laboratory sorting, must take more than 10 minutes but perhaps less than 40 minutes;.
- at least ten ditches must be sampled on a marsh to be sure that a site fails to meet SSSI quality for water beetles (assuming that the figure of 50 species of water beetles is about right as a threshold).

5.2.3 Proposed methods

Aquatic survey

It is proposed that surveys should include:

- selecting a stretch of ditch containing some vegetation, preferably including rafts at the margins;
- free-style netting, with any other collecting methods used as an adjunct, to cover the range of vegetation structure but not necessarily in proportion to their abundance (so differing from the National Pond Survey (Pond Action, 1994) method);
- repeated netting with bank-sorting between dips;
- collecting vouchers, or recording on a form, the readily identifiable species, and collecting a series of species that cannot be identified in the field;
- continuing to record for 30 minutes, during which time at least 5 net hauls or equivalent samples (eg using a sieve) will have been taken.

Some workers prefer to sort samples after preservation or live in the laboratory. So long as the effort spent collecting the samples is similar to that proposed above, this should not matter to the results. Preserving samples in the field may save perhaps 25 of the 30 minute bank-sorting time, but will take many hours instead in the laboratory, although there may be a slight increase in the number of species recorded (eg compare the Bure (live sorted) and Yare (dead-sorted) medians in Figure 2). Mechanically preserving samples after collecting them allows an experienced surveyor no opportunity to vary sampling to maximise the return – there is a lot to be said for the old-fashioned gentleman-naturalist's approach to survey since survey is expensive.

5.2.4 Terrestrial sampling

As so many terrestrial groups can be found on grazing marshes, it is inappropriate to list them. Wetland groups that have been shown to be useful in site evaluation are many families of beetles (notably Carabidae, Staphylinidae, Coccinellidae, Chrysomelidae, Curculionidae and Scirtidae) and flies (notably Stratiomyidae, Dolichopodidae, Empididae, the several families of craneflies, Tabanidae, Sciomyzidae and Syrphidae; but many others too). Rather

fewer surveyors have produced useful results using bugs (except for Saldidae), spiders and moths but this may reflect lack of coverage in surveys since these groups contain many wetland species. Dry parts of grazing marshes, such as sea defence walls, can support bees and wasps but there appear to be none characteristic of grazing marsh. Although stray saltmarsh, dune, reedbed and fenland species have been recorded, the groups is not worth the effort unless there is good reason, such as old reedbed around ditches, or particularly floriferous banks in otherwise desolate surroundings.

Methods that will record a range of species useful for site evaluation are sweep netting and water trapping for flying species and those on vegetation, pitfall trapping for ground-dwelling groups such as ground carabid and staphylinid beetles, and direct observation for dragonflies (with occasional netting of difficult species). Groups that are less likely to be useful in evaluation are moths, since records from light-trap catches cannot be localised, and butterflies, since there are no grazing marsh specialists. Details of these methods are given by Sheppard (1991).

If there are problems with deriving a standard method for aquatic sampling, it is far worse for terrestrial work. Very few surveyors of the works examined for this report specify their method. In a survey of Somerset and Gwent ditches, sampling each ditch lasted for 30 minutes, during which time individuals were observed directly, collected individually or collected using a light sweep net from which insects were removed using a pooter (Drake *et al*, 1984, Drake 1986). The length of ditch surveyed was probably shorter than 100m, but will have varied depending on the vegetation available. It was felt that the sample was fairly complete after 30 minutes, although each sample from the Gwent Levels contained on average only 11% (64 species) of the *c*.600 total recorded. Recent surveys of other habitats in which a sample time of 10 minutes was used was felt to be unsatisfactory as, when replicate samples were taken, a large proportion of this time was spent re-recording the dominant species, while those scarce on the site were probably repeatedly missed.

In view of the lack of standard methods for terrestrial invertebrates in any habitat, it seems inappropriate to suggest one specifically for grazing marshes. It is worth pointing out, though, that sampling should not be confined to the wetland element at ditches and ponds but should include dry banks, tracks and areas of ruderal vegetation which sometimes support species of dry places (eg grasslands, dunes), hedges, isolated bushes and trees (especially willows), and wet grassland if this is floristically rich. Most grass swards on grazing marshes tend to be dull and are not worth devoting time to.

6. References

These include reports that have not been seen and are not referred to in this work. It is unlikely to be a complete list but will include most unpublished reports undertaken in England. Where relevant, the reference is annoted with the county and species or major taxa if only one is involved. Some Thames marshes in Greater London are allocated to nearby Kent or Essex for simplicity; Sussex is treated as one county.

	Area	Species
ABRAHAM, F. ALLEN, S.D., HODGE, P.J. & WILLING, M.J. 1997. *A survey of the flora and selected invertebrate groups of the ditches of the Lower Arun Valley 1997.* Unpublished report to Arun District Council.	Sussex	
AERC. 1998. *Rainham Marsh Ecological Ditch Survey. Applied Environmental Research Centre.* Unpublished report No. 74004 to Havering Riverside.	Essex	
ANDERSON, M., HILL-COTTINGHAM, M.P. & DUFF. A.G. 1991. *Avon invertebrate survey.* Unpublished report by Somerset Ecology Consultants for English Nature. 36p.	Somerset	
ANDERSON, M., HILL-COTTINGHAM, M.P. & DUFF. A.G. 1992. *Invertebrate survey of ditches on the Avon Levels and Moors.* Unpublished report by Somerset Ecology Consultants for English Nature. 36p.	Somerset	
ARGUS ECOLOGICAL SERVICES. 1999. *Gwent Levels Wetland Reserve, Uskmouth. Freshwater invertebrate survey.* Unpublished report	Gwent	
ARMITAGE, P.D. 1981. *A survey of the aquatic invertebrates of the Somerset Levels, August 13-14, 1981.* Unpublished report for English Nature. 17p.	Somerset	
ARMITAGE, P.D., SZOSZKIEWICZ, K., BLACKBURN, J.H. & NESBITT, I. 2003. Ditch communities: a major contributor to floodplain biodiversity. *Aquatic Conservation,* **13**: 165-185.	Dorset	
AUSDEN, M.J. 1995. *The effects of raising water levels on invertebrates in lowland wet grassland - implications for the management of lowland wet grassland for breeding waders. Second year progress report.* University of East Anglia.		
AUSDEN, M.J. 1997. The effects of raising water levels on invertebrate food supply for breeding waders on lowland wet grassland. *In*: R.D. SHELDRICK, 1997. Grassland management in the 'Environmentally Sensitive Areas'. *Occasional Symposium* No. 32, British Grassland Society, 1977.		
AUSDEN, M.J. date? *The soil macroinvertebrate fauna of lowland wet grassland and the effects of winter flooding on soil macroinvertebrate biomass.* (draft)		
AUSDEN, M., BANKS, B., DONNISON, E., HOWE, M., NIXON, A., PHILLIPS, D., WICKS, D. & WYNNE, C. 2002. The status, conservation and use of the medicinal leech. *British Wildlife,* **13**, 229-238.	Kent	*Hirudo medicinalis*
BALL, S.G. 1990. *Department of Transport A13 improvements. Ferry Lane to London Road section. Proof of evidence.* Unpublished report for Nature Conservancy Council. 2 vols.	Essex	
BEALE, G. & DOBERSKI, J., 2002. Nursery web site selection by *Dolomedes plantarius* (Clerk, 1757) on the Pevensey Levels, East Sussex. *British Arachnological Society Newsletter,* **95,** pp. 12-13.		*Dolomedes plantarius*

BEER, T., 1983. *Braunton Marsh survey, 1983. Odonata species.* Unpublished report for nature Conservancy Council. 1p.	Devon	Odonata
BELDEN, P., 1987. *Pevensey Levels dragonflies.* Unpublished report for Nature Conservancy Council and East Sussex County Council. 61p.	Sussex	Odonata
BELTMAN, B., 1984. Management of ditches. The effect of cleaning of ditches on the water coenoses. *Verh. Internat. Verein. Limnol.* **22**, pp. 2022-2028.	Netherlands	
BENSTEAD, P.J., JOSE, P.V., JOYCE, C.B. & WADE, P.M., 1999. *European wet grassland. Guidelines for management and restoration.* Sandy: RSPB.		
BENSTEAD, P., DRAKE, M., JOSÉ, P., MOUNTFORD, O., NEWBOLD, C. & TREWEEK, J., 1997. *The wet grassland guide: managing floodplain and coastal wet grasslands for wildlife.* RSPB, English Nature and ITE.		
BOOTH, F., 1992. *Botanical and invertebrate survey*. Unpublished report to Gillingham Borough Council.	Kent	
BOYCE, D., 2000. The ecology and distribution of the lesser silver water beetle *Hydrochara caraboides* on the Somerset Levels, 2000. Interim report.		*Hydrochara caraboides*
BOYCE, D., in prep. The ecology and distribution of the lesser silver water beetle *Hydrochara caraboides* on the Somerset Levels, 2000.		*Hydrochara caraboides*
BRATTON, J.H., 2001. A comparison of the efficiency of pond net and sieve for catching aquatic beetles and aquatic bugs over the course of a year in a grazing levels ditch in Maltreath Marsh, Anglesey, Wales. *Countryside Council for Wales Natural Science Report* No. 01/5/1.	Anglesey	
BRATTON, J.H., 2002. A possible method for assessing the thoroughness of invertebrate surveys and the success of mitigation schemes in the Gwent Levels. *Countryside Council for Wales Natural Science Report* No. 00/5/1.	Gwent	
BRATTON, J.H., 2002. *Aquatic invertebrates recorded in the Gwent Levels: introduction, checklist and bibliography*. Countryside Council for Wales *Natural Science Report* No. 02/5/2.	Gwent	
BRISTOL, BATH AND AVON WILDLIFE TRUST, 1997. *Dragonfly Survey 1997 of Tickenham, Nailsea and Kenn Moors and Congresbury Moor (North)*. Unpublished report.	Somerset	Odonata
BROOKER, M.P., 1976. The ecological effects of the use of Dalapon and 2,4-D for drainage channel management. 11. Fauna. *Archive fur Hydrobiologie,* **78**, pp. 507-525.		
BROWN, A.L., 1983. *Survey of aquatic fauna in two ditches transecting Braunton Marsh*. Unpublished report for Nature Conservancy Council. 2p.	Devon	
CARR, R., 1984. *A survey of the aquatic Coleoptera of the Pevensey Levels.* Unpublished report for Nature Conservancy Council. 24p.	Sussex	Coleoptera
CARR, R., 1985. Aquatic Coleoptera on the Pevensey Levels. *Balfour-Browne Club Newsletter* No. 32, pp. 7-8.	Sussex	Coleoptera
CARR, R., 1986. *A survey of the aquatic Coleoptera of the Dartford and Crayford Marshes, 1986.* Unpublished report for Nature Conservancy Council. 7p.	Kent	Coleoptera
CARR, R., 1987. Water beetles of the Dartford and Crayford Marshes. *Balfour-Browne Club Newsletter* No. 39, pp. 6-7.	Kent	Coleoptera
CARR, R., 1995. *A survey of the aquatic Coleoptera on the North Kent Marshes October 1995.* Unpublished report to English Nature.	Kent	Coleoptera

CARR, R., 2000. *A survey of the aquatic Coleoptera on High Halstow and Elmley RSPB Reserves*. Unpublished report to RSPB.	Kent	Coleoptera
CARR, R. & PHILP, E.G., 1988. A summary of recent records of aquatic Coleoptera in Kent. *Entomologist's Gazette,* **39**, pp. 211-226.	Kent	Coleoptera
CASPERS, H. & HECKMAN, C.W., 1981. Ecology of orchard drainage ditches along the freshwater section of the Elbe Estuary. *Arch. Hydrobiol. Supplemen*t, **43**, pp. 347-486.	Germany	
CHARMAN, K., PALMER, M. & PHILP, E.G., 1985. Survey of aquatic habitats in the north Kent marshes. *Transactions of the Kent Field Club*, **10** (1), pp. 19-32.	Kent	
CLANCY, S., 2000. The Marsh Mallow Moth *Hydraecia osseola* ssp *hucherardi* survey 2000. *Butterfly Conservation Report* No. S010.	species	*Hydraecia osseola*
CLANCY, S., 2001. The Marsh Mallow Moth *Hydraecia osseola* ssp *hucherardi* survey 2001. *Butterfly Conservation Report* No. S010-50.	species	*Hydraecia osseola*
CLARE, P., 1979. *The distribution of aquatic macroinvertebrates in the Gwent Levels.* Unpublished PhD Thesis, University of Wales Institute of Science and Technology. 322p.	Gwent	
CLARE, P. & EDWARDS, R.W., 1983. The macro-invertebrate fauna of the drainage channels of the Gwent Levels, South Wales. *Freshwater Biology,* **13**, pp. 205-225.	Gwent	
CLEMONS, L., 1982. A survey of the flora and fauna of Murston Marshes. *Transactions of the Kent Field Club*, **9**, pp. 31-64.	Kent	
CLEMONS, L. 1984. Some interesting Diptera records from North Kent in 1982. *Entomologist's Record* **96**, 202-206.	Kent	Diptera
CLEMONS, L., 1995. *English Nature 1995 North Kent Marshes invertebrate surveys.* Unpublished report to English Nature.	Kent	
COOTER, J., CROPPER, R., HECKFORD, R. G., McLEAN, I. F. G., PALMER, M. & STUBBS, A.E., 1981. *A survey of the invertebrates of the Somerset Levels, June 1979.* Unpublished report for Nature Conservancy Council.	Somerset	
CROPPER, R., 1985. *Invertebrate fauna of ditches [at Westhay Moor] recorded by R. Cropper in Sept. 85*. Unpublished results of survey. [species list included in D.A. SHEPPARD, 1987. *An invertebrate survey of selected ditches on Westhay Moor SSSI.* Unpublished report for Nature Conservancy Council. 26p]	Somerset	
CROSSLEY, R., 1987. *Derwent Ings Survey 1987.* Unpublished report.	Yorkshire	
CROSSLEY, R., 1991. *Wheldrake Insect Survey 1990*. Unpublished report.	Yorkshire	
CROSSLEY, R., 1993. *Derwent Ings NNR: Drains and Dykes Invertebrate Survey 1992*. Unpublished report.	Yorkshire	
CROSSLEY, R., Undated. *Derwent Ings Insect Survey. 1987-1989.* Unpublished report.	Yorkshire	
CROSSLEY, R., Undated. *Derwent Ings NNR Master List for Invertebrates to the end of 1992*. Unpublished report.	Yorkshire	
CURSON, S., HODGE, P J., RYLAND, K. & WILLING, M.J., 2002. *Baseline biological survey of the Lower Ouse Valley 2002*. Unpublished report to English Nature, Lewes.	Sussex	
DARGIE, T.C., 1993. The distribution of lowland wet grassland in England. Peterborough: *English Nature Research Reports,* No. 49.	England	

DARGIE, T.C., 1995. Lowland wet grassland resource survey: Module 2. Vol. 1: Biota reference inventory [six reports for north west, west Midlands, east, south west, south and south east regions]. Peterborough: *English Nature Research Reports*, No. 149, 6 vols.	England	
DARGIE, T.C., 1995. Lowland wet grassland resource survey: Module 2. Vol. 2: Biota reference. Inventory and quality profiling report. Peterborough: *English Nature Research Reports,* No. 149.	England	
DAVIDSON, N.C. *et al,* 1991. *Nature Conservation and Estuaries in Great Britain*. Peterborough, Nature Conservancy Council, pp 120-125.	Britain	
DAWSON, I & DAWSON, D., 2000. *Invertebrates recorded at Shorne Marshes, 3 June 2000.* Unpublished report to RSPB.	Kent	
DENTON, J., 1991. *The water beetles of 'The Dowels' part of the Walland Marsh SSSI, Kent*. Unpublished report to English Nature.	Kent	Coleoptera
DRAKE, C.M., 1986. *Entomological survey of the main sites affected by the proposal to build the channel tunnel*. England Field Unit Project No. 45a. Peterborough: Nature Conservancy Council. 73pp.	Kent	
DRAKE, C.M., 1986. *A survey of the invertebrates of the Gwent Levels*. Contract Surveys No. 1, Nature Conservancy Council. 222pp.	Gwent	
DRAKE, C.M., 1987. Dragonflies of the Gwent and Somerset Levels and Moors. *Journal or the British Dragonfly Society*, **3,** pp. 1-4.	Gwent	Odonata
DRAKE, C.M., 1987. *Meromyza hispanica* Fedoseeva 1971 (Dipt., Chloropidae) new to Britain. *Entomologist's monthly Magazine*, **123**, pp. 217-218.		*Meromyza hispanica*
DRAKE, C.M., 1987. Taxonomic and ecological notes on the British *Scirtes* (Coleoptera: Scirtidae). *Entomologist's Gazette*, **38**, pp. 83-85.		Scirtes
DRAKE, C.M., 1988. *A survey of the aquatic invertebrates of the Essex grazing marshes, 1987*. England Field Unit Project No. 50a. Peterborough: Nature Conservancy Council. 100pp.	Essex	
DRAKE, C.M., 1988. *A survey of the aquatic invertebrates of the Suffolk grazing marshes*. England Field Unit Project No. 50b. Peterborough: Nature Conservancy Council. 84pp.	Suffolk	
DRAKE, C.M., 1988. Diptera from the Gwent Levels, South Wales. *Entomologist's monthly Magazine*, **124**, pp. 37-44.	Gwent	Diptera
DRAKE, C.M., 1988. Water beetles of the Gwent Levels. *Balfour Brown Club Newsletter*, **43**, pp. 13-15.	Gwent	Coleoptera
DRAKE, C.M., 1989. *A brief survey of the aquatic invertebrates in the vicinity of the Sizewell power station.* England Field Unit Project No. 112. Peterborough: Nature Conservancy Council.	Suffolk	
DRAKE, C.M., 1989. *A rapid survey of the Lewes Brooks for rare invertebrates*. England Field Unit Project No. 106. Peterborough: Nature Conservancy Council.	Sussex	
DRAKE, C.M., 1989. *Somerset and Avon aquatic invertebrate survey, 1989.* England Field Unit Project No. 107. Peterborough: Nature Conservancy Council. 66pp.	Somerset	
DRAKE, C.M., 1990. Larval records of *Lestes dryas* in Essex. *Journal of the British Dragonfly Society*, **6**, pp. 34-41.		*Lestes dryas*
DRAKE, C.M., 1990. *Monitoring the invertebrate interest on Wennington Marsh, Inner Thames Estuary SSSI.* England Field Unit Project No. 130, Nature Conservancy Council. 14pp.	Essex	

DRAKE, C. M. 1990. *Terrestrial invertebrates of Ridham and Coldharbour Marshes, part of the Swale SSSI extension, Kent*. England Field Unit Project No. 134. Peterborough: Nature Conservancy Council.	Kent	
DRAKE, C.M., 1991. *A rapid survey of the invertebrates of the Kennet Valley near Hungerford*. Unpublished report to Nature Conservancy Council.	Berkshire	
DRAKE, C.M., 1991. Ephemeroptera and Plecoptera in freshwater and brackish grazing marshes in England and Wales. *Entomologist's Gazette*, **42**, pp. 45-59.	England	Ephemeroptera, Plecoptera
DRAKE, C.M., 1991. The condition of *Lestes dryas* Kirby (Odonata) larval populations in some Essex grazing marshes in May, 1990. *Journal of the British Dragonfly Society*, **7**, pp. 10-17.		*Lestes dryas*
DRAKE, C.M., 1991. *A brief survey of the aquatic invertebrates of the drainage ditches of the grazing marsh of the Lyth Valley and Foulshaw Mosses*. Unpublished report. Peterborough: English Nature. 11p.	Cumbria	
DRAKE, C.M., 1998. The important habitats and characteristic rare invertebrates of lowland wet grassland in England. *In*: C.B. Joyce and P.M. Wade, eds. *European wet grasslands: biodiversity, management and restoration*. John Wiley, pp 137-149.	England	
DRAKE, C.M., 2002. *A survey of the aquatic molluscs and beetles of the Yare Valley, 2001*. Unpublished report to The Broads authority.	Norfolk	
DRAKE, C.M., 2003. *A survey of the aquatic invertebrates of the Stert Peninsula*. Unpublished report to English Nature.	Somerset	
DRAKE, C.M., 2003. *A survey of the aquatic molluscs and beetles of the Bure Valley, 2002*. Unpublished report to The Broads authority.	Norfolk	
DRAKE, C.M., (in press but symposium volume never published!). Factors influencing the species richness of aquatic invertebrates in grazing marsh ditches. In: *Nature conservation and the management of drainage system habitat*. Ed. J Harpley. Symposium held at Nottingham University, September 1993. International Centre for Landscape Ecology.	England	
DRAKE, C.M. & SHEPPARD, D.A., 1998. Changes in the fortunes of invertebrates of floodplain habitats. In: *United Kingdom Floodplains*. pp 229-236. Westbury Publishing.	England	
DRAKE, C.M., FOSTER, A.P. & PALMER, M., 1984. *A survey of the invertebrates of the Somerset Levels and Moors*. Chief Scientist Team Report, Nature Conservancy Council. 354pp.	Somerset	
DRISCOLL, R. J., 1973. *A survey of the aquatic macrophyte flora and aquatic vertebrate and invertebrate fauna in drainage dykes at Hemsby, Norfolk, carried out by David J. Harcombe and Robert J. Driscoll, summer 1973*. Unpublished report. 13p.	Norfolk	
DRISCOLL, R.J., 1975. *The Thurne catchment area: supplement.* Unpublished report for Nature Conservancy Council. 66p.	Norfolk	
DRISCOLL, R.J., 1975. [*Broadland dyke survey, 1975*]. Unpublished results of survey. 188 record sheets.	Norfolk	
DRISCOLL, R.J., 1976. *The aquatic macrophyte flora and aquatic vertebrate and invertebrate fauna of Holkham Lake and the dykes draining the reclaimed marshes, Holkham National Nature Reserve, Norfolk.* Unpublished report for Nature Conservancy Council. 78p.	Norfolk	
DRISCOLL, R.J., 1976. *Broadland dyke survey (maps).* Nature Conservancy Council. 8 microfiches (CST Report no 139).	Norfolk	

DRISCOLL, R. J., 1978. *Survey of the aquatic macrophyte flora and aquatic vertebrate and invertebrate fauna of Holkham Lake and the dykes draining the reclaimed marshes, Holkham National Nature Reserve, Norfolk. Distribution maps of the aquatic vertebrates and invertebrates recorded in the lake and dykes, summer 1975.* Unpublished report for Nature Conservancy Council. 109p.	Norfolk	
DRISCOLL, R.J., 1978. A preliminary report on the distribution of water beetles in Broadland dykes. *Balfour-Browne Club newsletter,* **8**, pp. 3-14.	Norfolk	Coleoptera
DRISCOLL, R.J., 1981. *A biological survey of the upper reaches of the River Wensum and its tributaries, carried out by R. E. Baker, R. J. Driscoll and P. W. Lambley, 1976-1977.* Unpublished report. 3 vols.	Norfolk	
DRISCOLL, R.J., 1981. *Distribution maps of aquatic vertebrates and invertebrates recorded from drainage dykes in Happisburgh-Winterton internal Drainage board sub-areas 1 and 2, summer 1973.* Unpublished report. 104p.	Norfolk	
DRISCOLL, R.J., 1981. *Distribution maps of aquatic vertebrates and invertebrates recorded from drainage dykes in Happisburgh-Winterton internal Drainage board sub-areas 1 and 2, summer 1974.* Unpublished report. 95p.	Norfolk	
DRISCOLL, R.J., 1982. *Distribution maps of aquatic vertebrates and invertebrates recorded from drainage dykes in Happisburgh-Winterton internal Drainage board sub-areas 1 and 2, summer 1981.* Unpublished report. 89p.	Norfolk	
DRISCOLL, R.J., 1983. Broadland dykes: the loss of an important wildlife habitat. *Transactions of the Norfolk and Norwich Naturalists' Society,* **26**, pp. 170-172.	Norfolk	
DRISCOLL, R.J., 1984. *Distribution maps of aquatic vertebrates and invertebrates recorded from drainage dykes in Happisburgh-Winterton internal Drainage board sub-areas 1 and 2, summer 1982.* Unpublished report. 106p.	Norfolk	
DRISCOLL, R. J., 1986. Changes in land management in the Thurne catchment area, Norfolk, between 1973 and 1983 and their effects on the dyke flora and fauna. In: *Proceedings of the European Weed Research Society / Association of Applied Biologists 7th International Symposium on Aquatic Weeds, 1986,* pp. 87-92.	Norfolk	
DRISCOLL, R.J., 1986. The effect of changes in land management on the dyke fauna at Somerton and Winterton. *Transactions of the Norfolk and Norwich Naturalists' Society,* **27**, pp. 218-220.	Norfolk	
DRISCOLL, R.J. & LEES, A.J., 1973. *Broadland dyke survey Distribution maps, using a 1-km grid system, of the aquatic vertebrates and invertebrates recorded in drainage dykes in Broadland, summer 1972*. Unpublished report for Nature Conservancy Council. 165p.	Norfolk	
DRISCOLL, R.J. & LEES, A.J., 1973. *The Thurne catchment area: a survey of land use, drainage and the flora and fauna of drainage dykes.* Unpublished report for Nature Conservancy Council. 78p.	Norfolk	
DUFF, A., 1993. *Beetles of Somerset - their status and distribution*. Somerset Archaeological and Natural History Society.	Somerset	Coleoptera
EDWARDS, M., 1992. *Lower Test N. R. aculeate Hymenoptera survey, 1992*. Unpublished report. 18p.	Hampshire	Hymenoptera
EDWARDS, M., 1994. *Report on the entomological survey of Winnall Moors Nature Reserve, March to October 1994.* Unpublished report. 16p.	Hampshire	

