The Auchenorrhyncha communities of chalk grassland in southern England

Dissertation

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Contents

1 Introduction

Between 1998 and 2003 the Department for Environment Food and Rural Affairs (DEFRA) in the UK conducted a project (BD1414) concerning the enhancement of plant and invertebrate diversity on chalk grassland through the use of Environmental Land Management Schemes (MASTERS 2004). Within this project the invertebrate fauna of grassland sites which had undergone different land management practices in the past was surveyed. Most of these sites are now entered into two different Environmental Land Management Schemes, ESA (Environmentally Sensitive Areas) and CSS (Countryside Stewardship Scheme). ESA's were introduced in the 1986 Agriculture Act (UK) and are administered by DEFRA. There are now 22 such areas in England created to protect particular national landscapes, wildlife, historic or archaeological interests potentially threatened by changes in farming practices. The Countryside Stewardship Scheme offers incentives for adopting practices which enhance existing areas of (for example) chalk grassland or recreate species-rich grassland on cultivated land, targeting sites outside ESA's. Both schemes are aimed at encouraging the preservation of biological diversity and important landscape features on agricultural land through the adoption of environmentally beneficial farming and management practices.

Within the framework of this project a large body of data regarding the Auchenorrhyncha fauna of different types of chalk grassland was collated. This presented the opportunity to examine the assemblages of this ecologically important insect group of grassland systems on a wider scale for the first time. Beside the possibility to analyse the impact of plant community composition, vegetation structure and land management practises on the Auchenorrhyncha communities, the set-up of the project enabled the linking of Auchenorrhyncha communities to British plant communities as defined in the NVC (National Vegetation Classification). A new method to deliver quickly relevant information about the position of single species within the investigated grassland system and the overall composition of the occurring Auchenorrhyncha assemblages was developed. This was reached by applying the classical way of displaying botanical data using frequency and abundance (BRAUN-BLANQUET & FURRER 1913, OBERDORFER 1957, BRAUN-BLANQUET 1964, RODWELL 1998) to an invertebrate group for the first time.

1.1 Chalk grassland

Grasslands have been described as 'early successional' communities (MORRIS 2000). At least most grasslands in Britain are plagioclimaxes, and need management to prevent succession into different seres of vegetation (DUFFEY ET AL. 1974). Chalk grassland in particular is the product of many centuries of extensive grazing, in the UK primarily by sheep. Such grasslands once covered large tracts of southeastern England (SMITH 1980). The dryness and infertility of the soil, combined with the effects of grazing generally results in a plant community of exceptionally high diversity (RODWELL 1998). A characteristic of chalk grassland as a mature system is a high number of perennial plants and subsequently a high stability of the habitat over a long period (ODUM 1969, MÖSELER 1989, ANDOW 1991).

Agricultural intensification has led to the loss of large areas of species-rich grasslands. The loss of chalk grassland, considered the most diverse plant community in England, has been particularly severe (MASTERS 2004). Between 1949 and 1989 over 80 % of the original amount of calcareous grassland in the UK has been lost or suffered serious damage (NEWBOLD 1989). The main causes include the conversion of land for the cultivation of arable crops and the improvement of areas of permanent pasture by the application of fertilizers, herbicides and pesticides (BLACKWOOD & TUBBS 1970, KEYMER & LEACH 1990). In addition, in areas unsuitable for improvement, chalk grassland has been lost through the encroachment of scrub due to neglect of management (THOMPSON ET AL. 1999, ROBINSON & SUTHERLAND 2002).

As a consequence of these rapid and immense changes, chalk grassland is now a target habitat of the Government's Biodiversity Action Plan (DEPARTMENT OF ENVIRONMENT 1994, UK BIODIVERSITY GROUP 1998), which satisfies the following criteria:

- habitat on which priority species depend
- habitat for which the UK holds an important part of the total world or European resource
- habitat declining rapidly in area
- habitat declining rapidly in quality
- habitat which is rare
- habitat which is listed in Annex 1 of the EU Habitat and Species Directive

1.2 Arthropods as biological indicators

For about 25 years the concept of biological indicators has been important for nature conservation and the monitoring of environmental issues (BICK 1982, KNEITZ 1980, 1983). Biological indicators can be a particular useful tool to measure intensity and effects of habitat management and disturbance, success of restoration efforts, or the value of habitats for nature conservation through parameters like diversity, species composition and others. Several aspects define whether a group of organisms can be used as suitable biological indicators or not (SPANG 1992):

- knowledge of ecology, biogeography
- sensitivity, precision and presence within the monitored habitats
- availability of a high number of species in certain habitats
- availability of suitable methods for qualitative and/or quantitative surveys
- sufficient knowledge for identification to species level, availability of taxonomists
- amount of time needed for survey and identification

Animal groups selected as biological indicators are only valuable tools for nature conservation if they reflect different aspects of habitat quality than the vegetation, which is usually much easier to monitor. Invertebrates can make good biological indicators as a result of their short lifecycles and their often precise and restricted habitat requirements (MCLEAN 1990). Indeed, invertebrates may be better indicators of the current state of a community than plant species. The invertebrate fauna is a product of both plant community composition and vegetation structure under given climatic conditions. Therefore, changes in management which result in alterations in canopy structure may affect the insect community long before changes in plant community composition are manifested (McLean 1990, Brown et al. 1990). For example, the Heteroptera react quicker to a change of grassland management than the vegetation (Di Giulio et al. 2001). Another factor making insects valuable environmental indicators is that they often show a particularly high variation of assemblages, as has already been demonstrated for carabids in grassland systems (Luff 1996).

1.3 Auchenorrhyncha as suitable biological indicators to monitor the success of chalk grassland restoration

The systematics of the Hemiptera have undergone substantial changes over the last 80 years. Starting with a first classification by Muir (1923) they evolved to a more modern approach based on synapomorphies (Boulard 1988, Hamilton 1996). The classical linking of Cicadomorpha and Fulgoromorpha as Auchenorrhyncha is probably not a monophyletic one (Bourgoin & Campbell 2002). In fact, the Heteroptera are most likely more closely related to the Cicadomorpha than the Fulgoromorpha (Bourgoin & Campbell 2002). Although the Auchenorrhyncha are probably not a monophyletic group, there are good reasons to study the Fulgoromorpha and Cicadomorpha together, separated from other groups like the Aphidoidea and Heteroptera (Nickel 2003). The species of both groups are part of the same ecological guild. They do not include predators and the sampling methods are the same for both groups.

Despite a number of early studies concerning the ecology of grassland Auchenorrhyncha, this group was regarded as inferior biological indicators in comparison with some other insect groups until the early 1990‘s, mainly due to the lack of sufficient detailed knowledge about their ecology (Spang 1992). Even overviews of basic methodological standards for the surveys of indicator groups excluded the Auchenorrhyncha completely (Trautner 1992). Probably another reason for not using leafhoppers as biological indicators was that Homoptera count for less than 5 % of the living animal biomass within grassland systems (Reich 1988).

However, it has been demonstrated that the Auchenorrhyncha are indeed particularly good organisms to monitor conditions of grassland habitats (Kuntze 1937, Marchand 1953, Emmrich 1966, Schiemenz 1969, Andrzejewska 1979, Bornholdt & Remane 1993, Hildebrand 1990, Nickel & Achtziger 1999, Nickel et al. 2002, Nickel & Hildebrandt 2003). The properties, which make Auchenorrhyncha suitable grasslands indicators are summarized by Stewart (2002) as follows:

- Population densities are often high and can exceed those of other key invertebrate groups (in excess of 1,000 individuals per m^2 (Waloff 1980).
- The autecology is well studied in terms of host plant, habitat association and response to management.
- Auchenorrhyncha perform an important functional role in the grassland communities as herbivores.
- The structure and composition of Auchenorrhyncha communities generally reflects a combination of the species composition and physical structure of the vegetation (Brown et al. 1992).

- Auchenorrhyncha communities respond rapidly and precisely to management regimes.
- There are well tested and widely accepted sampling techniques for sampling the Auchenorrhyncha assemblages in grasslands.

NICKEL & ACHTZIGER (1999) demonstrated that it is possible to categorize grassland Auchenorrhyncha according to their preferences within a moisture gradient from extreme dry to very wet and a gradient of the intensity of landuse from unused to intensively managed. Additionally, NIEDRINGHAUS (1999) showed the suitability of grassland leafhoppers to indicate habitat restoration success. By separating leafhopper species into different guilds according to their habitat requirements (for example, preferences for fine-leaved grasses, tall grass stands or nitrogen rich habitats) Auchenorrhyncha indicate different grassland conditions on a rather fine-tuned level (BORNHOLDT 2002).

One challenge for this study was that the basic knowledge of grassland Auchenorrhyncha in the UK is still inadequate, as was pointed out by EYRE ET AL. (2001). They found a surprisingly high number of notable and rare species during a survey not designed to find especially rare species, concluding that the rarity status of some species is questionable. The autecology of British Auchenorrhyncha species has been intensively studied only for a few species so far, though one good example is *Conomelus anceps* (ROTHSCHILD 1966). Auchenorrhyncha communities of calcareous grassland, although certainly one of the better investigated habitats in the UK, have been so far only studied within a mere handful of projects (MORRIS 1967, 1973, 1981a,b, COOK 1996, MORTIMER ET AL. 1998), all of them restricted to only one or a low number of sites. Furthermore, some of the descriptions of calcareous grassland communities in Britain derive from grassland which has undergone heavy improvement or was in a comparably late successional stage due to cessation of management and did not belong to one of the typical calcareous grassland plant communities according to the NVC (for example MORRIS 1979).

On the other hand, ecological data of Auchenorrhyncha species gained from chalk grassland sites on the continent (France, Germany and Poland) are to a certain degree transferable to the conditions in southern Britain. The continental 'Gentiano-Koelerietum pyramidata KNAPP 1942' and 'Mesobrometum erecti BR.-BL. AP. SCHERRER 1925' are very similar to the equivalent of the communities described by the NVC code CG2. However, there are distinct differences in plant species composition, microclimate and landuse management. For example, on the continent mowing of chalk grassland is a much more widespread type of landuse, resulting in the dominance of different plants especially grasses like *Bromopsis erecta* (MÖSELER 1989).

2 Methods

2.1 Sampling sites

Southern England, here defined as the area south of a line from the Wash to the Bristol Channel, is characterized by three major outcrops of cretaceous chalk stretching from the Norfolk coast, Kent and Sussex towards the southwest and west, where they join up to build the Salisbury Plain. The monitoring work was carried out across sites in the South Downs ESA, South Wessex Downs ESA and CSS sites in the North and Berkshire Downs, the Chilterns and the Isle of Wight (Figure 1 shows the geographical distribution of the sites). All ESA sites involved existing chalk grassland and its management (Table 1 shows the number of sites in each category) and these were surveyed in 1998 and 2000. The CSS sites were focused towards enhancement or recreation of chalk grassland (Table 1) and were surveyed in 1999 and 2002. The scheduled 2001 monitoring programme of these sites could not proceed due to Foot and Mouth Disease quarantine measures (MASTERS 2004).

A total of 100 grassland and arable reversion sites were surveyed twice during the course of the project. Further details of all the sites are given in Annex 1. The grassland sites were classified as unimproved, semi-improved or improved. Unimproved sites represent the classical chalk grassland (downland), which has never or at least not for a long time been treated with fertilizer. On the other hand, improved grassland was subject to substantial input of fertilizers in the past and is, therefore, often not typical species-rich chalk grassland at all. Grasslands showing signs of a moderate fertilizer input, but with vegetation still including at least some elements typical for unimproved grassland sites, were classified as semi-improved. Arable reversion sites have been previously managed as arable fields, usually involving a high input of fertilizers. These sites have been converted into grassland either through the use of certain seed mixtures or through self-sowing.

Table 1: Geographic breakdown of the replicate sites. U: unimproved, SI: semi-improved, I: improved and AR: arable reversion.

landuse type	Chilterns	North Downs	South Downs	South Wessex Downs	Isle of Wight	sum
U	8	12	7	16	3	46
SI	2	3	6	1	1	13
I	2	3	9	7	1	22
AR	3	5	9	1	1	19
sum	15	23	31	25	6	100

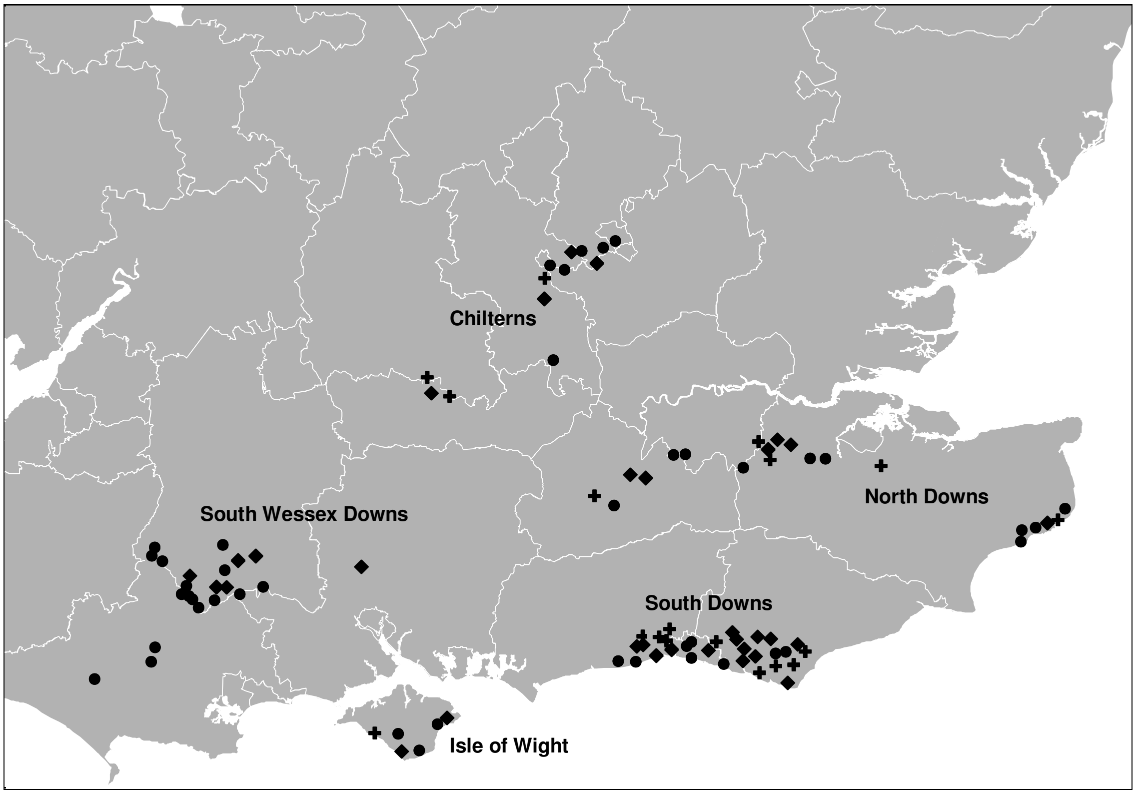


Figure 1: Geographic location of the sites. ● = unimproved sites, ◆ semi-improved and improved sites, ✚ arable reversion sites.

Similar to the approach used for the sampling of calcicolous grassland assemblages for the description of the British plant communities by RODWELL (1998), the design of the project has the advantage of avoiding a focus on the most species-rich chalk grasslands (for example nature reserves) in southern England. These sites would stand out sharply from the rest and would become the standard against which all else must be judged as impoverished (RODWELL 1998).

According to RODWELL (1998) there are seven calcareous grassland communities (including 25 sub-communities) in southern England. Five of these communities (including eleven sub-communities) were sampled during this study. All four mesotrophic grassland communities occurring on dry basic substrates in southern England were sampled, including seven of the 14 existing sub-communities. An overview of the sampled grassland communities is given in tables 2 and 3.

Table 2: Overview of the sampled grassland communities (excluding AR sites).

CG Grassland (52 sites)
CG2 *Festuca ovina-Avenula pratensis* grassland (37 sites) a. *Cirsium acaule-Asperula cynanchica* sub-community (14 sites) b. *Succisa pratensis-Leucanthemum vulgare* sub-community (7 sites) c. *Holcus lanatus-Trifolium repens* sub-community (16 sites)
CG3 *Bromus erectus* (now *Bromopsis erecta*) grassland (10 sites) a. Typical sub-community (3 sites) b. *Centaurea nigra* sub-community (4 sites) c. *Knautia arvensis* sub-community (1 site) d. *Festuca rubra-Festuca arundinacea* sub-community (2 sites)
CG4 *Brachypodium pinnatum* Grassland (2 sites) c. *Holcus lanatus* sub-community (2 sites)
CG5 *Bromus erectus* (now *Bromopsis erecta*) -*Brachypodium pinnatum* Grassland (3 sites) a. Typical sub-community (3 sites)
MG Mesotrophic grassland (29 sites)
MG1 *Arrhenatherum elatius* grassland (*Arrhenatheretum elatioris* Br. -Bl. 1919) (5 sites) a. *Festuca rubra* sub-community (3 sites) d. *Pastinaca sativa* sub-community (1 site) number of sites where classification to sub-community was not possible: 1
MG5 *Cynosurus cristatus* grassland (*Centaureo-Cynosuretum cristati* Br.-Bl. & Tx. 1952) (6 sites) b. *Galium verum* sub-community
MG6 *Lolium perenne-Cynosurus cristatus* grassland (*Lolio-Cynosuretum cristati* Br.-Bl. & De Leeuw 1936) (11 sites) a. Typical sub-community (5 sites) c. *Trisetum flavescens* sub-community (5 sites) number of sites where classification to sub-community was not possible: 1
MG7 *Lolium perenne* leys and related grasslands (Lolio-Plantaginion Sissingh 1969 *p.p.*) (7 sites) a. *Lolium perenne-Trifolium repens* leys (6 sites) b. *Lolium perenne-Poa trivialis* leys (1 site)

Table 3: Overview of the communities from the sampled arable reversion sites.

MG Mesotrophic grassland (18 sites)
MG1 *Arrhenatherum elatius* grassland (1 site) no further classification possible
MG5 *Cynosurus cristatus* grassland (3 sites) a. *Lathyrus pratensis* sub-community (1 site) b. *Galium verum* sub-community (2 sites)
MG6 *Lolium perenne-Cynosurus cristatus* grassland (*Lolio-Cynosuretum cristati*) (6 sites) a. Typical sub-community (6 sites)
MG7 *Lolium perenne* leys and related grasslands (*Lolio-Plantaginetum*) (8 sites) a. *Lolium perenne-Trifolium repens* leys (2 sites) b. *Lolium perenne-Poa trivialis* leys (6 site)
number of sites where classification was not possible: 1

2.2 Sampling regime and sampling technique

At each site, the invertebrates and the vegetation were sampled three times in a year, in late spring/early summer, mid-summer and late summer/early autumn. ESA sites were sampled in 1998 and 2000; CSS sites were sampled in 1999 and 2002. The scheduled 2001 monitoring programme of these sites could not proceed due to Foot and Mouth Disease quarantine measures. A transect across the site, running through an previously monitored botanical quadrat established by the agricultural and environmental advising group ADAS during earlier studies, was taken and five equidistant sampling points chosen. Invertebrates were sampled on these five sampling plots covering the length of the field. If the size of the field allowed, the intersampling distance was 60 m, otherwise consistent but shorter distances between the plots were used to cover the length of the field in a straight line or, in small sites, the transect was laid out in a shape resembling a 'T', 'L' or 'X' (MASTERS 2004).

The Auchenorrhyncha were sampled with a 'Vortis'-suction sampler (Burkhard Manufacturing, Rickmansworth, UK). On each plot, 15 sampling intervals (duration of ten seconds each) were conducted within a radius of 3 m around the centre of the plot. During each invertebrate sample, ten samples of the vegetation height were taken randomly with a standardized 'drop-disk' (30 cm diameter, 200 g weight) STEWART ET AL. 2001). In addition time, weather conditions (cloud cover, wind) and the current grazing regime were recorded.

The vegetation community was surveyed within 2 x 2 m quadrats over the centre of each sampling plot by the botanists of the team conducting the project; ESA-sites in 1998, CSS-sites in 1999. The vegetation mapping was done twice on each site: firstly in June to map the occurrence of species, secondly in July using the domin-scale. The surrounding land use was recorded in 1998 and 1999 on OS 1:25,000 base map (MASTERS 2004)

2.3 Sample processing and species identification

The invertebrates from the vortis samples were collected live and, back in the laboratory, transferred to tubes containing 70 % industrial methylated spirit (IMS). Samples were then sorted to order. The Auchenorrhyncha were identified to species using the keys of RIBAUT (1936, 1952), LE QUESNE (1960b, 1965C, 1969), LE QUESNE & PAYNE (1981), OSSIANILSSON (1978, 1981, 1983), DELLA GIUSTINA ET AL. (1989) and HOLZINGER ET AL. (2003), in particular. Other publications were used as needed. Nomenclature is according to HOLZINGER ET AL. (1997) with adaptations from SZWEDO (2002) and HOLZINGER ET AL. (2003). Plant names follow STACE (1997).

2.4 Analysis

2.4.1 Used parameters

Dominance

The dominance (D) describes the relative abundance of a species within a community (TISCHLER 1977). It is measured as:

$$D = \frac{b}{a} \times 100$$

b = number of individuals of the species

a = number of individuals of all species

Diversity

The diversity of communities was measured according to Shannon-Wiener (H_s) (SHANNON 1948):

$$H_s = - \sum_{(i=1)}^{s} p_i \times \log p_i$$

s = number of species

p_i = relative abundance of species i to the overall number of individuals in the community

2.4.2 Display of community data

Auchenorrhyncha communities can be displayed in the same way that is usually used for plant communities. To compare two communities or sub-communities the order of species using frequency and dominance classes follows some simple rules to allow a quick overview of the displayed and compared communities. The used frequency and dominance classes are shown in tables 4 and 5. The species are arranged in blocks according to their pattern of occurrence among the compared (sub-) communities. Within these blocks they are ordered by decreasing frequency. The first group is made up of the community constants, that are those species occurring in the frequency class IV or V. This is followed by a second block showing the preferential species which are more frequent and usually more abundant in the first community compared with the second one. In this study species with the same frequency class but significant differences of abundance are also included here. In the next block the species more frequent or abundant in the second community are displayed. The last group of species lists the general associates of the communities.

Table 4: Frequency classes (number of classes following the usual phytosociological convention, percentage ranges slightly adapted from RODWELL 1998).

frequency class I	>0 ≤ 10 %
frequency class II	>10 ≤ 30 %
frequency class III	>30 ≤ 50 %
frequency class IV	>50 ≤ 70 %
frequency class V	> 70 %

Table 5: Dominance scale (logarithmic after ENGELMANN, 1978).

6 (eudominant)	> 32.0 ≤ 100 %
5 (dominant)	> 10.0 ≤ 32.0 %
4 (subdominant)	> 3.2 ≤ 10.0 %
3 (recedent)	> 1.0 ≤ 3.2 %
2 (subrecedent)	>0.32 ≤ 1.0 %
1 (sporadic)	≤ 0.32 %
0 (missing)	= 0 %

Definition of preferential and differential species

A community display as described above can be used as the basis for the description of characteristic or preferential species. These are typically more frequent and abundant in one community in comparison with a second one. To conform with the terminology used by the National Vegetation Classification of British plant communities (NVC) the term ‘preferential’ is in this study preferred to ‘characteristic’. Species, which are restricted to only one of the compared communities, can be classified as differential species (MEYER-CORDS & BOYE 1999). In this study the classification of preferential and differential species follows some definitions given in table 6. Additionally, the term ‘umbrella species’ is used to estimate the monitoring capacity of a species for the restoration success in grassland habitats. Umbrella species require very specific habitat conditions on a spatial or structural scale. If these conditions are fulfilled, usually the habitat requirements for a larger group of other organisms will be equally provided. Subsequently, the protection of certain umbrella species implies automatically the support of these organisms (MEYER-CORDS & BOYE 1999).

Table 6: Definition of species classification.

Community constants

- species with a frequency value of IV and V in all communities are regarded as constant unless there are significant differences in their dominance structure

Preferential species

- frequency value at least one class higher than in the other compared communities
- frequency value at least class III
- if frequency value is only class II or I, the average dominance value has to be at least 2 and the maximum dominance value at least 3 or there are significant differences in the dominance structure
- if the frequency value is the same in compared groups, preferential species can still be described if the dominance structure is significantly different

Differential species

- frequency value at least II, average dominance value at least 2 or the maximum dominance value at least 5
- species has to be absent in the compared community
- if frequency is only I or dominance value only 1, a species can still be regarded as differential species if habitat requirements (e.g. host plant appearance) make it most unlikely for the species to be found in the compared community

General associates

- all other species are regarded as general associates of the community
- species with a higher frequency class in one community but a higher abundance in the compared one and not fitting the criteria of community constants are regarded a general associates as well

2.4.3 Statistics

The testing of significant differences between species and species groups of compared communities was done using the 'Mann-Whitney U test' after converting the raw data into ranks by using the dominance values of each species, using the statistical package of SPSS (Version 10.0). This nonparametric test was chosen because of its robustness when dealing with unbalanced data. Correlations and regression analysis were tested using Excel 97 (Graphs and tables displaying columns with the same letter indicate that there are no significant differences between these columns).

A number of multivariate approaches were used to explore the invertebrate community data, these included both weighted averaging (e.g. CCA) and linear (e.g. RDA) methods on Hellinger transformed species data (to account for long gradients), using the CANOCO package (ter Braak & Smilauer 1998). Weighted averaging techniques can suffer from the undue influence of 'rare' species so a cautionary approach was taken with the analysis. A series of CA's were conducted on data which had the rare species removed sequentially, i.e. on all species, then those that occurred in greater than one site, two sites etc. until the eigenvalues of the first axes changed significantly. This allowed overall noise in the data to be removed whilst not affecting any observed patterns. This exploration of the dataset revealed that removal of species only occurring at one site successfully removed unwanted noise but left important trends unchanged, therefore, this procedure was used for all species data. It should however be pointed out, that this does not mean that rare species are here regarded as a group of only marginal importance. Rare species cannot be excluded as an artefact and should be targeted as an important biological phenomenon (NOVOTNÝ & BASSET 2000). Explanatory variables were selected by forward selection and any that caused instability were removed. Statistical testing was done using the Monte Carlo test.

3 Results

3.1 General results

3.1.1 Species numbers

Overall, 110 species of leafhoppers have been recorded in this study. Ninety-seven were present on the grassland sites included in the present analysis. An overview of the recorded species, the number of sampled individuals and the number of sites with records are given in table 7. On three chalk grassland sites in the Chilterns and North Downs, sampled during the project to investigate the impact of scrub clearance, 13 additional species were found (Table 8). However, data from these three sites is not included in the analysis due to a different sampling regime at these sites.

Of the 97 species occurring on the analysed 100 grassland sites, 86 are typical grassland species or at least inhabitants of the herbaceous layer at some stages of their lifecycle. The other 11 taxa belong to species feeding on woody shrubs and trees. Of the 86 grassland species 60 feed exclusively on monocotyledonous plants (grasses, sedges and rushes). Only 23 species feed on dicotyledonous forbs or both plant categories (percentages in figure 2). On the basis of a host specification classified according to NICKEL & REMANE (2002) and NICKEL (2003) (see chapter 6) the 86 grassland species can be separated into 12 polyphagous (feeding on more than two plant families), 44 oligophagous (feeding on only one or two plant families) and 27 monophagous species (feeding only on one plant genus) (percentages in figure 3).

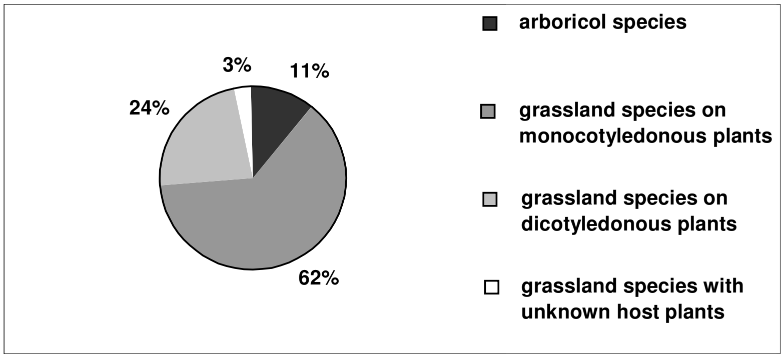


Figure 2: Percentage of Auchenorrhyncha species separated according to main ecological guilds.

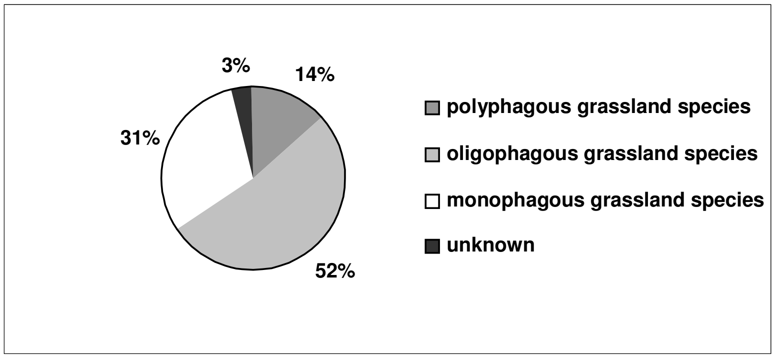


Figure 3: Percentage of grassland Auchenorrhyncha species separated according to host specificity.

Seven of the species have been classified by the UK Biological Records Centre (BRC) or by KIRBY (1992) as ‘notable’, which means they are thought to be nationally scarce and occupy fewer than 100 10 x 10 km squares of the UK National Grid. Within the classification scheme provided by the Nature Conservancy Council (NCC) a distinction has been made between ‘notable A’ and ‘notable B’ (for details of the scheme see HAYMAN & PARSONS 1992). Notable A describes taxa, which do not fall within Red Data Book (RDB) categories but 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. Notable B is used for 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, between eight and twenty vice-counties.

Of the notable species recorded in this study *Eurysanoides douglasi* has been classified as notable A, the other six species (*Ribautodelphax angulosa, Ribautodelphax pungens, Utecha trivia, Agallia brachyptera, Athysanus argentarius* and *Psammotettix albomarginatus*) as notable B (KIRBY 1992).

Eurysanoides douglasi, a monophagous species feeding on *Brachypodium pinnatum*, was found in two sites in the South Downs (National grid reference TQ189087 and TR292415). The first site is classified as semi-improved belonging to *Brachypodium pinnatum* grassland (CG4). With 47 sampled specimens *E. douglasi* shows a comparably high density on this site. The second site is unimproved, belonging to *Brachypodium pinnatum – Bromus erectus* grassland (CG5). Here only four specimens were sampled.

Table 7: Auchenorrhyncha species recorded from the analysed grasslands during the project (order according to HOLZINGER ET AL. 1997).

Species	n	D	F	H
Fulgoromorpha EVANS, 1946				
Cixiidae SPINOLA, 1839				
Tachycixius pilosus (OLIVIER, 1791)	3	0,01	2	a
Delphacidae LEACH, 1815				
Kelisia guttula (GERMAR, 1818)	91	0,25	20	h
Kelisia occirrega Remane & Guglielmino, 2002	371	1,01	35	h
Stenocranus minutus (FABRICIUS, 1787)	499	1,36	43	h
Eurysa lineata (PERRIS, 1857)	5	0,01	3	h
Eurysanoides douglasi (SCOTT, 1870)	51	0,14	2	h
Delphacinus mesomelas (BOHEMAN, 1850)	51	0,14	13	h
Hyledelphax elegantula (BOHEMAN, 1847)	1153	3,15	54	h
Megamelodes quadrimaculatus (SIGNORET, 1865)	2	0,01	1	h
Muellerianella fairmairei (PERRIS , 1857)	98	0,27	9	h
Kosswigianella exigua (BOHEMAN, 1847)	1472	4,02	60	h
Dicranotropis hamata (BOHEMAN, 1847)	43	0,12	14	h
Xanthodelphax straminea (STAL, 1858)	1047	2,86	17	h
Criomorphus albomarginatus CURTIS, 1833	121	0,33	27	h
Javesella pellucida (FABRICIUS, 1794)	717	1,96	85	h
Javesella dubia (KIRSCHBAUM, 1868)	238	0,65	41	h
Javesella obscurella (BOHEMAN, 1847)	1	0,00	1	h
Ribautodelphax angulosa (RIBAUT, 1953)	5	0,01	1	h
Ribautodelphax pungens (RIBAUT, 1953)	4	0,01	2	h
Cicadomorpha EVANS, 1946				
Cercopidae LEACH, 1815				
Neophilaenus exclamationis (THUNBERG, 1784)	536	1,46	23	h
Neophilaenus lineatus (LINNAEUS, 1758)	427	1,16	54	h
Aphrophora alni (FALLEN, 1805)	20	0,05	14	h
Philaenus spumarius (LINNAEUS, 1758).	239	0,65	43	h
Membracidae RAFINESQUE, 1815				
Centrotus cornutus (LINNAEUS, 1758)	6	0,02	4	a
Cicadellidae LATREILLE, 1825				
Utecha trivia (GERMAR, 1821)	79	0,22	4	h
Megophthalmus scanicus (FALLÉN, 1806)	379	1,03	46	h
Megophthalmus scabripennis EDWARDS, 1915	147	0,40	20	h
Macropsis fuscula (ZETTERSTEDT, 1828)	9	0,02	1	h
Agallia brachyptera (BOHEMAN, 1847)	19	0,05	2	h
Agallia consobrina CURTIS, 1833	33	0,09	10	h
Anaceratagallia ribauti (OSSIANNILSSON, 1938)	808	2,20	47	h
Anaceratagallia venosa (FOURCROY, 1785)	29	0,08	14	h
Batracomorphus irroratus LEWIS, 1834	364	0,99	12	h
Eupelix cuspidata (FABRICIUS, 1775)	657	1,79	43	h
Aphrodes bicincta (SCHRANK, 1776)	145	0,40	31	h
Aphrodes makarovi ZAKHVATKIN, 1948	383	1,04	62	h
Planaphrodes bifasciata (LINNAEUS, 1758)	2	0,01	2	h
Anoscopus albifrons (LINNAEUS, 1758)	858	2,34	77	h
Anoscopus flavostriatus (DONOVAN, 1799)	58	0,16	14	h
Anoscopus serratulae (FABRICIUS, 1775)	1182	3,22	59	h
Evacanthus acuminatus (FABRICIUS, 1794)	5	0,01	2	h
Evacanthus interruptus (LINNAEUS, 1758)	6	0,02	4	h
Cicadella viridis (LINNAEUS, 1758)	1	0,00	1	h
Emelyanoviana mollicula (BOHEMAN, 1845)	52	0,14	9	h
Dikraneura variata HARDY, 1850	71	0,19	11	h
Forcipata citrinella (ZETTERSTEDT, 1828)	1	0,00	1	h

Species	n	D	F	H
Notus flavipennis (Zetterstedt, 1828)	2	0,01	1	h
Fagocyba cruenta (Herrich-Schäffer, 1838)	2	0,01	2	a
Edwardsiana crataegi (Douglas, 1876)	1	0,00	1	a
Ribautiana tenerrima (Herrich-Schäffer, 1834)	1	0,00	1	a
Eupteryx aurata (Linnaeus, 1758)	5	0,01	4	h
Eupteryx origani Zakhvatkin, 1948	57	0,16	8	h
Eupteryx urticae (Fabricius, 1803)	20	0,05	4	h
Eupteryx stachydearum (Hardy, 1850)	2	0,01	2	h
Eupteryx vittata (Linnaeus, 1758)	20	0,05	7	h
Eupteryx notata Curtis, 1937	888	2,42	49	h
Alnetoidea alneti (Dahlbom, 1850)	2	0,01	2	a
Zyginidia scutellaris (Herrich-Schäffer, 1838) sensu Ribaut, 1936	4059	11,07	91	h
Zygina flammigera (Geoffroy, 1785)	2	0,01	2	a
Zygina hyperici (Herrich-Schäffer, 1836)	1	0,00	1	h
Arboridia parvula (Boheman, 1845)	1318	3,60	29	h
Balclutha punctata (Fabricius, 1775)	3	0,01	2	h
Macrosteles laevis (Ribaut, 1927)	153	0,42	21	h
Macrosteles viridigriseus (Edwards, 1922)	268	0,73	22	h
Deltocephalus pulicaris (Fallén, 1806)	7580	20,68	80	h
Recilia coronifer (Marshall, 1866)	172	0,47	20	h
Doratura stylata (Boheman, 1847)	86	0,23	20	h
Allygus mixtus (Fabricius, 1794)	2	0,01	2	a
Allygus modestus Scott, 1876	1	0,00	1	a
Graphocraerus ventralis Fallén, 1806	4	0,01	3	h
Rhytistylus proceps (Kirschbaum, 1868)	104	0,28	19	h
Rhopalopyx adumbrata (Sahlberg, 1842)	30	0,08	11	h
Elymana sulphurella (Zetterstedt, 1828)	16	0,04	8	h
Cicadula persimilis (Edwards, 1920)	7	0,02	4	h
Mocydia crocea (Herrich-Schäffer, 1837)	874	2,38	37	h
Mocydiopsis attenuata (Germar, 1821)	203	0,55	30	h
Speudotettix subfusculus (Fallen, 1806)	1	0,00	1	a
Thamnotettix dilutior (Kirschbaum, 1868)	9	0,02	3	a
Macustus grisescens (Zetterstedt, 1828)	4	0,01	3	h
Athysanus argentarius Metcalf, 1955	17	0,05	5	h
Conosanus obsoletus (Kirschbaum, 1858)	66	0,18	9	h
Euscelis incisus (Kirschbaum, 1858)	1139	3,11	81	h
Euscelis lineolatus Brulle, 1832 sensu Ribaut, 1952	694	1,89	42	h
Streptanus aemulans (Kirschbaum, 1868)	42	0,11	19	h
Streptanus sordidus (Zetterstedt, 1828)	431	1,18	51	h
Arocephalus punctum (Flor, 1861)	2	0,01	1	h
Psammotettix albomarginatus Wagner, 1941	1	0,00	1	h
Psammotettix cephalotes (Herrich-Schäffer, 1834)	49	0,13	6	h
Psammotettix confinis Dahlbom, 1850	2448	6,68	72	h
*Psammotettix helvolus (*Kirschbaum, 1868)	228	0,62	19	h
Adarrus multinotatus (Boheman, 1847)	2	0,01	2	h
Errastunus ocellaris (Fallén, 1806)	13	0,04	4	h
Turrutus socialis (Flor, 1861)	1565	4,27	54	h
Jassargus pseudocellaris (Flor, 1861)	1	0,00	1	h
Jassargus flori (Fieber, 1869)	6	0,02	2	h
Arthaldeus pascuellus (Fallén, 1826)	1517	4,14	63	h
Arthaldeus striifrons (Kirschbaum, 1868)	52	0,14	11	h

Legend: n = number of recorded individuals, D = Dominance (%), F = frequency (number of localities with records), H = habitat specification, a = arboricolous species, h = species at least partly using the herbaceous layer

Table 8: Auchenorrhyncha species recorded during the project outside analysed grassland sites.

Stiroma affinis FIEBER, 1866
Cercopis vulnerata ROSSI, 1807
Macropsis scotti EDWARDS, 1920
Oncopsis avellanae EDWARDS, 1920
Alebra albostriella (FALLEN, 1826)
Alebra wahlbergi (BOHEMAN, 1845)
Empoasca decipiens PAOLI, 1930
Eupteryx cyclops MATSUMURA, 1906
Eupteryx thoulessi EDWARDS, 1926
Edwardsiana diversa (EDWARDS, 1914)
Macrosteles sexnotatus (FALLEN, 1806)
Thamnotettix confinis (ZETTERSTEDT, 1828)
Jassargus pseudocellaris (FLOR, 1861)

Ribautodelphax pungens, also feeding monophagously on *Brachypodium pinnatum*, was recorded from two sites in the North Downs (TR229380 and TR236378). Both sites are unimproved; the first one belonging to *Festuca ovina* – *Avenula pratensis* grassland (CG2), the second one belonging to *Brachypodium pinnatum* grassland (CG4). On both sites only two individuals were sampled.

Ribautodelphax angulosa is a species feeding exclusively on *Anthoxanthum odoratum*. It was found only with five specimens on one site in the South Wessex Downs (ST809088). This unimproved downland site belongs to *Cynosurus cristatus* – *Centaurea nigra* grassland (MG5).

There is still uncertainty concerning the host plants of *Utecha trivia*, although it has been suggested that the species may feed polyphagously on different forbs. It was found on three sites in the South Wessex Downs (ST949242, ST955213, ST800047) and one site on the Isle of Wight (SZ481828). All sites are unimproved chalk grasslands belonging to *Festuca ovina* – *Avenula pratensis* grassland (CG2). Altogether 79 specimens were obtained from these four sites.

Agallia brachyptera feeds on a range of low growing forbs. The species was found on two unimproved chalk grassland sites in the Chilterns (TL098244, TL007209). The first site belongs to *Festuca ovina* – *Avenula pratensis* grassland (CG2). Here, four individuals of *A. brachyptera* were obtained. On the second site, which is classified as *Bromus erectus* grassland (CG3), 15 specimens were sampled.

Athysanus argentarius was recorded from two sites each of the Chilterns and North Downs and from one site on the South Downs. Densities on these sites were low, although the species can become occasionally abundant (pers. observations from Wytham Woods, Oxfordshire). *Athysanus argentarius* was only a sporadic species on CG grassland and did not occur on MG grassland at all. Altogether 17 specimens were sampled.

Psammotettix albomarginatus is a species usually found on sandy acidic dry grassland, where it may be confined to *Agrostis vinealis* (NICKEL 2003). The only record of a single specimen stems from a *Lolium* *perenne* ley (MG7) in the South Downs (TQ187082) and the species is almost certainly only a vagrant on this site.

Kelisia occirrega REMANE & GUGLIELMINO, 2002 and *Psammotettix helvolus* (KIRSCHBAUM, 1868), are additions to the British list of Auchenorrhyncha. Both species are rather common and widespread throughout all investigated regions suggesting that they are not new to the British fauna but have not been recognized so far due to difficulties in their identification.

Kelisia occirrega was originally regarded as a western European form of *Kelisia irregulata* Haupt, 1935 and has only recently been described as a distinct species (REMANE & GUGLIELMINO 2002). The main morphological difference between the two species lies within the structure of the female ectodermal genitalia. Whereas *K. irregulata* shows a distinct bifid sclerotisation in the base of the dorsal wall of the edeagal duct, a sclerotisation of that shape is missing within *K. occirrega* (Figure 4). Additionally, the subanal appendages in *K. occirrega* are longer than in *K. irregulata*, reaching caudal at least three quarters of the anal tube's length (REMANE & GUGLIELMINO 2002). Both taxa are closely related to *K. vittipennis* (J. SAHLBERG, 1868). According to HOLZINGER ET AL. (2003) they can be separated by the form of their aedeagi (Figures 5 and 6) and their pygophor. Whereas *K. vittipennis* lives monophagously on *Eriophorum spp*. in wet habitats, *K. occirrega* and *K. irregulata* seem to be confined to *Carex spp.* both in wet and dry habitats (REMANE & GUGLIELMINO 2002, NICKEL 2003). Subsequently, it is likely that previous records of *K. vittipennis* from dry calcareous grassland are actually referring to *K. occirrega*. Within the present study *K. occirrega* was altogether found on 34 sites, mostly unimproved chalk grassland.

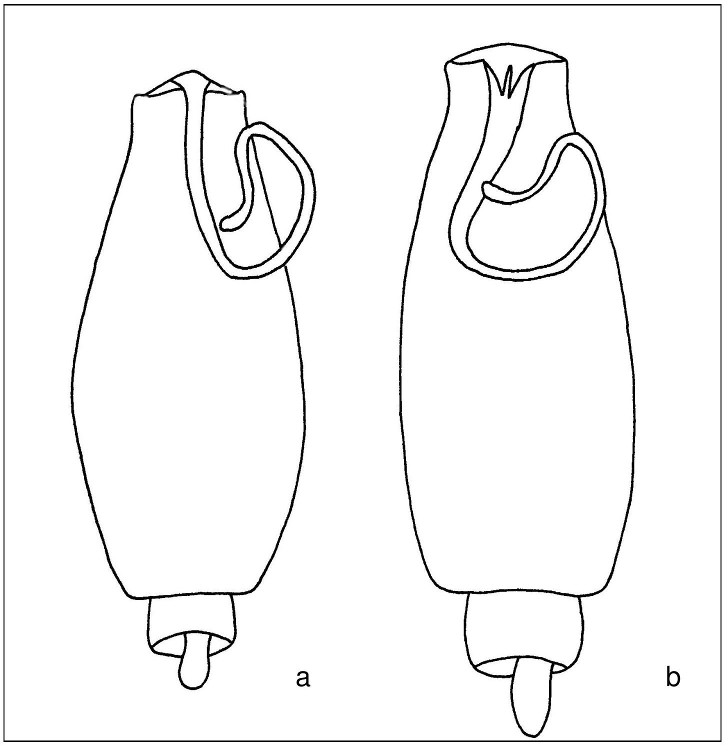


Figure 4: Dorsal view of edeagal ducti; a: *Kelisia occirrega*, b: *Kelisia irregulata* (simplified after REMANE & GUGLIELMINO 2002).

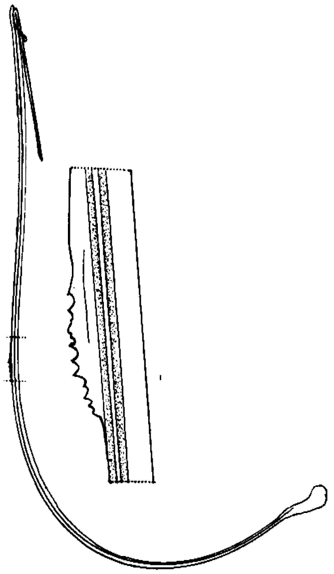


Figure 5: Aedeagus of *Kelisia vittipennis* (SAHLBERG, 1868)(drawing from OSSIANILSSON 1978).

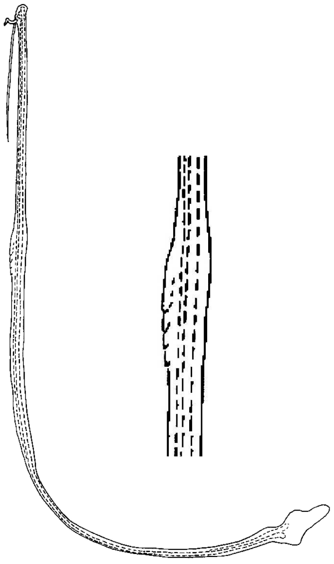


Figure 6: Aedeagus of *Kelisia irregulata* HAUPT, 1935 (drawing adapted from HOLZINGER ET AL. 2003).

Psammotettix helvolus is a species probably formerly confused with *P. cephalotes* or *P. confinis*. With *P. confinis* it shares the outer morphological appearance, which makes it impossible to distinguish between the females of these two taxa (see Remane 1987). On the other hand, the aedeagus of *P. helvolus* looks almost exactly like the aedeagus of *P. cephalotes*. However, these two species are comparably easy to distinguish by other morphological features. *P. cephalotes* is characterized by shorter completely hyaline and patternless wings just reaching the tip of the abdomen (submacropterous). The body is generally unicolourous greenish (recognizable even after a period of two to four years in alcohol) and the eyes are black. In contrast, *P. helvolus* has longer wings (macropterous) extending the tip of the abdomen, part of the cells bordered blackish forming an identical pattern as in *P. confinis*. Again the body is identically coloured as with *P. confinis*, notably the striped pattern of vertex and pronotum. The eyes of specimens preserved in alcohol are red.

On the continent two different form of *Psammotettix helvolus* have been recognized (Remane 1987). The specimens found during this study, most likely belong to a longwinged taxon named 'helvolus basic' occurring mainly in neutral to basic dry sites. A second taxon, provisionally called 'helvolus acidic', is brachypterous and inhabits acidic sites of higher altitudes (Remane 1987). Whereas *P. cephalotes* seems to be a K-strategist living monophagously on *Briza media* in lean and usually stable grassland systems, the longwinged form of *P. helvolus* seems to be more a r-strategist living oligophagously on grasses and readily colonising disturbed or newly created grassland on neutral or basic soils (Nickel 2003). *Psammotettix helvolus* has been found throughout the project on 19 sites.

Table 9: Auchenorrhyncha species classified in order of their indicator qualities for Great Britain.

chalk grassland species	dry grassland species	eurytopic species	nitrophilic species
Kelisia occirrega *Kelisia guttula* *Eurysanoides douglasi* *Ribautodelphax pungens* *Utecha trivia* *Batracomorphus irroratus* *Emelyanoviana mollicula* *Eupteryx notata* *Arboridia parvula* *Mocydia crocea* *Mocydiopsis attenuata* *Psammotettix cephalotes* *Adarrus multinotatus* *Turrutus socialis*	*Kelisia occirrega* *Eurysanoides douglasi* *Ribautodelphax pungens* *Utecha trivia* *Batracomorphus irroratus* *Emelyanoviana mollicula* *Mocydia crocea* *Mocydiopsis attenuata* *Psammotettix cephalotes* *Adarrus multinotatus* *Turrutus socialis* *Hyledelphax elegantula* *Ribautodelphax angulosa* *Kosswigianella exigua* *Neophilaenus exclamationis* *Anaceratagallia ribauti* *Anaceratagallia venosa* *Eupelix cuspidata* *Aphrodes bicincta* *Eupteryx origani* *Arboridia parvula* *Zygina hyperici* *Rhytistylus proceps* *Rhopalopyx adumbrata* *Arocephalus punctum* *Doratura stylata* *Jassargus pseudocellaris* *Dikraneura variata* *Psammotettix albomarginatus*	*Criomorphus albomarginatus* *Dicranotropis hamata* *Javesella dubia* *Javesella pellucida* *Philaenus spumarius* *Megophthalmus scanicus* *Aphrodes makarovi* *Anoscopus albomarginatus* *Anoscopus serratulae* *Eupteryx aurata* *Zyginidia scutellaris* *Macrosteles laevis* *Deltocephalus pulicaris* *Doratura stylata* *Elymana sulphurella* *Athysanus argentarius* *Euscelis incisus* *Stratums aemulans* *Psammotettix confinis* *Jassargus pseudocellaris* *Arthaldeus pascuellus*	*Javesella pellucida* *Aphrodes makarovi* *Anoscopus serratulae* *Eupteryx urticae* *Deltocephalus pulicaris* *Cicadula persimilis* *Euscelis incisus* *Euscelis lineolatus* *Psammotettix confinis* *Errastunus ocellaris*

On the basis of their known autecology from the literature (e.g. SCHIEMENZ 1969, COOK 1996, NICKEL & ACHTZIGER 1999, NICKEL 2003) most of the recorded Auchenorrhyncha species could be provisionally classified as typical chalk grassland, dry grassland, eurytopic or nitrophilic species. Due to geographical variation in habitat requirement the classification may in some cases only be valid for the southern half of Britain (Table 9). This process subsequently allows further analysis of the species composition on different grassland sites or site groups. Altogether 14 chalk grassland species, 29 dry grassland species, 21 eurytopic species and ten nitrophilic species were sampled during the project.

Table 10 gives an overview of the general statistics of the sampled Auchenorrhyncha species. The number of recorded species can vary significantly from just six species up to a maximum of 39 recorded species on the richest site. On average sites supported around 20 Auchenorrhyncha species. There were at least one nitrophilic or four eurytopic species recorded from every site. On the other hand, some sites lack typical dry grassland or chalk grassland species completely.

Table 10: Number of Auchenorrhyncha species and individuals per site.

no. per site	average*	maximum	minimum
no. of Auchenorrhyncha species	20	39	6
no. of specimens (excl. nymphs)	367	1600	27
no. of specimens (incl. nymphs)	1257	5584	110
no. of chalk grassland species	3	8	0
no. of dry grassland species	6	14	0
no. of eurytopic species	9	16	4
no. of nitrophilic species	5	8	1

* numbers rounded

3.2 The Auchenorrhyncha chalk grassland communities in comparison with the NVC vegetation communities

3.2.1 Comparison of calcareous grassland (CG) with mesotrophic grassland (MG)

The Auchenorrhyncha fauna of 81 sites, 52 belonging to CG grassland and 29 belonging to MG grassland, has been included in this comparison of the two major grassland groups occurring on chalk in southern England. The data of 19 additional arable reversion sites, almost exclusively belonging to the MG grassland, has been excluded from this comparison to avoid overlaying effects of colonization time lag caused by species not having colonized these sites yet. Additionally, arable reversion sites often do not fit easily into the NVC.

The result of the comparison is shown in table 11. On CG grassland, 89 species were recorded in comparison to only 76 species on MG grassland. There are no highly frequent species, which do not show a significant preference for one of the two groups. Of the eight species occurring in both groups with frequency class IV or V, three - *Zyginidia scutellaris*, *Anoscopus albifrons* and *Kosswigianella exigua* - appear in significantly higher abundance on the CG grassland. These species are, therefore, regarded as preferential species of this grassland type in comparison with the mesotrophic grassland. On the other hand, *Deltocephalus pulicaris*, *Euscelis incisus*, *Javesella pellucida*, *Arthaldeus pascuellus* and *Psammotettix confinis* are preferential species of MG grassland despite showing a high frequency on CG grassland as well. Of the 29 species characteristic for CG grassland, only three are also frequently occurring on MG grassland, whereas out of the only 12 preferential species on the MG grassland, five are equally constant on CG grassland. On CG grassland only *Zyginidia scutellaris* reaches on average the status of a dominant species. Subdominant species are *Anoscopus albifrons*, *Turrutus socialis*, *Kosswigianella exigua*, *Hyledelphax elegantula*, *Mocydia crocea*, *Neophilaenus exclamationis*, *Arboridia parvula* and *Deltocephalus pulicaris*. With the exception of *A. albifrons*, which reaches as a maximum only dominance class 5, all of these species become eudominant on single sites. Other species that can become eudominant on single CG grassland sites are *Eupelix cuspidata*, *Batracomorphus irroratus* and *Psammotettix confinis*. *Stenocranus minutus*, *Neophilaenus lineatus*, *Megophthalmus scabripennis*, *Euscelis incisus*, *Euscelis lineolatus*, *Anoscopus serratulae*, *Anaceratagallia ribauti*, *Macrosteles laevis* and *Emelyanoviana mollicula* reach the status of a dominant species on some sites.

On MG grassland *Deltocephalus pulicaris* is, on average, an eudominant species. None of the other species in this grassland group is, on average, dominant. Subdominant species are *Euscelis incisus*, *Javesella pellucida*, *Arthaldeus pascuellus*, *Psammotettix confinis*, *Arboridia parvula* and *Anaceratagallia ribauti*. However, *Euscelis incisus*, *Arthaldeus pascuellus*, *Arboridia parvula* and *Anaceratagallia ribauti* can become eudominant on some sites. Another species, although on average occurring in lower numbers, which can become occasionally eudominant is *Euscelis lineolatus*. On single sites *Javesella pellucida*, *Psammotettix confinis*, *Anoscopus serratulae*, *Streptanus sordidus*, *Macrosteles viridigriseus* and *Javesella dubia* reach the status of a dominant species.

Utecha trivia and *Psammotettix cephalotes* fulfil the criteria for differential species of the CG grassland. Although not found in sufficient numbers to be classified as preferential species, *Eurysanoides douglasi* and *Ribautodelphax pungens* can be listed as differential species as well, because of the unlikely appearance of their host plant *Brachypodium pinnatum* in mesotrophic grassland. *Adarrus multinotatus* should be regarded as a differential species for CG grassland for the same reason. A single specimen, found within the study on one MG grassland site, refers almost certainly to a vagrant. There are no distinct differential species on the MG grassland.

The group of general associates comprises 53 species. 19 of them have been found exclusively on CG grassland sites, seven only on mesotrophic grassland sites.

Of the six notable species found within the project, four (*Agallia brachyptera*, *Utecha trivia*, *Eurysanoides douglasi*, *Ribautodelphax pungens*) were observed only on CG grassland. With the exception of *Agallia brachyptera*, which could not be found in a sufficient frequency or abundance for analysis, all of them can be classified as differential species in comparison with mesotrophic grassland on chalk. *Psammotettix albomarginatus* and *Ribautodelphax angulosa*, both ‘notable B’ species, were found exclusively on single sites belonging to MG grassland.

Table 11: Comparison of CG and MG grassland.

	CG			**MG**		
	frequency	dominance		frequency	dominance	
	n = 52	average	maximum	n = 29	average	maximum
preferential species of CG						
Zyginidia scutellaris	V	5**	6	V	4	6
Anoscopus albifrons	V	4**	5	IV	2	4
Turrutus socialis	V	4**	6	II	1	3
Aphrodes makarovi	V	3	4	III	3	5
Kosswigianella exigua	IV	4*	6	IV	2	4
Hyledelphax elegantula	IV	4*	6	III	3	6
Eupteryx notata	IV	4**	6	III	2	4
Stenocranus minutus	IV	3	5	III	2	4
Neophilaenus lineatus	IV	3*	5	III	1	4
Philaenus spumarius	IV	3	4	III	2	4
Megophthalmus scanicus	IV	3	5	III	2	5
Mocydia crocea	IV	4**	6	II	2	5
Kelisia occirrega	IV	3**	5	II	1	4
Eupelix cuspidata	IV	3**	6	II	1	3
Neophilaenus exclamationis	III	4*	6	II	1	3
Recilia coronifer	III	2	4	II	3	5
Mocydiopsis attenuata	III	2	4	II	2	4
Criomorphus albomarginatus	III	2	4	II	1	4
Aphrodes bicincta	III	2*	4	II	1	2
Kelisia guttula	III	2**	4	I	1	3
Megophthalmus scabripennis	III	2*	5	I	1	3
Batracomorphus irroratus	II	3*	6	I	1	2
Psammotettix cephalotes	II	2*	4			
Delphacinus mesomelas	II	2*	3	I	1	4
Dikraneura variata	II	2	4	I	1	1
Agallia consobrina	II	1	4	I	1	1
Anaceratagallia venosa	II	1*	3	I	1	1
Utecha trivia	I	2	5			
Eurysanoides douglasi	I	1	4			
Ribautodelphax pungens	I	1	2			
preferential species of MG						
Deltocephalus pulicaris	IV	4	6	V	6**	6
Euscelis incisus	IV	3	5	V	4	6
Javesella pellucida	V	2	4	V	4**	5
Arthaldeus pascuellus	IV	2	4	V	4*	6
Psammotettix confinis	IV	3	6	V	4**	5
Euscelis lineolatus	II	2	5	IV	3**	6
Anoscopus serratulae	III	3	5	IV	3*	5
Streptanus sordidus	III	2	4	IV	3*	5
Macrosteles viridigriseus	II	1	4	III	3	5
Psammotettix helvolus	I	1	3	II	3*	5
Muellerianella fairmairei	I	1	4	II	2	5
Xanthodelphax straminea	I	1	3	II	2	4
Conosanus obsoletus	I	1	3	II	2*	4
associates						
Arboridia parvula	III	4	6	III	4	6
Anaceratagallia ribauti	III	3	5	III	4	6
Javesella dubia	III	2	4	III	3	5
Macrosteles laevis	II	2	5	II	2	4
Emelyanoviana mollicula	II	2	5	II	1	3
Doratura stylata	II	2	4	II	1	3

	CG			**MG**		
	frequency	dominance		frequency	dominance	
	n = 52	average	maximum	n = 29	average	maximum
Rhytistylus proceps	II	2	4	II	1	3
Arthaldeus striifrons	II	1	4	I	1	2
Streptanus aemulans	II	1	3	II	2	4
Dicranotropis hamata	II	1	3	II	1	4
Anoscopus flavostriatus	II	1	3	II	1	3
Aphrophora alni	II	1	2	II	1	2
Rhopalopyx adumbrata	II	1	3	I	1	3
Elymana sulphurella	I	1	3	II	1	2
Eupteryx origani	I	1	3	I	1	4
Eupteryx urticae	I	1	2	II	1	3
Eupteryx vittata	I	1	3	I	1	2
Thamnotettix dilutior	I	1	3	I	1	2
Centrotus cornutus	I	1	2	I	1	2
Eurysa lineata	I	1	2	I	1	1
Evacanthus interruptus	I	1	2	I	1	1
Graphocraerus ventralis	I	1	2	I	1	1
Cicadula persimilis	I	1	2	I	1	1
Adarrus multinotatus	I	1	2	I	1	1
Eupteryx aurata	I	1	1	I	1	2
Eupteryx stachydearum	I	1	1	I	1	1
Allygus mixtus	I	1	1	I	1	1
Agallia brachyptera	I	1	3			
Evacanthus acuminatus	I	1	3			
Jassargus flori	I	1	3			
Tachycixius pilosus	I	1	2			
Planaphrodes bifasciata	I	1	2			
Cicadella viridis	I	1	2			
Notus flavipennis	I	1	2			
Fagocyba cruenta	I	1	2			
Alnetoidea alneti	I	1	2			
Balclutha punctata	I	1	2			
Speudotettix subfusculus	I	1	2			
Athysanus argentarius	I	1	2			
Macustus grisescens	I	1	2			
Arocephalus punctum	I	1	2			
Jassargus pseudocellaris	I	1	2			
Forcipata citrinella	I	1	1			
Edwardsiana crataegi	I	1	1			
Zygina flammigera	I	1	1			
Allygus modestus	I	1	1			
Macropsis fuscula				I	1	3
Megamelodes quadrimaculatus				I	1	2
Ribautodelphax angulosa				I	1	2
Psammotettix albomarginatus				I	1	2
Errastunus ocellaris				I	1	2
Ribautiana tenerrima				I	1	1
Zygina hyperici				I	1	1
no. specimens (excl. larvae) per site		332	741		412,7	886
no. specimens (incl. larvae) per site		1274	2978		1264	2640
no. species per site		22.2*	39		18.1	36
no. chalk grassland species per site		4.3**	8		1.7	6
no. dry grassland species per site		7.7**	14		3.9	12
no. eurytopic species per site		9	16		9.6	14
no. nitrophilic species per site		4.1	7		5.7**	7

Significant difference in average abundance tested with Mann-Whitney U; * = $P \leq 0.05$, ** = $P \leq 0.001$

The maximum number of species found on single CG grassland sites is, at 39 species, not much higher than the maximum of 36 species found on single MG grassland sites. However, the average number of 22 species on chalk grassland shows a significantly higher species richness compared with the mesotrophic grassland, which is, on average, inhabited only by 18 species. The average number of typical chalk grassland species is highly significant different between the two grassland groups with more than four on CG grassland compared with only two on MG grassland. The same applies for dry grassland species. With on average 7.7 species on each CG grassland site, the number of typical dry grassland leafhoppers is here nearly double as high as the number occurring on MG grassland, where on average only 3.9 typical dry grassland Auchenorrhyncha occur. On the other hand, the number of nitrophilic species is significantly higher on MG grassland (on average 5.7 species) compared with only 4.1 species on CG grassland. However, the maximum number of seven nitrophilic species on a single site was found on sites belonging to both grassland types.

3.2.2 Comparison of *Festuca ovina-Avenula pratensis* grassland (CG2) with the combined samples of rank chalk grassland communities (CG3, CG4 and CG5)

The main differences between these two grassland groups are shorter swards, lower amount of dead plant material and a higher rate of disturbance with the occurrence of bare patches on the CG2 grassland in comparison with the ranker grassland of the CG3, CG4 and CG5. The main cause for these differences is the generally more intensive grazing on the CG2 grassland.

Due to the low number of available samples from ranker, unmanaged or only extensively managed chalk grassland sites, the three NVC code communities CG3 (*Bromus erectus* grassland), CG4 (*Brachypodium pinnatum* grassland) and CG5 (*Bromus erectus*-*Brachypodium pinnatum* grassland) have been combined to avoid working with unbalanced data and allowing a statistical comparison with the usually grazed and more intensively managed CG2 grassland. The three combined communities all show a similar plant species composition and structural appearance. Their basic difference is restricted to the abundance and combination of the two grasses *Brachypodium pinnatum* and *Bromopsis erecta*. This grassland group will always be referred to as CG3-5 grassland in the following text.

During this study, a total of 89 Auchenorrhyncha species were recorded from the grassland types compared here (Table 12). On the CG2 grassland, 82 species were found compared with only 66 species on the rank CG3-5 grassland. However, this difference in species richness is probably caused by the lower number of sampled sites within the CG3 to CG5 grasslands. It is noteworthy that despite no significant differences in species number or the number of species from the different ecological groups, the average abundance of leafhoppers is significantly higher on the ranker chalk grassland communities.

Ten species occur in high frequency and abundance within both grassland types and comprise the group of constant species. Among these, only *Zyginidia scutellaris* is, on average, dominant in both grassland groups, becoming eudominant in some sites. On the CG3-5 grassland *Turrutus socialis* is the only other species on average dominant. Although on average not as abundant as the former species, *Deltocephalus pulicaris* and *Kosswigianella exigua* reach the status of eudominance on some sites of both grassland groups. Other species becoming eudominant on single CG2 grassland sites are *Eupteryx notata*, *Hyledelphax elegantula*, *Psammotettix confinis*, *Neophilaenus exclamationis*, *Mocydia crocea* and *Arboridia parvula*. On the *Brachypodium* and *Bromus* dominated grassland (CG3-5) these species are *Eupelix cuspidata*, *Arboridia parvula* and *Batracomorphus irroratus.* This last species shows a very patchy and clustered distribution resulting in a low frequency class of only II. Nevertheless, it usually occurs in high numbers on the sites.

The nine preferential species of the CG2 grassland, particularly *Kosswigianella exigua* and *Neophilaenus exclamationis*, are mostly species known to prefer short swards. *Neophilaenus exclamationis* shows a relatively low frequency (class III), but still is on average a subdominant species. This again indicates a patchy or clustered appearance of the species combined with high densities as soon as suitable habitat requirements are met. Especially noteworthy is the appearance of *Megophthalmus scabripennis* as a preferential species of this grassland group, since not much is known about its ecology. Interestingly, *Euscelis incisus*, *Arthaldeus pascuellus*, *Psammotettix confinis*, preferential species of the MG grassland in comparison with CG grassland, are here now preferential species of the CG2 grassland in comparison with the CG3-5 grassland.

Delphacinus mesomelas and *Utecha trivia* can be classified as CG2 differential species in comparison with the CG3-5 grassland.

Although showing a lower overall number of recorded species, the number of preferential species is at 13 notably higher on the CG3-5 grassland. This group comprises firstly species known to prefer tall grass stands like *Neophilaenus lineatus*, *Mocydia crocea*, *Stenocranus minutus* and *Criomorphus albomarginatus*. It is noteworthy, that *Kelisia occirrega*, although presumably living in Britain mainly on the short growing *Carex flacca*, which appears in higher abundances on the CG2 grassland, is a valuable preferential species of the ranker chalk grassland communities. *Kelisia occirrega* is one of the constant species of the CG3-5 grassland, which show here a significantly higher abundance compared with the CG2 grassland. The only differential species of the CG3-5 grassland is *Eurysanoides douglasi*, indicating that its occurrence may be restricted to dense undisturbed growing patches of the presumed host plant *Brachypodium pinnatum*.

Table 12: Comparison of CG2 and the combined samples of CG3, CG4 and CG5 grassland.

	CG2			**CG3-5**		
	frequency	dominance		frequency	dominance	
	n = 37	average	maximum	n = 15	average	maximum
constant species						
Zyginidia scutellaris	V	5	6	V	5	6
Anoscopus albifrons	V	4	5	V	4	5
Turrutus socialis	V	4	5	V	5	6
Aphrodes makarovi	V	3	4	V	3	4
Javesella pellucida	V	2	4	V	3	4
Eupteryx notata	V	4	6	IV	3	5
Deltocephalus pulicaris	V	4	6	IV	4	6
Eupelix cuspidata	IV	3	5	V	4	6
Hyledelphax elegantula	IV	4	6	IV	3	5
Megophthalmus scanicus	IV	3	5	IV	2	3
preferential species of CG2						
Kosswigianella exigua	V	4*	6	III	4	6
Euscelis incisus	V	4*	5	III	3	5
Psammotettix confinis	IV	3	6	III	2	4
Arthaldeus pascuellus	IV	3	4	III	2	4
Neophilaenus exclamationis	III	4*	6	II	2	5
Megophthalmus scabripennis	III	3	5	II	1	3
Javesella dubia	III	2	4	II	2	4
Delphacinus mesomelas	III	2*	3			
Utecha trivia	II	2	5			
Psammotettix cephalotes	II	2	4	I	1	1
preferential species of CG3-5						
Neophilaenus lineatus	IV	3	5	V	3*	4
Mocydia crocea	III	3	6	V	4**	5
Kelisia occirrega	III	3	5	V	4*	5
Stenocranus minutus	III	3	5	V	3*	5
Anaceratagallia ribauti	III	3	5	IV	3*	4
Philaenus spumarius	III	2	4	IV	3	4
Aphrodes bicincta	III	2	4	IV	2	3
Mocydiopsis attenuata	II	2	4	IV	2	4
Criomorphus albomarginatus	II	1	4	IV	2*	4
Rhytistylus proceps	II	1	4	III	3*	4
Recilia coronifer	II	2	4	III	2	4
Arthaldeus striifrons	II	1	3	III	2	4
Eurysanoides douglasi				II	2*	4
associates						
Anoscopus serratulae	III	3	5	IV	2	4
Arboridia parvula	III	3	6	III	4	6
Kelisia guttula	III	2	4	III	2	4
Streptanus sordidus	III	2	4	III	2	3
Batracomorphus irroratus	II	2	5	II	3	6
Euscelis lineolatus	II	2	5	II	2	4
Emelyanoviana mollicula	II	2	5	II	1	2
Macrosteles laevis	II	2	5	II	1	2
Dikraneura variata	II	2	4	II	1	3
Doratura stylata	II	2	4	II	1	3
Agallia consobrina	II	1	4	II	1	3
Anoscopus flavostriatus	II	1	3	II	1	2
Rhopalopyx adumbrata	II	1	3	II	1	2

	CG2			CG3-5		
	frequency	dominance		frequency	dominance	
	n = 37	average	maximum	n = 15	average	maximum
Streptanus aemulans	II	1	3	II	1	2
Psammotettix helvolus	II	1	3	I	1	2
Dicranotropis hamata	II	1	2	II	1	3
Macrosteles viridigriseus	II	1	4	I	1	2
Eupteryx origani	II	1	3	I	1	2
Anaceratagallia venosa	II	1	3	I	1	1
Aphrophora alni	II	1	2	I	1	1
Xanthodelphax straminea	I	1	3	II	1	3
Athysanus argentarius	I	1	2	II	1	2
Agallia brachyptera	I	1	3	I	1	3
Evacanthus acuminatus	I	1	3	I	1	2
Thamnotettix dilutior	I	1	2	I	1	3
Tachycixius pilosus	I	1	2	I	1	2
Ribautodelphax pungens	I	1	2	I	1	2
Macustus grisescens	I	1	2	I	1	1
Centrotus cornutus	I	1	1	I	1	2
Muellerianella fairmairei	II	1	4			
Eupteryx vittata	II	1	3			
Elymana sulphurella	II	1	3			
Conosanus obsoletus	I	1	3			
Jassargus flori	I	1	3			
Eurysa lineata	I	1	2			
Evacanthus interruptus	I	1	2			
Cicadella viridis	I	1	2			
Alnetoidea alneti	I	1	2			
Balclutha punctata	I	1	2			
Graphocraerus ventralis	I	1	2			
Adarrus multinotatus	I	1	2			
Arocephalus punctum	I	1	2			
Jassargus pseudocellaris	I	1	2			
Forcipata citrinella	I	1	1			
Eupteryx aurata	I	1	1			
Eupteryx stachydearum	I	1	1			
Edwardsiana crataegi	I	1	1			
Zygina flammigera	I	1	1			
Allygus mixtus	I	1	1			
Allygus modestus	I	1	1			
Planaphrodes bifasciata				II	1	2
Fagocyba cruenta				II	1	2
Notus flavipennis				I	1	2
Eupteryx urticae				I	1	2
Cicadula persimilis				I	1	2
Speudotettix subfusculus				I	1	2
no. specimens (excl. larvae) per site		309	741		387.8*	620
no. specimens (incl. larvae) per site		1341.1	2978		1106.7	2823
no. species per site		21.6	39		23.7	31
no. chalk grassland species per site		3.9	8		5.3	8
no. dry grassland species per site		7.3	14		8.7	12
no. eurytopic species per site		8.9	16		9	14
no. nitrophilic species per site		4.1	7		4	7

Significant difference in average abundance tested with Mann-Whitney U; * = P ≤ 0.05, ** = P ≤ 0.001

3.2.3 Comparison of three sub-communities of the *Festuca ovina-Avenula pratensis* grassland (CG2): *Cirsium acaule-Asperula cynanchica* sub-community (CG2a), *Succisa pratensis-Leucanthemum vulgare* sub-community (CG2b) and *Holcus lanatus-Trifolium repens* sub-community (CG2c)

The differences in vegetation composition and structure on the level of sub-communities are naturally not as prominent as those at the community level. In summary, the CG2b sub-community differs from the classical downland CG2a sub-community in slightly more nutrient rich conditions, with a generally higher plant species richness. The frequent occurrence of *Succisa pratensis* indicates this sub-community may not be as intensively or frequently effected by droughts as the CG2a grassland. CG2c grassland occurs in relative nutrient rich conditions, with plants typical for mesotrophic grassland communities like *Holcus lanatus* or *Trifolium repens* becoming more dominant. In fact CG2c grassland intermediates between the classical chalk grassland as described in the CG2a sub-community and the MG5 grassland community (RODWELL 1998).

