



The ecological status of ditch systems

**An investigation into the current status of the
aquatic invertebrate and plant communities of
grazing marsh ditch systems in England and
Wales**

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Summary of methods and major findings**

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Figure 2.2 Map showing the location of the areas surveyed



consistently under-represented and group F (Frogbit / Water-soldier (*Stratiotes aloides*) vegetation) was absent where these species were recorded.

The comparisons with only eastern marshes from Walland to Minsmere for the five beetles in this group showed some finer distinctions in habitat preference. *Helophorus alternans* was probably at the most extreme end of the brackish-water spectrum and occupied ditches that tended to have less dense vegetation, although other preferences could not be identified. *Enochrus halophilus* preferred 'older' ditches with gently sloping grassy margins although the centre of these ditches (where the beetle probably did not venture) was not necessarily particularly choked. *Graptodytes bilineatus*, in contrast, seemed to occupy ditches with a similar physical structure but at a later successional stage, being much more choked. Apparently 'younger' but nevertheless grassy ditches with more tangled vegetation supported *Rhantus frontalis*, and, moving towards an even earlier stage, *Hygrotus parallellogrammus* was more frequent. Features of ditches with *Agabus conspersus* were compared in just the North Kent and Thames estuary marshes, and the ditches it occupied were most similar to those favoured by *Rhantus frontalis* and *Graptodytes bilineatus*, although were probably rather smaller field ditches. The damselfly *Lestes dryas* was compared between ditches only the North Kent to Crouch, sites since this encompassed the records in the survey, but the conclusions from this more limited range emphasised its preference for small (shallow, narrow), 'old' and moderately choked ditches.

The associated fauna in the occupied ditches was no more species-rich than in ditches where a species was not recorded, and was significantly poorer for *Enochrus halophilus* and *Helophorus alternans*, which is likely to be a direct consequence of brackish ditches being naturally poor in species. The quality of the fauna, indicated by the Species Conservation Status (SCS) and fidelity indices, were both above average. A further indication that half of these species tended to be found in ditches of higher quality was the lower median naturalness index (non-natives).

6.5.4 Habitat requirements of species sometimes associated with mildly brackish water

Three of the more frequent uncommon species showed a weak association with brackish water, indicated by the median conductivity of the ditches in which they occurred being greater than $1000\mu\text{S}^{-1}$. They included the beetles *Limnoxenus niger* and *Noterus crassicornis* and the soldierfly *Stratiomys singularior*. Unlike the halophiles described above, these species probably had no common factor determining their occurrence, as their distributions were dissimilar (Table 6.2..5a). It was also clear that they were not united by a preference for slightly more brackish ditches, but probably all tolerated such conditions.

Limnoxenus niger was a widespread species and was particularly frequent in southern marshes. Its apparent absence from the Gwent Levels was probably due to few smaller ditches sampled being sampled here. It showed a weak positive correlation with increasing conductivity and occupied ditches had a median of $1100\mu\text{Scm}^{-1}$ compared to $830\mu\text{Scm}^{-1}$ where it was not recorded. Apart from mat vegetation being marginally denser where it was recorded, no other environmental variable was different between the suite of ditches where it was found and the remaining ditches. It was also marginally over-represented in botanical group G ditches (Sea club-rush) but was otherwise fairly evenly spread across the botanical groups. Species richness, SCS and marsh fidelity scores in ditches with *Limnoxenus niger* were significantly higher than in the remaining ditches.

Noterus crassicornis had a disjunct distribution, being widespread in Norfolk and Walland ditches, scarce in the North Kent and Thames marshes, and surprisingly also frequent in Anglesey. Comparisons between ditches in these areas, excluding the sparsely occupied North Kent and Thames marshes, showed a clear preference for larger and 'younger' ditches which tended to be wider, deeper, with steep-sided underwater profiles, supporting vegetation at an earlier successional stage indicated by greater amounts of submerged aquatics and open water, and low cover of emergents or mats in the channel. This was reflected in these ditches being conspicuously over-represented in the related botanical groups E (Frogbit) and F (Frogbit / Water-soldier) which were found in larger ditches with a rich submerged vegetation. *Noterus crassicornis* was also found in slightly brackish ditches, although this was not an important feature, as indicated by its under-representation in the brackish botanical group G ditches. It did not occur on peat. Species richness, SCS and marsh fidelity indices in ditches with *N. crassicornis* were significantly higher than in the remaining ditches.