EDWARDS, M., 1996. *Report on entomological survey of areas within Titchfield Haven NNR, July to October 1996.* Unpublished report to Hampshire County Council. 25p.	Hampshire	
EDWARDS, M., 1999. *Hymenoptera records for NKM - including Bombus sylvarum*. Copy held in site file at English Nature, Kent.	Kent	Hymenoptera
EDWARDS, M., 2000. *An entomological survey of RSPB reserves, 2000 (Rainham, Ramsey Island and Strumpshaw), plus results of malaise trap survey of Abernethy, 1999*. Unpublished report to RSPB. 57p.	Essex, Suffolk	
EDWARDS, M. ,2001. *An entomological survey of Mershead RSPB reserve, 2001.* Unpublished report to RSPB. 17p.	?Dumfries	
EDWARDS, M., 2001. *Entomological survey of Meadow Marsh, RSPB Minsmere: July - September 2001.* Unpublished report to RSPB. 20p	Suffolk	
EDWARDS, M., 2002. *Report on invertebrate habitat features on selected reserves, 2002.* Unpublished report to Hampshire and Isle of Wight Wildlife Trust. 161p.	Hampshire	
EDWARDS, M. & HODGE, P., 1997. *An entomological survey of Tournerbury Farm, Hayling Island.* Unpublished report . 9p.	Hampshire	
EDWARDS, M. & HODGE, P., 2000. *An entomological survey of Hacketts Marsh.* Unpublished report to Hampshire County Council. 24p.	Hampshire	
ELLISON, M., 1998. *Lestes dryas: north-west Kent Marshes, 1998.* Unpublished report to RSPB.		*Lestes dryas*
ENVIRONMENT AGENCY. No date. [*Pevensey Levels Study - no title provided*]. Unpublished report. Worthing: Environment Agency.	Sussex	
ENVIRONMENTAL ADVISORY UNIT LTD., 1990. *Aquatic invertebrate survey of the ditches of the Caldicot Levels: October 1990.* Unpublished report.	Gwent	
EVERSHAM, B.C., 1990. *Inner Thames Marshes SSSI (Rainham), invertebrate survey 1990, 2nd interim report.* Unpublished report for Institute of Terrestrial Ecology. 68p. [draft of appendices only]	Essex	
EVERSHAM, B.C. & GREATOREX-DAVIES, J.N., 1989. *Inner Thames Marshes SSSI, Rainham. Report on preliminary invertebrate survey at Wennington and Aveley Marshes*. Unpublished report for Institute of Terrestrial Ecology. 66p.	Essex	
EXTENCE, C. & CHADD, R., 1996. *The conservation of aquatic macroinvertebrates populations - a community based classification scheme.* Environment Agency, Anglian Region (Northern Area). April 1996, 35p.		
FARRELL, L. & PALMER, M., 1980. *Brief survey of Amberley Wildbrooks and Coldwaltham Canal - July 1979.* Unpublished report for Nature Conservancy Council. 8p.	Sussex	
FLINT, J.H., 1987. *Insect Survey, Derwent Ings, 1987*. Unpublished report.	Yorkshire	
FOSTER, A.P., 1983. Modern water beetle records from the Somerset Levels and Moors. *Balfour-Browne Club Newsletter,* No.**30**, pp. 11-23.	Somerset	Coleoptera
FOSTER, A.P., 1983. Water beetles of the Romney Marshes. *Balfour-Browne Club Newsletter,* No.**28**, pp. 4-7.	Kent	Coleoptera
FOSTER, A.P. & JACKSON, P.K., 1999. *Blakeney Freshes, Norfolk.* Unpublished report to National Trust.	Norfolk	
FOSTER, A.P. & LISTER, J.A., 1994. *Chyngton Farm, East Sussex*. Unpublished report to National Trust.	Sussex	
FOSTER, A.P. & LISTER, J.A., 1998. *Heigham Holmes, Norfolk*. Unpublished report to National Trust.	Norfolk	

FOSTER, A.P. & LISTER, J.A., 2002. *Fairlight, East Sussex.* Unpublished report to National Trust.	Sussex	
FOSTER, A.P., JACKSON, P.K. & LISTER, J.A., 1994. *Frog Firle Farm, East Sussex.* Unpublished report to National Trust.	Sussex	
FOSTER, G.N., 1980. And several more water beetles from the Somerset Levels. *The Balfour-Browne Club Newsletter,* **17**: pp. 3-4.	Somerset	Coleoptera
FOSTER, G.N. (in prep). *A review of the scarce and threatened Coleoptera of Great Britain. Part 3. Aquatic Coleoptera.* Peterborough: Joint Nature Conservation Committee.		Coleoptera
FOSTER, G.N. & EYRE, M.D., 1992. Classification and ranking of water beetle communities. *UK Nature Conservation*. Peterborough: Joint Nature Conservation Committee.		Coleoptera
FOSTER, G.N., FOSTER, A.P., EYRE, M.D. & BILTON, D.T., 1990. Classification of water beetle assemblages in arable fenland and ranking of sites in relation to conservation value. *Freshwater Biology,* **22**, 343-354.	Fenland	Coleoptera
FRIDAY, L.E., 1988. A key to the adults of British water beetles. *Field Studies,* **7**, pp. 1-151.		
GIBBS, D.J., 1985. *The invertebrates of the Kennet Valley (1985). A comparative assessment of sites in the Kennet Valley for their entomological value*. Unpublished report.	Berkshire	
GIBBS, D.J., 1991. *A quantitative base-line survey of the invertebrates of the Gwent Levels, 1991.* Unpublished report for Countryside Council for Wales, South Wales Region. 222p.	Gwent	
GIBBS, D.J., 1993. *Invertebrate survey of Fobbing Marsh ditch system 24 May - 3 June 1993.* Unpublished report 58p.	Essex	
GIBBS, D.J., 1993. *Ouse Washes SSSI: invertebrate survey of ditch system. July and September 1993.* Unpublished report for English Nature	Cambridgeshire	
GIBBS, D.J., 1994. *A survey of the invertebrate fauna of ditches on the Somerset Levels and Moors*. Unpublished report for English Nature, Somerset and Avon Team.	Somerset	
GIBBS, D.J., 1994. *A survey of the invertebrate fauna of the Somerset Levels*. Unpublished report for English Nature, Taunton.	Somerset	
GIBBS, D., 1999. [*Aquatic Invertebrate survey of Weston Fen* or similar title] Unpublished report to Avon Wildlife Trust.	Somerset	
GODDARD, D.G., 1981. *River Soar - report of survey of aquatic and riparian invertebrates, 1980*. Leicester: Leicestershire Museums, Art Galleries and Records Service. 40p. (Leicestershire Museums publication no 33.)	Leicestershire	
GODDARD, D.G., 1981. *Soar and Trent valleys - report on surveys of riparian and aquatic invertebrates, May and June 1981.* Unpublished report. 30p.	Leicestershire	
GODFREY, A., 1992. *Terrestrial invertebrate survey for the A249 Iwade Bypass to Queenborough.* Unpublished report to developer.	Kent	
GODFREY, A., 1993. *A249 Iwade to Queenborough road improvement invertebrate survey report.* Unpublished report by Ecosurveys Ltd.	Kent	
GODFREY, A., 1998. *Aquatic invertebrate survey of the north Somerset Levels*. Unpublished report for English Nature, Somerset and Avon Team.	Somerset	
GODFREY, A., 1992. *Invertebrate survey for the proposed A249(T) re-alignment, Walland Marsh.* Unpublished report to developer.	Kent	

GODFREY, A., 1999. *Aquatic invertebrate survey of the north Somerset Levels*. Unpublished report for English Nature, Somerset and Avon Team.	Somerset	
Godfrey, A., 2000. *Aquatic invertebrate survey of Somerset Levels and Moors 1999*. Unpublished report to English Nature.	Somerset	
GODFREY, A., 2003. *Grazing marsh invertebrate project*. Unpublished report for Environment Agency and English Nature.	Kent	
GREGORY, R.D., 1986. *Freshwater invertebrate survey of the dyke systems of the lower Derwent valley*. Unpublished report for Nature Conservancy Council. 52p.	Derwent	
GREGORY, R.D., 1986. *Freshwater Invertebrate Survey of the Dyke System of The Lower Derwent Valley*. Unpublished report by University of York to Nature Conservancy Council.	Yorkshire	
HAMMOND, M., 1998c. *Environmentally Sustainable Management of the Water Resources of The Lower Derwent Valley, III: Ecological Requirements of Key Features B: Invertebrates other than Coleoptera and Odonata, March 1998*. Unpublished report by Entotax Consultants.	Yorkshire	
HAMMOND, M., 1997. *Environmentally Sustainable Management of the Water Resources of The Lower Derwent Valley II: Invertebrates. December 1997*. Unpublished report.	Yorkshire	
HAMMOND, M., 1998. *Environmentally Sustainable Management of the Water Resources of The Lower Derwent Valley, III: Ecological Requirements of Key Features C: Invertebrates Coleoptera and Odonata, March 1998*. Unpublished report by Entotax Consultants.	Yorkshire	
HAMMOND, M., 1998. *Lower Derwent Valley Water Beetle Records, 31st August 1998*. Unpublished report to Ryedale District Council.	Yorkshire	Coleoptera
HAMMOND, M., 1998. *Water Beetle Records from The Lower Derwent Valley* [North Duffield Ings and Thornton Ings]. Unpublished report.	Yorkshire	Coleoptera
HAMMOND, M., 1999. *Water Beetles Recorded from North Duffield Carrs*. Unpublished report to Ryedale District Council.	Yorkshire	Coleoptera
HEMINGWAY, D.G., 1997. *Survey and Monitoring - Panagaeus cruxmajor*. Unpublished report to English Nature bu Entotax Consultants, Huddersfield.	Yorkshire	*Panagaeus cruxmajor*
HICKLIN, A.J., 1986. *An evaluation of the nature conservation status of the Lewes Brooks drainage system, East Sussex*. Unpublished report to+B167 Nature Conservancy Council, South East Region. 38p.	Sussex	
HIGLER, L.W.G., 1977. *Macrofauna-cenoses on Stratiotes plants in Dutch broads*. Research Institute for Nature Management.	Netherlands	
HIGLER, L.W.G., 197?. Observations on the macrofauna of a Dutch ditch. Journal?, pp. 66-73.	Netherlands	
HIGLER, L.W.G. & VERDONSCHOT, P.F.M., 1989. Macroinvertebrates in the Demmerik ditches (The Netherlands): the role of environmental structure. *Hydrobiological Bulletin,* **23**, pp. 143-150.	Netherlands	
HIGLER, L.W.G., TORENBEEK, R. & VERDONSCHOT, P.F.M., 1986. A new ordination technique for ecological purposes applied to caddis larvae in ditches. *Proceedings of the 5th International Symposium on Trichoptera, Junk*, pp. 299-303.	Netherlands	
HILL-COTTINGHAM, P., 1998. *A study of the distribution of Valvata macrostoma march RDB2 in a ditch on West Sedgemoor*. Unpublished report to RSPB.		*Valvata macrostoma*
HILL-COTTINGHAM, P & SMITH, T., 1995. *Somerset Levels and Moors, aquatic macroinvertebrate survey*. Unpublished report to Environment Agency.	Somerset	

HILL-COTTINGHAM, P & SMITH, T., 1996. *Pawlett Hams ditch survey*. Unpublished report to English Nature. 36p.	Somerset	
HILL-COTTINGHAM, P & SMITH, T., 1996. *South Somerset District biodiversity survey*. Unpublished report to Somerset Environmental Records Centre.	Somerset	
HILL-COTTINGHAM, P & SMITH, T., 1998. *Effects of the summer flood on aquatic invertebrates on West Moor, Wet Moor and Currey and Hay Moors: 1997 - 1998.* Unpublished report to English Nature. 75p.	Somerset	
HILL-COTTINGHAM, P & SMITH, T., 1998. *Pawlett Hams Ponds: survey of aquatic invertebrates on Bridgewtaer Bay SSSI.* Unpublished report to English Nature. 42p.	Somerset	
HINGLEY, M.R., 1979. The colonisation of newly-dredged drainage channels on the Pevensey Levels (East Sussex), with species reference to gastropods. *Journal of Conchology,* **30**, pp. 105-122.	Sussex	Mollusca
HODGE, P. & EDWARDS, M., no date. *A further survey of insects at Tournerbury Farm, Hayling Island.* Unpublished report . 7p.	Hampshire	
HODGE, P.J., 1978. Somerset Coleoptera, including several new county records. *Entomologists. mon. Mag.*, **114**, p.82.	Somerset	Coleoptera
HODGE. P.J., 1987. *Insect records extracted from Pett Levels entomological survey report - May to July 1987.* Unpublished report to Nature Conservancy Council, South East Region	Sussex	
HODGE. P.J., 1987. *Pett Levels entomological survey - May to July 1987.* Unpublished report. 18p	Sussex	
HODGE. P.J., 1988. *Report for 'The Pells' invertebrate survey*. Unpublished report. 11p	Sussex	
HODGE. P.J., 1990. *A survey of the aquatic insects of East Guldeford Level*. Unpublished report to Chris Blandford Associates. Blackboys.	Sussex	
HODGE. P.J., 1990. *A survey of the Coleoptera, Diptera and Hemiptera-Heteroptera of the Arun Levels between Arundel and Pulborough.* Unpublished report to Nature Conservancy Council, South East Region.	Sussex	
HODGE. P.J., 1990. *A survey of the insects of the Somerset Moors peat production zone with recommendations for their conservation.* Unpublished report to Nature Conservancy Council.	Somerset	
HODGE. P.J., 1990. *A survey of the Coleoptera, Diptera and Hemiptera-Heteroptera of the Arun Levels between Arundel and Pulborough.* Unpublished report for Nature Conservancy Council, South East Region. 72p.	Sussex	
HODGE. P.J., 1991. *The Coleoptera of Arundel Park*. Unpublished report to English Nature.	Sussex	
HODGE. P.J., 1991. *A survey of aquatic invertebrates of selected ponds and dykes within Pevensey Levels SSSI (including Pevensey Levels NNR).* Unpublished report for Nature Conservancy Council. 12p.	Sussex	
HODGE. P.J., 1991. *A survey of insects of the upper Combe Haven valley wetlands.* Unpublished report to Chris Blandford Associates: Blackboys.	Sussex	
HODGE. P.J., 1992. *A survey of aquatic insects along proposed route of A259 Bexhill to Hastings by-pass for assessment of water quality at proposed outfall sites*. Unpublished report to Chris Blandford Associates: Blackboys.	Sussex	
HODGE, P.J., 1992. *A survey of insects from the West Hythe wetlands*. Unpublished report to Chris Blandford Associates: Blackboys.	Kent	

Hodge, P.J., 1992. *A survey of part of the Newhaven Marshes in East Sussex for water beetles and bugs* Unpublished report to Chris Blandford Associates: Blackboys	Sussex
HODGE, P.J., 1992. *A survey of the wetland insects of part of the Rye Harbour SSSI.* Unpublished report to Chris Blandford Associates: Blackboys.	Sussex
HODGE, P.J., 1992. *A survey of the wetland insects of part of Walland Marsh SSSI and a small area of grazing marsh and shingle beach habitats near Northpoint Beach*. Unpublished report to Chris Blandford Associates: Blackboys	Kent
HODGE. P.J., 1992. *A survey of West Brede Level wetland insects.* Unpublished report to Chris Blandford Associates: Blackboys	Sussex
HODGE, P.J., 1992. *An aquatic insect survey of drainage outfall sites for proposed road construction at West Hythe and a brief survey of aquatic insects in a section of the Kent Ditch.* Unpublished report to Chris Blandford Associates: Blackboys.	Kent
HODGE. P.J., 1992. *A survey of the insects of Westcourt Marshes and part of Filborough Marshes.* Unpublished report for Nature Conservancy Council. 25p.	Kent
HODGE, P.J., 1992. *An invertebrate survey of Ingrebourne Marshes, south Essex.* Unpublished report.	Essex
HODGE, P.J., 1993. *A further survey of aquatic insects at selected sites along the western section of the Hastings by-pass route*. Unpublished report to Chris Blandford Associates: Blackboys.	Sussex
HODGE, P.J., 1993. *A survey of aquatic insects at selected sites along the western section of the Hastings by-pass route*. Unpublished report to Chris Blandford Associates: Blackboys	Sussex
HODGE, P.J., 1994. *Entomological survey of National Trust land at Chyngton Farm, Seaford*. Unpublished report to National Trust	Sussex
HODGE, P.J., 1994. *Entomological survey of National Trust land at Frog Firle Farm, Alfriston.* Unpublished report to National Trust.	Sussex
HODGE. P.J. 1994. *Insects recorded from Pulborough Brooks R.S.P.B. nature reserve (TQ053164) on 20th July 1994*. Unpublished report to Royal Society for the Protection of Birds.	Sussex
HODGE, P.J., 1995. *A survey of insects from Horsham Marsh, north Kent*. Unpublished report to English Nature, Wye.	Kent
HODGE, P.J., 1995. *A survey of insects from part of Cooling Marshes, north Kent*. Unpublished report to English Nature, Wye.	Kent
HODGE, P.J., 1995. *A survey of insects on parts of Walland Marsh relating to the proposed A259 improvement between the Kent Ditch and Brookland.* Unpublished report to Chris Blandford Associates, 1995	Kent
HODGE, P.J., 1996. *A survey of the insects of the turf fields at Stodmarsh NNR*. Unpublished report to English Nature, Wye.	Kent
HODGE, P.J., 1996. *The Brede valley entomological assessment. A survey of insects within the River Brede flood plain between Westfield and Rye*. Unpublished report to English Nature, Lewes.	Sussex
HODGE, P.J., 1999. *A survey of aquatic insects at West Dean Brooks, East Sussex.* Unpublished report to Sussex Downs Conservation Board.	Sussex
HODGE, P.J., 1999. *A survey of invertebrates at Montague Farm. Report No. 1. Survey of Hankham Level on 20th August 1999.B145.* Peterborough: English Nature. Unpublished report.	Sussex

HODGE, P.J., 1999. *The Pells, Lewes. Survey of Insects. Report No. 1. (Records for 1974 - 1998).* Unpublished report, Voluntary survey for Pells Amenity Group, Lewes.	Sussex	
HODGE, P.J., 2000. The diving beetle (*Laccophilus poecilus*) (Dytiscidae): Historical review, survey and monitoring on the Lewes Levels. Peterborough: *English Nature Research Reports,* No. 357.		*Laccophilus poecilus*
HODGE. P.J., 2000. *The Pells, Lewes. Survey of Insects. Report No. 2. (Records for 1999).* Unpublished report, Voluntary survey for Pells Amenity Group, Lewes.	Sussex	
HODGE, P., 2001. *Laccophilus poecilus* Klug (Coleoptera, Dytiscidae) Species Recovery Programme. Interim Report - Mar. - Oct. 2000. Monitoring on the Lewes Levels and surveys in Yorkshire. Unpublished report to English Nature.		Laccophilus poecilus
HODGE, P.J., 2001. *Ouse estuary - invertebrate survey. A survey of insects of the coastal shingle and wetland habitats likely to be affected by the proposed Newhaven Port access road.* Unpublished report to East Sussex County Council.	Sussex	
HODGE, P.J., 2002. *Ouse valley survey 2002 Aquatic Coleoptera (water beetles) and Hemiptera-Heteroptera (water bugs).* Isfield: Dolphin Ecological Surveys. Unpublished report.	Sussex	
HODGE, P.J., 2003. *Laccophilus poecilus* Klug Col., Dytiscidae. Species Recovery Programme report March 2000 - August 2001. Monitoring on the Lewes Levels and surveys in Yorkshire. Peterborough: *English Nature Research Reports,* No. 509.		*Laccophilus poecilus*
HODGE, P.J. ?in prep. The Arun Valley. *A survey of aquatic insects within the flood plain between Pulborough & Littlehampton*. Unpublished report.	Sussex	
HODGE, P.J., 2003. *Ouse baseline survey 2003 Aquatic Coleoptera (water beetles) and Hemiptera (water bugs).* Unpublished report to Sussex Wildlife Trust.	Sussex	
HODGE, P.J., 1987 - 2002. *The insects of the Lewes Railway Land and The Meadowlands. Reports Nos. 1 - 18*. Unpublished report to Railway Land Wildlife Trust, Lewes.	Sussex	
HODGE, P.J., [?In prep Is this the same as the 1996 report?]. *An assessment of the entomological importance of the Brede Levels, East Sussex based on existing data.* Unpublished report to English Nature.	Sussex	
HOWLETT, D., 1996. *Mid-Yare mollusc survey, 1996.* Unpublished report to RSPB.	Norfolk	
HYDER CONSULTING, 2001. *Gwent Europark - WDC2. Reen flora and invertebrate monitoring 2000.* Unpublished report.	Gwent	
HYDER CONSULTING, 2001. *South eastern coastal strategy. Reen flora, invertebrate and water quality monitoring 1999 - 2000*. Unpublished report to Welsh Water.	Gwent	
JACKSON, M.J., 1997. *Sampling methods for studying macroinvertebrates in the littoral vegetation of shallow lakes.* Norwich: Broads Authority.		
JACKSON, M.J. & CHARTER, E., 1978. *Ecological survey of the Yare basin marshlands. Part II. Parts of the mid Yare, lower Brue & Waveney valley. July - Sept 1978.* Unpublished report for Nature Conservancy Council. 140p.	Norfolk	
JACKSON, M.J. & HOWLETT, D.J., 1999. *Freshwater molluscs of the River Waveney grazing marshes. A survey carried out during the summer of 1997.* Norwich: Broads Authority.	Norfolk	Mollusca

JACKSON, P.K., FOSTER, A.P. & LISTER, J.A., 1995. *Crutches Farm, East Sussex.* Unpublished report to National Trust.	Sussex	
JACKSON, P.K. & FOSTER, A.P., 2002. *Horsey Estate, Norfolk.* Unpublished report, National Trust.	Norfolk	
JONES, E., 1992. *The status of Dolomedes plantarius on Pevensey Levels*. Unpublished report to English Nature.		*Dolomedes plantarius*
KASPRZAK, K. & BANASZAK, J., 1982. The evaluation of numbers, biomass, and respiration of phytophilous macrofauna in a field drain canal. *Acta Hydrobiol*., **24**, pp. 167-173.	Poland	
KEY, R.S., 1990. *Nature Conservancy Council. Lionhope Swale Project. Planning application nos SW/89/1050, SW/89/1052 & SW/89/1053. This evidence relates only to application no SW/89/1053 (case 12481). Proof of evidence.* Unpublished report for Nature Conservancy Council. 2 vols.	Kent	
KEYMER, R.J., BLAKE, C.P. & DRAKE, C.M., 1989. *Pevensey Levels - final report. Proposed boundary for renotification under the Wildlife and Countryside Act 1981*. England Field Unit Project No. 25. Peterborough: Nature Conservancy Council. 53p.	Sussex	
KILLEEN I.J. & WILLING, M.J., 1997. Species Recovery Programme: survey of ditches in East Anglia and south-east England for the freshwater snails *Segmentina nitida* and *Anisus vorticulus*. Peterborough: *English Nature Research Reports,* No. 229.		*Segmentina, Anisus*
KILLEEN, I.J., 1992. *The land and freshwater molluscs of Suffolk.* Suffolk Naturalist's Society.	Suffolk	Mollusca
KILLEEN, I.J., 1995. A survey of the freshwater Mollusca of Pevensey Levels, East Sussex. Peterborough: *English Nature Research Reports,* No. 124.	Suffolk	Mollusca
KILLEEN, I.J., 1997. *A survey of the freshwater Mollusca of selected National Trust properties in Oxfordshire, Hampshire and Sussex*. Malacological Services unpublished report to the National Trust.		Mollusca
KILLEEN, I.J., 1998. *A survey of the freshwater Mollusca of National Trust properties at Bridge's and Lower Barn farms, Essex.* Malacological Services unpublished report to the National Trust.		Mollusca
KILLEEN, I.J., 1998. An assessment of the mollusc faunas of grazing marsh ditches using numerical indices, and their application for monitoring and conservation. *Journal of Conchology Special Publication,* No **2**, pp. 101-112.	England	Mollusca
KILLEEN, I.J., 1999. The freshwater snail *Anisus vorticulus*: 1998 monitoring survey of ditches in East Anglia. Petrborough: *English Nature Research Reports,* No. 311.		*Anisus vorticulus*
KILLEEN, I.J., 1999. *A survey of the freshwater molluscs of marsh dykes at West Caister, Norfolk.* Malacological Services unpublished report to Ecology, Land & People.		Mollusca
KILLEEN, I.J., 2000. A survey of the East Kent grazing marshes for the freshwater snail *Segmentina nitida. English Nature Research Reports,* No. 356.		*Segmentina nitida*
KILLEEN, I.J., 2000. A survey of Westbere Marshes, Kent for the terrestrial mollusc *Vertigo moulinsiana*. Petrborough: *English Nature Research Reports,* No. 350.		*Vertigo moulinsiana*
KIRBY, P., 1983. Corixidae (Hem.) from the south Lincolnshire fens. *Entomologist's Monthly Magazine,* **119**, pp. 43-49.	Lincolnshire	Corixidae
KIRBY, P., 1991. *Cliffe & Higham Marshes, Kent. Survey of terrestrial invertebrates July 1991*. Unpublished report for English Nature. 34p.	Kent	