Although the botanical differences are rather subtle, they are still reflected in differences of the Auchenorrhyncha communities as shown in table 13. Altogether 81 species were found on the CG2 grassland; 75 of them recorded from the CG2a sub-community, 48 from the CG2b sub-community and 63 from the CG2c sub-community. Although the relatively low species richness on CG2b grassland can probably be related to the lower number of samples taken from this type of chalk grassland, the high number of species on CG2a grassland in comparison with CG2c is still notable. In this aspect CG2c shows its closeness to the comparably species poor mesotrophic grassland of improved sites.

The number of typical chalk grassland Auchenorrhyncha species is significantly higher on the CG2a and CG2b grassland compared with the CG2c sites (Table 13). The number of dry grassland species is also significantly higher on CG2a and CG2b. For this ecological guild the difference between CG2b and CG2c is highly significant. There are no significant differences in the overall species number, the abundance of leafhoppers and the number of eurytopic or nitrophilic species between the three compared groups. However, it is notable that the average number of eurytopic and nitrophilic species is highest within the nutrient richer CG2c sub-community.

While total of 15 leafhopper species can be classified as constants occurring in a high frequency class in at least two of the three sub-communities, there are preferences of some species visible within this group. *Turrutus socialis* and *Eupelix cuspidata* seem to avoid CG2c grassland. On the other hand, *Deltocephalus pulicaris* and *Psammotettix confinis* have their main occurrence on the CG2c sub-community within the CG2 grassland.

Altogether eight species can be classified as preferential species of CG2a grassland. Notably *Kelisia occirrega* and *Arboridia parvula* seem to have the greatest affinities towards this sub-community. Four species, *Aphrodes bicincta*, *Kelisia guttula*, *Neophilaenus exclamationis* and *Batracomorphus irroratus* are most frequent and abundant on the CG2b grassland. *Anoscopus serratulae* and *Streptanus sordidus*, both preferential species of the MG grassland in comparison with CG grassland, generally have their main distribution within the CG2 grassland on the richest sub-community (CG2c). Other species with a preference for this sub-community and being classified as preferential species are *Javesella dubia*, *Delphacinus mesomelas*, *Criomorphus albomarginatus* and *Macrosteles viridigriseus*.

Furthermore, the absence of characteristic chalk grassland species like *Batracomorphus irroratus* and *Utecha trivia* from the CG2c sub-community is noteworthy.

On the level of sub-communities within the CG2 grassland no differential species could be identified.

Table 13: Comparison of the CG2a, CG2b and CG2c sub-communities.

	CG2a			**CG2b**			**CG2c**		
	frequency	dominance		frequency	dominance		frequency	dominance	
	n = 14	average	maxim.	n = 7	average	maxim.	n = 16	average	maxim.
constant species									
Anoscopus albifrons	V	4	5	V	3	4	V	3	5
Zyginidia scutellaris	V	5	6	V	5	6	V	5	6
Javesella pellucida	V	2	3	V	2	3	IV	2	4
Kosswigianella exigua	V	4^{a}	6	V	5^{b}	5	IV	4^{a}	5
Turrutus socialis	V	4^{ab}	5	V	5^{a}	5	IV	3^{b}	4
Aphrodes makarovi	V	3	4	V	2	3	III	3	4
Eupelix cuspidata	V	3^{a}	4	V	4^{a}	5	II	2^{b}	4
Euscelis incisus	V	3^{a}	4	IV	4^{ab}	5	V	4^{b}	5
Hyledelphax elegantula	V	4	5	IV	4	5	IV	4	6
Deltocephalus pulicaris	IV	3^{a}	4	V	3^{ab}	4	V	5^{b}	6
Eupteryx notata	IV	4	6	V	4	6	IV	4	6
Megophthalmus scanicus	IV	2	3	IV	2	3	IV	3	5
Arthaldeus pascuellus	IV	2	4	III	2	3	IV	3	4
Neophilaenus lineatus	III	3	5	V	2	3	IV	3	4
Psammotettix confinis	III	3	4	V	2	3	IV	4	6
preferential species of CG2a									
Kelisia occirrega	V	3^{a}	5	IV	3^{ab}	4	II	2^{b}	4
Arboridia parvula	IV	4^{a}	6	III	3^{b}	5	II	3^{ab}	5
Philaenus spumarius	IV	3	4	II	1	3	III	3	4
Mocydia crocea	IV	4	6	II	3	4	III	2	4
Mocydiopsis attenuata	III	2	4	II	1	3	II	2	4
Dikraneura variata	III	2	4	II	2	3	I	2	4
Psammotettix cephalotes	III	2^{a}	4		^{b}			^{ab}	
Aphrophora alni	III	1^{a}	2		^{b}		I	1^{b}	2
preferential species of CG2b									
Aphrodes bicincta	III	1^{a}	3	V	3^{b}	4	III	1^{ab}	3
Kelisia guttula	III	1^{ab}	3	V	2^{a}	4	II	1^{b}	3
Neophilaenus exclamationis	II	4^{a}	5	V	4^{b}	5	III	4^{ab}	6
Batracomorphus irroratus	II	3^{a}	5	IV	1^{a}	3		^{b}	
preferential species of CG2c									
Anoscopus serratulae	III	3	5	II	2	3	IV	3	4
Javesella dubia	II	1^{ab}	3	II	1^{a}	2	IV	2^{b}	4
Streptanus sordidus	II	2^{a}	4	II	1^{a}	2	IV	2^{b}	4
Delphacinus mesomelas	II	1	3	II	1	3	III	2	3
Criomorphus albomarginatus	II	2	4				III	2	4
Macrosteles viridigriseus	I	1	2	II	1	1	III	2	4
associates									
Stenocranus minutus	III	3	4	III	2	3	III	3	5
Megophthalmus scabripennis	III	3	5	III	3	4	II	2	4
Anaceratagallia venosa	III	2	3	III	1	2	II	1	3
Recilia coronifer	III	2	4	III	1	3	II	1	2
Anaceratagallia ribauti	III	3	5	II	2	4	III	3	5

	CG2a			CG2b			CG2c		
	frequency	dominance		frequency	dominance		frequency	dominance	
	n = 14	average	maxim.	n = 7	average	maxim.	n = 16	average	maxim.
Agallia consobrina	II	1	2	II	1	1	II	1	4
Macrosteles laevis	II	1	2	II	3	5	II	1	3
Doratura stylata	II	2	4	II	2	4	II	1	3
Rhytistylus proceps	II	2	4	II	1	2	I	1	2
Rhopalopyx adumbrata	II	1	3	II	1	2	I	1	2
Arthaldeus striifrons	II	1	2	II	1	1	I	1	3
Utecha trivia	II	3^{ab}	5	II	2^{a}	3		^{b}	
Evacanthus interruptus	II	1	2	II	1	2			
Anoscopus flavostriatus	II	1	3				II	2	3
Emelyanoviana mollicula	II	2	5				II	1	3
Eupteryx vittata	II	1	3				II	1	3
Elymana sulphurella	II	1	3				II	1	2
Streptanus aemulans	II	1	3				II	1	3
Eupteryx origani	II	2	3				I	1	3
Alnetoidea alneti	II	1	2						
Jassargus flori	II	1	3						
Dicranotropis hamata	I	1	2	II	1	2	II	1	2
Muellerianella fairmairei	I	1	3	II	2	4	II	1	3
Xanthodelphax straminea	I	1	3	II	1	2	I	1	2
Conosanus obsoletus	I	1	3	II	1	1			
Euscelis lineolatus	I	1	2				II	3	5
Psammotettix helvolus	I	1	1				II	1	3
Eupteryx aurata	I	1	1				I	1	1
Zygina flammigera	I	1	1				I	1	1
Balclutha punctata	I	1	2				I	1	1
Macustus grisescens	I	1	1				I	1	2
Eurysa lineata	I	1	2						
Centrotus cornutus	I	1	1						
Evacanthus acuminatus	I	1	3						
Cicadella viridis	I	1	2						
Eupteryx stachydearum	I	1	1						
Edwardsiana crataegi	I	1	1						
Graphocraerus ventralis	I	1	2						
Thamnotettix dilutior	I	1	2						
Adarrus multinotatus	I	1	2						
Arocephalus punctum	I	1	2						
Jassargus pseudocellaris	I	1	2						
Ribautodelphax pungens				II	1	2			
Tachycixius pilosus							I	1	2
Agallia brachyptera							I	1	3
Forcipata citrinella							I	1	1
Allygus mixtus							I	1	1
Allygus modestus							I	1	1
Athysanus argentarius							I	1	2
no. specimens (excl. larvae) per site		313.5	478		376	741		275.8	516
no. specimens (incl. larvae) per site		1154.1	2677		1703	2703		1346.4	2978
no. species per site		23.8	39		21.7	29		19.6	38
no. chalk grassland species per site		5.1^{a}	8		5.1^{a}	7		2.4^{b}	6
no. dry grassland species per site		9.4^{a}	14		8.9^{a}	12		4.9^{b}	8
no. eurytopic species per site		8.9	14		8	11		9.5	16
no. nitrophilic species per site		3.9	6		4	5		4.4	7

Significant difference in average abundance tested with Mann-Whitney U; $P \leq 0.05$, values with the same letter or without letters are not significantly different

3.2.4 Comparison of *Arrhenatherum elatioris* grassland (MG1) with the *Cynosurus cristatus-Centaurea nigra* grassland (MG5)

In comparison with the MG5 grassland, MG1 grassland is generally characterized by taller swards. It tends to be on average more extensively grazed and more often mown. On the other hand, MG5 grassland includes the floristically most diverse sites within the MG grassland group on calcareous soils, often with a high importance for species conservation.

With 58 species, compared to only 42 species on the MG5 grassland, the MG1 grassland shows a much more diverse Auchenorrhyncha community, although the average species richness is still not significantly higher than the one on the MG5 grassland (Table 14). Indeed, there are an average of five typical chalk grassland species and 9.4 typical dry grassland species on MG1, which is significantly higher than on the MG5 (2.2 typical chalk grassland species and 3.8 dry grassland species).

Only six of the 68 species found altogether within the two communities can be regarded as constant species for both grasslands. Again *Zyginidia scutellaris* is very abundant in both groups, being on average a dominant species on the MG1 grassland and a subdominant species on the MG5 grassland. On certain sites *Z. scutellaris* can become eudominant within both communities. With the exception of *Javesella pellucida*, which is on average a subdominant species on MG5 grassland, none of the other constant species reaches on average a higher status than that of a recedent species.

The total of 23 species classified as preferential species of the MG1 grassland is substantially higher than the 11 preferential species of the MG5 grassland. Among the most dominant preferential species of the MG1 community are typical chalk grassland species like *Arboridia parvula*, *Mocydia crocea*, *Mocydiopsis attenuata* and *Kelisia occirrega* as well as species preferring tall vegetation like *Hyledelphax elegantula*, *Stenocranus minutus* and *Criomorphus albomarginatus.*

Mocydia crocea, *Kelisia occirrega*, *Recilia coronifer*, *Criomorphus albomarginatus* and *Elymana sulphurella* have the status of differential species of MG1.

The preferential species of the MG5 community are mainly species preferring lower vegetation, notably *Euscelis incisus*, *Deltocephalus pulicaris* and *Psammotettix confinis*. Another characteristic feature of the MG5 grassland is the appearance of nitrophilic species among the group of preferential species, such as *Psammotettix confinis*, *Deltocephalus pulicaris* and *Euscelis lineolatus*. The only typical chalk grassland species within this group are *Eupteryx notata* and *Turrutus socialis*. Notably, two of the preferential species *Macrosteles laevis* and *Macrosteles viridigriseus* are indicators for disturbances such as trampling. Their absence from the MG1 grassland may indicate their suitability as differential species for MG5 grassland in comparison with MG1 grassland.

It should be mentioned that a number of typical chalk grassland species occurs on only one of the two compared grasslands. Whereas *Batracomorphus irroratus* was only found on MG1 grassland *Neophilaenus exclamationis* and *Psammotettix cephalotes* were only recorded from the MG5 grassland. The rare species *Ribautodelphax angulosa* and *Megamelodes quadrimaculatus* were only found on MG5 grassland.

Table 14: Comparison of MG1 and MG5 grassland.

	MG1			MG5		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 6	average	maximum
constant species						
Zyginidia scutellaris	V	5	6	V	4	6
Javesella pellucida	V	3	4	V	4	4
Anoscopus albifrons	V	2	3	V	3	4
Arthaldeus pascuellus	V	3	4	IV	3	4
Kosswigianella exigua	IV	3	4	IV	3	4
Aphrodes makarovi	IV	3	4	IV	3	5
preferential species of MG1						
Arboridia parvula	V	5*	6	III	1	2
Hyledelphax elegantula	V	4	5	III	4	6
Megophthalmus scanicus	V	4	5	III	2	3
Anoscopus serratulae	V	4	5	III	2	3
Anaceratagallia ribauti	V	4	4	III	4	6
Mocydia crocea	V	4*	5			
Stenocranus minutus	V	3*	4	II	1	2
Mocydiopsis attenuata	V	3*	4	II	1	2
Kelisia occirrega	V	3*	4			
Recilia coronifer	IV	4*	5			
Criomorphus albomarginatus	IV	3*	4			
Eupelix cuspidata	IV	2	3	II	1	1
Aphrodes bicincta	IV	1	2	III	1	2
Aphrophora alni	IV	1	2	II	1	1
Elymana sulphurella	IV	1*	2			
Eupteryx origani	III	3	4			
Dicranotropis hamata	III	2	3	II	1	3
Neophilaenus lineatus	III	2	4	II	1	2
Anoscopus flavostriatus	III	2	3	II	1	1
Centrotus cornutus	III	1	2			
Emelyanoviana mollicula	III	1	3			
Kelisia guttula	II	2	3			
Macropsis fuscula	II	2	3			
preferential species of MG5						
Euscelis incisus	V	3	4	V	5*	5
Deltocephalus pulicaris	IV	3	5	V	5*	6
Psammotettix confinis	IV	2	3	V	4*	4
Eupteryx notata	III	1	2	V	3	4
Euscelis lineolatus	II	1	1	V	3*	5
Javesella dubia	II	1	1	IV	3	4
Turrutus socialis	II	1	2	IV	2	3
Macrosteles laevis				III	2	4
Macrosteles viridigriseus				III	2	3
Conosanus obsoletus				III	2	3
Delphacinus mesomelas				II	2	4
associates						
Philaenus spumarius	IV	2	3	III	3	4
Streptanus sordidus	IV	2	3	III	3	5
Muellerianella fairmairei	III	2	3	III	3	5
Streptanus aemulans	III	1	1	III	3	4
Eupteryx urticae	II	1	2	II	2	3
Doratura stylata	II	1	1	II	1	3
Megophthalmus scabripennis	II	1	3			
Agallia consobrina	II	1	1			

	MG1			MG5		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 6	average	maximum
Batracomorphus irroratus	II	1	2			
Evacanthus interruptus	II	1	1			
Dikraneura variata	II	1	1			
Eupteryx stachydearum	II	1	1			
Eupteryx vittata	II	1	2			
Ribautiana tenerrima	II	1	1			
Zygina hyperici	II	1	1			
Allygus mixtus	II	1	1			
Graphocraerus ventralis	II	1	1			
Rhytistylus proceps	II	1	3			
Cicadula persimilis	II	1	1			
Thamnotettix dilutior	II	1	2			
Errastunus ocellaris	II	1	2			
Arthaldeus striifrons	II	1	2			
Megamelodes quadrimaculatus				II	1	2
Ribautodelphax angulosa				II	1	2
Xanthodelphax straminea				II	1	2
Neophilaenus exclamationis				II	1	1
Eupteryx aurata				II	1	2
Psammotettix helvolus				II	1	2
no. specimens (excl. larvae) per site		491.8	881		313.67	523
no. specimens (incl. larvae) per site		1305	2259		1446	2640
no. species per site		28.8	36		19.167	25
no. chalk grassland species per site		5*	6		2	3
no. dry grassland species per site		9.4*	12		3.7	7
no. eurytopic species per site		11.6	14		10.7	14
no. nitrophilic species per site		5.4	7		6.2	7

Significant difference in average abundance tested with Mann-Whitney U; * = P ≤ 0.05, ** = P ≤ 0.001

3.2.5 Comparison of *Arrhenatherum elatioris* grassland (MG1) with the *Lolium perenne-Cynosurus cristatus* grassland (MG6)

Whereas the MG1 grassland is often rich in plant species and characterized by relatively tall swards, the MG6 grassland typically shows a much reduced number of plant species, and usually a higher level in disturbance generally due to a more intensive grazing regime.

Despite the lower number of samples taken from MG1 grassland, more Auchenorrhyncha species (58) were found in this community than in the MG6 community (Table 15). The average number of species per site is 28.8 on MG1 compared to only 14.8 on the MG6. Likewise the number of chalk grassland, dry grassland and eurytopic species is significantly higher in the MG1 community, whereas the number of nitrophilic species is more or less the same in both grassland types.

There are six species which can be classified as constants in both grassland types. However, none of them exceeds an average status of a subdominant species. *Anoscopus serratulae* occasionally becomes a dominant species on some sites belonging to MG1 grassland. *Javesella pellucida* and *Arthaldeus pascuellus* have the same dominance grade on MG6 grassland.

In MG1 grassland the overall number of preferential species is much higher than in MG6 sites (28 versus 8). The high proportion of these species preferring tall vegetation such as *Hyledelphax elegantula*, *Stenocranus minutus*, *Mocydia crocea*, *Recilia coronifer*, *Criomorphus albomarginatus* among others is characteristic. *Hyledelphax elegantula*, *Stenocranus minutus* and *Mocydia crocea* show the most drastic differences. *Arboridia parvula*, *Kelisia occirrega* and *Mocydiopsis attenuata* are all consistently found on MG1 sites and can be regarded as valuable differential species due to their complete absence from MG6 grassland. *Aphrodes bicincta*, *Eupteryx origani*, *Muellerianella fairmairei*, *Anoscopus flavostriatus* and *Emelyanoviana mollicula* may in the future become good differential species, but the number of specimens collected from the small number of samples from these two compared grassland groups is too low to confirm their status. Other constant species on MG1 grassland that show significantly higher abundances compared with MG6 grassland are *Zyginidia scutellaris*, *Megophthalmus scanicus*, *Anaceratagallia ribauti*, *Anoscopus albifrons*, *Recilia coronifer*, *Criomorphus albomarginatus* and *Eupelix cuspidata*.

Deltocephalus pulicaris, *Psammotettix confinis* and *Euscelis lineolatus* are the most dominant preferential species of the MG6 grassland with *D. pulicaris* being on average an eudominant species. All three species are nitrophilic. *Psammotettix helvolus*, *Macrosteles laevis*, *M. viridigriseus* and *Conosanus obsoletus* have the status of differential species. The only other preferential species of MG6 in comparison with MG1 is *Javesella dubia*. Characteristic of the preferential species of the MG6 grassland is the high proportion of nitrophilic species, a preference of these species for short swards (e.g. *P. confinis*) and a high frequency of disturbance (*M. laevis, M. viridigriseus*).

On the MG6 grassland there is no typical chalk grassland species which can be classified as a preferential species, whereas a range of typical chalk grassland species are representative on the MG1 grassland including *Mocydia crocea*, *Arboridia parvula*, *Kelisia occirrega*, *Mocydiopsis attenuata*, *Eupteryx notata*, *Emelyanoviana mollicula* and *Kelisia guttula*.

Table 15: Comparison of MG1 and MG6 grassland.

	MG1			MG6		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 11	average	maximum
constant species						
Anoscopus serratulae	V	4	5	V	3	4
Javesella pellucida	V	3	4	V	3	5
Euscelis incisus	V	3	4	V	3	4
Arthaldeus pascuellus	V	3	4	IV	4	5
Kosswigianella exigua	IV	3	4	IV	2	3
Streptanus sordidus	IV	2	3	IV	3	5
preferential species of MG1						
Zyginidia scutellaris	V	5*	6	V	3	5
Megophthalmus scanicus	V	4*	5	III	2	3
Anaceratagallia ribauti	V	4*	4	III	4	6
Anoscopus albifrons	V	2*	3	III	2	4
Hyledelphax elegantula	V	4**	5	II	1	2
Stenocranus minutus	V	3	4	II	1	3
Mocydia crocea	V	4**	5	I	1	1
Arboridia parvula	V	5*	6			
Kelisia occirrega	V	3*	4			
Mocydiopsis attenuata	V	3*	4			
Philaenus spumarius	IV	2	3	III	1	2
Aphrodes makarovi	IV	3	4	II	1	2
Recilia coronifer	IV	4*	5	I	1	3
Criomorphus albomarginatus	IV	3*	4	I	1	1
Eupelix cuspidata	IV	2*	3	I	1	1
Elymana sulphurella	IV	1*	2	I	1	1
Aphrophora alni	IV	1	2			
Aphrodes bicincta	IV	1*	2			
Dicranotropis hamata	III	2	3	II	1	4
Eupteryx notata	III	1	2	II	1	3
Streptanus aemulans	III	1	1	I	1	3
Eupteryx origani	III	3*	4			
Muellerianella fairmairei	III	2*	3			
Anoscopus flavostriatus	III	2*	3			
Centrotus cornutus	III	1*	2			
Emelyanoviana mollicula	III	1*	3			
Kelisia guttula	II	2	3			
Macropsis fuscula	II	2	3			
preferential species of MG6						
Deltocephalus pulicaris	IV	3	5	V	6*	6
Psammotettix confinis	IV	2	3	V	5*	5
Euscelis lineolatus	II	1	1	V	4*	6
Javesella dubia	II	1	1	III	3	5
Macrosteles viridigriseus				III	4	5
Psammotettix helvolus				III	4	5
Macrosteles laevis				II	2	3
Conosanus obsoletus				II	2	4
associates						
Neophilaenus lineatus	III	2	4	III	1	2
Doratura stylata	II	1	1	II	1	3
Turrutus socialis	II	1	2	II	1	3
Megophthalmus scabripennis	II	1	3	I	1	1
Rhytistylus proceps	II	1	3	I	1	2

	MG1			MG6		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 11	average	maximum
Arthaldeus striifrons	II	1	2	I	1	2
Eupteryx vittata	II	1	2	I	1	1
Batracomorphus irroratus	II	1	2			
Eupteryx urticae	II	1	2			
Thamnotettix dilutior	II	1	2			
Errastunus ocellaris	II	1	2			
Agallia consobrina	II	1	1			
Evacanthus interruptus	II	1	1			
Dikraneura variata	II	1	1			
Eupteryx stachydearum	II	1	1			
Ribautiana tenerrima	II	1	1			
Zygina hyperici	II	1	1			
Allygus mixtus	II	1	1			
Graphocraerus ventralis	II	1	1			
Cicadula persimilis	II	1	1			
Xanthodelphax straminea				II	1	3
Neophilaenus exclamationis				II	1	3
Rhopalopyx adumbrata				I	1	3
Eurysa lineata				I	1	1
Anaceratagallia venosa				I	1	1
Adarrus multinotatus				I	1	1
no. specimens (excl. larvae) per site		491.8	881		429.6	788
no. specimens (incl. larvae) per site		1305	2259		1181.8	2233
no. species per site		28.8*	36		14.8	22
no. chalk grassland species per site		5*	6		0.6	2
no. dry grassland species per site		9.4*	12		2.4	6
no. eurytopic species per site		11.6*	14		8.6	12
no. nitrophilic species per site		5.4	7		5.6	7

Significant difference in average abundance tested with Mann-Whitney U; * = P ≤ 0.05, ** = P ≤ 0.001

3.2.6 Comparison of *Arrhenatherum elatioris* grassland (MG1) with the *Lolium perenne* leys (MG7)

The floristic differences between MG7 grassland and MG1 grassland are not surprisingly very similar to those seen between the MG6 and MG1 communities. The main difference is an even lower plant species richness and higher amount of disturbance on MG7, caused especially by frequent resowing of the leys. Subsequently, the differences between the Auchenorrhyncha communities are also very similar.

With 58 Auchenorrhyncha species recorded from only five MG1 sites, the species richness is much higher compared with the 37 species found on seven MG7 sites (Table 16). The average number of species on MG1 grassland (28.8) is nearly double that on MG7 grassland (14.9). Equally, the average number of typical chalk and dry grassland species is significantly higher on the MG1 sites. In contrast, the average number of eurytopic and nitrophilic species is very similar in both communities and does not show any significant difference.

The assemblage of species constant in both communities is the same as shown in the comparison of MG1 to MG6 grassland, except that it does not include *Kosswigianella exigua* anymore. This species can now be classified as a preferential species of MG1 grassland. *Arthaldeus pascuellus* and *Euscelis incisus* can become eudominant on sites of the MG7 grassland; *Javesella pellucida*, *Anoscopus serratulae* and *Streptanus sordidus* only reach the status of dominant species on a low number of sites.

The number of preferential species in the MG1 community is, with 29 listed species, even higher than that for the comparison of MG1 and MG6 grassland. The additional new species in this category is *Kosswigianella exigua.* Again, the main characteristic of this group is the dominance of species preferring tall vegetation.

The group of preferential species on the MG7 side comprises the same species as seen in the comparison of MG6 with MG1 grassland. The only additional species is *Xanthodelphax straminea.* Within all analysed communities this species has its main occurrence on MG7 grassland. *Deltocephalus pulicaris*, *Psammotettix confinis* and *Javesella dubia* occur in high frequency (class V) on the MG7 grassland and are the only species showing a significantly higher abundance compared with MG1 grassland. Similar to the comparison of MG6 to MG1, the preferential species of the MG7 grassland are mostly nitrophilic (*Deltocephalus pulicaris*, *Psammotettix confinis*) or indicate a high level of disturbance (*Macrosteles laevis*, *M. viridigriseus*).

Table 16: Comparison of MG1 and MG7 grassland.

	MG1			**MG7**		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 7	average	maximum
constant species						
Javesella pellucida	V	3	4	V	4	5
Euscelis incisus	V	3	4	V	4	6
Arthaldeus pascuellus	V	3	4	V	4	6
Anoscopus serratulae	V	4	5	IV	4	5
Streptanus sordidus	IV	2	3	V	3	5
preferential species of MG1						
Zyginidia scutellaris	V	5*	6	V	4	5
Hyledelphax elegantula	V	4*	5	III	1	2
Anaceratagallia ribauti	V	4	4	III	3	4
Anoscopus albifrons	V	2*	3	III	1	2
Arboridia parvula	V	5*	6	II	1	3
Stenocranus minutus	V	3*	4	II	1	2
Mocydiopsis attenuata	V	3*	4	II	1	1
Megophthalmus scanicus	V	4*	5			
Mocydia crocea	V	4*	5			
Kelisia occirrega	V	3*	4			
Kosswigianella exigua	IV	3	4	III	2	3
Criomorphus albomarginatus	IV	3	4	II	1	1
Aphrodes makarovi	IV	3	4	II	2	3
Philaenus spumarius	IV	2	3	II	1	1
Aphrophora alni	IV	1	2	II	1	1
Recilia coronifer	IV	4*	5			
Eupelix cuspidata	IV	2*	3			
Aphrodes bicincta	IV	1*	2			
Elymana sulphurella	IV	1*	2			
Muellerianella fairmairei	III	2	3	II	1	3

	MG1			MG7		
	frequency	dominance		frequency	dominance	
	n = 5	average	maximum	n = 7	average	maximum
Emelyanoviana mollicula	III	1	3	II	1	1
Eupteryx notata	III	1	2	II	1	3
Streptanus aemulans	III	1	1	II	2	3
Eupteryx origani	III	3	4			
Dicranotropis hamata	III	2	3			
Anoscopus flavostriatus	III	2	3			
Centrotus cornutus	III	1	2			
Kelisia guttula	II	2	3			
Macropsis fuscula	II	2	3			
preferential species of MG7						
Deltocephalus pulicaris	IV	3	5	V	6*	6
Psammotettix confinis	IV	2	3	V	4*	5
Javesella dubia	II	1	1	V	3*	4
Xanthodelphax straminea				III	3	4
Macrosteles laevis				III	3	4
Macrosteles viridigriseus				III	4	5
Conosanus obsoletus				II	3	4
associates						
Neophilaenus lineatus	III	2	4	III	1	2
Eupteryx urticae	II	1	2	II	1	2
Doratura stylata	II	1	1	II	1	1
Rhytistylus proceps	II	1	3	II	1	1
Cicadula persimilis	II	1	1	II	1	1
Euscelis lineolatus	II	1	1	II	2	3
Megophthalmus scabripennis	II	1	3			
Eupteryx vittata	II	1	2			
Batracomorphus irroratus	II	1	2			
Thamnotettix dilutior	II	1	2			
Errastunus ocellaris	II	1	2			
Agallia consobrina	II	1	1			
Evacanthus interruptus	II	1	1			
Dikraneura variata	II	1	1			
Eupteryx stachydearum	II	1	1			
Ribautiana tenerrima	II	1	1			
Zygina hyperici	II	1	1			
Allygus mixtus	II	1	1			
Graphocraerus ventralis	II	1	1			
Turrutus socialis	II	1	2			
Arthaldeus striifrons	II	1	2			
Eupteryx aurata				II	1	1
Psammotettix albomarginatus				II	1	2
Psammotettix helvolus				II	1	1
no. specimens (excl. larvae) per site		491.8	881		451.5	886
no. specimens (incl. larvae) per site		1305	2259		1206.9	1986
no. species per site		28.8*	36		14.9	23
no. chalk grassland species per site		5*	6		0.9	2
no. dry grassland species per site		9.4*	12		2.4	5
no. eurytopic species per site		11.6	14		9	12
no. nitrophilic species per site		5.4	7		5.4	7

Significant difference in average abundance tested with Mann-Whitney U; * = P ≤ 0.05, ** = P ≤ 0.001

Again, given more data *Megophthalmus scanicus*, *Mocydia crocea*, *Kelisia occirrega*, *Recilia coronifer*, *Eupelix cuspidata*, *Aphrodes bicincta* and *Elymana sulphurella* are likely to turn out to be valuable differential species. On the other hand, *Xanthodelphax straminea*, *Macrosteles laevis*, *M. viridigriseus* and *Conosanus obsoletus* are likely to turn out to be valuable differential species of the MG7 grassland.

3.2.7 Comparison of *Cynosurus cristatus-Centaurea nigra* grassland (MG5), *Lolium perenne-Cynosurus cristatus* grassland (MG6) and the *Lolium perenne* leys (MG7)

These three grassland types are closely related and comprise most of the regularly grazed mesotrophic grassland on chalk. From MG5 through MG6 towards MG7, soil conditions become increasingly rich due to increased input of fertilizers. On the other hand, the diversity of the flora becomes poorer with increasing soil fertility (RODWELL 1998). Vegetation heights depend mainly on the individual grazing regimes, but do not differ much between the three communities. However, it can be assumed that MG5 grasslands show a higher structural diversity than the other two grasslands due to the greater botanical richness.

The differences between the Auchenorrhyncha communities of the three compared grasslands are rather subtle and often not significant (Table 17). In principle MG6 and MG7 grasslands have regarding most aspects more in common and differences are highest between these two communities and MG5 grassland. The MG7 leys are species-poor (37 recorded species versus 43 species on MG5 and 46 species on MG6). The relatively high number of 46 species in the MG6 community is probably caused by the relatively high number of samples taken from this grassland type. The average species richness is highest on the MG5 grassland, although the differences are not significant. The average number of typical chalk grassland and dry grassland species is also higher on MG5 than on the other two groups. However, this difference is only significant in the comparison of chalk grassland species between MG5 and MG7.

There are six constant species occurring in all three groups with frequency classes IV or V. The most abundant species is *Deltocephalus pulicaris*, on average a dominant species in MG5 and even eudominant on MG6 and MG7. *Euscelis incisus* and *Arthaldeus pascuellus* can become eudominant on some sites of the MG7 grassland, while *Zyginidia scutellaris* does so on MG5 grassland.

A total of nine species can be classified as preferential species on MG5 grassland, of which *Aphrodes bicincta* and *Delphacinus mesomelas* can be regarded as differential species. Constant species within this group are *Anoscopus albifrons*, *Eupteryx notata*, *Aphrodes makarovi* and *Turrutus socialis*. Other less frequent and abundant species are *Streptanus aemulans*, *Muellerianella fairmairei* and *Arboridia parvula*. The proportion of typical chalk grassland species is, with *Eupteryx notata*, *Turrutus socialis* and *Arboridia parvula*, relatively high. The only preferential species for MG6 is *Psammotettix helvolus*. *Xanthodelphax straminea* is the only preferential species for MG7.

A group of four species (*Euscelis lineolatus*, *Kosswigianella exigua*, *Philaenus spumarius* and *Megophthalmus scanicus*) are more frequent on MG5 and MG6 and less common on MG7 grassland.

Dicranotropis hamata and *Neophilaenus exclamationis* were exclusively found on MG5 and MG6 grassland, although these differences were not significant due to the low number of sampled individuals. In contrast, *Anoscopus serratulae*, *Streptanus sordidus* and *Neophilaenus lineatus* are more often to be found on MG6 and MG7 than on MG5.

Table 17: Comparison between MG5, MG6 and MG7 grasslands.

	MG5			**MG6**			**MG7**		
	frequency	dominance		frequency	dominance		frequency	dominance	
	n = 6	average	maxim.	n = 11	average	maxim.	n = 7	average	maxim.
constant species									
Deltocephalus pulicaris	V	5	6	V	6	6	V	6	6
Euscelis incisus	V	5^{a}	5	V	3^{b}	4	V	4^{ab}	6
Zyginidia scutellaris	V	4^{a}	6	V	3^{b}	5	V	4^{ab}	5
Javesella pellucida	V	4	4	V	3	5	V	4	5
Psammotettix confinis	V	4	4	V	5	5	V	4	5
Arthaldeus pascuellus	IV	3	4	IV	4	5	V	4	6
preferential species of MG5									
Anoscopus albifrons	V	3^{a}	4	III	2^{b}	4	III	1^{ab}	2
Eupteryx notata	V	3^{a}	4	II	1^{b}	3	II	1^{b}	3
Aphrodes makarovi	IV	3^{a}	5	II	1^{b}	2	II	2^{ab}	3
Turrutus socialis	IV	2^{a}	3	II	1^{ab}	3		^{b}	
Streptanus aemulans	III	3	4	I	1	3	II	2	3
Muellerianella fairmairei	III	3^{a}	5		^{b}		II	1^{ab}	3
Arboridia parvula	III	1^{a}	2		^{b}		II	1^{ab}	3
Aphrodes bicincta	III	1^{a}	2		^{b}			^{ab}	
Delphacinus mesomelas	II	2	4						
preferential species of MG6									
Psammotettix helvolus	II	1	2	III	4	5	II	1	1
Recilia coronifer				I	1	3			
Rhopalopyx adumbrata				I	1	3			
preferential species of MG7									
Xanthodelphax straminea	II	1	2	II	1	3	III	3	4
preferential species of MG5 & MG6									
Euscelis lineolatus	V	3^{ab}	5	V	4^{a}	6	II	2^{b}	3
Kosswigianella exigua	IV	3	4	IV	2	3	III	2	3
Philaenus spumarius	III	3	4	III	1	2	II	1	1
Megophthalmus scanicus	III	2	3	III	2	3			
preferential species of MG6 & MG7									
Anoscopus serratulae	III	2	3	V	3	4	IV	4	5
Streptanus sordidus	III	3	5	IV	3	5	V	3	5
Neophilaenus lineatus	II	1	2	III	1	2	III	1	2
associates									
Javesella dubia	IV	3	4	III	3	5	V	3	4
Anaceratagallia ribauti	III	4	6	III	4	6	III	3	4
Macrosteles viridigriseus	III	2	3	III	4	5	III	4	5
Hyledelphax elegantula	III	4	6	II	1	2	III	1	2
Macrosteles laevis	III	2	4	II	2	3	III	3	4
Conosanus obsoletus	III	2	3	II	2	4	II	3	4
Stenocranus minutus	II	1	2	II	1	3	II	1	2
Doratura stylata	II	1	3	II	1	3	II	1	1
Dicranotropis hamata	II	1	3	II	1	4			
Neophilaenus exclamationis	II	1	1	II	1	3			
Eupelix cuspidata	II	1	1	I	1	1			

	MG5			MG6			MG7		
	frequency	dominance		frequency	dominance		frequency	dominance	
	n = 6	average	maxim.	n = 11	average	maxim.	n = 7	average	maxim.
Aphrophora alni	II	1	1				II	1	1
Eupteryx aurata	II	1	2				II	1	1
Eupteryx urticae	II	2	3				II	1	2
Mocydiopsis attenuata	II	1	2				II	1	1
Megamelodes quadrimaculatus	II	1	2						
Ribautodelphax angulosa	II	1	2						
Anoscopus flavostriatus	II	1	1						
Criomorphus albomarginatus				I	1	1	II	1	1
Rhytistylus proceps				I	1	2	II	1	1
Eurysa lineata				I	1	1			
Megophthalmus scabripennis				I	1	1			
Anaceratagallia venosa				I	1	1			
Eupteryx vittata				I	1	1			
Elymana sulphurella				I	1	1			
Mocydia crocea				I	1	1			
Adarrus multinotatus				I	1	1			
Arthaldeus striifrons				I	1	2			
Emelyanoviana mollicula							II	1	1
Cicadula persimilis							II	1	1
Psammotettix albomarginatus							II	1	2
no. specimens (excl. larvae) per site		313.7	523		429.6	788		451.6	886
no. specimens (incl. larvae) per site		1446	2640		1181.8	2233		1206.9	1986
no. species per site		19.2	25		14.8	22		14.9	23
no. chalk grassland species per site		2^{a}	3		0.6^{ab}	3		0.9^{b}	2
no. dry grassland species per site		3.7	7		2.4	6		2.4	5
no. eurytopic species per site		10.7	14		8.5	12		9	12
no. nitrophilic species per site		6.2	7		5.6	7		5.4	7

Significant difference in average abundance tested with Mann-Whitney U; $P \leq 0.05$, values with the same letter or without letters are not significantly different

3.3 Auchenorrhyncha and plant community structure

3.3.1 Plant diversity

There is a strong positive relationship between the number of recorded plant species from vegetation quadrats and the species richness of the corresponding Auchenorrhyncha fauna (Figure 7). The majority of grassland Auchenorrhyncha feed on grasses and sedges. However, the correlation between the number of recorded grasses/sedges and the number of leafhopper species is less strong though still significant (Figure 8). The proportion of graminoid species to forbs also effects the species richness of Auchenorrhyncha. This relationship is negative, mainly caused by the fact that a high proportion of grasses is often associated with a low overall number of plant species (Figure 9). There was no significant correlation between the abundance of leafhoppers and the plant species richness (Figure 10).

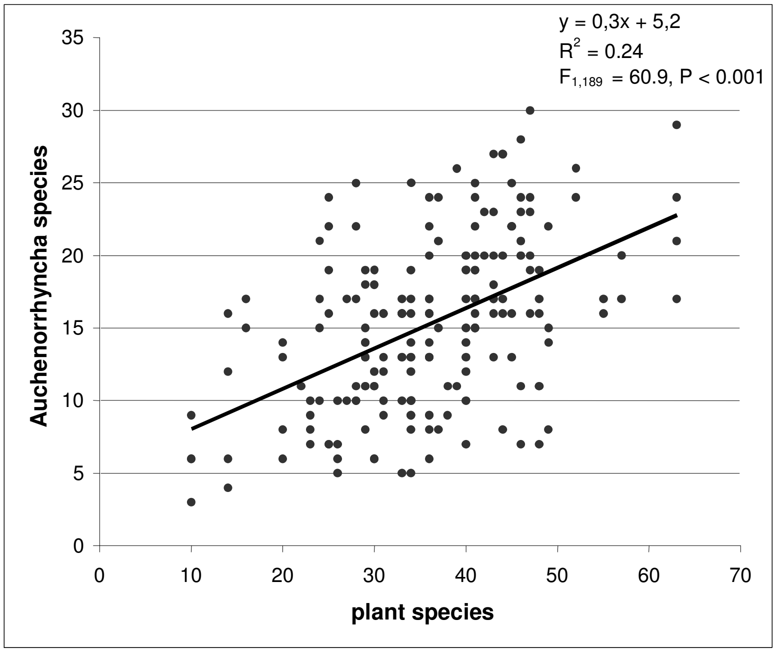


Figure 7: The relationship between Auchenorrhyncha species richness and plant species richness.

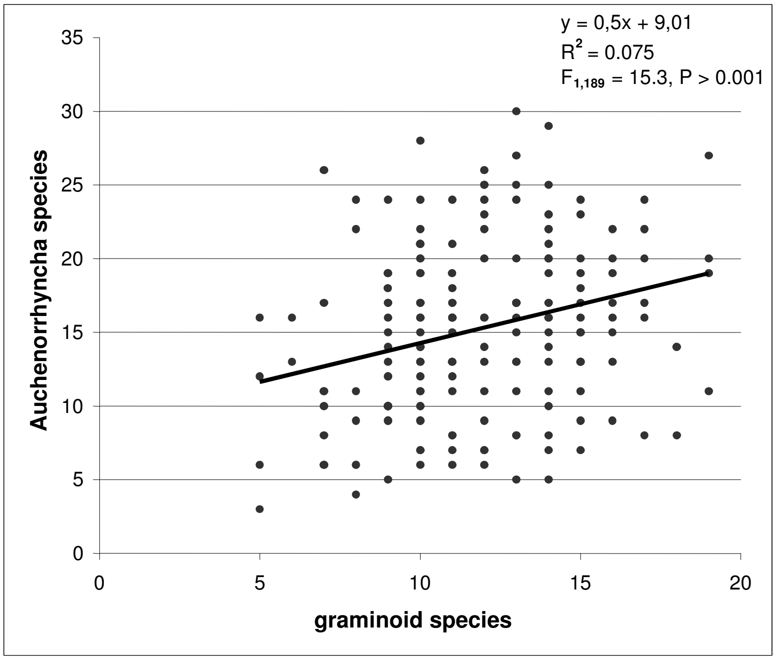


Figure 8: The relationship between Auchenorrhyncha species richness and graminoid species richness.

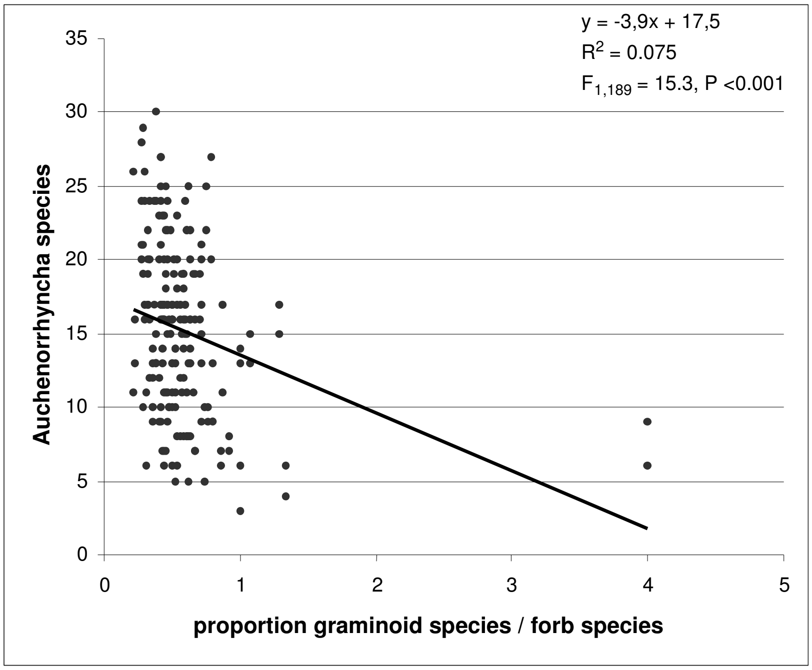


Figure 9: The relationship between Auchenorrhyncha species richness and the proportion of graminoids/forbs.

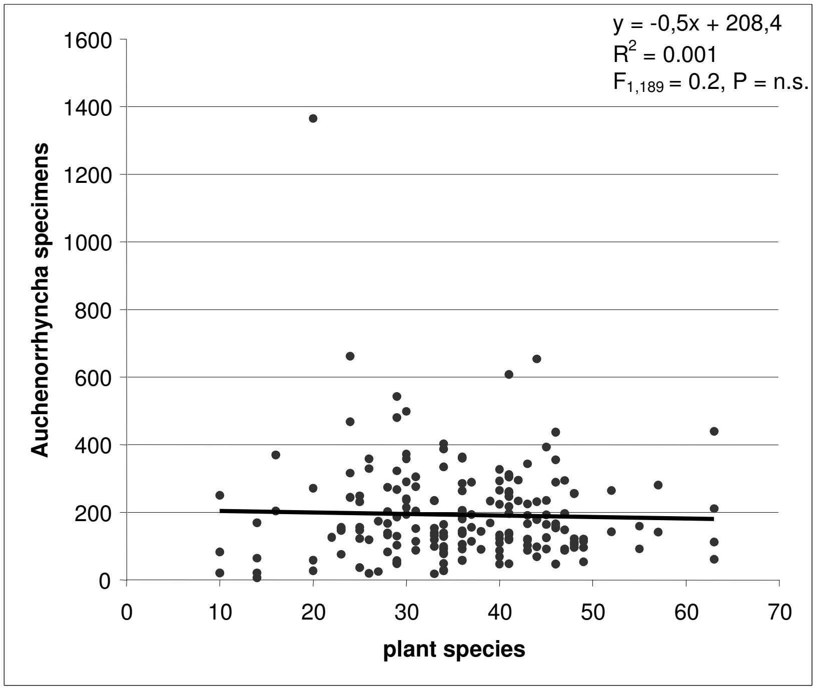


Figure 10: The relationship between Auchenorrhyncha abundance and plant species richness.

3.3.2 Vegetation structure

There was a strong positive correlation between the number of Auchenorrhyncha species and the average vegetation height (Figure 11). The correlation of Auchenorrhyncha species richness with structural diversity, based on vegetation height variance, was also significant ($P < 0.001$) (Figure 12). Another way of estimating structural diversity is by the alpha diversity of the floristic species composition. Alpha diversity indices of vegetation communities indicate the relationship of species richness with the dominance ranking of the single plant species. Subsequently, it may be assumed that the higher the alpha diversity of a plant assemblage is, the higher will be the structural diversity in the sense of providing available niches for herbivores. However, a regression of the Shannon-Wiener index of plant diversity with the number of Auchenorrhyncha species showed little positive correlation (Figure 13). There was no correlation between the abundance of leafhoppers and vegetation height (Figure 14).

At species level, groups with preferences for certain sward height can be distinguished. Table 18 compares short grazed sites with an average sward height under 6 cm, sites with medium vegetation heights between 6 and 10 cm and sites with swards higher than 10 cm, based on the analysis from all sampled sites belonging to the CG2 grassland community. Only species which occur at least in frequency class II or dominance class 2 are listed.

Deltocephalus pulicaris, *Psammotettix confinis* and *Euscelis lineolatus* are the only species showing a clear preference for short vegetation. A second group comprising species generally occurring on medium height-vegetated sites contains *Turrutus socialis*, *Delphacinus mesomelas*, *Kelisia guttula* and *Psammotettix cephalotes*. The biggest group (21 species) consists of the Auchenorrhyncha species preferring stands of vegetation with average yearly height over 10 cm. *Rhopalopyx adumbrata*, *Dikraneura variata*, *Emelyanoviana mollicula* and *Eupteryx origani* were found exclusively on sites with tall vegetation.

Kosswigianella exigua, *Neophilaenus exclamationis*, *Utecha trivia*, *Macrosteles laevis*, *M. viridigriseus* and *Doratura stylata* inhabit equally sites with short and medium height swards but avoid tall vegetation. In contrast, frequency and abundance of some species do not differ on sites with medium and tall vegetation, but these species seem to avoid the extreme shortly grazed sites. This group comprises *Zyginidia scutellaris*, *Anoscopus albifrons*, *A. serratulae*, *Anaceratagallia ribauti*, *Arboridia parvula*, *Streptanus sordidus* and *Recilia coronifer*. Widely distributed and abundant species which are indifferent to vegetation heights are *Eupteryx notata*, *Euscelis incisus* and *Eupelix cuspidata*.

It is noteworthy, that although the number of Auchenorrhyncha species is positively correlated with the vegetation height as well as with the number of plant species, the number of plant species is not related to the average vegetation height (Table 18).

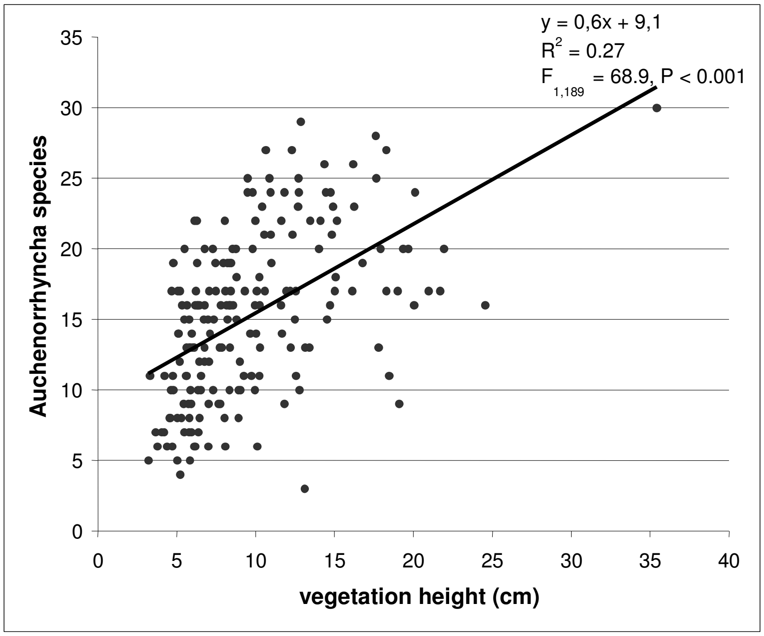


Figure 11: The relationship between number of Auchenorrhyncha species and the mean vegetation height.

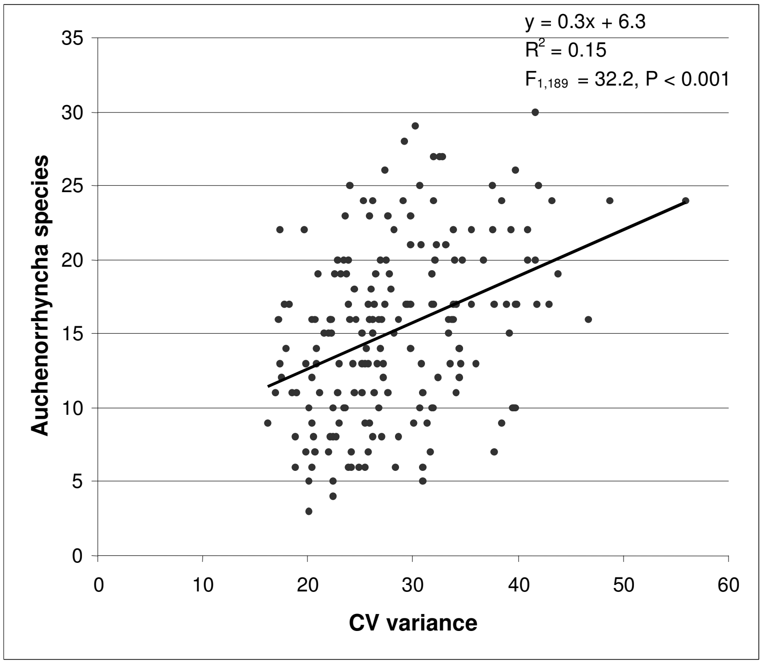


Figure 12: The relationship between number of Auchenorrhyncha species and the community variance of the vegetation.

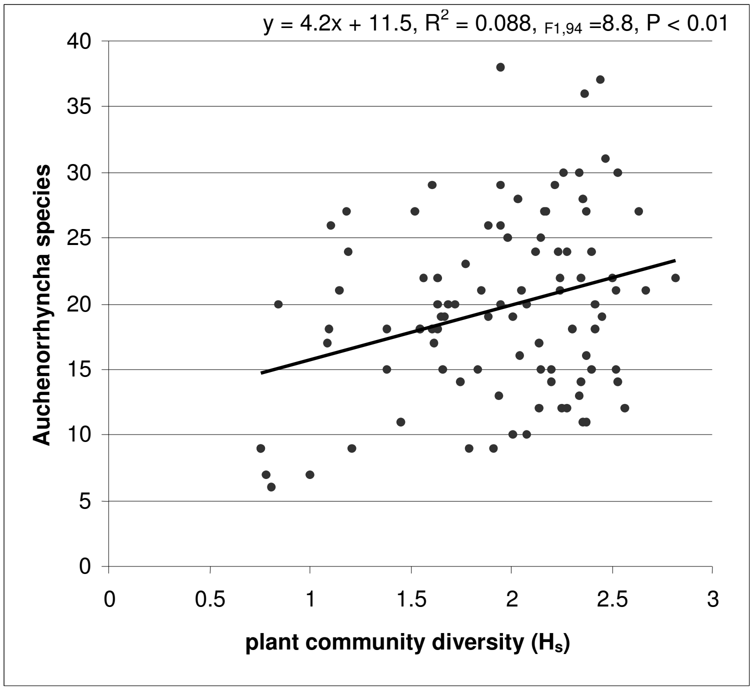


Figure 13: The relationship between the number of Auchenorrhyncha species and the vegetation diversity after SHANNON-WIENER (H_s).

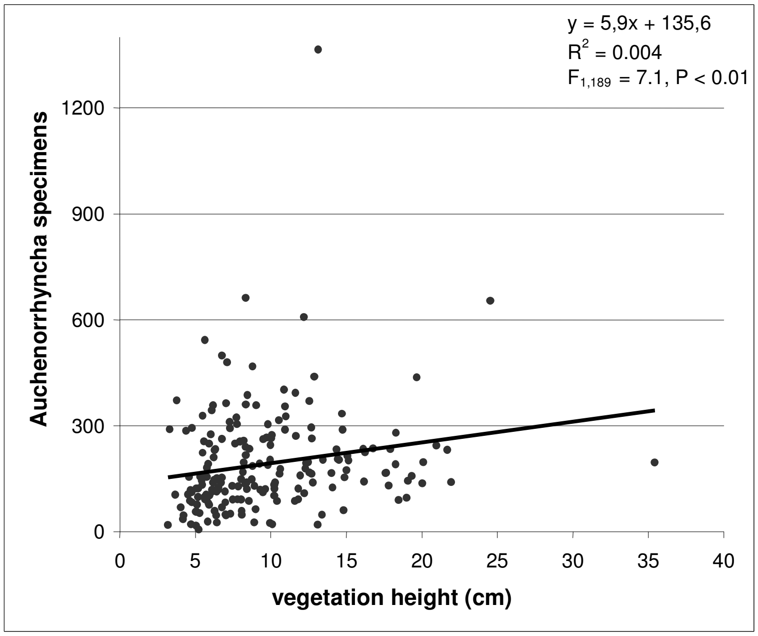


Figure 14: The relationship between abundance of Auchenorrhyncha and the mean vegetation height.

Table 18: Comparison between short, medium high and tall vegetation of CG2 grassland.

	average vegetation height < 6 cm n = 23		average vegetation height between 6 and 10 cm n = 26		average vegetation height > 10 cm n = 25	
	frequency	dominance	frequency	dominance	frequency	dominance
species of short vegetation						
Deltocephalus pulicaris	V	5^{a}	IV	5^{ab}	III	3^{b}
Psammotettix confinis	V	4^{a}	III	3^{b}	II	1^{b}
Euscelis lineolatus	II	3^{a}	I	1^{ab}		^{b}
species of medium high veg.						
Turrutus socialis	IV	4	V	4	IV	4
Delphacinus mesomelas	II	1	III	2	II	2
Kelisia guttula	I	1^{a}	III	2^{b}	II	2^{b}
Psammotettix cephalotes	I	1^{a}	II	2^{b}	I	1^{a}
species of high vegetation						
Javesella pellucida	III	2	III	2	IV	2
Hyledelphax elegantula	II	2^{a}	IV	4^{b}	V	5^{c}
Philaenus spumarius	II	2^{a}	III	2^{a}	IV	3^{b}
Mocydia crocea	II	1^{a}	II	2^{a}	IV	4^{b}
Kelisia occirrega	I	1^{a}	III	2^{b}	IV	3^{c}
Megophthalmus scabripennis	II	2	II	3	III	3
Aphrodes bicincta	II	2^{a}	II	1^{a}	III	3^{b}
Neophilaenus lineatus	II	1^{a}	III	2^{a}	IV	3^{b}
Megophthalmus scanicus	II	1^{a}	III	3^{b}	IV	3^{b}
Aphrodes makarovi	II	1^{a}	III	3^{b}	IV	3^{b}
Arthaldeus pascuellus	I	1^{a}	III	2^{b}	V	3^{c}
Stenocranus minutus	I	1^{ab}	II	2^{a}	V	4^{b}
Criomorphus albomarginatus	I	1^{a}	I	1^{a}	III	2^{b}
Anoscopus flavostriatus	I	1^{a}	I	1^{a}	II	2^{b}
Mocydiopsis attenuata	I	1^{a}	I	1^{a}	III	3^{b}
Muellerianella fairmairei		^{a}	I	1^{ab}	II	2^{b}
Agallia consobrina		^{a}	I	1^{ab}	II	2^{b}
Rhopalopyx adumbrata		^{a}		^{a}	III	1^{b}
Dikraneura variata		^{a}		^{a}	III	3^{b}
Emelyanoviana mollicula		^{a}		^{a}	II	2^{b}
Eupteryx origani		^{a}		^{a}	II	2^{b}
species preferring short to medium high vegetation						
Kosswigianella exigua	IV	5^{a}	V	4^{a}	III	3^{b}
Neophilaenus exclamationis	IV	4^{a}	IV	4^{a}	II	2^{b}
Utecha trivia	II	3	II	2	I	1
Macrosteles laevis	II	3^{a}	II	1^{ab}		^{b}
Doratura stylata	II	2^{a}	II	2^{ab}	I	1^{b}
Macrosteles viridigriseus	II	1	II	2	I	1
Rhytistylus proceps	II	1	II	2	I	1
species preferring medium high to tall vegetation						
Zyginidia scutellaris	IV	4^{a}	V	5^{b}	V	5^{b}
Anoscopus albifrons	IV	3^{a}	V	4^{b}	V	3^{b}
Anaceratagallia ribauti	II	2	III	3	III	3
Arboridia parvula	II	4^{a}	III	3^{ab}	III	3^{b}
Anoscopus serratulae	II	1	III	3	III	3
Streptanus sordidus	I	1	III	2	III	3
Recilia coronifer		^{a}	II	2^{b}	II	2^{ab}
species indifferent to vegetation height						
Eupteryx notata	IV	4	IV	4	IV	4

	average vegetation height < 6 cm n = 23		average vegetation height between 6 and 10 cm n = 26		average vegetation height > 10 cm n = 25	
	frequency	dominance	frequency	dominance	frequency	dominance
Euscelis incisus	IV	4	IV	4	IV	3
Eupelix cuspidata	III	3	III	3	III	3
Batracomorphus irroratus	II	3	II	3	II	1
Anaceratagallia venosa	II	1	II	1	II	1
Javesella dubia	I	2	II	2	II	2
Arthaldeus striifrons	I	1^{ab}		^{a}	II	1^{b}
Aphrophora alni		^{a}	II	1^{ab}	II	1^{b}
Dicranotropis hamata		^{a}	I	1^{ab}	II	1^{b}
Eupteryx vittata		^{a}	I	1^{ab}	II	1^{b}
Elymana sulphurella			I	1	II	1
Streptanus aemulans		^{a}	I	1^{ab}	II	1^{b}
Psammotettix helvolus			II	1		
		average no. per site		average no. per site		average no. per site
specimens excl. nymphs		125.4^{a}		146.3^{a}		208.9^{b}
specimens incl. nymphs		498.5^{a}		680.3^{ab}		905.7^{b}
all species		11.9^{a}		16.4^{b}		21.0^{c}
chalk grassland species		1.7^{a}		2.6^{b}		2.9^{b}
dry grassland species		4.0^{a}		5.2^{b}		6.3^{b}
eurytopic species		5.2^{a}		6.7^{b}		7.9^{b}
nitrophilic species		3.2		3.0		3.0
no. plant species per site		40.9		41.1		41.8

One replicate is data from one year and one site resulting in n = 74.
Values with the same letter are not significant (in case of no significant differences in a row no letters are shown).

3.4 Auchenorrhyncha and management of chalk grassland

3.4.1 Intensity of land use

Although the majority of sites were subjected to a grazing regime with a limitation in stocking rates and the cessation of fertilizer input, their structural appearance and botanical composition were still determined by former historical management. The sites classified as improved grassland and arable reversion were still strongly influenced by former high input of fertilizers. On the other hand, most of the unimproved chalk grassland sites have never had an additional input of fertilizers or only a very long time ago. For example, some sites now classified as unimproved chalk grassland had been converted into arable fields during the second world war.

In general, the swards are taller on unimproved sites decreasing over semi-improved sites towards improved sites. Arable reversion sites have higher vegetation than improved sites, but still are characterized by shorter swards than unimproved sites. However, the average differences in vegetation heights are rather subtle and are not significant (Figure 15). The variation of vegetation heights within each landuse-type frequently varies much more than the average between the different groups.

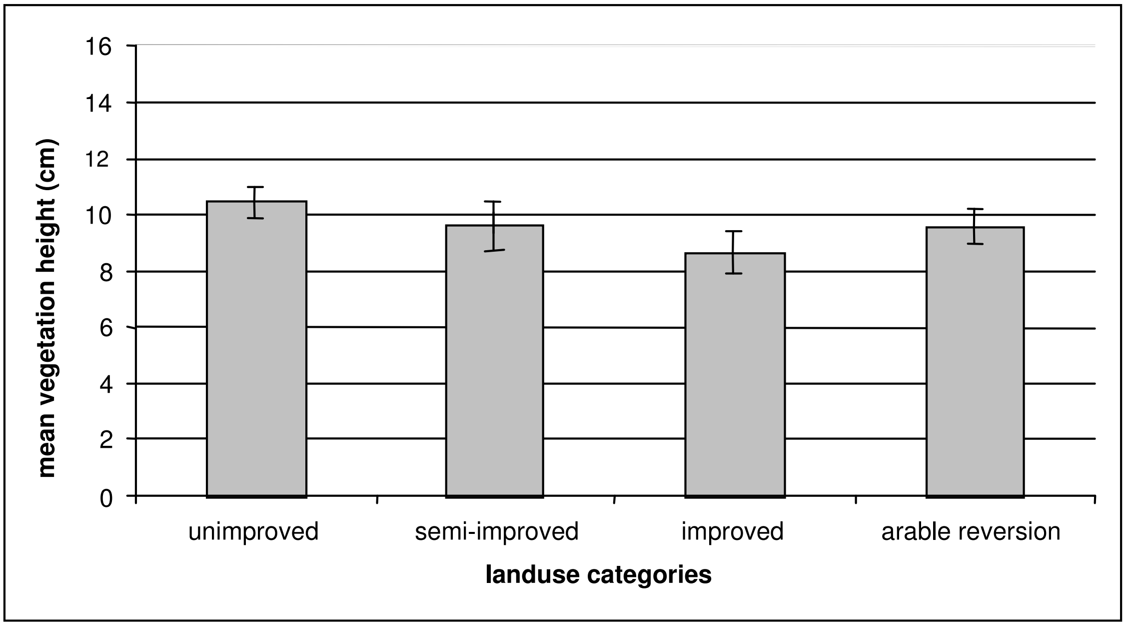


Figure 15: Mean vegetation height (± one S.E.M.) of the different landuse-types (none of the differences are significant).

They are significant differences in plant species richness between the four grassland types, with unimproved grassland having the highest richness (Figure 16). Species richness decreased towards improved grassland sites and is lowest on arable reversion sites. The same trend was recognizable for the average number of grass and sedge species, although the differences were smaller and not significant (Figure 16). The sharp decrease of the number of forb species resulted in a significant change of the proportion of graminoids to forbs between the sites (Figure 17). The proportion of graminoids to forbs was lowest on unimproved sites and increased towards improved and arable reversion sites.

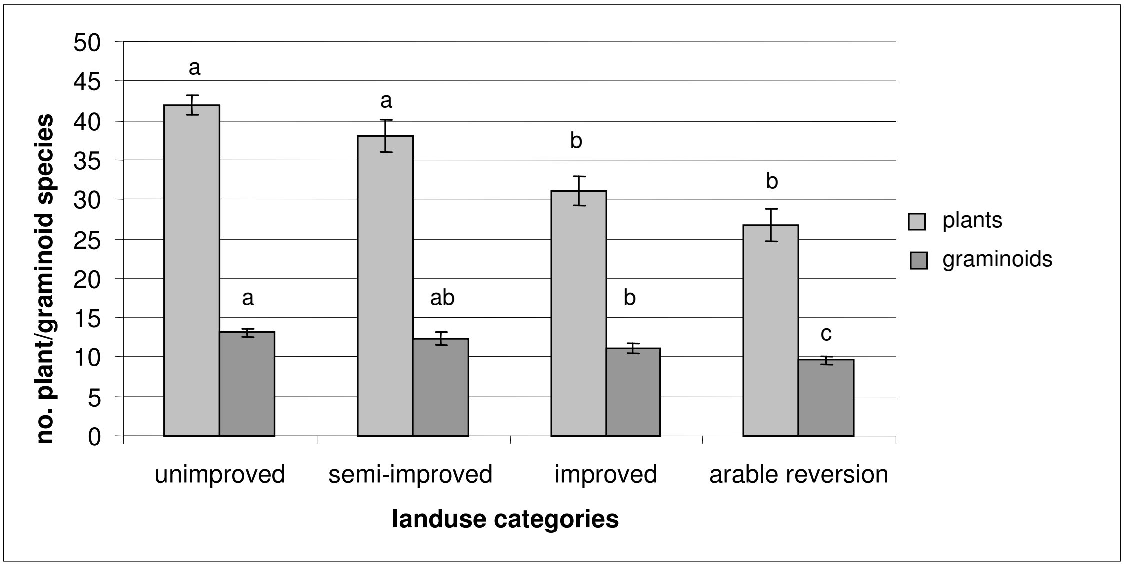


Figure 16: Overall number (± one S.E.M.) of plant species and number of graminoid species of the different landuse-types.

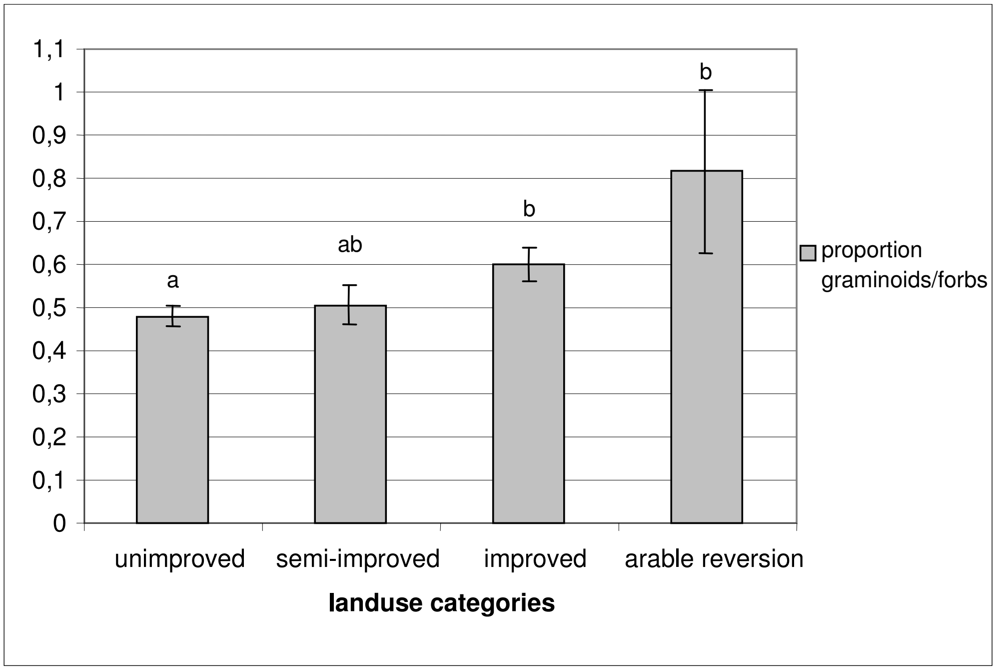


Figure 17: Proportion of graminoids (± one S.E.M.) to forbs of the different landuse-types.