The large soldierfly *Stratiomys singularior* was widespread and more frequent in the marshes of Somerset, Kent and Essex than elsewhere, and absent or scarce in Welsh and Sussex marshes. To some extent its distribution resembled that of *Limnoxenus niger*. The occupied ditches tended to be narrower and shallower than those where it was not recorded, and had more tangled vegetation that included greater cover of mat-forming plants. There were indications that it was more frequent where greater effects of cattle were noted (shelf and block formation). Median conductivity was higher in occupied ditches and this was reflected in a clear over-representation in the brackish botanical group G ditches, although it also occurred in all other botanical ditch types. The associated fauna had significantly greater SCS and marsh fidelity scores, but was no more species-rich than in unoccupied ditches.

6.5.5 Habitat requirements of freshwater species

The remaining eleven scarce or rare species that were moderately frequent in the dataset were clearly associated with freshwater.

The tiny skater *Hebrus pusillus* had a disjunct distribution. It was frequent in the Pevensey Levels, Walland and Norfolk marshes where it was found in 13 to 33% of ditches. In these areas, it showed a tendency to occupy ditches that were slightly narrower and shallower, 'older', and with more gently sloping under-water profiles compared to those where it was not recorded, and which had several indications of greater effects due to cattle (grassier margins, more poaching, bare ground and short grass). Several aspects of the vegetation were slightly denser: more submerged aquatics and algae, more mat vegetations and slightly more choked vegetation in the channel. A very similar picture emerged when occupied ditches were compared with the remainder in the whole dataset, which suggested that these weak trends were probably real, and this was further supported by the over-representation of botanical ditch group C ('swampy' or grassy ditches), and under-representation in the deeper group D (Frogbit ditches). The associated fauna had significantly greater SCS and marsh fidelity scores, but species richness was only just significantly greater than in unoccupied ditches.

These marshes are probably the sites of previous records mentioned in the water-bug atlas (Huxley, 2003). These are significant since the populations were reasonable on large marshes so may represent considerable strongholds for a bug otherwise found in poorly defined habitats scattered around the southern British coast.

The other tiny skater, *Microvelia pygmaea*, was present in nearly all marshes from the Arun valley eastwards, but was nowhere frequent. Comparison of ditches with and without the bug in these marshes showed a number of features indicating less impact by cattle (less grazing, poaching, shelf formation, grassy margin and 'tangledness' of vegetation). Ditches supporting the species had steeper banks and underwater profile and slightly greater cover of floating *Lemna* and other floating aquatic plants, but less mat vegetation and more of the channel occupied by emergents. It was not clear what type of ditch this combination represented, but it may have been early to mid-stage ditches with margins less disturbed by grazing animals owing to their steepness, leaving a denser marginal fringe in which the bugs could live quietly. Although emergents were no more frequent than in ditches where the bug was not recorded, it was over-represented in botanical groups A (Common reed *Phragmites*-dominated) and E (Frogbit with Common reed), so there may have been an association with taller marginal vegetation. There was no difference in the species richness or SCS of occupied ditches compared with the remainder, and the marsh fidelity score was significantly lower. These results suggested that the bug was not responding to conditions that would normally result in a 'good' ditch fauna.

The diving beetle *Hydaticus transversalis* was moderately frequent in the Gwent Levels and Somerset moors and levels, and with rare records from Minsmere and the Bure marshes, but was not recorded elsewhere. Comparison of the conditions in just the Gwent and Somerset ditches indicated a slightly confused preference. On the one hand, it was found where effects due to cattle were slightly more pronounced (more grazing, block formation and shorter grass on the bank, and more tangled vegetation and shelf formation at the edge) but it was also associated with marginally less choked conditions and greater cover of submerged plants. Three-quarters of the occupied ditches were on peat, and nearly 70% were in the botanical group D (Frogbit ditches), but the apparent preferences for these two variables was probably just related to their greater prevalence in Somerset. Species richness, SCS and marsh fidelity in ditches with *H. transversalis* were significantly higher than in the remaining ditches.

Hydaticus seminiger, in contrast to *H. transversalis*, was more widespread but nowhere especially frequent. Walland Marshes had the greatest proportion of ditches with the beetle. It was not recorded in the Welsh marshes. When compared across all ditches in the dataset, it showed a clear preference for smaller, shallowly profiled ditches at a late successional stage and with more mat vegetation, litter and a choked central channel. Despite this obvious preference, it was distributed remarkably evenly among botanical groups. Species richness and SCS were significantly greater where *H. seminiger* was found, but there was no difference in marsh fidelity score.

