A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of grazing marsh ditch systems

Version 4

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1 Introduction

Ditches in England and Wales are of great importance for biodiversity, and are especially rich in aquatic invertebrates and plants. These networks of channels, although artificial, act as refuges for communities typical of previously extensive natural wetland systems.

Ditch complexes are found in wetlands such as fens, grazing marshes and water meadows. Among the most extensive and species-rich ditch systems are those in the fenlands of Cambridgeshire and Lincolnshire and in the grazing marshes of Norfolk Broadland, the Pevensey Levels, Romney Marsh, the Somerset and Gwent Levels, and the Thames and Humber estuaries. Most of the coastal grazing marsh systems display a transition from fresh to saline water, which is an important factor in maintaining their biodiversity. Some ditches running through arable land support rare species or rich assemblages (Mountford & Arnold, 2006), but these are the exception in this type of landscape.

Many of the most extensive ditch systems lie within Sites of Special Scientific Interest, but the flora and fauna of ditch systems in general may be threatened by agricultural pollution, unsuitable water level management, wholesale mechanical ditch clearance and climate change.

Coastal and flood plain grazing marsh is a priority habitat under the UK Biodiversity Action Plan and numerous UK Biodiversity Action Plan priority species are associated with ditch systems. Schemes to recreate coastal grazing marshes may become necessary to replace habitat lost as a result of the 'squeeze' created by rising sea levels.

The European Water Framework Directive (WFD) aims to improve the ecological status of inland and coastal waters. Aquatic plants and invertebrates are among the 'quality elements' used to assess the ecological status of surface water bodies. Although the principal surface waters targeted under the WFD are large lakes, rivers, transitional waters and coastal waters, the functional importance of wetlands is acknowledged. Natura 2000 Sites (Special Areas of Conservation under the EC Habitats Directive and Special Protection Areas under the Birds Directive) are designated under the WFD as Protected Areas, to which the WFD's full programme of measures can be applied. Some grazing marshes and fens containing ditch networks are Natura 2000 sites.

In order to conserve the biodiversity of these ditch systems it is necessary to assess their value in a national context and to monitor their condition. This should help in understanding what constitutes the optimum management regime for the ditches themselves and their immediate catchment areas. Standarised survey and conservation evaluation methods are essential tools for monitoring. This Manual presents such a methodology, which can be applied to the aquatic plant and invertebrate assemblages of coastal and flood plain grazing marsh ditches in England and Wales. A few changes (e.g. to the target list of invertebrate species and to the emphasis on salinity gradient) would be necessary to make the manual applicable to wetlands (e.g. fenlands) in England and Wales other than coastal grazing marshes and flood plain marshes in the lower reaches of rivers. Further modifications would be needed in order to apply the scheme to Scotland.

The survey protocols for aquatic vegetation and invertebrates described in this manual are based on methods that have been in use for several decades by the British statutory nature conservation agencies (now Natural England and the Countryside Council for Wales). The survey and evaluation methods presented here have been tested during a three year project managed by Buglife – The Invertebrate Conservation Trust, which covered coastal and flood plain grazing marshes in Somerset, Sussex, Kent, Essex, Suffolk, Norfolk, Gwent and Anglesey (Drake *et al.*, 2010).

4.5 The scoring system

4.5.1 General principles

One recent conservation evaluation scheme for freshwater invertebrate communities (Chadd & Extence, 2004) uses a single index summarizing several attributes (e.g. species richness and rarity). In the scheme presented in this Manual, metrics are produced for a number of separate attributes, and a single, combined quality score is not given. This is the approach taken in two other schemes: SERCON (System for Evaluating Rivers for Conservation) (Boon *et al.*,1997) and PSYM (Predictive System for Multimetrics) (Williams *et al.*, 1998).

For ditches, the most appropriate attributes for plant and invertebrate assemblages are considered to be

- Native Species Richness
- Species Conservation Status (Species Quality Index)
- Habitat Quality
- Naturalness (i.e. the impact of introduced species)

The scoring system therefore contains elements of four 'Nature Conservation Review' evaluation criteria (Ratcliffe, 1977): diversity, rarity, representativeness and naturalness. Each of the metrics can be applied to a single sample, a group of samples or a whole wetland.

4.5.2 Native Species Richness

Native Species Richness scores for both plants and invertebrates are simply the number of taxa recorded, using the check lists of native aquatic ditch species (Tables 1 and 2).