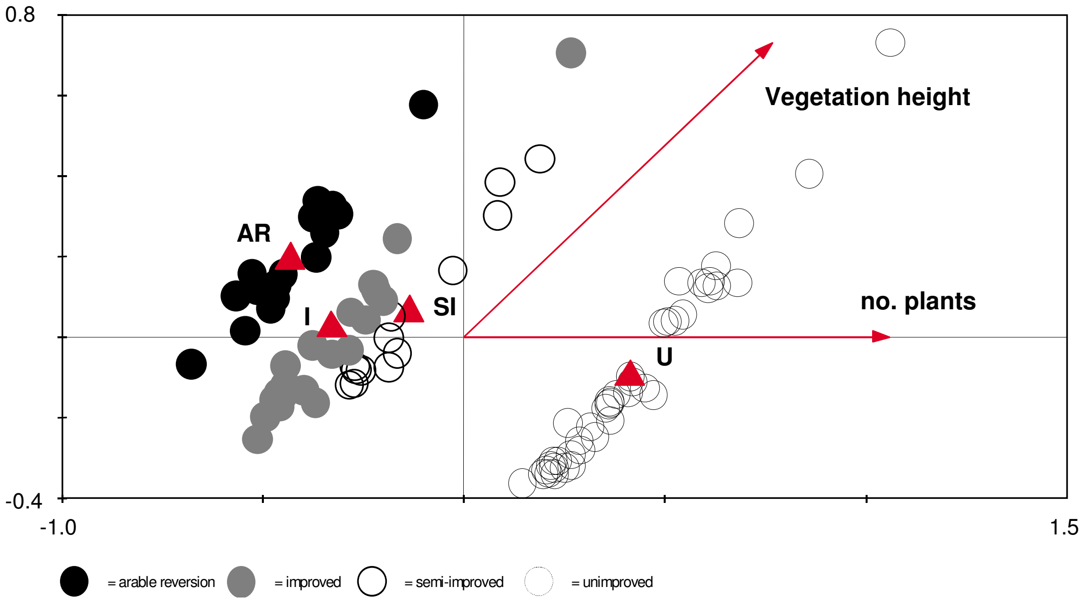


Figure 18: RDA of Hellinger transformed data of all investigated sites. (explained variance of species data on axis 1 = 16.9, eigenvalue axis 1 = 0.169, eigenvalue axis 2 = 0.055, Monte Carlo test F-ratio = 18.28, P = 0.002) (triangles = centroids of landuse categories: AR = arable reversion, I = improved, SI = semi-improved, U = unimproved; no. plant = number of plant species).

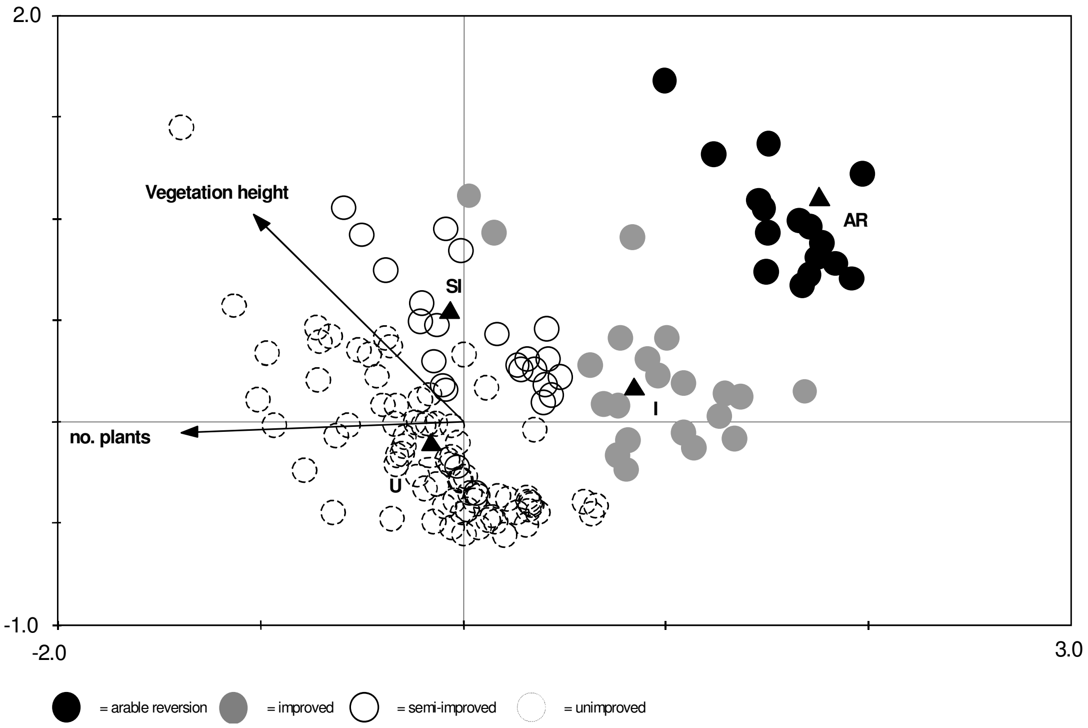


Figure 19: CCA of all investigated sites, samples separated into sampling years and rare species downweighted (explained variance of species data on axis 1 = 11.6, eigenvalue axis 1 = 0.33, eigenvalue axis 2 = 0.18) () (triangles = centroids of landuse categories: AR = arable reversion, I = improved, SI = semi-improved, U = unimproved; no. plant = number of plant species).

The differences in the vegetational structure and species composition between the four investigated landuse types are reflected by the distinct Auchenorrhyncha assemblages associated with them (Figures 18 and 19). In particular, there is a strong correlation between the leafhopper communities and plant species richness. Although differences of the overall abundance of leafhoppers were not significant, there was a slight increase of the abundance of adult leafhoppers from unimproved towards improved and arable reversion sites (Figure 20).

In contrast, there was a significant decrease of Auchenorrhyncha species richness from unimproved sites towards improved and arable reversion sites (Figure 21). These differences were greater when only typical chalk grassland and typical dry grassland species were compared (Figure 22). Numbers of eurytopic species did not show significant differences with the exception of the semi-improved grassland in comparison to improved grassland (Figure 23). The number of nitrophilic species, however, was significantly lower on unimproved sites and was highest on arable reversion sites (Figure 23). A RDA analysis of the Auchenorrhyncha communities shows distinct affinities of some species for certain landuse-types (Figure 24). *Euscelis lineolatus*, *Javesella pellucida*, *Arthaldeus pascuellus* and *Anoscopus serratulae* show a high affinity towards arable reversion sites, *Psammotettix confinis* and *Deltocephalus pulicaris* towards semi-improved and improved sites. A number of species is associated with unimproved grassland like *Eupelix cuspidata*, *Kelisia guttula*, *K irregulata*, *Aphrodes bicincta*, *Turrutus socialis*, *Mocydia crocea* and *Eupteryx notata*. The alpha diversity of the Auchenorrhyncha communities increases from arable reversion over improved towards semi-improved and unimproved sites (Figure 25). Apparently this effect is correlated with vegetation height.

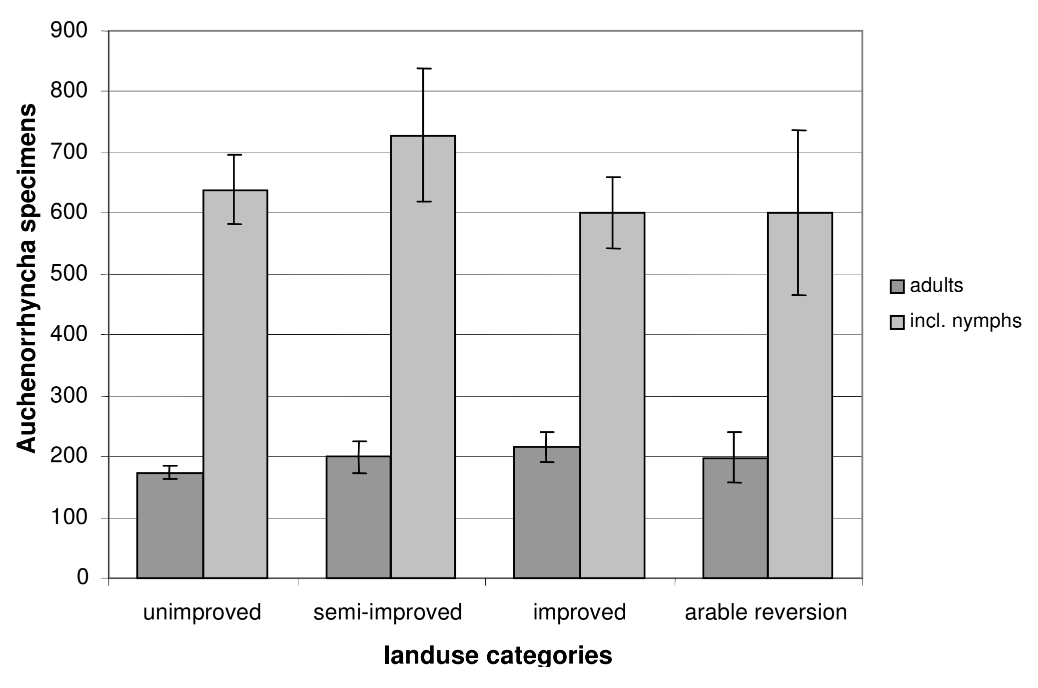
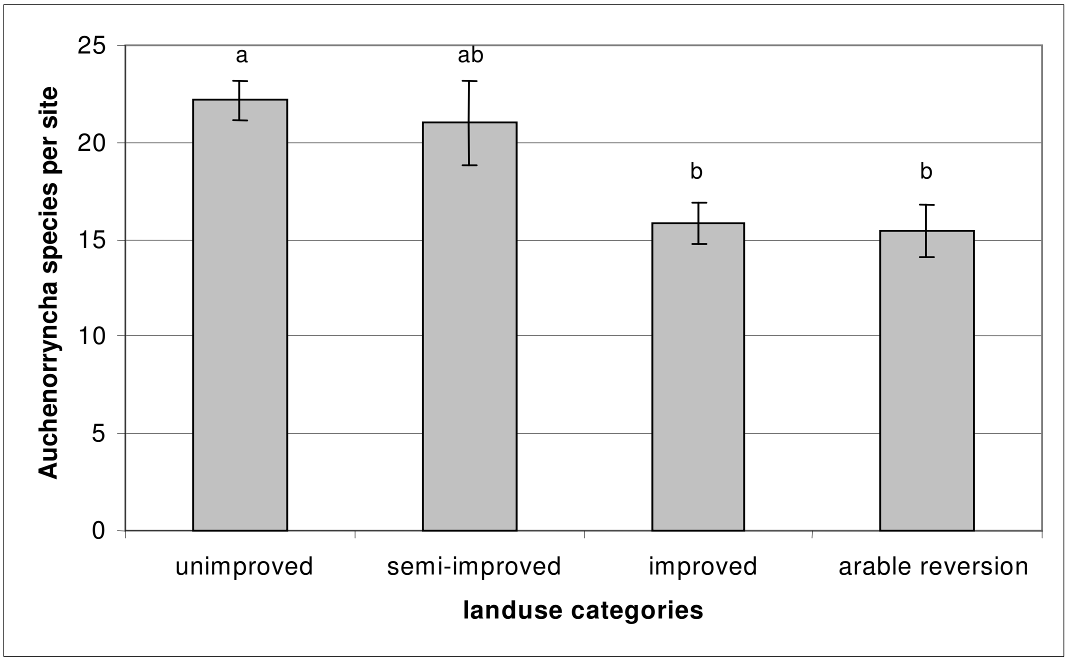
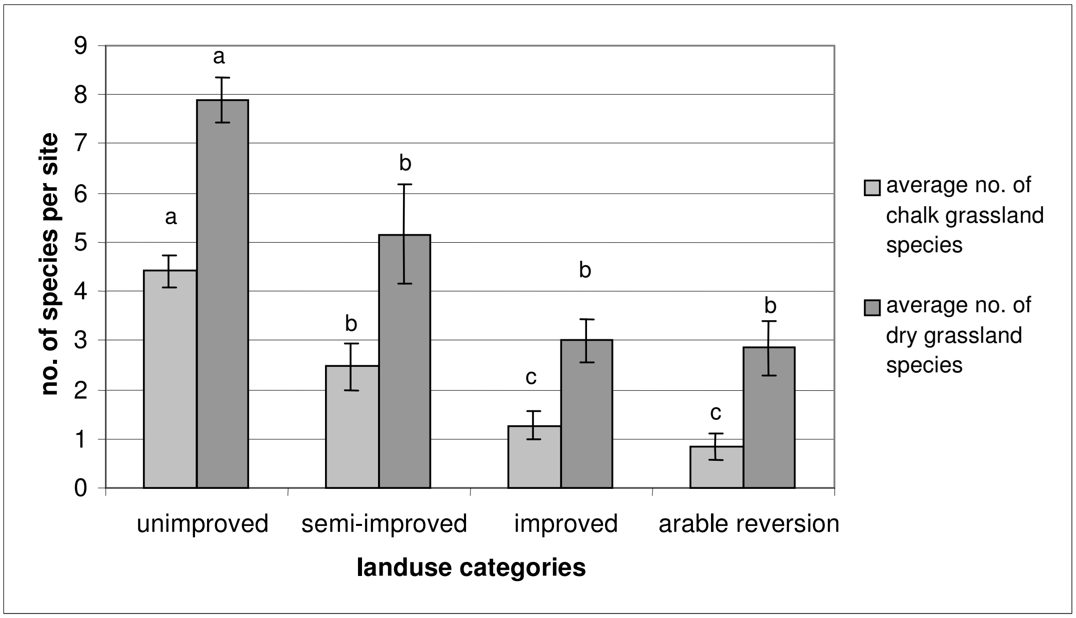


Figure 20: Mean number of Auchenorrhyncha specimens (± one S.E.M.) associated with the different landuse-types (none of the differences are significant).



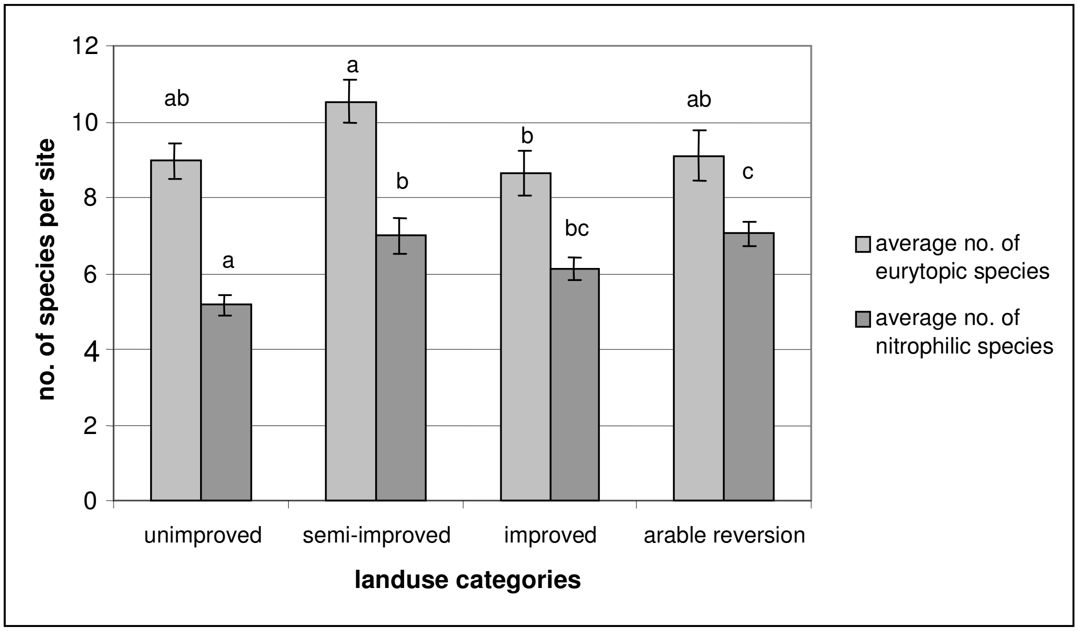
Columns with the same letter are not significantly different

Figure 21: Mean number of Auchenorrhyncha species (± one S.E.M.) associated with the different landuse-types.



Columns with the same letter are not significantly different

Figure 22: Mean number of dry grassland and chalk grassland Auchenorrhyncha species (± one S.E.M.) associated with the different landuse-types.



Columns with the same letter are not significantly different

Figure 23: Mean number of eurytopic and nitrophilic Auchenorrhyncha species (± one S.E.M.) associated with the different landuse-types.

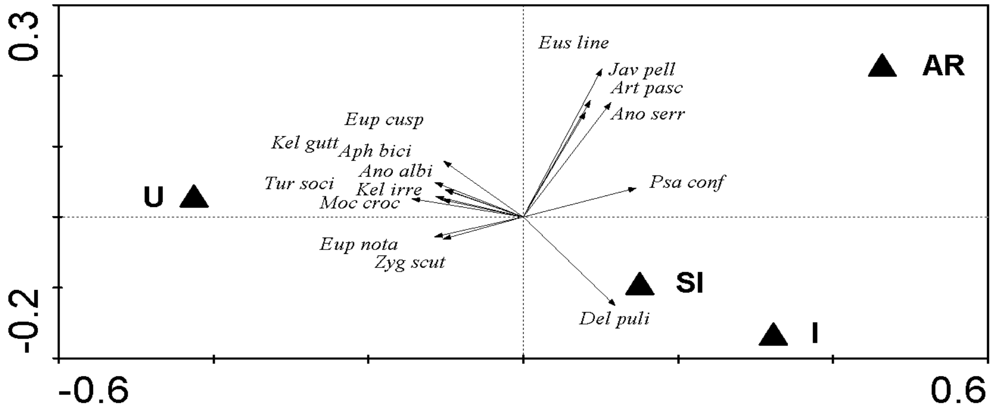


Figure 24: RDA of Hellinger transformed data of all investigated sites (explained variance of species data on axis 1 = 14.9, eigenvalue axis 1 = 0.169, eigenvalue axis 2 = 0.017, Monte Carlo test F-ratio = 16.05, P = 0.002), (triangles = centroids of landuse categories: AR = arable reversion, I = improved, SI = semi-improved, U = unimproved).

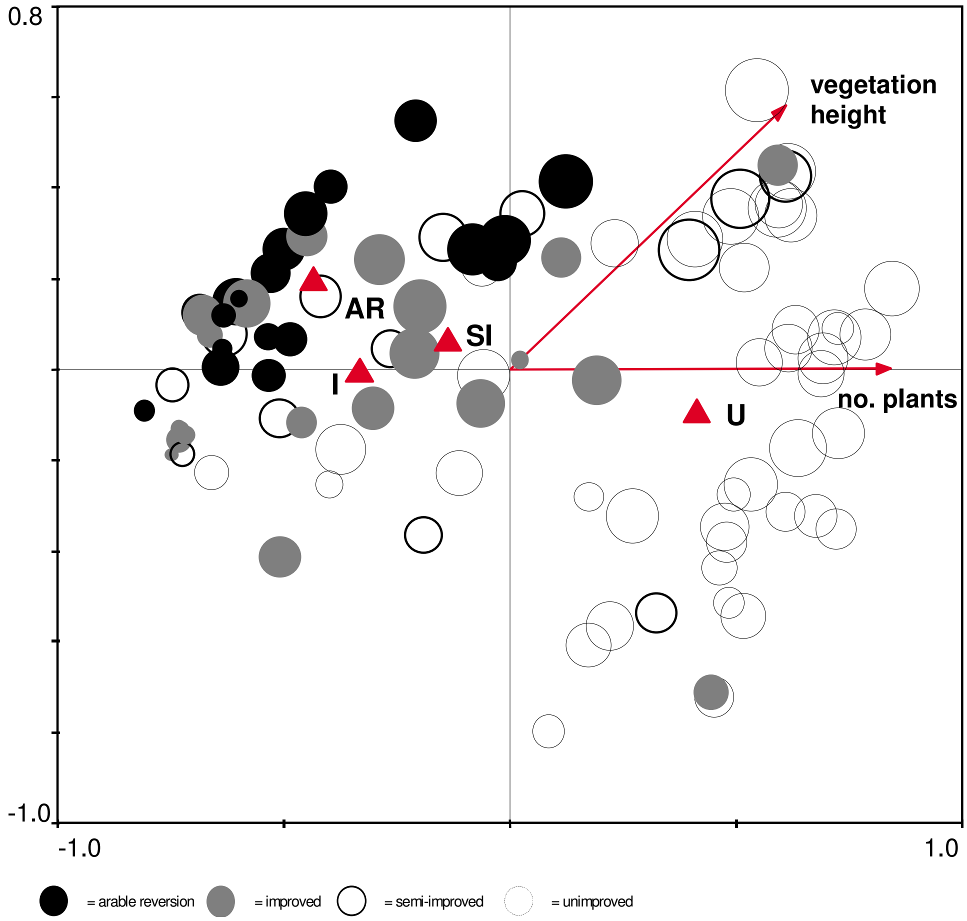


Figure 25: RDA of Hellinger transformed data of all investigated sites, size of circles increasing with increasing Shannon-Wiener index (H_s) (explained variance of species data on axis 1 = 16.9, eigenvalue axis 1 = 0.169, eigenvalue axis 2 = 0.055, Monte Carlo test F-ratio = 18.28, P = 0.002), (triangles = centroids of landuse categories: AR = arable reversion, I = improved, SI = semi-improved, U = unimproved, no. plant = number of plant species).

Although the number of samples from the different landuse-types is unbalanced, the number of recorded species for each group is still noteworthy. From 46 unimproved sites a total of 91 Auchenorrhyncha species were recorded. From only 13 sites of semi-improved grassland 72 species were sampled. Those numbers drop down to 63 species found on 22 improved sites and only 57 species on 19 arable reversion sites.

Kelisia guttula is the most abundant species occurring exclusively on unimproved chalk grassland. Other species which were recorded only from this landuse-type are *Utecha trivia*, *Evacanthus interruptus*, *E. acuminatus*, *Macustus grisescens*, *Ribautodelphax pungens*, *R. angulosa*, *Agallia brachyptera*, *Planaphrodes bifasciata*, *Balclutha punctata* and *Jassargus flori*. Additionally, species feeding on woody plants like *Centrotus cornutus*, *Thamnotettix dilutior*, *Tachycixius pilosus*, *Fagocyba cruenta* and *Alnetoidea alneti* have all been exclusively sampled on unimproved grassland due to scrub encroachment on some of the sites. *Elymana sulphurella* has been found only on unimproved and semi-improved grassland sites.

Macropsis fuscula, *Notus flavipennis*, *Ribautiana tenerrima* and *Zygina hyperici* were only sampled from semi-improved sites. Only *Errastunus ocellaris* and *Javesella obscurella* (the latter only as a single individual) were found exclusively on arable reversion sites.

A ranking order of the species according to their average abundance is given for all landuse-types in table 19.

Zyginidia scutellaris is the most abundant species on unimproved grassland followed by *Turrutus socialis*, *Kosswigianella exigua* and *Hyledelphax elegantula*. There is an expectedly high proportion of typical chalk grassland species among the 20 most abundant species. The group includes (in rank) *Eupteryx notata*, *Mocydia crocea*, *Arboridia parvula*, *Neophilaenus exclamationis*, *Batracomorphus irroratus* and *Kelisia occirrega*. Nitrophilic species among the 20 most abundant are *Deltocephalus pulicaris*, *Euscelis incisus Stenocranus minutus*, *Aphrodes makarovi* and *Arthaldeus pascuellus*. However, most of these species occur in significantly lower numbers on unimproved chalk grassland compared with the other grassland groups.

On semi-improved grassland the most abundant species are *Deltocephalus pulicaris*, *Zyginidia scutellaris*, *Psammotettix confinis* and *Anoscopus serratulae*. With the exception of *Zyginidia scutellaris* these species are all regarded to be indicators for eutrophic conditions. Five more nitrophilic species (*Euscelis incisus*, *Arthaldeus pascuellus*, *Stenocranus minutus*, *Javesella pellucida* and *Euscelis lineolatus*) are among the 20 most abundant species, compared with only three typical chalk grassland species (*Arboridia parvula*, *Mocydia crocea* and *Eurysanoides douglasi*).

By far the most dominant species on improved grassland on chalk is *Deltocephalus pulicaris* followed in much lower density by *Psammotettix confinis*, *Arboridia parvula* and *Zyginidia scutellaris*. Eight species among the 20 most abundant are regarded as nitrophilic. Within this landuse type only *Arboridia parvula* and *Eupteryx notata* can be classified as typical chalk grassland species.

Table 19: Frequency (%) and average abundance of the Auchenorrhyncha on the different landuse types (order according to their ranking appearance on unimproved chalk grassland).

	Unimproved		**Semi-improved**		**Intensive**		**Arable reversion**	
	frequency	average	frequency	average	frequency	average	frequency	average
Anoscopus albifrons	97,8	10,3^{a}	84,6	5,5^{b}	50,0	4,3^{b}	52,6	11,4^{b}
Zyginidia scutellaris	91,3	62,1^{a}	100,0	36,3^{ac}	86,4	23,0^{bc}	89,5	11,7^{b}
Aphrodes makarovi	84,8	4,8^{a}	46,2	2,8^{b}	27,3	3,5^{b}	57,9	2,7^{ab}
Turrutus socialis	84,8	32,5^{a}	46,2	2,2^{b}	22,7	1,8^{b}	21,1	0,2^{b}
Javesella pellucida	73,9	2,8^{a}	100,0	10,1^{abc}	90,9	7,6^{b}	94,7	15,2^{c}
Hyledelphax elegantula	71,7	20,3^{a}	53,8	8,6^{ab}	36,4	4,5^{b}	31,6	0,5^{b}
Eupteryx notata	69,6	16,5^{a}	53,8	2,0^{ac}	31,8	4,5^{bc}	15,8	0,2^{b}
Eupelix cuspidata	69,6	11,6^{a}	23,1	0,3^{b}	13,6	1,6^{b}	26,3	4,4^{b}
Euscelis incisus	67,4	9,7^{a}	100,0	12,3^{a}	90,9	10,6^{a}	89,5	15,8^{a}
Deltocephalus pulicaris	65,2	16,9^{a}	92,3	121,4^{b}	86,4	176,2^{b}	100,0	71,0^{b}
Kosswigianella exigua	65,2	21,8^{a}	61,5	10,9^{a}	59,1	6,8^{a}	47,4	9,4^{a}
Kelisia occirrega	63,0	7,1^{a}	30,8	2,4^{b}	4,5	0,6^{c}	5,3	0,1^{c}
Arthaldeus pascuellus	58,7	3,6^{a}	61,5	11,2^{ab}	63,6	13,6^{ab}	73,7	47,6^{b}
Neophilaenus lineatus	58,7	3,9^{a}	46,2	2,1^{a}	50,0	1,4^{a}	52,6	10,1^{a}
Stenocranus minutus	56,5	6,2^{a}	53,8	10,2^{ac}	27,3	3,5^{bc}	21,1	0,4^{b}
Mocydia crocea	56,5	15,6^{a}	38,5	11,5^{ac}	13,6	0,2^{b}	15,8	0,3^{bc}
Aphrodes bicincta	56,5	2,9^{a}	15,4	0,3^{b}	9,1	0,2^{b}	5,3	0,1^{b}
Megophthalmus scanicus	54,3	4,8^{ac}	69,2	6,3^{a}	27,3	1,3^{b}	31,6	2,4^{bc}
Philaenus spumarius	52,2	3,4^{a}	69,2	1,7^{ac}	27,3	1,2^{bc}	21,1	1,7^{b}
Psammotettix confinis	50,0	3,6^{a}	76,9	31,8^{b}	95,5	40,6^{b}	94,7	51,3^{b}
Anoscopus serratulae	50,0	2,9^{a}	76,9	14,3^{bc}	50,0	17,0^{ac}	78,9	25,7^{b}
Anaceratagallia ribauti	47,8	8,0^{ab}	69,2	10,4^{a}	27,3	7,5^{b}	52,6	7,4^{ab}
Arboridia parvula	43,5	13,1^{a}	23,1	12,8^{ab}	22,7	24,8^{b}	5,3	0,1^{b}
Mocydiopsis attenuata	41,3	2,3^{a}	23,1	2,0^{a}	18,2	2,5^{a}	21,1	0,7^{a}
Kelisia guttula	41,3	2,0^{a}	0,0	< 0,1^{b}	4,5	0,0^{b}	0,0	0,0^{b}
Streptanus sordidus	39,1	2,2^{a}	61,5	7,0^{ab}	63,6	6,8^{b}	57,9	4,6^{ab}
Neophilaenus exclamationis	37,0	10,5^{a}	7,7	2,7^{ab}	18,2	0,6^{b}	5,3	0,2^{b}
Megophthalmus scabripennis	37,0	3,1^{a}	7,7	0,1^{b}	9,1	0,2^{b}	0,0	0,0^{b}
Javesella dubia	34,8	1,8^{a}	30,8	2,8^{a}	54,5	4,5^{a}	47,4	0,9^{a}
Criomorphus albomarginatus	34,8	1,9^{a}	38,5	2,1^{ab}	13,6	0,2^{b}	15,8	0,2^{ab}
Recilia coronifer	30,4	1,3^{a}	30,8	8,4^{ac}	9,1	0,1^{bc}	0,0	0,0^{b}
Rhytistylus proceps	26,1	1,7^{a}	7,7	0,4^{a}	18,2	0,4^{a}	10,5	0,6^{a}
Anaceratagallia venosa	23,9	0,6^{a}	7,7	0,1^{ab}	4,5	0,0^{b}	5,3	0,1^{ab}
Batracomorphus irroratus	23,9	7,8^{a}	0,0	0,0^{ab}	4,5	0,2^{b}	0,0	0,0^{b}
Doratura stylata	21,7	0,9^{a}	30,8	1,1^{a}	13,6	0,7^{a}	15,8	0,8^{a}
Delphacinus mesomelas	21,7	0,8^{a}	7,7	0,2^{a}	9,1	0,4^{a}	0,0	0,0^{a}
Anoscopus flavostriatus	21,7	1,1^{a}	15,4	0,5^{ab}	4,5	0,0^{b}	5,3	0,1^{ab}
Dicranotropis hamata	19,6	0,5^{a}	15,4	0,2^{a}	9,1	0,7^{a}	5,3	0,1^{a}
Aphrophora alni	19,6	0,3^{a}	15,4	0,4^{a}	9,1	0,1^{a}	5,3	0,1^{a}
Arthaldeus striifrons	19,6	0,7^{a}	7,7	1,5^{ab}	4,5	0,0^{ab}	0,0	0,0^{b}
Macrosteles laevis	17,4	1,5^{a}	7,7	0,7^{a}	36,4	1,6^{a}	21,1	2,2^{a}
Streptanus aemulans	17,4	0,4^{a}	23,1	0,4^{a}	27,3	0,6^{a}	10,5	0,2^{a}
Agallia consobrina	17,4	0,7^{a}	0,0	0,0^{a}	4,5	0,1^{a}	5,3	0,1^{a}
Rhopalopyx adumbrata	17,4	0,4^{a}	7,7	0,1^{a}	4,5	0,2^{a}	5,3	0,2^{a}
Dikraneura variata	17,4	1,3^{a}	15,4	0,8^{ab}	0,0	0,0^{b}	5,3	0,1^{ab}
Macrosteles viridigriseus	15,2	0,5^{a}	23,1	7,9^{ab}	40,9	5,1^{b}	15,8	1,6^{ab}
Euscelis lineolatus	13,0	1,2^{a}	61,5	3,9^{b}	63,6	6,8^{b}	73,7	23,1^{b}
Psammotettix cephalotes	13,0	1,1	0,0	0,0	0,0	0,0	0,0	0,0
Emelyanoviana mollicula	13,0	1,0^{a}	15,4	0,5^{a}	4,5	0,0^{a}	0,0	0,0^{a}
Muellerianella fairmairei	10,9	0,7^{a}	7,7	0,6^{a}	13,6	2,6^{a}	0,0	0,0^{a}
Eupteryx origani	10,9	0,6^{a}	15,4	2,2^{a}	0,0	0,0^{a}	5,3	0,1^{a}

	Unimproved		Semi-improved		Intensive		Arable reversion	
	frequency	average	frequency	average	frequency	average	frequency	average
Elymana sulphurella	10,9	0,3^{ab}	23,1	0,3^{a}	0,0	0,0^{b}	0,0	0,0^{b}
Eupteryx vittata	8,7	0,3^{a}	7,7	0,2^{a}	4,5	0,1^{a}	5,3	0,1^{a}
Utecha trivia	8,7	1,7^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Evacanthus interruptus	8,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Xanthodelphax straminea	6,5	0,1^{a}	30,8	1,5^{b}	22,7	5,7^{b}	26,3	47,2^{b}
Psammotettix helvolus	6,5	0,2^{a}	30.8	1,5^{ab}	22,7	5,8^{b}	36,8	3,8^{b}
Conosanus obsoletus	6,5	0,3^{a}	7,7	0,1^{a}	18,2	2,2^{a}	5,3	0,1^{a}
Centrotus cornutus	6,5	0,1^{a}	7,7	0,2^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Thamnotettix dilutior	6,5	0,2^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Macustus grisescens	6,5	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Eupteryx aurata	4,3	0,0^{a}	0,0	0,0^{a}	9,1	0,1^{a}	0,0	0,0^{a}
Tachycixius pilosus	4,3	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Ribautodelphax pungens	4,3	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Agallia brachyptera	4,3	0,4^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Planaphrodes bifasciata	4,3	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Evacanthus acuminatus	4,3	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Fagocyba cruenta	4,3	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Alnetoidea alneti	4,3	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Zygina flammigera	4,3	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Balclutha punctata	4,3	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Jassargus flori	4,3	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Athysanus argentarius	2,2	0,0^{a}	7,7	0,1^{a}	4,5	0,1^{a}	10,5	0,6^{a}
Eurysa lineata	2,2	0,0^{a}	7,7	0,1^{a}	0,0	0,0^{a}	5,3	0,1^{a}
Graphocraerus ventralis	2,2	0,0^{a}	7,7	0,1^{a}	0,0	0,0^{a}	5,3	0,1^{a}
Eurysanoides douglasi	2,2	0,1^{a}	7,7	3,6^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Ribautodelphax angulosa	2,2	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Cicadella viridis	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Forcipata citrinella	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Eupteryx stachydearum	2,2	< 0,1^{a}	7,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Edwardsiana crataegi	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Allygus mixtus	2,2	< 0,1^{a}	7,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Allygus modestus	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Speudotettix subfusculus	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Adarrus multinotatus	2,2	< 0,1^{a}	7,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Arocephalus punctum	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Jassargus pseudocellaris	2,2	< 0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Cicadula persimilis	0,0	0,0^{a}	7,7	0,1^{ab}	9,1	0,2^{b}	5,3	0,1^{ab}
Eupteryx urticae	0,0	0,0^{a}	15,4	0,3^{b}	9,1	0,7^{b}	0,0	0,0^{ab}
Megamelodes quadrimaculatus	0,0	0,0^{a}	0,0	0,0^{a}	4,5	0,1^{a}	0,0	0,0^{a}
Psammotettix albomarginatus	0,0	0,0^{a}	0,0	0,0^{a}	4,5	0,0^{a}	0,0	0,0^{a}
Errastunus ocellaris	0,0	0,0^{a}	7,7	0,2^{ab}	0,0	0,0^{ab}	15,8	0,6^{b}
Javesella obscurella	0,0	0,0^{a}	0,0	0,0^{a}	0,0	0,0^{a}	5,3	0,1^{a}
Macropsis fuscula	0,0	0,0^{a}	7,7	0,7^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Notus flavipennis	0,0	0,0^{a}	7,7	0,2^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Ribautiana tenerrima	0,0	0,0^{a}	7,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}
Zygina hyperici	0,0	0,0^{a}	7,7	0,1^{a}	0,0	0,0^{a}	0,0	0,0^{a}
sum species	100,0	23,0^{a}	100,0	21,0^{ab}	100,0	15,9^{b}	100,0	15,4^{b}
eurytopic species	100,0	9,1^{ab}	100,0	10,5^{a}	100,0	8,6^{b}	100,0	9,1^{ab}
nitrophilic spec.	100,0	4,0^{a}	100,0	5,8^{b}	100,0	5,2^{bc}	100,0	6,1^{c}
dry grassland species	100,0	7,9^{a}	100,0	4,6^{b}	86,4	2,8^{b}	84,2	2,7^{b}
chalk grassland species	97,8	4,7^{a}	92,3	2,5^{b}	63,6	1,3^{c}	47,4	0,9^{c}

average values showing the same letter are not significantly different between landuse types

The composition of the 20 most abundant leafhopper species on the arable reversion sites resembles very much the leafhopper assemblage of improved chalk grassland. Again the two most abundant species are *Deltocephalus pulicaris* and *Psammotettix confinis*. These species are closely followed by *Arthaldeus pascuellus* and *Xanthodelphax straminea*, both species reaching their highest densities on arable reversion sites. Eight species are classified as nitrophilic, with the exception of *Deltocephalus pulicaris* and *Aphrodes makarovi* all of these species reach their highest densities on this grassland type. Among the 20 most abundant species of arable reversion sites there are no typical chalk grassland species.

3.4.2 Grazing

In order to measure the short term effect of grazing on the Auchenorrhyncha fauna, a comparison of those sites was made which had undergone different grazing regimes by sheep, cattle, a combination of sheep and cattle or which have been complete unmanaged throughout the sampling year. To eliminate the long-term effects of previous improvement, the group of unimproved sites was analysed separately from a pooled group of arable reversion, improved and semi-improved sites.

On the unimproved chalk grassland sites there was no difference in the effects of sheep and cattle grazing on the vegetation and invertebrates (Figure 26). In comparison with unmanaged sites however, the effects of grazing are clearly visible and significant. The main effect of grazing is the expected reduction of sward height and the unexpected reduction of plant species richness (Figure 26).

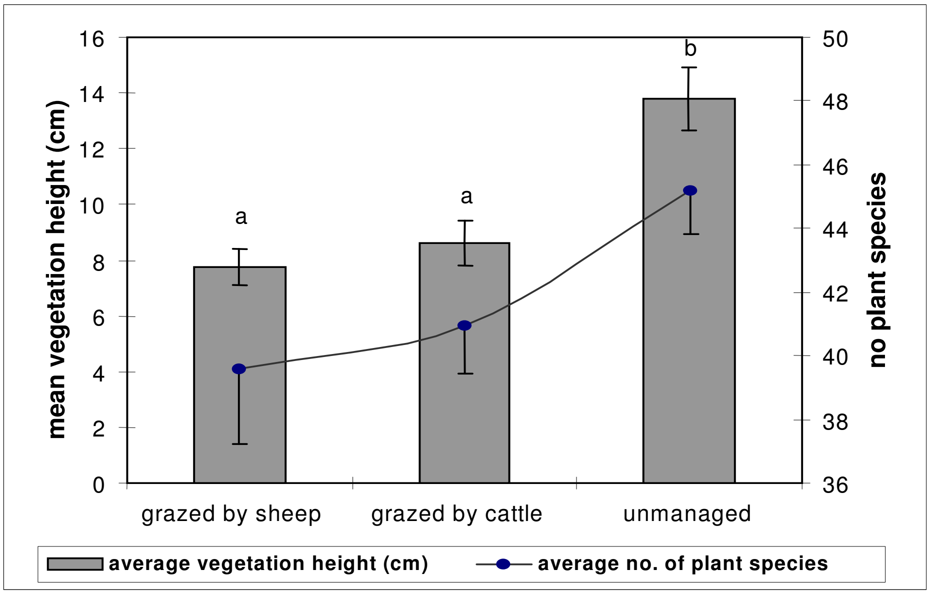
Grazing by both sheep and cattle reduced Auchenorrhyncha species richness (Figure 27). There was also a reduction in leafhopper abundance, but this was only significant for cattle grazed sites where there was a larger sample size than for sheep grazed fields (Figure 28). This short term negative effect of grazing was visible for highly specialized chalk grassland and dry grassland species (Figure 29).

For the group of arable reversion and improved sites, a similar pattern was found, but there appears to be an interaction when sheep grazing was combined with cattle grazing. The reduction of vegetation height through grazing is clearly visible, but it is greatest where grazing of sheep and cattle is combined (Figure 30). The difference between sheep grazed sites and sites with combined grazing was significant. The effect of grazing on plant species richness was only significant for the combination of sheep and cattle grazing (Figure 31).

On improved grassland, the effect of grazing on leafhopper abundance was greatest on cattle grazed sites and sites with a combination of cattle and sheep grazing (Figure 32). The same was true regarding the negative effect on species richness, but there was a significant difference between sheep grazed and sites with combined grazing (Figure 33).

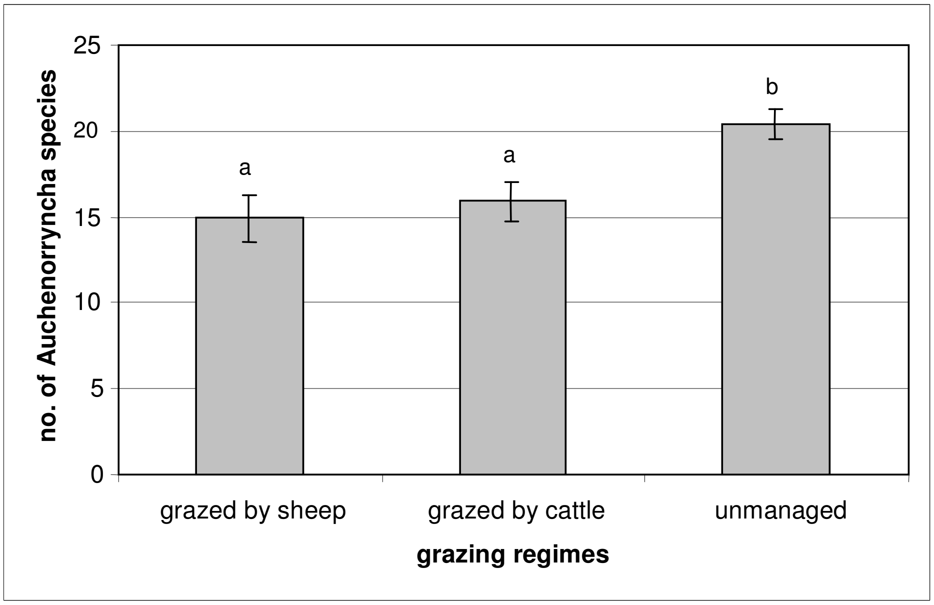
At the level of Auchenorrhyncha guilds on improved grassland, the difference between grazed and ungrazed sites was most apparent for the dry grassland leafhoppers. Here any type of grazing resulted in clear differences to unmanaged sites. For typical chalk grassland Auchenorrhyncha a significant difference was observed only for the combination of cattle and sheep grazing. For the biggest

Auchenorrhyncha guild, the eurytopic species, there was a negative effect of grazing on species richness for the combined grazing and sheep grazing. Additionally, there is a significant difference between cattle grazing and the combined grazing regime. Grazing does not seem to have any effect on nitrophilic species on improved and arable reversion sites (Figure 34).



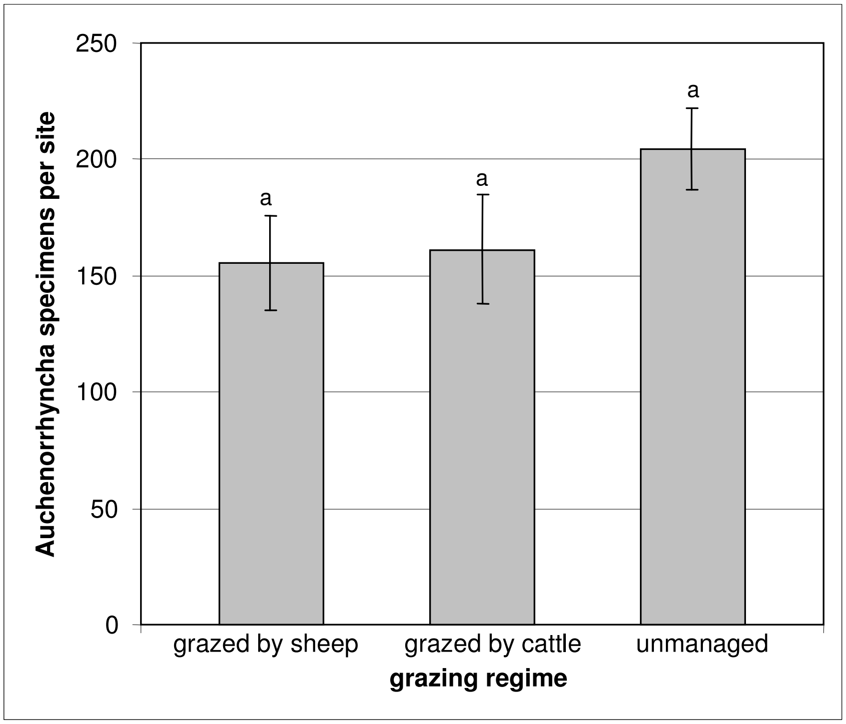
Columns with the same letter are not significantly different

Figure 26: Mean vegetation height (cm) and number of recorded plant species (± one S.E.M.) on unimproved chalk grassland in relation to grazing regime



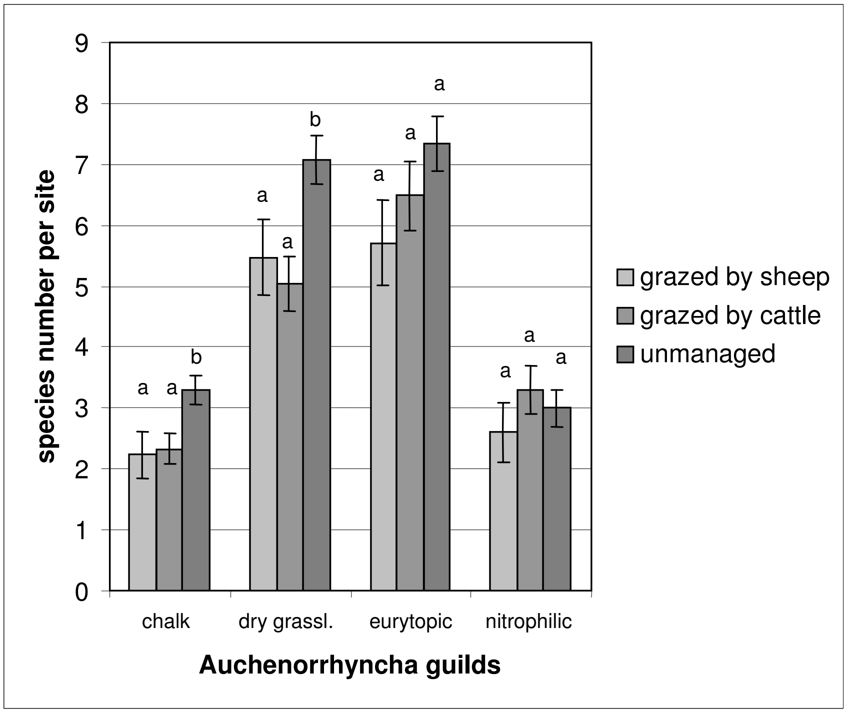
Columns with the same letter are not significantly different

Figure 27: Mean number of Auchenorrhyncha species (± one S.E.M.) on unimproved chalk grassland in relation to grazing regime.



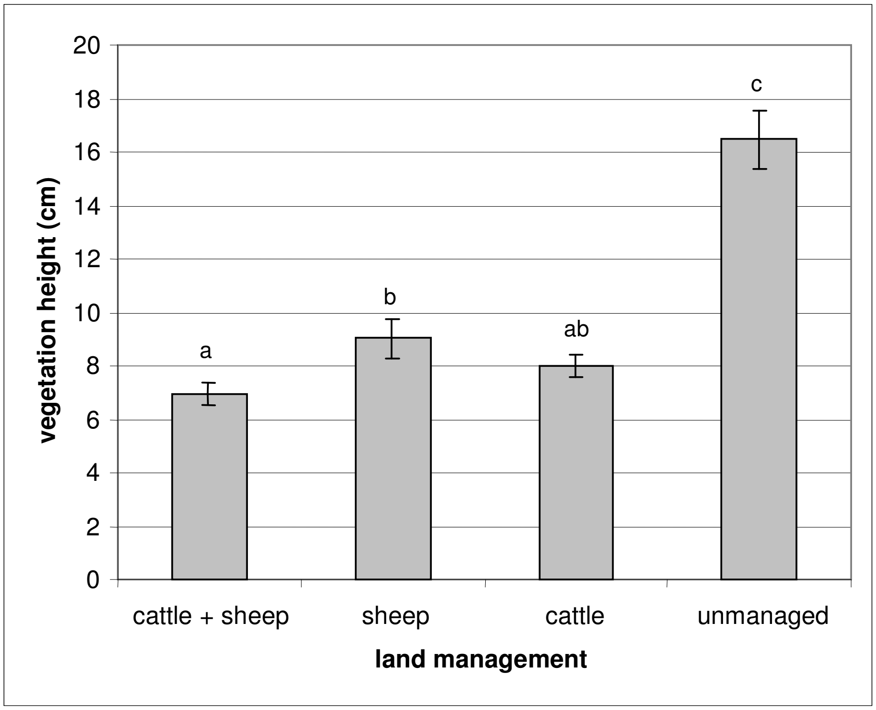
Columns with the same letter are not significantly different

Figure 28: Mean number of Auchenorrhyncha specimens (± one S.E.M.) on unimproved chalk grassland in relation to grazing regime.



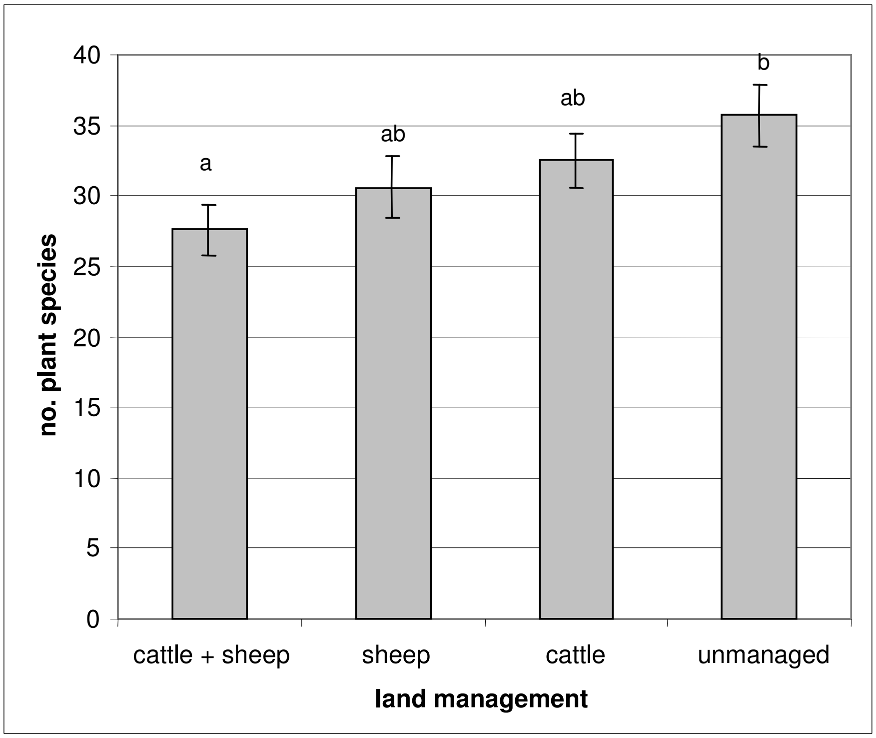
Columns with the same letter are not significantly different

Figure 29: Mean number of Auchenorrhyncha species (± one S.E.M.) on unimproved chalk grassland belonging to different guilds in relation to grazing regime.



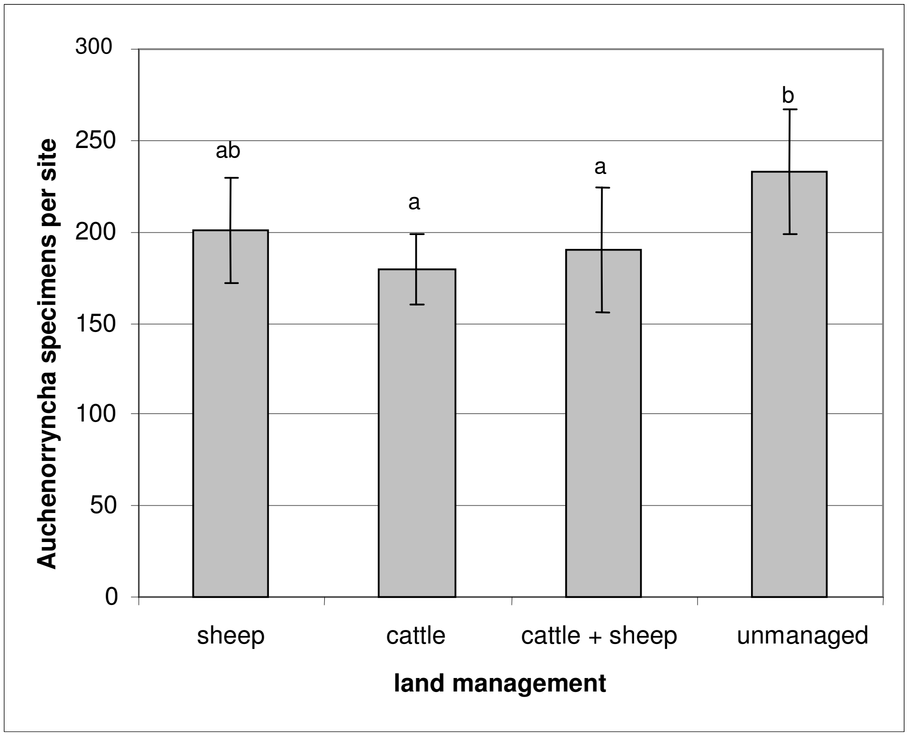
Columns with the same letter are not significantly different

Figure 30: Mean vegetation height (cm) (± one S.E.M.) on improved, semi-improved and arable reversion sites in relation to grazing regime.



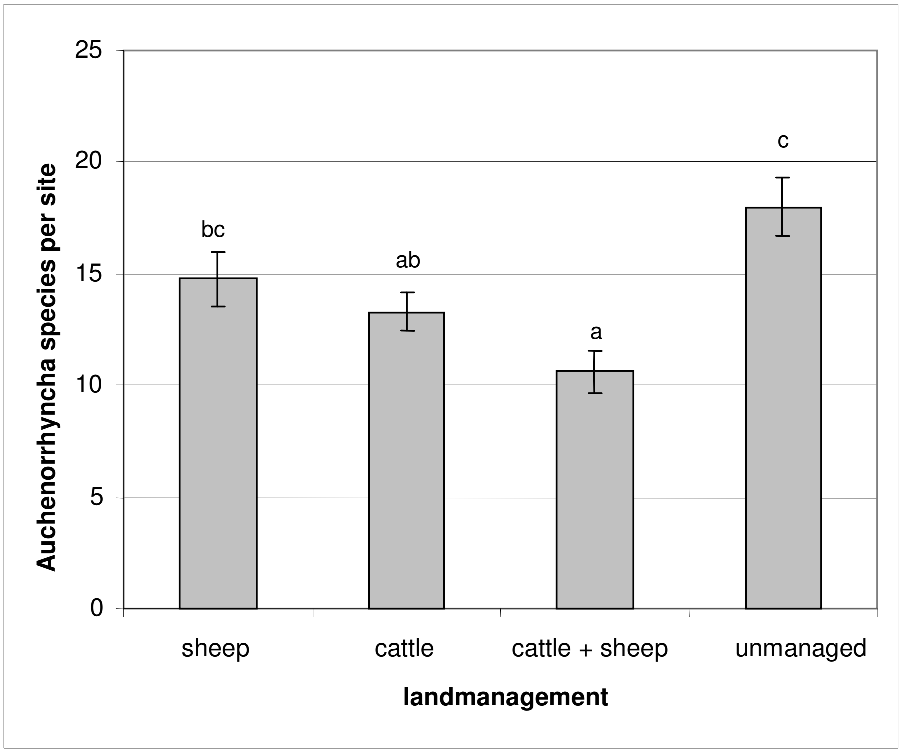
Columns with the same letter are not significantly different

Figure 31: Mean number of recorded plant species (± one S.E.M.) on improved, semi-improved and arable reversion sites in relation to grazing regime.



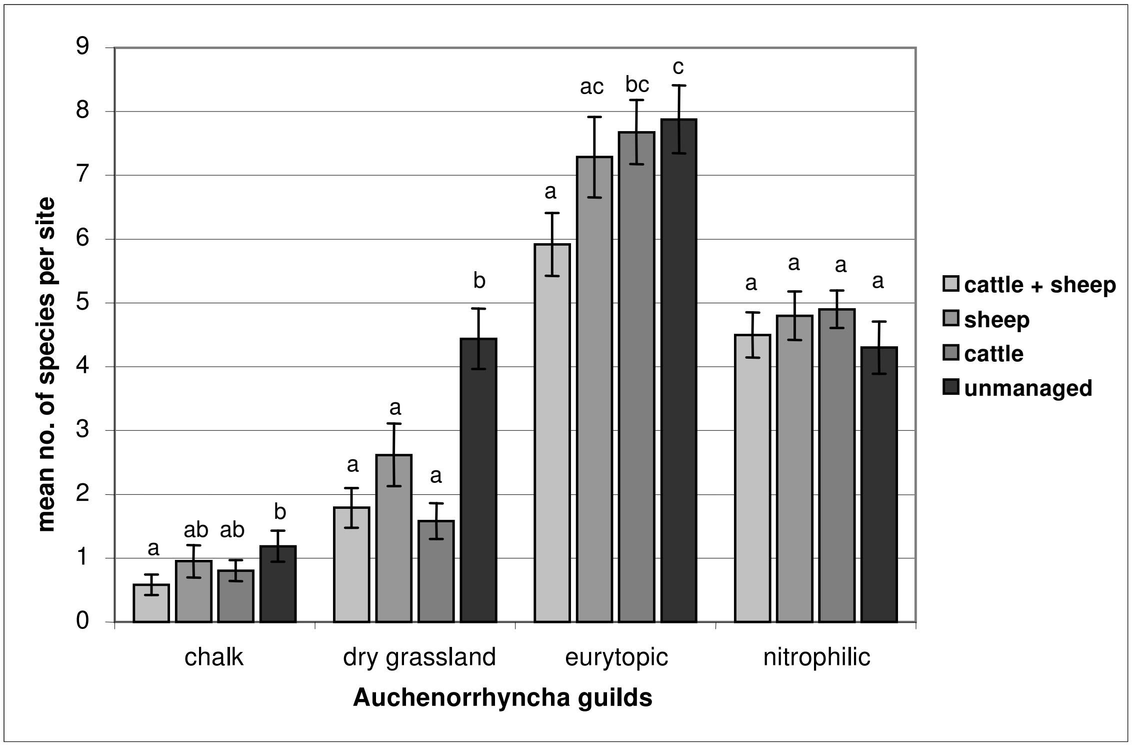
Columns with the same letter are not significantly different

Figure 32: Mean number of Auchenorrhyncha specimens (± one S.E.M.) on improved, semi-improved and arable reversion sites in relation to grazing regime.



Columns with the same letter are not significantly different

Figure 33: Mean number of Auchenorrhyncha species (± one S.E.M.) on improved, semi-improved and arable reversion sites in relation to grazing regime.



Columns with the same letter are not significantly different

Figure 34: Mean number of Auchenorrhyncha species (± one S.E.M.) on improved, semi-improved and arable reversion sites belonging to different guilds in relation to grazing regime.

3.5 Re-colonization

Table 20 shows the frequency in which arable reversion sites are colonized by Auchenorrhyncha in relation to the number of sites with available food plants. The list excludes species living exclusively on woody plants. Table 21 shows the percentage colonization by the Auchenorrhyncha species grouped by their host plant specialization.

The most commonly distributed species on arable reversion sites are mainly ubiquitous nitrophilic species especially *Deltocephalus pulicaris*, *Psammotettix confinis*, *Arthaldeus pascuellus*, *Anoscopus serratulae*, *Euscelis lineolatus*, *Euscelis incisus*, *Javesella pellucida* and *Aphrodes makarovi*.

The seven most frequent species found on arable reversion sites are either oligophagous on grasses or at least have grasses as their main hosts. The percentage of species able to re-colonize arable reversion sites decreases from oligophagous towards monophagous species. The effect is primarily caused by the lack of available food plants. For example, in the case of chalk grassland *Brachypodium pinnatum* and *Carex flacca* fail to colonize arable reversion sites, which also prevents a range of monophagous Auchenorrhyncha species from colonization. Interestingly, on one site, *Kelisia occirrega* was recorded without a record of the food plant *Carex flacca*. It remains unclear if the host plant was not detected or if the sampled specimens were only vagrants. The only monophagous Auchenorrhyncha species frequently successfull in colonising arable reversion sites is *Stenocranus* *minutus* living on *Dactylis glomerata*. It is noteworthy that some of the specialized and normally widespread species on chalk grassland are slow colonizers despite the wide availability of their host plants. Species such as *Cicadula persimilis* living on *Dactylis glomerata*, *Rhopalopyx adumbrata* associated with *Festuca spp.*, as well as *Recilia coronifer* and *Muellerianella fairmairei* both living on *Holcus spp.*, show a wide discrepancy between the availability of host plants and their colonization success. Among the oligophagous species *Aphrodes bicincta*, *Arboridia parvula*, *Anoscopus flavostriatus* and *Elymana sulphurella* are absent or are only found in low frequency on arable reversion sites despite a common appearance on the other investigated grassland types.

Psammotettix helvolus seems to be a frequent colonizer being present on a number of arable reversion sites despite the fact that it has not previously been recognized in Britain.

Table 20: Frequency of Auchenorrhyncha species on arable reversion sites and the availability of host plants (host specialization after NICKEL (2003) as described in chapter 6).

	frequency (%)	**host specialization**	**host plants**	**no. of sites with suitable host plants (n = 19)**
Deltocephalus pulicaris	100,0	oligophagous	grasses	19
Javesella pellucida	94,7	polyphagous	grasses, Cyperaceae	19
Psammotettix confinis	94,7	oligophagous	grasses	19
Zyginidia scutellaris	89,5	polyphagous	grasses	19
Euscelis incisus	89,5	oligophagous	grasses, Fabaceae	19
Anoscopus serratulae	78,9	oligophagous	grasses	19
Arthaldeus pascuellus	73,7	oligophagous	grasses	19
Euscelis lineolatus	73,7	oligophagous	Fabaceae	19
Aphrodes makarovi	57,9	polyphagous	dicotyledones	19
Streptanus sordidus	57,9	oligophagous	*Agrostis spp.*	16
Anoscopus albifrons	52,6	oligophagous	grasses	19
Neophilaenus lineatus	52,6	polyphagous	grasses, sedges, rushes	19
Anaceratagallia ribauti	52,6	oligophagous	*Plantago spp.*	19
Kosswigianella exigua	47,4	monophagous	*Festuca spp.* on chalk	12
Javesella dubia	47,4	oligophagous	grasses	19
Psammotettix helvolus	36,8	oligophagous	grasses	19
Hyledelphax elegantula	31,6	oligophagous	grasses	19
Megophthalmus scanicus	31,6	oligophagous	Fabaceae	19
Eupelix cuspidata	26,3	monophagous	*Festuca spp.* on chalk	12
Xanthodelphax straminea	26,3	monophagous	*Agrostis spp.*	16
Turrutus socialis	21,1	oligophagous	grasses	19
Stenocranus minutus	21,1	monophagous	*Dactylis glomerata*	14
Philaenus spumarius	21,1	polyphagous	dicotyledones	19
Mocydiopsis attenuata	21,1	monophagous	*Festuca spp.*	12
Macrosteles laevis	21,1	polyphagous	grasses/forbs	19
Eupteryx notata	15,8	oligophagous	dicotyledones	19
Mocydia crocea	15,8	oligophagous	grasses	19
Criomorphus albomarginatus	15,8	oligophagous	grasses	19
Doratura stylata	15,8	oligophagous	*Festuca spp., Agrostis spp.*	19
Macrosteles viridigriseus	15,8	oligophagous	grasses	19
Errastunus ocellaris	15,8	oligophagous	grasses	19
Rhytistylus proceps	10,5	monophagous	*Festuca ovina, F. rubra*	12
Streptanus aemulans	10,5	oligophagous	grasses	19
Athysanus argentarius	10,5	oligophagous	grasses	19
Kelisia occirrega	5,3	monophagous	*Carex flacca*	0

	frequency (%)	host specialization	host plants	no. of sites with suitable host plants (n = 19)
Aphrodes bicincta	5,3	oligophagous	Fabaceae	19
Arboridia parvula	5,3	oligophagous	dicotyledones	19
Neophilaenus exclamationis	5,3	oligophagous	*Festuca ovina, Deschampsia flexuosa*	4
Anaceratagallia venosa	5,3	oligophagous	Fabaceae	19
Anoscopus flavostriatus	5,3	oligophagous	grasses	19
Dicranotropis hamata	5,3	oligophagous	grasses	19
Aphrophora alni	5,3	polyphagous	dicotyledones	19
Agallia consobrina	5,3	oligophagous	Lamiaceae	19
Rhopalopyx adumbrata	5,3	monophagous	*Festuca rubra, F. ovina*	12
Dikraneura variata	5,3	oligophagous	fine leaved grasses	12
Eupteryx origani	5,3	monophagous	*Origanum vulgare*	2
Eupteryx vittata	5,3	oligophagous	dicotyledones	19
Conosanus obsoletus	5,3	oligophagous	grasses	19
Eurysa lineata	5,3	oligophagous	grasses	19
Graphocraerus ventralis	5,3	oligophagous	grasses	19
Cicadula persimilis	5,3	monophagous	*Dactylis glomerata*	14
Javesella obscurella	5,3	oligophagous	grasses	19
Kelisia guttula	0,0	monophagous	*Carex spp.*	0
Megophthalmus scabripennis	0,0	unknown	unknown	n.a.
Recilia coronifer	0,0	oligophagous	*Holcus spp., Molinia spp.*	13
Batracomorphus irroratus	0,0	monophagous	*Helianthemum nummularium*	0
Delphacinus mesomelas	0,0	monophagous	*Festuca spp.*	12
Arthaldeus striifrons	0,0	monophagous	*Festuca spp.*	12
Emelyanoviana mollicula	0,0	polyphagous	dicotyledones	19
Muellerianella fairmairei	0,0	monophagous	*Holcus spp.*	13
Elymana sulphurella	0,0	oligophagous	grasses	19
Utecha trivia	0,0	unknown	unknown	19
Evacanthus interruptus	0,0	polyphagous	dicotyledones	19
Macustus grisescens	0,0	oligophagous	grasses	19
Eupteryx aurata	0,0	polyphagous	dicotyledones	19
Ribautodelphax pungens	0,0	monophagous	*Brachypodium pinnatum*	0
Agallia brachyptera	0,0	oligophagous	Fabaceae, Asteraceae	19
Planaphrodes bifasciata	0,0	oligophagous	grasses	19
Evacanthus acuminatus	0,0	polyphagous	dicotyledones	19
Balclutha punctata	0,0	oligophagous	grasses	19
Jassargus flori	0,0	monophagous	*Poa pratensis*	19
Eurysanoides douglasi	0,0	monophagous	*Brachypodium pinnatum*	0
Ribautodelphax angulosa	0,0	monophagous	*Anthoxanthum odoratum*	1
Cicadella viridis	0,0	polyphagous	rushes, grasses, sedges	19
Forcipata citrinella	0,0	monophagous	*Carex spp.*	0
Eupteryx stachydearum	0,0	oligophagous	Lamiaceae	19
Adarrus multinotatus	0,0	monophagous	*Brachypodium pinnatum*	0
Psammotettix cephalotes	0,0	monophagous	*Briza media*	0
Arocephalus punctum	0,0	monophagous	*Festuca ovina*	12
Jassargus pseudocellaris	0,0	oligophagous	grasses	19
Eupteryx urticae	0,0	monophagous	*Urtica spp.*	4
Megamelodes quadrimaculatus	0,0	unknown	unknown	12
Psammotettix albomarginatus	0,0	monophagous	*Agrostis spp.*	16
Macropsis fuscula	0,0	monophagous	*Rubus spp.*	0
Notus flavipennis	0,0	oligophagous	*Carex spp., Bolboscoenus*	0
Zygina hyperici	0,0	monophagous	*Hypericum perforatum*	4

Table 21: Re-colonization success in correlation to host plant specialization.

host plant specialization	no. grassland species recorded in study	no. of species colonising AR sites	% of species colonising AR sites	no. of species with host plants available on at least 1 site	% of species with host plants available on at least 1 site
polyphagous	12	7	58,3	12	100
oligophagous	44	35	79,5	43	97,7
monophagous	27	8	29,6	18	66,7

4 Discussion

4.1 Methodology

4.1.1 Sampling techniques

The wider debate about the most efficient sampling techniques for grassland Auchenorrhyncha is still ongoing. Two classical sampling methods are sweep netting and the use of pitfall traps. In contrast to other invertebrate groups like the Coleoptera, sweep netting is generally more efficient for Auchenorrhyncha than pitfall trapping and usually obtains a higher number of Auchenorrhyncha and a higher proportion of adults (GÜNTHART & THALER 1981, PAYNE 1982, STANDEN 2000). However, trapping can be made more efficient by changing standard pitfall traps for bigger watertraps (GÜNTHART & THALER 1981). KAMITANI & URANO (2000) estimated the optimal number of sweepnet sweeps to record the diversity of hoppers on grassland with around 720 sweeps. On the other hand, 100 sweeps per sample are usually considered to be the minimum for quantitative investigations (KONTKANEN 1950). Data obtained by different sample methods can sometimes lead to very different sets of results. For example, in Switzerland the total number of Auchenorrhyncha obtained from sweepnet samples was positively correlated to the number obtained from suction samples but negatively correlated to results derived from pitfall traps (KORICHEVA ET AL. 2000).

Generally, it is thought that no single sampling technique can be relied upon to reveal the full range of species or provide unbiased estimates of population densities for all species (TÖRMÄLÄ 1982, STEWART 2002). Due to a vertical stratification of leafhopper communities within the vegetation, different sampling techniques (pitfall traps, sweepnets) can target different Auchenorrhyncha communities (CHERILL & SANDERSON 1994). To prevent biased sampling sometimes different sampling methods are used within single studies (TÖRMÄLÄ 1982, AJAYI & PLUMB 1986). In grassland systems the combination of sweepnetting with suction sampling is especially suitable to obtain quantitative data on Hemiptera (TÖRMÄLÄ 1982, STANDEN 2000). However, as in almost every study time and cost limitations play a major role, there usually has to be a concentration on one efficient method.