Hydrochus elongatus was found sparsely in marshes between the Arun valley and Thames but was frequent in the Pevensy Levels. In these marshes it showed a weak preference for ditches that were probably less intensively grazed, indicated by greater amounts of tall grass and less short grass on the banks, and slightly more mat vegetation and litter, but these effects were unsupported by other variables. The occupied ditches had a lower conductivity than where the beetle was not recorded. Its prevalence in botanical group E (Frogbit with Common reed) ditches may have reflected the preponderance of this ditch type in the south-eastern marshes. The associated fauna was significantly more species-rich but showed no difference in SCS or marsh fidelity score.

The Great silver water beetle (*Hydrophilus piceus*) was widespread and sometimes frequent. It was easily recorded not just as adults but as larvae and egg cocoons, and these immature stages almost doubled the number of records. Nearly all other beetles were not identified as larvae. *Hydrophilus* was particularly frequent in the Somerset and Norfolk marshes. Ditches where the beetle was found showed greater effects due to cattle (more poaching and block formation), greater vegetation complexity (tangledness), considerably greater cover of submerged plants and more mat vegetation, but less cover of emergents. This was the condition of botanically rich ditches at an early to mid stage in the succession. This conclusion was to some extent supported by the low number of occupied ditches falling into botanical groups A and B (Reed-dominated and floating duckweed-dominated, respectively). Species richness, SCS and marsh fidelity scores in ditches with *Hydrophilus* were significantly higher than in the remaining ditches, and it was noteworthy that the median species-richness (50 species) was so high for such a widespread species, suggesting that its presence may indicate some of the best ditches in English grazing marshes.

Peltodytes caesus was another very widespread beetle, absent only from Malltraeth marshes, and showed rather more even distribution than any other of the scarce or rare species. Perhaps because of its wide and even distribution, it showed relatively small preference for particular conditions, although the median values of occupied ditches compared with the remained suggested that it was more prevalent in deeper, more open ditches at an earlier hydrosere stage, with more floating aquatics and less emergent cover and its associated litter. Occupied ditches were distributed fairly evenly across the different botanical types although with slight under-representation of group A (Common reed-dominated) and slightly more group F (Frogbit / Water-soldier) ditches. Species richness, SCS and marsh fidelity scores in ditches with *P. caesus* were significantly higher than in the remaining ditches.

The large soldierfly *Odontomyia ornata* was one of the most widespread of the scarce species, being absent only from Malltraeth marshes. It was particularly frequent in the Somerset Levels and relatively common at Walland and Norfolk marshes. Its wide occurrence led to relatively few clear indications of preferences but it appeared to prefer early to mid-stage ditches, indicated by the low estimated 'age', steep underwater profile and low cover of emergents and its associated litter, although with greater cover of mat vegetation, as occurs in mid-stage ditches. Grazing intensity was also slightly greater next to occupied ditches, and conductivity was low. Occupied ditches were under-represented in botanical groups A (Common reed-dominated), C (grassy) and G (brackish); these associations reinforced the suggested preference for more open, early-stage ditches and avoidance of brackish water. Species richness, SCS and marsh fidelity in ditches with *O. ornata* were significantly higher than in the remaining ditches, and, as noted for *Hydrophilus piceus*, the median species-richness (50 species) was high for a widespread species, suggesting that its presence may also indicate some of the best ditches in English grazing marshes.

Odontomyia tigrina was distributed similarly to *O. ornata*, being absent only from Malltraeth Marsh and particularly frequent in the Somerset Levels. However, it occupied a different type of ditch that was older, narrower and shallower, with more complex vegetation, including greater amounts of mat

formation. These features indicated late-stage ditches. Although *O. tigrina* showed no response to conductivity, botanical group G (brackish) ditches were over-represented among those that were occupied, although it was absent from group A ditches (Common reed-dominated). There is probably a requirement for late-stage ditches that are not choked to the extent that algae, on which the larvae graze, are reduced by shading. Species richness, SCS and marsh fidelity scores in ditches with *O. tigrina* were significantly higher than in the remaining ditches, although the differences between the medians were rather small.

The Shining ram's-horn snail (*Segmentina nitida*) was very patchily distributed. It was almost common in Pevensey, scarce in Norfolk, where it was recorded only in a few ditches in the Bure valley, and with a single record from one Somerset moor. Comparison of median values for variables of ditches in the Pevensey and Bure marshes indicated a preference for 'older' ditches that were rather more choked in the channel and had more litter. Conductivity was also marginally lower than where the snail was absent. Botanical groups C, E and F (grassy, Frogbit with reed, Frogbit / Water-soldier, respectively) were over-represented, whereas groups B (floating *Lemna*-dominated) was under-represented and group G (brackish) was not represented among occupied ditches. SCS and marsh fidelity scores were significantly higher in occupied ditches compared to those where *S. nitida* was not recorded, but species-richness was similar, although still very high (55 species).