KIRBY, P., 1991. *Ramsey Marsh, Essex TL940056. Survey of aquatic and marginal invertebrates 2 November 1991.* Unpublished report for English Nature. 11p.	Essex	
KIRBY, P., 1992. *Habitat management for invertebrates: a practical handbook*. Sandy: RSPB.		
KIRBY, P., 1993. *Brightlingsea NNR aquatic invertebrate survey September 1993.* Unpublished report to English Nature.	Essex	
KIRBY, P., 1995. *Shorne Marshes, Kent. Aquatic invertebrate survey 1995.* Unpublished report to English Nature.	Kent	
KIRBY, P., 1995. *Stoke and Allhallows Marshes, Kent. Terrestrial invertebrate survey of ditches.* Unpublished report to English Nature	Kent	
KIRBY, P., 1999. *Dibden Bay invertebrate survey 1999*. Unpublished report to Jonathan Cox Associates.	Hampshire	
KNAPPS, S., 1991. *Survey of Arachnida, Eames Farm, Thorney Island, 22-23 August 1991.* Unpublished report to English Nature.	Sussex	
KNIGHTS, B. & CUNNINGHAM, I.R., 1983. The ecology of Dartford Creek and the Thames Estuary near Dartford, Kent. *London Naturalist,* **62**, pp. 60-68.	Kent	
KNIGHTS, B. & POWLESLAND, C., 1984. The ecology of the freshwater and saline ditches on Crayford and Dartford Marshes, Kent. *London Naturalist,* **63**, pp. 79-91.	Kent	
Lambert, F.J., 1930. 37. Animal life in the marsh ditches of the Thames Estuary. *Proc. Zool. Soc. London,* **11**, pp. 801-808.	Essex	
LAWTON, J.H., Undated. *Freshwater Invertebrate Survey of The Lower Derwent Ings SSSI, University of York.* Unpublished report.	Yorkshire	
LEEMING, D., 1990. *A biological survey of Erith Marshes, August 1990.* Internal Report, National Rivers Authority Thames Region, Oct 1990.	Kent	
LEEMING, D., 1997. *A biological survey of drainage dykes at Crayford Marshes, Kent on 12/9/96.* Unpublished report to Environment Agency Thames Region.	Kent	
LEEMING, D., 1998. *Aquatic invertebrate survey of marsh dykes within the Inner Thames Marshes SSSI, June 1998.* Unpublished interim report to Environment Agency.	Essex	
LEEMING, D., 2001. *Aquatic invertebrate survey of drainage ditches and standing water within Rainham Marshes on July 12th 2001.* Unpublished report to the Environment Agency.	Essex	
LINDSEY, B.I., 1991. *The freshwater invertebrates of Shinewater Marsh Eastbourne Levels*. Unpublished report to English Nature.	Sussex	
MALARD, F., 1989. *A survey of the aquatic invertebrates of Hatfield Chase*. Unpublished report for Loughborough University of Technology. 106p.	Hatfield	
MALARD, F. 1990. *Factors affecting the distribution of the aquatic invertebrates of Hatfield Chase*. Unpublished student project, Loughborough University of Technology. 96p.	Hatfield	
MARSHALL, E.J.P., 1984. The ecology of a land drainage channel - II. Biology, chemistry and submerged weed control. *Water Research,* **18**, pp. 817-825.	Gwent	
McCONNELL, H., 2000. *A study of medicinal leech (Hirudo medicinalis) in the Romney Marsh Natural Area, 2000.* Unpublished report to Romney Marsh Countryside Project.		*Hirudo medicinalis*

McLEAN, I.F.G., 1982. *The Gwent Levels. A report on the terrestrial invertebrates recorded in July 1991.* Unpublished report for Nature Conservancy Council. 60p.	Gwent	
MOORE, N.W., 1980. *Lestes dryas* Kirby - a declining species of dragonfly (Odonata) in need of conservation: notes on its status and habitat in England and Ireland. *Biological Conservation,* **17**, pp. 143-148.		*Lestes dryas*
MOUNTFORD, J.O., COOPER, J.M., ROY, D.B. & WARMAN, E.A., 1999. Targeting areas for the restoration and re-creation of coastal and floodplain grazing marsh. Peterborough: *English Nature Research Reports,* No. 332.	England	
NATIONAL TRUST, c. 1989. *Wickham Manor Farm, Winchelsea, East Sussex* . Unpublished report to National Trust.	Sussex	
NATURE CONSERVANCY COUNCIL AND SOUTHERN WATER, 1979. *A survey of the invertebrate fauna and flora of the dykes of the lower Stour valley, Kent Autumn 1978.* Unpublished report. 170p	Kent	
NATURE CONSERVANCY COUNCIL AND SOUTHERN WATER, 1989. *Romney Marsh - land drainage and conservation. An assessment of the environmental impact of selected land drainage operations on the flora and fauna of Lambs Farm Dyke on Romney Marsh.* Unpublished report. 76p.	Kent	
NAU, B. 2000, Hemiptera recorded at Dingle Marshes, RSPB reserve, August 2000. Unpublished report to RSPB.	Suffolk	Hemiptera
NIXON, A., 1998. *A survey of medicinal leech (Hirudo medicinalis) in the Romney Marsh Natural Area - interim report, 1998.* Unpublished report to RSPB.		*Hirudo medicinalis*
NORRIS, A., 1998. *Survey of Derwent Ings N.C.C. Nature Reserve 1987.* Unpublished report.	Yorkshire	
OATES, M., 1987. *Hackett's Marsh and Meadows entomological survey*. Unpublished report to landowner.	Hampshire	
PAINTER, D., 1995. *Fen ditch excavation patterns: effects on aquatic communities*. Unpublished DPh thesis, University of Cambridge.	Cambridgeshire	
PAINTER, D., 1998. Effects of ditch management patterns on Odonata at Wicken Fen, Cambridgeshire, UK. *Biological Conservation,* **84**, pp. 189-195.	Cambridgeshire	Odonata
PAINTER, D.J., 1999. Macroinvertebrate distributions and the conservation value of aquatic Coleoptera, Mollusca and Odonata in the ditches of traditionally managed and grazing fen at Wicken Fen, UK. *J. Applied Ecol*., **36**, pp. 33-48.	Cambridgeshire	
PAINTER, D.J., 2000. As dull as ditch water? Managing ditches for wildlife. *British Wildlife,* **11**, pp. 258-262.	Cambridgeshire	
PAINTER, D.J. & FRIDAY, L.E., 1995. Restoring fen ditches: the case of Wicken Fen National Nature Reserve. *In:* B.D. WHEELER, S.C. SHAW, W.J. FOJT and R.A. ROBERTSON, eds. *Restoration of temperate wetlands.* Chichester: John Wiley, pp241-250	Cambridgeshire	
PALMER, M., 1979. Invertebrate survey of the Somerset Levels 1979. Unpublished report, Nature Conservancy Council.	Somerset	
PALMER, M., 1980. *Survey of the aquatic fauna of the North Kent Marshes, 1980.* Unpublished report for Nature Conservancy Council, Chief Scientist's Team. 43p.	Kent	
PALMER, M., 1980. Water beetles from the Somerset Levels. *Balfour-Browne Club Newsletter* no. 17, 1-3.	Somerset	Coleoptera
PALMER, M., 1981. Water beetles from the north Kent marshes. *Balfour-Browne Club Newsletter,* **21**,pp. 6-7.	Kent	Coleoptera

PALMER, M., 1982. *A comparison of Freshwater Biological Association and Nature Conservancy Council surveys of the aquatic invertebrates of the Somerset Levels.* Unpublished report for Nature Conservancy Council Chief Scientist's Team. 3p.	Somerset	
PALMER, M., 1982. *Survey of the aquatic invertebrates of the Walland Marsh area of Romney Marsh, 1982*. Unpublished report for Nature Conservancy Council, Chief Scientist's Team. 43p.	Kent	
PALMER, M., 1984. *A comparison of the flora and invertebrate fauna of watercourses in old pasture and arable land in the Pevensey levels, Sussex, in 1983*. Unpublished report for Nature Conservancy Council, Chief Scientist's Team. 30p.	Sussex	
PALMER, M., 1986. The impact of a change from permanent pasture to cereal farming on the flora and invertebrate fauna of watercourses in the Pevensey Levels, Sussex. In: *Proceedings of the European Weed Research Society / Association of Applied Biologists 7th International Symposium on Aquatic Weeds, 1986.* pp. 233-238.	Sussex	
PALMER, M., 1987. A survey of the aquatic invertebrates of Romney Marsh. *Transactions of the Kent Field Club*, **10**, pp. 123-133.	Kent	
PERRIN, V.L., 1999. Observations on the distribution, ecology and behavior of the Hairy Dragonfly *Brachytron pratense* (Muller). *J. Br. Dragonfly Soc.,* **15**, pp. 39-45.		*Brachytron pratense*
PHILP, E.G., 1980. *North Kent marshes survey, July 1980*. Unpublished results of survey. 5p.	Kent	
PHILP, E.G., 1983. *Essex marshes survey, 17th-22nd July 1983*. Unpublished results of survey. 12p.	Essex	
PHILP, E.G., 1984. *A preliminary report on the Minster and Elmley Marshes on Sheppey*. Unpublished report to Maidstone Borough Council.	Kent	
PHILP, E.G., 1985. *Survey of the Ham Marshes and Ham gravel pits*. Unpublished report.	Kent	
PHILP, E.G., 1987. [*North Kent marshes survey, 1987*.] Unpublished results of survey. 9p.	Kent	
PHILP, E.G., 1991. *Cliffe aquatic invertebrate survey*. Unpublished report for Nature Conservancy Council. 24p.	Kent	
PHILP, E.G., 1994. *Invertebrate survey of Uplees, Seasalter and Graveney Marshes*. Unpublished report to English Nature, Kent.	Kent	
PHILP, E., 2000. Shorne Marshes and High Holston, Kent, 3 June 2000. Report on BENHS meeting, *Br. J. Ent. Nat. Hist*., pp. 14:57.	Kent	
PLANT, C.W., 1986. *Report on the invertebrate fauna of Rainham Rifle Ranges Essex (a part of the Rainham Marshes complex).* Unpublished report for Nature Conservancy Council, London. 28p.	Essex	
PLANT, C.W., 1987. *Report on the invertebrate fauna of Purfleet Army Range Essex (as part of the Rainham Marshes complex) with particular reference to the drainage dykes.*. Unpublished report for Nature Conservancy Council, London. 37p.	Essex	
PLANT, C.W., 1988. *Report on the invertebrate fauna of Wennington Marshes Essex* . Unpublished report for Nature Conservancy Council, London. 21p.	Essex	
PLANT, C.W., 1991. *Invertebrates at Crayford Marsh: an assessment.* Unpublished report for English Nature, London. 51p.	Kent	
PLANT, C.W., 1992. *Invertebrates at Dartford Marsh: an assessment.* Unpublished report for English Nature, London. 50p.	Kent	

PLANT, C.W., 1993. *Invertebrates at Erith and Belvedere Marshes: an assessment.* Unpublished report for English Nature, London. 63p.	Kent	
PLANT, C.W., 1997. *Ingrebourne Marshes aquatic invertebrate survey.* Unpublished report to London Borough of Havering.	Essex	
PLANT, C.W., 1999. *Dingle Marshes, Suffolk, Diptera survey - 1999.* Unpublished report to RSPB.	Suffolk	Diptera
PLANT, C.W., 2002. *An inventory survey of water beetles at the Cliffe Marshes complex.* Unpublished report to the Kent Wildlife Trust.	Kent	
PLANT, C.W., 2002. *An inventory survey of water beetles at the Inner Thames Kent marshes.* Unpublished report to Groundwork Kent Thames-side.	Kent	
POND ACTION, 1992. *An aquatic macroinvertebrate survey of ditches on Westcourt Marshes, Kent.* Unpublished report for RPS Clouston. 14p.	Kent	
POND ACTION, 1994. *National Pond Survey methods*. Oxford Brookes University.		
RIETVELD, W. & BELTMAN, B., 1982. A qualitative analysis of macrofauna sampling in ditches. *Hydrobiological Bulletin,* **16**, pp. 149-157.	Netherlands	
ROBERTS, M.J., 1995. *Collins field guide. Spiders of Britain & Northern Europe*. HarperCollins.		
RUSSEL SONEHAM ESTATE MANAGEMENT LTD., 1990. *Howbury Park - ecological report.* Unpublished report		
SAVAGE, A.A., 1989. Adults of the British aquatic Hemiptera Heteroptera. A key with ecological notes. *Freshwater Biological Association Scientific Publication,* No. 50.		
SCHEFFER, M., ACHTERBERG, A.A. & BELTMAN, B., 1984. Distribution of macro-invertebrates in a ditch in relation to the vegetation. *Freshwater Biology,* **14**, pp. 367-370.	Netherlands	
SCOTT WILSON RESOURCE CONSULTANTS, 1996. *Aquatic macroinvertebrate communities of dykes within the Barking levels, the Inner Thames Marshes SSSI, Thurrock Marshes and Botany Marshes*. Unpublished report to Union Railways.	Essex	
SERJEANT, T., 1994. *Macroinvertebrate Communities in Freshwater Rhyne Systems on the Avon Levels*. MSc Thesis, Durrell Institute of Conservation & Ecology.	Somerset	
SHEPPARD, D.A., 1985. *An survey of the aquatic invertebrates from selected ditches in the Somerset Levels.* Unpublished report for Nature Conservancy Council. England Field Unit. 12p.	Somerset	
SHEPPARD, D.A., 1987. *An invertebrate survey of selected ditches on Westhay Moor SSSI.* Unpublished report for Nature Conservancy Council. 26p	Somerset	
SHEPPARD, D.A., 1991. Site survey methods. In R. FRY and D. LONSDALE, eds. Habitat conservation for insects: a neglected green issue. *The Amateur Entomologist,* **21**, pp. 205-208.		
SMITH, E.K.G., 1985. Water beetles at Rye Harbour. *Balfour-Browne Club Newsletter,* **32**, pp. 12-14.	Kent	Coleoptera
SOMERSET ECOLOGY CONSULTANTS LTD., 1991. *Avon invertebrates survey.* Unpublished report for English Nature, South-west Region. 46p.	Somerset	
SOMERSET ECOLOGY CONSULTANTS LTD., 1993. *Invertebrate survey of ditches on Avon Levels and Moors 1993.* Unpublished report to English Nature, South-west Region. 29p.	Somerset	

SOMERSET ECOLOGICAL CONSULTANTS, 1995. *Somerset Levels and Moors: Aquatic Macro-invertebrate Survey*. Unpublished report to English Nature.	Somerset
SOMERSET ECOLOGICAL CONSULTANTS, 1997. *Somerset Levels and Moors: Aquatic Macro-invertebrate Survey*. Unpublished report to English Nature	Somerset
SOMERSET INVERTEBRATES GROUP, 1998. *Catcott Lows Reserve Invertebrate Survey.* Unpublished report to Somerset Wildlife Trust	Somerset
SOUTHERN WATER AUTHORITY, 1978. *A survey of the dyke fauna of the lower Stour valley, Kent*. Unpublished report. 40p. [first draft]	Kent
STEVENSON, N., BARBER, R. & WATSON, D., 2001. *Invertebrate and fish survey of the brackish lagoons at the Gwent Levels Wetlands Reserve (final report)*. Unpublished report from Ecoscope Applied Ecologists to Countryside Council for Wales.	Gwent
STUBBS, A.E., 1979. *Somerset Levels survey: June 1979.* Unpublished report for Nature Conservancy Council, Chief Scientist's Team. 4p.	Somerset
STUBBS, A.E., 1980. *North Kent marshes. Invertebrate survey 8-12 September 1980 - preliminary report*. Unpublished report for Nature Conservancy Council, Chief Scientist's Team. 3p.	Kent
STUBBS, A.E., McLEAN, I.F.G. & SHEPPARD, D., 1982. *North Kent marshes. A report on the terrestrial invertebrates recorded in July and September 1980.*	Kent
SUSSEX AREA BIOLOGY TEAM, 2000. *Report on the effect of the herbicide treatment of* Hydrocotyle ranunculoides *on the macroinvertebrate fauna of Hurst Haven, Pevensey Levels*. Internal Report no. G19PL991/3. April 2000.	Sussex
THE ENVIRONMENT PRACTICE, 1994. *Gwent Europark, Llandevenny. Baseline monitoring report. Part 2: invertebrate fauna*. Unpublished report	Gwent
THE ENVIRONMENT PRACTICE, 1996. *Gwent Europark: biological monitoring 1996. Part 2(a) - aquatic invertebrates; Part 2(b) - terrestrial invertebrates.* Unpublished report.	Gwent
THE ENVIRONMENT PRACTICE, 1997. *Gwent Europark. Annual monitoring: invertebrates*. Unpublished report.	Gwent
TIBBETTS, R.A. & FOSTER, A., 2000. *Copt Hall Farm, Essex*. Unpublished report to National Trust.	Essex
UK BIODIVERSITY GROUP, 1999. *Tranche 2 action plans. Volume IV - invertebrates.* Peterborough: English Nature.	
UNIVERSITY OF ESSEX, no date. *Invertebrate survey of Elmley marshes, Kent. No date.* Unpublished report to RSPB. 22p.	Kent
UNIVERSITY OF ESSEX, 1987. *Invertebrate survey of Elmley Marshes, Kent.* Unpublished report to RSPB.	Kent
VERDONSCHOT, P.F.M., 1990. *Ecological characterization of surface waters in the province of overijssel (The Netherlands).* Research Institute for Nature Management, Province of Overijssel.	Netherlands
VERDONSCHOT, P.F.M. & Higler, L.W.G., 1989. Macroinvertebrates in Dutch ditches: a typological characterization and the status of the Demmerik ditches. *Hydrobiol Bull.,* **23** (2), pp. 135-142.	Netherlands
WADE, P.M., 1977. *The dredging of drainage channels: its ecological effects*. Unpublished PhD thesis, University of Wales Institute of Science and Technology. 400p.	Gwent

WADE, P.M., 1987. *Survey of dragonflies in the Hatfield Chase area*. Unpublished report for Nature Conservancy Council	Hatfield	Odonata
WADE, P.M. & SCOTTER, C.N.G., 1987. *The distribution of macro-Crustacea in the permanent drainage channels of the Monmouthshire (Gwent) Levels*. Unpublished draft of paper. 25p.	Gwent	Crustacea
WARING, P., 1994. *The current status of the Marsh Mallow Moth Hydraecia osseola Staudinger 1882 in England*. Unpublished report to English Nature.		*Hydraecia osseola*
WARING, P., 1999. Marsh Mallow Moth rediscovered in Sussex. *Butterfly Conservation News,* **59**, p. 11.		*Hydraecia osseola*
WATERHOUSE, M., 2002. *Northward Hill / Rye Street invertebrate surveys.* Unpublished reports to RSPB.	Kent	
WATSON A.M. & ORMEROD, S.J., 2004. The distribution of three uncommon freshwater gastropods in the drainage ditches of British grazing marshes. *Biological Conservation*. In Press.	Sussex	Mollusca
WATSON A.M. & ORMEROD, S.J., 2004. The micro-distribution of three uncommon freshwater gastropods in drainage ditches of British grazing marshes. *Aquatic Conservation.* In Press.	Sussex	Mollusca
WATSON A.M. & ORMEROD, S.J., in press. Factors influencing the distribution of Pisidium pseudosphaerium and associated freshwater molluscs in the drainage ditches of lowland British grazing marsh. *Biodiversity and Conservation.* In Press.	Sussex	*Pisidium pseudosphaerium*
WILLIAMS, J.H.G., 1982. *A survey of Odonata of Kent in 1982*. Unpublished report to Nature Conservancy Council.	Kent	Odonata
WILLIAMS, S.K., 1999. Recent records of *Emus hirtus* (Linneaus) (Staphylinidae) at the Isle of Sheppey, Kent. *The Coleopterist,* **8**, pp. 112.		*Emus hirtus*
WILLING, M.J., 1992. *A molluscan survey of wetlands in the Rother Valley, West Sussex (extension report).* Unpublished report to JNCC.	Sussex	Mollusca
WILLING, M.J., 1998. *Molluscan survey: Lower Avon Valley*. Unpublished report to Environment Agency, Blandford Forum.	Sussex	Mollusca
WILLING, M.J., 1999. *A survey of the freshwater snail Valvata macrostoma in selected areas of the Avon Valley 1999.* Unpublished report to English Nature.		*Valvata macrostoma*
WILLING, M.J., 1999. Monitoring populations of *Anisus vorticulus* (the little whirlpool ramshorn snail) in West Sussex, May - November 1998. Petrborough: *English Nature Research Reports,* No. 310.		*Anisus vorticulus*
WILLING, M.J., 1999. *A baseline molluscan survey of the RSPB Pulborough Brooks Reserve.* Unpublished report to The Environment Agency, Worthing.	Sussex	Mollusca
WILLING, M.J., 1999. *A molluscan survey of: (1) ditches adjacent to the middle River Arun & lower River Rother, West Sussex & (2) a monitoring ditch on Amberley Wildbrooks.* Unpublished report to The Environment Agency, Worthing.	Sussex	Mollusca
WILLING, M.J., 1999. *Molluscan survey of drainage ditches at Watersfield, near Coldwaltham, West Sussex (May 1999.* Unpublished report to English Nature.	Sussex	Mollusca
WILLING, M.J., 2000. Fresh- and brackish water molluscs: some current conservation issues. *British Wildlife,* **15**, pp. 1-15.		molluscs
WILLING, M.J., 2001. *A survey of the freshwater snail* Valvata macrostoma *in selected areas of the Avon Valley (continuation report 2000).* Unpublished report to English Nature.	Sussex	*Valvata macrostoma*

WILLING, M.J., 2001. *Molluscan monitoring of two ditches on Amberley Wildbrooks, 2000.* Unpublished report to Environment Agency, Worthing.	Sussex	Mollusca
WILLING, M.J., 2001. *Molluscan monitoring of two ditches on Amberley Wildbrooks, 2000.* Unpublished report to Environment Agency, Worthing.	Sussex	Mollusca
WILLING, M.J., 2002. *A survey of the freshwater snail* Valvata macrostoma *on selected areas of West Sedgemoor (August 2002)*. Unpublished report to RESPB.43p.		*Valvata macrostoma*
Willing, M. J., 2002. *Bishop's Waltham Moors Terrestrial Molluscan Survey (2000 – 2002).* Unpublished report to Environment Agency & Hampshire County Council. Hants. Countryside Service, Westwood Office, Southampton	Hampshire	Mollusca
WILLING, M.J., 2002. *Hackett's Marsh Terrestrial & Aquatic Molluscan Survey (October 2001)*. Unpublished report to Hampshire County Council. Hants. Countryside Service, Westwood Office, Southampton.		Mollusca
WILLING, M.J., 2002. *Ouse Valley Biological Survey (Mollusca)*: part of Ouse Valley Biological Survey, Dolphin Ecological Consultants. Unpublished report to English Nature, Lewes.	Sussex	Mollusca
WILLING, M.J., 2003. *Invertebrate survey (aquatic Mollusca) A27 Road Improvements, near Lewes, East Sussex 2003*. Unpublished report to Bullen Consultants Ltd. Croydon.	Sussex	Mollusca
WILLING, M.J., 2003. Baseline biological survey of the Lowere Ouse Valley, Tarring Neville, Southease, Offham Marshes. *In:* T. GREENAWAY 2004. Record Centre Survey Unit, Sussex Wildlife Trust, Woods Mill, Henfield – *report in preparation to English Nature, Lewes.*	Sussex	Mollusca
WILLING, M.J., 2004. *Invertebrate Survey (Mollusca) – West Dean Brooks, East Sussex*. Unpublished report to English Nature, Lewes.	Sussex	Mollusca
WILLING, M.J., 2004. *Monitoring populations of the freshwater snail Valvata macrostoma on selected ditches, West Sedgemoor 2003 and the development of a local monitoring protocol for the species*. Sandy: RSPB – report in preparation.	Somerset	*Valvata macrostoma*
WILLING, M.J. & KILLEEN, I.J., 1998. The freshwater snail *Anisus vorticulus* in ditches in Suffolk, Norfolk and West Sussex. Peterborough: *English Nature Research Reports,* No. 287.		*Anisus vorticulus*
WILLING, M.J. & KILLEEN, I.J., 1999. *Anisus vorticulus* - a rare and threatened water snail. *British Wildlife,* **10**, pp. 412-418.		*Anisus vorticulus*
WILLIS, P.D., 1980. *A macro-invertebrate survey of some drainage dykes at Strumpshaw Fen, with particular reference to discovering the effect of dyke management on macro-invertebrate diversity and density*. Unpublished undergraduate project, University of East Anglia. 87p.	Norfolk	

Appendix 1. Species with fidelity to grazing marshes

Status is taken from Recorder 3.3, and revised status for water beetles from Foster (in prep.). Fidelity classes A to C are defined in section 3.1.2. 'Records' and '%' are the numbers from the sample of surveys as explained in sectionn 3.1.3. Known ecology is taken almost verbatim from the literature reference given. For water beetles, the final columns are the percentage occurrence of each species in the sample of surveys, and indicate regional variation in frequency; the numbers below the county names are the number of ditches on which the percentage is base.