Surprisingly, only during the last few years suction sampling has become increasingly important in obtaining standardized samples of invertebrates, despite the fact that this method had already been used successfully for insect and particularly for leafhopper sampling as early as the late 1950's (e.g. REMANE 1958). Generally, suction sampling is regarded as very efficient for quantitative surveys of Auchenorrhyncha in comparison with other methods like sweep netting, pitfall traps, heat extraction and labour intensive hand collecting (ACHTZIGER & NICKEL 1997, KÖRNER ET AL. 2001, BORNHOLDT 2002). TÖRMÄLÄ (1982) regards suction sampling as the most effective method for sampling arthropods of the field layer. Even in structurally very diverse habitats such as coastal scrub, and equally very monotonously structured habitats like lentil fields, suction sampling proved to be the most effective single method for a range of invertebrate groups, including Homoptera (SCHOTZKO &

O'KEEFFE 1989, BUFFINGTON & REDAK 1998). However, a careful standardization of the sampling procedure in the field is necessary to obtain reliable data (SAMU ET AL. 1997).

The choice of suction sampling for this study in context of a sampling period stretched over five years, including a repeated sampling on each site during two vegetation periods, turned out to be a very efficient way to obtain estimates of the Auchenorrhyncha communities. Having in mind that the species composition varies considerably between sites, sampling of a large number of localities covered a wide range of Auchenorrhyncha communities occurring on certain grassland types. The obtained data set made it possible to display the average typical community for these grassland types and to show the potentially extreme variations very clearly. This stands in contrast to other studies concentrating on only a few sites, which are then investigated more intensively and over a longer time period (for example MORRIS 1971a, 1973, COOK 1996).

4.1.2 Fluctuations in leafhopper abundances

One of the main problems when analysing quantitative arthropod data pose sometimes extreme differences in occurrence and abundance of Auchenorrhyncha over time. For example, within the present study some species like *Conosanus obsoletus* and *Xanthodelphax straminea* did not at all occur on any of the studied 100 sites in one year, but were common during the next. ROMBACH (1999) observed extreme differences in abundance and rank abundance between two successional years, sometimes recording a population decrease of up to 98 % (*Kelisia guttula*). In this study only a few species remained at roughly the same densities over the course of two successional years. Such fluctuations can often develop without any obvious change in land management. For example, *Kosswigianella exigua* was observed to decrease greatly in numbers after hay cutting in one year but to increase after the same management in the following (ROMBACH 1999). However, it is not surprising that the community structure (abundance and dominance) can vary a lot between two sampling years on the same sites. Insect populations regularly undergo heavy changes due to changing weather conditions and predator or parasite cycles (REMMERT 1980, MASTERS ET AL. 1998). For Auchenorrhyncha this has been demonstrated by ANDRZEJEWSKA (1979). In particular, changing weather conditions have a great impact on abundance and dominance structure of Auchenorrhyncha communities in successive vegetative seasons (KONTKANEN 1950, ANDRZEJEWSKA 1979). High humidity and low temperatures negatively affect Auchenorrhyncha, especially during larval development (ANDRZEJEWSKA 1979). RAATIKAINEN (1971) demonstrated, that the occurrence (emergence) of the same group of leafhopper species differed by a whole month when the warmest and coldest summers were compared. Another cause for different densities and dominance structures obtained from the same sampling plot lies in the clustering habit of the Auchenorrhyncha, even in homogenous habitats (BORNHOLDT & REMANE 1993). In general, insect populations seem to be distributed patchier than vertebrates and plants, resulting in a higher heterogeneity of their communities in relation to their spatial distribution (DI GIULIO ET AL. 2001). Overall, leafhopper communities tend to be labile and their species assemblage may change quickly (HUUSELA-VEISTOLA & VASARAINEN 2000). On the other hand, there are examples, particular from calcareous grassland, which show that the composition (species and dominance structure) of the Auchenorrhyncha fauna can be surprisingly stable over several years, despite severe fluctuations of the abundance of single species (MÜLLER 1978). Sharp changes in species composition and densities which can occur on single sites over time underline the importance of extending sampling periods over at least two years and the need to study as many sites as possible (HOLLIER ET AL. in prep.).

4.2 General characteristics of chalk grassland Auchenorrhyncha communities

Based on the comparison of only one acidic grassland site in Berkshire with data from two calcareous grassland sites in Oxfordshire and Bedfordshire, WALOFF & SOLOMON (1973) stated that the leafhopper communities of acidic and calcareous grassland differ only little in their species composition, but more in their rank abundance. Later, WALOFF (1980) estimated that the diversity on acidic grassland, based on these data, is higher than on calcareous soils. However, neither hypothesis is supported by later studies, including this one. While some acid grassland communities studied had high species richness - WALOFF & SALOMON (1973) recorded 42 and later HOLLIER (1987) 53 species - these results are derived from larger and more habitat-rich areas than the single-field sites of the present study, and may not be generalized. On the other hand, the highest numbers of species found on single calcareous grassland sites in England during studies concentrating on more or less uniform dry habitat conditions reached 39 (this study), 40 (COOK 1996) and even 69 (MORRIS 1990C).

COOK (1996) gives an overview of the most abundant species from nine different study sites (three on acid to neutral grassland, six from calcareous grassland), suggesting that the presence of particular grass-hosts, or range of hosts, determine the distribution of leafhopper species. WALOFF & SOLOMON (1973) and WALOFF (1980) had already suggested that some species (e.g. *Batracomorphus irroratus*, *Mocydia crocea*, *Mocydiopsis attenuata*, *Neophilaenus campestris*, *N. exclamationis*, *Turrutus socialis*, *Psammotettix cephalotes*, *Utecha trivia*) are typical of calcareous grassland whilst others (*Jassargus pseudocellaris*, *Errastunus ocellaris*, *Macrosteles sexnotatus*, *M. viridigriseus*, *Mocydiopsis parvicauda*, *Psammotettix confinis*, *Ribautodelphax angulosa* and *Scottianella dalei*) are acidic grassland species. COOK (1996) adds *Adarrus multinotatus*, *Rhopalopyx adumbrata*, *Planaphrodes bifasciata*, *Zyginidia scutellaris* and *Rhytistylus proceps* to the list of species preferring calcareous conditions. Particular dominant and constant species on central European dry calcareous grassland, which are also widespread and abundant on British chalk grassland are *Philaenus spumarius*, *Turrutus socialis*, *Doratura stylata*, *Emelyanoviana mollicula*, *Anaceratagallia ribauti* and *Mocydia crocea* (SCHIEMENZ 1969). However, these species are also frequently inhabiting acidic grassland.

The results of the present study, comprising the data of 46 unimproved plus 35 semi-improved or improved chalk grassland sites distributed over southern England, can confirm most of the suggestions made by WALOFF (1980) and COOK (1996). However, there are some notable differences. *Macrosteles viridigriseus* and *Psammotettix confinis* are widespread and common on chalk grassland although not among the dominant species. Both species seem to be more dependent on management intensity and vegetation height than on substrate. As a result *P. confinis* is one of the dominant species of improved grassland on chalk.

On the other hand, *Rhopalopyx adumbrata* and *Rhytistylus proceps* are on average comparatively rare on chalk grassland. The current knowledge of the two species suggests that they are generalists on dry grassland (NICKEL 2003). *Planaphrodes bifasciata*, although earlier recorded as a dominant species on one site in Lincolnshire (COOK 1996), is very rare on dry chalk grassland in southern England. However, it can be found in high densities on unimproved neutral wet grassland (own observations). This suggests that this species occurs in calcareous grassland only under relatively moist conditions.

The results of this study provide evidence that some species generally play a more important role within Auchenorrhyncha communities on calcareous grassland than previously thought. *Aphrodes makarovi* and *Eupelix cuspidata* are widely distributed and on average highly abundant species on chalk. So far, both species have not been recorded as particularly abundant in this type of habitat. *Anoscopus albifrons*, previously only observed once as a dominant species on calcareous grassland (WHITTAKER 1969), turned out to be one of the most frequent and dominant species. On the other hand, some of the abundant species from previous studies on calcareous grassland were absent or extremely rare during this study. These species, namely *Forcipata citrinella*, *Neophilaenus campestris*, *Arocephalus punctum* and *Planaphrodes bifasciata* should, therefore, not be regarded as typical species of calcareous grassland since they seem to be much more common in other habitats.

Scottianella dalei is an example of a group of species which one would expect to be widespread on chalk grassland due to the widespread appearance of their host plants (in this case *Agrostis capillaris* and/or *Festuca rubra*). However, the species was not recorded during this study, although it was found to be abundant in similarly structured, species-rich grassland (MG5) on clay in Dorset (own observations).

According to MORRIS (1971a), *Recilia coronifer*, *Agallia consobrina*, *Anoscopus flavostriatus* and *Hyledelphax elegantula* are species of casual occurrence on chalk grassland, but all of them were frequently found on unimproved chalk grassland in this study, suggesting that they form a substantial part of the Auchenorrhyncha fauna on British chalk grassland.

Further evidence which questions the argument that the species composition between acidic and calcareous grasslands is not substantially different, is that many species confined to one of the two grassland groups are specialists depending on certain host plants or abiotic conditions. Often such species are scarce and occur only in low densities, whereas the dominant species include a higher proportion of widespread and common eurytopic leafhoppers. Therefore, it can be assumed, that the main differences between the two grassland systems are to be found among the long list of relatively rare resident species, supporting the idea that leafhoppers with distinct host plant preferences contribute most to assemblage differences (NOVOTNÝ 1991). This contrasts older suggestions that both monophagous and extreme polyphagous species are generally rare in grassland systems (KONTKANEN 1950, WHITCOMB ET AL. 1973, PRESTIDGE & MCNEILL 1983), and that an association to grasses with the same nitrogen level including the ability to change hosts when nitrogen levels change is relatively common (PRESTIDGE & MCNEILL 1983). Subsequently, typical grassland Auchenorrhyncha were often regarded to be generalists and not highly specialized (BROWN ET AL. 1992, HOLLIER ET AL. 1994). However, there is new evidence from intensive studies on the autecology of Auchenorrhyncha that almost all of the rare grassland species will turn out to be more restricted in their diet breadth than previously thought (NICKEL 2003). For chalk grassland this may prove to be particularly important since the host plant range of Auchenorrhyncha is generally narrower in permanent than in ephemeral habitats (NOVOTNÝ 1994a).

Some of the species regularly encountered in high densities on chalk grassland during this study are widespread and common opportunists like *Javesella pellucida* and *Macrosteles laevis*. Such species are characterized by a wide host plant range, bivoltine life cycle, macroptery and a large geographic range (NOVOTNÝ 1995). According to WALOFF (1994) *Zyginidia scutellaris*, the most abundant species in this study, may be the only multivoltine leafhopper species in British grasslands, enabling it to respond readily to favourable weather conditions and the nutritional state of grass by increased mobility and emigration.

4.3 Habitat requirements of chalk grassland Auchenorrhyncha in southern England compared to central and northern Europe

The niche width of a species is correlated with its occurrence inside its natural geographical range. In the centre of their range species tend to be more eurytopic, whereas they behave more stenotopic at the verge of their geographical distribution (SCHIEMENZ 1969). This phenomenon is known as the 'Kuehnelt'sches Prinzip' (ruele of Kuehnelt). According to this ruele, one can assume a more xerophilic behaviour of a lot of grassland species in Britain compared with central Europe, since they are at the edge of their natural geographical range. One can also predict a reduction in the number of annual generations with the decrease of summer temperatures in Britain compared with conditions on the continent. However, so far this has not been observed for any of the grassland Auchenorrhyncha with a known phenology in both Britain and central Europe (WALOFF & SOLOMON 1973).

There is some evidence from previous studies that species occupy different niches in Britain compared to the continent, and seemingly respond differently to a changing environment. Leafhopper species, which react positively to droughts in Britain even on the dry chalk grassland, behave like true xerophilic species. MORRIS & PLANT (1983) observed this phenomenon with *Recilia coronifer*, *Adarrus multinotatus*, *Psammotettix confinis* and *Arocephalus punctum*. In central Europe only *A. multinotatus* and *A. punctum* are regarded as xerophilic. In contrast, *P. confinis* behaves as a mesophilic species on the continent and *R. coronifer* as a hygrophilous species (HILDEBRANDT 1995). According to WALOFF (1980) and MORRIS (1974) *Notus flavipennis* - feeding on *Carex spp*. and restricted to wet habitats on the continent - has never been reported from dry calcareous grassland in England. However, it is common on the Burren in Ireland (MORRIS 1974), where due to climatic conditions the species can survive on calcareous grassland in areas of high rainfall as well as in marshes and bogs, its usual habitats. Within the present study *N. flavipennis* was found on a single chalk grassland site in southern

England. Considering the climatic differences of Ireland and central Europe, it seems possible that some chalk grassland sites in England already provide suitable conditions for this species.

The results of this study support the hypothesis that a number of species seem to be more xerophilic in Britain compared to the continent. However, this might not be a true change of their ecological requirements. Probably, a more regular rainfall pattern and generally higher humidity for microclimatic conditions, may enable some species, regarded as rather hygrophilic in central Europe, to colonize 'dry grassland' in Britain. Species belonging to this category are *Xanthodelphax straminea*, *Agallia brachyptera*, *Anoscopus flavostriatus*, *A. serratulae*, *Notus flavipennis*, *Macrosteles viridigriseus*, *Recilia coronifer*, *Rhopalopyx adumbrata*, *Streptanus sordidus*, *Arthaldeus striifrons* and possibly *Neophilaenus lineatus.* However, on the continent the latter species is often replaced by the closely related *N. minor* and *N. infumatus*. It remains unclear whether this species is able to widen its niche in Britain due to different climatic conditions on chalk grassland or due to the lack of competition from other species. The same could be said for *Rhopalopyx adumbrata*, which is regarded to be fairly hygrophilic on the continent. On dry grassland it is often replaced by *R. preyssleri*, which again is missing in Britain. However, competition between these two species can be ruled out since they feed on different host plants (NICKEL 2003).

It is notable that a number of species preferring wooded habitats in central Europe seem to expand or shift their niche into open grassland inside Britain. Within this study this phenomenon was observed for *Hyledelphax elegantula*, *Neophilaenus exclamationis*, *Agallia consobrina* and *Dikraneura variata*. Again this could be due to different climatic conditions with higher humidity and more evenly distributed rainfall in southern England compared with most parts of central Europe. Some of these sciobiotic species (e.g. *N. exclamationis*) leave their woodland habitats on the continent at higher altitudes (NICKEL 2003).

Another group of species seems to behave more stenotopicly in Britain than on the continent. For example, the preference for calcareous grassland over mesotrophic grassland may indicate that *Criomorphus albomarginatus* occupies a smaller niche in Britain than on the continent, where it is more frequently found on mesotrophic grassland. The results of this study also suggest that *Psammotettix cephalotes* may be a species much more confined to intact chalk grassland in Britain than previously thought. This species is apparently very specialized and occupies a narrower niche than in central Europe where it occurs towards the centre of its natural range. It should be mentioned that previous studies in Britain probably sometimes confused this species with *P. helvolus*. *Turrutus socialis* also seems to be more specialized in Britain, showing a much stronger avoidance of improved grassland than on the continent. Although this species feeds on several grasses it does not easily colonize arable reversion sites, despite the usually close vicinity of a recruitment pool due to its common distribution on chalk grassland. Therefore, *Turrutus socialis* can be regarded as a good indicator species to measure the success of chalk grassland restoration.

In contrast to these species, *Batracomorphus irroratus* gives the impression to be more eurytopic in Britain than in central Europe. The relatively wide distribution of *B. irroratus* in Britain on calcareous grassland can lead to the conclusion that the species is either not as xerothermophilous as previously thought or that it occupies a wider niche in western Europe. In Britain it seems that the occurrence of its host plants more than climatic conditions restrict the distribution of this species. A preference for milder winter conditions can be ruled out since *B. irroratus* is a palaearctic species with a wide geographical range expanding as far east as China (NAST 1972).

4.4 The Auchenorrhyncha chalk grassland communities linked to the NVC

Generally, each site has a unique Auchenorrhyncha community. MORRIS (1990c) demonstrated that chalk grassland sites can be very different in their species composition, even if only sites of established old grassland is compared. On his five study sites, which contained a total of 100 species, only 22 species occurred at every site and only eight were regarded as resident at every site (*Neophilaenus lineatus*, *Anoscopus albifrons*, *Rhopalopyx adumbrata*, *Mocydia attenuata*, *Zyginidia scutellaris*, *Arboridia parvula*, *Stenocranus minutus* and *Javesella pellucida*). Only *Z. scutellaris* was highly abundant on all sites. Because of this high variability, even in relatively stable old grassland, the leafhopper assemblages of sites with known history and management can be predicted only to a certain degree (BROWN ET AL. 1992). However, the results of this project show that it is possible to identify and describe typical Auchenorrhyncha communities. It proved possible to classify preferential species of grassland groups, vegetation communities and even sub-communities. The previously available data on calcareous grassland Auchenorrhyncha were largely gained from research projects concentrating on one or a few sites often close together. In some cases this has given misleading impressions of the composition of British chalk grassland Auchenorrhyncha communities. For example, MORRIS (1973) suggests that *Arocephalus punctum* is very abundant on calcareous grassland and a typical component of the corresponding Auchenorrhyncha community. However, the data presented here suggest that the species is much more likely to be of exceptional occurrence in this grassland type. Only two specimens were found on one of a 100 sampled sites. It is important to point out regional differences occurring in Auchenorrhyncha communities similar to the regional differences of vegetation assemblages. According to COOK (1996) *Adarrus multinotatus*, *Planaphrodes bifasciata*, *Turrutus socialis* and *Verdanus abdominalis* were the most abundant leafhoppers on calcareous grassland in northern England. Only *T. socialis* is also common and characteristic on chalk in southern England; *Verdanus abdominalis* was completely absent and the other two species extremely rare.

It has been shown previously that the correlation between vegetation composition and Auchenorrhyncha communities is much tighter than between vegetation and ground beetles or spiders (IRMLER ET AL. 1998). However, there have been no previous attempts to link Auchenorrhyncha communities to vegetation units like the ones provided by the NVC in Britain. Comparable studies and classification schemes conducted on the continent concentrated on different grassland types and cannot be compared with the situation in Britain (for example MARCHAND 1953, REMANE 1958). Only recently carabid beetles were linked to NVC grassland communities (BLAKE ET AL. 2003). This follows other attempts to classify grassland habitats on a broader British and European scale using carabid beetles (EYRE & LUFF 1990, LUFF ET AL. 1992).

There are notable differences in the appearance of constant, preferential and differential species if vegetation types of different hierarchical levels are compared. On a higher level, in this case the comparison of CG with MG grassland, the number of constant species is low and the number of preferential and differential species is comparably high. During this study there were indeed no highly frequent species which did not show a significant preference for one of the two compared grassland groups (Table 11). On the other hand, at the level of communities or even sub-communities the proportion of constant species rises whereas the number of preferential species and differential species tends to decrease due to the rising similarity of the compared habitats. The sub-communities compared in this study did not show any differential species at all.

Some communities seem to contain a number of valuable differential species. For example, *Mocydia crocea*, *Kelisia occirrega*, *Recilia coronifer*, *Criomorphus albomarginatus* and even *Elymana sulphurella* are classified in this study as differential species of the MG1 community compared with MG5 grassland (Table 14). However, the results are based on a relatively low number of samples. With more samples taken in the future at least some of these species will be probably downgraded to 'preferential' species. The same is true for *Psammotettix helvolus*, *Macrosteles laevis*, *M. viridigriseus* and *Conosanus obsoletus* as differential species of MG6 grassland in comparison to the MG1 community. Again the number of investigated sites in this study is still too small to ascertain their preliminary status.

The description of the Auchenorrhyncha communities of the investigated NVC communities may provide a baseline to which future data can be easily added. Despite not being complete, and the high likelihood that some species will change their position in the system or their classification as preferential or differential species, the charts could already be useful for conservation. For example, the success of habitat restoration could be assessed by monitoring the Auchenorrhyncha communities and comparing the results with the average assemblage of the target grassland.

4.5 Auchenorrhyncha and plant community structure

Spatial structure has important effects on leafhopper assemblages. This does not necessarily mean a dependence of this effect on distinct plant communities. Some distinct plant communities may provide the same structural conditions even on a small scale (MÜLLER 1978), which helps explain the relative high constancy of some dominant dry grassland species in both acidic and calcareous grassland, and the differences in species combination of scarcer recedent species (MÜLLER 1978). Generally, the Auchenorrhyncha communities are not predominantly determined by just one single (e.g. structure) but by a combination of several factors (BROWN ET AL. 1992).

4.5.1 Plant diversity

Plant species richness is supposed to be itself positively related to stability, but may also have an indirect effect on the stability of grassland sites via the support of a corresponding diversity of the invertebrate fauna. A high diversity of phytophagous communities is often related to a high stability of the system (for example ODUM 1971, ANDRZEJEWSKA 1979, ANDOW 1991). However, there seems to be no coherent correlation of arthropods and plant species diversity within grassland ecosystems. For example, it has been shown that there is none or merely a weak correlation between Heteroptera, Coleoptera or Arachnida species richness and the number of plant species in different grassland types (IRMLER ET AL. 1998, DI GIULIO ET AL. 2001). With the exception of the Heteroptera these arthropod groups consist mainly of predatory species, which are apparently more effected by structure and microclimate than by plant species richness (DI GIULIO ET AL. 2001). Still, a high plant diversity does not necessarily imply a high richness of herbivores. WHITTAKER (1969) demonstrated that *Brachypodium pinnatum* dominated grassland had more Auchenorrhyncha species than other botanical more diverse sites. He emphasized that structural diversity is a more important factor influencing leafhopper diversity. However, he later suggested that differences in plant community composition may still account for differences in Auchenorrhyncha density and diversity (WHITTAKER 1977). Additional observations made in other experiments seemingly contradict a positive correlation of grassland leafhopper richness with plant diversity. For example, plant species composition had little effect on the Auchenorrhyncha communities during a grazing experiment with sheep on ex-arable land on limestone in England (BROWN ET AL. 1992). Studies in grass- and sedge-rich habitats in the Czech Republic also showed no correlation of leafhoppers assemblages and the overall vegetation species diversity (NOVOTNÝ 1990). NOVOTNÝ showed that leafhopper diversity was correlated with the species number of grasses and sedges and the moisture condition of the habitat. In succession experiments on permanent field strips the species richness of leafhoppers remained the same despite a decline of plant species due to the loss of annual dicotyledones, leading to the assumption that multilayered permanent habitats are more important for leafhoppers than plant species-rich habitats (HUUSELA-VEISTOLA & VASARAINEN 2000). However, the results of the last three mentioned experiments derive only from a small set of plots on artificially manipulated arable reversion sites and unstable highly dynamic ruderal communities investigating only early successional stages. They may not, therefore, be representative for long established grassland communities, because their Auchenorrhyncha fauna should be dominated by pioneer species.

The data presented here show a strong positive correlation between the number of Auchenorrhyncha species and plant species (Figure 7). This result is in line with other studies suggesting that a simplification of plant species diversity is followed by a decrease in the species diversity of herbivores, especially of leafhoppers (ANDRZEJEWSKA 1979, 1991, EYRE ET AL. 2001). A general effect of plant species diversity on dependent herbivorous groups like Auchenorrhyncha seems only logical, but the degree of the effect probably depends on the degree of host plant specialization among the herbivores. Grassland Auchenorrhyncha communities are characterized by a relatively high proportion of grass and sedge feeders, with only few species feeding on forbs (MORRIS 2000, NICKEL 2003). Additionally, more species than formerly known, especially rare ones, may prove to be very specialized or monophagous (NICKEL 2003). Furthermore, grassland leafhoppers seem to be able to switch between host plants according to changing nutrient supply (PRESTIDGE & MCNEILL 1983). CHERILL & RUSHTON (1993) found a strong relationship between the number of Auchenorrhyncha and the number of grass species. In their study the increase of grass and leafhopper species was correlated with a higher pH-value resulting in a lower abundance of sedges. The relationship between Auchenorrhyncha species richness with the number of grasses helps to explain rapid changes in early successional stages when plant composition changes from a high forb proportion to a low one (HOLLIER ET AL. 1994). However, within the present study the positive correlation of leafhopper species richness and plant species richness could only partially be attributed to the group of grasses and sedges.

There was no correlation of leafhopper abundance and the numbers of plant species (Figure 10). Other available data regarding numbers of leafhoppers in the context of plant diversity show heterogeneous results. Thus the numbers of Cicadellidae showed a linear negative relationship to the numbers of plant species on experimentally manipulated plots in Switzerland and Sweden (KORICHEVA ET AL. 2000). However, these results were statistically valid only for sweepnet samples and not for suction sampling or pitfall traps. Taking plant biomass and percentage plant cover into account the results were no longer significant. The explanation given was that the covariates biomass and plant cover were significantly correlated. Reduction of leafhopper numbers in high diversity plots was due to increased biomass and percent cover (KORICHEVA ET AL. 2000). The ratio of grasses to forbs had no significant effect on the number of Auchenorrhyncha, but presence of legumes effected the number of leafhoppers from sweepnet samples (KORICHEVA ET AL. 2000).

According to ANDRZEJEWSKA (1979) a simplification of the plant community is followed by an increase in the proportion of invasive leafhopper species. This phenomenon was not followed up in this study due to the difficulties in defining invasive species for British chalk grassland.

4.5.2 Vegetation structure

Grasslands are often considered as nearly two-dimensional systems. This impression is especially emphasized on heavily grazed pastures with short swards (MORRIS 2000). Still, the importance of vegetation structure and especially the spatial structure of grassland systems has been investigated for a wide range of invertebrate groups (DUFFEY 1962a,b, 1975, SOUTHWOOD ET AL. 1979, MORRIS 2000). The highest insect diversity within chalk grasslands is usually found on sites with a range of vegetation structure, from short turf through to scrub (KIRBY 2001). In general, highest abundances of invertebrates are found in areas of taller turf (BROWN ET AL. 1990). A relatively wide range of studies demonstrated that vegetation structure and especially the spatial structure of plant communities is a very important factor influencing the Auchenorrhyncha assemblages (ANDRZEJEWSKA 1965, 1979a, WALOFF & SOLOMON 1973, DENNO 1977, MORRIS 1981a,b, SERGEL 1988, BROWN ET AL. 1992, NOVOTNÝ 1992, EYRE ET AL. 2001). STINSON & BROWN (1983) observed a strong correlation between leafhopper species richness and the architectural diversity of vegetation. However, these results gained from early successional stages, often during only one growing season, may be somewhat flawed by the fact that due to the lifecycles of plant and insects and colonization processes one might expect parallel increases in species richness and structural diversity to occur independently. ANDRZEJEWSKA (1965) states that different meadow leafhopper species occupy different layers in meadows regardless of the character of the habitat.

The effects of structural diversity of vegetation are often impossible to distinguish from the direct effects of plant species richness (LAWTON 1983). Indeed plant species richness probably contributes to structural diversity. The amount of this contribution may be at least partially expressed by the alpha diversity of the plant communities on the sites which - measured through the Shannon-Weaner index (H_s) - was in this study positively correlated with leafhopper species richness (Figure 13).

There was a strong positive correlation between leafhopper species richness and vegetation height as one of the most important parameters of structural diversity. It should be pointed out that in this case vegetation height was not correlated to plant species richness. The effect of vertical structure on leafhopper assemblages has been observed previously by a range of authors (ANDRZEJEWSKA 1965, WHITTAKER 1969, MORRIS 1971a, WALOFF & SOLOMON 1973, DENNO 1977, 1994). There is only one study, conducted in grass-dominated ruderal habitats, showing no correlation of leafhoppers assemblages and vegetation characteristics including vegetation height at all (NOVOTNÝ 1990).

A taller vegetation provides more complex structural diversity and therefore, more niches for insect species (MORRIS 2000). Additionally, taller swards improve the hiding conditions and provide shelter for herbivores. Thus, predators which hunt visually like the carabid species of the genus *Notiophilus* are characteristic for open conditions and short grassland (MORRIS 2000). KUNTZE (1937) observed that Auchenorrhyncha remain in the lower part of the plants during cold and windy weather. There have also been vertical movements of insects (here Nabidae) observed during the diurnal cycle (FEWKES 1961).

The results of this study suggest that for some species vegetation structure is more important than availability or food quality of their hosts. For example, *Stenocranus minutus* is more abundant on ranker chalk grassland sites than on mesotrophic grassland with higher abundances of its only host grass *Dactylis glomerata* (Table 11 and 12). This suggests that structural conditions (high vegetation as a consequence of low grazing pressure) may be more important for its existence than a high abundance of its host plant or good nutrient supply by the host plant due to growing on nutrient rich sites. Similarly *Kelisia occirrega* prefers higher swards even though the main host plant *Carex flacca* is short growing and occurs on the shorter swards in higher frequencies (Table 18).

A number of leafhopper species have already been recognized as typical for taller grassland vegetation in Britain (Annex 6). This study can support the classification of these species as typical inhabitants of tall grassland vegetation. Exceptions are *Arboridia parvula*, which showed significantly higher densities on sites with short vegetation, and *Conosanus obsoletus*, *Cicadula persimilis* and *Adarrus multinotatus*, where the low number of sampled individuals did not provide enough information. Additionally, a preference for tall vegetation was observed for *Mocydia crocea*, *Kelisia occirrega*, *Megophthalmus scabripennis*, *M. scanicus*, *Mocydiopsis attenuata*, *Rhopalopyx adumbrata*, *Emelyanoviana mollicula*, *Eupteryx origani*, *Zyginidia scutellaris* and *Recilia coronifer*.

A wide range of the more stenotopic Auchenorrhyncha species living in grassland require almost certainly special habitat structures on a very small scale (MORRIS 2000), as has been already demonstrated for some other insect groups. A good example for British chalk grassland is the silver-spotted skipper (*Hesperia comma*), which needs short *Festuca ovina* patches surrounded by bare ground for oviposition (THOMAS ET AL. 1986). Unfortunately, little is known about similar habitat requirements within the Auchenorrhyncha, although this might have important implications for habitat conservation. Species richness and abundance of Auchenorrhyncha can increase with high small-scale structural heterogeneity (here tussocks versus even sward) (DENNIS ET AL. 1998). A multilayered structure of vegetation satisfies habitat requirements for more species than simplified grassland as, for example, intensively cultivated leys or regularly mown lawns. Consequently, HUUSELA-VEISTOLA & VASARAINEN (2000) were able to show that multilayered permanent habitats are more important for leafhoppers than plant species-rich habitats.

In contrast, a low sward gives only species which live in lower parts of the plants or are specially adapted to the litterzone a chance to survive (ANDRZEJEWSKA 1979). In Poland intensively grazed pastures with low vegetation were basically inhabited by *Deltocephalus pulicaris*, *Aphrodes spp*. *Macrosteles laevis*, *M. sexnotatus* and *Javesella pellucida* (AndRZEJEWSKA 1991). Other species typical for short turf are *Euscelis incisus* and *Psammotettix confinis* (MORRIS 1990c, BROWN ET AL. 1992, WALOFF & SOLOMON 1973). Species on chalk grassland in southern England adapted to such conditions as shown in this study are *Deltocephalus pulicaris*, *Psammotettix confinis* and *Euscelis lineolatus*. All three species are significantly more abundant on sites with short vegetation and prefer nutrient rich improved grassland. However, HOLLIER (1989) suggests that *Euscelis lineolatus* can be equally abundant in short and tall swards. In contrast to species of low vegetation, species of higher layers like *Neophilaenus lineatus* and *Philaenus spumarius* are more abundant in less intensively managed or unmanaged sites (ANDRZEJEWSKA 1965). However, it is often said that invertebrates of tall chalk grassland tend to be common, whereas those of short turf are rare and can easily be lost through poor site management (KIRBY 2001). This is certainly not true for rare Auchenorrhyncha on chalk. Of the seven notable Auchenorrhyncha species recorded, four (*Eurysanoides douglasi*, *Ribautodelphax angulosa*, *Ribautodelphax pungens*, *Athysanus argentarius*) prefer taller swards and one is typical for rank but open vegetation (*Agallia brachyptera*). Only *Utecha trivia* shows a slight preference for short turf. The remaining species (*Psammotettix albomarginatus*) is not a typical chalk grassland element at all.

The abundance of leafhoppers on chalk grassland is also positively correlated with vegetation height (Table 18) which has already been observed by many other authors (ANDRZEJEWSKA 1965, MORRIS 1971b, 1973, 1974, WALOFF & SOLOMON 1973, MORRIS & LAKHANI 1979, MORRIS & RISPIN 1994, BROWN ET AL. 1992, MORRIS 2000). However, one has to keep in mind that in more diverse grassland communities the average abundance of each species tends to be relatively low (ANDRZEJEWSKA 1979).

It is noteworthy that diversity, species number and number of individuals of leafhoppers can increase with increasing encroachment of scrubs as shown on calcareous grassland in southeast Germany (KOPETZ & KÖHLER 1991). In contrast, cutting and grazing leads to the reduction of structural diversity and, thus, to a decrease of diversity and evenness of Auchenorrhyncha communities (ROMBACH 1999).

This effect, namely a reduction of structural diversity (vegetation height and plant species richness) through grazing and subsequently a decrease of Auchenorrhyncha species richness was observed in this study as well.

Some Auchenorrhyncha species need special grass structures for oviposition. For example, *Rhytistylus proceps* seems to lay eggs only in dead flower stems of grasses (COOK 1997). Species of the litter layer like *Agallia brachyptera*, *Xanthodelphax straminea*, *Streptanus sordidus* and *Aphrodes makarovi* have a better survival chance in semi natural grassland, which accumulates more litter than intensively managed grassland (ANDRZEJEWSKA 1965). Coarse grassland seems to be especially important as an overwintering habitat for leafhoppers as has been demonstrated for *Javesella pellucida* (MORRIS 1990b). The Auchenorrhyncha on sown calcareous grassland showed the development of different assemblages on a fine leave grass mixture compared with a coarse one within two years (MORRIS 1990b). Bivoltine Auchenorrhyncha species like *Zyginidia scutellaris*, *Javesella pellucida* and *Cicadula persimilis* appeared to be mainly associated with coarse grasses, while univoltine species like *Mocydiopsis attenuata*, *Criomorphus albomarginatus* and *Rhopalopyx adumbrata* preferred fine-leaved grasses (MORRIS 1990b). Extensively managed comparable lean grasslands like *Nardus stricta* grassland are characterized by a high ratio of fine-leaved grasses and subsequently a high number of associated specialized Auchenorrhyncha (BORNHOLDT 2002).

4.6 Auchenorrhyncha and management of chalk grassland

4.6.1 General aspects

It has often been observed that intensification of management on grassland leads to a change of species composition and often to a decrease in invertebrate species richness (CURRY 1987, 1994, EYRE ET AL. 1989, ANDRZEJEWSKA 1991, NORDHEIM 1992, DI GIULIO ET AL. 2001, SÖDERSTRÖM ET AL. 2001, KRUESS & TSCHARNTKE 2002). This effect is usually explained with a structural simplification of improved habitats. According to ANDRZEJEWSKA (1991) a change from a fine mosaic of various habitats into little diversified intensively used monocultures results in the following changes within the Auchenorrhyncha fauna:

- Reduction of species diversity
- Occurrence of very active species (invading species)
- Considerable time variability of species composition and density of Auchenorrhyncha communities
- Retarded formation of the community
- Ousting of species of a narrower trophic and habitat specialization.

The insect communities of only extensively used grassland can sometimes be characterized by a higher variation of species composition than the intensively managed ones (DI GIULIO ET AL. 2001). On the other hand, a comparison of improved with natural grassland showed a higher stability of the Auchenorrhyncha community together with a lower amount of invasive species on the natural grassland (ANDRZEJEWSKA 1991).

One can assume that lower species richness on improved grassland is accompanied by a higher abundance of single species according to the “Biozönotisches Grundgesetz” of THIENEMANN (adapted after REMMERT 1980). This is probably true considering the results of this and other studies (ANDRZEJEWSKA 1976, 1979, 1991). It is only rarely observed that intensive annual land management reduces abundance and diversity equally (MORRIS 2000). Within this project no significant differences in the overall abundance of leafhoppers between the different landuse types were recorded, which is in contrast to some other studies. Thus, intensive cultivation on moist meadows in Poland led to an increase of leafhopper abundance in comparison to unimproved grassland (ANDRZEJEWSKA 1979, CHUDZICKA 1989). This effect can be explained with a high nutrient value of host plants during the whole growing season and a slowdown of the process of maturing and dying of plants (ANDRZEJEWSKA 1979).

Increase of landuse intensity on chalk grassland in the sense of increased grazing pressure and improvement through fertilization had a strong and long lasting impact on the Auchenorrhyncha communities of the investigated sites. Although the majority of the semi-improved and improved sites of this study now have restrictions in grazing intensity and fertilizer input, their leafhopper communities are still very different from those on unimproved chalk grassland. On average, the vegetation height and the number of plant species is highest on unimproved sites (Figures 15, 16 and 19), and the ratio of grasses to forbs is lowest on such sites and increases towards improved sites (Figure 17). Some important leafhopper host plants like *Carex flacca* decline rapidly with the application of fertilizers (MOUNTFORD ET AL. 1996). Such species are almost absent on improved grassland sites and the floral composition on improved sites always indicates nitrogen rich conditions.

The number of Auchenorrhyncha species, especially of those highly adapted to conditions on chalk or dry grassland drops down dramatically on improved grassland. On the other hand, the number of nitrophilic leafhopper species increases significantly on improved or arable reversion sites (Figure 23). Similar results, notably a significant decrease of specialized and threatened species on intensively managed grassland, have been obtained for Auchenorrhyncha in central Europe (ACHTZIGER & NICKEL 1997, NICKEL & ACHTZIGER 1999, NICKEL & HILDEBRANDT 2003). Generally, intensively managed grassland supports only very species-poor Auchenorrhyncha communities (NICKEL ET AL. 2002). In Britain MORRIS & PLANT (1983) also observed a negative response in species richness by Auchenorrhyncha to intensification of management.

Some species display a noteworthy discrepancy between their average abundance and their frequency of occurrence on the different landuse categories. *Anoscopus albifrons* is the most constant species on chalk grassland occurring on almost all sampled sites but it only reached 11th rank in average density (Table 19). Other species which occur on unimproved chalk grassland in high frequency, but are usually found only in small numbers are *Aphrodes makarovi*, *A. bicincta*, *Javesella pellucida*, *Kelisia occirrega*, *Arthaldeus pascuellus* and *Neophilaenus lineatus*. On semi-improved grassland species with high frequencies and low average numbers include *Anoscopus albifrons*, *Aphrodes makarovi*, *Turrutus socialis*, *Eupteryx notata*, *Neophilaenus lineatus*, *Philaenus spumarius* and *Euscelis lineolatus*. In contrast, *Eurysanoides douglasi* is a rare species on the sampled semi-improved sites, but reached such high densities on a single site that it still ranks among the 20 most abundant species. *Javesella pellucida* and *Euscelis incisus* are among the most constant species on improved grassland, but occur in relatively low densities. On arable reversion sites *Javesella dubia* shows the same pattern.

Not only the number of species but also the number of potential residents on the sites can change with intensification of landuse. In this study 29 species (more than a quarter of all recorded species) were sampled exclusively from unimproved sites. However, this phenomenon is partly caused by accidental sampling of leafhopper species living on woody plants, originating from scrub encroachment on a number of unimproved sites. The overall potential number of Auchenorrhyncha species in intensively managed grassland is given by NICKEL & ACHTZIGER (1999) as just 20 compared to 120 in extensively or unused grassland in Germany. Single sites of extensively managed grassland in Britain and central Europe can hold up to 30 or even 40 species (MORRIS 1973, NICKEL ET AL. 2002). These results are in line with the maximum of 40 species recorded from one single unimproved site during this presented study. The combination of the high maximum of observed species on single sites with the much higher number of potential species that could be expected on unimproved grassland, leads to a higher variation of species composition than on intensively managed sites. This effect has been already observed for some other arthropod groups (DI GIULIO ET AL. 2001).

In some cases the absence of species on intensively managed sites can be explained with the absence of suitable host plants. This is, for example, the case for *Kelisia guttula*, *Ribautodelphax pungens* and *Eurysanoides douglasi*. For other species, such as *Utecha trivia* and *Agallia brachyptera*, other factors like structural density of plant cover, amount of litter or a different microclimate may be relevant factors. The microclimate in grassland is not only affected by the density and height of grass species, but also by the amount of tussocks as the results of LUFF (1965) suggest.

Although the overall number of Auchenorrhyncha individuals can stay level or even increases with intensification, most of the Auchenorrhyncha species respond negatively to an increase of management (MORRIS & PLANT 1983). Within this study species generally regarded as typical inhabitants of chalk or dry grassland have higher abundances on unimproved sites. The fact that semi-improved grassland stands in contrast to unimproved chalk grassland already characterized by eurytopic and nitrophilic species is of high importance for conservation issues. On semi-improved grassland *Deltocephalus pulicaris* is the most abundant species, occurring here already in densities about five times higher than on unimproved grassland. Seven more nitrophilic species are among the 20 most abundant species of this grassland type, compared with only three typical chalk grassland species.

By far the most dominant species on improved chalk grassland is *Deltocephalus pulicaris*, on average being here more than ten times as abundant than on unimproved sites. On arable reversion sites this species is still four times more abundant than on unimproved grassland. The observed remarkable differences in alpha diversity between the four landuse categories are partly caused by the extreme abundance of *Deltocephalus pulicaris* on improved grassland in combination with a generally higher species richness on unimproved chalk grassland sites. Among the 20 most abundant species of the improved grassland eight are regarded as being nitrophilic and only two (*Arboridia parvula*, *Eupteryx notata*) can be classified as typical chalk grassland species.

4.6.2 Fertilizer

Despite a recent restriction of fertilizer input improved grassland and arable reversion sites of this study are still characterized by high nitrogen levels, as is shown by their mesotrophic grassland communities with a high percentage of nitrophilic plant species. Next to intensive management regimes, especially heavy grazing, it has probably been primarily the fertilizer input in the past, which is still responsible for a low Auchenorrhyncha diversity on these sites.

European grasslands are characterized by an increase of plant species richness with increasing productivity in terms of above ground biomass (HECTOR ET AL. 1999). However, the increase of biomass due to heavy fertilizer input often results in a decrease of floral diversity. Equally an increase of fertilizer usually leads to an increase of overall leafhopper numbers and a decrease of Auchenorrhyncha species richness (PRESTIDGE 1982, SEDLACEK ET AL. 1988). There can be similar changes of Auchenorrhyncha and plant communities regarding dominance-structure and the disappearance of low abundance species (ANDRZEJEWSKA 1976). WHITTAKER (1977) and ANDRZEJEWSKA (1976) recorded an increase of leafhopper biomass with higher levels of fertilization. However, the increase of biomass is not necessarily accompanied with an increase of the overall numbers of leafhoppers (ANDRZEJEWSKA 1976). Within other insect groups, for example Orthoptera, even a decrease in numbers after fertilization has been observed (VAN WINGERDEN ET AL. 1992). In general, fertilising of grassland leads to leafhopper assemblages with high densities, low diversity and a high proportion of bivoltine oligo- and polyphagous species readily invading new established habitats (NOVOTNÝ 1991)

Nitrogen increases the food quality and has consequently a positive effect on the numbers of leafhoppers. Additionally, more living space due to rapid growth after fertilization might result in higher abundances of leafhoppers. However, diversity usually decreases because only few species profit disproportional from this effect (PRESTIDGE 1982).

Due to fertilization the species with narrow habitat specialization disappear first. Eurytopic species are less sensitive and tend to be dominant in both unfertilized and fertilized meadows, as has been observed for *Turrutus socialis* and *Errastunus ocellaris* (ANDRZEJEWSKA 1979). Equally there is a group of dominant invasive species, notably *Javesella pellucida*, *Macrosteles laevis* and *Streptanus aemulans* which occur mainly on fertilized meadows (ANDRZEJEWSKA 1979).

On intensively used (grazed, mown) grassland with low swards and suitable conditions only for species living close to the ground, application of higher fertilizer does result in quicker plant growth and can promote the occurrence of species living in higher plant layers (ANDRZEJEWSKA 1965, 1991). In extreme cases this can result in the absence of nitrophilic but short sward preferring species like *Deltocephalus pulicaris* and *Psammotettix confinis* (ANDRZEJEWSKA 1976, 1979, MORRIS 1992).

A number of species show a clear preference for fertilized and nitrogen-rich grassland. *Deltocephalus pulicaris*, *Errastunus ocellaris*, *Javesella pellucida*, *Dicranotropis hamata*, *Jassargus pseudocellaris*, *Macrosteles laevis*, *M. sexnotatus*, *Streptanus aemulans*, *S. sordidus*, *Aphrodes makarovi*, *Philaenus spumarius* and *Euscelis incisus* belong to this group (WHITTAKER 1977, ANDRZEJEWSKA 1976, 1979, MORRIS 1990c, BORNHOLDT & REMANE 1993, BORNHOLDT 2002). *Deltocephalus pulicaris*, *Errastunus ocellaris*, *Javesella pellucida*, *Dicranotropis hamata* and *Euscelis incisus* were observed to prefer especially fertilized meadows in contrast to unimproved calcareous grassland (BORNHOLDT & REMANE 1993).

Doratura stylata, although in central Europe often abundant on lean grassland (MÜLLER ET AL. 1978, BORNHOLDT & TAMM 1986, NICKEL 2003), responded with a high increase to treatment of permanent old grassland with fertilizer in the United States (SEDLACEK ET AL. 1988). In contrast, *Turrutus socialis*, *Agallia venosa*, *Aphrodes bicincta*, *Emelyanoviana mollicula*, *Rhytistylus proceps* and *Verdanus abdominalis* showed a clear preference for nutrient poor sites on limestone (BORNHOLDT & REMANE 1993).

An interesting issue for nature conservation is the increase of *Brachypodium pinnatum* with increasing nitrogen levels (HURST & JOHN 1999). Although usually absent from improved grassland, it can become a problematic species on unmanaged unimproved grassland due to its invasive behaviour and only strict management regimes are able to reduce its dominance (BOBBINK & WILLEMS 1991). However, some of the more specialized chalk grassland leafhopper species like *Eurysanoides douglasi* and *Ribautodelphax pungens* feed exclusively on *B. pinnatum*.

4.6.3 Disturbance

There is no exact definition of the term disturbance. Sometimes it is used to describe direct effects caused by trampling through humans or grazing animals. More often the term is used in a wider sense to describe any form of management (e.g. grazing and mowing) as a form of disturbance in contrast to unmanaged natural habitats (NICKEL & HILDEBRANDT 2003).

So far, there have been only a few studies looking into the directs effects of human trampling or trampling by grazing animals, generally observing a decrease of numbers and biomass of invertebrates (DUFFEY 1975, Andrzejewska 1979).

An increase in meadow habitat disturbances caused by management practises in Poland was accompanied by a reduced diversity of Auchenorrhyncha communities (ANDRZEJEWSKA 1991). An increase of disturbances on urban greens of Warsaw showed an increase in abundance and a decrease of diversity within the Auchenorrhyncha (CHUDZICKA 1987). However, urban greens are generally extremely poor; for example, on sites in central Finland only *Deltocephalus pulicaris* was caught in abundance (TÖRMÄLÄ & VÄNNINEN 1983). The large number of macropterous examples and the low numbers of nymphs on the disturbed sites in Finland led to the assumption that especially the delphacids sampled were mainly immigrants. These results are in concordance with a study by ANDRZEJEWSKA (1991), who observed that the degree of community structure simplification through disturbance can be determined by the spatial structure of the surrounding habitats. The more serious the meadow habitat disturbance, the more dependent are Auchenorrhyncha communities on immigrants.

Undisturbed natural meadows with a lot of litter contain a higher species diversity, presumably due to more diverse structure and layers, than disturbed, managed meadows. Due to greater numbers of predators, however, the numbers of individuals and the lifespan seems to be much lower (ANDRZEJEWSKA 1971). A large number of leafhopper species responds to disturbances with a lower average density. In cultivated meadows fewer individuals emerge, but survival rate is higher than in natural meadows (ANDRZEJEWSKA 1971).

Leafhopper assemblages on ruderal host plants in highly disturbed habitats have a significantly lower proportion of brachypterous specimens than on perennial host plants in undisturbed habitats. SANDERSON (1992) showed that on ruderal sites brachypterous Auchenorrhyncha were less common compared with older habitats. On ruderal sites leafhoppers have a wider host plant range, larger geographic range and are more frequently bivoltine than species on competitive and stress tolerant plants (NOVOTNÝ 1995). "The predominance of brachypters in permanent habitats indicates that a density-dependent decrease in fitness usually does not offset the potential decrease in fitness connected with macroptery and dispersal. Because of this inability of leafhopper populations to decrease significantly the quality of their resources, a high population density cannot be used as a predictor of future quality of their resources, which is information essential for efficient dispersal behaviour" (NOVOTNÝ 1994b).

Macrosteles laevis is a classic biological indicator for disturbed grassland. It is an extremely eurytopic species, which distribution stretches from western Europe to the taiga, mixed forests, savannah woodland, steppe and the arid and semiarid zones of the former USSR. Even so, within its range it is very scarce in some habitats. *Macrosteles laevis* readily responds positively to disturbance of natural meadows by ploughing or mowing and can reach high abundances (ANDRZEJEWSKA 1962). Other indicators for disturbance are probably *Macrosteles viridigriseus* and *M. sexnotatus*.

4.6.4 Grazing

Grazing is characterized by treading, selectiveness in feeding and the deposition of dung (MORRIS 2000). Intensive grazing often has a negative effect on species richness, abundance and biomass of a wide range of invertebrate orders (ANDRZEJEWSKA 1979, PEUSER 1987, HARNISCHMACHER 1988, MORRIS 2000). Smaller insects, including leafhoppers, seem to be more affected than bigger ones (MORRIS 2000). Only a few leafhopper species prefer or rely on short grazed grassland like *Neophilaenus exclamationis*, *N. campestris*, *Macrosteles laevis*, *Psammotettix cephalotes*, *P. confinis* and *Euscelis incisus*, whereas most of the species are more abundant on tall grassland than on short ones (MORRIS 1971a, 1973, BROWN ET AL. 1992). Consequently, in grazing experiments in England and on the continent, generally more Auchenorrhyncha species preferred ungrazed plots with higher vegetation to intensively grazed plots with shorter vegetation (MORRIS 1971a, KRUESS & TSCHARNTKE

2002). For example, *Mocydia crocea*, *Arboridia parvula* and *Stenocranus minutus* respond highly negatively to grazing (BROWN ET AL. 1992). Particularly sheep grazing on calcareous grassland can lead to a decrease of species depending on tall grass stands (BORNHOLDT 1991). However, sometimes a surprisingly low effect of cutting and grazing on the phenology of Auchenorrhyncha is observed in comparison with other groups like Diurna, Heteroptera, Diptera and Bumblebees (ROMBACH 1999). Species apparently not much affected in their phenology by grazing and/or cutting are *Doratura stylata*, *Psammotettix cephalotes*, *Adarrus multinotatus*, *Arthaldeus pascuellus* and *Turrutus socialis* (BROWN ET AL. 1992, ROMBACH 1999).

Timing and intensity of grazing greatly influences the species richness and abundance of leafhopper communities (WALOFF 1980, BROWN ET AL. 1992). Effects of grazing in autumn and winter on abundance are considered to be less severe than in spring and summer. However, species diversity is not much lower after spring and summer grazing compared with grazing in autumn and winter (MORRIS 1973). Apparently leafhoppers feeding on dicotyledonous plants like *Batracomorphus irroratus* and *Eupteryx notata* are more numerous when grazing was set in spring (MORRIS 1973). Many leafhopper species, for example *Anoscopus flavostriatus* and *Streptanus aemulans*, become rare or absent if grazing continues for longer than three months a year, even if it is done during autumn or winter (MORRIS 1973). *Criomorphus albomarginatus* reacts especially negative to autumn and winter grazing, because this species overwinters as a nymph. Some species, for example *Aphrodes makarovi*, *Rhopalopyx adumbrata* and *Cicadula persimilis*, can tolerate autumn and winter grazing, but react very negatively to summer grazing. Species such as *Arocephalus punctum* and *Rhytistylus proceps* seem to thrive best on short grassland, but still react negatively to grazing in spring and summer (MORRIS 1973).

Negative short term effects of grazing can be followed by beneficial long term effects. For example, in saltmarshes grazing has generally a negative effect on *Psammotettix putoni*. However, since grazing leads to a higher amount of young grass-shoots it results in a more regular distribution of this leafhopper species due to even distribution of food resources and suitable oviposition sites (TULOWITZKI 1990). A positive effect of grazing on the development of the second generation of grass-feeding leafhoppers was also observed (TULOWITZKI 1990). Selective grazing can lead to the forming of tussocks, which in theory might lead to more structural diversity and more niches for Auchenorrhyncha in comparison with mowing, as has already been demonstrated for beetles (LUFF 1966, CURRY 1994).

4.6.5 Cutting

Cutting is non-selective, reduces the vegetation to uniform height, increases the proportion of bare ground and can be seen as a more catastrophic event compared with grazing, although a recovery is generally quick and follows the regrowth of vegetation (ANDRZEJEWSKA 1979, BRIEMLE 1990, MORRIS 2000). Due to the resulting rejuvenating effect, rotational cutting will have a positive effect on diversity and species richness compared with a lack of any management (MORRIS & PLANT 1983). In comparison with grazing, mowing is often regarded as having a more negative long-term effect on the diversity and abundance of insects (MORRIS & RISPIN 1987, KIRBY 2001). However, for some groups like grasshoppers, spiders and beetles, excectly the opposite has been observed (SIEPEL ET AL. 1989, FRICKE & VON NORDHEIM 1992). A summary of the often contradictory results from studies on effects of mowing on invertebrate species and groups is given by GERSTMEIER & LANG (1996).

Immediate effects of cutting on Auchenorrhyncha are a reduction in abundance and diversity (MORRIS 1981a,b), but in the long term there seems to be little overall effect due to mulching or mowing (BORNHOLDT 1991). Generally, more species react negatively to cutting on a short term basis compared with the ones showing an immediate positive reaction. Species regarded as reacting negatively are *Hyledelphax elegantula*, *Streptanus aemulans*, *Neophilaenus lineatus*, *Rhopalopyx adumbrata*, *Elymana sulphurella*, *Muellerianella fairmairei*, *Philaenus spumarius*, *Agallia consobrina*, *Anoscopus albifrons*, *Aphrodes makarovi*, *Mocydiopsis attenuata*, *Ribautodelphax pungens* (MORRIS1981a,b, ROMBACH 1999). Species reacting positively to cutting are *Errastunus ocellaris* and *Euscelis incisus* (MORRIS 1981b).

In the long term, cutting enhances the growth of heliophilic plants like *Prunella spp.*, *Thymus spp*. and *Hieracium pilosella* which results in positive effects on species depending on such plants like *Eupteryx notata* (BORNHOLDT 1996). Cutting also provides an advantage for narrow-leaved grasses (*Avenella flexuosa*, *Festuca ovina*, *Nardus stricta*) (BORNHOLDT 1996). Again, a number of leafhopper species depend on these grasses as their only host plants. However, on grassland types like moist grasslands in flood plains a mowing regime still seems to have a much more negative long-term impact on Auchenorrhyncha diversity than grazing. Even extensively used meadows are not able to provide for the necessary requirements for highly specialized species (NICKEL & HILDEBRANDT 2003).

As with grazing, timing and frequency of applied cuts is important. Annual cutting leads to a decrease of species richness and abundance in comparison with abandoned grassland (BORNHOLDT 1996). Possible causes are a lack of food and emigration of specimens into adjacent fields. However, fresh shoots should soon provide a better food resource in comparison to unmanaged sites (BORNHOLDT 1996).

According to some authors early cutting (May) reduces only a small number of species, especially monovoltines, which emerge early in the year. In contrast, midsummer cutting has a relatively strong negative effect on most species (MORRIS & LAKHANI 1979, MORRIS 1981a,b, GERSTMAIER & LANG 1996, ROMBACH 1999). BORNHOLDT (1991) observed a decrease of *Ribautodelphax pungens* through cutting in September. The main causes seemed to be a lack of plant parts suitable for feeding and insufficient weather protection in the lower plant cover. In contrast, bivoltine taxa seem to profit from cutting in summer, which leads to the recommendation of cutting at the beginning of July until the beginning of August (ROMBACH 1999). Particularly *Neophilaenus lineatus*, *Philaenus spumarius*, *Elymana sulphurella* and *Verdanus abdominalis* are sensitive to early mowing (BORNHOLDT 2002). An explanation for the Cercopids is that at this time of the year the spittle masses containing the larvae are situated on the upper parts of grasses (BORNHOLDT 2002).

A second cut (usually only done in highly productive and fertile grasslands) supports (with the exception of *Muellerianella fairmairei*) only pioneer species or generalists among the grassland species like *Anaceratagallia ribauti*, *Aphrodes makarovi*, *Philaenus spumarius*, *Macrosteles laevis*, *M. viridigriseus*, *Euscelis incisus* and *E. lineolatus* (NICKEL ET AL. 2002). On the other hand, a biannual cut in spring and autumn had a relatively low impact (least damaging management) on numbers of Auchenorrhyncha in field margins (HAUGHTON ET AL. 1999).

Mulching can lead to a higher density of individuals due to lack of nutrient loss, as has been observed for *Errastunus ocellaris* (BORNHOLDT 1996).

4.6.6 Unmanaged grassland

Abandoned grassland can become a refugee habitat for leafhopper species, especially after catastrophic events like cutting on neighbouring sites. They generally show higher abundances and species numbers in comparison with managed sites (BORNHOLDT 1996). Unmanaged grassland especially supports those species which require a levelled microclimate or relatively dense vegetation structure like *Criomorphus albomarginatus*, *Neophilaenus lineatus*, *Philaenus spumarius* and *Verdanus abdominalis* (BORNHOLDT 1996). Characteristic for abandoned grassland is a high ratio of stenotopic Auchenorrhyncha species and species living on tall grasses (ROMBACH 1999, BORNHOLDT 2002). There are several reasons why unmanaged grassland provides better conditions for a high number of species compared with grazed or cut grasslands. Cessation of management initially provides better conditions for the Auchenorrhyncha fauna due to the lack of disturbance, higher structural diversity of vegetation and a more even microclimate, leading to higher diversity and evenness of the leafhopper community (BORNHOLDT 1996, ROMBACH 1999). However, the development of species-rich abandoned land needs a relatively long time period. Little effect was shown for leafhoppers when the grazing stopped only for two seasons (MORRIS 1967). In comparison to abandoned arable fields the increase of species numbers and diversity of leafhoppers on nine year old fallow sites is higher if the former use was as a pasture than after use as a arable field (WITSACK ET AL. 1997).

4.6.7 Re-colonization of arable reversion sites

Insects respond to successional changes of plant species composition or to the response of host plants and prey species to such changes (BROWN & HYMAN 1986, BELSHAW 1992, HOLLIER & BELSHAW 1992). One feature of grasslands is that vegetation changes from a high proportion of annuals and high richness in forbs to more perennials and higher proportion of grasses during the process of succession (BROWN ET AL. 1992). Mature communities are hypothesized to be more stable than younger communities (ODUM 1969). Therefore, early successional stages show the greatest turnover of species though such turnover is still considerably high in old grassland, probably due to subtle changes of the vegetation (BROWN ET AL. 1992). NOVOTNÝ (1994a) showed that permanent old habitats show a higher number of specialists with low host plant searching efficiency. An expansion of polyphagous generalists is restricted by low nutrient suitability and, possibly, the better anti-herbivore defences of permanent plant species. Especially fast colonizers and species restricted to disturbed sites are characteristic for early successional stages like *Macrosteles spp*. *Euscelis incisus*, *Javesella pellucida* and *Zyginidia scutellaris* (HOLLIER ET AL. 1994). Species that become dominant in early successional stages have good dispersal abilities and breed rapidly (WALOFF 1973, BROWN 1986, HOLLIER ET AL. 1994).

Successional trends generally show an increase in less active, univoltine or bivoltine species compared with more mobile and multivoltine or bivoltine species in earlier successional stages (HOLLIER ET AL. 1994). The dominant species show large changes in abundance with succession (HOLLIER ET AL. 1994). Flight ability often decreases in the course of secondary succession (BROWN & SOUTHWOOD 1987).

The restoration of species-rich grassland on sites previously used to produce arable crops can be described as ‘creative management’ or ‘creative conservation' (THOMPSON ET AL. 1999, MORRIS 2000). There are several factors influencing restoration success on ex-arable land like fertilizer deposit, exposition, steepness, etc.. One important factor in re-establishing chalk grassland vegetation is the proximity of a species pool, which may be much more important than the indigenous seed bank (MITCHLEY 1988). However, HUTCHINGS & BOOTH (1996a,b) demonstrate that both the invasion of plant species from adjacent chalk grassland into ex-arable sites and the contribution of the seed bank is slow. They suggest the artificially introduction of typical chalk grassland species to prevent the dominance of fast growing weedy species. Indeed the creation of chalk grassland vegetation can be done in a relatively short time (2 years) through sowing, whereas unsown control plots often develop quickly into species-poor grassland (STEVENSON ET AL. 1995).

The re-colonization of newly created habitats by invertebrates including Auchenorrhyncha has been the subject of several studies (BROWN ET AL. 1992, GIBSON ET AL. 1992, ACHTZIGER 1995, 1998, MORTIMER ET AL. 2002). Intensive studies of the re-colonization of newly sown calcareous grassland have been done by MORRIS (1990a,b,c). Within two years 50 species of leafhoppers could be observed on the newly sown grassland. However, many occurred only as single specimens indicating a status of occasional vagrants rather than founders of new populations. On newly sown grassland the number of univoltine species is usually lower than on the established chalk grassland, since the early colonists tend to be bivoltine or multivoltine (MORRIS 1990a,c).

Amongst a wide range of species with high dispersal abilities (Annex 7) *Macrosteles sexnotatus*, *M. laevis* and *Javesella pellucida* are generally seen as very good colonizers (WALOFF 1973, 1980, SCHULZ & MEIJER 1978). Most of the species listed in Annex 7 had established populations on the 19 arable reversion sites here investigated, but there are also notable differences. *Recilia coronifer* and *Errastunus ocellaris* were never, *Criomorphus albomarginatus*, *Rhopalopyx adumbrata* and *Arboridia parvula* were only very rarely found on arable reversion sites. *Psammotettix helvolus* (which may be the *P. cephalotes* from MORRIS'S studies) and *Xanthodelphax straminea* are other noteworthy regular colonizers. It has to be mentioned that the results of this study and the research work done by MORRIS (1990a,b,c) are not directly comparable. Whereas here the results mostly describe already well-established leafhopper communities (for a period up to ten years), MORRIS (1990a) studied the early colonising processes. A number of the species he recognized as good colonizers might again become rather quickly extinct again due to unsuitable conditions, since niche width becomes smaller with successional age (BROWN 1985, BROWN & SOUTHWOOD 1983). This is probably one of the main reasons why opportunistic grassland species such as *Macrosteles laevis*, *M. sexnotatus*, *Psammotettix confinis* and *Javesella pellucida* start to decline within the first years after rapid colonization (MORRIS 1990a, BROWN ET AL. 1992). NIEDRINGHAUS & BRÖRING (1990) showed that public lawns are colonized quite rapidly within five years by Auchenorrhyncha. However, a high number of species decline again significantly when tall herb stands in later successional stages take over the earlier grassy vegetation. *Arthaldeus pascuellus* might be a transient species of the middle stages of succession which is sometimes very abundant on chalk grassland and sometimes very scarce (MORRIS 1990c). *Stenocranus minutus* and *Hyledelphax elegantula* on the other hand, are dominant species on acidic grassland of late successional stages (HOLLIER ET AL. 1994).

Within four years after sowing scarcer chalk grassland species like *Psammotettix cephalotes*, *Rhytistylus proceps*, *Mocydia crocea*, *Criomorphus albomarginatus* and *Arboridia parvula* were able to colonize from a distance more than one mile to the next suitable habitat (MORRIS 1990c). However, even after this period the newly colonized sites were still more similar to improved *Arrhenatherum* grassland than to established chalk grassland sites (MORRIS 1990c). The similarity was related to the dominance of *Arthaldeus pascuellus*, a common grassland species, which is not especially typical for calcareous grassland. GIBSON ET AL. (1992) found that on ex-arable limestone with a controlled sheep-grazing regime nearby to older calcicolous grassland even some of the common Auchenorrhyncha species were restricted to the old grassland. Despite a relatively rapid increase of species richness and diversity during early successional stages, it has been emphasized that the establishment of mature grassland faunas by natural colonization takes a rather high number of years (MORRIS 1990C, WITSACK 1995).

The composition of the 20 most abundant leafhopper species on the investigated arable reversion sites resembles very much that of the improved chalk grassland including eight nitrophilic species. In both grassland groups the two most abundant species are *Deltocephalus pulicaris* and *Psammotettix confinis*. This indicates that arable reversion sites, at least initially, hold Auchenorrhyncha communities characterized by nitrophilic species, not resembling unimproved chalk grassland at all. Species richness on arable reversion sites is significantly lower compared with unimproved grassland, but not lower than on improved grassland. This is in contrast to observations in a different study, showing a higher species richness on older grasslands compared with ex-arable land (BROWN ET AL. 1992).

Although plant succession on newly created habitats often develops very rapidly due to a rapid colonization of annual forbs, the leafhopper communities may not undergo such rapid changes. This has been shown for perennial strips in fields where, due to the high percentage of grassfeeders among the leafhoppers, the plant succession changed more rapidly than the leafhopper succession (HUUSELA-VEISTOLA & VASARAINEN 2000). This effect can be partly explained by the fact that usually only polyphagous species feed on annuals (WHITCOMB ET AL. 1987, 1988).

Important factors influencing the rate of colonization are the size of the habitat patch and the distance to other patches, which can be a source for colonising individuals. For monophagous and oligophagous species even the host plants themselves can be sometimes considered as colonizable islands within a single site (JANZEN 1968). Small newly set up wet meadows (1-7 ha) within natural and semi-natural surrounding habitats were quickly colonized by a comparable large number of species (25-38) within a year (ANDRZEJEWSKA 1991). However, within large intensively cultivated areas, even after ten years meadows were populated by relatively species poor Auchenorrhyncha communities and stenotopic species were rare or absent within these areas. An intensive management of adjacent habitats holds Auchenorrhyncha communities back at early development stages (ANDRZEJEWSKA 1991). Not only the intensity of landuse, but also the structural similarity of neighbouring habitats effects the migration rates of Auchenorrhyncha (HAYNES & CRONIN 2003).

Interestingly, the species richness can be higher on fallow fields in relative closeness to semi-natural grasslands than within these habitats themselves. This has been observed equally for older (12 years) and relatively young (four years) fields (HAHN 1995). One explanation is that on the unused fallow sites a lot of polyphagous species preferring habitats of a comparably low stability inhabit the fallow land. Of 45 observed species only two feed monophagous on a single host plant (*Cicadula persimilis*, *Zygina hypericum*). This can be taken as a suggestion that even after 12 years the re-colonization process is still in the beginning stage (HAHN 1995).

There are several mechanisms driving the colonization of new habitats by Auchenorrhyncha. The best colonizers are species capable of long flights, with several migration activity periods in a season and with low specialization regarding host plants and habitat structure (ANDRZEJEWSKA 1991). On the other hand, colonization success depends fundamentally on habitat preference, preference for special groups of host plants and for particular stages of the landscape development, degree of niche overlap and abundance in recruitment area, but not from dispersal ability and feeding specificity in terms of host plant taxa and body size (NIEDRINGHAUS 2002). Dispersal of leafhoppers is generally by flight, although short distances can also be travelled by hopping (WALOFF 1973, 1980). Although they are abundant insects in grassland systems, only about 1 % of the insects caught in aerial suction traps belong to this order (LEWIS & TAYLER 1965). WALOFF'S (1980) conclusion was that not only are a high proportion of leafhoppers short-winged, but also a lot of longwinged individuals do not migrate. That might especially be the case in Britain where weather conditions keeping the grasses in almost all habitat-types green and suitable as food plants for leafhoppers during the growing season. In comparison, in different climate zones (e.g. North America) leafhoppers are known to migrate in high numbers over long distances (WALOFF 1980). Auchenorrhyncha in Europe are mainly short-distance migrants keeping mostly near ground level (DELLA GIUSTINA 2002). Colonization of isolated habitats by leafhoppers can be very efficient over short distances. For example, *Eupteryx cyclops*, *E. urticae* and *E. aurata* occurred on every single isolated patch of their host plant (*Urtica dioica*) over a distance between 75–300 m from the next host plant patch (ZABEL & TSCHARNTKE 1998). In central Europe only a few species like *Javesella pellucida* and *Zyginidia scutellaris* are specialized for long distance flights (DELLA GIUSTINA 2002). Not genetic but environmental effects like temperature, food availability, food quality and crowding triggers the development of macropterous forms and migration (ROSE 1972, WALOFF 1980). However, a high persistence of habitats leads to the evolution of flight reduction in Auchenorrhyncha in the first place (DENNO 1976, DENNO ET AL. 2001). Migration in a sense of ‘leaving the host plant’ seems to be highest at the end of the lifecycle of the host plant (TAYLOR 1985, TAYLOR ET AL. 1993).

In comparison with arboreal leafhoppers, where no short-winged species are known from Britain, the grassland Auchenorrhyncha fauna is characterized by a majority of species occurring both in a short and a long-winged form. Even generally long-winged species like *Javesella pellucida* appear occasionally short-winged, which can be explained by the fact that there is a cost to flight, which drives the evolution of flightlessness (ROFF 1990). Some species like *Stenocranus minutus* have a macropterous and a submacropterous form. Both are able to fly, but only the macropterous form seems to migrate and has been caught in aerial traps (WALOFF 1980). Within macropterous species often only specimens with extra-long wings were caught in aerial traps (WALOFF 1973). The dispersal ability of these species is difficult to judge, because no data are available about the general proportion between these two forms. The percentage of macropterous individuals within species which develop both forms can vary significantly within a season and between years (WALOFF 1980). In some species most of the migrating individuals are females, as, for example, in *Errastunus ocellaris*. It is notable that in species where macroptery is rare, the longwinged specimens are almost exclusively all females (WALOFF 1973). Sometimes only the premature females are able to fly with some individuals never being able to fly at all as has been demonstrated for *Errastunus ocellaris* and *Arthaldeus pascuellus* (WALOFF 1980).

Some species can be very early colonizers despite the fact that the majority of individuals are short-winged. This has been proven for *Javesella dubia*, *Dicranotropis hamata* and *Streptanus sordidus* (WALOFF & SOLOMON 1973). Even flightless species can exploit new grasslands under some circumstances as shown by MORRIS (1990c) who recorded *Agallia brachyptera* on newly sown calcareous grassland in more than a mile away from the next semi-natural chalk grassland. However, *A. brachyptera* although a rare and scarce species, is not restricted to chalk grassland. RAATIKAINEN (1972) showed that nymphs or flightless adults can migrate short distances into new habitats. Fliers travelling within the vegetation layer did manage to travel at least 20 m per month into oat fields. Active fliers, which leave the vegetation cover are able to cover a distance of 1 km and more (RAATIKAINEN 1972).

Within a landscape consisting of a habitat mosaic containing different microhabitats and changing conditions within a season, leafhoppers adapt in different ways. Monophagous and short-winged species adapt with high stress tolerance to changing habitat conditions (example *Kosswigianella exigua*) whereas more polyphagous and longwinged species (example *Turrutus socialis*) respond with active migration processes to changing habitat conditions (GYORFFY & KARSAI 1991). Mobility and dispersal are also important factors to avoid competition (WALOFF 1979, MATSUMURA & SUZUKI 2003).