The Large-mouthed valve snail (*Valvata macrostoma*), like *Segmentina nitida*, was very patchily distributed, being common at Pevensey Levels and locally frequent at just one Somerset moor. Comparison of conditions with and without *V. macrostoma* in these two areas perhaps showed a slight preference for a later stage in succession (marginally shallower water, more gentle under-water profile, more tangled vegetation, less open water and more mat vegetation) although these differences were not likely to be significant. Botanical group E ditches (Frogbit) were over-represented. SCS and marsh fidelity scores were significantly higher in occupied ditches compared to those where *V. macrostoma* was not recorded, but species richness was similar, although still high (52 species).

6.5.6 Habitat requirements of less frequent species

Some of the infrequently found species deserve brief comment since the strength of British populations may partly depend on 'good' grazing marshes.

The beetle *Dryops auriculatus* was found only on the Pevensey Levels but here it was frequent, found in 40% of the samples. It is a species of fens and heathland pools, so the clay ditches of Pevensey were an unexpected habitat for it.

The beetle *Agabus uliginosus* was found only at West Sedgemoor on the Somerset Levels where it was recorded in several ditches, including one of those that was sampled in all three years of the project, where its constant presence over this period indicated the permanent nature of this highly localised population. Among the other surveys used in site comparisons, *A. uliginosus* occurred only once, again at West Sedgemoor in 1994 (Gibbs, 1994). Ditches do not fit the characteristic habitat of the beetle which is described as "primarily confined to highly temporary still waters on low ground, sometimes on marshes subject to tidal influence, and in the south-west in association with puddles around springs in otherwise dry terrain" (Foster, in press). Perhaps the high water levels maintained by the RSPB at West Sedgemoor produce similar habitat at shallowly flooded margins.

The tiny Hydraenidae beetles live at the water margin and were almost certainly under-sampled by pond-netting with a net whose mesh was about the same size as the beetles' lengths. Of the records relevant to ditch systems, the few for the minute *Aulacochthebius exaratus* raised the possibility that this species has moderate dependency on eastern coastal marshes. It was recorded frequently at Pevensey Levels and North Kent marshes by other surveyors, who probably used direct searching or a sieve to supplement pond-netting. Its distribution coincides well with the coastal marshes (NBN Gateway). The distribution of *Ochthebius viridis*, which was found occasionally in the greater Thames estuary marshes, also shows a moderate coincidence with coastal marshes but occurs in other coastal habitats.

Hydrochus ignicollis was quite frequent at Pevensey Levels and scarce in Kentish marshes and at Fambridge, but these records, coupled with the NBN Gateway map, suggest that marshes are important to this species in at least south east England.

Enochrus bicolor is almost confined to brackish water (Foster, in press), and while grazing marshes are not the only sites with brackish water, they do provide one of the more extensive expanses of suitable habitat. Records during the project were obtained from Kent and Essex marshes, as were all other records from the surveys used in comparisons here, but some more remarkable ones were from Cantley in the Norfolk Yare valley and South Walsham in the Bure marshes. While the Cantley record may represent either a stray of a relict from the recent more saline conditions before the river wall was made impervious to brackish water incursions from the river, the South Walsham records were inexplicable.

6.5.7 Summary

The analysis of habitat requirements for rare and scarce species confirmed previous opinions (e.g. Drake 1991, 2005; Foster, in press; Huxley, 2003). The results highlighted the broad range of conditions needed to maintain just this small suite of species, ignoring the numerous scarce species that were too infrequent to analyse. Just as the ordination analysis indicated salinity and successional stage to be the key factors influencing assemblage composition, these were recurrent themes in the requirements of the rare and scarce species (see Tables 6.5.2b and 6.5.2c). It seems that invertebrate species have a preference for or intolerance of particular conditions, which are indicated by the associated vegetation type. Many species could be fitted to a matrix of salinity versus successional stage (Table 6.5.7). However, a few of these species may respond primarily to a minor habitat feature unrelated to either of these key trends, as shown by their uncertain positioning within the matrix (indicated by the arrows).

Table 6.5.7 The preferred conditions of the more frequently recorded scarce species.