Species	Synonyms	Family	Status	Revised status	Fdelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Araneae										
Argyroneta aquatica		Argyronetidae	L		C			still freshwater	Lives in vegetated water where there is little current.	Roberts 1995
Dolomedes plantarius		Pisauridae	RDB1		B			still freshwater		
Coleoptera										
Cantharis fusca		Cantharidae	pRDB3		C	11	1.5	wetlands	Wet places. Larvae predators on soil surface. Adults usually on flowers, especially umbellifers. Declining. Now apparently restricted to small part of S Britain where it still can be found in abundance.	Recorder
Cantharis lateralis		Cantharidae	L		B	95	13.3	fen, marsh	Marshy places. Local, becoming more so in the north.	Recorder
Cantharis thoracica		Cantharidae	L		C	23	3.2	grassland, wetland	Recorded from grassland and wetland throughout the British Isles. Larvae are probably free living predators.	Recorder
Silis ruficollis		Cantharidae	Nb		C	11	1.5	fen, reedbeds	Found in fens and reedbeds. Widely distributed in southern England but very rare in the north.	Recorder
Acupalpus dubius		Carabidae	L		C	10	1.4	marsh	Frequently found in litter in marshy habitats as far forth as Yorkshire, and extremely local further north than this.	Luff 1998
Acupalpus exiguus		Carabidae	Nb		C	0	0	marsh, saltmarsh, sea shore	It occurs in shaded marshy sites, usually on clay soils, and it also found on the coast in strandline debris and in saltmarshes.	Luff 1998

Species	Synonyms	Family	Status	Revised status	Fdelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Agonum nigrum		Carabidae	Nb		C	0	0	marsh, saltmarsh	It inhabits well vegetation-rich marshes (including saltmarshes) and the edges of lakes and other standing freshwater.	Luff 1998
Agonum thoreyi		Carabidae	L		C	15	2	fen, marsh	Common in well vegetated marshes, fens and reed beds.	Luff 1998
Badister dilatatus		Carabidae	Nb		C	1	0.1	marsh	It is found on mud or in lush vegetation beside standing freshwater. Most records are from the south coast but there are scattered occurrences north to Lincolnshire and in the east and Angelesy in the west.	Luff 1998
Badister peltatus		Carabidae	Na		B	0	0	marsh	It is found on mud or in lush vegetation beside standing freshwater. Recent records are from the coast of East Sussex and Kent.	Luff 1998
Bembidion fumigatum		Carabidae	Nb		C	3	0.4	marsh, fen	An easterly species found north to Yorkshire. It inhabits well vegetated marshy areas such as fens, usually on clay soils, estuaries and saltmarshes.	Luff 1998
Bembidion varium		Carabidae	C		C	12	1.6	riparian, saltmarsh, [marsh]	Records are most frequent from the saltmarshes of south-east England, from Essex to Suffolk, but it also occurs frequently inland. It is found on partly bare ground near water.	Luff 1998
Chlaenius nigricornis		Carabidae	Nb		C	2	0.3	marsh, mire	It lives in marshes, wet grassland, moorland and mires, and in coastal litter.	Luff 1998
Demetrias imperialis		Carabidae	Nb		B	16	2.2	reedbeds	This species used to be more or less confined to the East Anglian fens and Thames marshes, living among tall plants such as rushes growing in water. In the last 30 year its range has expanded considerably and it is now recorded throughout much of south-east England, in reedbeds and flood litter.	Luff 1998
Dromius longiceps		Carabidae	Na		B	0	0	fen, marsh, reedbeds	Restricted to a few sites in eastern England from Yorkshire to Essex. It occurs in fens, marshes and reedbeds, and also on the coast under tufts of vegetation.	Luff 1998

Species	Synonyms	Family	Status	Revised status	Fdelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Dyschirius luedersi		Carabidae	L		C	14	1.9	riparian, saltmarsh, [marsh]	It occurs both on the coast and inland in marshes and on damp clay soils. Most records are from the south-east of England.	Luff 1998
Odacantha melanura		Carabidae	Nb		B	10	1.4	fen, reedbeds	It occurs in the south of England and Wales, usually on or neat the coast but also in inland fens. It is associated with reed beds and can be found sheltering in floating heaps of dead reeds or in reed stems. [The distribution maps closely matches major grazing marshes].	Luff 1998
Oodes helopioides		Carabidae	Nb		C	7	1	fen, marsh	It is found at the margins of well vegetated lakes, slow rivers and fens.	Luff 1998
Pterostichus gracilis		Carabidae	Nb		C	0	0	marsh, carr	It is found in wet, well vegetated habitats near water, usually on clay soils.	Luff 1998
Stenolophus mixtus		Carabidae	L		B	20	2.7	marsh	It lives in moist habitats such as winter-flooded woodland, marshes and at the edges of ponds, usually on clay.	Luff 1998
Stenolophus skrimshiranus		Carabidae	Na		C	1	0.1	fen, marsh	It is found in fens, marshes and well-vegetated lakesides in southern and eastern England, mainly near the coast.	Luff 1998
Chaetocnema subcoerulea		Chrysomelidae	Nb		C	1	0.1	wetland, wet heath	Wetland, wet heathland and damp grassland. Probably associated with rushes and sedges.	Hyman & Parsons 1992; Wright 2003
Donacia dentata		Chrysomelidae	Na		C	6	0.8	still freshwater	Associated with *Sagittaria* and occasionally recorded from *Potamogeton.* It appears to prefer large stands of arrowhead to isolated plants.	Hyman & Parsons 1992
Donacia marginata		Chrysomelidae	L		B	119	14.4	still freshwater	Larvae feed in nodules on the roots of *Sparganium* and *Carex* in standing water.	Recorder
Donacia semicuprea		Chrysomelidae	L	common	B	111	13.9	still freshwater	The larvae feed at the roots of *Glyceria maxima* and the adults graze the leaves. One of the commoner reed beetles, at least in the south.	Recorder
Donacia simplex		Chrysomelidae	L	common	B	71	8.9	still freshwater	The larvae feed at the roots of *Sparganium erectum* and the adults graze the leaves. The commonest member of the genus.	Recorder

Species	Synonyms	Family	Status	Revised status	Fidelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Donacia versicolorea		Chrysomelidae	L		C	2	0.3	still freshwater	A reed beetle, dark metallic blue in colour. Larvae feed at the roots of *Potamogeton,* usually *P. natans*. The adult beetles occur on the leaves from mid to late summer. Widespread and one of the commoner reed beetles.	Recorder
Donacia vulgaris		Chrysomelidae	L		B	35	4.4	still freshwater	The larvae feed at the roots of *Typha* and the adult beetles graze the leaves. Seldom abundant but quite widespread in the southern half of England.	Recorder
Galerucella calmariensis		Chrysomelidae	L		C	25	3.1	water margins	Feeds on *Lythrum salicaria*. Widespread but local, a frequent species in southern Britain.	Recorder
Galerucella sagittariae		Chrysomelidae	L		B	72	8.8	water margins	Feeds on foliage of various aquatic plants. Widespread but local.	Recorder
Macroplea mutica		Chrysomelidae	Na		C	2	0.3	brackish water	Primarily coastal, and associated with brackish lakes, ponds and ditches. Associated with *Potamogeton pectinatus* and possibly *Zostera marina*. Found almost exclusively in the east of England.	Hyman & Parsons 1992
Plagiodera versicolora		Chrysomelidae	L		C	24	2.9	marsh, fen	Feeds on willows in marsh and fenland. Southern species, becoming rare in the north.	Recorder
Plateumaris braccata		Chrysomelidae	Na		C	4	0.5	still freshwater	Aquatic and semi-aquatic habitats. Primarily found near the coast. Associated with *Phragmites*.	Hyman & Parsons 1992
Plateumaris sericea		Chrysomelidae	L	common	B	154	19.3	still freshwater	The most common reed beetle, found in a wide variety of water's edge habitats but especially in the north and west on wet moorland. The larvae feed at the roots of wetland plants, especially sedges and cotton grass but probably a wide range of monocots.	Recorder
Prasocuris junci		Chrysomelidae	L		C	20	2.5	water margins	Found mainly on brooklime in wet places. Very local in N England.	Recorder
Prasocuris phellandrii		Chrysomelidae	L		B	84	10.3	water margins	Feeds on buttercup flowers in marshy places. Widespread but local.	Recorder
Anisosticta novemdecimpunctata		Coccinellidae	L		B	144	12.7	fen, marsh	Found in fens and marshes.	Recorder
Coccidula scutellata		Coccinellidae	L		C	52	4.6	marsh, fen	Found in marshes.	Recorder

Species	Synonyms	Family	Status	Revised status	Fdelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Tytthaspis sedecimpunctata		Coccinellidae	L		C	44	3.9	marsh, fen	Local in marshy places but can occur in other habitats.	Recorder
Telmatophilus caricis		Cryptophagidae	L		C	58		marsh, fen	Small beetle found on *Carex*, *Typha* etc in wet places. Local, rare in the north.	Recorder
Amalorrhynchus melanarius		Curculionidae	L		C	9	1.1	still freshwater	Weevil living on watercress. Local in wet places.	Recorder
Bagous cylindrus		Curculionidae	RDB2		A	22	0.9	still freshwater	An aquatic weevil feeding on *Glyceria* aquatic grasses. Very restricted in distribution and almost certainly declining, confined to the grazing levels of the Thames Marshes and Sussex, although with an old record from Bedfordshire. May be abundant where found. This species is rare in Europe.	Recorder
Bagous nodulosus		Curculionidae	RDB1		C	2	0.2	still freshwater	Ditches, dykes and ponds. Associated with *Butomus umbellatus*.	Hyman & Parsons 1992
Bagous subcarinatus		Curculionidae	Na		B	3	0.4	brackish and still freshwater	Freshwater and brackish water ditches in southern England. Associated with *Ceratophyllum submersum*.	Hyman & Parsons 1992
Bagous tempestivus		Curculionidae	Nb		C	4	0.5	still freshwater and brackish water	Wetlands, including brackish ditches. Associated with a variety of wetland and aquatic plants,in particular sedges, pondweeds and *Sagittaria*.	Hyman & Parsons 1992
Drupenatus nasturtii		Curculionidae	Nb		C	3	0.4	still freshwater	Wetlands, particularly base-rich streams and drainage ditches. Associated with *Nasturtium officinale*.	Hyman & Parsons 1992
Eubrychius velutus		Curculionidae	Nb		C	4	0.5	still freshwater	Found on aquatic plants, particularly *Myriophyllum* and *Potamogeton* in stagnant and slow flowing water. Widespread but local.	Recorder
Gymnetron villosulum		Curculionidae	Nb		B	10	1.2	water margins	Wetlands. Associated with *Veronica catenata*, *V. anagallis-aquatica* and perhaps *V. beccabunga* and *V. scutellata*.	Hyman & Parsons 1992
Hydronomus alismatis		Curculionidae	Nb		B	50	6.1	still freshwater	Aquatic habitats, associated with *Alisma plantago-aquatica* and possibly *Sagittaria.*	Hyman & Parsons 1992

Species	Synonyms	Family	Status	Revised status	Fdelity	Records	%	Main habitat or microhabitat	Known ecology	Literature reference
Litodactylus leucogaster		Curculionidae	Nb		B	4	0.5	still freshwater	Feeds on *Myriophyllum* and possibly on other aquatic plants in ponds and marshy places.	Recorder
Notaris bimaculatus		Curculionidae	Nb		C	6	0.7	still freshwater	Wetlands and river banks. Associated with *Phalaris*, *Phragmites*, *Typha* and possibly *Carex*.	Hyman & Parsons 1992
Poophagus sisymbrii		Curculionidae	L		C	14	1.7	still freshwater	A widespread but local weevil, particularly in the north. It lives underwater on the leaves of crucifers, particularly *Rorippa [?*Nasturtium*],* in still or slowly flowing water.	Recorder
Thryogenes festucae		Curculionidae	L		C	9	1.1	still freshwater	Weevil occurring in marshy areas where on feeds on a variety of plants including *Carex* spp and *Schoenoplectus lacustris*. Widespread but local in occurrence.	Recorder
Thryogenes nereis		Curculionidae	L		C	10	1.2	still freshwater	Brown weevil found in marshy areas and probably feeds on *Carex* spp. Widespread but local.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
											771	236	380	339	598	118
Agabus conspersus		Dytiscidae	Nb		B	159	6.5	brackish pools	The species is generally regarded as being confined to coastal brackish water but it has been found inland in water of high conductivity associated with mine workings.	Foster in prep.	1	0.4	17.9	24.2	0	0
Copelatus haemorrhoidalis		Dytiscidae	L		C	229	9.4	still freshwater	Mainly a south-eastern species reaching its northern limit around Cumbria-Yorkshire and absent from Scotland except for one locality in Dumfries. Fairly common in south-east England, local in the rest of its range.	Foster 1983; Recorder	10.5	20.3	9.5	15.9	1.5	0.8

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Dytiscus circumflexus		Dytiscidae	Nb		B	56	2.3	still freshwater, brackish water	It occurs in lowland ponds and artificial lakes with patches of vegetation and plenty of exposed substratum. It tolerates brackish water but is not confined to it.	Foster in prep. & 1985	0.1	0	9.2	5.9	0	0
Dytiscus dimidiatus		Dytiscidae	RDB3	EN	C	9	0.4	still freshwater	It occurs in rich fen vegetation in lowland drains and ponds. It is concentrated in the Cambridgeshire Fens, Broadland and the coastal fens of Kens and Sussex.	Foster in prep. & 1985	1.2	0	0	0	0	0
Dytiscus semisulcatus		Dytiscidae	L		C	68	2.8	still freshwater	Common water beetle in the south, especially in heathy pools and more acid water, but scarce in the north.	Recorder	0.8	0	8.7	8.3	0.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Graptodytes bilineatus		Dytiscidae	RDB3	VU	C	31	1.3	water margins, fresh to brackish	The typical habitat is reedswamp with some moss, receiving brackish or otherwise base-rich water.	Foster in prep.	0	0	1.3	7.7	0	0
Graptodytes pictus		Dytiscidae	L		B	554	22.7	still freshwater	A southern water beetle found in ditches and ponds. In northeastern England, it is mainly found in man-made waterbodies, and it appears to be declining in this region. Widespread in lowland Britain, but absent from the south-west and northern Scotland.	Foster 1981; Recorder	27.4	16.1	11.3	10.6	30.1	39

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydaticus seminiger		Dytiscidae	Nb		C	41	1.7	fen carr	It is confined to lowland fen pools with dense vegetation, often in shade, and often small and isolated. It occurs in ditches on coastal levels but is probably restricted there by the shade afforded by reedbeds.	Foster 1985	0.6	8.5	1.8	0.6	1.2	0
Hydaticus transversalis		Dytiscidae	pRDB3	LRnt	A	169	6.9	still freshwater	It occurs in permanent water in exposed ponds and drainage ditches with rich vegetation. It is frequent in the Somerset and Gwent ditch systems.	Foster in prep. & 1985	20.4	0	0	0	2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydroglyphus pusillus	*Guignotus pusillus*	Dytiscidae	Nb	LRlc	C	37	1.5	still freshwater	The species is most characteristic of still water with a clay or mud substratum but is also typical of shallow ditch systems of the Somerset Levels, and will occur amongst shallowly flooded moss.	Foster in prep. & 1981	1.9	2.5	2.4	0.6	0.8	0
Hydroporus incognitus		Dytiscidae	L		C	77	3.2	still freshwater	Usually found in woodland but sometimes common in slow-flowing water and peat bogs and fens in open situations.	Foster 1984	7.5	0.4	1.1	0.3	1.5	3.4
Hydroporus striola		Dytiscidae	L		C	92	3.8	still freshwater	A 'local' species of fens and marshes with a strong lowland distribution.	Foster 1984	11.4	0	0.8	0	0.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydrovatus clypealis		Dytiscidae	Na	LRnt	C	13	0.5	still freshwater	It occurs in lowland muddy ponds and ditches with marginal vegetation. Records are mainly from the south coast of England.	Foster in prep. & 1981	0	3.8	0.8	0.3	0	0
Hygrotus impressopunctatus	*Coelambus impressopunctatus*	Dytiscidae	L		C	185	7.6	still freshwater & brackish water	A mildly halophilic species.	Foster 1981	2.1	4.7	11.8	21.5	6.7	0
Hygrotus parallelogrammus	*Coelambus paralleogrammus*	Dytiscidae	Nb		B	72	2.9	brackish water	Almost all records are for stagnant brackish water on the coast.	Foster in prep.	0.4	1.7	10	7.7	0.2	0
Hygrotus versicolor		Dytiscidae	L		C	88	3.6	still freshwater	It is found mainly in clay pits and fen drains	Foster 1981	6.5	1.7	0	0.3	3.2	11.9
Ilybius ater		Dytiscidae	C		B	189	7.7	still freshwater	An active water beetle usually recorded from temporary, lowland pools, but capable of turning up just about anywhere.	Recorder	11.2	7.2	9.5	4.7	4.7	5.1

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Ilybius quadriguttatus		Dytiscidae	C		B	261	10.7	still freshwater	Water beetle found in ponds and ditches. Mainly southern distribution reaching its northern limit in Durham. Tends to be coastal in Wales.	Recorder	19.8	9.7	5	12.4	3	5.1
Laccophilus hyalinus		Dytiscidae	C		C	211	8.6	still freshwater	Found in open water including canals, gravel pits and large drains. Fairly common in the south, but scarcer in northern England, reaching its northern limit in Yorkshire and Lancashire.	Recorder	10.9	20.3	10.8	1.8	4.5	4.2
Laccophilus minutus		Dytiscidae	L	common	B	659	27	still freshwater	It is found in well established lowland ponds throughout England and Wales, but more restricted in Scotland and absent from all upland areas.	Foster 1981; Recorder	28.4	34.7	33.9	24.2	23.2	6.8

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Laccophilus poecilus	*Laccophilus obsoletus*	Dytiscidae	RDB2	CR	B	0	0	still freshwater	It occupies lowland rich fens near the coast. The only recently known population is on the Lewes Levels, East Sussex.	Foster in prep.; Hodge 2003	0	0	0	0	0	0
Porhydrus lineatus		Dytiscidae	L		B	328	13.4	still freshwater	A southern water beetle found in ponds and ditches. Widespread in the southern half of England, but scarce or absent in the south-west, west Wales and much of Scotland.	Foster 1987; Recorder	30.7	13.1	12.4	0	1	5.9

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Rhantus frontalis		Dytiscidae	Nb		A	184	7.5	still freshwater	It inhabits a wide range of lowland stagnant water habitats, including drainage ditches on coastal marshes, duneslack ponds, pingo fen pools and fluctuating Breckland mere. The sites are exposed with sparse vegetation over sand and silt and a tendency to dry out in the summer.	Foster in prep. & 1985	1.3	0	22.6	24.5	0.8	0
Rhantus grapii		Dytiscidae	Nb		B	182	7.5	still freshwater	It lives in lowland stagnant water, usually in partly shaded fen conditions, among dense vegetation. Some sites are very base-rich. It is known to move into temporary pools in bogs and fens, presumably for reproduction.	Foster in prep. & 1985	16.7	1.7	0.5	1.2	7.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Rhantus suturalis		Dytiscidae	Nb	LRlc	B	311	12.7	still freshwater	It occurs in exposed lowland ponds and ditches amongst vegetation.	Foster in prep. & 1985	4.4	16.1	7.1	6.8	31.6	0
Suphrodytes dorsalis	*Hydroporus dorsalis*	Dytiscidae	L		C	47	1.9	still freshwater	A lowland fen species tolerant of carr.	Foster 1984	4.2	1.3	2.1	1.2	0	0
Gyrinus caspius		Gyrinidae	L		B	104	4.3	coastal standing water	Mainly coastal still water.	Foster in prep. & 1985	2.1	1.7	12.9	8.6	0.8	0.8
Gyrinus paykulli	*bicolor*	Gyrinidae	Na		C	19	0.8	still freshwater	It usually occurs in deep still water amongst reeds at the edge of lakes or in fenland ditches.	Foster in prep. & 1985	0	0	1.6	0.6	1.8	0
Haliplus apicalis		Haliplidae	Nb	LRlc	C	107	4.4	brackish water	It is mainly associated with pools subject to infrequent tidal flooding and occasionally occurs inland in pools receiving brackish water. It is most frequent marshes of the Thames estuary.	Foster in prep. & 1981	0	0.8	17.9	10.6	0.2	0
Haliplus flavicollis		Haliplidae	L		C	91	3.7	still freshwater	A water beetle of open water, including large drains, gravel pits, lakes and lochs.	Recorder	7.4	5.1	0.5	0	2.8	2.5

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Haliplus heydeni		Haliplidae	Nb		C	29	1.2	still freshwater	It is associated with highly enriched , well-vegetated , stagnant water, sometimes in partial shade.	Foster in prep. & 1981	2.9	0	0	0.6	0	4.2
Haliplus immaculatus		Haliplidae	L		B	285	11.7	still freshwater	Water beetle of large lowland ponds and lakes. Widely distributed in England, appears to be more restricted in Wales and Scotland, especially in the north of Scotland.	Foster 1981, 1990; Recorder	13.2	12.7	12.9	7.4	13.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Haliplus obliquus		Haliplidae	L		C	59	2.4	still freshwater	A water beetle found in lowland lakes and ponds with little vegetation and a bare substrate where it is apparently associated with stoneworts. Widespread but local in Britain except for the Scottish highlands and some of the western Isles.	Recorder	3.5	0.4	1.3	1.2	3.7	0
Haliplus wehnckei		Haliplidae	L		C	206	8.4	still freshwater	Water beetle found in all types of lowland water. Widespread but local.	Recorder	14.3	3.4	0.8	2.9	7.5	25.4

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Peltodytes caesus		Haliplidae	Nb		A	252	10.3	still freshwater, brackish water	It is confined to lowland slow-moving drains and ponds with permanent water, often brackish, always base-rich and usually with a soft, muddy bottom.. Typically these lie in areas of old grazing fen on coastal marsh systems.	Foster in prep. & 1981	12.7	5.9	16.3	7.4	8.9	0
Helophorus alternans		Helophoridae	Na		B	61	2.5	brackish and freshwater	It is found in coastal fens and heathland pools.	Foster in prep. & 1987	0	1.7	11.8	3.5	0	0
Helophorus fulgidicollis		Helophoridae	Nb		C	25	1	brackish water	It breeds in saltmarsh and is an obligate halopbiont species.	Foster in prep.	0	0	1.1	6.2	0	0
Helophorus griseus		Helophoridae	Nb	LRlc	C	58	2.4	still freshwater, brackish water	It is found in exposed, temporary, clayey pools in lowlands; in the north and west it is found in saltmarshes.	Foster in prep.	5.4	0	0.5	2.4	0.3	3.4

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Helophorus nanus		Helophoridae	Nb		B	25	1	still freshwater, water margins	It is found in marshes edges of temporary lowland ponds and fens, particularly where there is a growth of mosses associated with temporary flooding. The species is typical of relict faunas associated with coastal, non-brackish grazing levels and with pingo fens.	Foster in prep. & 1987	0.4	0	0	6.2	0	0.8

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Aulacochthebius exaratus	*Ochthebius exaratus*	Hydraenidae	pRDB3	VU	B	41	1.7	water margins, fresh or brackish	It is probably confined to lowland coastal situation in south-east England because of its need for warmth. Typically it occurs on wet clay, often in coastal freshwater ponds but also in cliff landslip seepage and in brackish water. It occurs in many coastal levels.	Foster in prep. & 1990	0	5.9	7.1	0	0	0
Hydraena riparia		Hydraenidae	L		C	66	2.7	water margins	It is found in the muddy margins of ponds and, sometimes, rivers.	Recorder	4.9	0	0	1.5	2.7	5.9

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydraena testacea		Hydraenidae	Nb	LRlc	C	45	1.8	water margins	It is found in stagnant water in association with a well developed marginal vegetation line, and also in slow-moving water in canals and streams, being found in the moist zone just above the main water line.	Foster in prep. & 1990	3.4	3	1.8	1.2	0.2	0
Limnebius nitidus		Hydraenidae	Nb		C	42	1.7	water margins	It lives on moist clay or silt beds at the edges of ponds, ditches, slow streams, canals and rivers.	Foster in prep. & 1990	1.4	5.5	3.9	0.3	0.3	0
Limnebius papposus		Hydraenidae	Nb		C	42	1.7	water margins	It is largely confined to lowland fen areas in drains and ponds, usually with rich vegetation and detritus.	Foster in prep. & 1990	5.3	0	0	0.3	0	0
Ochthebius dilatatus		Hydraenidae	L		C	183	7.5	water margins	It is found in the muddy margins of lowland ponds.	Recorder	9.1	1.3	1.3	10.3	11.5	0.8