Dispersal and migration seem to be directed. Crop fields and man-changed natural habitats are quickly infested by leafhoppers. In contrast, mass migration does not occur in habitats undergoing slow natural changes (ANDRZEJEWSKA 1971). Within natural and semi-natural meadows immigrants accounted only for less than 2 % of community abundance compared to 16-30 % in managed meadows (ANDRZEJEWSKA 1991).

Stenotopic species re-colonize generally at a later stage and display a less vigorous dispersal behaviour than eurytopic species, but although less abundant they make up the most stable component of the Auchenorrhyncha communities on grassland habitats (ANDRZEJEWSKA 1991, HAHN

1995). They comprise, amongst others, species inhabiting the sward layer closest to the litter, the habitat of the least varying trophic conditions. This group includes all species of the genera *Aphrodes*, *Agallia*, *Streptanus*, *Jassargus* among others (ANDRZEJEWSKA 1991). NOVOTNÝ (1995) showed that leafhoppers on ruderal plants show a 'colonization syndrome‘ with greater dispersal ability, wider host plant ranges, larger geographic distribution and more generations per year than species on competitive and stress-tolerant plants. He found no brachypterous hoppers on annual host plants, but showed that many species on stress tolerant host plant (which is the case with most chalk grassland plants) are predominantly brachypterous. Also the percentage of macropters in population decreases as the persistence of their habitats grows longer (DENNO 1978, DENNO ET AL. 1991). These observations certainly support the idea that specialized chalk grassland species behave much less invasively than widespread generalists and are less capable of colonising new habitats.

On the investigated sites species are sometimes unable to found new populations simply due to the lack of food plants. This is probably the case with *Kelisia occirrega*. Although its host plant *Carex flacca* spreads basically by vegetative means, it has been observed to colonize arable reversion sites at least over short distances being then readily followed by the leafhopper (BROWN ET AL. 1992, MORTIMER ET AL. 1998). It can, therefore, be assumed that *K. irregulata* has probably the dispersal capacity to reach new sites. On the other hand, *Turrutus socialis* colonizes arable reversion sites in a very low frequency despite the availability of food plants. The species is usually brachypterous and might have dispersal constraints as already pointed out by BROWN ET AL. (1992). Other examples are *Criomorphus albomarginatus* and *Muellerianella fairmairei*, which did not, despite availability of host plants, colonize arable reversion sites in a study by BROWN ET AL. (1992). Both species were equally rarely found on arable reversion sites during this project. It is not easy to explain why Auchenorrhyncha species often do not colonize arable reversion sites despite good dispersal capacities and the abundant availability of suitable food plants. However, arable reversion sites often have much denser grass-stands than unimproved grassland, which may lead to higher humidity and lower maximum temperatures during the day. These factors might severely affect the colonization success of leafhoppers. Similarly, the effects of increased structural density and, consequently, decreasing maximum temperature near the soil surface were responsible for the decrease in grasshopper species richness and abundance in grasslands after fertilization (VAN WINGERDEN ET AL. 1992).

4.7 Fragmentation and habitat size

British chalk grassland habitats have, at least locally, existed continuously since the late-glacial period, although the species composition has greatly changed since then (BUSH & FLENLEY 1987, BUSH 1993). Since around 1950 there has been a sharp decline in unimproved species-rich downland leading to a significant fragmentation and reduction of average size of the remaining habitats (NEWBOLD 1989). Species area effects may be relatively unimportant in determining the numbers of insect herbivores associated with different host plants. However, host plant diversity itself must be a major determinant of insect diversity (CLARIDGE & WILSON 1981).

According to general ecological rules fragmentation and size reduction should both lead to a reduction of species richness. Generally stenotopic species seem to be more susceptible to size reduction and fragmentation of their habitats, as was shown for grasshoppers and butterflies on calcareous grassland (Sachteleben 2000). For Auchenorrhyncha it was demonstrated that fragmentation leads to reduced patch area, and as a result, the extinction probability of local populations is high in small fragmented habitats (Biedermann 2002). Generally higher densities in larger patches are predicted as a result of greater reproduction, reduced edge effect or reduced predator density. Consequently, for species with high dispersal ability like *Adarrus multinotatus* small patches may be sink habitats. Additionally, species with good dispersal ability are less effected by genetic isolation (Biedermann 2002). Niedringhaus & Bröring (1990) showed that the Auchenorrhyncha colonization rates on urban grassland depend upon the size of the habitat. Equally there has been shown a significant positive relationship between the probability of habitats being occupied (incidence) by certain leafhopper species and the size of the area (Biedermann 2002). Species with a recognized dependence of site size are *Adarrus multinotatus*, *Philaenus spumarius* and *Ribautodelphax pungens*. Interestingly, the mostly brachypterous *R. pungens* required much larger patches to reach the same incidence thresholds than the other species (>1ha for 95 % incidence compared with only 8 m^2 with *A. multinotatus*). The minimum habitat size seems to be comparatively small for leafhoppers. For tree dwelling species it is feasible that sometimes single trees can support metapopulations for relative long periods. Data available for *Macropsis scutellata*, a species living on *Urtica dioica*, suggests that the minimum size of a suitable habitat for a metapopulation of this species lies around 1000 m^2 (Zabel & Tscharntke 1998).

Isolation seems to have an important effect on leafhopper species diversity. In western Germany more isolated limestone grassland habitats showed a drastically reduced number of leafhopper species than habitats, which are part of a bigger grassland patchwork (Rombach 1999). These observations can be supported by the results of the present study for some insect groups (e.g. Coleoptera), but not significantly for Auchenorrhyncha, showing equally low species numbers on sites were the next suitable habitats are further than 1 km away compared with field which were attached to suitable neighbouring habitats on at least one side (Masters 2004). Adjacent intensive management, providing at least a partially isolation, also has a negative impact on leafhopper species richness on calcareous grassland (Rombach 1999). This suggests that leafhopper dispersal is strongly influenced by the surrounding habitats, which can function as effective dispersal barriers. For example, Schiemenz (1969) could not find a single dry grassland species with sweepnetting trials in adjacent oat-clover fields 30 m away from dry grassland sites. Notably, these results coincide with observation on carabid beetles where the effects of habitat isolation became apparent when buffers were wider than 1 km (Kinnunen et al. 1996). On ex-arable and ex-pasture fallows in a high distance to semi-natural grassland a distinct increase of leafhopper species richness and abundance was still observed between the first and forth year of succession (Hahn 1995, Witsack 1995). Some of the species (*Arboridia parvula*, *Criomorphus albomarginatus*, *Delphacinus mesomelas*) could not be observed in the vicinity of the fallow fields and are probably long-distance colonizers.

It has been shown that habitat fragmentation and isolation are more important for monophagous Auchenorrhyncha than for polyphagous species (Zabel & Tscharntke 1998). Richness and abundance of generalists increase with increasing landscape diversity. In contrast, isolation does not always affect highly specialized insects, as examples with Auchenorrhyncha in alfalfa fields demonstrated (JONSEN & FAHRIG 1997). However, the results of that study indicate that both generalists and specialists may move over much larger distances than previously supposed.

Habitat fragmentation and dispersal difficulties may occur especially for usually short-winged species. Brachypterous specimens tend to be heavier than macropters of the same species (MAY 1971, 1975, HILL 1976, 1982). Maturation is delayed in macropters and short-winged forms lay more eggs, as was demonstrated by MAY (1975) on *Stenocranus minutus*. From an energetic point of view it is, therefore, very costly to develop a high number of macropters resulting in an offset of fitness, particularly for species at the verge of their range (NOVOTNÝ 1995). On the other hand, because of the restriction to special conditions provided only in rare habits, dispersal mechanisms would require an above average (compared with eurytopic species) number of macropters to find these rare and fragmented, isolated habitats. This hypothesized phenomenon might just become visible when populations of the same species from Finland and Britain are compared. In Finland (probably at the verge of their range due to a very restricted growing season) species develop a much higher proportion of long-winged specimens and behave much more like r-strategists compared with their ecology in Britain (RAATIKAINEN & VASARAINEN 1976, WALOFF 1980).

4.8 Climate change

Climate is one of the main limiting factors for range expansion of leafhoppers. For example, in northern Finland and northern Norway the number of Auchenorrhyncha species decreases with an average rate of 11 species every 100 km from south to north (RAATIKAINEN & YLONEN 1988). A change of climate will, therefore, result in substantial range expansions or retractions by leafhopper species seriously affecting the overall assemblage of invertebrate communities. WHITTAKER & TRIBE (1998) predicted a range expansion and higher densities for *Neophilaenus lineatus* with a rise of temperature. They predicted that a rise of 2^0 C in mean temperature is enough to trigger a range expansion due to the ability to complete the lifecycle two to three weeks earlier. MASTERS ET AL. (1998) demonstrated that warmer winters have an effect on the hatching dates of *Philaenus spumarius.* Further, they showed in a field experiment which simulated different climate changes an increase of Auchenorrhyncha numbers after supplemented summer rainfall, which leads to an increase of vegetation cover, but no corresponding decrease after a summer drought, which leads to a decrease of vegetation cover. Egg hatch and the termination of nymphal hibernation occurred earlier in winter warmed plots, but the rate of nymphal development was unaffected. According to different climates the number of generation differs for a range of species within their geographical range (WALOFF & SOLOMON 1973).

Current climate change models predict warmer, but wetter winters and warmer drier summers for southeast England (HULME ET AL. 2002). This may lead to the range expansion and higher population densities of a range of typical chalk grassland Auchenorrhyncha which are generally more xerothermophilic than species of other habitats. Species likely to benefit from warmer and drier summers are mainly rare xerophilic species like *Ribautodelphax pungens*, *Tettigometra impressopunctata*, *Euscelis venosus* and *Chlorita dumosa*. *Eurysanoides douglasi* as an Atlantic, western European species may benefit from milder winters. On the other hand, species restricted to woodland habitats in climates with drier and warmer summers like *Hyledelphax elegantula* and *Neophilaenus exclamationis* and to a certain degree *Dikraneura variata* may retreat in the future from open chalk grassland habitats into grass-rich forests.

4.9 Recommendations for habitat conservation

This chapter investigates the potential for the use of Auchenorrhyncha as indicators to contribute to conservation, and especially habitat restoration. A lot of work has already been done looking into different methods of habitat restoration for chalk grassland. It is well known, as often demonstrated for major invertebrate groups like butterflies and grasshoppers, that there cannot be a single method of management covering the requirements of all species typical for chalk grassland (DOLEK 1994).

One of the main issues within chalk grassland is to provide the right grazing or cutting regime to existing unimproved grassland to maintain its species richness and unique species composition. Unmanaged sites develop over a certain number of years a higher diversity of Auchenorrhyncha, and communities containing a significantly higher proportion of stenotopic species compared with managed grassland (ROMBACH 1999). These observations are supported by the results of this study demonstrating an immediate direct negative effect of grazing on richness, especially of highly specialized Auchenorrhyncha. However, on the long run some form of management has to be applied to avoid a succession into scrub and subsequently into woodland. The start and continuation of grazing on long unmanaged unimproved grassland can relatively quickly re-establish the typical Auchenorrhyncha fauna (ROMBACH 1999). There are, in general, surprisingly low direct effects of cutting and grazing on the phenology of Auchenorrhyncha in comparison with other groups like Diurna, Heteroptera, Diptera and Bumblebees, indicating that the type of management is not of great importance (ROMBACH 1999). However, two cuts a year, one in late spring and one in summer may have a severe long term effect on Auchenorrhyncha diversity as shown for grassland in floodplains (NICKEL & HILDEBRANDT 2003). ROMBACH (1990) recommends one cut between the beginning of July and the beginning of August as a compromise, having in mind that univoltine taxa profit through cutting in autumn, but bivoltine profit through cutting in summer. Other authors recommend grazing should start as early as possible in the year. Otherwise plants grow initially too high and a negative trampling effect will be bigger later in the year (BRUCKHAUS 1988). To avoid too harsh catastrophic effects on Auchenorrhyncha populations, MORRIS (1971b, 1983) recommends rotational management. One has also to bear in mind that different grazing regimes and intensities are beneficial or cause negative effects on different insect species as demonstrated by DOLEK (1994).

Unmanaged chalk grassland tends to develop into successional stages characterized by high dominance of single grasses (e.g. *Brachypodium pinnatum*, *Bromopsis erecta*). HURST & JOHN (1999) demonstrated the detrimental effect of *Brachypodium pinnatum* on plant species richness, triggered with high levels of soil nitrate. Although usually absent from improved grassland, *Brachypodium pinnatum*, in particular, can become a problematic species on unmanaged unimproved grassland due to its invasiveness. In comparison to other grasses like, for example, *Bromopsis erecta*, *Brachypodium pinnatum* is not as tolerant of herbivory through small animals like insects (CORCKET ET AL. 2003), but grazing with cattle or sheep has often a positive effect on this species due to selective feeding behaviour (coarse, spiky) in combination with vegetative reproduction. However, mowing as an alternative management often proves to be too difficult and expensive especially on slopes. Generally, there has to be a balanced approach estimating the necessary grazing intensity depending on amounts of nutrients in soil, animal breed, type of grazing regime etc. to control problematic species like *B. pinnatum* (HARNISCHMACHER 1988). However, some of the rarest Auchenorrhyncha species of Britain (*Eurysanoides douglasi* and *Ribautodelphax pungens*) rely on extensive areas of *B. pinnatum*. Thus, there are certainly cases in which the monitoring of a biological indicator group like the Auchenorrhyncha will provide valuable information in setting management priorities for habitat conservation.

Often grazing on chalk grassland with cattle shows several advantages compared with sheep, horses or goats (BRUCKHAUS 1988):

- cattle pulls up the vegetation but does not bite very low, which leads to a generally higher and structurally diverse sward.
- size of excrements leads to comparable big patches, which will be avoided by the cattle for a time long enough for plants to flower and set seeds.
- heavier trampling leads to more disturbed patches and, therefore, more structural niches for a higher animal diversity, plus providing the seed bed for a lot of plant species.

When choosing sheep grazing it is recommended to add a few goats to the grazing flock since they are more able to keep upcoming scrub down (HARNISCHMACHER 1988).

Before the start of restoration management on existing grassland, a monitoring of invertebrates is important to concentrate restoration efforts on sites which still support an above average diversity. Even minute differences of position within south facing hillsides can be important (MORRIS & RISPIN 1994). The explanation for different suitability of similar looking sites lies probably with abiotic factors such as temperature and moisture. Even slight moisture differences can determine Auchenorrhyncha communities as has already been shown by NOVOTNÝ (1990).

Another important approach to chalk grassland restoration is the restriction of grazing intensity combined with a cessation of fertilizer input into already improved sites. Since the breakdown of nitrogen levels is one major problem in restoring improved grassland, it often has to be considered if there is not the possibility to concentrate on and restrict conservation efforts to sites with already relatively lean conditions. That point of view is supported by data of this study demonstrating that even semi-improved grassland is, in contrast to unimproved chalk grassland, characterized by eurytopic and nitrophilic species. Establishment of species-rich semi-natural grassland happens only very slowly after extensification and is dependent on the loss of nutrients and the availability of seed banks or other sources for re-colonizing plants (BAKKER & BERENDSE 1999, OCHSE & MICHELS 1999). In one long-term experiment even after complete cessation of fertilization and two cuts per year the amount of nutrients stayed stable and could not be brought down within ten years (Briemle 1999). Consequently, mulching is not a suitable method to reduce nutrients (Briemle 1999).

The restoration of grassland on ex-arable land, the so-called ‘creative management’ (Thompson et al. 1999, Morris 2000), is another method of chalk grassland conservation. Morris (1990b) suggests that a patchy sowing with different grass mixtures creates better colonizable habitats than the use of only a single mixture. Even grass species which are not highly competitive have a chance to establish that way. In some cases, sown swards become suitable for the colonization by specialized species only when a suitable management has been applied (Morris 1990a). Generally, it is recommended to start with a rather intensive grazing or mowing regime in early successional stages to develop typical grassland communities and to avoid the establishment of arable weeds (Briemle et al. 1990). However, in some cases even a moderate grazing regime still showed positive results in terms of the establishment of plant components typical for mature chalk grassland. (Gibson et al. 1987). The necessity of reducing nitrogen levels remains a problem, however, especially under increasing atmospheric deposition (Bakker & Berendse 1999). None of the 19 investigated arable reversion sites analysed in this study has so far developed a vegetation composition similar to unimproved grassland, even on sites reversed into grassland ten years ago. Examples of successful habitat restorations by arable reversion are rare throughout Britain and central Europe and despite additional treatments like hayspreading or cultivation they usually fail to develop grasslands into the desired target vegetation communities quickly (Pywell et al. 2002). The consolidation stage of restored grassland both on ex arable land and intensively grazed or improved grassland may last many years (Willems 2001). Recovery of the vegetation on *Festuca*-grassland in Canada took from 14 years in only lightly grazed fields to more than the length of the study (32 years) in heavily grazed fields (Willems et al. 1985). Even with supporting measures like the use of seed mixtures initial re-colonization by invertebrates can be slow due to still unsuitable conditions (Blake et al. 1996, Mortimer et al. 2002). It is, however, often difficult to separate the effects of structural heterogeneity from the historical development of the sites. Age can be a very important factor usually positively correlated with the species richness both of flora and fauna on calcareous grassland (Mortimer et al. 1998, Pärtel & Zobel 1999).

Scrub clearance might successfully recreate chalk grassland, since even after long periods of succession on chalk grassland at least part of the original flora still remains (Ward & Jennings 1990). However, despite structural similarities and the presence of a range of typical chalk grassland plants, Auchenorrhyncha and Heteroptera did not re-colonize a cleared chalk grassland area in central Germany within four years. Especially xerothermophilous species were still missing. One explanation was the remaining different plant compositions in the herbaceous layer, and different abundances of the occurring plants (Bornholdt 2002).

Another possibility for chalk grassland restoration would be the translocation of original species-rich turf from grassland which will be lost at the original sites to new suitable areas. This method is relatively expensive, difficult and will result in a loss of species richness (Müller 1990). A further alternative to accelerate the colonization of newly created habitats is the release of sampled insect specimens (MORRIS 1990a).

Area size is an important factor for habitat restoration, resulting in the search for the 'Minimum Viable Population' (SHAFFER 1981, BELOVSKY 1987, EHRLICH & MURPHY 1987, QUINN & HARRISON 1988, HOVESTEDT 1990). Within the butterflies scheme SLOSS (Single Large Or Several Small remnant refuge patches), species numbers of a given area are apparently higher when it was composed of many small fragmented patches compared with the same size composed of only few large patches (RENGELSHAUSEN ET AL. 1997). Due to their patchy appearance and generally little known life history, the estimate of minimal sizes of habitats or the minimal numbers of inhabitable patches within a landscape network for the long-term conservation of Auchenorrhyncha is in most cases not possible. However, simulation models in combination with field experiments have been done by BIEDERMANN (2000) for a single species (*Neophilaenus albipennis*), which may give some rough estimate about the required dimension for other species with similar life traits. He calculated, that for *N. albipennis* a minimum of 0.16-0.31 km^2 dry grassland (in this case distributed as patches of different sizes over a study area of ca. 17 km^2) is required for the long term persistence (100 years) of a metapopulation.

5 Estimating success of restoration work on chalk grassland

A lot of models have been developed to measure the value of rare habitats for nature conservation and there are even computer aided models working as 'Decision-Support Systems' for nature management (SIEPEL 1996). However, little work has been done so far about monitoring the success of habitat restoration on the basis of single indicator groups.

HILDEBRANDT (1995) presents a model using Auchenorrhyncha which evaluates habitats and landscape with definition of species potential for every grassland habitat and measuring the completeness of the theoretical potential. WALTER (1996) used this method for the landscape Drömling in Germany to show deficits of certain habitat types.

Another quantitative model to evaluate the completeness of potential leafhopper communities is presented by NIEDRINGHAUS (1999). He uses the factors threat, typical presence in the investigated landscape and grade of establishment to give each species a certain score which then can be added up for the recorded community. A percentage of the theoretical completeness of community can then be estimated. This model needs adjusting for each region and each habitat type.

Despite not being complete, and with the likelihood that some species will change their position or classifications as preferential or differential species, the tables as provided above can still be useful already for conservation. For example, the success of habitat restoration can be measured by comparing the Auchenorrhyncha communities of a site with the average, typical assemblage for the target grassland. Additionally, the abundance of species typical for intact chalk grassland such as *Turrutus socialis*, *Psammotettix cephalotes* or *Mocydiopsis attenuata* could be monitored to balance the impact of grazing management on arthropod diversity as has been suggested in a similar way for carabids and staphylinids on acidic upland grasslands (DENNIS ET AL. 1997).

To facilitate using Auchenorrhyncha in controlling the effectiveness of calcareous grassland restoration, the next chapter summarises the ecology of chalk grassland Auchenorrhyncha and the suitability of the species to indicate success. A distinction is made between two major stages occurring in any successful restoration process. Stage I is here seen as the initial developmental phase in habitat restoration, when the floristic species composition is still very different from the target community, but habitat conditions should already allow the colonization of species named for this category. Stage II is the phase when the botanical and structural composition already matches the target community. Species named for this stage are suitable to monitor the successful re-colonization of typical and often more specialized components of the target community.

6 Review of the ecology of the Auchenorrhyncha species on chalk in southern England

In order to give a review of the Auchenorrhyncha assemblages on chalk grassland the ecology of each species is briefly described. The review focuses on the degree of confinement to calcareous grassland, host plant specificity, dispersal capacity, distribution within Great Britain and the suitability of each species to indicate success of chalk grassland restoration. Additional notes on the life history are given. The information leading to the different classifications of each species originates from a wide range of available literature. In the case of contradicting information gained from literature the higher relevance to the concerned geographical region is given precedence. Additional information on the scarcity of the species within Great Britain stems from the 'British Record Centre' (BRC). The classification into the different categories regarding the monitoring capacity of each species derives from the information listed above in combination with the results given by the analysis of data from the present study. Excluded from this review are those tree and scrub dwelling species, even though some can play an important part within the Auchenorrhyncha fauna on English downland, especially on more degraded calcareous grassland sites with a substantial amount of scrub invasion. Excluded are as well general eurytopic grassland species, which are common and widely distributed, but have been only found in very low numbers during this study. For these species the assumption is made that they are not playing a major role on chalk grassland in southern England. On the other hand, species with a distinct affinity to calcareous grassland but not being found in the project due to their extreme rareness have been included into this review, as being potentially important indicators.

The following definitions are used throughout:

1. Habitat specialization in Great Britain

species confined to calcareous grassland

This category includes species which occur within Great Britain only on calcareous grassland and/or live exclusively on host plants which are confined to calcareous grassland. Species which are found predominantly on calcareous grassland but have been recorded occasionally also from other habitats can also be included in this category. This is especially the case if reproduction in the other habitats is unlikely. On the other hand, extremely rare species which have been found so far only on calcareous grassland in Britain, but are more widespread in other habitats elsewhere, can be excluded from this category, especially if it is likely that further records inside Britain will include non-calcareous habitats.

species mainly on calcareous grassland

This category contains all grassland Auchenorrhyncha with a preference for calcareous grassland within Great Britain; more than half of all records known from the country should originate from calcareous grassland. It is also likely that the main host plants of these species are typical calcareous grassland species.

dry grassland species

Into this category all the species with a general preference for dry grassland habitats are included, where there is no clear preference for acidic or calcareous grassland recognizable. Some of these species might also live occasionally in mesotrophic and wet grassland. Extremely rare species only recorded in Britain from acidic habitats, but which dwell in calcareous grassland habitats elsewhere and which might be recorded from calcareous grassland in the future are also included here.

species mainly on acidic dry grassland

Species are listed here which are typical for different types of acidic grassland and heaths including wet communities of heathland. These species occur only occasionally on calcareous grassland.

eurytopic grassland species

Species which are generalists and do not show a certain preference for dry grassland habitats. Occasionally, these species even prefer wet or damp habitats, but are still able to exist on dry grassland to a certain degree. This category also includes as well species which mainly occur on highly fertilized meadows and are usually rare on unimproved calcareous grassland

2. ***Host specificity***

The information on host specificity is derived from literature sources. However, sometimes different authors present contradicting information. In these cases preference is given to the information based on the most reliable experiments or field observations.

The host specificity is classified according SCHAEFER (1992) and NICKEL (2003):

Diet breadth	**host specificity**
1 host species	1st degree monophagous
1 host genus	2nd degree monophagous
1 host family	1st degree oligophagous
2 host plant families or up to 4 species belonging to up to 4 plant families	2nd degree oligophagous
more	polyphagous

3. ***Distribution status according to the BRC:***

Information on the distribution within Britain was gained from the ‘BRC’ (Biological Records Centre). The following categories are used:

- common
- local
- notable B

  (notable B is used for taxa, thought to occur in between 31 and 100 10 km squares of the National Grid or - for less well recorded groups - between eight and 20 vice-counties)
- notable A

  (notable A describes taxa, 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)

4. ***Dispersal Capacity***

The scaling of the dispersal capacity is based on the combination of the factors distribution within Britain, host plant specificity and the physical ability to fly based on the wing length. Some species, where quick colonising of new habitats is a special strategy, are regarded as very good dispersers here. The following list gives an overview of the combinations used:

Situation		**Conclusion**
macropterous specimens dominant & widespread & opportunistic spreading behaviour	⇒	very good
macropterous specimens dominant & widespread	⇒	good
macropterous & brachypterous specimens both widespread	⇒	good
macropterous specimens rare but polyphagous & common or widespread	⇒	good
macropterous specimens rare & polyphagous & local or rare	⇒	poor
macropterous specimens rare & monophagous or oligophagous but common or widespread	⇒	poor
macropterous specimens rare & monophagous or oligophagous & local or rare	⇒	poor
macropterous specimens unknown or not recorded from Britain	⇒	very poor

5. ***Monitoring Capacity:***

Here a preliminary classification is given of whether a species is likely to be a good indicator for the restoration of calcareous grassland. Three categories are chosen to describe a positive indicator capacity for habitat restoration. Species which are typical for intact calcareous grassland and are able to colonize new habitats comparably quickly are called 'good indicator species for stage I'. These species should be found on restoration sites relatively early and even when the floristic composition of the site still does not resemble the target community. Species which are colonising newly created calcareous grassland only at a later stage when the new habitats already starts to come close to intact calcareous grassland and the floristic composition is close to the target community are called 'good indicator species for stage II'. Species of this second category, which are of special concern for nature conservation, are called 'umbrella species'. Additionally, species which indicate a failure of restoration success, or early stages in this process, are classified as ‘indicator for disturbance’. Species which do not fit in any of the categories described above are labelled ‘none’.

Kelisia guttula (Germar, 1818)

Habitat specialization n Great Britain: species mainly on calcareous grassland

Host specificity: probably 1st degree monophagous on *Carex flacca*

Distribution status according to the BRC: common

Distribution in Great Britain: *Kelisia guttula* is regarded to be widely distributed within Great Britain and Ireland (LE QUESNE 1960a,b). However, records from wet site are in need of revision due to the similarity of the species to *Kelisia sima* RIBAUT, 1934. Le Quesne (1960a) lists the following counties and sites: England: Staffordshire, Norfolk, Suffolk, Gloucestershire, Oxfordshire, Buckinghamshire, Kent, Surrey, Berkshire, Hampshire, Wiltshire, Dorset, Cornwall; Wales: Denbigh-Maes Hafn, near Mold, Caernarvon-Snowdonia; Scotland: Midlothian-Edinburgh, Clyde Isles-Glen Sannoy, Arran, Inverness-Loch an Eilan, Aviemore, Kincraig.

Dispersal Capacity: good

Ecology: In Britain *Kelisia guttula* is reported from sedges on dry calcareous grassland or marshy places (LE QUESNE 1960b, MORRIS 1971a, 1973, BROWN ET AL. 1992). In central and northern Europe records originate from calcareous grassland, montane meadows and fens (OSSIANNILSSON 1978, SCHIEMENZ 1987, NICKEL 2003). Again, records from wet sites in Britain and continental Europe predating 1997 are in need of revision due to possible misidentification with *Kelisia sima*.

Kelisia guttula is regarded to have a relatively low degree of habitat specialization (MÜLLER 1978). However, it requires only extensively managed or unmanaged habitats (NICKEL & ACHTZIGER 1999). Sometimes *K. guttula* is regarded as a typical hygrophilous species of wet grasslands, swamps, bogs and shores (MARCHAND 1953, SCHIEMENZ 1987, HILDEBRANDT 1995). However, there are records from both dry and wet localities, preferentially on lean soils (NICKEL 2003). According to HAUPT (1935) the species prefers dry grassy more or less shaded places, which corresponds to observations from *Carex* in woodland margins (GÜNTHART 1987). It can also have strongholds in regularly mown lean calcareous grassland (ROMBACH 1999). In Britain *K. guttula* can be among the most abundant Auchenorrhyncha species on calcareous grassland (MORRIS 1990c). However, it does not occur at all or only as a vagrant on intensively grazed calcareous grassland (MORRIS 1971a). The species seems to react positively to a cessation of intensive grazing (MORRIS 1971a).

Kelisia guttula lives on *Carex flacca*, perhaps also on other low-growing sedges (NICKEL 2003, NICKEL ET AL. 2002). It is known to be wing dimorphic (OSSIANNILSSON 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Kelisia guttula* has been found in this study in all investigated regions, on 20 sites altogether. It seems to be rather rare in the Chilterns, where it was only found on one site. Generally, in southern England *K. guttula* seems to be confined on chalk grassland to sites with a considerable amount of *Carex flacca,* which was, with the exception of *C. montana*, the only recorded *Carex*-species on the sampled plots. On unimproved chalk grassland *K. guttula* is on average a subrecedent species but can occasionally become subdominant. The species appears most constantly on ranker sites belonging to the CG5 community (*Brachypodium pinnatum-Bromus erectus* grassland). Within the grazed and managed chalk grassland (e.g. CG2) *K. guttula* is most frequent within the CG2b sub-community and occurs here in significantly higher numbers than in the nutrient richer CG2c sub-community. *Kelisia guttula* can be regarded, at least in southern England, as a preferential species of chalk grassland in comparison with mesotrophic grassland. Interestingly, *K. guttula* seems to prefer medium high swards with an average height between 6 to 10 cm, even though the main host plant *Carex flacca* is short growing and occurs on shorter swards in higher frequencies. It occurs only very sporadically on improved sites but can become subdominant within the *Arrhenatherum elatius* grassland (MG1). From mesotrophic grassland the species was only recorded from MG1 and can be used here as a differential species in comparison to MG5, MG6 and MG7. *Kelisia guttula* has not been recorded from the surveyed arable reversion sites, which can be explained by the complete absence of *Carex spp.* on these sites. The results of this study support the current knowledge on the ecology of the species. Its habitat requirements in southern England do not seem to differ from other parts of its known range.

Monitoring Capacity: good indicator species for stage II

Kelisia occirrega REMANE & GUGLIELMINO, 2002

Habitat-specialization in Great Britain: species confined to calcareous grassland

Host specificity: 2nd degree monophagous on *Carex spp.*

Distribution status according to the BRC: unknown

Distribution in Great Britain: The distribution of the species in Great Britain is unknown at the moment due to misidentification with *Kelisia vittipennis*, a species of wet habitats.

Dispersal Capacity: good

Ecology: *Kelisia occirrega* has only recently been split up from the closely related taxon *K. irregulata* (REMANE & GUGLIELMINO 2002). It has been recorded so far only from few localities in Spain and western France where it inhabits especially calcareous soil (REMANE & GUGLIELMINO 2002). From Britain there are a number of records of *K. vittipennis* from calcareous grassland, even as a dominant species (MORRIS 1971a, 1973, 1990c, BROWN ET AL. 1992, COOK 1996), which probably almost all refer to *K. occirrega*.

Exact habitat requirements of the species are still unknown. However, assuming that British records of *K. vittipennis* from dry calcareous grassland regard this taxon, *K. occirrega* does not occur at all or only as a vagrant on intensively grazed calcareous grassland in England (MORRIS 1971a). The species seems to react positive to a cessation of intensive grazing (MORRIS 1971a).

The only known host plants are *Carex spp.* (REMANE & GUGLIELMINO 2002). It is possible that *Kelisia occirrega* feeds even monophagously on *Carex flacca* as is assumed for the closely related *K. irregulata* in central Europe (NICKEL 2003, HOLZINGER ET AL. 2003).

Position within the chalk grassland Auchenorrhyncha communities: In southern England *Kelisia occirrega* seems to be confined to chalk grassland with a considerable amount of *Carex flacca*, which was, with the exception of *C. montana*, the only recorded *Carex*-species on the sampled localities. *Kelisia occirrega* was found regularly on unimproved grassland throughout all investigated regions, altogether on 35 sites. It was specifically common in the Chilterns and North Downs, were it is generally much more frequent and abundant than *K. guttula*.

On unimproved chalk grassland *K. occirrega* is on average a recedent species but can occasionally become dominant on single sites. Most constantly (frequency class V) the species appears on ranker sites belonging to the CG3, CG4 or CG5 communities. Within the grazed and frequently managed chalk grassland (e.g. CG2) *K. occirrega* reaches only frequency class III. Here it is most frequent within the CG2a and CG2b sub-communities and occurs in significantly higher numbers compared to CG2c. *Kelisia occirrega* can be regarded in southern England as a preferential species of chalk grassland in comparison with mesotrophic grassland and also as a preferential species of the ranker communities within the CG grassland. The species prefers high swards with an yearly average height of more than 10 cm, even so the main host plant *Carex flacca* is short growing and occurs on shorter swards in higher frequencies. This may explain why *K. occirrega* occurs with high constancy (class V) also on *Arrhenatherum elatius* grassland (MG1). Here *K. occirrega* is a recedent species, which can become subdominant. Within mesotrophic grassland it has only been recorded on MG1 grassland and can be used here as a differential species in comparison with MG5, MG6 and MG7. *Kelisia occirrega* was recorded only once from an arable reversion site probably as a vagrant since *Carex spp*. were absent on these sites. It avoids improved grassland, from where is could only be recorded from one single site. The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from its known ecology on continental Europe.

Monitoring Capacity: good indicator species for stage II

Anakelisia perspicillata (Boheman, 1845)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree monophagous on *Carex*

Distribution status according to the BRC: local

Distribution in Great Britain: According to LE QUESNE (1960b) *Anakelisia perspicillata* occurs locally on dry hillsides and heathy places in England and Scotland.

Dispersal Capacity: good

Ecology: In Scandinavia and central Europe *Anakelisia perspicillata* lives on dry meadows, calcareous grassland and slopes with *Carex* (OSSIANNILSSON 1978, NICKEL 1994). The species inhabits here mainly dry pastures, heaths, submontane meadows, dry forest margins, clearings and calcareous swamps (SCHIEMENZ 1987, NICKEL 2003).

Anakelisia perspicillata seems to be a rather eurytopic species of sunny and oligotrophic sites with short vegetation, although becoming more xerophilous towards the north. Habitat conditions can range from dry to temporarily wet and from basic to acidic substrates (NICKEL 2003). *Anakelisia perspicillata* is primarily a species of only extensively or unmanaged grassland (SCHIEMENZ 1969, 1987, NICKEL & ACHTZIGER 1999).

The main host plant on basic substrates is *Carex flacca*, on acidic sites *C. pilulifera* (NICKEL 2003, HOLZINGER ET AL. 2003). Hibernation takes place in the egg stage (SCHIEMENZ 1969). *Anakelisia perspicillata* is wing dimorphic (OSSIANNILSSON 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Anakelisia perspicillata* was not found within the project. However, since it is known to inhabit calcareous grassland, it is probably justified to regard *A. perspicillata* - although it is comparably rare - as a preferential species of chalk grassland. Because the species requires apparently relatively short vegetation, it is most likely to be found on grassland belonging to the NVC community CG2.

Monitoring Capacity: good indicator species for stage II

Stenocranus minutus (Fabricius, 1787)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree monophagous on *Dactylis spp.*

Distribution status according to the BRC: common

Distribution in Great Britain: In England as far north as Yorkshire, Northamptonshire and Gloucestershire. In Ireland as far north as County Dublin (LE QUESNE 1960b). Further records originate from Wales (HOLLIER pers. comment).

Dispersal Capacity: good

Ecology: In central Europe the species shows a wide distribution in a range of grassy habitats. It has mainly been reported from pastures, meadows, field margins, roadsides, dunes, sandy plains, marshes and forests (OSSIANNILSSON 1978, NICKEL 2003). In Britain and Ireland *Stenocranus minutus* is common on grasses in woods, meadows, etc. (LE QUESNE 1960b). Here it has frequently been reported both from dry calcareous and acidic grassland, including unmanaged ruderal sites (WALOFF & SOLOMON 1973, HOLLIER 1987, MORRIS 1971a, 1973, 1990a,c, BROWN ET AL. 1992, COOK 1996, EYRE ET AL. 2001).

Stenocranus minutus inhabits sunny to slightly shaded, moderately dry to moist and moderately eutrophic grassy sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). According to some authors it shows a preference for dry sunny habitats and occurs even on heavily drained xerothermic gypsum (MÜLLER 1978, GÜNTHART 1987, NICKEL ET AL. 2001).

Due to its host plants *Stenocranus minutus* prefers sites or at least patches rich in nitrogen indicating eutrophic conditions (BORNHOLDT & REMANE 1993, HILDEBRANDT 1995). However, the species can also become abundant on lean calcareous grassland (MORRIS 1990c). It favours tall swards and reacts sensitive to mowing and intensive grazing (WHITTAKER 1969, MORRIS 1981a, BROWN ET AL. 1992, BORNHOLDT & REMANE 1993). This can explain, why it is usually absent in most conventionally managed meadows and does not occur at all or only as a vagrant on intensively grazed calcareous grassland (MORRIS 1971a, NICKEL 2003). Characteristically, it increases in number after cessation of grazing (MORRIS & PLANT 1983). Overall it is a typical species of only extensively or unmanaged sites (NICKEL & ACHTZIGER 1999). *Stenocranus minutus* is able to colonize new sites very rapidly (WALOFF & SOLOMON 1973). The species has been found colonising within the second summer after sowing of new calcareous grassland at a distance of one mile from other semi-natural grassland (MORRIS 1990a). It is also typical for late successional stages of ruderal grassland on acidic soil (HOLLIER ET AL. 1994).

As early as 1942 *Dactylis glomerata* was recognized as the main host plant (MÜLLER 1942). On the other hand, it has been claimed that the species feeds polyphagous on grasses, but needs *Dactylis* only as a substrate for egg-laying. Consequently, *Dactylis* is the only plant on which *Stenocranus minutus* can be bred (MÜLLER 1978, GÜNTHART 1987). In England the species has been successfully reared from acidic grassland in Berkshire on *Dactylis glomerata* (WALOFF & SOLOMON 1973). Here *S. minutus* fed also exclusively on this plant (PRESTIDGE & MCNEILL 1983). Today *Dactylis glomerata* and probably as well *Dactylis polygama* are seen as the only host plants for *S. minutus* (NICKEL 2003, HOLZINGER ET AL. 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Stenocranus minutus* has been a common and constant species within the chalk grassland project. It was found on 43 sites. Notably, the species seems to occur much more frequently in the Chilterns and North Downs compared with the South Wessex Downs and South Downs. Despite living monophagously on a single host plant (*Dactylis glomerata*) which prefers nutrient rich conditions, *S. minutus* is much more frequent and abundant on semi- and unimproved chalk grassland sites. It occurs only rarely and usually in low numbers on arable reversion sites. This uneven distribution is reflected in the comparison of CG with MG grassland. On unimproved chalk grassland (e.g. CG) *S. minutus* occurs in frequency class IV and is on average a recedent species, which can become occasionally dominant. On mesotrophic grassland (e.g. MG) it reaches only frequency class III, is on average only subrecedent, but can still become on single sites a subdominant species. Within the unimproved chalk grassland *S. minutus* prefers in significantly higher abundance the ranker vegetation of the CG3, CG4 and CG5 grassland, where it is on average a recedent species, occasionally becoming dominant. Therefore, *S. minutus* can at least in Southern England be classified as a character species of chalk grassland and especially of the ranker communities within the CG grassland. On the level of sub-communities of CG2 grassland no significant differences occur. Within the mesotrophic grassland *S. minutus* is significantly more abundant on MG1 sites, where it is a constant and on average a recedent species, compared with MG5, MG6 and MG7 grassland. It is a rare and sporadic species on sites with low swards but a constant (frequency class V) and subdominant species on sites with higher swards.

The results suggest that structural parameters (high vegetation due to low grazing pressure) may be more important for *S. minutus* than high abundance of its host plant or good nutrient supply due to growth of its host plant under nutrient rich conditions. Otherwise the results support the current knowledge on the ecology of the species. Its habitat requirements in Britain seem not to differ from its occurrence on the continent.

Monitoring Capacity: good indicator species for stage I

Delphacinus mesomelas **(Boheman, 1850)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree monophagous on *Festuca spp.*

Distribution status according to the BRC: local

Distribution in Great Britain: *Delphacinus mesomelas* occurs locally in England, Scotland and Ireland (LE QUESNE 1960b). It has been reported to be common in dry heathlands in Wales (WHALLEY 1955).

Dispersal Capacity: good

Ecology: In northern Europe and northern central Europe *Delphacinus mesomelas* prefers heaths and other dry and sandy habitats. Towards the south it is mainly found on meadows at submontane altitudes, as well on various dry grasslands (OSSIANILSSON 1978, NICKEL 2003, HOLZINGER ET AL. 2003). In the former CSSR the species inhabits even bogs (DLABOLA 1954). Within the UK *D. mesomelas* is reported from grasses in dry heaths and the edges of woodland (LE QUESNE 1960b). Here it is mainly recorded from dry acidic and only occasionally from calcareous sites (WHALLEY 1955, MORRIS 1973, WALOFF & SOLOMON 1973, HOLLIER 1987, COOK 1996).

In central Europe *Delphacinus mesomelas* lives mainly in lean and sunny, low vegetated, very dry to wet sites (NICKEL 2003, HOLZINGER ET AL. 2003). It seems to be primarily a xerophilic and heliophilous species of dry moderately intensively managed or unmanaged grassland (EMMRICH 1966, NICKEL & ACHTZIGER 1999, NICKEL ET AL. 2002). Wet habitats are only colonized, if the sward is short and open (NICKEL ET AL. 2002). The species is able to colonize suitable habitats (fallow land) over long distances (WITSACK 1995). It prefers apparently short swards (HOLZINGER ET AL. 2003).

It was originally thought that *Delphacinus mesomelas* is a species living polyphagous on grasses (SCHIEMENZ 1987). Now it seems that fine-leaved species of fescue (mainly *Festuca ovina* agg. and *F. rubra*) are the main hosts (NICKEL 2003). Additionally, egglaying was recorded from *Sesleria sp.* (LAUTERER 1983).

Delphacinus mesomelas appears both in a macropterous and brachypterous form (LE QUESNE 1960b).

Position within the chalk grassland Auchenorrhyncha communities: *Delphacinus mesomelas* has been found within this study only on 13 sites. The vast majority of these records (ten sites) stem from the South Wessex Downs. Only one site each in the North Downs, South Downs and on the Isle of Wight held the species. There were no records from the Chiltern sites. The species is more frequent on unimproved chalk grassland (CG), where it is on average a subrecedent species, which can become recedent on single sites. Within the MG grassland it is on average only a sporadic species, but was recorded on one site as a subdominant species. On unimproved grassland it avoids the ranker vegetation types (CG3, CG4, CG5) completely and can, therefore, be regarded as a differential species for CG2 grassland in comparison with the communities above. On CG2 *D. mesomelas* occurs in the frequency class III, on average as a subrecedent species, which can become recedent on single sites. There are no significant differences on the level of sub-communities. Within the mesotrophic grassland *D. mesomelas* has been found only on two sites of the MG5 grassland. It may prove in the future to be a differential species for this community within the mesotrophic grassland. *Delphacinus mesomelas* has never been recorded from one of the arable reversion sites, despite a wide availability of its host plants and only twice on improved and once on semi-improved grassland. The species seems to prefer swards of a medium height, although the differences to sites with low or high swards are not significant. The results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology on the continent.

Monitoring Capacity: good indicator species for stage I

Eurysanoides douglasi **(Scott, 1870)**

Habitat-specialization in Great Britain: species mainly on calcareous grassland species

Host specificity: possibly 1st degree monophagous on *Brachypodium pinnatum*

Distribution status according to the BRC: notable A

Distribution in Great Britain: Within Britain *Eurysanoides douglasi* is confined to Kent and Sussex. There are records from Wye (1967), Folkestone Warren (19th century), Meopham (1975) and Murston (1982) (KIRBY 1992).

Dispersal Capacity: poor

Ecology: *Eurysanoides douglasi* has been first described from Kent (SCOTT 1870). The species seems to be very rare and has been recorded so far only from England, France and Greece (Korfu) (HOLZINGER ET AL. 2003). It is doubtful that an additional record from Siberia (NAST 1972) refers to this species, which shows otherwise an exclusive western European and Mediterranean distribution.

Eurysanoides douglasi has been found primarily low down amongst *Brachypodium pinnatum* on chalk hillsides (LE QUESNE 1960b). According to KIRBY (1992) this probably represents the usual habitat for the species. One additional record from *Juncus* growing on dry coastal ground from the last century may not refer to a host plant used by *E. douglasi*. DUFFIELD (1931) describes brachypterous and macropterous females and macropterous males from dried grass on a hillside at Wye, Kent.

Position within the chalk grassland Auchenorrhyncha communities: *Eurysanoides douglasi* was recorded within the project only from two sites, in the North Downs and the South Downs. On one side near Dover, Kent it was recorded only with four brachypterous specimens on two hillside plots dominated by *Brachypodium pinnatum* and *Bromopsis erecta* belonging to the CG5 community. It was also found within rank vegetation of *Brachypodium pinnatum* and *Bromopsis erecta* on an additional site near Brighton, Sussex belonging to the CG4 community. The latter site has been classified as semi-improved. The species appeared here in relatively high numbers (47 sampled specimens) making it one of the subdominant Auchenorrhyncha species of this particular site. Amongst the mostly brachypterous individuals some macropterous specimens both males and females could be found. *Eurysanoides douglasi* is probably a valid differential species for the ranker chalk grassland communities containing its presumed host plant *Brachypodium pinnatum* in high frequency. Although *B. pinnatum* occurs within the shorter swards of other chalk grassland communities, the species was not found on one of those sites.

Monitoring Capacity: good indicator species for stage II, umbrella species

Eurysa lineata (Perris, 1857)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: local

Distribution in Great Britain: *Eurysa lineata* is distributed in England south of a line from the Wash to the Bristol Channel plus an additional record from Yorkshire. In Ireland it has been recorded from the county Dublin (LE QUESNE 1960b).

Dispersal Capacity: poor

Ecology: In central Europe *Eurysa lineata* lives on dry meadows, dry forest glades, thermophilous deciduous and coniferous forests (mainly oak and pine) including their margins, as well as around hedges, solitary trees and shrubs on rather dry grassland (HAUPT 1935, OSSIANNILSSON 1978, REMANE 1987, NICKEL 2003). In Britain the species has generally been recorded from grasses in dry places including calcareous grassland (LE QUESNE 1960b, COOK 1996). In northern England one single specimen was found on a dry ruderal site with a considerable amount of bare ground (EYRE ET AL. 2001).

On the continent *Eurysa lineata* is a sciobiotic species of forests and forest margins (NICKEL ET AL. 2002). It is here reported to inhabit light forests with grassy undergrowth of *Poa nemoralis*, *Dactylis polygama*, *Melica uniflora*, *Deschampsia flexuosa* and *Agropyron repens* (NICKEL 1994). The species seems to be indifferent to the type of substrate (NICKEL 2003, HOLZINGER ET AL. 2003).

Host plants are various grasses (*Poa nemoralis, Deschampsia flexuosa, Melica uniflora* and others) (STRÜBING 1956, NOVOTNÝ 1995, NICKEL 2003). *Eurysa lineata* is wing dimorphic but is found only rarely macropterous (LE QUESNE 1960b, OSSIANNILSSON 1978). Hibernation takes place as larval instars (STRÜBING 1956).

Position within the chalk grassland Auchenorrhyncha communities: *Eurysa lineata* was found on only three sites, one each in the North Downs, South Downs and on the Isle of Wight. It is a sporadic species found only in low numbers on one mesotrophic arable reversion site (MG6) and on two additional chalk grassland sites, where it was sampled exclusively within the CG2a sub-community. All three sites are characterized by tall swards being on average higher than 10 cm indicating that *E. lineata* is a typical species of rank, often scrubby vegetation and, therefore, not a good indicator for frequently managed chalk grassland.

Monitoring Capacity: none

Hyledelphax elegantula (Boheman, 1847)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Hyledelphax elegantula* is common in England, Scotland and Ireland LE QUESNE (1960b).

Dispersal Capacity: good

Ecology: In central Europe *Hyledelphax elegantula* seems to be a sciobiotic species of deciduous and coniferous (especially open pine) forests and forest margins (EMMRICH 1966, NICKEL ET AL. 2002). It lives in the grass layer inhabiting moderately dry to moist sites, and occurs also under alleys and even solitary trees and shrubs (NICKEL 2003). The species appears here only rarely and in low numbers in treeless heaths and bogs and presumably occurs here only as a vagrant (NICKEL 2003, HOLZINGER ET AL. 2003). In northern Europe however, *H. elegantula* has been primarily found in moors and heaths (OSSIANNILSSON 1978). In Britain it is a common species among grasses, usually in rather dry places on both acidic and calcareous substrates (LE QUESNE 1960b, 1965a, MORRIS 1973, 1981a, 1990c, Waloff 1980, COOK 1996).

Hyledelphax elegantula has been classified as heliophilous and can be found within a wide moisture gradient ranging from bogs to dry grassland (SCHIEMENZ 1987, NICKEL & ACHTZIGER 1999). In Britain it favours tall swards (MORRIS 1981a, BROWN ET AL. 1992). It is here, therefore, a characteristic species of late successional stages of ruderal grassland on acidic soil (HOLLIER ET AL. 1994) and can be negatively effected by cutting (MORRIS 1981a). However, in one study its pattern of abundance on calcareous grassland was unrelated to grazing regime and vegetation height (MORRIS 1973).

On the continent *H. elegantula* lives on various grasses, notably *Calamagrostis arundinacea*, *Brachypodium pinnatum*, *Holcus mollis*, *Molinia caerulea*, *Poa nemoralis*, *Melica uniflora* and *Deschampsia flexuosa* (NOVOTNÝ 1995, NICKEL 2003, HOLZINGER ET AL. 2003). At higher altitudes in central Europe and towards northern Europe the species seems to be largely confined to *D. flexuosa* (SCHIEMENZ 1987, NICKEL 2003). On acidic grassland in England it was also recorded from *Festuca rubra* (WALOFF & SOLOMON 1973).

Hyledelphax elegantula is wing dimorphic (LE QUESNE 1960b, OSSIANNILSSON 1978). However, the vast majority of specimens are generally brachypterous (MORRIS 1973). Hibernation takes place in the larval stage (OSSIANNILSSON 1978).

Position within the chalk grassland Auchenorrhyncha communities: Within this study *Hyledelphax elegantula* was a common species which was found in all investigated regions, altogether on 54 sites. Frequency and abundance decrease sharply from unimproved towards improved and arable reversion sites. Within the CG grassland *H. elegantula* is one of the most frequent (class IV) and abundant species, where it is on average a subdominant species but can occasionally become eudominant. On mesotrophic grassland the species can also become eudominant, but ranks on average significantly lower as a recedent species with only a medium high frequency (class III). On CG grassland *H. elegantula* is a highly frequent and abundant species in all investigated communities. Here it does not show significant differences on community or sub-community level. On mesotrophic grassland *H. elegantula* is a subdominant preferential species of the MG1 community (frequency class V) and occurs less frequently on MG5 grassland. On MG6 and MG7 grassland the species is on average only a sporadic species, with a maximum abundance of a subrecedent species in both communities. *Hyledelphax elegantula* is a species of tall to medium high swards which avoids shorter turf with an average vegetation height below 6 cm. It is noteworthy that *H. elegantula* seems in Britain to be much more a species of open habitats, not depending on trees or scrubs as it does in central Europe. This could be due to different climatic conditions with a higher average of humidity and more evenly distributed rainfall in southern England compared with most part of central Europe. Otherwise, the results support the current knowledge about the ecology of this species. Its habitat requirements in Britain do not seem to differ from its known autecology in other parts of its range.

Monitoring Capacity: good indicator species for stage I

Muellerianella fairmairei (Perris, 1857)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree monophagous on *Holcus spp.*

Distribution status according to the BRC: common

Distribution in Great Britain: Widely distributed in damp places of England, Wales, Scotland and Ireland (LE QUESNE 1960b).

Dispersal Capacity: good

Ecology: On the continent *Muellerianella fairmairei* inhabits mainly meadows, pastures and forest glades (NICKEL 2003, HOLZINGER ET AL. 2003). It is there even sometimes regarded as a hygrophilous species of shores and wetlands (HILDEBRANDT 1995). In England and Scotland the species has been frequently found on acidic grassland (MORCOS 1953, WALOFF & SOLOMON 1973, EYRE ET AL. 2001). However, older records before 1981 may refer to *Muellerianella extrusa* (SCOTT, 1871) a sibling species living monophagously on *Molinia caerulea*. In northern England and Scotland *M. fairmairei* was abundant in riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland but avoided both dry and damp ruderal sites completely (EYRE ET AL. 2001). There are also records from calcareous grassland (MORRIS 1981a, BROWN ET AL. 1992).

On the continent *Muellerianella fairmairei* occupies wet to damp, usually rather cool and moderately eutrophic sites (MORCOS 1953, NICKEL & ACHTZIGER 1999, NICKEL 2003). It has here its main distribution in moderately intensive managed or unmanaged habitats (NICKEL & ACHTZIGER 1999). *Muellerianella fairmairei* favours tall swards and reacts with a decrease of abundance to cutting (MORRIS 1981a). On the other hand, it is probably the only monophagous grassland leafhopper in central Europe coping with intensive management (e.g. second cut) (NICKEL ET AL. 2002).

Food plants are *Holcus lanatus* and *H. mollis* (BOOIJ 1981, 1982). However, *Muellerianella fairmairei* lives only in localities where either *H. lanatus* or *H. mollis* (food plants) grow in close proximity to *Juncus effusus*. The latter is used only as an oviposition plant for overwintering eggs, whereas *Holcus spp*. are the oviposition plants under long-day conditions (DROSOPOULOS 1977). Under short day conditions, overwintering eggs are produced and laid exclusively on *Juncus effusus*, which is left immediately after hatching. Additionally, the species has been observed to use the runner stems of *Rubus fruticosus agg*, as egg-laying substrate (MORCOS 1953). *Muellerianella fairmairei* is often accompanied by asexual gynogenetic females. The frequency of triploid, pseudogamous females in mixed populations tends to increase with altitude and latitude and is related to wetness of the climate and the length of the growing season (BOOIJ & GULDEMOND 1984).

Muellerianella fairmairei is a wing dimorphic species (LE QUESNE 1960b).

Position within the chalk grassland Auchenorrhyncha communities: *Muellerianella fairmairei* was found within the project on nine sites altogether. The species occurred, with the exception of the South Downs, in every investigated region. Its occurrence seems to be more or less independent of the intensity of management, as it was found equally on unimproved and on improved sites. However, the species was never recorded from arable reversion sites, despite the frequent occurrence of its host plant *Holcus lanatus* on these sites. Within the chalk grassland communities *M. fairmairei* is a rare sporadic species, which can sometimes become subdominant. On mesotrophic grassland it becomes more frequent, and is here on average a subrecedent species, which can become even dominant. *Muellerianella fairmairei* seems to avoid the ranker vegetation of the CG3, CG4, CG5 communities completely. However, its appearance on the CG2 grassland is too scarce to make it a good differential species. On mesotrophic grassland *M. fa*irmairei is found rather constantly (frequency class III) in the MG1 and MG5 grassland, but again becomes scarce on the intensively managed MG7 community. There are no records from MG6 grassland at all. *Muellerianella fairmairei* prefers taller swards and seems to avoid sites with short turf completely. The results are in accordance with the observations from central Europe, stating that *M. fairmairei* is a species of moderately or unmanaged grassland, but can tolerate intensive management up to a certain degree.

Monitoring Capacity: none

Dicranotropis hamata (Boheman, 1847)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Dicranotropis hamata* is generally common on grasses in England, Wales, Scotland and Ireland (LE QUESNE 1960b). It has been reported from Kent up to Perthshire (PAYNE 1979, BADMIN 1981).

Dispersal Capacity: good

Ecology: In central Europe *Dicranotropis hamata* inhabits mainly mesotrophic dry to moist grassland, roadsides, ruderal sites, forest clearings, abandoned fields, occasionally also fertilized meadows, pastures and lawns (GÜNTHART 1987, SCHIEMENZ 1987, NICKEL 2003, HOLZINGER ET AL. 2003). In Scandinavia the species is common and often abundant in meadows, woods and cultivated fields (OSSIANILSSON 1978). British records originate both from acidic and calcareous dry grassland and also from a saltmarsh on the Isle of Wight (Le Quesne 1974a, WALOFF 1979, MORRIS 1981a, HOLLIER 1987, COOK 1996).

Dicranotropis hamata lives in moist to moderately dry, sunny to moderately shady, often disturbed sites (NICKEL 2003). It is generally a eurytopic species, which prefers tall swards on eutrophic, moderately intensive managed to unmanaged sites (BORNHOLDT & REMANE 1993, HILDEBRANDT 1995, NICKEL & ACHTZIGER 1999). On acidic grassland in England it can become a dominant species (WALOFF 1979). The species shows a high efficiency of nitrogen utilization and its fecundity is strongly correlated with the nitrogen content of the host plant (MCNEILL & SOUTHWOOD 1978, MCNEILL & PRESTIDGE 1982, WALOFF 1980). It has been reported to be an early colonizer (WALOFF & SOLOMON 1973).

Host plants are *Elymus repens*, *Dactylis glomerata*, *Holcus lanatus*, *H. mollis*, *Festuca arundinacea*, *Arrhenatherum elatius*, *Alopecurus pratensis*, *Lolium perenne* and other grasses (HOLZINGER ET AL. 2003, NICKEL 2003). Additionally, it has been reared on *Triticum aestivum*, *Avena sativa*, *Phleum pratense*, *Deschampsia cespitosa* and *Agrostis capillaris* (OSSIANILSSON 1978). On acidic grassland in England the species could be bred from tufts of *Holcus lanatus* and *H. mollis*, both species being used for oviposition (WALOFF & SOLOMON 1973, THOMPSON 1978, WALOFF 1979, WALOFF & THOMPSON 1980, PRESTIDGE & MCNEILL 1983).

Dicranotropis hamata is a wing-dimorphic species, but macropters are much rarer than brachypters (OSSIANILSSON 1978).

Position within the chalk grassland Auchenorrhyncha communities: Although *Dicranotropis hamata* usually appears only in small numbers on the investigated localities, it is, with records from 14 sites and observations from all regions, still a rather common species on chalk in southern England. Despite its recognition as a eurytopic species the majority of observations (nine sites) are from unimproved chalk grassland sites. Only two improved sites and one arable reversion site contained *D. hamata*. However, there are no significant differences on community level between mesotrophic grassland and chalk grassland. There are also no differences within the chalk grassland recognizable neither on community nor on sub-community level. On mesotrophic grassland *D. hamata* is fairly widespread within the MG1 community (frequency class III), where it is on average a subrecedent species becoming as a maximum a recedent species. On MG5 and MG6 grassland the species is less abundant and it avoids MG7 grassland altogether. *Dicranotropis hamata* seems to prefer tall swards and was not recorded from sites with short swards at all. The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from its situation in central Europe.

Monitoring Capacity: good indicator species for stage I

Kosswigianella exigua (Boheman, 1847)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree monophagous on *Festuca* (possibly 1st degree monophagous on *F. ovina agg.*)

Distribution status according to the BRC: local

Distribution in Great Britain: England south of a line from Wash to Bristol Channel; additionally recorded from Yorkshire, South and North Wales (LE QUESNE 1960b, HOLLIER pers. comment). There exists also a record from the Isle of Wight (LE QUESNE 1974a).

Dispersal Capacity: good

Ecology: In central and northern Europe the species is found mainly on grazed grassland, dry meadows and rocky heaths (OSSIANNILSSON 1978, MÜLLER 1987, NICKEL 2003). In Britain *Kosswigianella exigua* is mainly recorded from short grass in dry open places (LE QUESNE 1960b). Notably, it seems to be found more often on calcareous grassland and is absent from some well monitored dry acidic grassland sites completely (WALOFF 1980, MORRIS 1971a, 1973). Additionally, it was abundant on a heath with chalky sand in Norfolk (LE QUESNE & MORRIS 1971).

Generally, *Kosswigianella exigua* prefers sunny, oligotrophic, moderately dry to dry sites on acidic and basic substrates and occurs occasionally also on damp or very dry sites (NICKEL 2003). It is in central Europe an eurytopic but heliophilous species of xerophilous and mesotrophic habitats with short swards (MARCHAND 1953, EMMRICH 1966, SCHIEMENZ 1969, NICKEL 2003, NICKEL ET AL. 2002, HOLZINGER ET AL. 2003). Here the species belongs to the 'Corynephoretum agrostidetosum aridae', but has been equally regarded to be abundant and a character species in the calcareous 'Mesobrometum' (MARCHAND 1953, MÜLLER 1987, ROMBACH 1999). On calcareous grassland it is more typical on grazed pastures than on mown meadows (ROMBACH 1999). However, during one study in England *K. exigua* showed no significant differences when ungrazed and grazed plots were compared (MORRIS 1971a).

In the right habitat *Kosswigianella exigua* can be among the dominant species (OSSIANNILSSON 1978), and adapts at least in Hungary, where it is monophagous, to hot and dry climates with a high tolerance of extreme habitat conditions rather then the development of long-winged form to escape unfavourable conditions through migration (GYORFFY & KARSAI 1991).

Kosswigianella exigua was thought to live polyphagously on narrow-leaved grasses, but it is now assumed that the species shows a strong preference for sheep's fescue (*Festuca ovina* agg.). Other named host plants are *Corynephorus canescens* and *Deschampsia flexuosa* but these still need confirmation (NICKEL 2003). On acidic sites in England it has been equally observed colonising patches of *Festuca sp.* (WALOFF & SOLOMON 1973).

Kosswigianella exigua is wing dimorphic, but macropters are rare (LE QUESNE 1960b, OSSIANNILSSON 1978). The species hibernates in the in larval stage (KUNTZE 1937, MÜLLER 1957, REMANE 1958, SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Kosswigianella exigua* is one of the most common and abundant Auchenorrhyncha species on chalk in southern England. It was recorded from 60 sites, with records from all investigated regions. It seems especially constant and abundant in the South Wessex Downs, where more than 80 % of the sites contained this species. There are no differences in frequency between the types of landuse recognizable, except for a slightly lower frequency on arable reversion sites. However, *K. exigua* can be regarded as one of the main preferential species of chalk grassland in comparison to mesotrophic grassland. On the CG grassland the species appears in the frequency class IV and is on average a subdominant species. It can here become even eudominant on single sites. On mesotrophic grassland *K. exigua*, although reaching equally frequency class IV, occurs usually in much lower abundance, being on average a subrecedent species and reaching as a maximum only the abundance of a subdominant species. Within the CG communities there is a clear preference for the CG2 grassland where *K. exigua* is a constant species (class V) and occurs in significantly higher numbers than in the ranker chalk grassland communities of CG3, CG4 and CG5. *Kosswigianella exigua* can therefore be regarded as a preferential species of the CG2 grassland. Within the CG2 grassland *K. exigua* occurs in significantly higher abundance on sites which can be classified as CG2b grassland in comparison to CG2a and CG2c grassland. On mesotrophic grassland, with the exception of MG7, where *K. exigua* reaches only a frequency of class III, no differences in frequency or abundance are recognizable. Obviously, *K. exigua* avoids tall grass stands with a frequency of only class III and an average abundance of a recedent species on sites with high swards. The abundance is highest on sites with short swards where it occurs on average as a dominant species. The vast majority of recorded specimens were brachypterous. The results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its autecology on the continent.

Monitoring Capacity: good indicator species for stage I

Xanthodelphax straminea (Stål, 1858)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree monophagous on *Agrostis spp.*

Distribution status according to the BRC: local

Distribution in Great Britain: *Xanthodelphax straminea* has been reported locally from England and Scotland (LE QUESNE 1960b).

Dispersal Capacity: poor

Ecology: In central and northern Europe *Xanthodelphax straminea* inhabits a rather wide range of habitats with a main occurrence in lean acidic and dry meadows. Additionally, the species was found in intermediate and raised bogs, spring mires, wet meadows, clearings and grassy wood margins. It has also been mentioned from dry, sandy grassland and even from moderately saline sites (KUNTZE 1957, BITTNER & REMANE 1977, OSSIANNILSSON 1978, GÜNTHART 1987, SCHIEMENZ 1987, NICKEL 1999, NICKEL 2003, HOLZINGER ET AL. 2003). In Britain *Xanthodelphax straminea* has basically been found in acidic dry grassy places (LE QUESNE 1960b, WALOFF & SOLOMON 1973). In contrast, in northern Germany *Xanthodelphax straminea* is regarded as a hygrophilous species of shores and wetland and wet meadows (HILDEBRANDT 1995). However, moisture conditions can range from wet to moderately dry (NICKEL 2003). In central Europe the species seems to be confined to only extensively managed or unmanaged habitats (NICKEL & ACHTZIGER 1999).

Xanthodelphax straminea feeds usually on *Agrostis canina*, but is recorded also from *A. capillaris* and may feed additionally on *A. stolonifera* (NICKEL 2003). The suggestion that the species feeds equally on small sedges (*Carex spp.*) and *Deschampsia flexuosa* needs further investigation (BITTNER & REMANE 1977, NOVOTNÝ 1995)

Hibernation takes place in the larval stage (REMANE 1958). *Xanthodelphax straminea* is wing dimorphic (LE QUESNE 1960b).

Position within the chalk grassland Auchenorrhyncha communities: *Xanthodelphax straminea* was recorded from 17 sites with observations from all investigated regions. However, compared with the other regions it seems to be comparably rare in the South Wessex Downs and South Downs. *Xanthodelphax straminea* is a rare species on unimproved sites, where it occupies only about 6 % of the sites compared with about a quarter of the sites within the other landuse types. The highest abundances were recorded from arable reversion sites. The species occurs usually in low numbers but was eudominant and the most abundant Auchenorrhyncha species (altogether 887 sampled individuals) on one arable reversion site. *Xanthodelphax straminea* is only a sporadic species on CG grassland but slightly more frequent (class II) on mesotrophic grassland, where it is on average a subrecedent species, sometimes reaching subdominance. Within the MG grassland *X. straminea* is most frequent (class III) and abundant on MG7 sites, where it is on average a recedent species, occasionally reaching the status of a subdominant species. It seems to avoid MG1 grassland altogether. *Xanthodelphax straminea* can be regarded as a preferential species of mesotrophic grassland in comparison to CG grassland and here especially as a preferential species of the intensively managed leys of the MG7 community. The species could not be recorded from sites with short swards, but otherwise no preferences between medium high or high swards were recognizable. The species seems to undergo extreme population changes between years. Whereas in the years 1998 to 2000 *X. straminea* could only be found on one single site, it became much more widespread and abundant in the year 2002. There are several facts gained from this study which can be probably added to the current knowledge on the ecology of this species. In Britain it can not necessarily be regarded as a species preferring acidic conditions. Additionally, it can be assumed from its frequent occurrence on chalk, that *X. straminea* is not as hygrophilous in Britain as it is on the continent. This may be explained by different climatic conditions on chalk grassland in Britain with a higher or more regular supplement of rainfall in comparison to similar looking habitats in central Europe.

Monitoring Capacity: none

Criomorphus albomarginatus Curtis, 1833

Habitat-specialization in Britain: eurytopic grassland species

Host specificity: 2nd degree oligophagous on Poaceae and Juncaceae (*Luzula*)

Distribution status according to the BRC: common

Distribution in Great Britain: *Criomorphus albomarginatus* is common and widespread in England, Wales, Scotland and Ireland (Le Quesne 1960b). It was recorded from Huntingdonshire on grasses (Le Quesne 1965a).

Dispersal Capacity: good

Ecology: In central and northern Europe *Criomorphus albomarginatus* lives in meadows and pastures, coastal dunes, fens, bogs, in leys, abandoned grassland, roadside verges, ditches, forest edges and on low vegetation in forests (Kuntze 1937, Raatikainen & Vasarainen 1976, Schiemenz 1987, Nickel 2003, Holzinger et al. 2003). In Britain there are records from grasses in woods and on hillsides (Le Quesne 1960b). It has been frequently found on acidic grassland in northern England and Scotland including dry to damp ruderal sites, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland (Eyre et al. 2001). Additionally, on acidic grassland in Berkshire it was bred from tufts of *Holcus spp*. (Waloff & Solomon 1973). Within Britain the species has also been recorded from calcareous grassland (Morris 1973, 1981a, Brown et al. 1992, Cook 1996).

In central Europe *Criomorphus albomarginatus* is regarded as a eurytopic species, which only avoids intensively managed grassland (Hildebrandt 1995, Nickel & Achtziger 1999, Nickel 2003). Here it occurs mainly in wet to damp sites, both sunny and shady (Nickel 2003).

As a tall grass species, which becomes adult very early in the year, *C. albomarginatus* reacts negative to grazing in winter and to cutting in May, but benefits probably from infrequent cutting later in the year (Morris 1973, Morris 1981a). It does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a). The species was observed colonising suitable habitats (abandoned fields) over long distances (Witsack 1995).

Host plants of *Criomorphus albomarginatus* are a wide range of grasses including *Festuca rubra*, *Deschampsia cespitosa*, *D. flexuosa*, *Calamagrostis arundinacea*, *Poa pratensis*, *Phleum pratensis* and *Agropyron repens* (Raatikainen & Vasarainen 1976, Schiemenz 1987, Nickel 2003). A few additional records of adults are from *Luzula sp*. (Nickel 2003). In experiments the species reproduced on oat and on *Festuca pratensis* (Raatikainen & Vasarainen 1976). *Criomorphus albomarginatus* is wing-dimorphic, but macropters are rare (Ossianilsson 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Criomorphus albomarginatus* is a widespread species with records on 27 sites, and from all investigated regions. It seems to have a stronghold in the Chilterns were it appears on two third of all sites; more than double the frequency in comparison with all other regions. It is much more frequent on unimproved and even more constant on semi-improved sites than on improved chalk grassland or arable reversion sites. It is a preferential species of calcareous (CG) grassland in comparison to mesotrophic grassland (MG) on chalk. Within the CG grassland the species reaches a frequency class of III compared with only II on MG grassland. It is on average a subrecedent species in CG communities compared with being only a sporadic species in mesotrophic (MG) sites. However, in both grassland groups *C. albomarginatus* can occasionally become a subdominant species. Within the CG grassland it is a preferential species of the rank communities of the CG3, CG4, CG5 grassland. Here *C. albomarginatus* reaches a high frequency (class IV) and becomes significantly more abundant, although on average is still only a subrecedent species. Interestingly, within the CG2 grassland, *C. albomarginatus* could not be found on sites belonging to the CG2b sub-community but regularly on CG2a and CG2c. On the MG grassland *C. albomarginatus* has an obvious stronghold within the MG1 community, reaching here a frequency class of IV and becoming on average a recedent species. It appears in much lower constancy and abundance on the MG6 and MG7 communities. There are surprisingly no records from MG5 grassland at all. The species prefers taller swards; on sites with medium high or short swards it appears only sporadically in low numbers. The avoidance of mesotrophic grassland in comparison to CG grassland may indicate that *C. albomarginatus* occupies perhaps in Britain a smaller niche compared to its situation on the continent, where it is more frequently found on mesotrophic grassland. Otherwise the results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its ecology on the continent.