Where a specimen cannot be identified to species (e.g. an immature stage of some insect groups, non-flowering *Utricularia*) the taxon should be included in the count only if species of the same family or genus are absent from the sample (i.e. there should be no possibility of 'double counting').

Species richness is obviously very much influenced by the ditch management cycle. A newly cleaned ditch may contain few plant species, and one that has not been managed for ten years may have developed a monoculture of reed. Ditches in mid cycle would be expected to be the most diverse. The use of Native Species Richness scores is therefore most appropriate for whole sites or sections of sites that contain a range of ditch 'ages'. Salinity also affects species richness (see Section 4.6.1).

4.5.3 Native Species Conservation Status (Species Quality Index)

Plants

Each of the native aquatic plant taxa Table 1 is given a Conservation Status Score (for definitions of categories see Section 4.4.1), scored as follows:

Category	Score
*Habitats Directive Annex II/IV, Schedule 8 or Red List	5
*Near Threatened or Nationally Rare (but not Red List)	4
Nationally Scarce (but not Red List)	3
Local (in specific Environment Agency Regions)	2
None of the above (common)	1

* Some of these are UK Biodiversity Action Plan priority species.

Where multiple categories apply to a species, the highest score is used, not the sum of the scores. Where a specimen cannot be identified to species (e.g. non-flowering *Utricularia*) the taxon should be included in the calculation only if species of the same family or genus are absent from the sample. The Conservation Status Score used should be the lowest of the species in the higher taxonomic group.

threat scores in areas to which they have been introduced. (Note that these two species merit high Conservation Status Scores where they occur within their natural range.)

The Naturalness Score is simply the sum of the threat scores for the introduced species recorded, expressed as a negative score. If no introduced species are present, the Naturalness Score is 0 (no impact from introductions). If a ditch length contains *Crassula helmsii*, *Elodea canadensis* and introduced *Nymphoides peltata*, the Plant Naturalness Score is:

(1 x -5) + (1 x -2) + (1 x -2) = -9.

For comparisons over time, a marked increase or decrease in the abundance of any introduced species should be noted.

Invertebrates

Non-native invertebrate species known to occur in ditches or likely to colonise them are listed in Table 5. Threat scores range from 1 to 5, reflecting the threat they are thought to pose to native biota.

The species known to have a marked impact on native biota are the American signal crayfish *Pacifastacus leniusculus* and the Asiatic clam *Corbicula fluminea*, so these are given high threat scores.

This metric was tested on the data from Buglife's grazing marsh survey of 2007-2009 but it was found to be less useful than the Plant Naturalness Score because of the small number of non-native invertebrate species present and their widespread distribution (see Section 4.7.1).

4.6 Applying the scoring system

4.6.1 Ranking sites using the metrics

The final products of the assessment of the data from the 2007 to 2009 Buglife grazing marsh survey included four separate metrics for aquatic plants and two for aquatic invertebrates.

- **Native Plant Species Richness** (Number of native aquatic species recorded, based on check list)
- **Plant Species Conservation Status Score** (Average score per native taxon)
- **Plant Habitat Quality Score** (Uses water quality as a surrogate)
- **Plant Community Naturalness** (The sum of threat scores for introduced species, expressed as a negative score)
- **Native Invertebrate Species Richness** (Number of native aquatic taxa recorded, based on the check list)
- **Invertebrate Species Conservation Status Score** (Species Quality Index – average score per native taxon)

The metrics for the individual elements of the evaluation cannot be directly compared, and plant and invertebrate scores should not be equated. For instance, Native Species Richness scores for invertebrates will generally be much higher than those for plants, as the invertebrate check list is over twice the length of the plant list. However, sites or sections of sites can be ranked according to their individual invertebrate or plant scores and the rankings can be compared.

Scores can be applied to a species list from a specified ditch length (e.g. the 20 m recommended as the standard survey length for plants), a whole ditch, a ditch network or a whole site. Scores must be interpreted carefully, bearing in mind the effects of the ditch management cycle. Ranking for whole wetlands can be based either on overall score or on the mean or median score per sample. The method employed should always be stated. A fair comparison using complete species lists for wetlands can only

4.7 Testing the scoring system

4.7.1 The metrics

The evaluation system described here was tested on data from a survey of ditch plants and invertebrates carried out by Buglife – the Invertebrate Conservation Trust between 2007 and 2009. Over 540 ditches were sampled in this survey, which covered coastal and flood plain grazing marshes in Gwent, Anglesey, Somerset, Sussex, Kent, Essex, Suffolk and Norfolk (Drake *et al.*, 2010).