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Ochthebius marinus		Hydraenidae	Nb		C	55	2.3	brackish water margins	It occurs in a wide range of brackish habitats, and has rarely been recorded inland.	Foster in prep. & 1990	2.7	0.8	2.1	6.8	0	0.8
Ochthebius nanus		Hydraenidae	Nb	LRnt	C	48	2	water margins	It occurs in stagnant water pools and in slow-flowing drains in lowland rich and grazing fen.	Foster in prep. & 1990	0.6	4.7	0.5	2.7	3.5	0
Ochthebius viridis		Hydraenidae	Nb		B	80	3.3	water margins, brackish or fresh	It is typically associated with brackish pools and ditches on coastal levels but also occurs in exposed pools on lowland heathland.	Foster in prep. & 1990	3.4	0	6.8	8.3	0	0
Hydrochus angustatus		Hydrochidae	Nb		C	22	0.9	still freshwater	It occurs in a variety of habitats in the East Anglian fens but otherwise it is mainly associated with heathland, in exposed ditches, shallow pools and temporary puddles.	Foster in prep.	2.2	0.4	0	0	0.7	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydrochus elongatus		Hydrochidae	RDB3	LRnt	C	10	0.4	still freshwater water margins	It occurs in shallow, well vegetated, still water, often in reedbeds and other areas with rich emergent vegetation over clay, in low-lying areas.	Foster in prep.	0	1.7	0.3	0.3	0.5	0.8
Hydrochus ignicollis		Hydrochidae	RDB3	VU	C	16	0.7		This species occurs in stagnant, well vegetated pools, often in association with mosses in the margins of pools that dry out. It is exclusively associated with ancient fenland.	Foster in prep.	0	1.3	2.6	0.9	0	0
Anacaena bipustulata		Hydrophilidae	Nb	LRlc	B	289	11.8	still freshwater	It is found mainly in ditches and ponds in former fenland and occasionally inland in small streams in the Weald.	Foster in prep. & 1987	8.2	11.4	16.3	4.7	20.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Anacaena lutescens		Hydrophilidae	C		C	182	7.5	still freshwater	Only recently recognised as distinct from *A. limbata, so r*ecords are confused but both species appear to be widespread and common in Britain. Found in standing water, including puddles.	Recorder	16.5	3	0.8	6.2	4	0
Berosus affinis		Hydrophilidae	Nb		A	201	8.2	still freshwater	It is mainly associated with slow-flowing drains and ponds on coastal levels, with some vegetation over mud or silt.	Foster in prep. & 1987	11.9	10.6	20.5	1.8	0	0
Berosus signaticollis		Hydrophilidae	Nb		C	52	2.1	still freshwater	It is often associated with shallow, rain-filled temporary pools, but also can survive in shallow muddy ponds subject to intense fouling by livestock. It is an important component of the southern heathland community.	Foster in prep. & 1987	0	0	0.5	14.7	0	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Cercyon convexiusculus		Hydrophilidae	Nb	LRlc	C	54	2.2	water margins	It lives in litter in beds of reeds, sedges, or other wet, thickly vegetated situations	Recorder	3.4	0.8	2.1	2.4	1.7	0
Cercyon marinus		Hydrophilidae	L		C	64	2.6	water margins	It lives among submerged plant litter at the edges of still water and in marshes.	Recorder	2.1	1.3	2.9	7.4	1.5	0
Cercyon sternalis		Hydrophilidae	Nb		B	88	3.6	water margins	It lives among litter in lowland fen ponds and ditches.	Foster in prep. & 1987	1.8	1.3	5.3	13	1.2	0
Cercyon tristis		Hydrophilidae	Nb	LRlc	C	111	4.5	water margins	It occurs in a wide range of lowland wetland habitats, specially in association with muddy beds of litter in mesotrophic mires. It is found on many coastal fens.	Foster in prep. & 1987	3.9	0	0.5	17.4	3.3	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Cercyon ustulatus		Hydrophilidae	Nb	L	C	38	1.6	water margins	It is associated with wet litter and mud at the edges of ponds, canals, oxbows and slow rivers. It is a typical inhabitant of base-enriched peat cuttings with reedbeds.	Foster in prep.	2.2	0.8	0.8	0.3	2.5	0
Coelostoma orbiculare		Hydrophilidae	L		C	102	4.2	still freshwater	Frequently living in moss or wet plant debris at the side of freshwater as well as living in the water itself. Very common in a variety of water types.	Recorder	5.6	7.6	1.8	4.4	3.2	0
Cymbiodyta marginella		Hydrophilidae	L		B	472	19.3	still freshwater	Found in decaying vegetation such as *Phragmites* litter.	Foster 1987; Recorder	19.1	11.4	29.5	44	6.2	0
Enochrus bicolor		Hydrophilidae	Nb		B	54	2.2	brackish water	It is confined to brackish water in coastal ponds and slow-flowing ditches.	Foster in prep.	0.5	0.4	4.5	9.4	0	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Enochrus coarctatus		Hydrophilidae	L	LRlc	B	224	9.2	still freshwater	A small brown water beetle occurring in non-acid well-vegetated standing water, usually with much detritus.	Recorder	19.7	11.4	2.1	0	6.2	0
Enochrus halophilus		Hydrophilidae	Na		B	117	4.8	brackish water	It is found in brackish pools on the coast and inland in areas receiving saline seepage. It is particularly frequent in the North Kent Marshes.	Foster in prep.	0	0.4	13.9	18.6	0	0
Enochrus melanocephalus		Hydrophilidae	Nb		C	94	3.8	still freshwater and brackish water	It is found in exposed base-rich sites including coastal pools and ditches with a brackish influence.	Foster in prep.	4	3	4.5	3.8	4.3	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Enochrus ochropterus		Hydrophilidae	Nb		C	122	5	still freshwater	It is typical of mesotrophic mires, including small base-enriched sections of otherwise nutrient-poor bogs, base-flushed peat cutting and mossy duneslack and oxbow ponds. It can occur in fen carr and appears to be particularly common in litter zones or where mosses are decaying after trampling.	Foster in prep.	15.3	1.3	0.3	0	0	0
Enochrus testaceus		Hydrophilidae	L		B	450	18.4	still freshwater	Occurs in well-vegetated fresh water.	Foster 1987; Recorder	22.2	25.4	15	13.6	19.2	0.8
Helochares lividus		Hydrophilidae	Nb	LRlc	B	385	15.8	standing water	Occurs in freshwater ditches, fens and ponds. Found mainly in the south-east.	Recorder	27.9	20.8	21.6	5.9	3.2	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Hydrochara caraboides		Hydrophilidae	RDB1	VU	B	9	0.4	still freshwater	In the Somerset Levels, it is confined to ditches in one more acid peat area. It is found in field ponds in Cheshire.	Foster in prep.; UK Biodiversity Group 1999	1.2	0	0	0	0	0
Hydrophilus piceus		Hydrophilidae	RDB3	LRnt	A	196	8	standing water	It is largely confined to drains in coastal levels. Those specially favoured at choked with vegetation such as *Lemna trisulca* and fringed by common reed. It is well established in the Somerset Levels, the Broads and coastal levels in Kent and Sussex.	Foster in prep. & 1987	10	8.1	19.5	2.7	2.8	0
Laccobius biguttatus		Hydrophilidae	L		B	292	12	still freshwater	It is found at the margins of large, lowland ponds.	Recorder	8.7	11.4	6.6	6.8	25.1	0
Laccobius minutus		Hydrophilidae	L		B	160	6.6	still freshwater	It is found in ditches in grazing levels and well established lowland ponds.	Recorder	6.9	9.7	7.9	5	4.5	8.5

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Limnoxenus niger		Hydrophilidae	Nb		A	249	10.2	still freshwater, brackish water	It occupies a range of exposed lowland fen habitats including peaty areas with rich vegetation and exposed clay in brackish ponds. It is largely confined to coastal marshes and the Somerset Levels.	Foster in prep. & 1987	7.3	14.4	24.7	10.9	4.7	0
Hygrobia hermanni		Hygrobiidae	L		C	151	6.2	still freshwater	A water beetle of silt and detritus ponds, particularly those visited by cattle with high ammonia content, also lakes and gravel pits. A predominantly southeastern English species.	Foster 1981, 1990; Recorder	6.1	18.6	9.7	1.8	2.8	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Lit. reference	S'set, Gwent	Hants, Sussex	Kent	Essex, Suffok	Norfolk	northern
Noterus clavicornis		Noteridae	L		B	1063	43.5		A local water beetle of lowland, grassy ponds, found mostly in the southern half of Britain and often abundant where it occurs. In the north it does appear to be confined to older, well established sites.	Foster 1981; Recorder	31.6	63.1	54.7	41.3	53.8	0
Noterus crassicornis		Noteridae	Nb		B	486	19.9	still freshwater	It is a lowland species of fen drains, mires and rafts of vegetation at the edges of lakes, often found in coastal ditches but not in brackish water. It is one of the commonest water beetles in Norfolk grazing marshes.	Foster in prep. & 1981	0	0	9.2	6.8	71.6	0

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Aphodius plagiatus		Scarabaeidae	Nb		C	1		dry sandy places	Sandhills, dunes, saltmarshes and damp places near the coast.	Hyman & Parsons 1992
Cyphon phragmiteticola		Scirtidae	L		C	17	1.8	water margins	It occurs locally in marshy areas.	Recorder
Scirtes hemisphaericus		Scirtidae	L		B	171	17.8	water margins	Adults lives on rushes in wet places; the larvae are aquatic.	Recorder
Scirtes orbicularis		Scirtidae	Na		B	43	4.5	water margins	Wetlands, marshes, grazing levels and marshy dykes. Adults occur among wetland herbage, including sedges, reedmace and bur-reeds. The larvae are aquatic.	Hyman & Parsons 1992
Paederus riparius		Staphylinidae	L		C	75	7.9	fen	Rove beetle found on bare mud and among reed litter by lakes and in fens. Mainly southern.	Recorder
Philonthus punctus		Staphylinidae	pRDB3		B	1	0.1	riparian	Associated with coastal marshes and also found at the edge of saltmarshes along the south and east English coasts	Hyman & Parsons 1994
Stenus canaliculatus		Staphylinidae	L		C	25	2.6	riparian	Local in marshy places, usually among lush vegetation or among *Glyceria* or *Phragmites* litter etc.	Recorder
Stenus canescens		Staphylinidae	Nb		C	11	1.2	riparian	Wetlands.	Hyman & Parsons 1994
Stenus cicindeloides		Staphylinidae	L		B	120	12.6	fen, marsh	Small rove beetle living on ground and climbing vegetation in marshy places. Common in S England, becoming more local in the north.	Recorder
Stenus fornicatus		Staphylinidae	Nb		C	19	2	fen	A wetland species found in fens, along dykes and from the margins of freshwater.	Hyman & Parsons 1994
Stenus incrassatus		Staphylinidae	L		C	8	0.8	riparian	Widespread but local in marshy places, mainly in the south.	Recorder
Stenus solutus		Staphylinidae	L		C	12	1.3	fen	Small rove beetle of marshy places. Nowhere common, mainly S England.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Diptera										
Anagnota bicolor		Anthomyzidae	Nb		C	0	0	fen, marsh	Stands of *Phragmites, Carex paniculata* or grasses in marshes and coastal levels. The larvae may develop in galls formed by other flies, such as *Lipara* cigar galls on *Phragmites.*	Falk & Ismay in prep
Anagnota collini		Anthomyzidae	RDB3		C	0	0	marsh	Probably marshes and coastal levels. The larvae may develop in galls formed by other flies, such as *Lipara* cigar galls on *Phragmites.*	Falk & Ismay in prep
Typhamyza bifasciata	*Anthomyza bifasciata*	Anthomyzidae	Nb		C	2	0.4	fen, marsh, wet wood	Ditches and pond margins on fens, coastal levels and damp woods, with a requirement for *Typha angustifolia* (although it does occur where *T. latifolia* grows). Larvae develop in the rotting basal portion of *Typha*.	Falk & Ismay in prep
Stenomicra cogani		Aulacicagstridae	RDB3		C	4	0.8	fen, marsh	Fens, coastal levels and the marginal vegetation of water bodies. The larvae probably mine the stems of monocotyledons or develop in decaying vegetable matter.	Falk & Ismay in prep
Cryptonevra nigritarsis		Chloropidae	Nb		C	0	0	marsh	*Phragmites* stands, usually those with saline influence. Most sites are coastal.	Falk & Ismay in prep
Dicraeus scibilis		Chloropidae	Nb		B	12	2.3	coastal grassland, saltmarsh, dunes	Coastal grasslands, including that associated with saltmarsh and sand dunes. Inland records are from water meadows and unimproved pastures. The larvae probably develop in grass seeds. It is frequent in the North Kent marshes.	Falk & Ismay in prep
Dicraeus tibialis		Chloropidae	Nb		C	33	6.3	grassland	Grasslands, particularly calcareous to neutral unimproved meadows, but also waste ground and coastal grassland. The larvae develop in seed heads.	Falk & Ismay in prep
Elachiptera megaspis		Chloropidae	L		C	35	6.7	still freshwater	The larvae are stem borers in *Nasturtium officinale*. Distribution little known.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Elachiptera pubescens		Chloropidae	Nb		B	27	5.1	brackish marsh, wet heath	Brackish coastal levels and to a lesser extent a short way inland on damp heathland, gravel pits and marshland. There seems to be a requirement for Phragmites beds.	Falk & Ismay in prep
Elachiptera rufifrons		Chloropidae	RDB3		C	4	0.8	fen, marsh	Wetlands, including coastal marshes and freshwater fens. The larvae probably develop in decaying vegetable matter, and there may be a requirement for *Phragmites*.	Falk & Ismay in prep
Eribolus slesvicensis		Chloropidae	Nb		B	1	0.2	reedbeds, marsh	Reedbeds and water margins, usually on coastal levels, occasionally a short distance inland. Adults have been associated with *Phragmites* growing in semi-saline conditions and have been found more often on the water side of the reedbeds.	Falk & Ismay in prep
Eurina lurida		Chloropidae	RDB3		B	0	0	brackish marsh	Coastal levels and marshes a short distance inland where there has been some salinity in the past. Larvae probably feed within galls on *Scirpus maritimus*.	Falk & Ismay in prep
Meromyza hispanica		Chloropidae	RDBK		C	0	0	marsh	The only record is from a freshwater ditch on the Somerset Moors.	Falk & Ismay in prep; Drake 1987
Meromyza nigriseta		Chloropidae	Nb		B	0	0	fen, marsh	Wetlands, both inland fens and coastal marshes. Larvae probably develop in grasses. Most records are from south-east England.	Falk & Ismay in prep
Meromyza pleuriseta		Chloropidae	Nb		B	0	0	dry grassland	Known from a few dry grassland sites near the coast and further inland in south-east England. The larvae probably develop in grasses.	Falk & Ismay in prep
Oscinella angularis		Chloropidae	Nb		C	22	4.2	fen, marsh, wet heath	Wetlands, including fen, damp heathland, water meadows, coastal marshes and dry ponds. There is a requirement for *Phalaris arundinacea*.	Falk & Ismay in prep

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Oscinella angustipennis		Chloropidae	Nb		C	38	7.2	marsh	Wetlands, including fen, coastal levels and beside ditches with *Phragmites, Typha* or *Butomus*. There are strong populations in the Somerset and Gwent Levels	Falk & Ismay in prep
Aedes dorsalis		Culicidae	RDB3		B	0		brackish water	larval sites include brackish water in the ditches and pools of coastal marshes and amongst growths of emergent plants in an intermittent freshwater meadow pool that may have brackish water influence.	Falk & Chandler in prep.
Aedes flavescens		Culicidae	RDB2		B	0		brackish water	Coastal marshes, both freshwater and brackish. Larval sites include unshaded ditches, marshy area and small temporary pools with winter flooding.	Falk & Chandler in prep.
Phalacrocera replicata		Cylindrotomidae	Nb		C	4	0.8	fen, mire	Mossy pools, either with *Sphagnum* or other semi-aquatic mosses, and in fen and bog.	Falk 1991
Dixella attica		Dixidae	Nb		B	0	0	brackish water	Brackish ditches with emergent vegetation, mainly coastal, very few inland records.	Disney 1999
Argyra vestita		Dolichopodidae	L		B	54	7.6	marsh, sea shore	Metallic fly usually found on seaweed covered rocks [this does not agree with my experience]. Usually numerous where it occurs. Widespread but local.	Recorder
Campsicnemus magius		Dolichopodidae	RDB3		B	4	0.6	marsh	The principal habitat appears to be coastal levels and other situations with intermediate salinity, and not normally saltmarshes themselves. Bare mud beside pools and ditches is probably a requirement.	Falk & Crossley in prep.
Dolichopus brevipennis		Dolichopodidae	L		B	206	28.9	wetland	Adults typically in wet situations. Locally abundant, perhaps more frequent in the north and west.	Recorder
Dolichopus cilifemoratus		Dolichopodidae	Nb		C	2	0.3	wet grassland	Known sites are wetlands such as damp meadows and field dykes.	Falk & Crossley in prep.
Dolichopus diadema		Dolichopodidae	L		C	33	4.6	saltmarsh, brackish marsh	A fly which lives on the surface of pools in salt marshes.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Dolichopus latelimbatus		Dolichopodidae	L		C	19	2.7	wetland	Rather uncommon in the southern half of England.	Recorder
Dolichopus wahlbergi		Dolichopodidae	L		C	7	1.1	wetland	Found in fairly wet places. Widely distributed, but rather local.	Recorder
Hercostomus celer		Dolichopodidae	L		C	32	4.5	wetland	Found in damp places	Recorder
Hercostomus cupreus		Dolichopodidae	L		C	26	3.6	wetland	Found in damp grassland and at the edges of ponds and streams. Widespread but local. Abundant where it occurs.	Recorder
Hercostomus nanus		Dolichopodidae	L		C	29	4.1	stream margins	Favours the banks of streams. Uncommon, England north to Yorkshire, also noted in south Wales.	Recorder
Micromorphus 'albipes'		Dolichopodidae	L		B	93	13	wetland	Adults usually found in damp woodland or carr situations.	Recorder
Poecilobothrus ducalis		Dolichopodidae	pRDB3		B	0	0	brackish marsh	Ditches and pools on coastal marshes appear to be the preferred habitats.	Falk & Crossley in prep.
Poecilobothrus principalis		Dolichopodidae	L		B	28	3.9	brackish marsh, saltmarsh	Found on coastal levels and saltmarshes. Adults are found beside brackish pools and ditches and there is a single record from a swallows nest near Gibraltar Point - presumably resulting from the birds feeding on nearby saltmarshes. Essentially a coastal species recorded from the south and east coast of Britain from Pembrokeshire to Lincolnshire with an isolated record from Durham.	Recorder
Rhaphium antennatum		Dolichopodidae	Nb	Local in Falk & Crossley in prep.	C	15	2.1	water margins	Found at water margins in fens, grazing levels and gravel pits, chiefly coastal with scattered records through southern England north to Yorkshire; apparently relatively frequent in the Thames marshes.	
Scellus notatus		Dolichopodidae	L		C	25	3.5	wetland	It is widespread, though somewhat local, in England and Wales but may be scarce in Scotland, and is usually found in woodland and scrub.	Kirby 1991

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Syntormon pumilus		Dolichopodidae	L		B	62	8.7	wetland	Widespread but very scattered and sparse distribution and found in damp, well vegetated places.	Recorder
Teuchophorus spinigerellus		Dolichopodidae	L		B	75	10.5	wetland	Found in wet places.	Recorder
Empis decora		Empididae	Nb		C	0		unknown	Although there appears to be an association with coastal marshes, there are also records from inland sites, including wetlands and woodland.	Falk & Crossley in prep.
Hilara fulvibarba		Empididae	L		B	15		marsh	An empidid fly that has been reported from several localities, many near the coast. Distributed from Hampshire, Dorset, London, East Anglia, Nottinghamshire, Cumberland and in Wales from Glamorganshire.	Recorder
Hilara merula		Empididae	pRDB3		C	2		?flowing water margins	The few records are from the margins of drainage ditches in winter-flooded hay meadow in the Derwent Valley and from a small stream in grazing marsh in Somerset.	Falk & Crossley in prep.
Hilara subpollinosa		Empididae	L		A	141		marsh	Larval habitats are mainly found near coasts and estuaries and include slightly brackish waters, such as dykes, with emergent sedges and grasses. Also recorded from marginal swamps bordering ponds, lakes and rivers.	Recorder
Rhamphomyia physoprocta		Empididae	pRDB3		C	0		marsh	The habitats include marsh, pingo pools, and from ditches on flood plains.	Falk & Crossley in prep.
Notiphila guttiventris		Ephydridae	L		C	0		still freshwater	Newly added to the British list, but found from two grazing marshes. The larvae are aquatic.	Drake 2001
Notiphila nubila		Ephydridae	L		C	0		still freshwater	Newly added to the British list, and found at several grazing marshes. The larvae are aquatic.	Drake 2001
Platypalpus pallidicornis		Hybotidae	L		C	40		reedbeds	The predatory adults are typically found in *Phragmites* beds.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Platypalpus pictitarsis / kirtlingensis		Hybotidae	L		C	39		marsh	Adults found on hedges and bushes. Records include sites in Essex, Cambs and Berks. [It was frequent in western grazing marshes.]	Recorder
Platypalpus praecinctus		Hybotidae	Nb		C	1		unknown	The majority of sites are wetlands, including coastal levels and inland fens and marshes.	Falk & Crossley in prep.
Calliopum elisae		Lauxaniidae	L		C	23		fen, marsh	Mainly in fens. Most records are from Scotland and northern England where it is locally common. Larvae probably in decaying vegetation.	Recorder
Dicranomyia ventralis	*Limonia ventralis*	Limoniidae	Nb		B	1	0.2	brackish and freshwater margins	Many records refer to brackish ditches on coastal levels, and others to muddy, sparsely vegetated margins of lakes and ponds.	Falk 1991
Erioptera bivittata		Limoniidae	RDB2		A	6	1	brackish water	Coastal levels with mildly brackish ditches and ponds, favouring muddy areas with sparse vegetation. Occasionally occurring on inland fens where a saline influence is present.	Falk 1991
Erioptera squalida		Limoniidae	L		B	56	9.5	still freshwater	Ditches and ponds of levels, grazing marshes and canals. Larvae associated with Glyceria maxima, puncturing plant tissue with spiracles for air.	Recorder
Helius pallirostris		Limoniidae	Nb		C	5	0.8	water margins	A wide range of wetlands are used including marshes, ditches on coastal levels, dune slacks and sluggish calcareous rivers. There seems to be an association with tall emergent vegetation beside ditches and pond.	Falk 1991
Limnophila pictipennis		Limoniidae	pRDB2		C	4	0.7	water margins	Records include coastal marshes and inland gravel pit ponds and fens, and the presence of a rich marginal vegetation beside ditches and ponds may prove an important requirement.	Falk 1991
Molophilus pleuralis		Limoniidae	L		B	17	2.9	still freshwater and brackish water	Found mainly near the coast, tolerant of quite brackish conditions in marshes and along ditches, but rare inland. Larvae are thought to live in wet soil.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Pilaria scutellata		Limoniidae	Nb		C	4	0.7	mire, carr	Associated with partly bare humic mud or peat, usually on open sites but occasionally in carr. It tends to be associated with eutrophic sites on acid soils or poor fen. Widespread in Britain but particularly numerous in the Kent marshes.	Falk 1991
Calobata ephippium		Micropezidae	L		C	22		wetland	Wetlands	
Lispe caesia		Muscidae	Nb		B	0		marsh, saltmarsh, brackish water	Around brackish pools and ditches on coastal marshes, saltmarsh and dune slacks	Falk & Pont in prep.
Lispe loewi		Muscidae	Nb		C	5		marsh, saltmarsh, brackish water	Around pools, ditches and marshes in a wide range of brackish situations including salt marshes, coastal levels, possibly dune slacks and occasionally inland (usually in areas of high salinity).	Falk & Pont in prep.
Lispe nana		Muscidae	Nb		C	0		marsh, saltmarsh, brackish water	Around pools, ditches and marshes in brackish coastal situations (including dune slacks, coastal levels and possibly saltmarsh) but occasionally also inland.	Falk & Pont in prep.
Lispe uliginosa		Muscidae	Nb		C	0		marsh, fen, wet heath	The margins of pools and ditches in a variety of situations, including moorland and heathland, coastal marshes and fens. The species may be associated with peat.	Falk & Pont in prep.
Phaonia fusca		Muscidae	RDB3		C	0		marsh, saltmarsh, reedbeds	Estuarine marshes and coastal levels, where it is associated with saltmarsh and reedbeds	Falk & Pont in prep.
Ptychoptera contaminata		Ptychopteridae	L		B	151	25.6	water margins	Widespread in England in most districts where suitable habitat with tall emergent vegetation is present. It is a characteristic species of ditches on coastal levels and is found around the margins of lowland eutrophic and mesotrophic ponds, lakes, canals and very slow-flowing rivers.	Stubbs 1993