Monitoring Capacity: good indicator species for stage I

Javesella pellucida (Fabricius, 1794)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: polyphagous on Poaceae, Juncaceae, Cyperaceae, (Equisetaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: *Javesella pellucida* is common and widely distributed in England, Wales, Scotland and Ireland (LE QUESNE 1960b). It was commonly recorded from grasslands in Wales (WHALLEY 1955).

Dispersal Capacity: very good

Ecology: *Javesella pellucida* is a typical species of cultivated fields, dry grassland, drained, ploughed and sown grassland with a mixture of meadow grasses, and is only missing under extreme dry or wet conditions (EMMRICH 1966, 1969, SCHIEMENZ 1987, RAATIKAINEN & YLÖNEN 1989, ANDRZEJEWSKA 1991, HILDEBRANDT 1995, NICKEL & ACHTZIGER 1999, NICKEL 2003). It was dominant in mesophilous grassland in Thuringia, eastern Germany (MÜLLER ET AL. 1978), and has also been found to be characteristic of dry psammophilous meadows in Poland (SZWEDO 1998). In Great Britain *J. pellucida* is generally common on grasses (LE QUESNE 1960b). Interestingly, the species was recorded from acidic sites but not from limestone in the area of Teesdale (WHITTAKER 1964, 1977). Otherwise the species can be in Great Britain equally dominant on acidic and calcareous grassland (WALOFF 1980, MORRIS 1971a, 1990c).

Javesella pellucida is a very eurytopic species living in various wet to dry, sunny to moderately shady sites. Highest abundances are usually found under moderate conditions in eutrophic meadows and pastures, including salt marshes (NICKEL 2003). The species prefers nutrient rich, eutrophic habitats (BORNHOLDT & REMANE 1993, WALTER 1996, ANDRZEJEWSKA 1976). A positive connection between the amount of available nitrogen and the abundance of *J. pellucida* has been documented for *Trisetum*-grassland in the ‘Rhön’, Germany (BORNHOLDT 2002). *Javesella pellucida* is among the very few species, which are able to survive at least temporarily in intensively managed grassland, as well as in other very intensively managed habitats like lawns and cereal fields (NICKEL 2003).

The species has a very good colonising ability (SCHULZ & MEIJER 1978). On acidic grassland in Berkshire it was an early colonizer of sown fields (WALOFF & SOLOMON 1973). *Javesella pellucida* was also typical for early successional stages of ruderal grassland on acidic soil, staying dominant into later successional stages (HOLLIER ET AL. 1994). On the other hand, *J. pellucida* can decline again quite early after colonising on arable reversion sites (MORRIS 1990a).

Breeding plants and food plants are many grasses, including cereals like *Avena sativa. Lolium perenne* is apparently one preferred oviposition plant (OSSIANILSSON 1978). Other host grasses named in literature are *Festuca spp.*, *Elymus spp.*, *Dactylis spp.*, *Poa spp.*, *Deschampsia spp.*, *Agrostis spp.*, *Calamagrostis spp.*, *Phleum spp.* and *Coleanthus subtilis* (NOVOTNÝ 1995, NICKEL 2003, HOLZINGER ET AL. 2003). It is less commonly reported from Cyperaceae (*Eleocharis ovata*, *Carex bohemica*), Juncaceae (*Juncus articulatus*, *Juncus bufonius*) and may feed even on Equisetaceae (NOVOTNÝ 1995, NICKEL 2003). On acidic grassland in Britain *J. pellucida* fed on experimental plots with sown grasses mainly on *Dactylis glomerata* and *Festuca pratensis* and was successfully bred from *Holcus mollis* (WALOFF & SOLOMON 1973, PRESTIDGE & MCNEILL 1983).

Javesella pellucida is wing-dimorphic with macropters more common than brachypters (LE QUESNE 1960b, OSSINANILSSON 1978). Populations with brachypterous individuals are usually restricted to lean meadows, fens, abandoned fields and slightly saline sites. In contrast, macropterous individuals colonize all kinds of open habitats, particularly in high summer. However, reproductive success in these habitats varies considerably (HOLZINGER ET AL. 2003).

Position within the chalk grassland Auchenorrhyncha communities: As one of the most widespread Auchenorrhyncha species *Javesella pellucida* was recorded in all regions and from 85 sites. It is a common species in all types of landuse although occurring with a lower frequency and abundance on unimproved sites. It is highly significant more abundant on mesotrophic grassland, where it is on average a subdominant species and able to become dominant compared with CG grassland, where it is on average only a subrecedent species able to become subdominant. In both grassland groups *Javesella pellucida* is a constant species (frequency class V). There are no significant differences within the CG and MG community groups. Both on community or sub-community level *J. pellucida* always belongs to the constant species. The results indicate that *J. pellucida* seems to have a slight preference for higher swards. Habitat requirements in Britain do not seem to differ from its autecology in continental Europe.

Monitoring Capacity: none

Javesella dubia (Kirschbaum, 1868)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Javesella dubia* is common and widely distributed on grasses, especially in woods. It is recorded from England, Scotland and Ireland (Le Quesne 1960b). Additionally, there are records from Wales (Whalley 1955).

Dispersal Capacity: good

Ecology: As a widespread species in central Europe *Javesella dubia* inhabits there meadows, pastures, forest roads, ruderal sites, abandoned fields, moist forests, glades, marshes, lean lawns, leys and cereal fields. Most of these habitats are managed but the species occupies equally semi-natural or natural habitats like salt marshes, shores of lakes and rivers, reed swamps, fen woods, sphagnous spruce woods, *Oxalis-Myrtillus* spruce woods and rich moist or swampy woods (Kuntze 1937, Linnavuori 1952, Whalley 1955, Wagner & Franz 1961, Raatikainen & Vasarainen 1976, Günthart 1987, Schiemenz 1987, Nickel 2003). In England it is recorded from acidic grassland in Berkshire and Huntingdonshire (Le Quesne 1965a, Waloff & Solomon 1973, Prestidge & McNeill 1983). The species was also found in reed swamps and grass meadows in Wales (Whalley 1955).

Javesella dubia is highly eurytopic, preferring sunny to shady, damp to moderately wet, intensively managed as well as extensively managed or unmanaged sites (Hildebrandt 1995, Nickel & Achtziger 1999, Nickel 2003). On acidic grassland in Berkshire it was recognized to be an early colonizer (Waloff & Solomon 1973).

The species feeds on grasses usually on *Agrostis stolonifera* and *A. capillaris* (Nickel 2003). There are also records from *Avena sativa*, *Lolium perenne* and *Phleum pratense* (Schiemenz 1987). In tests it fed and reproduced on *Avena sativa* and *Arrhenatherum elatius* (Ossianilsson 1978, Günthart 1987). In Britain preferred host plants on acidic grassland were *Festuca pratensis* and *Dactylis glomerata* (Prestidge & McNeill 1983).

Both brachypters and macropters appear (Le Quesne 1960b, Ossianilsson 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Javesella dubia* was a widespread species within this study, being recorded from 41 sites and all investigated regions. It is rather more frequent on improved and arable reversion sites than on unimproved and semi-improved sites. The highest abundances are on improved sites the lowest on arable reversion sites. In general, *J. dubia* occurs on CG and MG grassland in a medium frequency (class III) and is on average a subrecedent species on CG grassland and a recedent species on MG grassland. However, there are no significant differences in the overall abundances. On mesotrophic grassland *J. dubia* can become a dominant species on single sites, but on CG grassland only subdominant. Within the CG grassland *J. dubia* is more frequent in the CG2 community compared with CG3, CG4 and CG5, but shows no significant differences in the abundances. Interestingly, on sub-community level the species is more frequent (class IV) within the richer CG2c sub-community compared with CG2a and CG2b (both frequency class II). It shows here as well significantly higher abundances than on CG2b. Within the mesotrophic grassland *J. dubia* is a constant (class V) species of the intensively managed leys of the MG7 grassland and can become here a subdominant species (on average recedent). It appears in lower frequency on MG5 and MG6 grassland but is still in MG5 on average a recedent species. In contrast, *J. dubia* is only a rare and sporadic species on MG1 grassland. There are no significant differences in abundances and frequency for different vegetation heights recognizable. However, there seems to be a slight preference for medium to high swards. The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology in other parts of its range.

Monitoring Capacity: none

Ribautodelphax angulosa (Ribaut, 1953)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree monophagous on *Anthoxanthum odoratum*

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Ribautodelphax angulosa* is restricted to southeastern England. There are records from Hertfordshire, Berkshire, Surrey, Hampshire, Isle of Wight and Dorset (Le Quesne 1960a,b, Kirby 1992). However, some of the older records may refer to the only recently described *Ribautodelphax vinealis* Bieman, 1987.

Dispersal Capacity: very poor

Ecology: In central Europe *Ribautodelphax angulosa* lives in dry grassland on sandy or siliceous substrates like sandy abandoned grassland, lean pastures, dry slopes and meadows (Wagner & Franz 1961, Ossiannilsson

1978, Nickel 1994, Nickel 1997, Nickel 2003). However, records before 1987 have to be treated with caution, due to the possible confusion with *Ribautodelphax vinealis*. For example, the suggestion made by Marchand (1953) that *R. angulosa* is a xerophilic species belonging to the 'Corynephoretum agrostidetosum aridae' may refer in fact to *R. vinealis*. There is only one published record of *R. angulosa* from moist and swampy meadows with stands of *Molinia* as a main habitat (Wagner & Franz 1961). Despite a wide distribution of its host this species is apparently rare and very localized in central Europe (Nickel 2003). In Britain *Ribautodelphax angulosa* is confined to dry grassland and grassy places and it is known from both calcareous and fairly acid soils (Le Quesne 1960b, Waloff & Solomon 1973, Prestidge 1982, Kirby 1992).

Ribautodelphax angulosa is apparently a psammophilous species (Nickel 2002, Nickel et al. 2002). In central Europe it lives in sunny, moderately dry, occasionally also moderately moist, usually acidic and oligotrophic sites (Nickel 2003). It seems to be confined to only extensively managed or unmanaged sites (Nickel & Achtziger 1999).

The species feeds apparently monophagously on *Anthoxanthum odoratum* (den Bieman 1987, Nickel 2003, Holzinger et al. 2003). However, it has also been mentioned being polyphagous on grasses with a preference for *Lolium perenne* and *Dactylis glomerata* (Prestidge & McNeill 1983).

For a long time only brachypterous specimens were known (Le Quesne 1960b, 1960b, Ossiannilsson 1978). Only recently macropterous females have been reported (den Bieman 1987).

Position within the chalk grassland Auchenorrhyncha communities: *Ribautodelphax angulosa* was only found with five specimens on one unimproved grassland site in the South Wessex Downs. The site has been classified as mesotrophic grassland belonging to the MG5 community. *Ribautodelphax angulosa* is possibly a species with a main occurrence on acidic dry grassland and, therefore, not a regular element of the British chalk grassland fauna.

Monitoring Capacity: good indicator species for stage II

Ribautodelphax imitans (Ribaut, 1953)

Habitat-specialization: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Festuca arundinacea*

Distribution status according to the BRC: notable A

Distribution in Great Britain: Recorded only from Devon (Axmouth-Lyme Regis) and Dorset (Southwell, Portland; Corfe) (Le Quesne 1960a,b, Kirby 1992).

Dispersal Capacity: very poor

Ecology: In central Europe *Ribautodelphax imitans* inhabits meadows, pastures and abandoned grassland. (Nickel 2003, Holzinger et al. 2003). The species is found in Britain only on calcareous downland, but may also occur on other types of dry grassland (Kirby 1992).

Ribautodelphax imitans mainly occurs in sunny, temporarily moist to temporarily wet and rather eutrophic habitats (Nickel 2003, Holzinger et al. 2003). The species is confined to only extensively managed or unmanaged sites (Nickel & Achtziger 1999). *Festuca arundinacea* is the only known food plant in central Europe, from which *Ribautodelphax imitans* was also recorded in France and Greece (den Bieman 1987, Holzinger et al. 2003).

In Great Britain only brachypters are known (Le Quesne 1960b).

Position within the chalk grassland Auchenorrhyncha communities: *Ribautodelphax imitans* has not been found within the project. It has been reported in Britain only from calcareous grassland sites (Kirby 1992). However, it may not prove to be a typical chalk grassland species, especially since its host plant is much more widespread in a range of other grassland communities.

Monitoring Capacity: good indicator species for stage I

Ribautodelphax pungens (Ribaut, 1953)

Habitat-specialization: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Brachypodium pinnatum*

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Ribautodelphax pungens* is reported only from England: Folkestone Warren, Sandwich and Wye in Kent, Withington and Colesborne in Gloucestershire, Worth in Dorset, Isle of Wight, Surrey, Berkshire (Le Quesne 1960a,b, Kirby 1992).

Dispersal Capacity: very poor

Ecology: On the continent *Ribautodelphax pungens* is a stenotopic, xerophilous species of dry grass meadows and heaths. The species prefers basic sites and is particularly common and often among the dominant species in calcareous grassland and open pine forests. It rarely occurs also under damp conditions (Nickel 1994, Nickel 2003, Nickel et al. 2002). It is a character species of dry grassland in Germany, especially in the Brachypodietum pinnatae (Schiemenz 1987, Rombach 1999). *Ribautodelphax pungens* is as well a typical species on calcareous grassland in Poland, which is characterized by a much more continental climate with drier summers and colder winters compared to the British conditions (Gebicki 1987). British records originate mainly from chalk and limestone grassland. Additional records from coastal dunes at Sandwich Bay in Kent (Kirby 1992) have to be treated with caution due to the possible confusion with *Ribautodelphax vinealis* Bieman 1987.

The phenology of *R. pungens* populations can be heavily negatively influenced through cutting in summer (Rombach 1999).

Host plant in central and northern Europe is *Brachypodium pinnatum*, other *Brachypodium spp.* are used in the Mediterranean region (den Bieman 1984, 1987, Nickel 1994, Nickel 2003).

Only brachypterous specimens are known (Le Quesne 1960b, Ossiannilsson 1978). Some populations are reported to comprise varying proportions of triploid, pseudogamous females (den Bieman 1987). Hibernation takes place in the larval stage (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Ribautodelphax pungens*, which is one of the common and often abundant typical chalk grassland species in central Europe, was surprisingly rare within the project and could only be found in low numbers on two unimproved chalk grassland sites of the North Downs. Although the rareness of the species makes it difficult to show significant differences, *R. pungens* can be regarded as a good differential species of CG grassland versus MG grassland, since its only host plant *Brachypodium pinnatum* is basically confined to the CG communities. Within the CG grassland *R. pungens* is probably a preferential species of the CG4 and CG5 communities with their high frequency and abundance of *B. pinnatum*. However, only one of the two sites with positive records belonged to CG4 grassland. The other site has been classified as belonging to the CG2b sub-community, although the vegetation on this site showed already signs of transitions to the ranker communities. The vegetation on both sites was characterized by high swards. The results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology on the continent.

Monitoring Capacity: good indicator species for stage II, umbrella species

Tettigometra impressopunctata Dufour, 1846

Habitat-specialization: dry grassland species

Host specificity: unknown

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Tettigometra impressopunctata* has been locally found in southern England and Wales on chalk and sand hills. There are records from Oxfordshire, Buckinghamshire, Surrey, Kent, Wiltshire, Isle of Wight, Dorset, Gloucestershire, Glamorgan and Pembrokeshire (Le Quesne 1960b, Kirby 1992).

Dispersal Capacity: good

Ecology: In central Europe *Tettigometra impressopunctata* occurs along sunny woodland margins, grazed dry grasslands, rocky heaths, steppes, glades, along spatially diverse forests margins and on gravel banks of alpine rivers with scattered scrubs, occasionally also on the verges of fens (Schiemenz 1987, Nickel 2003, Holzinger et al. 2003). There are also older records from fenland habitats at the foothills of the Alps (Nickel 2003). The habitats of *Tettigometra impressopunctata* in Britain seem to be restricted to chalk and limestone grassland, sand hills and calcareous dunes (Le Quesne 1960b, Kirby 1992).

On the continent this xerothermophilic species lives in dry to temporarily dry and warm sites, both on acidic and basic substrates (Nickel 2003, Holzinger et al. 2003). *Tettigometra impressopunctata* is typical for fairly short or thin grassy vegetation, often with patches of bare ground or sand. It is usually found in sheltered hollows and on south facing slopes (Kirby 1992). *Tettigometra* species seem to depend upon the occurrence of a certain amount of woody structures (e.g. scrub, woodland margins) within their occupied habitat (Nickel pers. comment). Consequently, habitat restoration involving intensive scrub clearing may cause locally a threat to *Tettigometra* populations.

Adults are found among herbaceous vegetation as well as on shrubs and trees (*Quercus*, *Taxus*, *Myricaria* and others) (Schiemenz 1987, Nickel 2003). Foodplants in Britain are unknown (Kirby 1992).

The species overwinters as an adult (Kirby 1992).

Position within the chalk grassland Auchenorrhyncha communities: *Tettigometra impressopunctata* has not been found within the project. However, it has been reported in Britain mainly from calcareous grassland sites (Kirby 1992). Therefore, it seems justified to regard *T. impressopunctata*, although it is comparably rare, as a character species of chalk grassland. Kirby et al. (2001) see *T. impressopunctata* as a good indicator species of diverse and undisturbed calcareous grassland since its habitats tend to be warm and sheltered, floristically rich locations. Since the species requires apparently relatively short vegetation, it is most likely to be found on grassland belonging to the NVC community CG2. However, considering the habitat descriptions from central Europe the species may require a relative high structural diversity with patches of bare ground on the one side and ranker grass stands and scrubs on the other.

Monitoring Capacity: good indicator species for stage II, umbrella species

Cicadetta montana **(Scopoli, 1772)**

Habitat-specialization in Great Britain: dry grassland species

Host specificity: polyphagous on trees and *Pteridium aquilinum*, larvae possibly as well on *Molinia caerulea*

Distribution status according to the BRC: notable A

Distribution in Great Britain: *Cicadetta montana* is currently only known from the New Forest, Hampshire, but with no certain records over the last years (Kirby 1992, Pinchen & Ward 2002). Old records are from near Haslemere in 1864 and near Chidingfold, both Surrey, near Woolmer and one unconfirmed record from Epping Forest, Essex (Morley 1941, Le Quesne 1965c, Kirby 1992, Pinchen & Ward 2002). A very local species *C. montana* is erratic in its appearance, but was locally found in numbers (Kirby 1992, Pinchen & Ward 2002). On the basis of bioacoustical studies *C. montana* has recently been split into a complex of several different taxa (Gogala 2002, Gogala & Trilar 1998, 2004). If the British population can remain within the nominate form has still to be confirmed.

Dispersal Capacity: good

Ecology: In Britain *Cicadetta montana* is currently known only from glades in woodland on heavy soils (clay) (Kirby 1992, Pinchen & Ward 2002). In the New Forest it was found in fairly open deciduous or mixed woodland, preferring southern fringes bordering rough common, or broad rides, firebreaks or clearings (Kirby 1992). On the continent it is as well a characteristic species of scrubby, dry limestone grassland (Hidvegi & Baugnée 1992, own observations). Otherwise it is here a species among open stands of shrubs or trees and of sunexposed hillsides or plateaus. Main habitats are dry pastures, meadows and sunny forest margins (Wagner & Franz 1961, Schiemenz 1969, Ossiannilsson 1981, Schiemenz 1988, Emmrich 1984, Nickel 2003). The conditions within these habitats range from moderately dry to dry (Nickel 2003). However, the microclimate on British chalk grassland may be characterized by to much humidity compared with similar inhabited biotopes on the continent.

The larvae live several years subterranean (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: As expected the species was not found during this project. However, there is still a small chance that *C. montana* will be discovered eventually on scrubby Downland. With a changing climate it may also find here suitable habitats in the not so far future.

Monitoring Capacity: good indicator species for stage II, umbrella species

Neophilaenus campestris **(Fallén, 1805)**

Habitat-specialization in Great Britain: species mainly on calcareous grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: local

Distribution in Great Britain: Locally found in England as far North as Yorkshire and Ireland (Le Quesne 1965c). Reported from calcareous grassland in Bedfordshire (Morris 1967).

Dispersal Capacity: good

Ecology: On the continent *Neophilaenus campestris* is reported from grassy ruderal or grazed sites, particularly from disturbed, grazed or trampled patches in dry grassland. Otherwise it inhabits dry calcareous and sandy grassland in warm localities, coastal and inland dunes, sandy fields, sunny slopes, mining areas, roadsides, military training areas or grassy patches in dry xerophilic woodland (Kuntze 1937, Wagner & Franz 1961, Müller 1978, Günthart 1987, Nickel 1997, Nickel 2003). It is also mentioned for heavily drained xerothermic gypsum sites in Germany (Nickel et al. 2001). In Britain *N. ca*mpestris lives locally on grasses, mainly on calcareous sites, but as well on acidic dry grassland (Le Quesne 1965c, Morris 1967, Waloff & Solomon 1973, Badmin 1997).

In central Europe *N. campestris* seems to be a stenotopic, xerophilous and heliophilous species of dry and sunny sites, where it often can be highly dominant (SCHWOERBEL 1957, SCHIEMENZ 1969, NICKEL 2003, NICKEL ET AL. 2002). *Neophilaenus ca*mpestris was found in England on heavily grazed plots as well as in plots where grazing had stopped for over one year (MORRIS 1967). The species seems to benefit from cutting, but only if it is done infrequently and preferably later in the year (MORRIS 1981b). The species showed no significant preference for grazed or ungrazed sites during one study in England (MORRIS 1971a). It seems to be associated with open ground (WHITTAKER 1969).

Host plants are various grasses, particularly *Agrostis capillaris*, but probably as well *Elymus repens*, *Arrhenatherum elatius*, *Poa compressa* and others (NICKEL 2003). Some adults ascend into *Pinus spp.* and other woody plants during hot summer days (NICKEL 2003).

*Neophilaenus ca*mpestris is univoltine and hibernates in the egg stage (OSSIANNILSSON 1981).

Position within the chalk grassland Auchenorrhyncha communities: *Neophilaenus campestris* has not been found within the project. However, since it has been reported from calcareous grassland sites in Britain it is probably justified to regard *N. campestris*, although it is rather rare, as a character species of chalk grassland.

Monitoring Capacity: good indicator species for stage II

Neophilaenus exclamationis (Thunberg, 1874)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree monophagous on *Festuca ovina* (1st degree oligophagous on Poaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: Locally common in England, Wales and Scotland (WHALLEY 1955, LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In central and northern Europe *Neophilaenus exclamationis* is reported from coastal dunes, sandy fields, heaths, moors, on dryish meadows, rocky islets, seashores, in moist sloping meadows, cultivated fields, open dry forests (especially pine afforestations and open dry oak forests), boreal forests, roadside margins, also from grassland of the subalpine and alpine belt of the Alps (KUNTZE 1937, KONTKANEN 1938, LINNAVUORI 1952, SCHIEMENZ 1988, RAATIKAINEN & YLÖNEN 1989, NICKEL 2003). In Britain *N. exclamationis* lives on short grasses, often on calcareous hillsides or on acid soils over gritstone hillsides (LE QUESNE 1965c). It is generally associated with calcareous grassland, where it can become dominant, but has been also reported from acidic grassland in Berkshire and from dry sandy heaths, particularly in *Salix repens* areas in Wales (WHALLEY 1955, MORRIS 1971a, 1973, 1990c, WALOFF & SOLOMON 1973). The species was also abundant on a heath with chalky sand in Norfolk (LE QUESNE & MORRIS 1971), and was also common on limestone around Teesdale (WHITTAKER 1964, 1977).

Neophilaenus exclamationis is regarded as a eurytopic species of xerothermophilous habitats and mesotrophic meadows, usually occurring in oligotrophic, damp to moderately dry, basic as well acidic sites (SCHIEMENZ 1969, NICKEL 2003). In Germany it is generally a sciobiotic species of open pine and oak forests, but not confined to trees in the Alps. Apparently, here it is not as typical species of calcareous grassland at all but prefers short swards (NICKEL ET AL. 2002, HOLLIER 2004). *Neophilaenus exclamationis* showed no significant preference for grazed or ungrazed sites during one study in Britain (MORRIS 1971a). It seems here to be associated with open ground (WHITTAKER 1969).

In lowland regions the main host plant is apparently *Festuca ovina*. The species may also live on *Deschampsia flexuosa* and additional grasses (SCHIEMENZ 1988, NICKEL 2003). On calcareous grassland in Great Britain the species is known to completes its whole lifecycle on *Festuca ovina* (WHITTAKER 1965).

The species is univoltine and hibernates in the egg stage (MÜLLER 1957, OSSIANNILSSON 1981).

Position within the chalk grassland Auchenorrhyncha communities: On chalk in southern England *Neophilaenus exclamationis* shows an interesting distribution pattern. The species could not be found in the North Downs or on the Isle of Wight at all and only on one site in the Chilterns. In the South Downs *N. exclamationis* is more widespread occupying almost a quarter of all site. It becomes even more frequent in the South Wessex Downs with positive records from more than 60 % of all investigated sites. Altogether it has been found on 23 sites, the majority of which are unimproved chalk grassland with additional records from four improved and one arable reversion site. *Neophilaenus exclamationis* is a valid preferential species of chalk grassland in comparison with mesotrophic grassland on chalk. On CG grassland it is rather constant (frequency class III) with an average abundance of a subdominant species, which can become occasionally eudominant on single sites. On mesotrophic grassland is occurs less frequently (class II) and in lower numbers, on average being only a sporadic species. However, it is here able to become a recedent species on single sites as well. Within the CG grassland *N. exclamationis* is a preferential species of the CG2 grassland with a frequency class III and on average a subdominant species with the ability to become even a eudominant species on some sites. On sub-community level *N. exclamationis* is typically a constant species of the CG2b community with a significantly higher abundance compared to CG2a. On CG2c the frequency is lower but average abundances are not significantly different. Within the MG grassland *N. exclamationis* occurs in low numbers and frequencies in the MG5 and MG6 communities. There are no records from MG1 and MG7 at all. The avoidance of MG1 may be explained with tall vegetation heights, the avoidance of MG7 by a sensibility to intensive management practices and the missing of the main host plant *Festuca ovina*. The species avoids higher swards but there was no difference in the preference of short with medium vegetation heights. It is noteworthy, that *N. exclamationis* is in Britain much more a species of open grassland without trees compared with its habitat requirements in central Europe, where it leaves forests only at higher altitudes (Nickel 2003). This may be explained by different climatic conditions on British chalk grassland with on average a higher humidity and a more regular supply with rainfall compared to the same type of habitat on the continent. Otherwise the results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology in central Europe.

Monitoring Capacity: good indicator species for stage II

Neophilaenus lineatus (Linnaeus, 1758)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: polyphagous on Poaceae, Juncaceae and Cyperaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Common on grasses in England, Wales, Scotland and Ireland (Le Quesne 1965c).

Dispersal Capacity: good

Ecology: In central and northern Europe *Neophilaenus lineatus* is mainly reported from bogs and mires of various types like pine bogs, spruce-birch swamps and treeless fens. It also inhabits wet grasslands rich in sedges, peaty meadows, lean meadows and pastures, ruderal sites, abandoned arable fields, the edge of ditches, open forests, spruce forests with stands of *Calamagrostis*, swampy woods, salt marshes along the coast and inland, coastal dunes and the drier meadow edge of seashores (Kuntze 1937, Kontkanen 1938, Linnavuori 1952, Schiemenz 1975, Raatikainen & Vasarainen 1976, Schiemenz 1988, Raatikainen & Ylönen 1989, Nickel 2003). It is here only rarely found in dry grassland (Günthart 1987). In northern Germany the species was found in the 'Cariceto canescentis, Agrostidetum caninae, subassociation with *Carex inflata* (Marchand 1953). In Poland *N. lineatus* is a dominant species in the 'Caricetum caespitosae' and 'Peucedano-caricetum paradoxae' (Andrzejewska 1991). It has been frequently found on acidic and calcareous grassland in England and Scotland including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland (Whittaker 1964, 1977, Waloff & Solomon 1973, Hollier 1987, Morris 1973, 1981a, 1990a, Brown et al. 1992, Cook 1996, Eyre et al. 2001). In northwest England it was virtually ubiquitous in ruderal habitats (Sanderson 1992). The species was also common in damp meadows in Wales (Whalley 1955). In the northern Pennines *N. lineatus* was able to sustain viable population up to a height of 2,250 feet (Whittaker 1965).

On the continent *Neophilaenus lineatus* is a eurytopic species. Its habitat conditions can range from sunny to shaded and wet to moderately dry, unmanaged or only extensively managed sites (Nickel & Achtziger 1999, Nickel 2003). Notably, it has here its main occurrence in moist to very wet habitats (Emmrich 1966, Schiemenz 1988, Hildebrandt 1995, Nickel & Achtziger 1999). It can be especially abundant along open or flowing water in raised bogs and between tussocks of *Eriophorum vaginatum* but also in abandoned fields of northern Scandinavia (Schiemenz 1975, Raatikainen & Ylönen 1989). Both in Britain and Europe *N. lineatus* is a species of tall stands of grasses or sedges, preferring the upper stratum of the vegetation (Whittaker 1969, Novotný 1992, Nickel 2003). In England the species does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a). On chalk grassland next to ungrazed plots it was most abundant in autumn and winter grazed plots (Morris 1973). *Neophilaenus lineatus* obviously does not like cutting and increases in number after cessation of grazing (Morris 1981a, Morris & Plant 1983). One cause for its sensitivity to early mowing may lay in the fact that the spittle masses are positioned on the upper parts of grasses (Bornholdt 2002). *Neophilaenus lineatus* has been found colonising newly sown calcareous grassland in the third summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a). It was as well recognized as an early colonizer on acidic grassland in Berkshire (Waloff & Solomon 1973).

Host plants are a wide range of Poaceae like *Calamagrostis canescens*, *Calamagrostis vill*osa, *Calamagrostis epigejos*, *Deschampsia spp*., *Festuca spp*, *Agrostis spp*., *Holcus spp*., *Ammophila arenaria*, *Nardus stricta*, Cyperaceae (*Carex spp*., *Carex nigra*, *Carex rostrata*, *Eriophorum vaginatum*, *Trichophorum cespitosum* and others), probably also Juncaceae (*Juncus spp*., *Luzula sylvatica*) and other families (Whittaker 1965, Novotný 1995, Nickel 2003). In Britain dark forms seem to be associated with *Molinia* (Le Quesne 1965c). On acidic grassland on experimental plots with sown grasses in Berkshire the species fed mainly on *Dactylis glomerata* and *Holcus lanatus* (Prestidge & McNeill 1983). Here the species could be bred out of tufts of both grasses (Waloff & Solomon 1973). On chalk a positive correlation between the abundance of *Agrostis stolonifera* and this species was observed (Brown et al. 1992). *Neophilaenus lineatus* could be reared over several weeks on *Festuca rubra*, *Deschampsia cespitosa*, *D. flexuosa*, *Alopecurus pratensis*, *Phalaris arundinacea*, *Carex nigra* and *C. magellanica*, *Calamagrostis epigejos* and *Festuca arundinacea* (Raatikainen & Vasarainen 1976).

Position within the chalk grassland Auchenorrhyncha communities: *Neophilaenus lineatus* is a widespread and common species within this study, found on 54 sites within all investigated regions. There are no regional differences, or differences in the occupation of different landuse types obvious. The only exception is a higher abundance on arable reversion sites. *Neophilaenus lineatus* is a constant preferential species of CG grassland with a frequency class IV and an average abundance of a recedent species, which can become dominant on single sites. On mesotrophic grassland, although still rather widespread (frequency class III), *N. lineatus* is generally only a sporadic species but can occasionally become subdominant. Within the CG grassland the species is characteristic for the rank communities (CG3, CG4, CG5), where it is highly constant (frequency class V) and occurs in significantly higher numbers than on the CG2 community. This is reflected in the species' preference of tall swards. The frequency and abundance increases from short over medium to tall vegetation heights significantly. Within the MG grassland a preference for the MG1 community can be recognized.

On the continent *N. lineatus* seems to be much more a hygrophilous species than in Britain, whereas here it is a widespread and common species on dry grassland. In central Europe *N. lineatus* is often replaced in dry habitats by other species like *N. minor* or *N. infumatus*. It remains unclear whether the species is able to widen its niche in Britain due to different climatic conditions on chalk grassland or due to the lack of competition from other species. Otherwise, the results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its ecological preferences on the continent.

Monitoring Capacity: none

Aphrophora alni (Fallén, 1805)

Habitat-specialization in Great Britain: eurytopic species (ubiquitous species)

Host specificity: polyphagous

Distribution status according to the BRC: common

Distribution in Great Britain: *Aphrophora alni* is widely distributed in England, Wales, Scotland and Ireland (LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: The species is usually found along shores of lakes, ponds, rivers, brooks and hedges, as well as in parks, forests (mainly along edges and roads) and xerothermic sites with scattered scrubs (NICKEL 2003). In Great Britain it was reported throughout England and Scotland from acidic and calcareous grassland particularly on riverside places with adjacent broadleaved trees (WALOFF & SOLOMON 1973, COOK 1996, Eyre et al. 2001).

Aphrophora alni is a eurytopic species occurring among a variety of wooded habitats in wet to dry sites (NICKEL 2003). Adults are usually recorded from deciduous shrubs and trees like *Salix spp.*, *Alnus glutinosa*, *Populus spp.*, *Betula spp.*, *Prunus spinosa*, *Corylus avellana*, *Rosa spp.*, *Cytisus spp.* and many others (LE Quesne 1965c OSSIANILSSON 1981, NICKEL 2003). In Huntingdonshire it was particularly reported from *Populus tremula* (Le QUESNE 1965a). Recorded host plants of the larvae are *Hypericum spp.*, *Erigeron spp.*, *Polygonum viviparum*, *Geum rivale*, *Filipendula ulmaria*, *Trifolium hybridum*, *T. repens*, *T. medium*, *Lotus corniculatus*, *Galium verum*, *Ranunculus flammula*, *Hieracium umbellatum*, *Sonchus arvensis*, *Carduus crispus*, *Cirsium palustre*, *Salix caprea*, *Betula pubescens*, *Alnus glutinosa*, *Viola canina*, *Potentilla reptans* and *P. anserina* (OSSIANILSSON 1981, NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Aphrophora alni* was found on 14 sites altogether, although there were no records from the Isle of Wight and the North Downs. The majority of records stem from unimproved sites (nine sites) with additional observations from two semi-improved, two improved and one arable reversion site. *Aphrophora alni* occurs in low frequency and only in small numbers within all investigated grassland communities. The only community without a record is MG6. There are no records from sites with short turf. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its known autecology in other parts of its range.

Monitoring Capacity: none

Philaenus spumarius (Linnaeus, 1758).

Habitat-specialization in Great Britain: eurytopic grassland species (ubiquitous species)

Host specificity: polyphagous

Distribution status according to the BRC: common

Distribution in Great Britain: *Philaenus spumarius* is abundant on a wide variety of low plants in England, Wales, Scotland and Ireland (LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: *Philaenus spumarius* has been recorded from a wide range of habitats such as meadows, pastures, dry grassland, fens, open forests, banks of running and standing water, roadsides, ruderal sites, primary dunes, salt marshes and subalpine stands of herbs (NICKEL 2003). It is equally observed to be an abundant and dominant species in wet meadows, floodplain grassland, abandoned arable fields and on calcareous grassland in central and northern Europe (MARCHAND 1953, MÜLLER 1978, RAATIKAINEN & YLÖNEN 1989). *Philaenus spumarius* can be the sole dominant species on some continental xerothermic calcareous grassland communities in Poland (GEBICKI 1987). It is equally frequently found on calcareous grassland in Britain (MORRIS 1973, 1981a, BROWN ET AL. 1992, COOK 1996).

Philaenus spumarius is extremely eurytopic and polyphagous (OSSIANILSSON 1981). However, there are some obvious habitat preferences. It seems to prefer treeless mesophilous and moist or wet sites, which are unmanaged or only moderately intensively managed (SCHIEMENZ 1988, HILDEBRANDT 1995, NICKEL & ACHTZIGER 1999). It is often abundant in lean meadows and abandoned fields, with a high proportion of forbs, but is usually rare or absent in intensively managed grassland, where reproductive success is uncertain (NICKEL 2003). On dry grassland *P. spumarius* is usually confined to margins and disturbed patches (NICKEL 2003). In Britain the species has been recorded also from a number of acidic grassland sites including dry to damp ruderal places, riversides, upland grass moor, *Calluna* heath, and unmanaged damp and dense upland grassland (DOUGLAS 1874, HOLLIER 1987, HARTLEY & GARDNER 1995, EYRE ET AL. 2001). In northwest England it was virtually ubiquitous in ruderal habitats (SANDERSON 1992). It was also common in damp meadows, grasslands and gardens in Wales (WHALLEY 1955). *Philaenus spumarius* does not like cutting (MORRIS 1981a), and increases in number after cessation of grazing (MORRIS & PLANT 1983). The species is especially sensitive to early mowing due to the positioning of spittle masses on upper parts of grasses (BORNHOLDT 2002). Although widely distributed in unimproved habitats with poor soil conditions, *P. spumarius* does respond - at least under certain circumstances - with an increase of density to the application of ammonium nitrate fertilizer (HARTLEY & GARDNER 1995).

Philaenus spumarius is polyphytophagous species living especially on herbaceous plants in meadows and cultivated fields. The total number of host plants in the world exceeds 1,000 (OSSIANILSSON 1981). Also adventitious shoots and shoots of the current year's growth of a number of woody phanerogames can serve as breeding plants (OSSIANILSSON 1981). Adults and spittle masses are usually found on dicotyledonous herbs (but also on grasses, ferns, horsetails, dwarf shrubs). In lean meadows and abandoned fields, with dominating dicotyledonous herbs, spittle masses may be extremely abundant on *Silene flos-cuculi*, *Cirsium arvense*, *Urtica dioica*, *Ranunculus repens*, *Filipendula ulmaria* and others (NICKEL 2003). *Philaenus spumarius* is also found in low numbers on plant taxa largely avoided by other Auchenorrhyncha, e.g. Rubiaceae, Boraginaceae, Primulaceae, Brassicaceae and Orchidaceae (NICKEL 2003). In Britain the species is abundant on a wide variety of low plants (LE QUESNE 1965c).

Position within the chalk grassland Auchenorrhyncha communities: *Philaenus spumarius* was found on 43 sites evenly distributed through all investigated regions. It seems to prefer unimproved and semi-improved sites where is occupies more than 50 % of all sites. In contrast, only about a quarter of the arable reversion sites and improved sites are occupied. *Philaenus spumarius* is a constant species (frequency class IV) of CG grassland but usually only occurring in low numbers making it on average a recedent species, which only rarely can become subdominant. On mesotrophic grassland *P. spumarius* appears in a lower frequency (class III), has the same average abundance of a subrecedent species, but can also reach a maximum of a subdominant species on some sites. Within the CG2 grassland *P. spumarius* is on average a subrecedent species still recorded from single sites being subdominant. It appears here only in the frequency class III. However, the species occurs much more frequent on the ranker communities of the CG3, CG4 and CG5 communities (frequency class IV) compared to the CG2 community (frequency class III). On sub-community level there is a slight preference for CG2a and avoidance for CG2b recognizable. On mesotrophic grassland a decrease of frequency and abundance becomes obvious from MG1 over MG5 and M6 towards MG7. *Philaenus spumarius* prefers higher swards and shows an increasing frequency and abundance from short over medium towards tall vegetation heights. The results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology on the continent. However, it may not reach such a high dominance in dry grasslands in Britain as has been reported from the continent.

Monitoring Capacity: none

Utecha trivia (Germar, 1821)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: unknown

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Utecha trivia* is a very local species reported only from southern England. Records come from Cambridgeshire, Bedfordshire, Oxfordshire, Essex, Kent, Sussex, Surrey, Isle of Wight, Dorset, Wiltshire, Somerset, Devon and Cornwall (HUTCHINSON 1921, DUFFIELD 1926, LE QUESNE 1965C, MORRIS 1971a, KIRBY 1992).

Dispersal Capacity: poor

Ecology: Typical habitats of *Utecha trivia* in central Europe are dry grasslands (Mesobrometum), particularly sheep grazed pastures (Günthart 1987, Schiemenz 1988). It is also a characteristic species on calcareous grassland in Poland, which is characterized by a much more continental climate with drier summers compared to British conditions (Gebicki 1987). In England *U. trivia* is reported mainly from chalk and limestone grassland, but also found regularly on calcareous dunes. The species also has been reported to be common on the vegetated shingle at Dungeness, Kent, and there is an isolated record away from the chalk in Essex (Duffield 1926, Le Quesne 1965c, Waloff & Solomon 1973, Kirby 1992).

Utecha trivia is regarded as a xerophilous species of sunny and oligotrophic, moderately dry to dry sites, usually on basic substrate (Nickel et al. 2002, Nickel 2003). It seems to prefer shortly grazed swards on the continent and was here notably found in sunny patches close to the ground (Schiemenz 1988). In Great Britain *U. trivia* seems to be tolerant of a wide range of vegetation structures. It has been recorded from very short or sparse turf and from tall grassland, although it is normally found on very rank or overgrown sites. Most recorded habitats are on south facing slopes, but it has been recorded from almost level ground and from slopes of other aspects (Morris 1971a, Kirby 1992). From chalk grassland in Bedfordshire *U. trivia* was only taken from ungrazed exclosures on an intensively grazed site (Morris 1971a). Occasionally the species can become rather abundant (Morris 1990c). All stages are ground dwelling (Kirby 1992).

The host plants are still uncertain. So far *Galium verum*, *Plantago lanceolata*, *Hippocrepis comosa*, *Rumex acetosella* and *Anthoxanthum odoratum* have been discussed as possible foodplants (Morris 1971a, Kirby 1992, Nickel 2003). It may also be associated with *Echium vulgare* on which it is reported to hibernate (Haupt 1935, Le Quesne 1965c). However, in east Germany *Utecha trivia* was recorded from dry calcareous grassland without *Echium vulgare*. Here the suggested host plant was *Hippocrepis comosa* (Schiemenz 1988).

Utecha trivia is wing dimorphic, but fully-winged specimens occur only very rarely. The species is univoltine with the females overwintering. Egglaying takes place in spring (Le Quesne 1965c, Morris 1971a, Waloff 1980, Kirby 1992).

Position within the chalk grassland Auchenorrhyncha communities: *Utecha trivia* has been found on three sites in the South Wessex Downs and on one site of the Isle of Wight. There were no records from the other regions. All sites with positive records are unimproved chalk grassland belonging to the CG2 community, two sites to the sub-community CG2a and two sites the sub-community CG2b. Within these communities *U. trivia* occurs in frequency class II and is here on average a subrecedent (CG2b) or recedent (CG2a) species. On one of the CG2a sites *U. trivia* occurred in such high numbers that in effect it became here a dominant species. *Utecha trivia* seems to prefer short to medium high vegetation but was found as well on one site with tall swards. It is a valid differential species for CG grassland and within this group of communities as well for CG2 grassland in comparison with the other here investigated communities. Although still not much is known about the ecology of the species it may turn out to be a typical species of other chalk grassland communities not included in this study CG1 or CG7.

Monitoring Capacity: good indicator species for stage II, umbrella species

Megophthalmus scabripennis Edwards, 1915

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: unknown

Distribution status according to the BRC: common

Distribution in Great Britain: England as far north as Lancashire and Yorkshire; Wales. There are records from Denbighshire, Hereford, Snowdon, Sherwood Forest and Linby, Nottinghamshire and Kent (China 1929, Whalley 1955, Le Quesne 1965c, Badmin 1981).

Dispersal Capacity: good

Ecology: *Megophthalmus scabripennis* is a Mediterranean and western European species, of which the ecology is only sparsely known. It was first described from a specimen found in Somerset (Edwards 1915). In central Europe *M. scabripennis* is regarded as a xerophilic species (Nickel et al. 2002). Occupied habitats are mainly sunny margins and xerothermic forests (Guglielmino 1993, Nickel 2003). From Germany exist so far only two records from sun-exposed rocky slopes (Nickel 2003). In Britain *M. scabripennis* is found among grasses, often in sandy places but also on calcareous grassland (Le Quesne 1965c, Morris 1973). It was mentioned from grass under a sycamore in Wales (Whalley 1955). *Megophthalmus scabripennis* does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a).

Position within the chalk grassland Auchenorrhyncha communities: *Megophthalmus scabripennis* was found in all regions from 20 sites altogether. It seems to be relatively rare in the Chilterns, where it was recorded only from one single site. The vast majority of records are from unimproved sites; only one semi-improved and two improved sites contained the species. There are no records from arable reversion sites. On the CG grassland

M. scabripennis occurs in frequency class III and is on average a subrecedent species, which can become sometimes even dominant. The significantly higher abundances makes it a valid preferential species for chalk grassland (CG) in comparison to MG grassland where it is less frequent (class I). Here it is usually a sporadic species reaching as a maximum only the status of a recedent species. Within the CG grassland it is typical for the CG2 community, showing here the same frequency than for the whole grassland group (class III) with an average status of a recedent species. Within the CG3, CG4 and CG5 grassland it is on average only a sporadic species, becoming at a maximum a recedent species on single sites. On MG grassland *M. scabripennis* occurs mainly on sites belonging to the MG1 community, where it can become a recedent species. There are a few additional records from MG6 grassland, but no observations from MG5 or MG7. *Megophthalmus scabripennis* prefers higher swards but still regularly occupies sites with medium to short vegetation.

Monitoring Capacity: none

Megophthalmus scanicus (Fallén, 1806)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: *Megophthalmus scanicus* is distributed in England, Wales, Scotland and Ireland (Le Quesne 1965c);

Dispersal Capacity: good

Ecology: *Megophthalmus scanicus* occurs on the continent mainly in lean meadows and pastures, dry grassland, wet meadows, steppe forests, heaths, fens, verges of mires, abandoned fields and roadsides (Kuntze 1937, Wagner & Franz 1961, Ossianilsson 1981, Schiemenz 1988, Nickel 2003). In northern Germany it was found within the ‘Molinio-Arrhenatheretea’ in different types of mesophilous and hygrophilous grassland, but as well on dry sandy grassland (Marchand 1953, Emmrich 1966). In Poland it is a characteristic species of dry psammophilous swards (Szwedo 1998). *Megophthalmus scanicus* was frequently found on acidic grassland in England and Scotland including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath and unmanaged damp, dense upland grassland (Waloff & Solomon 1973, Eyre et al. 2001). The species was common in damp grassy meadows, but also on sandy heaths in Wales (Whalley 1955). There are also records from calcareous grassland in Britain (Morris 1971a, 1973, Cook 1996).

Megophthalmus scanicus is generally a eurytopic species of sunny, wet to moderately dry, unmanaged or only moderate intensively managed sites (Hildebrandt 1995, Nickel & Achtziger 1999, Nickel 2003). The species lives mainly on the ground and among grass roots (Le Quesne 1965c, Schiemenz 1988). Single macropterous specimens can be swept from higher vegetation and woody plants (Le Quesne 1965c, Nickel 2003). On calcareous grassland in Britain *M. scanicus* seems to be associated with long coarse grass stands (Morris 1971a).

Host plants are various species of Fabaceae like *Trifolium dubium*, *Medicago lupulina* and *Lotus pendunculatus* (Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Megophthalmus scanicus* is a common and widespread species on chalk grassland in southern England, found on 46 sites within this study. Although the majority of records are from unimproved grassland (25 sites), improved sites and arable reversion sites are regularly occupied, as well. *Megophthalmus scanicus* is one of the constant species of CG grassland (frequency class IV) and here on average a recedent species, which can become dominant on single sites. On mesotrophic grassland *M. scanicus* is less frequent (class III) and here on average only a subrecedent species. However, the differences in abundance are not significant and even within the mesotrophic grassland *M. scanicus* can become sometimes a dominant species (although only within the MG1 community). There are no significant differences in frequency and abundance within the communities and sub-communities of the CG grassland. Within the MG grassland *M. scanicus* is a constant species of the MG1 community (frequency class V) and is here on average a subdominant species. It is less frequent and abundant on MG5 and MG6 sites. The difference in abundance between MG1 and MG5 is significant. There are no records from MG7. *Megophthalmus scanicus* prefers high swards, can still be found in medium high vegetation, but is very rare on short turf. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation on the continent.

Monitoring Capacity: none

Hephathus nanus (Herrich-Schäffer, 1835)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: unknown (possibly monophagous on *Cirsium acaule*)

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Hephathus nanus* is chiefly recorded from southeastern England, with records from Bedfordshire (Barton Hills), Kent (Hillside), Sussex (Seaford), Surrey (Boxhill; Shere; Aldbury), Berkshire (Silwood Park), Wiltshire (Savernake Forest), Hampshire (Freshwater, Isle of Wight). There exists an isolated record from Risby Warren, North Lincolnshire (Le Quesne 1965c, Kirby 1992).

Dispersal Capacity: good

Ecology: *Hephathus nanus* inhabits usually heavily grazed pastures, dry grassland on sunny slopes, slopes with steppe vegetation, dry meadows and occurs mainly on basic substrates (Haupt 1935, Lindberg 1947, Wagner & Franz 1961, Schiemenz 1988, Nickel et al. 2002, Nickel 2003). In central and northern Europe it is a xerophilous species of sunny, oligotrophic and xerothermic sites with short vegetation (Nickel 2003). In England it can be found on dry grassland with preference for short vegetation, but seems to be indifferent to substrate as long as the sites are welldrained. It is recorded chiefly from calcareous grassland but occasionally from grassland on acid soils (Le Quesne 1965c, Kirby 1992).

The host plants are unknown, but perhaps there is an association with *Cirsium acaule* (Schiemenz 1988, Nickel 2003).

Univoltine, hibernation takes place in the egg stage (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Hephathus nanus* has not been found within this study. However, it has been reported in Britain mainly from calcareous grassland sites (Kirby 1992). Therefore, it seems justified to regard *H. nanus*, although it is comparatively rare, as a character species of chalk grassland. Since the species requires apparently relatively short vegetation it is most likely to be found on grassland belonging to the NVC community CG2.

Monitoring Capacity: good indicator species for stage II, umbrella species

Agallia brachyptera (Boheman, 1847)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree oligophagous on Asteraceae and Fabaceae (possibly polyphagous)

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Agallia brachyptera* is predominantly an eastern species. There are records from Northumberland, Yorkshire, Lincolnshire, Derbyshire, Leicestershire, Northamptonshire, Huntingdonshire, Cambridgeshire (Wicken Fen), Suffolk, Bedfordshire, Oxfordshire, Wiltshire and Dorset. It is absent in the extreme southeastern counties (Kirby 1992, Eyre at al. 2001, Eyre et al. 2003). Older records from further west, include Ireland (Cork, Galway) (Le Quesne 1965c, Kirby 1992).

Dispersal Capacity: very poor

Ecology: In central Europe *Agallia brachyptera* is mentioned to inhabit a rather wide variety of different habitats including moors, forests, glades, peaty sites, meadows, dryish fields, moist meadows, cultivated fields, rich swampy woods and moist woods with an underlayer of grasses and forbs (Haupt 1935, Kuntze 1937, Linnavuori 1952). In Britain the species has been recorded both from dry and marshy places like Wicken Fen, Woodwalton, Chippenham Fens and saltmarshes in Ireland. However, the majority of records are from dry localities including cliffs. There may be a preference for calcareous substrates including chalk grassland and sparsely vegetated limestone quarries (Le Quesne 1965c, Morris 1973, Kirby 1992). The species has also been frequently found on rather dry acidic grassland in northern England (Eyre et al. 2001, 2003).

In Germany *Agallia brachyptera* is a mesophilous to hygrophilous meadow species of sunny to shady, damp to wet sites, but is found only occasionally in moderately dry sites (Marchand 1953, Schiemenz 1964b, Emmrich 1966, Bittner & Remane 1977 Nickel 2003). In Switzerland *A. brachyptera* has been recorded both from dry grassland and mires (Günthart 1987). However, it is in central Europe generally regarded a more hygrophilous species of unmanaged or only extensively managed sites (Emmrich 1966, Müller 1978, Hildebrandt 1995, Nickel & Achtziger 1999). *Agallia brachyptera* is a ground living species of the litter layer (Andrzejewska 1965, Bittner & Remane 1977, Novotný 1992). Large populations have been found on disturbed ground, so partial re-vegetation may represent particularly good conditions in Britain. Apparently *A. brachyptera* requires fairly open conditions in all its habitats (Kirby 1992).

Presumably this species lives polyphagously on various species of Fabaceae and Asteraceae like *Taraxacum.* It is also reported from *Trifolium*, *Onobrychis*, *Achillea* and from *Rumex* (Bittner & Remane 1977, Günthart 1987, Nickel 2003). Old reports refer to *Mentha sp.* (Haupt 1935). The larvae have been found under *Rumex acetosella, Trifolium repens* and *Taraxacum sp.*, where they were observed feeding on these plants and also on *Achillea millefolium* (Ossiannilsson 1981).

The species hibernates in the egg stage (Remane 1958). It seems to be always shortwinged (Kirby 1992), although Waloff (1980) mentions that macropters occur extremely rare.

Position within the chalk grassland Auchenorrhyncha communities: Within this project *Agallia brachyptera* has been found on two unimproved chalk grassland sites in the Chilterns. Altogether only 19 specimens of this notable species could be recorded. One site belongs to the CG2c sub-community. *Agallia brachyptera* was here classified as a recedent species. The other site belongs to the CG3 community and *A. brachyptera* was ranked here even among the subdominant species. Both sites are characterized by tall vegetation. In Britain *A. brachyptera* does not seem to be as hygrophilous compared with its occurrence on the continent. This fact may be caused by different climatic conditions, for example, more regular rainfall or higher humidity on British dry grassland compared to the same habitats in central Europe. Otherwise the results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from its known ecology on the continent.

Monitoring Capacity: good indicator species for stage II

Agallia consobrina Curtis, 1833

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Lamiaceae (possibly polyphagous)

Distribution status according to the BRC: common

Distribution in Great Britain: Recorded from England, Wales and Scotland (Whalley 1955, Le Quesne 1965c). Recorded on low vegetation from Huntingdonshire (Le Quesne 1965a).

Dispersal Capacity: good

Ecology: In central Europe *Agallia consobrina* is mainly found in open deciduous forests with luxuriant growth of herbs (coppices, coppice with standards, glades, occasionally also floodplain forests and alder fen woods), dry grassland and abandoned vineyards with scattered shrubs and trees (Wagner & Franz 1961, Lauterer 1984, Schiemenz 1988, Nickel 2003). British records originate both from acidic and calcareous grassland (Le Quesne 1965a, Morris 1981a).

The species occurs on the continent in shady, moderately dry to moist sites on acidic to basic substrates, usually in rather warm situations and is generally regarded as a sciobiotic species of forest margins (Nickel et al. 2002, Nickel 2003). It is ground dwelling and prefers shady sites (Lauterer 1984). In Britain it is generally common among low plants (Le Quesne 1965c). For example, it has been recorded from grass turf in mountains of Wales (Whalley 1955). *Agallia consobrina* does not like cutting and increases in number after cessation of grazing (Morris 1981a, Morris & Plant 1983).

Agallia consobrina lives on various species of Lamiaceae (*Glechoma*, *Teucrium*, probably also *Lamium*, *Stachys* and others), perhaps also on grasses and *Urtica dioica* (Kuntze 1937, Lauterer 1984, Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: With the exception of the Isle of Wight *Agallia consobrina* was found within all investigated regions, from ten sites altogether. Eight sites belong to unimproved chalk grassland and there was only one record from improved and arable reversion sites each. *Agallia consobrina* seems to be a weak preferential species of CG grassland but is within this grassland group still a comparable rare species. It occurs here with a frequency of class II and is on average only a sporadic species. However, *A. consobrina* can sometimes become a subdominant species on unimproved chalk grassland sites. Within the MG grassland it seems to be restricted to the MG1 community with no record from the usually grazed sites of the MG5, MG6 and MG7 communities. The species prefers tall swards and could not be found on heavily grazed sites with short turf at all. *Agallia consobrina* may be another leafhopper species, which prefers on the continent wooded habitats but widens or shifts its niche in Britain into open grassland, probably due to differences in the microclimate.

Monitoring Capacity: none

Anaceratagallia ribauti (Ossiannilsson, 1938)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree oligophagous, but possible 2nd degree monophagous on *Plantago spp.*

Distribution status according to the BRC: local

Distribution in Great Britain: In England *Anaceratagallia ribauti* has been recorded from Suffolk, Buckinghamshire, Oxfordshire, Hertfordshire, Essex, Kent, Surrey, Berkshire and Devon. In Wales it is known from Caernshire (LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: *Anaceratagallia ribauti* inhabits mainly dry grassland, lean or mesophilic meadows, abandoned fields, sandy fields, sunny slopes, mining areas, roadsides and inland or coastal dunes (KUNTZE 1937, MÜLLER 1978, NICKEL & ACHTZIGER 1999, NICKEL 2003). It was recorded as a dominant species of calcareous grassland in eastern Germany but also as a characteristic species of floristically rich psammophilous swards in Poland (MÜLLER 1978, SZWEDO 1998). Within central Europe the species seems to be confined to the lowlands (NICKEL 2003). In Britain *A. ribauti* is mentioned from grass in dry notably acidic places but also from calcareous grassland (LE QUESNE 1965c, WALOFF & SOLOMON 1973, COOK 1996). All ecological data concerning *A. ribauti* has to be treated with caution though, since it may refer to a complex of two species (*A. ribauti*, *A. lithuanica*) with different ecological requirements including different host plant spectrums (VILBASTE 1974, NICKEL pers. comment).

In northern and central Europe *Anaceratagallia ribauti* lives in sunny, dry to damp, occasionally also moist sites on acidic to basic substrates. Occupied habitats range from unmanaged to moderately intensively managed sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). It is a typical ground dwelling species of xerophilic grassland, although it occurs as well in mesotrophic grasslands (MÜLLER 1978). Notably, in dry grassland *A. ribauti* inhabits mainly disturbed, grazed or trampled patches (NICKEL 2003). *Anaceratagallia ribauti* appears often syntopic with *A. venosa*, but is more dominant in acidic and sandy sites, and seems to be less xerophilic than the latter one (MÜLLER 1978, NICKEL 2003).

Main host plants are *Plantago lanceolata* and *P. major* but the species has been reared in the laboratory on other dicotyledonous plants like *Medicago spp. Trifolium spp.*, *Onobrychis sp.*, additionally on Lamiaceae and Scrophulariaceae (NICKEL 2003). It has been found on herbs in dry warm places, often underneath *Thymus* (WAGNER & FRANZ 1961, REMANE & WACHMANN 1993).

The species hibernates as adult females and is univoltine (SCHIEMENZ 1964b, 1969, MÜLLER 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Anaceratagallia ribauti* is a very common and widespread species on chalk in southern England. It was recorded on 47 sites from all investigated regions. Compared with the other regions it is less frequent in the South Wessex Downs, where it seems to be partially replaced by *A. venosa*. The species seems to be less widespread on improved grassland but otherwise there is no preference for one of the other landuse types recognizable. *Anaceratagallia ribauti* is rather widespread both on CG and on MG grassland (frequency class III) with slightly higher abundances on the mesotrophic grassland where it is on average a subdominant species (as a maximum eudominant) compared with its average status of a recedent species (also as a maximum dominant) on CG grassland. However, the differences in abundance are not significant enough to make *A. ribauti* a preferential species of the MG grassland. Within the CG grassland it is significantly more abundant and occurs in a higher frequency (class IV) on the ranker sites belonging to the CG3, CG4 and CG5 communities compared to the more frequently managed CG2 grassland. On the MG grassland *A. ribauti* is a constant (frequency class V) species of the MG1 communities but is still widespread on MG5, MG6 and even MG7 sites. On the first two of these communities it is on average a subdominant species and on MG7 a recedent species. *Anaceratagallia ribauti* can become a eudominant species on single sites of the MG5 and MG6 grassland. There is no preference for vegetation heights recognizable, except for a slight avoidance of extremely short swards. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its autecology on the continent.

Monitoring Capacity: good indicator species for stage I

Anaceratagallia venosa (Fourcroy, 1785)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree oligophagous on Fabaceae and Lamiaceae

Distribution status according to the BRC: common

Distribution in Great Britain: In England recorded from Lancashire, Somerset and Devon; in Wales from Carmathenshire, Pembrokeshire. There are additional records from Scotland (Dumfriesshire) (MURRAY 1940, WHALLEY 1955, LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In Scandinavia and central Europe *Anaceratagallia venosa* is reported from sandfields, sunny slopes, meadows, dryish fields, moist sloping and dry meadows, heaths, rich swampy woods, rich moist grass-herb woods, dry *Vaccinium* pine woods, forest-steppes, mires, mountain meadows, submediterranean rocky heaths and quarries (HAUPT 1935, KUNTZE 1937, LINNAVUORI 1952, OKÁLI 1960, MÜLLER 1978, NICKEL 2003). In Britain *A. v*enosa is reported from grass in dry places (LE QUESNE 1965c). It has been frequently found on dry acidic grassland and upland grassland in northern England and Scotland (EYRE ET AL. 2001). It occurred also on a heath with chalky sand in Norfolk and calcareous grasslands in southern England, where is can be among the dominant species (Le Quesne & Morris 1971, 1973, Morris 1990c, Cook 1996). Additional records stem from *Festuca*-turf at a shoreline in Wales (Whalley 1955).

On the continent *A. v*enosa is regarded as a xerophilic ground dwelling species of dry grassland (Emmrich 1966, 1969, Müller 1978, Günthart 1984, Witsack 1985, Nickel et al. 2002). On calcareous grassland it seems to prefer grazed sites to the ranker vegetation of unmanaged sites (Bornholdt & Remane 1993). Generally, it lives in similar habitats as *A. ribauti* and occasionally syntopic, but seems to prefer dryer, more basic, less vegetated sites and extends at least in Germany to higher altitudes (Nickel 2003). In Great Britain autumn grazed sites are preferred to summer grazed or ungrazed patches (Morris 1973). *Anaceratagallia venosa* has been found colonising newly sown calcareous grassland in the third summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a).

The species lives on low-growing dicotyledonous plants. It feeds apparently mainly on *Lotus corniculatus*, but is also reported from *Hippocrepis comosa*. (Müller 1978, Günthart 1984, Witsack 1985, Nickel 2003).

Hibernation takes place in the egg stage (Schiemenz 1969, Müller 1978). *Anaceratagallia venosa* is a univoltine species (Müller 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Anaceratagallia venosa* has been recorded from 14 sites, and all investigated regions. However, the vast majority (nine sites) are from the South Wessex Downs, where is seems to partly replace *A. ribauti*. It is a typical species of unimproved chalk grassland with only one record from semi-improved, improved and arable reversion sites each. Although *A. venosa* is still a relatively rare species on CG grassland (frequency class II, on average a sporadic species, with a maximum of a recedent species) it can, due to its significantly higher abundance, be regarded as a preferential species in comparison to MG grassland. Here it was only found with one specimen on a single site belonging to the MG6 community. It is more frequent and abundant on the CG2 grassland compared with CG3, CG4 and CG5 grassland. However, the differences are not significant. There is no preference for a vegetation height recognizable. The species has been found equally on sites with very short turf and on sites with tall vegetation. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its situation on the continent.

Monitoring Capacity: good indicator species for stage I

***Batracomorphus irroratus* Lewis, 1834**

Habitat-specialization in Great Britain: species confined to calcareous grassland

Host specificity: 1st degree monophagous on *Helianthemum nummularium*

Distribution status according to the BRC: local

Distribution in Great Britain: In England as far north as South Yorkshire and Derbyshire (Le Quesne 1965c).

Dispersal Capacity: poor

Ecology: In central Europe *Batracomorphus irroratus* lives in xerothermic grassland and along sunny margins of pine and oak forests, usually on limestone and other basic substrates (Haupt 1935, Schiemenz 1988, Nickel 2003). The species does not occur in Scandinavia (Ossianilsson 1981). In Britain it is recorded from *Helianthemum nummularium* on calcareous hillsides and other types of calcareous grassland, where it can be locally common (Le Quesne 1965c, Morris 1973, Waloff & Solomon 1973, Cook 1996).

For central Europe *Batracomorphus irroratus* is regarded as a xerothermophilous species (Schiemenz 1988, Nickel et al. 2002). On intensively grazed calcareous grassland in Bedfordshire *B. irroratus* was mainly taken from ungrazed exclosures (Morris 1971a). It seems to become more abundant when grazing takes place in spring (Morris 1973).

The only known host plant at the moment is *Helianthemum nummularium* (Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Batracomorphus irroratus* was found within this study on altogether 12 sites. There are no records from the South Downs and the Isle of Wight. All but one record are from unimproved chalk grassland sites. The only site classified as improved grassland belongs to the MG1 community but has still strong elements of the CG2 community, from which it certainly has evolved historically. On CG grassland *B. irroratus* is not a widespread species (frequency class II) with an average abundance of a recedent species. However, it can become on some sites an abundant species sometimes even eudominant. *Batracomorphus irroratus* can be regarded as a valid preferential species or even a differential species for chalk grassland in comparison with mesotrophic grassland. Within the CG grassland there are no major differences in frequency or abundance between the communities except for its missing occurrence on the comparably rich CG2c sub-community. The species seems to prefer low and medium high swards and to avoid tall vegetation. This reflects the distribution of its main host plant *Helianthemum nummularium* in southern England. The relatively wide distribution of *B. irroratus* in Britain on calcareous grassland shown by this and other studies can lead to the conclusion that perhaps the species is either not as xerothermophilic as described for central Europe or that it occupies a slightly wider niche towards western Europe. In Britain it seems more the occurrence of its host plant than climatic conditions that restrict the distribution of the species. However, a preference of milder winter conditions can widely ruled out since *B. irroratus* is a palaearctic species with a wide geographical range expanding as far east as China (NAST 1972).

Monitoring Capacity: good indicator species for stage II, umbrella species

Eupelix cuspidata (Fabricius, 1775)

Habitat-specialization: dry grassland species

Host specificity: 2nd degree monophagous on *Festuca*, perhaps even 1st degree monophagous on *Festuca ovina* agg..

Distribution status according to the BRC: common

Distribution in Great Britain: *Eupelix cuspidata* is distributed throughout England, Scotland, Wales and Ireland (WHALLEY 1955, LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In central Europe *Eupelix cuspidata* lives in various types of dry grassland, coastal and inland dunes, lean meadows, pastures, heaths, sandfields, sunny and dry slopes, mires, ruderal sites, roadsides, sunny forest margins, forests, moderately saline sites and dry places (KUNTZE 1937, WAGNER & FRANZ 1961, REMANE & WACHMANN 1993, NICKEL 2003). The species even occurs on highly drained and xerothermic gypsum sites in Germany (NICKEL ET AL. 2001). It is typical for the 'Corynephoretum agrostidetosum aridae', 'Mesobrometum' and 'Seslerietum' (MARCHAND 1953, SCHIEMENZ 1988). In Britain *E. cuspidata* is a species of open ground on grasses in dry places (LE QUESNE 1965C, WHITTAKER 1969). It has been frequently found on acidic grassland, especially dunes and sandy open ruderal sites in northern England and as well as on other acidic grassland sites in southern England (WALOFF & SOLOMON 1973, HOLLIER 1987, EYRE ET AL. 2001). In Wales it was found on grass meadows and dry grass slopes (WHALLEY 1955). There are also records from calcareous grassland (MORRIS 1973, HOLLIER pers. comment).

On the continent *Eupelix cuspidata* has been found mainly in sunny to moderately shady, dry to damp, occasionally also moist or even temporarily wet sites. However, the species is here generally regarded as a moderately xerophilic and heliophilic species of dry grasslands and ruderal sites (EMMRICH 1966, SCHIEMENZ 1988, NICKEL ET AL. 2002). Within its wide habitat range *E. cuspidata* prefers unmanaged or only extensively managed sites. It occurs only occasionally also on moderately intensive managed grassland (NICKEL & ACHTZIGER 1999). *Eupelix cuspidata* has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). Some authors mention a migration especially of females from moist habitats in spring/early summer to drier grassland sites later in the year (HAUPT 1935, KUNTZE 1937, TRÜMBACH 1959).

The main host plant is *Festuca ovina*, although *F. rubra* and other additional grasses are also possible hosts (NICKEL 2003).

Hibernation takes place in the egg stage (REMANE 1958, SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Eupelix cuspidata* has been recorded from all investigated regions and is common and widespread with records from 43 sites. However, *Eupelix cuspidata* seems to be relatively scarce in the South Downs. Although the species can be found on all types of land use, it is most frequent on unimproved chalk grassland were it occupies nearly 70 % of all sites. *Eupelix cuspidata* is definitely a good preferential species of CG grassland, where its is one of the constant (frequency class IV) species in comparison with the mesotrophic grassland (MG) where it seems to be rather scarce (frequency class II). On CG grassland the species has the average abundance of a recedent species, occasionally becoming eudominant. The abundance here is highly significantly greater than on mesotrophic grassland where it is only a sporadic species reaching as a maximum the status of a recedent species. It is a constant species both on CG2 grassland and the rank communities belonging to CG3, CG4 and CG5. *Eupelix cuspidata* shows a slightly higher frequency and abundance within the ranker communities of the *Brachypodium pinnatum* and *Bromus erectus* grasslands, where it reaches a constancy of class V. Within the CG2 communities it is highly frequent (class V) on the CG2a (average abundance recedent) and CG2b (average abundance subdominant) sub-communities, whereas on CG2c the species is less frequent (class II) and shows significantly lower numbers (average abundance of subrecedent species). Within the MG grassland *E. cuspidata* is most frequent and abundant on the MG1 grassland with declining numbers and frequency over MG5 towards MG6. There are no records from the intensively managed MG7 sites. *Eupelix cuspidata* is one of the few species where the occurrence seems to be absolutely independent from the vegetation height. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation in other parts of its range.

Monitoring Capacity: good indicator species for stage I

Aphrodes bicincta (Schrank, 1776)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous (possible polyphagous)

Distribution status according to the BRC: local

Distribution in Great Britain: Due to the difficulties in separating *Aphrodes bicincta* from *A. makarovi* and *A. diminuta* the distribution within Great Britain remains unclear (TISHECHKIN 1998). It has been reported from Kent (BADMIN 1981).