It appeared possible to make an adequate assessment of both fauna and flora using these metrics on a sample of ditches, making a comprehensive survey of a whole site unnecessary. Data from the 2007-2009 Buglife survey indicated that twenty samples should be the target for botanical surveys. For invertebrate survey, which is more labour intensive, the minimum number of samples recommended is ten. However, fifteen samples was shown to result in about three quarters of the maximum number of invertebrate species being recorded, so if resources allow, the target should be fifteen.

For whole wetland comparisons, using the means of the sample scores is recommended rather than applying the metrics to whole site data, as values obtained from the latter are more effort-dependent. Invertebrate and plant scores are not directly comparable, although ranking of scores can be used for making comparisons.

The proposed invertebrate Habitat Quality Score for a sample was to be the mean of 'grazing marsh fidelity' scores for all the species present. This metric was finally rejected because when it was tested on the Buglife dataset it produced little information that was not given by the Species Conservation Status Score. This is because almost all the 'faithful' species are also uncommon, so the two metrics are not independent. Nevertheless, the data on grazing marsh fidelity given in Table 1 is useful background information, as it indicates key species for the grazing marsh habitat.

The only non-native species encountered during the 2007-2009 Buglife survey were the amphipod crustacean *Crangonyx pseudogracilis* (threat score -3) and the snails *Potamopyrgus antipodarum* and *Physella acuta* (each with a threat score of -2). The 'maximum' possible score was therefore -7. Because so few species were involved, the Naturalness Score did not perform well statistically, so its usefulness was felt to be limited. However, the inclusion of at least a statement about the non-native invertebrate species present in a site was considered to be essential in the evaluation process.

4.7.2 Salinity

The tolerance of individual plant and invertebrate species to salinity is indicated Tables 1, 2, 3 and 5. Salinity indices, based on the tolerance scores for species, were used as adjuncts to conductivity, to indicate brackish conditions. For invertebrates, simply adding the scores for all the species present produced a useful salinity index for an assemblage, but taking the mean of the species scores worked best for the plants.

The suites of metrics for plants and invertebrates behaved differently when applied to samples from freshwater and brackish ditches. Species Richness and Naturalness Scores for both taxonomic groups were generally lower for brackish ditches than for freshwater ones. For plants, both mean Species Conservation Status (SCS) and Habitat Quality Scores were lower in brackish ditches than freshwater ones, whereas for invertebrates mean these scores were higher in brackish than in freshwater ditches. This is due to the fact that brackish water supports a considerable number of rare invertebrates, but this is not the case for plants.

The values in the following table can be used as yardsticks against which to judge the quality of the flora and fauna of freshwater and brackish ditches and grazing marshes. The figures are based on data from the 2007 to 2009 Buglife grazing marsh survey, with conductivity measurements taken in spring for invertebrates and in summer for plants.

A few changes (e.g. to the target list of invertebrate species and to the emphasis on salinity gradient) would be necessary to make the evaluation system described in this Manual applicable to wetlands (e.g. fenlands) in England and Wales situated more than a few miles inland. Further modifications would be needed in order to apply the scheme to Scotland.

This system has not been produced to compete with the current method used in Common Standards Monitoring of statutory sites (Joint Nature Conservation Committee, 2005), or with ISIS (Invertebrate Species-habitat Information System) (Lott, 2006). An outline botanical classification of ditch systems and an indication of minimum standards required for SSSI designation are given in *Guidelines for selection of biological SSSIs* (Nature Conservancy Council, 1989), but these require updating. The method described in this Manual may ultimately contribute to all these existing monitoring and evaluation systems.

A large body of data on the flora and fauna of ditch systems has been collected in the last three decades, much of which has been digitised by Buglife under contract to Natural England. Data from the 2007-2009 Buglife survey have also been digitised and classifications of ditch flora and fauna for Wales and southern England have been produced (Drake *et al.*, 2010). These achievements go some way to providing the contextual information needed for wetland ditch systems to be evaluated at a national level.