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Ptychoptera minuta		Ptychopteridae	L		C	17	2.9	water margins	It is associated with standing water and its preferred habitat is eutrophic ponds and swamps, including swamp carr, where organically rich mud or peat occurs at the water surface.	Stubbs 1993
Cleigastra apicalis	*Cnemopogon apicalis*	Scathophagidae	L		C	15		reedbed, carr	Predatory fly found in reedbeds and carr situations often, but not exclusively, where *Phragmites* grows. Larvae live in stems and are predators of gall forming and stem boring species such as *Lipara lucens*. Distribution poorly known, but locally abundant in suitable situations.	Recorder
Trichopalpus fraternus		Scathophagidae	L		B	57		damp grassland	Found in rank grassland, possibly with some preference for wetter sites.	Recorder
Colobaea punctata		Sciomyzidae	Nb		C	14	2.1	water margins	Lush marginal vegetation beside rivers, lakes, ponds and ditches. The adults are characteristically found where lower summer water levels leave their aquatic snail hosts stranded beside ditches and ponds.	Falk 1991, Ball & McLean 1986
Elgiva cucularia		Sciomyzidae	L		C	27	4.1	water margins	Adults are found near ponds and ditches and in a variety of wetland habitats. The larvae eat aquatic snails.	Ball & McLean 1986
Pherbellia dorsata		Sciomyzidae	Nb		C	11	1.7	water margins	It occupies a wide range of wetlands, both inland and coastal, shaded and unshaded. It is usually found in fens and grazing marshes.	Falk 1991, Ball & McLean 1986
Sepedon sphegea		Sciomyzidae	L		B	69	10.4	water margins	Adults are usually near mesotrophic ponds and ditches. The larvae eat aquatic snails.	Ball & McLean 1986
Sepedon spinipes		Sciomyzidae	L		B	168	25.3	water margins	Adults are usually near mesotrophic ponds and ditches in a variety of wetland habitats including grazing marshes. The larvae eat aquatic snails.	Ball & McLean 1986
Tetanocera arrogans		Sciomyzidae	L		C	43	6.5	water margins	Larvae predators of snails at margins of water bodies, adults in a variety of mesotrophic wetlands including levels marshes.	Ball & McLean 1986
Themira superba		Sepsidae	L		C	9		water margins	Widespread but not common; adults near water and often associated with waterfowl droppings.	Pont 1986

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Nemotelus nigrinus		Stratiomyidae	L		C	17	2.4	fen, marsh, seepage	It is associated mainly with fens and marshy ground in chalk and limestone districts but also occurs locally along ditches of coastal marshes and in wet dune slacks. The larvae are amphibious.	Stubbs & Drake, 2001
Nemotelus notatus		Stratiomyidae	L		C	39	5.4	saltmarsh, brackish marsh	It is salt-marsh species that also occurs in brackish pools and ditches behind the sea wall.	Stubbs & Drake 2001
Nemotelus pantherinus		Stratiomyidae	L		B	17	2.4	fen, marsh, seepage	It is as frequent on freshwater coastal marshes as on lowland inland fens and wet meadows where it may be locally common.	Drake 1991
Nemotelus uliginosus		Stratiomyidae			C	16	2.2	saltmarsh, brackish marsh	It is associated with saline habitat and is entirely coastal in distribution. The larvae are amphibious.	Stubbs & Drake, 2001
Odontomyia angulata		Stratiomyidae	RDB1		B	0	0	fen	A very rare fenland species. Some early records are from the Somerset Moors	Stubbs & Drake 2001
Odontomyia argentata		Stratiomyidae	RDB2		B	0	0	fen	A rare fenland species that has declined drastically, although it has always been uncommon. Some records are from ditch systems in peatlands.	Drake 1991
Odontomyia ornata		Stratiomyidae	RDB2		A	183	17.3	still freshwater, marsh	The larvae are aquatic and are frequent in botanically rich ditches at a relatively early successional stage, where they can be found crawling among the surface layers of vegetation. The species is almost confined to grazing marshes in England and Wales	Stubbs & Drake 2001; Drake 1991
Odontomyia tigrina		Stratiomyidae	Nb		B	178	16.9	still freshwater, marsh	It is found at the margins of ponds, ditches and (more rarely) canals, usually those with a rich flora of both emergent and floating vegetation. The larvae are most frequent in ditches at a relatively late successional stage. The distribution is mainly	Stubbs & Drake 2001

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Oplodontha viridula		Stratiomyidae	L		C	263	24.9	still freshwater, marsh	This is one of the commonest aquatic soldierflies, found in many types of wetlands on a wide range of soil types, but it can be particularly abundant on grazing marshes. The larvae live in shallow water or at the water surface among dense vegetation.	Stubbs & Drake 2001
Oxycera rara	*Oxycera pulchella*	Stratiomyidae	L		C	7	1.1	wet grassland, seepage	The larvae are amphibious in a variety of wet habitats such as open seepages with springs, wet mud at the margins of ponds, ditches, wet meadows, marsh and fen. It can be moderately frequent in wet peaty pasture of grazing marshes.	Stubbs & Drake, 2001
Oxycera trilineata		Stratiomyidae	L		C	45	4.3	water margins	The larvae are amphibious in many water margin habitats but it is probably most abundant in grazing marshes, including slightly brackish sites.	Stubbs & Drake, 2001
Stratiomys longicornis		Stratiomyidae			B	1	0.2	saltmarsh, brackish marsh	This is a saltmarsh species that may breed in strongly brackish ditches on some coastal marshes. It is found from the Solent to Essex.	Stubbs & Drake 2001; Drake 1991
Stratiomys singularior	*Stratiomys furcata*	Stratiomyidae			B	53	5	marsh, brackish water	It is found mainly on brackish coastal marshes, although sparsely at some inland grazing marshes such as the Somerset Moors. The larvae are aquatic, living in shallow and densely vegetated water. They appear to be able to cope with temporary drying out.	Stubbs & Drake 2001
Anasimyia interpuncta		Syrphidae	RDB3		B	2	0.3	water margins	Adults are found in fens and river margins where decaying vegetation, especially *Glyceria*, is abundant, although the species has been recorded at localities dominated by *Phragmites*. It is an eastern species found in fens of East Anglia and the marshes of	Ball & Morris 2000
Anasimyia lineata		Syrphidae	L		C	22	2.8	water margins	Widely distributed in the lowlands, living in eutrophic wetlands of all sorts. Typical sites support emergent plants such as *Typha, Glyceria* and *Sparganium.*	Ball & Morris 2000

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Eristalinus sepulchralis		Syrphidae	L		B	98	12.6	water margins	Widely distributed and often abundant in wetlands in southern Britain, especially in lowland and coastal wetlands (eg coastal grazing marshes).	Ball & Morris 2000
Eristalis abusivus		Syrphidae	L		C	5	0.6	fresh and brackish water	Widely distributed throughout Britain, but more frequent near the coast and may be the most abundant *Eristalis* in some coastal wetlands.	Ball & Morris 2000
Helophilus hybridus		Syrphidae	L		C	39	5	water margins	Widespread but local. Usually the fly is found in the richer types of wetland including fen, coastal marshes and wet woodland.	Ball & Morris 2000
Lejogaster tarsata	*Lejogaster splendida*	Syrphidae	L		B	0	0	water margins	The larvae are aquatic and have been found amongst floating, decaying vegetation in a pond. Adults are most often found in or near coastal marshes, for example at the fringes of mildly brackish ditches, or in the transition zone between fresh and saline water in coastal flushes. It is mainly a coastal species in Britain.	Ball & Morris 2000
Lejops vittata		Syrphidae	RDB2		A	27	3.5	brackish marsh	A very local species of coastal grazing marshes, with most records from the Thames Marshes. The larvae are aquatic. In Britain it is associated with *Scirpus maritimus* in grazing marsh ditches.	Stubbs & Falk 2002; Ball & Morris 2000
Neoascia interrupta		Syrphidae	Nb		C	10	1.3	marsh, fen, water margins	It is recorded widely in the south-east of England. Adults have been found around mildly brackish ditches in grazing levels, in fenland and around richer ponds and ditches well inland. Adults are usually found at lush vegetation around ponds and ditches.	Ball & Morris 2000
Neoascia tenur	*Neoascia dispar*	Syrphidae	L	C	B	105	13.5	wetlands	Widespread in wetlands throughout Britain and often extremely abundant in suitable habitat [and probably does not qualify as 'local']. Found in lush vegetation around the margins of all types of water body, especially where beds of emergents plants such as *Glyceria*, *Typha* or *Phragmites* are present.	Ball & Morris 2000

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Platycheirus fulviventris		Syrphidae	L		C	36	4.6	marsh, fen, water margins	The larvae feed on the aphid *Hyalopterus pruni* on monocotyledon plants in wetlands. It is usually found in marshes, by ponds, ditches or slow flowing rivers, usually where lush vegetation such as *Phragmites* or *Glyceria maxima* occurs. It is most frequent in the lowlands of south-east England, especially wetlands along the east coast.	Ball & Morris 2000
Platycheirus immarginatus		Syrphidae	Nb		B	1	0.1	marsh, saltmarsh	The larvae feed on the aphid *Trichocallis cyperis* on *Carex* in wetlands. In Britain, it is usually found in brackish marshes and saltmarsh. Adults have been found at the flowers of *Scirpus maritimus*.	Ball & Morris 2000
Sphaerophoria rueppellii		Syrphidae	L		C	9	1.2	dry grassland	The larvae feed on aphids on plants such as *Brassica* and *Sonchus*. It can be found in dry, rank grassland and other open, dry situations such as ruderal communities. It is locally abundant in south-east England, and especially frequent in the marshes around the Thames where it is characteristically found on grassy flood banks.	Ball & Morris 2000
Tropidia scita		Syrphidae	L		C	27	3.5	marsh, fen, water margins	Larvae have been found between the basal leaf sheaths of *Typha* and will probably be found in wet debris around the base of emergent plants. The fly is found among emergent vegetation, especially *Phragmites* and *Typha,* in fens, ponds, drainage ditches an	Ball & Morris 2000
Atylotus rusticus		Tabanidae	RDB1		A	0	0	marsh	Recent records are mainly from coastal grazing marshes in East Sussex and it is assumed that grazing marshes provide the necessary habitat. It is common species in Europe where it presumably uses a wider range of habitats.	Stubbs & Drake 2001

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Haematopota subcylindrica		Tabanidae	RDB		B	2	0.3	marsh, saltmarsh	In Britain this horsefly is associated with coastal marshes where the larvae probably develop in brackish pools and ditches. It is likely to also breed on upper saltmarsh. It is recorded from grazing marshes in East Sussex and Essex.	Stubbs & Drake 2001
Hybomitra ciureai		Tabanidae	RDB3		A	0	0	marsh	The species is largely restricted to grazing marshes, and although the records are from coastal site, the actual sites appear to be freshwater. The larva is probably aquatic in shallow well vegetated water.	Stubbs & Drake 2001
Hybomitra expollicata		Tabanidae	pRDB2		A	14	2.1	brackish marsh	Brackish coastal marshes appear to be the habitat of this horsefly. Records are from Dorset to Essex.	Stubbs & Drake 2001
Tabanus autumnalis		Tabanidae	L		B	14	2.1	marsh, fen	This horsefly is widely distributed in wetland in southern Britain but is most frequent on grazing marshes. The larvae are probably aquatic in shallow well vegetated water.	Stubbs & Drake 2001
Nigrotipula nigra	*Tipula nigra*	Tipulidae	L		C	14	2.4	marsh, fen	Predominantly a fenland species with a concentration of records in East Anglia. It also occurs by ponds and ditches on coastal grazing levels. Usually there is some saturated bare mud or peat, with adjacent long herbage, although the larvae prefer unsaturated peat.	Stubbs 1992
Tipula pierrei	*Tipula solstitialis*	Tipulidae	L		C	28	4.4	marsh, water margins	There is a strong association with coastal ditches and pools, and also with more eutrophic lakes of the western Weald, the north Midlands and Scotland. Water margins have to be open and with some emergent vegetation; the shade of bushes and trees is avoided. The larvae are aquatic.	Stubbs 1992
Herina frondescentiae	Otitidae	Ulidiidae	L		C	16	2.2	damp grassland	Characteristically found in damp grassland.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Melieria crassipennis	Otitidae	Ulidiidae	L		B	43	6	marsh	Biology little known but the larvae are believed to develop in decaying vegetable matter. Adults usually found in long vegetation in marshy places. Widespread.	Recorder
Melieria omissa	Otitidae	Ulidiidae	L		C	14	1.9	marsh, water margins	Picture-winged fly of marshy places, pond margins, etc. Larvae in decaying vegetation.	Recorder
Melieria picta	*Otitidae*	Ulidiidae	Nb		B	21	2.9	brackish marsh, saltmarsh	Saltmarsh and brackish ditch and fleets of coastal levels. Larvae probably develop in decaying regrettable matter. Locally common the Thames estuary; scarce elsewhere.	Falk & Ismay in prep
Hemiptera										
Corixa affinis		Corixidae	L		B	35	3.6	brackish water	Mainly brackish pools but also non-brackish pools and ditches near the coast.	Huxley 2003
Corixa panzeri		Corixidae	L		C	20	2.1	still freshwater	Ditches, pools, lakes and slow rivers where the water is clear, neutral to alkaline or slightly saline and with extensive weed growth. It requires a minimum depth of water of about 60cm.	Huxley 2003
Cymatia coleoptrara		Corixidae	L		C	23	2.4	still freshwater	Well vegetated still water such as ditches, ponds.	Huxley 2003
Sigara concinna		Corixidae	L		C	16	1.6	still freshwater	Found in small numbers in a range of still waters in the lowlands. It is known to breed in saline water and may be associated with water with high conductivity.	Huxley 2003
Sigara selecta		Corixidae	L		B	3	0.3	brackish water	This is a scarce corixid confined to the English coastal counties, especially in the south-east. It is strictly coastal, confined to strongly saline or brackish habitats such as ditches and ponds close to the sea.	Huxley 2003
Sigara semistriata		Corixidae	L		C	1	0.1	standing water	Particularly associated with small base-deficient ponds but also found in ditches. On grazing marshes, it appears to be associated with peat substrates.	Huxley 2003

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Sigara stagnalis		Corixidae	C		B	65	6.7	brackish water	Brackish pools and ditches by the sea are typical habitats.	Huxley 2003
Sigara striata		Corixidae	Nb		B	12	1.2	still or slow-flowing water	It is confined to Kent and East Sussex where it lives in still or slow-flowing water. It is tolerant of a wide range of conditions. It can occur in open almost weed-free water and among fairly dense weed. It is tolerant of moderate salinity.	Huxley 2003
Hebrus pusillus		Hebridae	Nb		C	13	1.3	water margins	Found on the surface among dense vegetation of acid pools on lowland heaths, soft-rock seepages, wet dune slacks and eastern grazing marsh ditches.	Huxley 2003; Kirby1992
Hydrometra gracilenta		Hydrometridae	RDB3		B	0	0	fen, grazing marsh	Recent records are from fen and one from Pevensey Levels (grazing marsh).	Huxley 2003
Stenodema trispinosum		Miridae	Local		B	2		marsh, brackish marsh	Confined to southern and eastern coastal counties of England, this grassbug occurs on tall graminaceous plants in marshy places, usually near the coast or on estuarine or other brackish water.	Recorder
Ranatra linearis		Nepidae	L		C	12	1.2	still freshwater	Typically an inhabitant of ponds and canals with emergent vegetation; it can also be quite common in ponds and gravel pits of recent origin.	Huxley 2003
Ranatra linearis		Nepidae	L		C	1	0.1	ponds, canals, gravel pits	Ponds, etc with emergent vegetation	Huxley 2003
Saldula opacula		Saldidae	Nb		C	16	2	brackish marsh, saltmarsh	It has been recorded from a wide range of wetland habitats. Several are from the east coast estuaries and saltmarshes and from the margins of brackish ditches. It seems likely that in coastal situations it occurs particularly in the sheltered upper levels of saltmarsh and around pools and reeks further inland. It also occurs at pools in upland moorland and grassland.	Kirby 1992

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Saldula pilosella		Saldidae	Local		C	17	2.1	brackish marsh, saltmarsh	A shorebug of coastal saltmarshes, very occasionally in freshwater habitats, found fairly commonly around at least the south-eastern half of the English coast.	Recorder
Microvelia pygmaea		Veliidae	Nb		C	4	0.4	water margins	Usually found where there is thick emergent vegetation such as reeds or sedges, or extensive overhanging vegetation by still or very slow-flowing water.	Huxley 2003; Kirby1992
Hymenoptera										
Chalcis sispes		Chalcidae	Na		A	27		marsh	Parasitic on the aquatic larvae of the larger soldierflies eg *Stratiomys* spp. Very restricted in distribution, confined to coastal grazing marshes mainly around the Thames but also in Norfolk and Somerset.	Recorder
Mollusca										
Bithynia leachii		Hydrobiidae	Local		C			still freshwater	An aquatic operculate snail restricted to hard waters. Most records are from lowland England though it reaches mid-Yorkshire with an outlier near Edinburgh. Not a common species, its presence indicating a rich mollusc assemblage is likely.	Recorder
Hydrobia 'ventrosa'		Hydrobiidae	Local		C			brackish water	A small operculate snail found in coastal brackish waters. The fairly recent realisation that what was formerly thought to be *H. ventrosa* really includes more than one species leaves the full range of this species unknown, though it is recorded from the east coast of England and the Outer Hebrides.	Recorder
Aplexa hypnorum		Physidae	Local		C			temporary water	A watersnail of small pools and ditches, frequently ones that dry up occasionally. Widely distributed, but becoming more local northwards. Although not yet a rarity, this species is undergoing a rapid decline due to loss of habitat.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Pisidium pseudosphaerium		Pisidiidae	RDB3		B			still freshwater	A small bivalve usually occurring in marsh drains, but occasionally recorded from ponds. Requires clear, clean water in stagnant places choked with aquatic plants often over a richly organic bed. There are very few British records though these are widely spread, largely in grazing levels near the coast.	Recorder
Pisidium pulchellum		Sphaeriidae	Notable/Nb		C			still freshwater	A small freshwater mussel (pea mussel) found in marsh drains, slow streams and sometimes ponds and lakes. It is rather rare in Britain, despite being widely distributed. It requires cleaner water than many pea mussels, which may account for its scarcity.	Recorder
Anisus vorticulus		Planorbidae	RDB2		A			still freshwater	A ramshorn snail found in well oxygenated weedy ditches in grazing levels of southeastern England and East Anglia. Rather rare and declining due to pollution of its habitat by agricultural runoff and to reprofiling of its ditches during conversion of grazing levels to arable agriculture.	Recorder
Segmentina nitida		Planorbidae	RDB1		A			still freshwater	A ramshorn snail which has undergone a marked decline this century. It occurs in ponds and marsh drains, particularly those which are well oxygenated and have lush vegetation. It was formerly widespread in England as far north as York but is now restricted to a few unimproved grazing marsh sites in the southeast and East Anglia.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Oxyloma sarsi		Succineidae	RDB2		C			still freshwater	Very local in richly vegetated fens of lowland types, at the margins of rivers and lakes and in drainage dykes in levels. It is more aquatic than the common *O. pfeifferi*, never straying far from standing water and usually found either on emergent vegetation such as *Phragmites* or crawling on *Glyceria* and other water plants. It appears to be a calcicole. It is known from grazing marshes in Broadland.	Kerney 1999
Valvata macrostoma		Valvatidae	RDB2		A			still freshwater	A rare calcicole restricted to drainage ditches in marshland levels and river floodplains. It lives in stagnant or slowly moving water in well-vegetated places with a good diversity of species.	Kerney 1999
Valvata piscinalis		Valvatidae	Local		C			still freshwater	A large valve snail, to 7mm, with a shell as broad as it is high. A widespread species found in running water of all kinds, provided the current is not too fast; rarely in closed ponds.	Recorder
Vertigo antivertigo		Vertiginidae	Local		C			fen, marsh, water margins	A small snail of fens and marshes, often in sedge litter and flood litter at lake margins. Widespread but not common.	Recorder
Vertigo moulinsiana		Vertiginidae	RDB3		C			fen, water margins	A small snail occurring in calcareous fens and marshes, often on emergent vegetation. Confined to southern England and East Anglia except a few isolated outlying populations.	Recorder
Vertigo pygmaea		Vertiginidae	Local		C			dry grassland, marsh, fen	A tiny snail found in dry calcareous grassland, sand dunes and occasionally marshes. Widespread in Britain, including several offshore islands.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Odonata										
Aeshna isosceles	*Anachiaeschna isosceles*	Aeshnidae	RDB1		A			still freshwater	It breeds in unpolluted grazing marsh dykes which contain water-soldier and where the water table is maintained at high levels. Today, it is restricted to the broads of Norfolk and Suffolk, but it was once more widespread in the Fens. It was originally discovered at Whittlesea Mere in 1818 and this area remained a stronghold until it was drained in the 1850s. Within the Broads it has become restricted to relatively few areas which are relatively isolated from the polluted waters of the main rivers and broads. An important population was discovered in Suffolk in the early 1990s. It is a fully protected species under the Wildlife and Countryside Act 1981.	Recorder
Brachytron pratense		Aeshnidae	Nb		B	4		still freshwater	It breeds in mesotrophic, unpolluted lakes, ponds, mature sand and gravel pits, ditches and fens where there is an abundance of tall emergent vegetation such as club-rush, reed, bulrush and great fen sedge. Occasionally in slow moving rivers. It is most abundant in coastal grazing levels of Somerset, Sussex, Kent and Norfolk and also occurs in the East Anglian and Anglesey Fens, the Cheshire Meres and the coastal wetlands of south Wales. In many parts of the midlands, East Anglia, and Romney Marsh it has declined considerably in the post-war period, but has increased again recently especially in more mature sand and gravel pits and in unpolluted fen dykes in Cambridgeshire.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Coenagrion pulchellum		Coenagriidae	Nb		B	8		still freshwater	It breeds in fens, mesotrophic ponds, lakes, slow flowing ditches, canals and peaty pools in cut-over bogs, usually where there is abundant emergent vegetation. *C. pulchellum* is found most commonly in the coastal levels of Gwent, Somerset, Sussex, Kent and Norfolk and in the fens of East Anglia and Anglesey. Elsewhere in England and Wales it is a widespread but scarce species and has declined in recent decades.	Recorder
Lestes dryas		Lestidae	RDB2		B	1		still freshwater and brackish water	Breeds in shallow ponds and lakes, overgrown canals, ditches and temporary pools, generally neutral to slightly alkaline and where there is an abundance of emergent vegetation. In grazing levels it will tolerate brackish conditions and may be found where sea club rush predominates. This was always a scarce species in southern and eastern England. During the 1950s and 60s it was lost from many of its known sites and it was feared extinct in the 1970s. It was rediscovered in Essex in 1983 and has subsequently been found in Essex, Kent and Norfolk.	Recorder

Species	Synonyms	Family	Status	Revised status	fidelity	total records	%	Main habitat or microhabitat	Known ecology	Literature reference
Libellula fulva		Libellulidae	RDB3		B			still and slow-flowing freshwater	It breeds in unpolluted rivers and large dykes with slight to moderate flow and, occasionally, in still-water habitats such as mature gravel pits (at least 20 years old). It prefers stretches of water with tall emergent vegetation. It is a scarce species in Britain occurring on the River Avon in Wiltshire and Somerset; the Stour, Frome, Moors River and Avon in Dorset (to the Hampshire border); the Arun in Sussex; streams and ditches near Sandwich in Kent; the Nene and Ouse and nearby gravel pits and fen-dykes in Cambridgeshire; and on grazing marshes associated with the Waveney and Yare in Norfolk and Suffolk.	Recorder
Sympetrum sanguineum		Libellulidae	Nb		C			still freshwater and brackish water	It breeds in the marshy margins of ponds, lakes, old gravel and clay pits, canals and ditches where there is an abundance of tall emergent plants. It can tolerate quite brackish conditions and occurs in coastal grazing marshes where sea club rush is often dominant. It has a south-eastern distribution in Britain and is rare in south-west England and Wales and becomes scarce in the north-Midlands extending as far north as Barnsley. It has shown a marked increase in abundance in recent decades and may be spreading northwards.	Recorder

Appendix 2. Grazing marshes – importance and summary data for invertebrates

The rating given here is based on the data available so different ratings are given to the same marsh using different surveys. A more subjective overall appraisal for each marsh is given in Appendix 3.

Importance: 0 = less than county importance, C = county importance, R = Regional, N = National, for three habitat assemblages.
Fidelity: A to C – see section 3.1.2 for definitions and derivation of total and mean score.
Status: L – Local, Nb – Notable B, Na - Notable A, R3 to R1 – Red Data Book 3 to RDB1; SQI – Species Quality Index.