Dispersal Capacity: good

Ecology: On the continent *Aphrodes bicincta* has been mentioned both from basic and acidic sites. Named habitats are calcareous hillsides, inland dunes, heaths, lean meadows, dry roadsides and abandoned fields, also heavily drained, xerothermic gypsum sites (NICKEL ET AL. 2001, NICKEL 2003). So far there are no published records for British habitats.

Aphrodes bicincta is generally regarded as a xerophilic species, with habitat requirements ranging in central Europe from dry to mesotrophic conditions on unmanaged or only extensively managed sites (EMMRICH 1980, NICKEL & ACHTZIGER 1999). It occurs here mainly in sun-exposed places inhabiting the soil surface (NOVOTNÝ 1992, NICKEL 2003). The species seems to prefer grazed sites to the ranker vegetation of unmanaged calcareous grassland (BORNHOLDT & REMANE 1993). However, all older data concerning this species have to be treated with caution due to possible confusion with the only recently separated *A. diminuta* Ribaut, 1952 (TISHECHKIN 1998).

Host plants are species of Fabaceae and perhaps other plant families (EMMRICH 1980, TISHECHKIN 1998, NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: With the exception of the Isle of Wight *Aphrodes bicincta* was recorded from all investigated regions, altogether from 31 sites. It seems to be rather rare in the Chilterns. Most records (26 sites) are from unimproved chalk grassland. It seems to be a valid preferential species of CG grassland in comparison with MG grassland. On CG grassland *A. bicincta* occurs in frequency class III and is on average a subrecedent species, which can become subdominant on single sites. It is here significantly more abundant than on mesotrophic grassland on chalk where it is a sporadic species only occasionally becoming subrecedent (frequency class II). The species seems to be more frequent in *Brachypodium pinnatum* and *Bromus erectus* grasslands (CG3, CG4, CG5). However, the highest dominance on a single site was observed on a site belonging to the CG2b sub-community. Within the CG2 community the species occurs in frequency class V. The abundance in CG2b is significantly higher than within the CG2a sub-community. On mesotrophic grassland *A. bicincta* occurs in highest frequency and abundance on the MG1 grassland and is less abundant on the MG5 grassland. There were no records from MG6 and MG7. The species seems to prefer taller swards, but can regularly found on sites with short turf as well.

Monitoring Capacity: good indicator species for stage I

Aphrodes makarovi Zachvatkin, 1948

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: polyphagous

Distribution status according to the BRC: common

Distribution in Great Britain: Due to the difficulties in separating *Aphrodes makarovi* from *A. bicincta* and *A. diminuta* the distribution within Great Britain remains unclear, although most of the older records of *A. bicincta* probably belong to this species. It can therefore be assumed that *A. makarovi* is a widespread and common species in England, Wales, Scotland and Ireland (LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In central Europe *Aphrodes makarovi* occurs in fertilized meadows and pastures, stands of tall perennial forbs and grasses, abandoned fields, ruderal sites, edges of running and standing water, ditches, forest roads, alder fen woods, also from slightly saline sites inland and near the coast (NICKEL 2003). In Britain the species is common on grasses (LE QUESNE 1965c). It has been frequently found on acidic and calcareous grassland throughout England and Scotland including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland (WALOFF & SOLOMON 1973, MORRIS 1973, 1981a, PRESTIDGE 1982, COOK 1996, EYRE ET AL. 2001). There are also records from a heath with chalky sand in Norfolk (LE QUESNE & MORRIS 1971). It was common in grassland and on damp slopes in Wales (WHALLEY 1955). However, most of the above listed records are in need of confirmation due to the confusion with other closely related species.

Aphrodes makarovi is regarded as a eurytopic species, which is more hygrophilous than *A. bicincta* preferring mesotrophic to moist grassland ranging from unmanaged to intensively managed habitats (EMMRICH 1966, 1980, NICKEL & ACHTZIGER 1999). It occurs eurytopic in moderately wet to damp, sunny to shady sites, often in disturbed or eutrophic patches (NICKEL 2003). In Britain it was recorded on low vegetation in Huntingdonshire (LE QUESNE 1965a). In one British study *A. makarovi* did not occur at all or only as a vagrant on intensively grazed calcareous grassland (MORRIS 1971a). The species favours tall swards (MORRIS 1971a, 1981a), and, therefore, reacts negatively to cutting (MORRIS 1981a). It seems also to become rare if a site is grazed for three month a year, although it can tolerate grazing which takes place in autumn or winter (MORRIS 1973). *Aphrodes makarovi* increases in number after cessation of grazing (MORRIS & PLANT 1983).

Aphrodes makarovi is a polyphagous species feeding on various dicotyledonous herbs. Known host plants are *Taraxacum sp.*, *Cirsium sp.*, *Urtica dioica*, *Rumex sp.* and in England additionally *Trifolium sp.* and *Fragaria sp.* (KNIGHT 1965, EMMRICH 1980, NICKEL 2003). Records from *Holcus sp.* and *Dactylis glomerata* (WALOFF & SOLOMON 1973) probably do not refer to utilized host plants.

Position within the chalk grassland Auchenorrhyncha communities: *Aphrodes makarovi* was recorded from 62 sites altogether and is common in all investigated regions. The species was found in all types of landuse but least commonly in improved grassland, where less than a third of the sites where occupied. It is most widespread on unimproved chalk grassland where it was recorded from nearly 85 % of all investigated sites. *Aphrodes makarovi* is a constant (frequency class V) species on CG grassland where it is on average a recedent species with a maximum status of a subdominant species on some sites. On MG grassland it is much less frequent (class III), but occurs in the same average abundance reaching sometimes the status of a dominant species. On mesotrophic grassland *A. makarovi* favours the MG1 and MG5 communities and is on average only a sporadic species on MG6 and a subrecedent one on MG7 grassland. Within the CG grassland there are no clear preferences visible although the frequency of occurrence is highest within the ranker communities belonging to CG3, CG4 and CG5. *Aphrodes makarovi* prefers tall vegetation and is still relatively abundant on sites with medium high swards, but already rare and only found sporadically on short turf. The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its known autecology on the continent.

Monitoring Capacity: none

Planaphrodes bifasciata (Linnaeus, 1758)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree oligophagous on Poaceae and *Carex flacca*

Distribution status according to the BRC: common

Distribution in Great Britain: Widely distributed in England, Scotland, Wales and Ireland (DOUGLAS 1874, LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: *Planaphrodes bifasciata* inhabits in central Europe mainly meadows and pastures of the submontane belt dominated by *Nardus stricta*, *Trisetum flavescens* and dicotyledonous herbs like *Polygonum bistorta*. The species is also found in lowland areas in moist deciduous forests with lush undergrowth in floodplains and fens, among stands of tall perennials, along the edges of bogs and on rather dry grassland (WAGNER & FRANZ 1961, REMANE & WACHMANN 1993, NICKEL 2003). In Britain it is known equally from dry hillsides and marshy places (LE QUESNE 1965c). COOK (1996) regards it as a typical chalk grassland species in northern England and it has been reported from limestone around Teesdale (WHITTAKER 1964, 1977). Other authors see the species as typical for sedge dominated acidic places and it has been found very frequently on acidic grassland in northern England and Scotland. Other habitats with records include dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath and unmanaged damp, dense upland grassland (DOUGLAS 1874, CHERILL & RUSHTON 1993, EYRE ET AL. 2001). Own observations found *P. bifasciata* to be abundant in lean structurally rich wet meadows in Bedfordshire. There are additionally records from dry calcareous grassland (MORRIS 1973, 1971a, COOK 1996).

In Scandinavia *Planaphrodes bifasciata* is recorded from dry meadows (KONTKANEN 1938). In central Europe habitat requirements change more towards moderately wet to damp sites, both sunny and shady (NICKEL 2003). Other authors quote a main occurrence in moderately moist to wet, only extensively used or unmanaged habitats (NICKEL & ACHTZIGER 1999). In Great Britain *P. bifasciata* does not occur at all or only as a vagrant on intensively grazed calcareous grassland, but was found frequently within ungrazed exclosures in Bedfordshire (MORRIS 1971a). It was significantly more abundant in tussocks and hummocks compared with even swards (DENNIS ET AL. 1998).

No host plants are known from central Europe, but in Britain adults and nymphs have been found in numbers on several grasses in field choice experiments notably on *Helictotrichon pubescens*, *Brachypodium pinnatum*, *Briza media*, *Bromopsis erecta*, *Festuca ovina*, *Festuca rubra*, *Trisetum flavescens*, as well as on *Carex flacca* (COOK 1996, NICKEL 2003).

Hibernation takes place in the eggstage (SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Planaphrodes bifasciata* was only found with a single specimen each on two unimproved chalk grassland sites in the Chilterns, both belonging to the CG3a sub-community. In southern England it is probably for microclimatic reasons not typical on chalk grassland and may be in that region restricted to wetter habitats.

Monitoring Capacity: none

Anoscopus albifrons (Linnaeus, 1758)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: *Anoscopus albifrons* is widely distributed in England, Scotland, Wales and Ireland (Le Quesne 1965c).

Dispersal Capacity: good

Ecology: In central Europe *Anoscopus albifrons* inhabits mainly heaths, open forests, lean meadows and pastures, as well as mires with stands of *Sphagnum spp.*, *Calamagrostis canescens* or *Molinia caerulea*, forests and glades (Kuntze 1937, Dlabola 1954, Wagner & Franz 1961, Schiemenz 1976, Nickel 2003). British records originate from a wide range of acidic and calcareous grasslands throughout the country including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath, hill slopes, marshes and unmanaged damp, dense upland grassland (Murray 1935, Whalley 1955, Waloff & Solomon 1973, Morris 1973, 1981a, Cook 1996 Eyre et al. 2001). It was also abundant on a heath with chalky sand in Norfolk and equally in dunes on the Isles of Scilly (Woodroffe 1967, Le Quesne & Morris 1971).

Anoscopus albifrons is in central Europe a eurytopic species inhabiting all grassland types from dry to wet and sunny to moderately shady conditions (Schiemenz 1988, Nickel 2003). However, its main occurrence seems to be restricted to moderately dry to moist, only extensively managed or unused sites (Nickel & Achtziger 1999). In northern and central Europe *A. albifrons* is often regarded as a rather xerophilic character species of dry grassland, which seems to prefer localities with *Agrostis capillaris*, *Anthoxanthum odoratum*, *Luzula sp.*, *Holcus mollis* etc. (Linnavuori 1952, Schwoerbel 1957, Trümbach 1959, Remane 1958, Gravestein 1965, Emmrich 1969). In Britain it is thought to be common on grasses usually near ground level (Le Quesne 1965c). In western Germany *A. albifrons* replaced *A. serratulae* on calcareous grassland with lighter soil than adjacent meadows where the replacement took place vice versa (Bornholdt & Remane 1993). In England it does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a). *Anoscopus albifrons* does not like cutting and increases in number after cessation of grazing (Morris 1981a, Morris & Plant 1983). The species has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a).

Host plants are various grasses like *Deschampsia flexuosa*, *Holcus mollis*, *Brachypodium pinnatum* and others (Nickel 2003). In Berkshire it was recorded from *Holcus spp.* and *Dactylis glomerata* (Waloff & Solomon 1973).

Position within the chalk grassland Auchenorrhyncha communities: With records from altogether 77 sites *Anoscopus albifrons* is one of the most widespread and commonest species within the project. It was found evenly distributed over all investigated regions. *Anoscopus albifrons* occurs on all landuse types but favours unimproved chalk grassland, where it was found on nearly 100 % of all sites. In contrast, on arable reversion and improved sites only about 50 % of all sites were occupied by the species. This already indicates that *Anoscopus albifrons* can be seen as a preferential species of the CG grassland where it is highly constant (class V) and is on average a subdominant species sometimes becoming eudominant. The abundance on CG grassland is highly significantly greater than on mesotrophic grassland where *A. albifrons* occurs in frequency class IV and is on average only a subrecedent species, but raises here sometimes to eudominance as well. Within the different CG communities are no significant differences in frequency or abundance recognizable. On mesotrophic MG grassland *A. albifrons* is more widespread and appears in significantly higher numbers on the MG1 and MG5 communities in comparison to MG6 and MG7 grassland. There are no significant preferences for certain vegetation heights, although the highest abundances where recorded from medium high swards. Generally, *A. albifrons* seems to be more abundant on unmanaged and leaner grassland sites than its sibling species *A. serratulae*, but is partly replaced by *A. serratulae* on more intensively managed and fertilized sites.

Monitoring Capacity: none

Anoscopus flavostriatus **(Donovan, 1799)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: Widely distributed in England, Scotland, Wales and Ireland (LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In central Europe *Anoscopus flavostriatus* has been found in grass stands of various types. It inhabits mainly lean meadows and pastures, forest glades, mires, abandoned fields and open forests (KUNTZE 1937, NICKEL 2003). In Britain it has mainly been recorded from grasses in damp places (LE QUESNE 1965c). The species has been frequently found on acidic grassland in northern England and Scotland including dry to damp ruderal sites, riversides, upland grass moor, unmanaged damp, dense upland grassland and was also common in reed swamps in Wales (WHALLEY 1955, EYRE ET AL. 2001). There are additionally records from dry calcareous grassland (MORRIS 1973, COOK 1996).

Anoscopus flavostriatus seems to be a hygrophilous species belonging to the Molinietalia (MARCHAND 1953, GÜNTHART 1987, SCHIEMENZ 1988). In central Europe it prefers rather cool, wet to damp sites, for example, mesophilic montane meadows (SCHIEMENZ 1964a, NICKEL & ACHTZIGER 1999, NICKEL 2003). Here it seems to be restricted to extensively or unmanaged sites living mainly on the soil surface (NOVOTNÝ 1992, NICKEL & ACHTZIGER 1999). In Britain it becomes rare if sites are grazed for three months a year, even when grazing takes place in autumn or winter (MORRIS 1973). *Anoscopus flavostriatus* is here a species of tall grass stands, which increases in number after cessation of grazing (WHITTAKER 1969, MORRIS & PLANT 1983).

The host plants are grasses like *Deschampsia flexuosa*, *Dactylis glomerata* and *Elymus repens* (NICKEL 2003). *Anoscopus flavostriatus* was collected in Dumfriesshire from rushes (MURRAY 1935).

Position within the chalk grassland Auchenorrhyncha communities: Altogether 14 of the investigated sites held specimens of *Anoscopus flavostriatus*. It was most widespread in the North Downs, but there are no records from the South Wessex Downs. The majority of records are from unimproved or semi-improved chalk grassland sites (12 sites) with only one additional occupied arable reversion and improved site each. There are still no significant differences in frequency and abundance between CG and MG grassland. In both groups *A. flavostriatus* occurs in frequency class II being on average only a sporadic species and reaching in both grassland groups sometimes the status of a recedent species. There are no major differences within the CG grassland communities with the exception, that *A. flavostriatus* has not been found within the CG2b sub-community at all. On MG grassland *A. flavostriatus* is most constant and numerous in the MG1 community and less abundant on MG5 grassland. It was not found on sites belonging to the intensively managed MG6 and MG7 grasslands at all. *Anoscopus flavostriatus* does not seem to be as hygrophilous in Britain compared with its occurrence on the continent. This may be caused by different climatic conditions including a more regular rainfall and generally higher humidity on British dry grassland compared the same habitat type in central Europe. Otherwise, the results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its situation on the continent

Monitoring Capacity: none

Anoscopus histrionicus **(Fabricius, 1794)**

Habitat-specialization in Great Britain: dry grassland species

Host specificity: unknown (perhaps 1st degree oligophagous on Poaceae)

Distribution status according to the BRC: local

Distribution in Great Britain: *Anoscopus histrionicus* has been recorded from England, Scotland, Wales and Ireland (DOUGLAS 1874, LE QUESNE 1965c).

Dispersal Capacity: good

Ecology: In central and northern Europe *Anoscopus histrionicus* is reported to live in heaths, lean meadows, open thermophilic forests, coastal dunes, flood plains and glades (SAHLBERG 1871, KUNTZE 1937, NICKEL 2003). In Britain it was found on well drained acidic grassland in northern England and Scotland (DOUGLAS 1874, EYRE ET AL. 2001). The species was also common on limestone in Oxfordshire on arable reversion sites through a range of successional stages (BROWN ET AL. 1992). However, this record may need further confirmation.

On the continent *Anoscopus histrionicus* is reported to live in moist to moderately dry, usually sunny and oligotrophic, extensively managed or unused sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). In Germany it was once thought to be widespread, but has here declined strongly (HAUPT 1935, NICKEL 2003).

Host plants are probably grasses (although it has also been mentioned to be taken from the roots of *Achillea* *millefolium*) (Douglas 1874, Le Quesne 1965c, Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: The species was not found within the project and might not be part of the leafhopper communities on chalk grassland in southern England at all.

Monitoring Capacity: none

Anoscopus serratulae (Fabricius, 1775)

Habitat-specialization: dry grassland species

Host specificity: 1st degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: Recorded from England south of a line from Wash to Bristol Channel, additionally from Holyhead in Wales (Le Quesne 1965c).

Dispersal Capacity: good

Ecology: The species inhabits in central Europe more or less strongly fertilized meadows and pastures, moist and sometimes even dry grassland, ruderal sites, lawns in parks and gardens, also moderately saline sites and forests (Haupt 1935, Kuntze 1937, Wagner & Franz 1961, Günthart 1987, Schiemenz 1988, Nickel 2003). In northern Germany *Anoscopus serratulae* was recorded within the 'Arrhenatheretum elatioris' (Marchand 1953, Schiemenz 1988). In north eastern Europe it regarded as a species of the forest-steppe (Okáli 1960). Published British records stem almost exclusively from dry acidic grassland (Le Quesne 1965c, Waloff & Solomon 1973, Prestidge & McNeill 1983).

Anoscopus serratulae is on the continent a species of mesotrophic and hygrophilous habitats. Here it is generally found in grass stands in moderately dry to moist, occasionally also wet, usually sunny sites (Nickel 2003). It prefers heavy soils and fertilized meadows to nutrient poor calcareous grassland, but still sometimes occupies dry or unmanaged habitats (Schiemenz 1964a,1969, Remane 1987, Bornholdt & Remane 1993, Nickel & Achtziger 1999). In Britain *A. serratulae* is found on grass near ground level on dry places (Le Quesne 1965c). The species has sometimes even been found underneath stones (Kuntze 1937). In Germany *A. serratulae* has been observed to be a dominant colonizer on arable fallow land (Witsack 1995).

Host plants are grasses like *Elymus repens*, *Dactylis glomerata*, *Holcus spp.* and *Festuca rubra* (Waloff & Solomon 1973, Günthart 1987, Nickel 2003).

Hibernation of the univoltine species takes place in the egg stage (Schiemenz 1969, Ossiannilsson 1981).

Position within the chalk grassland Auchenorrhyncha communities: *Anoscopus serratulae* was recorded from all investigated regions, although its distribution seems to be more scattered within the South Wessex Downs. Altogether it was found on 59 sites. The records are relatively evenly distributed over the different land use types. Its stronghold lies within the mesotrophic (MG) grassland were it is one of the constant species (frequency class IV) and occurs in significantly higher number compared to CG grassland. On average it is a recedent species on mesotrophic and chalk grassland and can become in both grassland groups sometimes a dominant species. On the CG grassland it is less widely distributed reaching only frequency class III. Within both CG and MG grassland no major differences of frequency or abundance on community and sub-community level are obvious. The species favours medium high to tall vegetation and avoids sites with short swards. Generally, its sibling species *A. albifrons* seems to be more abundant on the unmanaged and leaner grassland sites than *A. serratulae*, but *A. serratulae* partly replaces *A. albifrons* on the more intensively managed and more fertilized sites. *Anoscopus serratulae* does not seem to be as hygrophilous in Britain compared with its occurrence on the continent. This may be caused by different climatic conditions on British dry grassland with a more regular rainfall or higher humidity, compared to the same habitats in central Europe. Otherwise, the results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from its known ecology in central Europe.

Monitoring Capacity: none

Emelyanoviana contraria (Ribaut, 1936)

Habitat-specialization in Great Britain: species confined to calcareous grassland

Host specificity: 2nd degree monophagous on *Helianthemum*

Distribution status according to the BRC: notable A

Distribution in Great Britain: The species has so far been found only in Scotland and Yorkshire. The Scottish records are from Morrone Birkwood, near Braemar in Aberdeenshire. In England the species has been recorded from South House Pavement, Ingleborough in Mid-West Yorkshire and Wytham, Oxfordshire (Woodroffe 1972,

LE QUESNE & PAYNE 1981, KIRBY 1992, BROWN ET AL. 1992).

Dispersal Capacity: good

Ecology: *Emelyanoviana contraria* is only known from the Pyrenees (France, Andorra), the Alps and mountainous regions of England and Scotland (NICKEL 2003). Most records are from sun-exposed, rocky and rather dry calcareous hillsides from the upper montane to the alpine belt (found between 1,500 and 2,500 m a.s.l. in the Alps) (NICKEL 2003).

Emelyanoviana contraria has been found on upland limestone turf in Scotland and on limestone pavement in Yorkshire, both records are from altitudes above 1,000 feet (KIRBY 1992). On the other hand, the species has also been mentioned from limestone grassland at Wytham, Oxfordshire (BROWN ET AL. 1992), which differs in its climatic conditions and floristic species composition very little from the chalk in southern England. However, this record certainly needs further confirmation.

The recorded host in Britain is *Helianthemum* without any information on certain species (LE QUESNE & PAYNE 1981, KIRBY 1992).

Position within the chalk grassland Auchenorrhyncha communities: *Emelyanoviana contraria* is probably a mountainous species occurring only in high altitudes. It is therefore unlikely to be found on chalk grassland in southern England, despite the wide occurrence of its host plant. However, in the unlikely event of being found on chalk in southern England it could automatically be regarded as a good biological indicator for intact chalk grassland.

Monitoring Capacity: good indicator species for stage II, umbrella species

Emelyanoviana mollicula (Boheman, 1845)

Habitat-specialization in Great Britain: species confined to calcareous grassland

Host specificity: polyphagous on forbs

Distribution status according to the BRC: local

Distribution in Great Britain: *Emelyanoviana mollicula* is widespread in England and Scotland north up to Kincardine. The species has been found in Ireland, as well (LE QUESNE & PAYNE 1981).

Dispersal Capacity: good

Ecology: On the continent *Emelyanoviana mollicula* has been recorded mainly from dry grassland, lean meadows and pastures, also ruderal sites, sunny slopes, glades and even gardens (HAUPT 1935, KUNTZE 1937, KONTKANEN 1950, GÜNTHART 1987, NICKEL 2003). In Germany it was additionally found on heavily drained gypsum (NICKEL ET AL. 2001). *Emelyanoviana mollicula* is also an abundant and dominant species on calcareous grassland in Poland. This type of habitat is there much dryer and characterized by a more continental climate compared to the conditions in Britain where the species is equally mainly recorded from calcareous sites (LE QUESNE & PAYNE 1981, GEBICKI 1987).

In central Europe *Emelyanoviana mollicula* seems to prefer sunny dry calcareous grassland rich in forbs, but its habitat conditions can range rather widely from dry to moist unmanaged or only extensively managed sites (NICKEL 1997, NICKEL & ACHTZIGER 1999, NICKEL 2003). However, it is not a dominant species on acidic grassland (MÜLLER 1978). In Britain the species was found among low plants in dry places (EDWARDS 1885). It seems to prefer the ranker vegetation of unmanaged calcareous grassland in comparison to grazed sites (BORNHOLDT & REMANE 1993).

Emelyanoviana mollicula is apparently a polyphagous species, which has been recorded from *Verbascum sp.*, *Salvia pratensis*, *Teucrium sp.*, *Mentha sp.*, *Satureja sp.*, *Origanum vulgare*, *Thymus sp.*, other labiate and additionally from *Cannabis sp.*, *Parietaria sp.* and *Artemisia sp.* (WAGNER & FRANZ 1961, VIDANO 1965). It was found breeding on cultivated strawberry plants in Norway (OSSIANNILSSON 1981). In Britain *E. mollicula* was bred from *Betonica officinalis* and is mentioned to be associated with *Primula veris*, *Plantago spp.*, *Calamintha clinopodium*, *Verbascum* sp. and *Origanum vulgare* (LE QUESNE & PAYNE 1981).

Hibernation takes place in the egg stage and the species is bivoltine (KONTKANEN 1950, SCHIEMENZ 1969). It is also assumed to overwinter occasionally as an adult (HAUPT 1935, NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Emelyanoviana mollicula* was found on four sites of the Chilterns and five sites of the North Downs. There are no records from the other investigated regions. The species inhabits unimproved and semi-improved chalk grassland in roughly the same frequency although occurring on the unimproved grassland in higher densities. It is found only rarely, and in very low numbers, on improved grassland and does not seem to be able to colonize arable reversion sites at all. However, due to the low number of sampled individuals the differences between the landuse types are not significant. Although showing higher abundances on CG grassland than on mesotrophic grassland, the differences are not significant. The same is true for the comparison of CG2 grassland with the *Brachypodium pinnatum* and *Bromus erectus* grasslands (CG3, CG4, CG5). However, the species seems to be more abundant on the CG2 grassland.

On mesotrophic grassland *E. mollicula* is more or less confined to the MG1 community, although it was also recorded from one MG7 ley. The species was only found on sites with tall vegetation, the differences to sites of low and medium swards being significant.

The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from its ecology on the continent. However, it is noteworthy that the species, although preferring high vegetation, occurred still in higher numbers on the managed CG2 grassland in contrast to the more often unmanaged CG3, CG4 and CG5 grassland. This result stands in slight contrast to the findings of BORNHOLDT & REMANE 1993 according to whom *E. mollicula* seems to prefer the ranker vegetation of unmanaged calcareous grassland in comparison with grazed sites.

Monitoring Capacity: good indicator species for stage I

Dikraneura variata Hardya, 1850

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Dikraneura variata* is found in England, Wales and Scotland (WHALLEY 1955, LE QUESNE & Payne 1981). There are published records from Huntingdonshire, Dumfriesshire and the Isle of Wight (MURRAY 1940, LE QUESNE 1965a, LE QUESNE 1974a). It is also frequently found in northern England and Scotland (EYRE ET AL. 2001).

Dispersal Capacity: good

Ecology: In central Europe *Dikraneura variata* lives in grass stands of damp to moderately dry and at least moderately shady sites. The species prefers acidic conditions and occurs only in lower abundances also on basic substrates (NICKEL 2003). It is generally regarded on the continent as a sciobiotic species of forests and forest margins, which inhabits open shady pine-spruce-forests and dry grassy patches in pine forests, sunny slopes, woody margins, forest paths and occasionally parks and gardens as well (KUNTZE 1937, FÖRSTER 1961, SCHIEMENZ 1964b, EMMRICH 1966, NICKEL ET AL. 2002, NICKEL 2003). In Italy it is mentioned from coppices and woods particularly of *Quercus spp*. and *Castanea sativa* (VIDANO 1965). In contrast, in Britain *D. variata* is found on grass, often in acidic heathy areas (Le Quesne 1965a, MORRIS 1971a, LE QUESNE & PAYNE 1981, HOLLIER 1987, EYRE ET AL. 2001). It inhabits a rather wide range of acidic grasslands including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland in northern England and Scotland (EDWARDS 1885, EYRE ET AL. 2001). For Wales it is particularly mentioned from dry *Salix* heath and hillside bracken (WHALLEY 1955). However, there are also some records from calcareous soils, where it even can be among the dominant species (MORRIS 1971a, 1981a, 1983, 1990c, COOK 1996). It was additionally found on marshland on the Isle of Wight (LE QUESNE 1974a).

Dikraneura variata is obviously a species of tall grass stands, which does not like yearly cutting (WHITTAKER 1969, MORRIS 1981a). It increases in number after cessation of grazing (MORRIS & PLANT 1983). Next to ungrazed sites it was found to be most abundant in autumn and winter grazed plots (MORRIS 1973). *Dikraneura variata* does not occur at all or only as a vagrant on intensively grazed calcareous grassland (MORRIS 1971a). The species has been found colonising newly sown calcareous grassland within the first summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). It seems to be significantly more abundant in tussocks and hummocks compared with even swards (DENNIS ET AL. 1998).

Dikraneura variata feeds on grasses. It often occurs in high abundance on *Deschampsia flexuosa*, preferentially under pine, beech, oak or spruce and in lower numbers on fescue (*Festuca ovina*, *F. rubra*, *F. heterophylla*) (VIDANO 1965, NOVOTNÝ 1995, NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: Although apparently a species associated with acidic grassland *Dikraneura variata* was regularly found on chalk, altogether on 11 sites. There were no positive records of the species from the South West Downs and the Isle of Wight. Its highest frequencies and abundances are on unimproved chalk grassland sites, where it was recorded from altogether eight sites. It was found additionally on two semi-improved sites and one arable reversion site but not on improved grassland at all. *Dikraneura variata* is more abundant and frequent on the CG grassland, where it is on average a subrecedent species becoming on single sites subdominant. In comparison, it shows only a sporadic occurrence on MG grassland. With the exception of a slight preference for the CG2a sub-community there are no significant differences within the CG communities recognizable. The only MG site with a positive record belongs to the MG1 community. *Dikraneura variata* is highly significant confined to sites with tall vegetation.

The results support the current knowledge on the ecology of the species. However, *D. variata* seems to be much more a species of open habitats in Britain than in central Europe, where it is more a sciobiotic species of forests and forest margins. Otherwise the habitat requirements in Britain do not seem to differ from other parts of its range.

Monitoring Capacity: none

Notus flavipennis (Zetterstedt, 1861)

Habitat-specialization in Great Britain: species mainly on wet base rich habitats

Host specificity: 2nd degree monophagous on *Carex spp.* (perhaps 1st degree oligophagous on Cyperaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: Locally common in base rich habitats in England, Scotland, Wales and Ireland (Le Quesne & Payne 1981)

Dispersal Capacity: good

Ecology: In central and northern Europe *Notus flavipennis* inhabits swamps with a dominance of sedges, meadows, margins of ditches and bogs and wet ruderal sites. It has been as well mentioned from salty places, seashores, shore meadows, fens, moors, *sphagnum* bogs, wet and dry peaty meadows, sphagnous birch and spruce woods, rich fen woods and forest glades (Kuntze 1937, Kontkanen 1938, Linnavuori 1952, Raatikainen & Vasarainen 1976, Hildebrandt 1995, Nickel 2003). An exceptionally high population density was observed in swamps and on swampy meadows (Förster 1961). According to Marchand (1953) *N. flavipennis* is a species of the 'Molinietalia'. In Britain it is locally common in base rich habitats (Le Quesne & Payne 1981). For examples it was common in damp *Carex* and *Juncus* dominated sites in Wales (Whalley 1955).

Notus flavipennis is generally regarded as a hygrophilous species (Emmrich 1966, Hildebrandt 1995). Habitat conditions range from moderately wet to temporarily flooded and from unused to moderately intensively managed usually sunny sites (Nickel & Achtziger 1999, Nickel 2003). *Notus flavipennis*, although feeding on *Carex*, apparently never occurs in dry calcareous grassland in Britain, but is common on the Burren in Ireland (Morris 1974, Waloff 1980). Morris (1974) suggests climatic reasons and that the species can survive in areas of high rainfall on calcareous grassland as well as in marshes.

Notus flavipennis feeds on various species of tall sedges. Named species are *Carex acutiformis*, *C. acuta*, *C. nigra*, *C. rostrata*, *C. vesicaria*, *C. paniculata* and *C. disticha.* Small numbers of adults were also found in slightly saline sites on *Bolboschoenus maritimus* (Nickel 2003). For Chechia Novotný (1995) mentions additionally *Carex brizoides*. In Britain *N. flavipennis* was recorded from various *Carex spp.* including *C. flacca*, *C. acutiformis* and *C. rostrata* (Whalley 1955, Le Quesne & Payne 1981). In the laboratory it fed on *Carex flacca*, *Plantago sp.*, *Juncus effusus*, *J. inflexus*, *Festuca rubra* and *Poa trivialis* (Whalley 1955), but these probably present not frequently utilized plants under normal circumstances.

Hibernation takes place in the egg stage (Törmälä & Raatikainen 1976).

Position within the chalk grassland Auchenorrhyncha communities: *Notus flavipennis* was only found with two single specimens on a semi-improved chalk grassland in the South Downs belonging to the CG4c sub-community. So far, it has never been reported from dry grassland in Britain or central Europe, although it is common on the dry calcareous Burren in Ireland. Whether *N. flavipennis* has established a viable population on the site where it was found remains unclear. *Notus flavipennis* has been reported to feed on *Carex flacca* a sedge species widely distributed in basic dry and wet habitats. Subsequently, it may possible that some areas in Britain are already above a threshold of required rainfall and humidity that enables *N. flavipennis* to colonize comparatively well-drained calcareous grassland.

Monitoring Capacity: good indicator species for stage II

Chlorita dumosa (Ribaut, 1933)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree monophagous on *Thymus spp.*

Distribution status according to the BRC: notable A

Distribution in Great Britain: The species has been first discovered in Britain in 1987 (Kirby et al. 2001). So far it has been found only at Harris, Rhum, Inner Hebrides and at Scout Scar, Westmoreland, Cumbria (Kirby 1992).

Dispersal Capacity: good

Ecology: *Chlorita dumosa* is a stenotopic species of dry grassland, which is usually found in sunexposed, dry to moderately dry and often grazed sites with short swards. It prefers sand and limestone, but can also be found on other well-drained substrates (Schiemenz 1969, Nickel 2003, Nickel et al. 2002). The two current records from Great Britain do not show if there is a preference for either acidic or calcareous grassland. Kirby (1992) suggests that *C. dumosa* will probably prove to be a northern species. However, its distribution and habitat requirements in central Europe do not support this idea. It might well be found in the future in southern England on chalk grassland with the right habitat conditions.

The species feeds exclusively on various species of *Thymus*, notably *Thymus praecox*, *T. serphyllum* and probably *T. pulegioides* (Wagner 1941, Förster 1961, Nickel 2003).

Hibernation takes place in the egg stage, the species is bivoltine (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Chlorita dumosa* was not found within the project and might not be part of the leafhopper communities on chalk grasslands in southern England at all. However, in the event of it being recorded on chalk in southern England it could automatically be regarded as a good biological indicator for intact chalk grassland.

Monitoring Capacity: good indicator species for stage II, umbrella species

Eupteryx aurata (Linnaeus, 1758)

Habitat-specialization in Great Britain: eurytopic grassland species (ubiquitous species)

Host specificity: polyphagous

Distribution status according to the BRC: common

Distribution in Great Britain: Common in England, Wales, Scotland and Ireland (Whalley 1955, Le Quesne & Payne 1981). For example, there are records from Huntingdonshire and Teesdale (Whittaker 1964, Le Quesne 1965a).

Dispersal Capacity: good

Ecology: *Eupteryx aurata* is a species inhabiting tall stands of forbs, often near water, along forest paths and among subalpine scrub. It inhabits in lower numbers also gardens and ruderal sites (Nickel 2003). In Great Britain it has been found commonly in grass and low herbage including calcareous grasslands (Whalley 1955, Brown et al. 1992).

The species is regarded as being eurytopic with its habitat conditions ranging from moist to very wet, tolerating only extensive or no management (Hildebrandt 1995, Nickel & Achtziger 1999). It prefers usually cool or moderately shady, moist or temporarily flooded sites (Nickel 2003).

Eupteryx aurata feeds on *Urtica dioica* and a lot of additional forbs like *Chaerophyllum sp.*, *Carduus personatus*, *Senecio sp.*, *Lamium sp.*, *Mentha sp.*, *Petasites sp.*, *Arctium sp.*, *Cirsium sp.*, *Dahlia sp.*, *Heracleum sphondylium*, *H. mantegazzianum*, *Althea rosea*, *Humulus lupulus*, *Solanum tuberosum*, *Galeopsis sp.* and *Stachys sp.* (Wagner & Franz 1961, Förster 1961, Knight 1965, Davies 1973, Günthart 1974, Nickel 2003). The first generation seems to be restricted to *Urtica dioica* and only the second is feeding also on other plants (Nickel 2003). This phenomenon has also been observed in Britain with the species being initially common on nettle, but later in the year feeding also on labiates like *Mentha sp.* or *Nepeta sp.*, additionally, on *Anthriscus sylvestris*, *Arctium sp.*, *Eupatorium cannabinum*, *Solanum tuberosum* and other plants (Whittaker 1964, Le Quesne 1965a, Woodroffe 1974, Stiling 1980).

Position within the chalk grassland Auchenorrhyncha communities: Although a widespread and common species in Britain *Eupteryx aurata* was only found on four sites within the project. The sampled individuals were found on two sites in the Chilterns an one site in the South Downs and on the Isle of Wight each. Two of the sites belong to unimproved and two to improved chalk grassland. The low number of sampled specimens (altogether five) does not show any preference for certain grassland communities. However, from its known host plant range it is likely to prove to prefer comparably nutrient rich sites with tall vegetation. It therefore may be possible to use *E. aurata* as an indicator for degraded chalk grassland.

Monitoring Capacity: indicator for eutrophic conditions in combination with lack of management

Eupteryx origani Zachvatkin, 1948

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree monophagous on *Origanum vulgare* (perhaps 2nd degree oligophagous on Lamiaceae and Scrophulariaceae)

Distribution status according to the BRC: local

Distribution in Great Britain: First found on the British Isles in 1974 (Le Quesne 1974b). Since then recorded from Yorkshire, Buckinghamshire, Hertfordshire, Kent, Surrey, Berkshire, Hampshire and Perthshire (Le Quesne & Payne 1981, Badmin 1981, Kirby et al. 2001).

Dispersal Capacity: good

Ecology: In central Europe *Eupteryx origani* lives mainly in oligotrophic, moderately dry to damp, moderately shady sites. It is here regarded as a moderately sciobiotic species inhabiting mainly forest margins (Nickel et al. 2002). It has been also been recorded from herbaceous margins in dry grassland, mountain meadows and pastures, preferably near trees or shrubs (Nickel 2003).

The only known foodplant in central Europe is *Origanum vulgare*, which is as well the main host in Britain (Le Quesne & Payne 1981, Nickel 2003). Additionally, it was here observed feeding on *Veronica chamaedrys* in Perthshire (Payne 1979).

Position within the chalk grassland Auchenorrhyncha communities: Within the project *Eupteryx origani* was recorded from two sites in the Chilterns and six sites in the North Downs. Five sites were unimproved and two semi-improved chalk grassland. There is one additional sample from an arable reversion site. However, the differences in occurrence and abundance between the landuse types are not significant despite an apparent preference for unimproved chalk grassland. There are no major differences between the compared NVC communities recognizable either. The only exception is that *E. origani* seems to be restricted to the ungrazed MG1 grassland within the MG communities. It reaches its highest frequency here (class III) and densities (on average being a recedent species and becoming on single sites subdominant) within the grassland communities on chalk. The species is restricted to places with tall vegetation and avoids sites with medium high and short swards completely and significantly.

The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from its ecology on the continent.

Monitoring Capacity: good indicator species for stage II

Eupteryx urticae (Fabricius, 1803)

Habitat-specialization in Great Britain: eurytopic grassland species (ubiquitous species)

Host specificity: 1st degree monophagous on *Urticaca dioica* (1st degree oligophagous on Urticaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: Widespread in England, Wales and Ireland. In Scotland as far North as East Sutherland (Whittaker 1964, Le Quesne & Payne 1981).

Dispersal Capacity: good

Ecology: *Eupteryx urticae* occurs preferentially in various types of forests, notably along margins, and also the banks of aquatic habitats (Nickel 2003). In Great Britain it has also been reported from calcareous grasslands (Brown et al. 1992). The species indicates eutrophic, moist to wet, shady or at least moderately shady conditions and usually occurs only on unmanaged sites (Hildebrandt 1995, Nickel & Achtziger 1999, Nickel 2003).

The species is common on *Urtica dioica*. In Wales and England individuals of the second generation may occur in numbers on *Urtica urens* and *Parietaria judaica*, although overwintering eggs are found on *U. dioica* only (Kuntze 1937, Wagner & Franz 1961, Davies 1973, Günthart 1974, Le Quesne & Payne 1981, Stewart 1988, Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Eupteryx urticae* was found, with the exception of the Isle of Wight, in all investigated regions, on four sites altogether. The species was only recorded from semi- improved and improved sites with a significant difference compared to the unimproved sites. Within the CG grassland *E. urticae* occurs only within the rank vegetation of the CG3 to CG5 grassland. On MG grassland it is roughly evenly distributed over the compared communities. Due to the comparably rare occurrence of the species on chalk grassland no significant differences between CG and MG grassland are recognizable. Since there are no records from CG2 grassland, not data is available about its preference for vegetation heights. However, from its host plant range it can be assumed that the species is restricted to sites with tall patches of rank vegetation. As a eutrophic species it is likely to prove to prefer comparably nutrient rich sites. It therefore is possible to use *E. urticae* as an indicator for degraded chalk grassland.

Monitoring Capacity: indicator for eutrophic conditions in combination with lack of management

Eupteryx stachydearum (Hardy, 1850)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: In Britain recorded from England, Wales, Scotland and Ireland (Le Quesne & Payne 1981).

Dispersal Capacity: good

Ecology: In central and northern Europe *Eupteryx stachydearum* prefers damp, usually shady sites in beech and oak forests (Kuntze 1937, Wagner & Franz 1961, Förster 1961, Nickel 1997, Nickel 2003). Here *E.*

stachydearum is generally seen as a sciobiotic species of forests (Nickel et al. 2002).

Eupteryx stachydearum feeds on a range of labiates, particularly *Stachys sylvatica*, *Lamium galeobdolon*, *Lamium album* and *Mentha sp.* (Ossianilsson 1946, Nickel 1997, Nickel 2003). In Italy it infests *Melissa officinalis* and *Mentha piperita* (Vidano et al. 1978). In central Europe *E. stachydearum* is replaced by *E. curtisii* on *Teucrium scorodonia* (Nickel 2003). In Britain *E. stachydearum* is common on labiates, especially *Stachys sylvatica*, *Teucrium scorodonia* and *Lamium galeobdolon*, but has been also reported from *Arctium sp.* (Le Quesne & Payne 1981, Stewart 1986).

Position within the chalk grassland Auchenorrhyncha communities: *Eupteryx stachydearum* was sampled only from one unimproved and one semi-improved site within the North Downs. The first site belongs to the CG2a sub-community the second to the MG1d sub-community. The low number of sampled individuals does not allow further analysis. *Eupteryx stachydearum* was taken from patches with *Teucrium scorodonia* making this plant the most likely host on the sampled sites. Since in central Europe *E. stachydearum* is often replaced by *E. curtisii* on this host on dry sites (Nickel 2003), it remains unclear if *E. stachydearum* is able to widen its niche into the ranker varieties of chalk grassland due to the lack of competition with *E. curtisii* or due to a generally milder and moister Atlantic climate.

Monitoring Capacity: none

Eupteryx tenella **(Fallén, 1806)**

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree monophagous on *Achillea millefolium*

Distribution status according to the BRC: local

Distribution in Great Britain: Recorded locally from England as far north as northeast Yorkshire and from Montgomeryshire in Wales (Le Quesne & Payne 1981). There are records from Norwich, Essex, Norfolk, Surrey, Merioneth (Welshpool) and Kent (Douglas 1876, Allen 1966).

Dispersal Capacity: good

Ecology: In central Europe *Eupteryx tenella* is recorded from stands of *Achillea millefolium* along herbaceous margins in moderately shady, damp to dry, basic to acidic sites. It is found mainly in grassy verges along hedges and forest edges, but seems to avoid open grassland (Nickel 2003). The species is apparently absent from mown meadows (Nickel 2003). In Britain and central Europe it was found additionally in gardens (Allen 1966, Nickel 2003).

The only certain host plant is *Achillea millefolium*, although *Hieracium pilosella*, *Hyssops officinalis*, *Urtica dioica* and grasses have been mentioned in literature as well (Douglas 1876, Wagner & Franz 1961, Le Quesne & Payne 1981, Ossiannilsson 1981, Nickel 2003). However, all British records originate from *Achillea millefolium* so far (Allen 1966, Quesne & Payne 1981, Stewart 1986).

In eastern Germany two generations have been observed (Schiemenz 1964).

Position within the chalk grassland Auchenorrhyncha communities: *Eupteryx tenella* has not been found within this study. However, it has been reported in Britain mainly from dry grassland sites (Allen 1966). Therefore, it seems justified to regard *E. tenella*, although being very rare, as a possible member of the chalk grassland fauna of southern England. Since the species requires apparently relatively undisturbed patches it is most likely to be found on more ranker only extensively managed sites.

Monitoring Capacity: good indicator species for stage I

Eupteryx vittata **(Linnaeus, 1758)**

Habitat-specialization in Great Britain: eurytopic grassland species (ubiquitous species)

Host specificity: polyphagous on forbs

Distribution status according to the BRC: common

Distribution in Great Britain: Occasional but widespread in England, Wales and Ireland. In Scotland it has been found as far north as Elgin (Le Quesne & Payne 1981).

Dispersal Capacity: good

Ecology: On the continent *Eupteryx vittata* is mainly reported from unimproved meadows and deciduous forests (Ribaut 1936, Nickel 2003).

Eupteryx vittata is regarded as a hygrophilous species of shady sometimes as well sunny places inhabiting moist to very wet sites, which are usually unused or only moderately intensively managed (HILDEBRANDT 1995, NICKEL & ACHTZIGER 1999, NICKEL 2003).

The species lives on various dicotyledones. Favoured host plants are *Ranunculus repens* and *Glechoma hederacea*, but the species also lives on *Ajuga reptans*, *Valeriana dioica*, *Mentha sp.*, *Stachys sp.* and others including some compositae (KUNTZE 1937, DLABOLA 1954, FÖRSTER 1961, NICKEL 2003). In Great Britain it has been reported to live on *Glechoma hederacea*, *Mentha spp.*, *Veronica montana*, *Prunella vulgaris*, *Plantago major*, *Urtica dioica* and *Crepis paludosa*, although some of the host species may be utilized in the second generation only (LE QUESNE & Payne 1981, STEWART 1986, NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Eupteryx vittata* was sampled from seven sites within the Chilterns, North Downs and South Downs. There are no significant differences in frequency and abundance between the four compared landuse types, although it was most often found on unimproved chalk grassland (four sites). *Eupteryx vittata* inhabits equally CG and MG grassland. Within the CG communities it was only found on CG2 grassland and here only within the CG2a and CG2c sub-communities. However, the differences are rather subtle and not statistically significant. On the mesotrophic grassland it was only found on MG1 and from one additional site belonging to the MG6 community. Abundances are significantly higher on high vegetation compared with sites having on average a short sward lower than 6 cm.

Monitoring Capacity: good indicator species for stage I

Eupteryx notata Curtis, 1937

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: polyphagous on forbs (perhaps 2nd degree oligophagus on Asteraceae and Lamiaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: Recorded from England, Scotland, Wales and Ireland (WHALLEY 1955, LE QUESNE & PAYNE 1981).

Dispersal Capacity: good

Ecology: In central Europe *Eupteryx notata* inhabits mainly lean meadows and pastures, dry grassland, heaths and roadside embankments. Occasionally it is found in wet meadows and calcareous fens (NICKEL 2003). Within Great Britain *E. notata* can mainly be found on low calcareous vegetation where it can become occasionally a dominant species (MORRIS 1971a, 1990c, LE QUESNE & PAYNE 1981). There is also a record from heath with chalky sand in Norfolk, where it occurred in abundance (LE QUESNE & MORRIS 1971). Around Teesdale it has been observed to inhabit limestone but not acidic sites (WHITTAKER 1964, 1977). There are only occasional observations from acidic grassland in Britain (WALOFF & SOLOMON 1973). It also seems here to be rather scarce under wet conditions although it has been mentioned to be common in reed swamps in Wales (WHALLEY 1955). Own observations are from a wet sedge-rich meadow on clay in Bedfordshire.

Generally the heliophilic *E. notata* tolerates a fairly wide range of habitat conditions from very dry to moderately wet sites, which are usually unused or only moderately intensive managed (NICKEL & ACHTZIGER 1999, NICKEL 2003). However, the species seems to prefer dryer or at least temporarily dry meadows (MARCHAND 1953). In central Europe *Eupteryx notata* lives among low-growing herbs in partially open, oligotrophic, basic to acidic places (NICKEL 2003). On managed chalk grassland in England the species seems to become more abundant when grazing is taking place in spring (MORRIS 1973). Generally, the species seems to react positive to a cessation of intensive grazing (MORRIS 1971a). On the other hand, cutting enhances the density of heliophilous plants like *Prunella vulgaris*, *Thymus spp.* and *Hieracium pilosella*. This may have consequently a positive effect on the density of *E. notata* (BORNHOLDT 1996). According to MARCHAND (1953) *E. notata* replaces on dry meadow its sibling species *E. vittata* which is more typical for moist meadows.

Eupteryx notata feeds on a range of low-growing grassland herbaceous plants like *Hieracium pilosella*, *Leontodon hispidus*, *Hypochaeris spp.*, *Plantago spp.*, *Prunella vulgaris*, *Thymus spp.* and *Crepis aurea* (KUNTZE 1937, FÖRSTER 1961, GÜNTHART 1974, STEWART 1986, NICKEL 2003). On dry calcareous sites in Britain it is probably associated with *Prunella vulgaris*, *Thymus sp.* and various compositae notably *Hieracium pilosella* (LE QUESNE & PAYNE 1981, STEWART 1986). On acidic grassland in Britain one of the main host plants seems to be *Hypochaeris radicata* (MORCOS 1953).

In Scandinavia and Germany two, in Britain even three generations have been observed, with the hibernation taking place in the egg stage (KONTKANEN 1938, MORCOS 1953, REMANE 1958, SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: With positive records from 49 sites, *Eupteryx notata* is by far the most widely distributed species of the genus on chalk grassland in southern England. It was found in all investigated regions with the exception of the Isle of Wight. *Eupteryx notata* occurs most constantly in the South Wessex Down with significantly higher densities compared to all other regions. Frequency and abundance decreases significantly from unimproved chalk grassland (32 sites) over improved grassland (seven sites) towards arable reversion sites (two sites). On CG grassland *E. notata* is a constant species (frequency class IV) and has here on average the status of a subdominant species, occasionally becoming eudominant on some sites. That makes it a valuable preferential species of CG grassland in comparison to mesotrophic grassland (MG). Here it occurs in highly significantly lower numbers (on average only a subrecedent species with a maximum status of a subdominant species on some sites) and lower frequency (class III). Within the CG grassland it can be classified as a constant species for both CG2 and CG3 to CG5 grassland, although being more frequent and abundant on the first community. However, these differences are not significant. There are no obvious differences when the three sub-communities of CG2 grassland are compared. Within the mesotrophic grassland *E. notata* is less commonly found on the MG1 grassland (frequency class III, on average only a sporadic species with a maximum of a subrecedent species) in comparison to MG5 grassland. Here it is a constant (frequency class V) and on average a recedent species, which can become subdominant on some sites. On MG6 and MG7 grassland it becomes again only a sporadic species (with a maximum dominance of a recedent species and frequency class II), with significantly lower densities than on the MG5 grassland. The occurrence of *Eupteryx notata* seems to be absolutely indifferent to vegetation height.

The results are in slight contrast to the observations made by MORRIS (1973) and BORNHOLDT (1996), who noticed an increase of the species after grazing and cutting, which usually results in a short vegetation sward.

Monitoring Capacity: good indicator species for stage II, umbrella species

Zyginidia scutellaris (Herrich-Schäffer, 1838) sensu Ribaut, 1936

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Recorded from England as far north as Yorkshire and Lancashire, as well reported from Wales (WHALLEY 1955, LE QUESNE & PAYNE 1981).

Dispersal Capacity: very good

Ecology: In central Europe *Zyginidia scutellaris* can be found mainly in ruderal sites, disturbed dry grassland, abandoned vineyards, unkempt gardens etc. The species undertakes flights in autumn and can then often be found in large numbers in abandoned fields, fallows, winter cereal fields, fertilized meadows and along roadside verges (NICKEL 2003, own observations). In Britain *Z. scutellaris* is generally common in grassy places both on acidic and calcareous substrates (WALOFF 1979, LE QUESNE & PAYNE 1981, MORRIS 1990c, BROWN ET AL. 1992, COOK 1996). It has also been reported from a reed swamp in Wales (WHALLEY 1955).

Habitat conditions range from dry to wet. The species inhabits preferably unmanaged to moderately intensively managed sites (NICKEL & ACHTZIGER 1999). In Britain *Z. scutellaris* can be among the most abundant species on acidic grassland dominated by *Holcus mollis* (WALOFF 1979). The species has also been found colonising newly sown calcareous grassland within the first summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a).

Host plants are various grasses, notably *Festuca spp.*, *Poa spp.* and *Dactylis glomerata*. It is reported to cause feeding damage on maize in France (DELLA GUISTINA 1989, NICKEL 2003). In Britain some authors claim a general association with *Dactylis glomerata* and *Festuca rubra* (LE QUESNE & PAYNE 1981). On acidic grassland the species may be associated with *Dactylis glomerata* but equally with *Holcus sp.* (WALOFF & SOLOMON 1973, WALOFF 1979, WALOFF & THOMPSON 1980). At least *Z. scutellaris* could be bred out of tufts from both species (WALOFF & SOLOMON 1973). On experimental plots on acidic grassland with sown grasses the species fed mainly on *Dactylis glomerata* and *Festuca pratensis* (PRESTIDGE & MCNEILL 1983). On limestone BROWN ET AL. (1992) could show a positive correlation between the abundance of *Agrostis stolonifera* and *Z. scutellaris*.

According to WALOFF (1994) *Zyginidia scutellaris* is a multivoltine species in Britain.

Position within the chalk grassland Auchenorrhyncha communities: *Zyginidia scutellaris* was sampled from altogether 91 of the 100 investigated sites making it the one of the most widely distributed leafhoppers and by far the most common Typhlocybine leafhopper within this project. The species usually occurred in high numbers throughout all investigated regions. Although the frequency in which *Z. scutellaris* occurs on the four compared landuse-types is similarly high in all groups, the average abundance is significantly higher on unimproved and semi-improved chalk grassland sites compared to improved and arable reversion sites. In a comparison of CG grassland with mesotrophic grassland *Z. scutellaris* can be classified as a preferential species of the CG grassland occurring here in significantly higher densities than on the latter grassland group. On CG grassland *Z. scutellaris* is on average a dominant species, which becomes frequently eudominant. On MG grassland it has on average the status of a subdominant species, but equally reaches sometimes the status of an eudominant species. *Zyginidia scutellaris* is equally a constant species in both grassland groups (class V). There are no major differences between the different communities of the CG grassland obvious. Within the MG grassland the densities of *Z. scutellaris* decrease significantly from the more extensively used MG1 and MG5 communities towards the MG6 grassland and MG7 leys. *Zyginidia scutellaris* avoids sites with short swards and is significantly more abundant on sites with medium high and tall vegetation. However, there seems to be no preference between medium high to high vegetation.

Monitoring Capacity: none

Zygina hyperici (Herrich-Schäffer, 1836)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Hypericum perforatum*

Distribution status according to the BRC: local

Distribution in Great Britain: So far only recorded from England with records from Leicestershire, Norfolk, Gloucestershire, Buckinghamshire, Hertfordshire, Kent, Surrey, Wiltshire and Dorset (Le Quesne & Payne 1981).

Dispersal Capacity: good

Ecology: On the continent the species usually lives in disturbed sites like ruderal habitats, roadsides, railway embankments, mining areas, also on grazed or abandoned grassland (Nickel 2003). In Poland it has been classified as a characteristic species of dry rank vegetation on sand (Szwedo 1998). In contrast, in Britain it can be found mainly in calcareous situations (Le Quesne & Payne 1981). Habitat requirements range in central Europe from damp to dry, usually sunny conditions (Nickel 2003).

Host plant is *Hypericum perforatum* (Le Quesne & Payne 1981, Günthart 1974, 1987, Remane & Wachmann 1993, Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: A single specimen of *Zygina hyperici* was found on one site in the North Downs on a semi- improved grassland belonging to the MG1 grassland community. No statistical analysis is possible but *Z. hyperici* can probably classified as a characteristic, although comparatively rare, species of rank chalk grassland, where stands of its host plant *Hypericum perforatum* occur.

Monitoring Capacity: good indicator species for stage II

Arboridia parvula (Boheman, 1845)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 2nd degree oligophagous on Rosaceae and Cistaceae (perhaps polyphagous on forbs)

Distribution status according to the BRC: local

Distribution in Great Britain: Distributed in England, Wales, Ireland and Scotland as far north as Haddington with records from Gloucestershire (Colesborne), Huntingdonshire, Surrey (Shere, Box Hill), Dorset (Poole Harbour, Blandford, Handley, Swanage), Carmarthenshire (Pendine), Hampshire (New Forest), Essex (Chingford, High Beech), Staffordshire (Dovedale) and Kent (Folkestone Warren, Deal) (China 1938, Le Quesne 1965a, Le Quesne & Payne 1981).

Dispersal Capacity: good

Ecology: Within northern and central Europe *Arboridia parvula* inhabits mainly woody margins. It can be found on dry grassland with scattered shrubs and trees, along hedges and forest margins (Ossiannilsson 1981, Nickel 2003). In Britain *A. parvula* is often recorded from low plants on calcareous soils and fenland and can become dominant at least on the former one (Le Quesne 1965a, Le Quesne & Payne 1981, Morris 1981a, 1990c, Brown et al. 1992).

On the continent *Arboridia parvula* occupies dry to moist sites, often in rather warm situations (Nickel 2003). The species seemingly does not like yearly cutting (Morris 1981a). It avoids heavy grazing and increases in number after cessation of grazing (Morris & Plant 1983, Brown et al. 1992). *Arboridia parvula* has been observed colonising newly sown calcareous grassland within the first summer and became established in the second year after sowing at a distance of one mile from semi-natural grassland (Morris 1990a). It was also a long distance colonizer on arable fallow land in Germany (Witsack 1995).

Adults feed on herbaceous and shrubby species of Rosaceae particularly *Potentilla incana*, *Filipendula ulmaria*, *Rubus idaeus* and *Rubus chamaemorus.* Specimens found on *Potentilla* may belong to a different species described as *Arboridia potentillae* (Moravskaja, 1948). There is a small possibility that this taxon occurs also in Great Britain. In lower numbers *A. parvula* can be found also on various deciduous trees like *Quercus sp*. and *Prunus padus* (Günthart 1974, Ossiannilsson 1981, Nickel 2003). However, most winter records are from herbaceous vegetation (Nickel 2003). *Arboridia parvula* may be associated with *Helianthemum nummularium* on dry calcareous grassland in Britain (Le Quesne & Payne 1981).

Hibernation takes place in the adult stage. Adults are found throughout the summer (Müller 1957, Linnavuori 1952). In Germany two generations have been observed (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Arboridia parvula*, with records from 29 sites and all investigated regions, is a common and widespread species on chalk in southern England. However, for unknown reasons it was significantly scarcer in the South Downs, where it was found only on one site. The species has its main distribution on unimproved chalk grassland (20 sites with positive records) where it occurs in significantly higher frequency than on the improved grassland and in much higher densities than on the arable reversion sites. Although it was only recorded from five improved grassland sites it was extremely abundant and eudominant on one of these sites belonging to the MG1 community. When CG grassland is compared with MG grassland there is no preference recognizable. *Arboridia parvula* occupies equally in both groups the status of a subdominant species, being able to become eudominant on some sites. In both grassland groups it occurs in the frequency class III. Within the CG grassland there is only a slight but not significant preference obvious for the ranker CG3, CG4 and CG5 communities in comparison to CG2 grassland. Within the CG2 community the species shows a higher frequency and abundance on the CG2a sub-community compared to CG2b and CG2c. The difference between CG2a and CG2b is significant. On mesotrophic grassland *A. parvula* is a valuable preferential species of the MG1 community, where it is on average a dominant species. Densities are here significantly higher compared with the MG5, MG6 and MG7 communities. It is here also a constant species (frequency class V), and shows much lower frequencies on MG5 (class III) and on MG7 (class II). There are no records at all from MG6 grassland. On MG5 and MG7 it is on average only a sporadic species, becoming within the latter community on single sites a recedent species. *Arboridia parvula* inhabits tall vegetation in significantly higher density than short vegetation. However, there seems to be no difference between medium high and tall vegetation.

The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from the its ecology on the continent.

Monitoring Capacity: good indicator species for stage II

Macrosteles laevis (Ribaut, 1927)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: polyphagous

Distribution status according to the BRC: common

Distribution in Great Britain: Distributed in England and Scotland. From Wales recorded from Caernshire (Le Quesne 1969).

Dispersal Capacity: very good

Ecology: In central Europe *Macrosteles laevis* is a species of sparsely vegetated mud banks along rivers and lakes, but appears as well often in high abundances in fertilized meadows, on ruderal sites, abandoned land, on temporarily dry ponds bottoms, in cereal crops and mining areas (Schiemenz et al. 1996, Nickel 2003). In Poland it seems to be typical for drained, ploughed and sown grassland with a mixture of meadow grasses (Andrzejewska 1991). It is here also a characteristic species of dry psammophilous meadows (Szwedo 1998). Interestingly, in North America the species seems to be restricted to the climatic conditions of Alaska and northwest Canada (Hamilton 1983). In Britain *M. laevis* has been found mainly on grasses, usually in drier areas such as calcareous hillsides. It has also been recorded on acidic dry grassland, damp meadows and even in saltmarshes (Whalley 1955, Whittaker 1964, Le Quesne 1969, Waloff & Solomon 1973, Hollier 1987, Brown et al. 1992).

Overall *Macrosteles laevis* is an extremely eurytopic species the range of which stretches into the taiga, mixed forests, savannah woodland, and steppe of the arid and semiarid zones of the former USSR, where its is the most ubiquitous of over 30 *Macrosteles* species (Andrzejewska 1962, Nast 1972). However, within that range it is yet very scarce in some habitats (Andrzejewska 1962). Conditions can range from moderately dry to wet and the species can be found in unused to moderately intensively managed sites (Schiemenz et al. 1996, Nickel & Achtziger 1999).

Generally, *M. laevis* can be regarded as a pioneer species of dynamic short-lived habitats (Nickel 2003). The species responds positively to disturbance of natural meadows by ploughing or mowing and can then reach high abundances (Andrzejewska 1962). It often occupies disturbed areas very quickly (Andrzejewska 1962). *Macrosteles laevis* is typical for early successional stages of ruderal grassland on acidic soil, disappearing again in later successional stages (Hollier et al. 1994, Huusela-Veistola & Vasarainen 2000). It can also decline again on arable reversion sites quite early after colonising (Morris 1990a). The species has been found colonising within the first summer after sowing of calcareous grassland at a distance of one mile from semi-natural grassland (Morris 1990a). On acidic grassland the species was found after early colonization of a sown field and of experimentally sown plots feeding mainly on *Agrostis capillaris*, *Poa pratensis* and *Holcus lanatus* (Waloff & Solomon 1973, Prestidge & McNeill 1983).

In Bedfordshire *Macrosteles laevis* was observed to be more abundant on ungrazed plots then on ungrazed exclosures on a intensively grazed site, but inhabited short grazed turf as well (Morris 1971a, 1973). In other experiments it favoured short swards (Brown et al. 1992). The species prefers grazed sites to ungrazed plots and increases with decreasing structural diversity (MORRIS 1971a, BROWN ET AL. 1992).

Macrosteles laevis lives polyphagously on grasses, rushes, sedges and also dicotyledonous herbs (NICKEL 2003). Food plants mentioned in literature comprise *Agrostis capillaris*, *Poa pratensis*, *Holcus lanatus*, *Alopecurus aequalis*, *Coleanthus subtilis*, *Carex spp*. *Juncus articulatus*, *J. bufonius* and others (WALOFF & SOLOMON 1973, PRESTIDGE & MCNEILL 1983, NOVOTNÝ 1995).

Macrosteles laevis is a species of economic importance. Cereals are attacked and it is a vector of European aster yellows and oat blue dwarf virus (OSSIANNILSSON 1983).

Position within the chalk grassland Auchenorrhyncha communities: *Macrosteles laevis* was sampled from 21 sites with records from all investigated regions. It is, however, significantly scarcer in the South Downs than in the Chilterns or South Wessex Downs. There is apparently no preference for one of the four compared landuse-types, with the exception of an insignificant rise of frequency and abundance towards the improved and arable reversion sites. Equally there is no difference in the appearance on CG grassland compared to MG grassland. *Macrosteles laevis* occurs on both grassland groups at a comparable low frequency (class II) and abundance, being on average only a subrecedent species. However, on sites of the CG grassland *M. laevis* can reach the maximum status of a dominant species and on sites of the MG grassland that of a subdominant species. The low average abundance is partly to explain with the fact that only males could be identified and only their number was subsequently analysed. *Macrosteles laevis* as *M. viridigriseus* avoid MG1 grassland completely. In the comparison with MG5 grassland, where *M. laevis* was sampled in the frequency class III and with an average abundance of subrecedent species (maximum on single sites subdominant), it can, therefore, be classified as a differential species of the MG5 community. The same is true within the comparison of the MG1 community to MG6 and MG7 grassland. On MG7 leys *M. laevis* occurs in an even higher frequency (class III). Subsequently no major differences are recognizable in the comparison of MG5, MG6 and MG7 grassland. Within the CG grassland there seems to be a slight but still insignificant preference of the CG2 grassland in comparison to the ranker grassland of the CG3 to CG5 communities. *Macrosteles laevis* prefers significantly short vegetation in comparison with tall vegetation.

Monitoring Capacity: indicator for disturbance

Macrosteles viridigriseus (Edwards, 1922)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree oligophagous

Distribution status according to the BRC: common

Distribution in Great Britain: Common and widespread in England, Wales and Scotland (WHALLEY 1955, LE QUESNE 1969, WOODROFFE 1972, LE QUESNE 1974a, BADMIN 1981). The species was first described from the Severn-side-marshes, Gloucestershire and from Herefordshire (EDWARDS 1924).

Dispersal Capacity: very good

Ecology: In northern and central Europe *Macrosteles viridigriseus* is a species of pastures and meadows, mainly river floodplains or floodplain depressions, the edges of aquatic habitats and moderately saline marshes (KUNTZE 1937, VILBASTE 1974, RAATIKAINEN & VASARAINEN 1976, SCHIEMENZ ET AL. 1996, NICKEL 2003). It also occurs in spring mires and fens and as a pioneer species on sparsely vegetated banks of gravel, sand and mud. Records from other habitats probably refer to vagrants (NICKEL 2003). According to MARCHAND (1953) it is a typical species of the 'Molinetum hydrocotyletosum', where it can be dominant. Likewise it can become a dominant species in grassland, which is flooded on a regular basis (WALTER 1996). In Britain it is common and widespread in marshy areas, often at margins of ponds (Le Quesne 1969, Le Quesne 1974a). *Macrosteles viridigriseus* was common in reed swamps in Wales (WHALLEY 1955). It has also been mentioned to be associated with acidic grassland (WALOFF & SOLOMON 1973).

The species can be described to be to a certain degree halophilous (LINNAVUORI 1952, EMMRICH 1966, HILDEBRANDT 1995, NICKEL ET AL. 2002). Habitat conditions can range from temporarily dry to very wet and the intensity of landuse can vary from intensively managed to unused (NICKEL & ACHTZIGER 1999). Despite a preference for wet grasslands it seems to disperse as well into drier *Arrhenatherum* grassland (STRÜBING 1955). On acidic soil it was observed to be an early colonizer of sown fields (WALOFF & SOLOMON 1973, HOLLIER 1989).

Host plants are various grasses like *Agrostis stolonifera*, probably also Cyperaceae. (NOVOTNÝ 1995, NICKEL 2003). As well rushes, clover and strawberry have been named as host plants (KNIGHT 1965, SCHIEMENZ ET AL. 1996). On acidic grassland in Berkshire it fed on *Dactylis glomerata* and on *Agrostis spp.* (WALOFF & SOLOMON 1973).

Position within the chalk grassland Auchenorrhyncha communities: *Macrosteles viridigriseus*, with records from 22 sites distributed over all investigated areas, is as common on chalk as *M. laevis*. The species is rather rare in the North Downs. It has its main stronghold on semi-improved and improved chalk grassland where it shows the highest frequencies and average abundances within the four compared landuse types. The difference between improved and unimproved sites is significant. In a comparison between CG and MG grassland *M.*

viridigriseus can be classified as a preferential species of MG grassland, where it occupies the frequency class III and is on average a recedent species becoming on some sites dominant. In contrast, on CG grassland *M. viridigriseus* occurs only in frequency class II, is on average a sporadic species and becomes as a maximum subdominant. Within the CG grassland *M. viridigriseus* is more frequent and dominant on CG2 grassland compared with CG3, CG4 and CG5 grassland. Within the CG2 grassland there seems to be a preference for the rich CG2c sub-community compared to CG2b and CG2a. Similar as with *M. laevis*, *M. viridigriseus* does not inhabit MG1 grassland at all and can, therefore, be recorded as a differential species in comparison with MG5, MG6 and MG7. The species inhabits each of the MG5, MG6 and MG7 communities with the frequency class III and has its highest abundances on the more heavily managed and more eutrophic sites of the MG6 and MG7 grassland. There *M. viridigriseus* is on average a subdominant species becoming occasionally dominant. On the MG5 grassland the species is on average only subrecedent becoming as a maximum on some sites recedent. *Macrosteles viridigriseus* prefers short and medium high vegetation having its highest abundances on medium high grassland. However, the differences between the height classes are not significant.

Although described to be generally a rather hygrophilous species the results of this study show that in Britain dry calcareous grassland is inhabited on a regular basis by *M. viridigriseus*. However, there is a clear preference for eutrophic and intensively managed sites, which may be characterized by a moister microclimate. On the other hand, *M. viridigriseus* may have been able to extend its niche width into drier grassland types on the British Isles due to general higher rainfalls throughout the year compared to its habitat range on the continent.

Monitoring Capacity: indicator for disturbance

Deltocephalus pulicaris (Fallén, 1806)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Commonly distributed in England, Wales, Scotland and Ireland (WHALLEY 1955, LE QUESNE 1969, EYRE ET AL. 2001).

Dispersal Capacity: very good

Ecology: *Deltocephalus pulicaris* is, on the continent, often extremely abundant in sheep and cattle pastures or improved meadows. Other occupied habitats are peaty meadows, cultivated or abandoned fields, leys, margins of forest and roads, fens, moderately saline habitats and lawns in parks, gardens and even sports grounds or other urban habitats (LINNAVUORI 1952, RAATIKAINEN & VASARAINEN 1973, REMANE 1987, RAATIKAINEN & YLÖNEN 1989, SCHIEMENZ ET AL. 1996, NICKEL 2003). It is a characteristic species of the ‘Molinio-Arrhenatheretea’ in northern Germany (MARCHAND 1953). In Poland *D. pulicaris* is typical for drained, ploughed and sown grassland with a mixture of meadow grasses (ANDRZEJEWSKA 1991). In Britain the species is common on short grasses, usually in drier localities, such as hillsides (LE Quesne 1969). It is frequently found on both acidic and basic grassland throughout the country (WALOFF & SOLOMON 1973, MORRIS 1973, 1990c, EYRE ET AL. 2001). However, WHITTAKER (1964, 1977) could find *D. pulicaris* only on limestone but not on acidic sites in the Teesdale area. In northern England and Scotland it was abundant in riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland but avoided here both dry and damp ruderal sites completely (EYRE ET AL. 2001). It has also been recorded from damp meadows in Wales (WHALLEY 1955).