Salinity	Successional stage		
	Early	Mid	Late
Strongly brackish	<i>Helophorus alternans</i> <i>Hygrotus</i> <i>parallelogrammus</i>	<i>Enochrus halophilus</i> <i>Rhantus frontalis</i>	→→→ →→→ <i>Agabus conspersus</i> <i>Graptodytes bilineatus</i> <i>Lestes dryas</i>
Mildly brackish to fresh	<i>Noterus crassicornis</i> ←←←	<i>Limnoxenus niger</i> <i>Stratiomys singularior</i>	→→→ →→→
Completely fresh	<i>Hydrophilus piceus</i> <i>Peltodytes caesus</i> <i>Odontomyia ornata</i> ???←←←	→→→ →→→ →→→ <i>Microvelia pygmaea</i> ←←← <i>?Hydrochus elongatus</i> <i>Hydaticus transversalis</i> <i>Odontomyia tigrina</i> <i>Valvata macrostoma</i> ←←←	→→→??? <i>Hebrus pusillus</i> <i>Hydaticus seminiger</i> →→→ <i>Segmentina nitida</i>

Most of these species were found in ditches with significantly higher medians of Species Conservation Status and Habitat Quality Scores compared with ditches from which they were not recorded. Clearly there was an element of circular reasoning, since SCS Score received a boost from the presence of the scarce species, but the differences were nearly all highly significant ($p < 0.001$), and most samples included several scarce species. Species Richness differed less often; in the sample of 21 species, ten were significantly richer and two significantly poorer in total species. The overall conclusion was that these more frequent rare and scarce species often indicate a fauna of great conservation interest.

The soldierfly *Odontomyia ornata* (Vulnerable) and the Great silver water beetle (*Hydrophilus piceus*) (Near Threatened) deserve greater attention in the context of grazing marshes. They were among the most widespread and frequent of the scarce species, and both were associated with early to mid stage ditches with particularly high Species Richness. Although median Species Conservation Status and Habitat Quality Scores for ditches supporting these two species were not exceptional compared with those occupied by other rare and scarce species, they may be regarded as flagship species for grazing marshes because they stand out as reliable indicators of particularly 'rich' conditions. Both are also frequent in this habitat but scarce elsewhere, for example, there are almost no records of *O. ornata* from ponds.

A few other species were also both frequent and widespread: the beetles *Hydaticus seminiger*, *Limnoxenus niger*, *Peltodytes caesus* and *Rhantus frontalis*, and the soldierflies *Odontomyia tigrina* and *Stratiomys singularior*. These too appear to find a national stronghold in grazing marshes although they are less dependent upon them than *O. ornata* and *Hydrophilus piceus*. Another suite of species with high occurrence differed in being locally abundant but with a far more limited distribution. Among these were the Large-mouthed valve snail (*Valvata macrostoma*), found mainly at Pevensey Levels, the beetles *Hydaticus transversalis* (south-western marshes), *Enochrus halophilus* (North Kent, Thames Estuary and Essex) and *Hydrochus elongatus* (Pevensey Levels). A case for using the snails *Segmentina nitida* and *Anisus vorticulus* as key indicators for grazing marshes has been made (Watson & Ormerod, 2004) but these are geographically very restricted so have limited leverage at a local level.

Evaluation of invertebrate assemblages and wetlands: key points

- Individual marshes and geographical areas were assessed using metrics for Species Richness, Species Conservation Status (threat and rarity), Habitat Quality (fidelity to grazing marsh) and Naturalness (lack of non-native species).
- The results were compared with the average scores for the whole dataset, using different standards for fresh and brackish systems. Fresh and brackish systems cannot be directly compared using the metrics because different thresholds are appropriate for each of the two habitat types.
- The areas with the highest average species-richness were the predominantly freshwater marshes in the Bure valley, Norfolk and the Pevensey Levels.
- The highest average Species Conservation Status Scores were for the Pevensey Levels, Walland Marsh and the predominantly brackish North Kent, Thames and Crouch areas.
- Average Habitat Quality Scores were highest in the North Kent and Thames areas.
- The three non-native species often present were the crustacean *Crangonyx pseudogracilis* and two snails: *Potamopyrgus antipodarum* and the more recent arrival, *Physella acuta*.
- 70 nationally rare or scarce invertebrates were recorded during the project, 47 of them beetles. Some of these species are closely associated with coastal grazing marshes.
- Nine UK BAP priority invertebrates were recorded, one of which, *Anisus vorticulus*, is protected under European legislation.
- The occurrence of the 21 nationally uncommon species found most frequently in the survey was examined in relation to environmental variables and vegetation groups.
- Many of these species were shown to have particular requirements related to both salinity and vegetation composition and structure (hydrosere stage).