Marsh	**Importance**			**Dargie**	**Water beetles**													**Other groups**									**Source**
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
					Fidelity					Status								Fidelity			Status						
Cumbria																											
Foulshaw Moss	0			NW82	7	4	0	15	0.36	42	11	5	0	0	0	0	1.64										Drake 1991
Lyth (all Drake 1991)	0			NW82	5	1	0	7	0.15	47	13	4	0	1	0	0	1.85										Drake 1991
Lyth Valley				NW82	4	1	0	6	0.19	31	8	0	0	1	0	0	1.74										Drake 1991
Essex																											
Aveley	R			SE198	7	11	4	41	0.73	56	13	17	1	1	0	0	2.54	2	1	0	2	1	0	0	0	0	Leeming 1998
Barking	0			SE201		3		6	0.67	9	0	2					1.67	1	1								Scott Wilson Resource Consultants 1996
Benfleet (Hadleigh)	C	N		SE18	8	13	5	49	1.11	44	8	13	1	2	0	0	2.91	7	4	1		2			2		Drake 1988
Black Grounds		C		E10		1							1						3			2					Philp, 1983
Bramble Island		0		no code	1	6	0	13	0.68	19	3	3	1	0	0	0	2		1								Drake 1988
Brightlingsea	R	R		E127	8	10	4	40	0.95	42	8	11	1	1	0	0	2.5	4	4			4					Drake 1988
Brightlingsea	C	R		E127	5	10	2	31	0.67	46	8	14	1	0	0	0	2.24	3	2	0	3	2	0	0	0	0	Kirby 1993
Canvey		R		E19	7	6	2	25	0.86	29	5	7	1	2	0	0	3.17	2	3			3			1		Drake 1988
Cattawade		C		?E125	7	10	0	27	0.82	33	7	7	1	0	0	0	2.06	2	2			2					Drake 1988
Essex (all Drake '87)	C	C			17	23	5	78	0.87	90	22	30	2	3	0	0	2.9										Drake 1988
Fambridge (all)	C	R		E88, 91, 92	11	15	3	50	0.98	51	11	14	1	1	0	0	2.47	4	6			4			1		Drake 1988

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Fambridge (Harris)		C		E92																							Drake 1988
Fambridge (Marsh Farm)		C		E92																							Drake 1988
Fambridge (West)		R		E88, 91, 92																							Drake 1988
Fingringhoe		R		E111	1	1						1						7	3	1		3		1			Philp, 1983
Fishermans Head		C		no code	1							3						2	2								Philp, 1983
Fobbing	R	N		E23	13	13	5	54	1	54	12	14	1	2	0	0	2.69	5	6	1		3			2		Drake 1988
Foulness		R		E6	7	9	2	31	0.86	36	6	12	2	0	0	0	2.56	2	5			1			1		Drake 1988
Holland Haven	0			E135	2	3	0	8	0.44	18	4	1	0	0	0	0	1.39	3	2			2					Drake 1988
Horsey Island		R		E140	8	11	1	33	1	33	6	12	2	0	0	0	2.7	5	4			3					Drake 1988
Ingrebourne	0		C	no code	5	6	0	17	0.49	35	7	8	0	0	0	0	1.89	13	10	0	22	3	0	0	0	0	Hodge 1992
Ingrebourne	0		C	no code	3	5	0	13	0.5	26	2	6	1	0	0	0	2.04	9	5	0	14	3	0	0	0	0	Plant 1997
Inner Thames		R		SE198	18	17	5	67	1	67	16	20	1	2	0	0	2.69										Drake 1988
Inner Thames		R		SE198	4	9	1	25	0.56	45	7	15	1	0	0	0	2.31	2	0	0	2	0	0	0	0	0	Leeming 1998
Langenhoe	C	R		E111	11	14	2	45	0.83	54	12	12	1	1	0	0	2.3	5	7			5			1		Drake 1988
Old Hall		R		E105	5	9	3	32	1	32	8	8	1	0	0	0	2.22	4	3			3					Drake 1988
Pitsea		R		E20	12	13	2	44	0.92	48	9	14	1	1	0	0	2.52	4	6			4			1		Drake 1988
Ramsey		N		no code	2	5	0	12	0.38	32	6	9	1	0	0	1	3.22	4	2	0	4	2	0	0	0	0	Kirby 1991
Ramsey	0			no code														2	1			1					Philp, 1983
Sandbeach		C		E94	0	10	0	20	0.87	23	4	5	1	0	0	0	2.13	2	2			2					Drake 1988
Shelford Head		R		E6	1	3						3	1					3	2					1	1		Philp, 1983
St Osyth	0			E130	5	5	2	21	0.68	31	5	5	0	0	0	0	1.65	1	4			3					Drake 1988
Steeple	0			E96														3	1								Philp, 1983
Thurrock	0			no code		3	1	9		8	0	3					2.13										Scott Wilson Resource Consultants 1996
Tilbury	0	0		E30	4	6	1	19	0.76	25	6	4	0	0	0	0	1.72	6	2			5					Drake 1988
Tollesbury Wick		R		E104	8	8	2	30	0.86	35	7	9	1	1	0	0	2.6	2	5			3					Drake 1988
Vange	R	R		E23	9	7	2	29	0.85	34	7	9	1	1	0	0	2.65	2	2			2					Drake 1988
Wennington	R	R		SE198	8	14	2	42	0.76	55	11	18	1	1	0	0	2.58	3	1	0	3	1	0	0	0	0	Leeming 1998

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Gwent																											
Caldicot Level	N	C		no code	26	20	5	81	0.81	100	30	25	1	2	0	0	2.42										Drake 1986
Gwent	N	C	N	no code	24	18	5	75	0.69	108	31	26	1	2	0	0	2.35	25	27	3	45	14	2	1	0	0	Drake 1986
Gwent			N	no code														15	9	0	25	3	0	0	0	0	McLean 1981
Gwent aquatic drake85	N	C		no code														8	8	0	14	4	3	0	0	0	Drake 1986
Wentlooge Level	C	N		no code	20	18	4	68	0.94	72	20	16	0	2	0	0	2.36										Drake 1986
Hampshire																											
Farlington		C	C	S21														5	7	2		7		1	2	1	Edwards 2002
Farlington		C	C	S21			1	3										25	20	5							Hants / IoW Trust
Hacketts Marsh	0			no code	2	3	1	11	0.5	22	4	3	0	0	0	0	1.59										Edwards & Hodge 2000
Keyhaven	0																	5	4								Hants / IoW Trust
Lower Test			C	S23	3	2		7										21	32								Hants / IoW Trust
Titchfield Haven	0			S18	4	8	1	23	0.74	31		5					1.7	4	3								Edwards 1996
Winnall Moors			C	S92														6	4								Edwards 1994
Winnall Moors			C	S92	2							2						4	3			2					Edwards 2002
Winnall Moors			C	S92	5	2		9										14	6								Hants / IoW Trust
Kent																											
All Hallows			C	SE186														16	15	3	24	8	0	1	2	0	Kirby 1995
Botany (Swancombe)	0			no code	1	2		5	0.31	16	2	2					2										Scott Wilson Resource Consultants 1996
Capel Fleet	0			SE168														6	3	0	6	3	0	0	0	0	Clemons 1995
Chetney		C		SE174														12	10	2	16	7	0	0	2	0	Clemons 1995
Cliffe		C	C	SE191	1						1							13	10	2	18	6	0	0	2	0	Kirby 1991
Cliffe lower		C		SE191	3	10	5	38	0.84	45	11	10	3	1	0	0	2.71										Plant 2002
Cliffe north	R	R		SE191	6	11	4	40	0.95	42	12	11	3	1	0	0	2.93	0	0	0	0	1	0	0	0	0	Plant 2002
Cooling	R	R	C	SE191	2	5	2	18	0.44	41	3	10	1	4	0	0	3.44	7	11	1	14	4	0	0	1	0	Hodge 1995
Cooling	R	R		SE191	8	17	5	57	0.95	60	15	13	3	2	0	0	2.75										Plant 2002
Cooling RSPB area	R	R		SE191	8	17	4	54	0.82	66	13	21	2	3	0	0	3.05										Plant 2002

Marsh	Importance			Dargie	Water beetles												Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Crayford	C	C		SE197	2	7	0	16	0.4	40	7	6	1	1	0	0	2.18										Carr 1986
Crayford	0	0		SE197	1	7	1	18	0.51	35	7	6	0	0	0	0	1.71										Leeming 1997
Dartford	C	C		SE193, 194, 195	6	9	0	24	0.48	50	14	8	1	1	0	0	2.2	3	3	0	5	1	0	0	0	0	Carr 1986
Dartford & Crayford	C	C	C	SE193, 194, 195	6	11	1	31	0.69	45	11	12	1	0	0	0	2.2	3	1	0	4	0	0	0	0	0	Plant 1992
Denley Hill	0		0	SE23	2	3	1	11	0.46	24	7	2	0	1			2.17	3	1	1		1			1		Philp 1994
Elmley		R		SE171	5	8	2	27	0.87	31	4	13	0	2	0	0	3.35										Carr 2000
Erith & Belvedere	0			SE199, 200	5	7	0	19	0.53	36	8	6	1	0	0	0	1.92	21	15	0	31	6	0	2	0	0	Plant 1993
Ferry		C	C	SE171														9	5	1	12	2		1	1		Godfrey1993
Graveney	C			SE23	3	8	1	22	0.67	33	11	6	2	0			2.3	5	4			5					Philp 1994
Halstow	R	R		SE191	6	12	2	36	0.6	60	11	18	1	2	0	0	2.7										Carr 2000
Halstow	0			SE191	1	2	0	5	1	5	0	3	2	0	0	0	5.6										Plant 2002
Higham		C	C	SE192		1						1						14	14	2	25	5	0	0	1	0	Kirby 1991
Luddenham		C		SE179														9	12	1	11	9	0	2	2	0	Clemons 1995
Neatscourt		C	C	SE171														9	9	3	15	5	1		2		Godfrey1993
North Kent (all sites including single 'sites')					3	11	4	37	0.7	53	12	14	1	1	0	0	2.43										Palmer 1980
Ridham		C	C	SE174														12	8	3	15	5	1		2		Godfrey1993
Seasalter			C	SE23	2	6	0	14	0.56	25	8	1	0	0			1.44	5	3	1		4			1		Philp 1994
Shorne	C	R		SE192	10	19	5	63	0.93	68	17	21	1	2	0	0	2.72	5	4	0	7	2	0	0	0	0	Kirby 1995
South Willesborough Dyles	0			SE222	2	1	0	4	0.1	40	12	1	0	0	0	0	1.38	3	3	0	6	2	0	0	0	0	Drake 1986
St Marys	R	R		SE190	4	8	5	35	0.88	40	8	9	1	2	0	0	2.8										Plant 2002
Stoke			C	SE186														18	17	3	24	10	2	0	3	0	Kirby 1995
Stray		C		SE171														10	9	2	13	6	0	2	2	0	Clemons 1995
Uplees		C		SE179	1	4	3	18	0.64	28	5	7	1	0			2.18	5	5			2		1			Philp 1994
Walland	C	C			2	12	2	32	0.74	43	14	10	2	1	0	0	2.7										Carr in Palmer 1982
Walland	R	R			3	15	2	39	0.81	48	13	12	3	1	0	0	2.77										Palmer 1992
Westcourt	R	C		SE192	6	10	6	44	0.79	56	10	17	1	3	0	0	3.02	5	2	1		3			1		Biggs et al 1992
Westcourt & Filborough	R	C		SE192	6	10	5	41	0.8	51	8	14	2	3	0	0	3.14	7	2	1	9	1	0	0	1	0	Hodge 1992

Marsh	Importance			Dargie	Water beetles												Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Norfolk																											
Beccles				E479	0	1	0																				Driscoll 1972
Blakeney Freshes	C	R		E568	4	4	1	15	0.33	46		9						1	3			3					Foster & Jackson 1999
Blundeston	R			E487																				1	1		Jackson & Howlett 1999
Buckenham	C			E505	14	13	1	43	0.81	53	18	10	0	1	0	0	2.19										Drake 2002
Bure (all Drake '02)	R				18	18	5	69	0.76	91	27	19	1	3	0	0	2.49										Drake 2003
Burgh Castle		C		E495	1	3	0											2									Driscoll 1972
Burgh St Peter	R			E488																				1	2	1	Jackson & Howlett 1999
Cantley	R			E505	14	16	3	55	0.82	67	20	12	1	2	0	0	2.39										Drake 2002
Carleton	C			E504	5	12	1	32	0.78	41	16	7	0	1	0	0	2.27										Drake 2002
Chet	C			E501	9	13	1	38	0.78	49	19	7	0	1	0	0	2.12										Drake 2002
Claxton	C			E504	12	14	3	49	0.79	62	19	8	0	2	0	0	2.18										Drake 2002
Clippesby	C			E524, E523	3	14	1	34	0.92	37	9	7	0	0	0	0	1.81										Drake 2003
Fishley	C			E522	6	14	4	46	1	46	13	9	0	1	0	0	2.2										Drake 2003
Fleggburgh	R			E521	7	14	3	44	0.94	47	14	8	0	2	0	0	2.45										Drake 2003
Geldeston	R			E211																					3	1	Jackson & Howlett 1999
Gillingham	R			E478																				1	2	1	Jackson & Howlett 1999
Great Yarmouth		C		E514	1	3	0	7				2						2									Driscoll 1972
Halvergate	R	R		E512	3	8	1	22				6						8									Driscoll 1972
Happisburgh - Winterton 1				?																							Driscoll & Lees 1973
Happisburgh - Winterton 2				E537, 538																							Driscoll & Lees 1973
Happisburgh - Winterton 3				E546																							Driscoll & Lees 1973
Hardley	R			E502	11	13	4	49	0.8	61	24	9	0	2	0	0	2.33										Drake 2002
Horning	R			E528, 527	13	14	2	47	0.84	56	20	9	0	2	0	0	2.38										Drake 2003
Horsey Estate	R		R	E537, 538								12	1	1								3			1		Jackson & Foster 2002
How Hill	0			E529	1	3	0	7	0.64	11	3	1	0	0	0	0	1.55										Drake 2003
Limpenhoe	R			E500	18	18	3	63	0.91	69	20	14	1	4	0	0	2.87										Drake 2002
Long Dam	R			E481, 483																				1	2	1	Jackson & Howlett 1999

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Norton Marshes	R			E491	2	8	0	18				3						6	1			1					Driscoll 1972
Oby	C			E524	4	16	3	45	0.92	49	11	10	0	1	0	0	2.14										Drake 2003
Ranworth	0			E526	3	6	0	15	0.75	20	5	4	0	0	0	0	1.85										Drake 2003
Repps	0			E524	3	5	0	13	0.59	22	8	1	0	0	0	0	1.5										Drake 2003
Short Dam	R			E485																				1	1	1	Jackson & Howlett 1999
Smallburgh 1				E543, H204544																							Driscoll & Lees 1973
Smallburgh 3				E536																							Driscoll & Lees 1973
Somerleyton	C			E490																					1		Jackson & Howlett 1999
South Walsham	0			E525	10	14	0	38	0.78	49	16	6	0	0	0	0	1.69										Drake 2003
St Benets	C			E527	8	13	3	43	0.91	47	14	6	1	1	0	0	2.15										Drake 2003
Strumpshaw	C			E505	13	15	1	46	0.84	55	17	13	0	0	0	0	2.02										Drake 2002
Thurne district	0				4	7	0	18	0.51	35	13	3	0	0	0	0	1.63										Driscoll & Lees 1973
Thurne Dyke	C			E524	10	12	3	43	0.96	45	12	9	1	0	0	0	2.02										Drake 2003
Upton	C			E525	6	12	4	42	0.89	47	12	9	0	1	0	0	2.15										Drake 2003
Wheatacre	R			E489																					2		Jackson & Howlett 1999
Whitehouse	C			E530	3	6	1	18	0.78	23	6	3	0	1	0	0	2.3										Drake 2003
Winsford	C			E519, E520	3	11	3	34	0.89	38	9	8	0	1	0	0	2.26										Drake 2003
Yare (all Drake '01)	R				25	20	4	77	0.76	101	29	20	1	3	0	0	2.4										Drake 2002
Somerset																											
Banwell	0			SW148	2	4	0	10	0.24	41	11	3	0	0	0	0	1.49	0	3	0	3	1	0	0	0	0	Drake 1989
Banwell	0			SW148	3	8	1	22	0.52	42	13	3	0	1	0	0	1.88										SEC 1991
Berrow & Bleadon	C	C	C	SW134, 139	9	13	4	47	0.92	51	16	9	0	1	0	0	2.14	12	15	1	24	7	1	0	1	0	Drake et al 1984
Biddle	0			SW148	5	9	2	29	0.64	45	15	5	0	1	0	0	2	3	6	1	7	2	1	0	1	0	Godfrey 1999
Catcott	R		R	SW134	19	15	5	64	0.84	76	19	20	1	4	0	0	2.92	23	20	2	43	13	0	1	1	0	Drake et al 1984
Catcott	R		R	SW134	7	12	4	43	0.81	53	12	10	0	4	0	0	2.92	0	5	1	3	1	1	0	1	0	Godfrey 2000
Clevedon	0			SW148	3	7	0	17	0.57	30	10	0	0	0	0	0	1.33	1	0	0	1	0	0	0	0	0	SEC 1991
Conglebury	C			SW148	3	8	1	22	0.65	34	9	3	0	1	0	0	1.97	0	1	0	1	0	0	0	0	0	SEC 1991
Curry Moor	C			SW115	6	9	1	27	0.59	46	11	7	0	1	0	0	2.02	2	8	1	9	3	0	0	1	0	Drake 1989

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Gordano	C		C	SW162	12	8	1	31	0.63	49	13	7	0	1	0	0	2	11	10	2	25	3	0	0	1	0	Drake et al 1984
Gordano	0			SW162	4	5	1	17	0.59	29	6	2	0	0	0	0	1.41	3	0	0	2	1	0	0	0	0	SEC 1991
Hay & Curry Moors	C			SW115	2	5	0	12	0.4	30	6	4	0	2	0	0	2.6										Hill-Cottingham & Smith 1998
Kenn	0			SW148	4	11	1	29	0.6	48	12	5	0	1	0	0	1.88	4	4	1	7	1	0	0	1	0	Drake 1989
Kenn			C	SW148														5	17	1	21	3	0	0	0	0	Drake et al 1984
Kenn	0			SW148	2	5	0	12	0.39	31	11	2	0	0	0	0	1.55	0	1	0	1	0	0	0	0	0	SEC 1991
Kings Sedgemoor	C		C	SW116	16	17	5	65	0.92	71	21	14	0	2	0	0	2.31	10	14	3	21	6	0	1	2	0	Drake et al 1984
Kings Sedgemoor	C		C	SW116	7	9	4	37	0.7	53	17	10	0	2	0	0	2.45	0	5	1	3	1	1	0	1	0	Godfrey 2000
Kingston	0			SW148	1	3	1	10	0.32	31	7	4	0	1	0	0	2.1										SEC 1991
Langmead	C				8	11	3	39	0.68	57	16	9	0	3	0	0	2.54	5	9	1	12	5	0	0	1	0	Drake 1989
Moorlinch	C		C	SW116	5	9	5	38	0.84	45	11	7	0	2	0	0	2.38	13	20	1	30	5	0	0	1	0	Drake et al 1984
Nailsea	C			SW148	7	11	2	35	0.7	50	14	6	0	2	0	0	2.24	2	4	1	5	1	0	0	1	0	Drake 1989
Nailsea	C			SW148	3	7	2	23	0.62	37	9	6	1	1	0	0	2.32	0	3	0	3	0	0	0	0	0	SEC 1991
North Moor	C		C	SW116	17	14	4	57	0.78	73	21	11	1	3	0	0	2.45	17	21	2	40	5	0	0	1	0	Drake et al 1984
North Moor	C			SW116	8	11	3	39	0.81	48	12	6	0	2	0	0	2.25	1	5	1	4	1	1	0	1	0	Godfrey 2000
Owen' Somerset sites																		34	29	3	60	9	0	3	2	0	Drake et al 1984
Pawlett Hams	C	C		SW134	9	12	4	45	0.88	51	13	11	0	1	0	0	2.2	5	3	1	8	1	0	0	1	0	Drake et al 1984
Puxton	C			SW148	10	12	1	37	0.71	52	15	9	0	1	0	0	2.1	1	2	1	1	2	0	0	1	0	Godfrey 1999
Somerset (all Drake '83)					30	22	6	92	0.72	127	35	36	1	5	0	1	3.02	60	35	4	99	31	3	3	2	1	Drake et al 1984
Southlake	C		C	SW116	11	12	4	47	0.87	54	15	9	0	2	0	0	2.33	9	23	3	29	7	1	0	2	0	Drake et al 1984
Southlake	C			SW116	7	6	1	22	0.56	39	10	7	0	1	0	0	2.18	1	5	1	4	1	1	0	1	0	Godfrey 2000
Stert	C			SW131	22	21	5	79	0.92	86	28	20	0	2	0	0	2.37										Drake et al 1984
Tadham	R		C	SW134	14	15	5	59	0.86	69	17	12	0	3	0	1	2.87	21	23	2	40	7	0	0	1	0	Drake et al 1984
Tadham	C			SW134	5	9	3	32	0.78	41	11	8	0	2	0	0	2.59	0	5	1	3	2	0	0	1	0	Godfrey 2000
Tickenham Moor	C			SW148	4	9	2	28	0.65	43	12	5	0	1	0	0	1.98	1	2	1	2	1	0	0	1	0	Godfrey 1999
West Moor	C		C	SW117	10	10	2	36	0.68	53	14	7	0	1	0	0	1.94	10	17	2	23	4	1	0	1	1	Drake et al 1984
West Moor	C			SW117	8	2	2	18	0.49	37	10	5	0	2	0	0	2.49	0	3	1	2	0	1	0	1	0	Godfrey 2000

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
West Moor	C			SW117	2	3	2	14	0.42	33	6	6	0	2	0	0	2.64										Hill-Cottingham & Smith 1998
West Sedgemoor	R		C	SW116	18	16	3	59	0.84	70	22	11	0	3	0	0	2.43	16	28	2	42	10	1	0	1	0	Drake et al 1984
West Sedgemoor	C			SW116	8	8	2	30	0.6	50	10	9	0	2	0	0	2.34	2	6	1	7	0	2	0	1	0	Godfrey 2000
Westhay	R		C	SW134	11	16	5	58	0.87	67	13	13	1	5	0	0	3	16	20	2	35	3	0	1	1	0	Drake et al 1984
Wet Moor	C		C	SW117	10	13	3	45	0.82	55	15	8	0	2	0	0	2.25	9	22	2	35	5	1	0	1	0	Drake et al 1984
Wet Moor	0			SW117	1	5	0	11	0.37	30	5	5	0	0	0	0	1.67										Hill-Cottingham & Smith 1998
Suffolk																											
Barsham	0			E212																					1		Jackson & Howlett 1999
Beccles	0			E479																					1		Jackson & Howlett 1999
Blythburgh	0	C		E199	4	5	0	14	0.67	21	5	2	1	0	0	0	1.86	4	1			3					Drake 1988
Bulcamp	0			E199	1	1	0	3	0.21	14	2	0	0	0	0	0	1.14										Drake 1988
Castle	R			E484																					2		Jackson & Howlett 1999
Coverts	0			E201	4	6	0	16	0.64	25	9	1	0	0	0	0	1.48	1	2			2					Drake 1988
Dingle	C	0		E196	9	9	2	33	0.89	37	12	4	2	0	0	0	2.03	8	2			3					Drake 1988
Dingle	R	C		E196														10	5	1		4		1			Plant 1999
Hazelwood	0	0		E171	5	7	0	19	0.63	30	9	3	0	0	0	0	1.6	2	1			2					Drake 1988
Mettingham, Broom & Outney	R			E212																				1	1	1	Jackson & Howlett 1999
Minsmere	C	C		E195	16	10	1	39	0.7	56	16	10	0	0	0	0	1.82	8		1					1		Drake 1988
Minsmere, Meadow Marsh	C			?														11	18	0	21	4	0	0	0	0	Edwards 2001
North Cove	R			E482																						1	Jackson & Howlett 1999
Orford		N		no code	5	6	0	17	0.71	24	4	6	1	1	0	0	2.83	4	4			2					Drake 1988
Oulton & Barnby	R			E486																				1	2	1	Jackson & Howlett 1999
Pottersbridge	0			E205	5	9	0	23	0.88	26	10	3	0	0	0	0	1.73	6	2			1					Drake 1988
Reydon	0			E203	2	9	0	20	0.91	22	8	3	0	0	0	0	1.77		1			1					Drake 1988
Shotley	C	C		E144	5	9	1	26	0.84	31	10	5	0	0	0	0	1.81	5	1			1					Drake 1988
Sizewell	C	0		E194	9	12	0	33	0.77	43	11	6	1	0	0	0	1.84	4	2			3					Drake 1988
Southwold		0		E203	3	2	0	7	0.58	12	4	1	0	0	0	0	1.58	2	1			1					Drake 1988

Marsh	Importance			Dargie	Water beetles													Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Suffolk (all Drake '88)					16	18	1	55	0.69	80	21	18	2	2	0	0	2.49										Drake 1988
Tinkers	0	C		E202	6	7	0	20	0.83	24	9	3	0	0	0	0	1.75	4	1			1					Drake 1988
WalberswickTown	0			E202	2	4	0	10	0.59	17	4	1	0	0	0	0	1.41										Drake 1988
Sussex																											
Adur Valley										40		3					1.58										Hodge in litt.
Arun Valley	C				8	13	2	40	0.48	84	23	35	2	5	0	1	3.95										Hodge 2003
Brede Level	C			SE67	11	12	4	47	0.66	71	18	16	2	1	0	0	2.34	13	15	0	23	3	1	1	0	0	Hodge 1996
Brede Level	C									86		21	2	2	1		2.4										Hodge in litt.
Church Farm		C		SE141	2	7	0	16	1.07	15		5					2.2	1	1								Hodge 1996
Combe Haven	C									78		17	1	2	1		2.56										Hodge in litt.
Crutches Farm	C			SE67	3	3		9				5	1	1					3			3					Jackson & Foster 1995
Cuckmere Valley	C									80		25	2	4			2.58										Hodge in litt.
Fairlight	0			near SE66		1	1	5				1	1						1					1			Foster & Lister 2002
Frog Firle Farm		C		SE76	1	1		3				6	1					2	3	1							Foster & Jackson 1994
Lyminster north	0			SE138	4	10	0	24	0.86	28		4					1.9										Hodge 1996
Lyminster south	0			SE138	1	8	0	17	0.65	26		3					1.9	1				1					Hodge 1996
Ouse Valley	R									138		36	6	11	2		3.46										Hodge in litt.
Pett	C			SE66	9	11	3	40	0.69	58	18	12	2	2	0	0	2.69										Hodge 1987
Pett			C	SE66														27	23	2	47	13	2	0	2	0	Hodge 1988
Pett	R			SE66						64		13	3	4	2	?1	4.2										Hodge in litt.
Pevensey	N	R		SE81	13	17	4	59	0.65	91	24	19	2	7	0	0	3.2										Carr 1984
Pevensey	N	R		SE81	4	9	3	31	0.6	52	11	11	1	4	0	0	3.13										Hodge 1991
Pevensey	N			SE81						120		33	4	8	1		3.41										Hodge in litt.
Pevensey	N			SE81	2	10	3	31	0.69	45	12	5	0	2	0	0	2.27	1	3	0	1	2	1	0	0	0	Palmer 1984
Rye	R			SE63, 64						113		34	8	5			3.03										Hodge in litt.
South Stoke - Offham	C			SE135	2	9	0	20	0.77	26		5					2.7										Hodge 1996
The Pells	0			SE102	0	5	1	13	0.32	41	10	3	0	1	0	0	1.83	7	10	0	15	3	0	0	0	0	Hodge 1988
Tillingham	C									45		5		3			2.49										Hodge in litt.

Marsh	Importance			Dargie	Water beetles												Other groups									Source
	fresh	brackish	wetland		C	B	A	total	mean	all spp	L	Nb	Na	R3	R2	R1	SQI	C	B	A	L	Nb	Na	R3	R2	R1	
Walland	N			SE62						102		30	5	7	1	1	3.89										Hodge in litt.
Wickham Monor Farm	C		C	SE67		1	2	8				2		1				14	16	2		6		1	2		?Alexander & Clements ?1987
Yorkshire																											
Hatfield	0				5	6	0	17	0.34	50	13	6	0	1	0	0	1.92										Malard 1990

Appendix 3. Grazing marsh site ranking

This list ranks sites in Appendix 2 by importance (then by county, by site). Rankings attempt to take account of all three interests in Appendix 2 (freshwater, brackish water, wetland) to produce a summary rank that may differ sometimes from that given on the basis of available data in Appendix 2. The column 'fresh', 'brackish', 'wetland' and 'Dargie block' repeat those in Appendix 2, and 0 = less than county importance, C = county importance, R = Regional, N = National.

Marsh	County	overall ranking	fresh	brackish	wetland	Dargie block
Benfleet (Hadleigh)	Essex	National	C	N		SE18
Fobbing	Essex	National	R	N		E23
Inner Thames Marshes	Essex	National		N		SE198
Caldicot Level	Gwent	National	N	C		no code
Gwent Levels	Gwent	National	N	C	N	no code
Wentlooge Level	Gwent	National	C	N		no code
Cliffe	Kent	National		C	C	SE191
Cooling	Kent	National	R	R	C	SE191
Walland	Kent	National	R	R		
Halvergate	Norfolk	National	R	R		E512
Catcott	Somerset	National	R		R	SW134
Tadham	Somerset	National	R		C	SW134
West Sedgemoor	Somerset	National	R		C	SW116
Pevensey	Sussex	National	N	R		SE81
Rye	Sussex	National	R			SE63, 64
Walland	Sussex	National	N			SE62
Derwent Ings	Yorkshire	National	N		N	
Brightlingsea	Essex	Regional	R	R		E127
Canvey Island	Essex	Regional		R		E19
Crouch Estuary - Fambridge	Essex	Regional	C	R		E88, 91, 92
Crouch Estuary - West Fambridge	Essex	Regional		R		E88, 91, 92
Fingringhoe	Essex	Regional		R		E111
Foulness	Essex	Regional		R		E6
Horsey Island	Essex	Regional		R		E140
Inner Thames - Aveley	Essex	Regional	R			SE198
Inner Thames - Wennington	Essex	Regional	R	R		SE198
Langenhoe	Essex	Regional	C	R		E111
Old Hall Marshes	Essex	Regional		R		E105
Pitsea Marsh	Essex	Regional		R		E20
Shelford Head	Essex	Regional		R		E6
Tollesbury Wick	Essex	Regional		R		E104
Vange	Essex	Regional	R	R		E23
Elmley	Kent	Regional		R		SE171
Halstow	Kent	Regional	R	R		SE191
Higham	Kent	Regional		C	C	SE192
Shorne	Kent	Regional	C	R		SE192
St Marys	Kent	Regional	R	R		SE190
Westcourt	Kent	Regional	R	C		SE192
Westcourt & Filborough	Kent	Regional	R	C		SE192
Blakeney Freshes	Norfolk	Regional	C	R		E568
Cantley	Norfolk	Regional	R			E505
Fleggburgh	Norfolk	Regional	R			E521

Marsh	County	overall ranking	fresh	brackish	wetland	Dargie block
Geldeston	Norfolk	Regional	R			E211
Gillingham	Norfolk	Regional	R			E478
Hardley	Norfolk	Regional	R			E502
Horning	Norfolk	Regional	R			E528, 527
Horsey Estate	Norfolk	Regional	R		R	E537, 538
Limpenhoe	Norfolk	Regional	R			E500
Long Dam	Norfolk	Regional	R			E481, 483
Gordano	Somerset	Regional	C		C	SW162
Kings Sedgemoor	Somerset	Regional	C		C	SW116
Westhay	Somerset	Regional	R		C	SW134
Castle	Suffolk	Regional	R			E484
Dingle	Suffolk	Regional	R	C		E196
Minsmere	Suffolk	Regional	C	C		E195
Orford	Suffolk	Regional		N		no code
Oulton & Barnby	Suffolk	Regional	R			E486
Sizewell	Suffolk	Regional	C	0		E194
Arun Valley	Sussex	Regional	C			
Brede Level	Sussex	Regional	C			SE67
Ouse Valley	Sussex	Regional	R			
Pett	Sussex	Regional	R		C	SE66
Black Grounds	Essex	County		C		E10
Cattawade	Essex	County		C		?E125
Crouch Estuary - Fambridge (Harris)	Essex	County		C		E92
Crouch Estuary - Marsh Farm	Essex	County		C		E92
Farlington	Hampshire	County		C	C	S21
Lower Test	Hampshire	County			C	S23
Winnall Moors	Hampshire	County			C	S92
All Hallows	Kent	County			C	SE186
Chetney	Kent	County		C		SE174
Crayford	Kent	County	C	C		SE197
Dartford	Kent	County	C	C		SE193, 194, 195
Dartford & Crayford	Kent	County	C	C	C	SE193, 194, 195
Ferry	Kent	County		C	C	SE171
Graveney	Kent	County	C			SE23
Luddenham	Kent	County		C		SE179
Neatscourt	Kent	County		C	C	SE171
Ridham	Kent	County		C	C	SE174
Stoke	Kent	County			C	SE186
Stray	Kent	County		C		SE171
Uplees	Kent	County		C		SE179
Blundeston	Norfolk	County	C			E487
Buckenham	Norfolk	County	C			E505
Burgh Castle	Norfolk	County		C		E495
Burgh St Peter	Norfolk	County	C			E488
Carleton	Norfolk	County	C			E504
Chet	Norfolk	County	C			E501
Claxton	Norfolk	County	C			E504
Clippesby	Norfolk	County	C			E524, E523
Fishley	Norfolk	County	C			E522
Great Yarmouth	Norfolk	County		C		E514
Happisburgh - Winterton	Norfolk	County				E537, 538, 546
Norton Marshes	Norfolk	County	C			E491

Marsh	County	overall ranking	fresh	brackish	wetland	Dargie block
Oby	Norfolk	County	C			E524
Short Dam	Norfolk	County	C			E485
Smallburgh	Norfolk	County				E543, 544, 536
Somerleyton	Norfolk	County	C			E490
St Benets	Norfolk	County	C			E527
Strumpshaw	Norfolk	County	C			E505
Thurne Dyke	Norfolk	County	C			E524
Upton	Norfolk	County	C			E525
Wheatacre	Norfolk	County	C			E489
Whitehouse	Norfolk	County	C			E530
Winsford	Norfolk	County	C			E519, E520
Berrow & Bleadon	Somerset	County	C	C	C	SW134, 139
Conglebury	Somerset	County	C			SW148
Curry Moor	Somerset	County	C			SW115
Hay & Curry Moors	Somerset	County	C			SW115
Kenn	Somerset	County			C	SW148
Langmead	Somerset	County	C			
Moorlinch	Somerset	County	C		C	SW116
Nailsea	Somerset	County	C			SW148
North Moor	Somerset	County	C		C	SW116
Pawlett Hams	Somerset	County	C	C		SW134
Puxton	Somerset	County	C			SW148
Southlake	Somerset	County	C		C	SW116
Stert	Somerset	County	C			SW131
Tickenham Moor	Somerset	County	C			SW148
West Moor	Somerset	County	C		C	SW117
Wet Moor	Somerset	County	C		C	SW117
North Cove	Suffolk	County	C			E482
Shotley	Suffolk	County	C	C		E144
Tinkers	Suffolk	County	0	C		E202
Adur Valley	Sussex	County				
Church Farm	Sussex	County		C		SE141
Combe Haven	Sussex	County	C			
Crutches Farm	Sussex	County	C			SE67
Cuckmere Valley	Sussex	County	C			
Frog Firle Farm	Sussex	County		C		SE76
South Stoke - Offham	Sussex	County	C			SE135
Tillingham	Sussex	County	C			
Wickham Manor Farm	Sussex	County	C		C	SE67
Fishermans Head	Essex	[County]		0		no code
Ramsey	Essex	[County]	0			no code
Seasalter	Kent	[County]			0	SE23
How Hill	Norfolk	[County]	0			E529
Ranworth	Norfolk	[County]	0			E526
Hatfield	Yorkshire	[County]	0			
Foulshaw Moss	Cumbria		0			NW82
Lyth (all Drake 1991)	Cumbria		0			NW82
Lyth Valley	Cumbria					NW82
Barking	Essex		0			SE201
Bramble Island	Essex			0		no code
Holland Haven	Essex		0			E135
Ingrebourne	Essex		0		C	no code

Marsh	County	overall ranking	fresh	brackish	wetland	Dargie block
Sandbeach	Essex			C		E94
St Osyth	Essex		0			E130
Steeple	Essex		0			E96
Thurrock	Essex		0			no code
Tilbury	Essex		0	0		E30
Hacketts Marsh	Hampshire		0			no code
Keyhaven	Hampshire				0	
Titchfield Haven	Hampshire		0			S18
Botany (Swancombe)	Kent		0			no code
Capel Fleet	Kent		0			SE168
Denley Hill	Kent		0		0	SE23
Erith & Belvedere	Kent		0			SE199, 200
South Willesborough Dyles	Kent		0			SE222
Beccles	Norfolk					E479
Repps	Norfolk		0			E524
South Walsham	Norfolk		0			E525
Thurne district	Norfolk		0			
Banwell	Somerset		0			SW148
Biddle	Somerset		0			SW148
Clevedon	Somerset		0			SW148
Kingston	Somerset		0			SW148
Barsham	Suffolk		0			E212
Beccles	Suffolk		0			E479
Blythburgh	Suffolk		0	C		E199
Bulcamp	Suffolk		0			E199
Coverts	Suffolk		0			E201
Hazelwood	Suffolk		0	0		E171
Mettingham, Broom & Outney	Suffolk		0			E212
Pottersbridge	Suffolk		0			E205
Reydon	Suffolk		0			E203
Southwold	Suffolk			0		E203
WalberswickTown	Suffolk		0			E202
Fairlight	Sussex		0			near SE66
Lyminster north	Sussex		0			SE138
Lyminster south	Sussex		0			SE138
The Pells	Sussex		0			SE102

Appendix 4. Biodiversity Action Plan Species recorded at grazing marshes

These species have been recorded on grazing marshes but are not necessarily dependent upon them or their management. Information has been extracted from the reports of the UK Biodiversity Group.

Species	Group	Family	habitat	sites where recorded (but may be extinct)	Fidelity
Dolomedes plantarius	Araneae	Pisauridae	freshwater ditches, ponds	Pevensey Levels (East Sussex)	B
Anisodactylus poeciloides	Coleoptera	Carabidae	saltmarsh, brackish ditches	Higham Marsh, Murston Marsh (Kent)	
Badister collaris	Coleoptera	Carabidae	muddy tree-shaded water margins and litter-rich margins	Brede & Guldeforrd Levels, Walland Marsh (Kent)	
Badister peltatus	Coleoptera	Carabidae	water margins in marsh and fen	coastal marshes of Sussex and Kent	B
Dyschirius angustatus	Coleoptera	Carabidae	sandy margins of fresh and brackish water	Pevensey Levels (East Sussex)	
Bidessus unistriatus	Coleoptera	Dytiscidae	shallow pools, choked drains	?Pevensey Levels (East Sussex) unconfirmed	
Laccophilus poecilus	Coleoptera	Dytiscidae	freshwater ditches, ponds, fen	Lewes Levels, Pevensey Levels (East Sussex)	B
Hydrochara caraboides	Coleoptera	Hydrophilidae	freshwater ditches, ponds	Somerset Moors	B
Paracymus aeneus	Coleoptera	Hydrophilidae	saltmarsh, lagoons,brackish ditches	Ramsey Marsh (Essex) which is scarcely grazing marsh	
Hydrometra gracilentis	Hempitera	Hydrometridae	fen, freshwater ditches	Pevensey Levels (East Sussex)	B
Hirudo medicinalis	Hirudinea	Hirudinidae	still freshwater	Romney Marsh (Kent)	
Hydraecia osseola	Lepidoptera	Noctuidae	on marsh Mallow in damp places by water courses	Romney Marsh (Kent)	
Anisus vorticulus	Mollusca	Planorbidae	still freshwater	Pevensey Levels (East Sussex), Arun valley (West Sussex), Bure, Yare, Waveney valleys (Norfolk)	A
Segmentina nitida	Mollusca	Planorbidae	still freshwater	Pevensey Levels (East Sussex), Arun valley (West Sussex), Bure, Yare, Waveney valleys (Norfolk), West Sedgemore (Somerset)	A
Vertigo moulinsiana	Mollusca	Vertiginidae	water margins with tall emergent vegetation	Westcourt Marshes (Kent), Yare Valley (Norfolk) and floodplain wetlands	C

Appendix 5. Species associated with brackish grazing marshes

Species ordered alphabetically in each major group. The strength of the association with brackish water is classed as strong or weak; strongly associated species are not necessarily obligate haliphiles. Fidelity classes are repeated from Appendix 1 and are defined in section 3.1.2.

Species	Group	Association	Status	Fidelity
Agabus conspersus	Coleoptera	stong	Nb	B
Aulacochthebius exaratus	Coleoptera	weak	pRDB3	B
Bagous subcarinatus	Coleoptera	weak	Na	B
Bagous tempestivus	Coleoptera	weak	Nb	C
Berosus affinis	Coleoptera	weak	Nb	A
Dytiscus circumflexus	Coleoptera	weak	Nb	B
Enochrus bicolor	Coleoptera	stong	Nb	B
Enochrus halophilus	Coleoptera	stong	Nb	B
Enochrus melanocephalus	Coleoptera	stong	Nb	C
Graptodytes bilineatus	Coleoptera	weak	RDB3	C
Gyrinus caspius	Coleoptera	weak	L	B
Haliplus apicalis	Coleoptera	stong	Nb	C
Helophorus alternans	Coleoptera	stong	Na	B
Helophorus fulgidicollis	Coleoptera	stong	Nb	C
Helophorus griseus	Coleoptera	weak	Nb	C
Hygrotus impressopunctatus	Coleoptera	weak	L	C
Hygrotus parallelogrammus	Coleoptera	stong	Nb	B
Limnoxenus niger	Coleoptera	weak	Nb	A
Macroplea mutica	Coleoptera	stong	Na	C
Ochthebius marinus	Coleoptera	stong	Nb	C
Ochthebius punctatus	Coleoptera	stong	Nb	
Ochthebius viridis	Coleoptera	stong	Nb	B
Peltodytes caesus	Coleoptera	weak	Nb	A
Aedes dorsalis	Diptera	stong	RDB2	B
Aedes flavescens	Diptera	stong	RDB2	B
Dicranomyia ventralis	Diptera	weak	Nb	B
Dixella attica	Diptera	stong	Nb	B
Dolichopus diadema	Diptera	stong	L	C
Elachiptera pubescens	Diptera	stong	Nb	B
Erioptera bivittata	Diptera	stong	RDB2	A
Eristalis abusivus	Diptera	weak	L	C
Eurina lurida	Diptera	stong	RDB3	B
Haematopota subcylindrica	Diptera	stong	pRDB	B
Hybomitra expollicata	Diptera	stong	pRDB2	A
Lejogaster tarsata	Diptera	weak	L	B
Lejops vittata	Diptera	stong	RDB2	A
Lispe caesia	Diptera	stong	Nb	B
Lispe loewi	Diptera	stong	Nb	C
Lispe nana	Diptera	stong	Nb	C

Species	Group	Association	Status	Fidelity
Molophilus pleuralis	Diptera	stong	L	B
Nemotelus notatus	Diptera	stong	L	C
Nemotelus uliginosus	Diptera	stong	L	C
Platycheirus immarginatus	Diptera	weak	Nb	B
Poecilobothrus ducalis	Diptera	stong	pRDB3	B
Poecilobothrus principalis	Diptera	stong	L	B
Stratiomys longicornis	Diptera	stong	RDB2	B
Stratiomys singularior	Diptera	weak	Nb	B
Corixa affinis	Hemiptera	weak	L	B
Saldula opacula	Hemiptera	weak	Nb	C
Saldula pilosella	Hemiptera	stong	L	C
Sigara concinna	Hemiptera	weak	L	C
Sigara lateralis	Hemiptera	weak	C	
Sigara selecta	Hemiptera	stong	L	B
Sigara stagnalis	Hemiptera	stong	C	B
Lestes dryas	Odonata	weak	RDB2	B
Limnephilus affinis	Trichoptera	weak	C	
Corophium spp	Crustacea	stong	C	
Gammarus duebeni	Crustacea	stong	C	
Gammarus tigrina	Crustacea	stong	C	
Gammarus zaddachi	Crustacea	stong	C	
Idotea granulosa	Crustacea	stong	C	
Jaera spp	Crustacea	stong	C	
Neomysis intiger	Crustacea	stong	C	
Palamonetes varians	Crustacea	stong	C	
Sphaeroma monodi	Crustacea	stong	?	
Sphaeroma rugicauda	Crustacea	stong	C	
Hydrobia ulvae	Mollusca	stong	C	
Hydrobia ventrosa	Mollusca	stong	L	C
Leucophytia bidentata	Mollusca	stong	L	
Phytia myosotis	Mollusca	stong	L	

Appendix 6. Definitions of species statuses

Red Data Book Category 1. RDB1 - Endangered.

Definition. Taxa in danger of extinction in Great Britain and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so dramatically reduced that they are deemed to be in immediate danger of extinction. Also included are some taxa that are possibly be extinct.

Criteria. Species which are known or believed to occur as only a single population within one 10km square of the National Grid.

Species which only occur in habitats known to be especially vulnerable.

Species which have shown a rapid and continuous decline over the last twenty years and are now estimated to exist in five or fewer 10 km squares.

Species which are possibly extinct but have been recorded this century but which if rediscovered would need protection.

Red Data Book Category 2. RDB2 - Vulnerable

Definition. Taxa believed likely to move into the Endangered category in the near future if the causal factors continue operating.

Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are under threat from serious adverse factors throughout their range.

Criteria. Species declining throughout their range.

Species in vulnerable habitats.

Red Data Book Category 3. RDB3 - Rare

Definition. Taxa with small populations in Great Britain that are not at present Endangered or Vulnerable, but are at risk.

These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Criteria. Species which are estimated to exist in only fifteen or fewer 10 km squares. This criterion may be relaxed where populations are likely to exist in over fifteen 10 km squares but occupy small areas of especially vulnerable habitat.

Red Data Book Category 4. RDB4 - Out Of Danger

Taxa formerly meeting the criteria of one of the above categories but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival in Great Britain has been removed.

Red Data Book Category 5. RDB5 - Endemic

Definition. Taxa which are not known to occur naturally outside Great Britain. Taxa within this category may also be in any of the other RDB categories or not threatened at all.

There are few truly endemic species in Britain. Most that have been identified are in fairly obscure groups which are relatively poorly known and the species may well eventually be discovered elsewhere in Europe.

Red Data Book Appendix. RDBAPP. Extinct

Definition. Taxa which formerly had breeding populations in Great Britain but which are now believed to have died out.

Red Data Book Category I. RDBI - Indeterminate

Definition. Taxa considered to be Endangered, Vulnerable or Rare, but where there is not enough information to say which of the three categories (RDB1 to 3) is appropriate.

Red Data Book Category K. RDBK - Insufficiently Known

Definition. Taxa that are suspected, but not definitely known, to belong to any of the above categories, because of lack of information.

Criteria. Taxa recently discovered or recognised in Britain which may prove to be more widespread in the future (although some recent discoveries may be placed in other categories if the group to which they belong is thought not to be under-recorded).

Taxa with very few or perhaps only a single known locality but which belong to poorly recorded or taxonomically difficult or unstable groups.

Species with very few or perhaps only a single known locality, inhabiting inaccessible or infrequently sampled but widespread habitats. such as some northern moorland species, ones associated with some agricultural situations and ones which are adult only during the winter.

Species with very few or perhaps only a single known locality and of questionable native status, but not clearly falling into the category of recent colonist, vagrant or introduction.

Provisional Red Data Book pRDB(x)

The prefix "p" before any Red Data Book category implies that the grading is provisional. In the majority of cases this means that the species' status has been reconsidered and changed in a Species Group Review produced subsequent to the publication of the relevant Red Data Book. The statuses so given are described as provisional, pending the publication of a future

edition of that Red Data Book. These statuses are however, based on a greater amount of evidence than was available for the original Red Data Book and therefore more likely to be a true representation of the species' actual status. The prefix "p" is also used for RDB status categories in groups where a Red Data Book has not yet been produced but is in preparation, or is used for species in groups covered by the original Red Data Book, where it is considered that there is evidence that the original grading was incorrect or that there has been a genuine change in status of the taxon.

Nationally Scarce (Notable) Category A - NA

Definition. Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and thought to occur in 30 or fewer 10 km squares of the National Grid or, for less well recorded groups, within seven or fewer Vice Counties.

Nationally Scarce (Notable) Category B - NB

Definition. Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and thought to occur in between 31 and 100 10 km squares of the National Grid or, for less well recorded groups, within between eight and twenty Vice Counties.

Nationally Scarce (Notable)

Definition. Species which are estimated to occur in 16 to 100 10km squares in Great Britain. The subdividing of this category into Nationally Scarce A and Nationally Scarce B has not been attempted for some species because of either the degree of recording that has been carried out in the group to which the species belongs, or because there is some other reason why it is not sensible to be so exact.

Regionally Scarce (Notable) Nr

Definition. Species which are considered to occur in 5 or less 10km squares in an area equivalent in size to a region of the old Nature Conservancy Council or larger, approximately one eighth the total area of England.

Such statuses were worked out during the compilation of the Invertebrate Site Registers. They cover various groups in Scotland, in Northern England as a whole, in North East and North West England, in Vice County Yorkshire and in the east Midlands and East Anglia. They were worked out by local entomologists.

Local

The term local is not rigidly defined, but loosely means species confined to a particular habitat type (usually associated with better quality examples of that habitat), a particular geographic area, or species that are too widespread to warrant Nationally Scarce (Notable) status but are nevertheless infrequently encountered.

Common

Common or ubiquitous species, frequently recorded.

Synanthropic Species

Species dependent on man, his buildings or crops.

Unknown

Species where no status has been attributed. There may be confusion over the species' taxonomy, it may belong to a poorly recorded group or may occur in an infrequently sampled habitat. As a species is entered into the Invertebrate Site Register or RECORDER, the status automatically defaults to "Unknown". Certain common or local species may therefore occasionally appear in this category if there has been no necessity to use the species record.

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Front cover photographs:
Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
Paul Glendell/English Nature 24,888