Deltocephalus pulicaris can be regarded as a very eurytopic species and an indicator for eutrophic conditions (EMMRICH 1966, HILDEBRANDT 1995, WALTER 1996). In central Europe it occurs in sunny, occasionally also moderately shady, wet to moderately dry, unused to intensively managed sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). It lives only in open habitats and prefers here areas with high nitrogen levels (BORNHOLDT & REMANE 1993, REMANE & WACHMANN 1993, SCHIEMENZ ET AL. 1996). *Deltocephalus pulicaris* has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a).

Food plants are grasses (RAATIKAINEN & VASARAINEN 1976). Host species listed in literature are *Agrostis capillaris*, *Poa spp.*, *Dactylis glomerata*, *Elymus sp.* and *Lolium perenne* (WALOFF 1980, MORRIS 1990b, NICKEL 2003). On acidic grassland on experimental plots with sown grasses in Berkshire it fed mainly on *Agrostis capillaris* (PRESTIDGE & MCNEILL 1983).

Hibernation takes place in the egg stage. In central Europe *D. pulicaris* has two generations (REMANE 1958, SCHIEMENZ 1969);

Position within the chalk grassland Auchenorrhyncha communities: *Deltocephalus pulicaris* is one of the most widespread and dominant species of nearly all grassland types on chalk in England. Within the project it was recorded throughout all investigated regions on 80 sites altogether. Compared with the other landuse types the abundances of *D. pulicaris* are significantly lower on unimproved chalk grassland. The average number of individuals was here more than ten times lower than on improved grassland and still more than four times lower compared to arable reversion sites. The species is highly constant (class V) on MG grassland, being here on average a eudominant species. On CG grassland *D. pulicaris* occurs only in frequency class IV. It is here on average a subdominant species becoming on some sites eudominant. The highly significant differences in abundance between the two grassland groups make *D. pulicaris* a distinct preferential species of the MG grassland in comparison with CG grassland. There are no major differences when CG2 grassland is compared with CG3, CG4 and CG5 grassland. Within the CG2 grassland however, there is a clear preference for the richer and more eutrophic CG2c sub-community in comparison with CG2a and CG2b. Although *D. pulicaris* is, on average, only a dominant species on MG5 grassland, compared with the status of an eudominant species on MG6 and MG7, there are no significant differences between these communities. In contrast, the differences in abundance are significant between the latter three communities and the MG1 grassland. Here *D. pulicaris* occupies on average only the status of a recedent species, becoming as a maximum on single sites a dominant species. *Deltocephalus pulicaris* occurs on MG1 grassland in frequency class IV. The species prefers short to medium high vegetation. It is equally on average a dominant species on short and medium high grassland, but significantly less abundant on sites with tall vegetation, where it is on average only a recedent species.

The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from the known autecology in other parts of its range.

Monitoring Capacity: none

Recilia coronifer **(Marshall, 1866)**

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Distributed throughout central and southern England, as far north as Staffordshire and Norfolk (LE QUESNE 1969).

Dispersal Capacity: good

Ecology: *Recilia coronifer* is found in central Europe mainly in open oak and pine forests, particularly in glades and along margins, also on the edges of bogs and on wet grassland (WAGNER 1939, SCHWOERBEL 1957, REMANE 1958, TRÜMBACH 1959, SCHIEMENZ 1964b, EMMRICH 1969, SCHIEMENZ ET AL. 1996, NICKEL 2003). In England the species occurs locally in heathy or calcareous situations (LE QUESNE 1969, MORRIS 1973, 1981b).

Generally, *Recilia coronifer* is regarded as a hygrophilous species (HILDEBRANDT 1995). Its habitat conditions in central Europe range from moderately moist to wet, with a restriction to unmanaged, moderately shady, occasionally also sunny and usually acidic sites (EMMRICH 1969, SCHIEMENZ ET AL. 1996, NICKEL & ACHTZIGER 1999, NICKEL 2003). In Britain *R. coronifer* can be among the most abundant species on acidic grassland dominated by *Holcus mollis* (WALOFF 1979), where it is sometimes recorded from rather tall swards (WALOFF & SOLOMAN 1973, HOLLIER ET AL. 1994). Despite these records and the fact that the species seems to avoid managed sites, it may on the other hand, be associated with short swards (EMMRICH 1969, LE QUESNE 1969, MORRIS 1973, 1981b). *Recilia coronifer* has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a).

Host plants in central Europe are *Holcus mollis* and less frequently *Molinia caerulea* (SCHIEMENZ ET AL. 1996, NICKEL 2003). In England the species has been found to be associated on acidic sites, both as host plant and egg-laying substrate, with *Holcus spp*., particularly *H. mollis* , from which it could be bred out of tufts (THOMPSON 1978, WALOFF 1979, WALOFF & THOMPSON 1980, WALOFF & SOLOMON 1973).

Position within the chalk grassland Auchenorrhyncha communities: With the exception of the Isle of Wight *Recilia coronifer* was found in all investigated regions, on 20 sites altogether. Half of the records are from unimproved grassland, where it is significantly more abundant than on improved or arable reversion sites. However, differences between CG and MG grassland are not significant. The frequency of the species tends to be higher on CG grassland (class III compared with class II on MG grassland) but average abundances are lower (subrecedent on CG and recedent on MG grassland). *Recilia coronifer* seems to prefer the ranker communities within the CG grassland (CG3, CG4, CG5), where it occurs in frequency class III compared with CG2 (frequency class II). Within the CG2 grassland there are no differences on sub-community level obvious. As a constant species (class IV) *R. coronifer* is a preferential species of the MG1 communities within the mesotrophic grassland, being on average a subdominant species, which can become on some sites dominant. In fact, it seems to avoid the other MG communities almost completely and was only sporadically sampled from MG6 grassland. *Recilia coronifer* was not recorded from sites with short vegetation at all. However, there seems to be no difference in the preference for medium high or tall swards.

Recilia coronifer seems to be more associated with taller or medium high vegetation and not with short swards as has sometimes been suggested. It has been associated with undisturbed and unmanaged sites as well. There may be a link in the sense that usually such sites tend to develop higher vegetation. Although *R. coronifer* was described to be generally a rather hygrophilous species, the results of this study show that in Britain dry calcareous grassland is inhabited on a regular basis. However, there is a clear preference for eutrophic and intensively managed sites, which may be characterized by a moister microclimate. On the other hand, *R. coronifer* may have been able to extend its niche width into drier grassland types on the British Isles due to general higher or more evenly distributed water supply throughout the year compared with calcareous grassland habitats on the continent.

Monitoring Capacity: good indicator species for stage I

Doratura stylata (Boheman, 1847)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Recorded from England, additionally, from Perthshire and the Fife in Scotland (LE QUESNE 1969, BADMIN 1981).

Dispersal Capacity: poor

Ecology: On the continent *Doratura stylata* is found in lean grassland, roadsides, ruderal sites, inland dunes and sandy fields. It is often dominant in meadows and pastures of the submontane belt (KUNTZE 1937, LINNAVUORI 1952, NICKEL 2003). According to MARCHAND (1953) it is characteristic for the 'Molinietum typicum, var. *Nardus stricta*'. It can also be a dominant species in the Peucedano-caricetum paradoxae in Poland (ANDRZEJEWSKA 1991). *Doratura stylata* is now one of the most common pest species on grasslands in eastern North America, only avoiding short grass prairie (HAMILTON 1983). In Britain *D. stylata* is widespread in open situations. It occurs often on sandy or calcareous soils, but sometimes on heavy, acidic substrates (LE QUESNE 1969, MORRIS 1973, HOLLIER 1987, COOK 1996). It was frequently found on acidic grassland, especially dunes and sandy open ruderal sites with a considerable amount of bare ground in northern England (EYRE ET AL. 2001). In southern England (Berkshire) *D. stylata* was found to establish large populations on acidic grassland dominated by *Holcus mollis* (WALOFF 1979).

The species is generally regarded as being xerophilous and heliophilous but rather eurytopic concerning substrate and intensity of management (EMMRICH 1966, REMANE 1987, SCHIEMENZ ET AL. 1996, NICKEL ET AL. 2002). In central Europe it *D. stylata* is found in oligotrophic and sunny, dry to damp, occasionally also moist, unused to moderately intensively managed sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). Here it has been recorded as a highly dominant species on some mesophilic grassland sites and as sometimes gaining a high dominance on semi dry calcareous grassland (MÜLLER 1978, BORNHOLDT & TAMM 1986). Generally, *D. stylata* seems to be a species of managed grassland (ROMBACH 1999). One study in Germany showed little influence of the type or intensity of the management on population density (ROMBACH 1999). However, in Britain *D. stylata* seems to become rare if sites are grazed for three months a year, although it can tolerate grazing that takes place in autumn or winter (MORRIS 1973). Wet habitats seem to be inhabited only if the vegetation is short and open (NICKEL ET AL. 2002). *Doratura stylata* apparently inhabits the litter and root zones of its host plants (BEIRNE 1956).

Main host plants in central Europe are *Festuca rubra*, *F. ovina* and *Agrostis capillaris*, probably also additional species of fine-leaved grasses e.g. *Poa angustifolia* and *Nardus stricta* (SCHIEMENZ ET AL. 1996, NICKEL 2003). On acidic grassland in Berkshire it fed on *Agrostis capillaris* from which it could be successfully bred and additionally on *Festuca rubra* (WALOFF & SOLOMON 1973, PRESTIDGE & MCNEILL 1983). On acidic grassland on experimental plots with sown grasses *D. stylata* fed as well mainly on *Agrostis capillaris* (PRESTIDGE & MCNEILL 1983).

Hibernation takes place in the egg stage. The species is univoltine (REMANE 1958, SCHIEMENZ 1969). *Doratura stylata* is wingdimorphic, however, macropters are rare (LE QUESNE 1969, WALOFF 1980, OSSIANNILSSON 1983).

Position within the chalk grassland Auchenorrhyncha communities: During this study *Doratura stylata* was found on 20 sites. With the exception of the North Downs it was sampled from all investigated regions, most commonly in the South Downs. The species occurs with highest densities and frequencies on unimproved and semi-improved chalk grassland. However, the differences between the landuse types are not significant. *Doratura stylata* inhabits the CG grassland in higher densities (on average a subrecedent species, as a maximum a subdominant species) than the MG grassland (on average only a sporadic species, as a maximum a recedent species). But again the differences are not statistically significant. In both grassland groups the frequency is comparably low (class II). Within the CG grassland *D. stylata* seems to prefer the CG2 community in comparison with the CG3, CG4 and CG5 grassland. It seems to appear in lower numbers on the richer sub-community CG2c in comparison with CG2a and CG2b. Again the differences are not very distinct and insignificant. There are no preferences for distinct communities recognizable within the mesotrophic grassland at all. *D. stylata* is one of the few species, which significantly prefers short to medium high swards in comparison to sites with tall vegetation.

The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation on the continent. However, the fact that in Britain *D. stylata* prefers short swards on dry sites is perhaps new.

Monitoring Capacity: good indicator species for stage I

Rhytistylus proceps (Kirschbaum, 1868)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Festuca ovina* (1st degree oligophagous on Poaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: *Rhytistylus proceps* is distributed in England south of a line from Wash to Bristol Channel (LE QUESNE 1969).

Dispersal Capacity: good

Ecology: In central Europe *Rhytistylus proceps* occurs mainly in sandy dry grasslands, heaths, open margins of pine forests, occasionally also calcareous hillsides (SCHIEMENZ ET AL. 1996, NICKEL 2003). It is here a typical species of the 'Corynephoretum' (MARCHAND 1953). In Great Britain *R. proceps* is locally common on calcareous soils, where it can become abundant (LE QUESNE 1969, MORRIS 1973, 1990c, COOK 1996). In one case it inhabited a disused railway cutting, where limestone ballast had raised the soil pH, resulting in a flora similar to calcareous grassland (SANDERSON 1992). There are also records from acidic grassland (WALOFF & SOLOMON 1973). *Rhytistylus proceps* was found to be abundant on a heath with chalky sand in Norfolk (LE QUESNE & MORRIS 1971).

Rhytistylus proceps is, on the continent, generally categorized as a psammophilous, xerophilous and heliophilous species and occurs here in sparse and low-growing stands of grasses in sunny, moderately dry to dry sites (MARCHAND 1953, EMMRICH 1966, SCHIEMENZ ET AL. 1996, NICKEL ET AL. 2002, NICKEL 2003). It was among the more dominant species on calcareous grassland in West Germany, possible confined here to patches with open swards (BORNHOLDT & REMANE 1993). The species does not occur at all or only as a vagrant on intensively grazed calcareous grassland in England (MORRIS 1971a). It seems to become rare if sites are grazed for three months a year, although the species can tolerate grazing that takes place in autumn or winter (MORRIS 1973). *Rhytistylus proceps* colonized newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). In Great Britain the species is reported to live near the base of taller grasses (LE QUESNE 1969).

The main host plant seems to be *Festuca ovina* (NICKEL 2003); additional species reported in the literature include fine leaved and tussocky growing grass species like *Corynephorus canescens*, *Nardus stricta* and *Carex arenaria* (KUNTZE 1937, OSSIANNILSSON 1983, REMANE 1987). In England it was found on *Festuca rubra* (especially on acidic sites), *Festuca ovina* and additional fine leaved grasses (WALOFF & SOLOMON 1973, WALOFF 1980, MORRIS 1990b, COOK 1996).

Hibernation takes place in the egg stage. The species is univoltine (REMANE 1958, SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Rhytistylus proceps* has been recorded from 19 sites throughout all investigated regions. However, it is distinctively more frequent in the North Downs and the Chilterns compared with the South Downs and South Wessex Downs. The species has its main distribution on the unimproved chalk grassland (12 sites with positive records), where it occurs in higher densities and a higher frequency than on the other landuse types, although the differences are not statistically significant. *Rhytistylus proceps* inhabits the CG grassland in higher densities (on average a subrecedent species, as a maximum a subdominant species) than the MG grassland (on average only a sporadic species, as a maximum a recedent species). Again the differences are not statistically significant. Within the CG grassland *R. proceps* can be described as a preferential species of the ranker communities (CG3, CG4, CG5) in comparison with the CG2 community. It occurs on the CG3 to CG5 communities in frequency class III (class II on CG2) and is here on average as a recedent species (with a maximum status of a subdominant species on some sites) significantly more abundant than on the CG2 community. Within the CG2 grassland *R. proceps* seems to avoid the richer sub-community CG2c where it is on average only a sporadic species occurring only in the frequency class I. On mesotrophic grassland *R. proceps* was more abundant in the MG1 community than on the MG6 or MG7 grassland. However, the differences are not significant. There are no records from the MG5 community at all. The species seems to prefer medium high swards and to avoid tall vegetation.

The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from its ecology on the continent.

Monitoring Capacity: good indicator species for stage I

Rhopalopyx adumbrata (Sahlberg, 1842) sensu Vilbaste (1962)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 2nd degree monophagous on *Festuca spp.*

Distribution status according to the BRC: local

Distribution in Great Britain: Distributed in England as far north as Yorkshire and Gloucestershire (LE QUESNE

1969).

Dispersal Capacity: good

Ecology: In central Europe *Rhopalopyx adumbrata* inhabits usually lean meadows, pastures, roadside verges, heaths and dry calcareous grasslands (Port 1981, Günthart 1987, Nickel 1997, Nickel 2003). To the east the species is more often reported from wet habitats like damp meadows, fens and bogs (Vilbaste 1962, Vilbaste 1974). At the border of the Baltic sea both dry sandy grassland and hygrophilous vegetation are inhabited (Emmrich 1973). In France, where the species was only recently discovered, it is recorded from humid grassland (Nusillard 2000a). In Britain *R. adumbrata* is found locally on grasses, usually on calcareous dry hillsides but as well in other dry grassland types on acidic soil like dry and damp ruderal places with a considerable amount of bare ground (Le Quesne 1969, Morris 1971a, 1973, Waloff & Solomon 1973, Cook 1996, Eyre et al. 2001).

Rhopalopyx adumbrata is regarded on the continent as a rather eurytopic and slightly hygrophilous species with its habitat conditions ranging from moderately dry to wet on only extensively managed or unused sites (Vilbaste 1962, Emmrich 1966, Hildebrandt 1995, Nickel & Achtziger 1999). It usually lives here in low-growing stands of grasses in oligotrophic, both acidic or basic habitats. In Great Britain it can become dominant on dry calcareous grassland (Morris & Plant 1983, Morris 1990c). According to Remane & Fröhlich (1994) *R. adumbrata* requires similar habitat conditions like its sibling species *R. preyssleri*, but is not as common on dry sites.

The species does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a). It seems to become rare if sites are grazed for three months a year, although it can tolerate grazing in autumn or winter (Morris 1973). *Rhopalopyx adumbrata* is a species of tall grass stands, which can react negatively to cutting (Whittaker 1969, Morris 1981a). However, it may also benefit from early cuts in May compared with cuts later in the year (Morris 1981b). The species has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a).

Host plants mentioned in literature are *Festuca rubra*, *F. ovina* and *Deschampsia flexuosa* (Port 1981, Schiemenz et al. 1996, Nickel 1997). According to Nickel (2003) definite host plant records all refer to *Festuca rubra* and less commonly *F. ovina*. From Britain only *F. rubra* is explicitly named (Cook 1996).

Position within the chalk grassland Auchenorrhyncha communities: With the exception of the Isle of Wight *Rhopalopyx adumbrata* was found in all investigated regions, altogether it was sampled from 11 sites. More than half of the records originate from the South Downs. Abundance and frequency is highest on unimproved chalk grassland with records from eight sites. From the other landuse types it was only recorded from one site each. Due to the low number of sampled individuals the differences are not statistical significant though. *Rhopalopyx adumbrata* is, on CG and on MG grassland, on average a sporadic species, which can become recedent on single sites. However, it has been found from nine sites belonging to CG grassland communities compared with only one site belonging to mesotrophic grassland. This results in a slightly higher frequency on CG grassland (class II compared with class I on MG grassland). Differences between the communities and sub-communities within the CG grassland are not distinct. Within the mesotrophic sites the species was only recorded from one site belonging to the MG6 community, where it was a recedent species. *Rhopalopyx adumbrata* is confined to sites with tall swards. The differences to sites with short and medium high vegetation are highly significant.

In Great Britain *Rhopalopyx adumbrata* seems to be a species confined to tall vegetation, which stands in contrast to observations from the continent describing it as a species from low-growing stands of grasses.

Monitoring Capacity: good indicator species for stage I

Elymana sulphurella (Zetterstedt, 1828)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Elymana sulphurella* is a common species on grasses in England, Wales, Scotland and Ireland (Murray 1935, Whalley 1955, Le Quesne 1969, Woodroffe 1974).

Dispersal Capacity: very good

Ecology: On the continent *Elymana sulphurella* inhabits lean meadows and pastures, dry grassland, peaty meadows, raised mires, abandoned and cultivated fields, clearings, shady patches in dry grassland and heaths, open forests, roadside verges, seashores and moderately saline sites along the coast and inland (Linnavuori 1952, Raatikainen & Ylönen 1989, Schiemenz et al. 1996, Nickel 2003). In Britain *E. sulphurella* is common on grasses, often in drier areas (Whalley 1955, Le Quesne 1969). The species has been found frequently on acidic and basic substrates (Waloff & Solomon 1973, Hollier 1987, Morris 1973, 1981a, Morris & Plant 1983, Cook 1996). Near the coast it was taken from a *Juncus maritimus* area in Wales and also from dunes in Scotland (Whalley 1955, Woodroffe 1974).

Elymana sulphurella is a eurytopic species of sunny or lightly shaded, dry to wet grassy places (MORCOS 1953, EMMRICH 1966, REMANE & WACHMANN 1993, HILDEBRANDT 1995, SCHIEMENZ ET AL. 1996, NICKEL & ACHTZIGER 1999, NICKEL 2003). It inhabits moderately intensively managed to unused sites (NICKEL & ACHTZIGER 1999). In central Europe *E. sulphurella* is often among the dominant species in lean grassland of the submontane belt, but largely restricted to margins along ditches and roadsides in more intensively utilized areas of lower altitudes (NICKEL 2003). In Scandinavia it can be very frequent and abundant in grass leys from where it often migrates into cereal crops (RAATIKAINEN & VASARAINEN 1976). In Great Britain *E. sulphurella* can be among the abundant species on acidic grassland dominated by *Holcus mollis* (WALOFF 1979). The species seems to prefer closed swards of tall grasses and seems to be particularly associated with long coarse grass stands, as observations from both acidic and calcareous grassland have shown (WHITTAKER 1969, MORRIS 1971a, REMANE 1987). The species prefers the upper stratum of the vegetation (NOVOTNÝ 1992). Within a grazing experiment on calcareous grassland, next to ungrazed plots, it was most abundant in autumn and winter grazed plots and increased in number after cessation of grazing (MORRIS 1973, MORRIS & PLANT 1983). *Elymana sulphurella* does not like cutting and seems to be especially sensitive to early mowing (MORRIS 1981a, BORNHOLDT 2002). The species was observed to be an early colonizer in clearings (REMANE & WACHMANN 1993).

Elymana sulphurella is polyphagous on grasses (REMANE & WACHMANN 1993, NICKEL 2003). Host plants named in literature are *Holcus mollis*, *H. lanatus*, *Calamagrostis epigejos*, *C. arundinacea*, *C. varia*, *C. villosa*, *Elymus repens* and *Brachypodium pinnatum* (MORCOS 1953, NOVOTNÝ 1995, NICKEL 2003). In acidic soil *Holcus mollis* seems to be the preferred host plant, which also serves as substrate for egg-laying (MORCOS 1953, THOMPSON 1978). In cages it reproduced on *Phleum pratense* and fed on *Avena sativa* and *Hordeum sp.* (RAATIKAINEN & VASARAINEN 1976, WITSACK 1995). On acidic soil in southern England the species seemed to be associated with *Holcus spp.* (WALOFF 1979, WALOFF & THOMPSON 1980). Here, it could be bred out of tufts of both *H. mollis* and *H. lanatus* but preferred on experimental plots with sown grasses mainly *H. lanatus* (WALOFF & SOLOMON 1973, PRESTIDGE & MCNEILL 1983).

Hibernation takes place in the egg stage and there is one generation in a year (MORCOS 1953, MÜLLER 1957, REMANE 1958, SCHIEMENZ 1969, RAATIKAINEN 1971).

Position within the chalk grassland Auchenorrhyncha communities: Although regarded to be a common and widespread grassland species *Elymana sulphurella* was found only on eight sites within this study. There is no record from the South Wessex Downs. The species could only be found on unimproved and semi-improved chalk grassland which results in a significant difference in abundance compared to improved and semi-improved grassland. Due to its appearance in only small numbers, there are no significant differences between the CG and MG communities. Within the CG grassland *E. sulphurella* seems to be confined to the CG2 grassland where it is only on average a sporadic species becoming recedent on single sites. Within the CG2 communities there are no records from the CG2b sub-community. On mesotrophic grassland *E. sulphurella* can be classified as a preferential species of the MG1 community with significant differences to the other three MG communities. It occurs here in the frequency class IV as a sporadic species becoming on single sites a recedent species. In fact, there are no records from the MG5 and MG7 communities at all. *Elymana sulphurella* was most frequent on sites with tall vegetation and could not be found on sites with short swards at all. However, the differences are due to the low number of sampled individuals still not significant.

The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation on the continent.

Monitoring Capacity: good indicator species for stage I

Cicadula persimilis (Edwards, 1920)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree monophagous on *Dactylis glomerata*

Distribution status according to the BRC: common

Distribution in Great Britain: *Cicadula persimilis* is locally common in England, Wales and Scotland (LE QUESNE 1969). The species has been first described from Gloucestershire (EDWARDS 1920). Paratypes stem from Tintagel, Cornwall (EDWARDS 1920, CHINA 1929).

Dispersal Capacity: good

Ecology: *Cicadula persimilis* is found in central and northern Europe in eutrophic meadows and pastures, abandoned fields, glades, dry slopes, ruderal sites, roadsides and a range of other habitats (KUNTZE 1937, KONTKANEN 1938, VILBASTE 1974, NICKEL 2003). In northern Germany it is a typical species of the 'Arrhenatheretum eliatioris' grassland (MARCHAND 1953). In Britain *C. persimilis* is locally common, often in marshy places, but sometimes in drier grasslands if plant cover is sufficient (LE QUESNE 1969). It has been found both on acidic and basic grassland and has been observed to become dominant on the latter one (WALOFF & SOLOMON 1973, HOLLIER 1987, MORRIS 1973, 1990C).

Cicadula persimilis can generally be described as a mesophilic and eurytopic species of sunny to slightly shady dry to moist grassy places, where landuse can range from unmanaged to moderately intensively managed (REMANE & FRÜND 1983, NICKEL & ACHTZIGER 1999, NICKEL 2003). Due to the preferences of its main host plant *Dactylis glomerata*, the species is confined to relatively nitrogen rich sites and can, therefore, be regarded as an indicator for eutrophic sites (BORNHOLDT & REMANE 1993, HILDEBRANDT 1995, SCHIEMENZ ET AL. 1996). In England *C. persimilis* seems to become rare if sites are grazed for three months a year, although it can tolerate a certain amount of grazing in autumn or winter (MORRIS 1973). It was most abundant in ungrazed plots in one grazing experiment on calcareous soil (MORRIS 1973). Here the species increases in number after cessation of grazing (MORRIS & PLANT 1983). *Cicadula persimilis* is a species of tall grass stands and seems to be particularly associated with long coarse grass species on calcareous grassland in Britain (WHITTAKER 1969, MORRIS 1971a). It has been found on newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a).

According to recent literature *C. persimilis* feeds monophagously on *Dactylis glomerata* (SCHIEMENZ ET AL. 1996, NICKEL 2003). Older host plant records from Britain include *Juncus spp.* (including *J. conglomeratus*), *Carex spp.* and *Holcus spp.* (LE QUESNE 1965a, LE QUESNE 1969, WALOFF & SOLOMON 1973). It could be bred out of tufts of *Dactylis glomerata* and *Holcus sp.* originating from acidic grassland in Berkshire (WALOFF & SOLOMON 1973). Records from rushes and sedges may be the result of a confusion with the very similar (perhaps conspecific) species *C. aurantipes* (Edwards, 1894).

Position within the chalk grassland Auchenorrhyncha communities: *Cicadula persimilis* is a comparatively rare species on chalk in southern Britain. It could only be found on two sites of the Chilterns and North Downs each. The records are from one arable reversion, two improved chalk grassland and one semi-improved chalk grassland site. The low number of collected individuals does not allow further statistical analysis, although it is noteworthy that it has been found on both CG and MG grassland. On CG grassland it was only found within the ranker vegetation of the CG3 to CG5 communities, which suggest a preference for higher vegetation. Within the MG grassland group the only positive records are from MG1 and MG7.

The results support the current knowledge on the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation in other parts of its range.

Monitoring Capacity: none

Mocydia crocea (Herrich-Schäffer, 1837)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Mocydia crocea* has been found in England as far north as Yorkshire, Derbyshire and Staffordshire. In Wales it was recorded from Pembrokeshire. There are as well records from Ireland (LE QUESNE 1969).

Dispersal Capacity: good

Ecology: On the continent *Mocydia crocea* inhabits dry grassland, ruderal sites, roadsides, locally also wet meadows, temporarily dry salt marshes and open, thermophilous forests of oak or pine (NICKEL 2003). In France the species was even reported from *Phragmites* reeds (NUSSILANT 2000b), and it has also been found on heavily drained, xerothermic gypsum in Germany (NICKEL ET AL. 2001). *Mocydia crocea* is a typical species on calcareous grassland both in Great Britain and in Poland, where this habitat can be much drier and is characterized by a much more continental climate compared to similar British habitats (WALOFF 1980, GEBICKI 1987, MORRIS 1973, 1990c, COOK 1996). There are as well records from acidic grassland in England and Scotland, particularly from dry ruderal sites and damp unmanaged grassland (WALOFF & SOLOMON 1973, EYRE ET AL. 2001).

On the continent *Mocydia crocea* was observed to be a thermophilous species, which can be eudominant in semi-dry but not dry calcareous grassland (Mesobrometum) (MÜLLER ET AL. 1978, MÜLLER 1978, SCHIEMENZ ET AL. 1996). Otherwise habitat conditions range in central Europe from dry to moist and the species is restricted to sunny or only moderately shady, unmanaged or only extensively managed sites on both basic and acidic substrates (NICKEL & ACHTZIGER 1999, NICKEL 2003). In Britain *M. crocea* does not like cutting or heavy grazing and prefers tall swards, occurring not at all or only as a vagrant on intensively grazed grassland (MORRIS 1971a, MORRIS 1981a, BROWN ET AL. 1992). It has been found colonising newly sown fields on calcareous soil in the third summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). However, the species is not regarded to be a good flier (WALOFF 1973).

Main host plants are *Brachypodium pinnatum*, *Bromopsis erecta* and *Dactylis glomerata*. Other records stem from *Calamagrostis epigejos*, *Lolium perenne*, *Deschampsia sp.*, *Trisetum flavescens*, *Phleum sp.*, *Elymus repens* and other tall-growing grasses (SCHIEMENZ ET AL. 1996, NICKEL 2003). *Brachypodium sylvaticum* has been named as a host plant as well (SCHIEMENZ ET AL. 1996). However, this may turn out to be not true since this grass species is normally not attacked by leafhoppers due to an endophytic fungus (BREM & LEUCHTMANN 2001). In Britain *M. crocea* is recorded from *Brachypodium pinnatum*, *Bromopsis erecta*, *Dactylis glomerata* and *Lolium perenne* (LE

Quesne 1969, Cook 1996).

Position within the chalk grassland Auchenorrhyncha communities: *Mocydia crocea* is one of the most constant and dominant leafhopper species on chalk grassland in southern England. It was found on altogether 37 sites throughout all investigated regions. The species was found significantly more often and in greater abundances in the North Downs and Chilterns than in the South Downs and South Wessex Downs. The species is most frequent and has its highest densities on unimproved grassland and decreases in frequency and abundances significantly over semi-improved grassland towards improved grassland and arable reversion sites. Its densities are highly significant greater on CG grassland than on MG grassland making it a preferential species of the former community group. On CG grassland it is a constant species (frequency class IV) and on average a subdominant species, which can become eudominant on some sites. In comparison, on MG grassland it occurs only in frequency class II, is here on average a subrecedent species and becomes as a maximum a dominant species. Within the CG grassland group *M. crocea* is highly significant more abundant on the ranker communities (CG3, CG4, CG5), which it inhabits in frequency class V on average as a subdominant species. It can, therefore, be regarded as a preferential species of the CG3 to CG5 grassland group in comparison to the CG2 community where it has been only recorded in the frequency class III, being on average a recedent species. Within the CG2 community the species is most frequent (class IV) and abundant (class 4) in the CG2a sub-community. Although the differences are still not significant from the results of this study, it may turn out in the future to be a valid preferential species of the CG2a sub-community. On mesotrophic grassland *M. crocea* is a distinct preferential species of the MG1 community in comparison with the three other investigated mesotrophic grassland communities. With a frequency class of V and being on average a subdominant species, becoming on some sites even dominant, its densities are here significantly higher than on the other MG communities, where it was only found as a sporadic species on one single site belonging to the MG6 community. *Mocydia crocea* is definitely a species of tall vegetation, occurring on sites with high swards in highly significant greater numbers than on sites with medium high or short vegetation.

The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from its known autecology on the continent.

Monitoring Capacity: good indicator species for stage I

Mocydiopsis attenuata (Germar, 1821)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 2nd degree monophagous on *Festuca spp.*

Distribution status according to the BRC: common

Distribution in Great Britain: *Mocydiopsis attenuata* is found in England as far north as Lancashire and Suffolk (Le Quesne 1969).

Dispersal Capacity: good

Ecology: On the continent *Mocydiopsis attenuata* inhabits mainly margins of pine, oak and beech forests, as well as lean grassland with scattered trees or shrubs, coastal dunes within the ‘Ammophiletum’, relatively dry calcareous slopes and the grassy formations of the ‘Callunetum’ (Remane 1961, Schiemenz et al. 1996, Nickel 2003). It was also mentioned as a littoral species (Gravestein 1953). In Britain *M. attenuata* is locally common on grasses, often on calcareous soils and very typical on downland (Le Quesne 1969, Waloff & Solomon 1973, Morris 1973, 1981a, Cook 1996).

Although some authors regard *Mocydiopsis attenuata* as a xerophilous to mesophilous species of open, dry and warm grassland and pastures (Remane 1987, Schiemenz 1969, Schiemenz et al. 1996), it is probably a moderately sciobiotic species of forest margins, inhabiting moderately shady, damp to moderately dry, both acidic or basic sites (Nickel et al. 2002). In England *M. attenuata* does not occur at all or only as a vagrant on intensively grazed calcareous grassland (Morris 1971a). The species reacts negatively to cutting (Morris 1981a).

Host plants are species of fescue like *Festuca ovina agg.*, *F. rubra* and *F. heterophylla* (Nickel 2003).

Both sexes hibernate (Remane 1961).

Position within the chalk grassland Auchenorrhyncha communities: *Mocydiopsis attenuata* is common within the investigated regions, but with positive records from only three sites not widely distributed in the South Downs. Altogether the species was found on 30 sites. *Mocydiopsis attenuata* is most widespread on unimproved chalk grassland. However, there are no significant differences in abundance between the four compared landuse types. The species is more frequent on CG grassland (class III) compared with MG grassland (class II), making it a preferential species of the former one. However, the average abundance is not significantly different between the two grassland groups. Within the CG grassland *M. attenuata* is much more frequent (class IV) on the ranker vegetation communities (CG3, CG4, CG5) compared with CG2 grassland (class II). There are no major differences in the densities. In both grassland types *M. attenuata* is on average a subrecedent species with a maximum of a subdominant species on single sites. Within the MG grassland *M. attenuata* is a preferential species of the MG1 community. As a constant species (frequency class V) and being on average a recedent species, it is here significantly more abundant and widespread than on MG5, MG6 and MG7. There are no records from the MG6 community at all. *Mocydiopsis attenuata* prefers tall vegetation. It was highly significant more abundant on sites with high swards compared with sites of medium high or short vegetation.

The habitat preference *of M. attenuata* seems to be mostly limited by the height of the vegetation. Subsequently, it does not prefer heavily grazed or intensively managed sites.

Monitoring Capacity: good indicator species for stage II

Athysanus argentarius Metcalf, 1955

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: notable B

Distribution in Great Britain: First reported from Britain in 1866, the species was not found again until 1951. Since then there have been a number of records within England from Suffolk, Kent, Sussex and Hampshire (LE QUESNE 1969). Additionally, it has been recorded from the Isle of Wight (LE QUESNE 1965b). Since the 1960s the species has undergone a dramatic expansion of its range, both inland and in a northerly direction (STEWART 1999, SALMON & CHAPMAN 2000, KIRBY ET AL. 2001).

Dispersal Capacity: good

Ecology: In central Europe the species lives mainly in fens, unimproved, preferably damp meadows, abandoned fields, forest clearings, moderately saline sites, inland or coastal dunes and heaths, but also roadsides and even clover fields (KUNTZE 1937, VILBASTE 1974, NICKEL 2003). It is here a typical species of the 'Molinio-Arrhenatheretea' (MARCHAND 1953). Originally, *Athysanus argentarius* was found in Britain only locally near the coast, often in saltmarshes. Later it expanded its range further inland (SALMON 1959, SALMON & CHAPMAN 2000, KIRBY ET AL. 2001).

Athysanus argentarius is generally regarded to be an eurytopic species tolerating dry to wet conditions and with a slight preference for mesotrophic sites (STRÜBING 1955, SCHIEMENZ 1969, SCHIEMENZ ET AL. 1996, HILDEBRANDT 1995, NICKEL & ACHTZIGER 1999). In central Europe the species inhabits stands of tall grasses in sunny, wet to moderately dry sites, which are only extensively managed or unused (NICKEL & ACHTZIGER 1999, NICKEL 2003). *Athysanus argentarius* prefers stands of tall grasses, especially underneath some scrub (GÜNTHART 1987, SCHIEMENZ ET AL. 1996, NICKEL 2003).

Host plants are various grasses including *Calamagrostis spp.*, *Elymus repens*, *Dactylis glomerata*, *Arrhenatherum elatius*, *Deschampsia cespitosa*, *Festuca arundinacea* and *Holcus spp.* (NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Athysanus argentarius* was sampled relatively seldom within this project. It was recorded from two sites of the Chilterns and North Downs each and from one site on the South Downs. Densities on these sites were low, although the species can become occasionally abundant (own observations from Wytham Woods, Oxfordshire). Due to the low numbers recorded there are no statistical differences between the landuse types. In fact, the records are evenly distributed over all four investigated landuse types. Differences between the vegetation communities are also not significant with *A. argentarius* being only a sporadic species on CG grassland and in this study not occurring on MG grassland at all.

Monitoring Capacity: good indicator species for stage I

Euscelidius variegatus (Kirschbaum, 1868)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: unknown

Distribution status according to the BRC: notable B

Distribution in Great Britain: *Euscelidius variegatus* is in Britain a species of coastal counties. It has been recorded so far from Yorkshire, Norfolk, Suffolk, Kent and Cornwall (LE QUESNE 1969, KIRBY 1992).

Dispersal Capacity: good

Ecology: In central Europe *Euscelidius variegatus* is apparently a species of warm and dry disturbed sites preferring sandy conditions. It has been found in ruderal habitats, abandoned fields, sand and gravel pits, roadsides, vineyards and gardens (SCHIEMENZ ET AL. 1996, NICKEL 2003). In Italy it is a common species of vineyards (KIRBY 1992). In Britain *E. variegatus* seems to be a dry grassland species which may be relatively indifferent to soil type as long as it is well drained (KIRBY 1992). It has been found in England on sand dunes, acid grassland, breckland and chalk downland (KIRBY 1992).

There has been the suggestion that the foodplants are either grasses, clover or other various dicotyledonous herbs, but the host plants are yet still unknown (Kirby 1992, Nickel 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Euscelidius variegatus* has not been found within the project. However, it has been reported from calcareous grassland sites in Britain (Kirby 1992). Since the species prefers ruderal conditions it is most likely to be found on ranker grassland belonging to the NVC communities CG3, CG4 or CG5 or even on arable reversion sites.

Monitoring Capacity: indicator of disturbance

Conosanus obsoletus **(Kirschbaum, 1858)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree oligophagous on Poaceae and Juncaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Conosanus obsoletus* is generally common in England, Wales, Scotland and Ireland (Whalley 1955, Le Quesne 1969).

Dispersal Capacity: good

Ecology: In central Europe *Conosanus obsoletus* is a species usually found in fens, lean meadows and pastures like *Molinia* grassland, *Caltha palustris* meadows and very wet sedge grassland, also in salt marshes, intermediate bogs, mires, forest clearings, ruderal sites, along roadsides, verges of ponds and ditches, only occasionally even on dry meadows (Marchand 1953, Günthart 1987, Schiemenz et al. 1996, Nickel 2003). In Britain *C. obsoletus* is generally common on grasses in damp places (Le Quesne 1969). It has been frequently found on acidic grassland in southern and northern England as well as in Scotland including dry to damp ruderal sites, riversides, upland grass moor and unmanaged damp, dense upland grassland (Waloff & Solomon 1973, Eyre et al. 2001). It was also observed to be common in damp reedy meadows and sand-dunes in Wales (Whalley 1955). Around Teesdale *C. obsoletus* was found on acidic sites but not on limestone (Whittaker 1964). The only records from calcareous soil so far originate from eastern England (Morris & Plant 1983, Morris 1990a).

Conosanus obsoletus is generally regarded to be a hygrophilous species of sunny, damp to very wet sites, which are usually unused or only extensively used (Emmrich 1966, Hildebrandt 1995, Schiemenz et al. 1996, Nickel & Achtziger 1999, Nickel 2003). In Britain *C. obsoletus* increases in number after cessation of grazing (Morris & Plant 1983). It has been found colonising newly sown calcareous grassland in the third summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a).

Host plants are rushes, particularly *Juncus effusus*, *J. filiformis*, *J. inflexus* and *J. gerardii* and tall grasses like *Festuca arundinacea*, perhaps *Elymus repens*, *Arrhenatherum elatius* or others (Novotný 1995, Schiemenz et al. 1996, Nickel 2003). The species seems to rely at least in some places on stands of *Juncus effusus* as a main substrate for egg laying (Wagner & Franz 1961).

Position within the chalk grassland Auchenorrhyncha communities: *Conosanus obsoletus* was found on five sites of the South Downs and four sites of the South Wessex Downs. It has been recorded from all landuse types with highest frequency and abundance on improved grassland. However, the differences are not statistically valid. *Conosanus obsoletus* can be regarded as a preferential species of mesotrophic grassland occurring here in a significantly higher densities being on average a subrecedent species, which can become subdominant on single sites. On the other hand, on CG grassland *C. obsoletus* is only a sporadic species reaching as a maximum on single sites the status of a recedent species. On CG grassland it has not been recorded from the ranker CG3, CG4 and CG5 communities. On mesotrophic grassland *C. obsoletus* can be classified as a preferential species of the MG5, MG6 and MG7 grassland in comparison with the MG1 communities, where it was not recorded at all.

Monitoring Capacity: none

Euscelis incisus **(Kirschbaum, 1858)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree oligophagous on Poaceae and Fabaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Euscelis incisus* is common in England, Wales, Scotland and Ireland (Le Quesne 1969, Eyre et al. 2001).

Dispersal Capacity: good

Ecology: In central Europe *Euscelis incisus* lives mainly in meadows, pastures, dry grassland, abandoned fields, ruderal sites, clover and alfalfa fields, coastal and inland dunes, along roadsides, ditches and also on lawns in gardens and parks (Kuntze 1937, Bornholdt & Tamm 1986, Schiemenz et al. 1996, Nickel 2003). In Britain *E. incisus* is a common species of grassy habitats (Le Quesne 1969). It is frequently found both on calcareous and acidic and preferably rather dry grassland (Waloff & Solomon 1973, Morris 1981b, Hollier 1987, Brown et al. 1992, Cook 1996, Eyre et al. 2001). However, from Wales it was recorded from reed swamps and also in a *Juncus*-rich area (Whalley 1955).

On the continent *E. incisus* is generally a mesophilous species and regarded as an indicator for nutrient rich conditions (Emmrich 1966, Bornholdt & Tamm 1986, Bornholdt & Remane 1993, Hildebrandt 1995, Schiemenz et al. 1996, Walter 1996). Here it is a species of sunny, wet to moderately dry, eutrophic to oligotrophic sites and inhabits, often abundant, fertilized pastures and meadows in sun exposed situations with short vegetation (Nickel 2003). It can be found both on very intensively managed and unused sites (Nickel & Achtziger 1999). *Euscelis incisus* seems to be mainly a species of drier *Arrhenatherum* grassland, is less common in *Molinia* grassland and rare in permanently wet *Caltha palustris* meadows (Marchand 1953). It was found to be eudominant in mesotrophic grassland but not in the semi-dry or dry calcareous grassland in Thuringia, Germany (Müller et al. 1978). In Britain *E. incisus* is typical for early successional stages of ruderal grassland on acidic soil, staying dominant into later successional stages (Waloff & Solomon 1973, Hollier et al. 1994). The species favours short swards and increases with decreasing structural diversity. It therefore benefits from cutting (Morris 1981b, Brown et al. 1992).

Host plants are various species of Fabaceae (mainly *Trifolium spp.*) and grasses. From England *Trisetum flavescens*, *Briza media*, *Helictotrichon pubescens*, *Arrhenatherum elatius* and *Bromopsis erecta* are named. Dicotyledonous plants like strawberries are mentioned as well (Knight 1965, Schiemenz et al. 1996, Nickel 2003). On acidic grassland on experimental plots with sown grasses it fed mainly on *Lolium perenne* and *Festuca pratensis* (Prestidge & McNeill 1983).

Position within the chalk grassland Auchenorrhyncha communities: With records from altogether 81 sites *Euscelis incisus* is one of the most widespread and common leafhoppers on chalk grassland in southern England. It has been recorded from all investigated regions, but is significantly less abundant in the South Downs compared with most other regions (except the Chilterns). *Euscelis incisus* is a common and widespread species within all compared landuse types showing no significant differences. However, there seems to be a tendency to avoid unimproved chalk grassland, where it has its lowest frequency and average abundance. *Euscelis incisus* is a valid preferential species of mesotrophic grassland, where it is on average a subdominant species, becoming occasionally eudominant on some sites and is also a constant species (frequency class V). On the other hand, on CG grassland it is on average only a recedent species, becomes as a maximum dominant and occurs in the frequency class IV. Within the CG grassland it is typically a constant preferential species for the more intensively grazed CG2 community where it is on average subdominant. In comparison, on the ranker chalk grassland communities (CG3, CG4 and CG5) it occurs only in frequency class III and is on average a recedent species. On the level of sub-communities within the CG2 grassland it is a constant species in all three sub-communities. It is however notable, that the densities are significantly higher on the richer CG2c sub-community compared with CG2a. On the mesotrophic grassland *E. incisus* has its main distribution in the MG5 community, where it is on average a dominant species. It can be classified as a preferential species of this community in comparison with the MG1 community where it, although being as well a constant species, has on average only the status of a recedent species. The differences between the other communities of the MG grassland are not significant. *Euscelis incisus* does not show any preference for a particular vegetation height.

The results support the current knowledge about the ecology of the species with one exception. *Euscelis incisus* has been always regarded as a species preferring short swards. This could not be observed in this study. There was an even distribution of density throughout the three compared vegetation height ranges.

Monitoring Capacity: none

Euscelis lineolatus Brulle, 1832 sensu Ribaut, 1952

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 2nd degree oligophagous on Poaceae and Fabaceae

Distribution status according to the BRC: common

Distribution in Great Britain: Locally common, in England as far north as Yorkshire and Gloucestershire; in Wales reported from Caernshire and Glamorgan. The species is also recorded from Ireland and was observed in Dumfriesshire (Murray 1935, Le Quesne 1969).

Dispersal Capacity: good

Ecology: *Euscelis lineolatus* lives in central Europe on eutrophic meadows and pastures, often in diked coastal grassland, also in clover and alfalfa fields (Nickel 2003). In Britain *E. lineolatus* is locally common on grasses (Le Quesne 1969). It has been found both on acidic and calcareous grassland (Waloff & Solomon 1973, Morris

1973, PRESTIDGE 1982, HOLLIER ET AL. 1994).

Habitat conditions range from moderately dry to moderately damp. The inhabited sites in central Europe are usually intensively managed (NICKEL & ACHTZIGER 1999). In Britain *Euscelis lineolatus* can be abundant both in short and tall swards (HOLLIER 1989). The species has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). It was an early colonizer reaching high dominance on acidic grassland in Berkshire (WALOFF & SOLOMON 1973, HOLLIER ET AL. 1994).

Host plants are species of Fabaceae. In England *Euscelis lineolatus* has been reported to live among *Trifolium sp.*, *Medicago sp.* and *Lotus sp.* in western and southwestern Europe and on grasses like *Lolium perenne*, *Holcus sp.*, *Festuca sp.*, *Poa sp.* and *Dactylis glomerata* (KNIGHT 1965, NICKEL 2003). In the laboratory the species could be reared on *Vicia faba* and outcompeted other *Euscelis* species (STRÜBING 1995). On acidic grassland on experimental plots with sown grasses in Berkshire the species mainly fed on *Lolium perenne* (PRESTIDGE & MCNEILL 1983). British records from additional dicotyledonous plants comprise clover and strawberry (KNIGHT 1965).

Position within the chalk grassland Auchenorrhyncha communities: *Euscelis lineolatus* was found during this study on 42 sites distributed over all investigated regions. It was significantly more abundant in the South Downs, where it partly replaces *E. incisus*, than in the other regions. This effect is probably caused by the higher percentage of sampled improved and arable reversion sites within this region. Frequency and average abundance rise steadily from unimproved over semi-improved and improved sites towards arable reversion sites with significant differences between the unimproved chalk grassland and the other landuse types. *Euscelis lineolatus* is a valid preferential species of mesotrophic grassland in comparison with CG grassland. On MG grassland it is a constant species (frequency class IV) and is here on average a recedent species, but able to become eudominant. Average densities are highly significant greater than on CG grassland, where *E. lineolatus* is only a subrecedent species, occasionally reaching the status of a dominant species and only occurring in the frequency class II. Within the CG grassland there are no major differences on community level. Although still not significant, there is an obvious trend of a preference for the richer CG2c sub-community (on average a recedent species) compared with CG2a (only a sporadic species) and CG2b (no records at all). Within the mesotrophic grassland *E. lineolatus* is a preferential species of the MG5 and MG6 communities, but avoids significantly both the ranker MG1 and intensively managed MG7 communities. The species is most abundant on the MG6 grassland, where it reaches on average the status of a subdominant species, becoming eudominant on single sites. *Euscelis lineolatus* is one of the few species significantly preferring short turf in contrast to high vegetation. It is more frequent and abundant on short turf than on medium high vegetation although the differences are not significant.

The preference of short vegetation stands in contrast to observation made by HOLLIER (1989). An occasional occurrence on unimproved grassland may indicate a wider niche in Britain within the centre of the range of this Atlantic species in contrast to its restriction to nutrient rich fields at the edge of its range in western Germany.

Monitoring Capacity: none

Euscelis venosus (Kirschbaum, 1868)

Habitat-specialization in Great Britain: species confined to calcareous grassland

Host specificity: unknown

Distribution status according to the BRC: notable A

Distribution in Great Britain: So far *Euscelis venosus* was found within Britain only in England. There are records from the Chiltern Hills, Aston Rowant, Oxfordshire (1967, 1969); Bradenham, Buckinghamshire (1999); Headley Warren, Surrey (1968) and St Catherine's Hill SSSI, Hampshire (1993) (LE QUESNE 1969, KIRBY 1992, HAWES & STEWART 1997, HOLLIER pers. comment).

Dispersal Capacity: good

Ecology: On the continent the species lives in usually shortly grazed pastures, dry grassland, scrubby unmanaged grassland and occasionally meadows (SCHIEMENZ ET AL. 1996, NICKEL 2003). Here the habitat conditions range from moderately dry to damp, extensively managed or unused oligotrophic sites (NICKEL & ACHTZIGER 1999, NICKEL 2003). In the Alps it inhabits mainly sun-exposed hillsides, in lower altitudes also north facing slopes (SCHIEMENZ ET AL. 1996, NICKEL 2003).

Euscelis venosus has been recorded in Britain up to now only from four sites, always from among tall rank vegetation on chalk (LE QUESNE 1969, KIRBY 1992). It was first taken from scrubby chalk grassland in the Oxfordshire Chilterns (WOODFROFFE 1968). Population densities can be under favourable conditions high, although the precise habitat requirements are obscure (HAWES & STEWART 1997, KIRBY ET AL. 2001).

The host plants are unknown, but are likely to include species of Asteraceae, perhaps *Carlina acaulis* and *C. vulgaris* (NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Euscelis venosus* has not been found within this study. However, it has been reported from calcareous grassland sites in Britain (Kirby 1992). It is therefore probably justified to regard *E. venosus*, although it is rare, as a character species of chalk grassland. Since the species requires apparently ranker vegetation it is most likely to be found on grassland belonging to the NVC class CG3 to CG6.

Monitoring Capacity: good indicator species for stage II, umbrella species

Streptanus aemulans (Kirschbaum, 1868)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: The species seems to be widely distributed in England, Wales, Scotland and Ireland (Le Quesne 1969).

Dispersal Capacity: good

Ecology: In central and northern Europe *Streptanus aemulans* lives mainly in meadows, pastures, forest glades, ruderal sites, roadsides, clover fields, mires, also white and grey dunes near the coast and moderately saline sites (Kuntze 1937, Vilbaste 1974, Schiemenz et al. 1996, Nickel 2003). Within Great Britain *S. aemulans* is recorded from grasses, often in damp places (Le Quesne 1969). The species was frequently found on acidic grassland in northern England and Scotland including dry to damp ruderal sites, riversides, upland grass moor, and unmanaged damp, dense upland grassland (Eyre et al. 2001). It has been recorded from damp meadows near water in Wales and white dunes in North Devon (Whalley 1955, own observations). There are also records from calcareous grassland (Morris 1973, 1981a, Morris & Plant 1983, Cook 1996).

Streptanus aemulans is on the continent generally regarded to be a eurytopic species living in sunny or lightly shady grass stands of moderately dry to damp or even wet, moderately intensively managed to unused sites (Hildebrandt 1995, Nickel & Achtziger 1999, Nickel 2003). It seems to prefer to a certain degree nutrient rich habitats (Bornholdt & Remane 1993, Andrzejewska 1976). *Streptanus aemulans* becomes rare if a site is grazed for at least three months a year, even when grazing takes place in autumn or winter (Morris 1973). It is apparently a species of tall coarse grass stands and does not like cutting (Whittaker 1969, Morris 1971a, 1981a).

Host plants are various grasses, often *Holcus lanatus*, *H. mollis* and *Elymus repens* (Nickel 2003). In coastal dunes the species can be obtained in numbers from pure stands of marram (*Ammophila arenaria*) (Niedringhaus 1991, own observations).

Position within the chalk grassland Auchenorrhyncha communities: *Streptanus aemulans* was found on 19 sites altogether. With the exception of the Isle of Wight the species has been found in all investigated regions. Although there are no significant differences the species seems to be most abundant and frequent on improved grassland. The are no major differences in the appearance of the species between CG and MG grassland, although on average *S. aemulans* is more abundant on mesotrophic grassland. Within the CG grassland are no preferences on community level recognizable. Although *S. aemulans* has its main distribution on the mesotrophic grassland, it still seems to avoid the extreme highly rich sites of the MG6 and MG7 communities, but also the MG1 community. It is most abundant in the MG5 community, where it is on average a recedent species becoming subdominant on single sites. On MG1 and MG6 grassland it is only a sporadic species and on MG7 grassland a subrecedent species. The species significantly prefers higher vegetation compared to short swards.

The results support the current knowledge about the ecology of the species. Its habitat requirements in Britain do not seem to differ from the situation on the continent.

Monitoring Capacity: none

Streptanus sordidus (Zetterstedt, 1828)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Streptanus sordidus* is a common species in England, Wales, Scotland and Ireland (Douglas 1874, Le Quesne 1969).

Dispersal Capacity: good

Ecology: On the continent *Streptanus sordidus* inhabits lean meadows and pastures, fens, mires, intermediate bogs and salt marshes, also open forests, clearings and even boreal forests; occasionally also fertilized grassland

and abandoned arable fields (KUNTZE 1937, RAATIKAINEN & YLÖNEN 1989, SCHIEMENZ ET AL. 1996, NICKEL 2003). It is a typical species of periodically wet *Molinia* grassland, *Caltha palustris* meadows and extremely wet grassland rich in sedges (MARCHAND 1953). In Britain *S. sordidus* is common on grasses (LE QUESNE 1969). The species has been found frequently on acidic dry grassland including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heath, and unmanaged damp, dense upland grassland (DOUGLAS 1874, WALOFF & SOLOMON 1973, HOLLIER 1987, EYRE ET AL. 2001). In Teesdale it was reported from acidic sites but not from limestone (WHITTAKER 1964). However, there are additional records from calcareous grassland (COOK 1996). The species was also common in damp reed swamps in Wales (WHALLEY 1955).

Streptanus sordidus is in central Europe regarded as a hygrophilous species, which inhabits sunny to moderately shady, damp to very wet or temporarily flooded, moderately intensively to unmanaged sites (EMMRICH 1966, HILDEBRANDT 1995, SCHIEMENZ ET AL. 1996, NICKEL & ACHTZIGER 1999, NICKEL 2003). In Germany it showed a higher abundance in *Trisetum flavescens* grassland compared to *Nardus stricta* grassland due to a higher humidity of the former (BORNHOLDT 1996). In Poland the species was associated with disturbance (ANDRZEJEWSKA 1971). It was observed to be an early colonizer on acidic grassland in England (WALOFF & SOLOMON 1973). *Streptanus sordidus* is apparently a good flier, although macropters are rare (WALOFF 1973, 1980). On calcareous grassland in Britain *S. sordidus* seems to be associated with long coarse grass stands (MORRIS 1971a). In addition, WHITTAKER (1969) associates *S. sordidus* with open ground.

Host plants are various grasses, notably *Agrostis stolonifera* and *A. capillaris*, perhaps also *Deschampsia cespitosa* and others (NICKEL 2003). On acidic grassland in Silwood it was successfully bred from *Agrostis capillaris* (WALOFF & SOLOMON 1973). In experimental plots with sown grasses on acidic soil *S. sordidus* fed mainly on *A. capillaris* (PRESTIDGE & MCNEILL 1983).

Position within the chalk grassland Auchenorrhyncha communities: With records from 51 sites, evenly distributed over all investigated regions *Streptanus sordidus* is one of the more common and widespread leafhopper species on chalk grassland. The species has significantly higher densities and shows a higher frequency on improved sites compared with unimproved grassland. It can be classified as a preferential species for mesotrophic grassland, where it is on average a recedent species, occasionally becoming dominant on some sites. In comparison, on CG grassland is its abundance significantly lower (on average a subrecedent species with a maximum status of a subdominant species on some sites). On MG grassland it occurs in the frequency class IV compared with only class III on CG grassland. There are no major differences within the group of CG grassland communities. However, it is significantly more abundant on the richer CG2c sub-community, where it is one of the constant species (frequency class IV) in comparison with CG2a and CG2b. On MG grassland there are no significant differences, but the species seem to have a slight preference for the nutrient rich sites of the MG7 community, where it is one of the constant (frequency class V) species. *Streptanus sordidus* prefers high swards compared with medium high or short vegetation. However, the differences are only significant if all investigated sites are taken into account, and not only the classical unimproved downland.

The results generally support the current knowledge about the ecology of the species. Generally, its habitat requirements in Britain do not seem to differ from other parts of its range. The only remarkable difference seems to be, that *S. sordidus* does not behave like a hygrophilous species in Britain as its frequent appearance on dry chalk grassland shows. *Streptanus sordidus* is probably one of the species that shifts or widens its niche in Britain into chalk grassland due to a climate characterized by higher moisture compared with the conditions in similar habitats on the continent.

Monitoring Capacity: none

***Arocephalus punctum* (Flor, 1861)**

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 2nd degree monophagous on *Festuca spp*. (perhaps 1st degree oligophagous on Poaceae)

Distribution status according to the BRC: common

Distribution in Great Britain: *Arocephalus punctum* is a common species in England and Wales. In Scotland recorded from Inverness-shire and Moray (LE QUESNE 1969).

Dispersal Capacity: good

Ecology: On the continent *Arocephalus punctum* is found in dry sandy meadows, dry grasslands, fens, salty areas, sandfields, dry pine forests with grassy undergrowth and even on rocky slopes (KUNTZE 1937, EMMRICH 1966, VILBASTE, 1974, GÜNTHART 1987, SCHIEMENZ ET AL. 1996, NICKEL 2003). At low altitudes the species favours sandy dry grassland, heaths and forest margins, locally also dry grassland on limestone. In mountainous landscapes it inhabits mainly submontane and montane meadows and pastures (NICKEL 2003). In Britain *A. punctum* is common on fine grasses in dry situations (LE QUESNE 1969). It was abundant on a heath with chalky sand in Norfolk (LE QUESNE & MORRIS 1971). In Dumfriesshire it was reported from a peat-moss (MURRAY 1935). *Arocephalus punctum* has been frequently found on acidic grassland (WALOFF & SOLOMON 1973), but can inhabit also calcareous grassland (MORRIS 1973, 1990c). In Teesdale the species was found both on limestone and acidic sites (WHITTAKER 1964, 1977).

Arocephalus punctum is regarded as a xerophilous and heliophilous species in central Europe, where its habitat conditions range from low-vegetated dry to occasionally wet both acidic or basic sites, which are only extensively managed or unused (Nickel & Achtziger 1999, Nickel et al. 2002, Nickel 2003). It inhabits dry sandy meadows, dry grassland, fens, salty areas, sandfields, dry pine forests with grassy undergrowth and even rocky slopes (Kuntze 1937, Emmrich 1966, Vilbaste, 1974, Günthart 1987, Schiemenz et al. 1996, Nickel 2003). In Britain on calcareous grassland the species reaches its highest abundances in autumn and winter grazed sites and seems to become rare, if sites are grazed for three months a year. On the other hand, it can tolerate grazing which takes place in autumn or winter (Morris 1973). On calcareous grassland it can be among the dominant species (Morris 1973). On acidic sites it was observed to be a colonizer of *Festuca sp.* (Waloff & Solomon 1973).

Arocephalus punctum lives on narrow leaved grasses, which built tussocks, e.g. *Corynephorus canescens*, *Nardus stricta, Festuca ovina* and *F. rubra.* (Sahlberg 1871, Remane & Wachmann 1993, Novotný 1995, Schiemenz et al. 1996, Nickel 2003). On acidic grassland in Berkshire the species fed on *Festuca rubra* (Waloff & Solomon 1973). In the Teesdale area, where *A. punctum* was found both on limestone and acidic sites, it was apparently only common on *Deschampsia* (Whittaker 1964). However, all records from other grasses than *Festuca ovina* and *F. rubra* are in need of revision (Nickel pers. comment).

Hibernation takes place in the egg stage. The species seems to be bivoltine (Remane 1958). However, according to Schiemenz (1969) there is only one generation.

Position within the chalk grassland Auchenorrhyncha communities: *Arocephalus punctum* was only found with two specimens on one unimproved chalk grassland site in the Chilterns. The site belonged to the CG2a sub-community. From the results in this study the species does not seem to be a typical element of the chalk grassland Auchenorrhyncha communities at all. This stands in sharp contrast to previous studies on calcareous grassland where *A. punctum* was found to be a highly dominant species (Morris 1973, 1990c).

Monitoring Capacity: none

Psammotettix cephalotes (Herrich-Schäffer, 1834)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Briza media*

Distribution status according to the BRC: common

Distribution in Great Britain: *Psammotettix cephalotes* is locally common in England, Scotland and Ireland (Le Quesne 1969). However, there may have been sometimes confusions with the similar *P. helvolus* in the past (s. below).

Dispersal Capacity: good

Ecology: On the continent *Psammotettix cephalotes* is largely restricted at lower altitudes to grazed dry grassland on basic soils. At submontane and higher altitudes it is more widespread and common, favouring peaty to moderately dry lean meadows and pastures and also inhabits acidic substrates (Wagner & Franz 1961, Schiemenz et al. 1996, Nickel 2003). According to Müller (1978) it is common in the 'Onobrychido-Brometum'. It has also been recorded from salty areas, fens, margins of woods, more or less damp meadows and very wet grasslands belonging to the 'Molinietum' (Kuntze 1937, Wagner & Franz 1961, Vilbaste 1974, Schiemenz et al. 1996). In Britain *P. cephalotes* is typical for short vegetation in calcareous areas, where it can become dominant (Le Quesne 1969, Waloff & Solomon 1973, Morris 1973, 1990c). However, some of these records may refer to the similar *P. helvolus* (s. below).

Psammotettix cephalotes is regarded as a mainly xerophilous and heliophilous species (Nickel et al. 2002). Habitat conditions can range from oligotrophic and sunny moderately dry to moderately wet, extensively managed or unused sites (Nickel & Achtziger 1999). *Psammotettix cephalotes* is often one of the typical, dominant species on dry, grazed calcareous grassland, but avoids at least on the continent the very dry conditions of the 'Xerobrometum' (Müller et al. 1978, Nickel 1994, Rombach 1999). Apparently the phenology of the species is not much influenced by the type of management (Rombach 1999). In Britain it was more abundant on grazed plots then on ungrazed exclosures on an intensively grazed site in Bedfordshire (Morris 1971a). *Psammotettix cephalotes* prefers grazed swards (Le Quesne 1969, Morris 1973, 1990c). However, it seems to be missing if the sward is extremely shortly grazed (Morris 1990c). It has been found only two month after the creation of newly sown calcareous grassland at a distance of one mile from semi-natural grassland (Morris 1990a).

The species lives monophagously on *Briza media* (Müller 1978, Schiemenz et al. 1996, Nickel 2003). However, older literature refers, probably erroneous, to the species as being polyphagous (in Schiemenz et al. 1996).

Hibernation takes place in the egg-stage (Müller 1957, Schiemenz 1969). In central Europe *P. cephalotes* is bivoltine (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Psammotettix cephalotes* was only found on unimproved chalk grassland sites in the South Wessex Downs (three sites), South Downs (two sites) and North Downs (one site). The species had its main distribution in the CG2a sub-community. Only one specimen was found outside this community on a sites belonging to the *Brachypodium pinnatum-Bromus erectus* grassland (CG5). *Psammotettix cephalotes* can be classified as a differential species of CG grassland in comparison with mesotrophic grassland and a preferential species of CG2 grassland in comparison with the ranker communities belonging to CG3, CG4 and CG5 grassland. Even on sub-community level the complete absence of *P. cephalotes* from the richer sub-community CG2c is significant in contrast to CG2a. *Psammotettix cephalotes* is significantly more abundant on medium high swards compared with short turf or high vegetation which underlines the results of MORRIS (1990c). He observed a preference of grazed swards but an avoidance if grazing pressure becomes to high. The results of this study suggest that *P. cephalotes* might be a species much more confined in Britain to intact chalk grassland than previously thought. It is subsequently much more specialized and occupies a narrower niche than in central Europe towards the centre of its natural range. It has to be mentioned that differences to previous studies in Britain may arise due to a former confusion with *P. helvolus*.

Monitoring Capacity: good indicator species for stage II, umbrella species

Psammotettix confinis Dahlbom, 1850

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Psammotettix confinis* is common and widespread in England, Wales and Ireland. Additionally, there are some records from Scotland (LE QUESNE 1969, WOODROFFE 1974). Southernmost records are from Kent and the Isle of Wight (LE QUESNE 1974a, BADMIN 1981).

Dispersal Capacity: very good

Ecology: On the continent *Psammotettix confinis* has been recorded from a wide range of habitats including pastures, fertilized meadows, ruderal sites, inland and coastal dunes, wet meadows, peaty meadows, dry fields, cultivated or abandoned fields, fens, raised peat bogs, river banks, lake and sea shores, wood margins, woodland clearings and even moderately brackish sites (KUNTZE 1937, KONTKANEN 1938, LINNAVUORI 1952, VILBASTE 1974, RAATIKAINEN & YLÖNEN 1989, SCHIEMENZ ET AL. 1996, NICKEL 2003). For northern Germany *P. confinis* was classified as a species of the ‘Arrhenatheretum elatioris’ (MARCHAND 1953). It is noteworthy that in North America the species seems to be restricted to the cold climate of Alaska and northwest Canada (HAMILTON 1983). In Britain *P. confinis* is common and widely distributed on grasses. Named habitats are ruderal sites, damp meadows, dunes, acidic and calcareous grassland, upland grass moor, heaths and marshland (WHALLEY 1955, LE QUESNE 1969, 1974a, WALOFF & SOLOMON 1973, WOODROFFE 1974, HOLLIER 1987, COOK 1996, EYRE ET AL. 2001). It is also a characteristic species of park grass (MORRIS 1990c).

Psammotettix confinis is generally regarded as a eurytopic species of grassy, sunny, dry to moderately wet, preferentially neutral to acidic sites, which range from only extensively to very intensively managed (EMMRICH 1966, SCHIEMENZ ET AL. 1996, NICKEL & ACHTZIGER 1999, NICKEL 2003). The species often indicates eutrophic conditions (HILDEBRANDT 1995, WALTER 1996). Subsequently it has its main occurrence on managed grassland, where, in central Europe, it can be especially abundant in pastures and fertilized meadows (ROMBACH 1999, NICKEL 2003). Notably, in Poland *P. confinis* was among the dominant species on intensively grazed calcareous grassland (GEBICKI 1987). It is also a characteristic species of dry psammophilous swards in early succession stages (SZWEDO 1998). Equally MARCHAND (1953) describes the species as xerophilous, which is in accordance with the observation that it becomes more and more a stenotopic species of dry grassland towards the northeast of central Europe and the north of Europe (EMMRICH 1969). In England *P. confinis* was found to establish a large population on acidic grassland dominated by *Holcus mollis* (WALOFF 1979).

Although the species favours short swards and increases with decreasing structure, it is missing if a site is extremely shortly grazed (WALOFF & SOLOMON 1973, MORRIS 1990c, BROWN ET AL. 1992). On calcareous grassland in England *P. confinis* was reported not to occur on uncut sites (MORRIS 1981b). It has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (MORRIS 1990a). It was equally reported to be an early colonizer of sown fields and early successional stages of grassland on acidic substrates (WALOFF & SOLOMON 1973, HOLLIER ET AL. 1994). However, *P. confinis* can decline already quite early after colonising on arable reversion sites (MORRIS 1990a).

The species is apparently polyphagous on various grasses, probably *Lolium perenne*, *Poa spp.*, *Festuca spp.*, *Agrostis stolonifera*, *Agrostis capillaris*, *Alopecurus aequalis*, *Coleanthus subtilis* (PRESTIDGE & MCNEILL 1983, COOK 1996, NICKEL 2003). One of the main hosts on acidic sites is *Agrostis capillaris*, from which it was successfully bred (WALOFF & SOLOMON 1973, PRESTIDGE & MCNEILL 1983). Additional records of successful breeding from acidic grassland in England refer to *Festuca rubra* and *Holcus mollis* (WALOFF & SOLOMON 1973). On acidic grassland on experimental plots with sown grasses it fed, after *Agrostis capillaris*, mainly on *Festuca pratensis* (PRESTIDGE & MCNEILL 1983)

The species hibernates in the egg stage (REMANE 1958, SCHIEMENZ 1969). In central Europe it has two generations (SCHIEMENZ 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Psammotettix confinis* was found on 72 sites throughout all investigated regions. The species is significantly less abundant and shows its lowest frequency on unimproved chalk grassland compared with the other three landuse types. *Psammotettix confinis* is a preferential species of mesotrophic grassland compared with the CG grassland. It occurs on the MG grassland as a highly constant species (frequency class V) and is here on average a subdominant species, occasionally becoming dominant. Its densities are significantly higher here than on CG grassland, where it occurs in frequency class IV and is on average a recedent species. It is however notable, that on one site belonging to this grassland group *P. confinis* reached eudominance. On CG grassland *P. confinis* can be classified as a preferential species of the CG2 community, where it has the status of a recedent species and occurs in the frequency class IV, compared with the ranker sites belonging to the CG3, CG4 and CG5 communities. Here it is on average only a subrecedent species, occurring in the frequency class III. On MG grassland *P. confinis* avoids the MG1 community, which is characterized by higher swards. It shows significantly lower densities and a lower frequency here than on the other communities of this grassland group. On MG5, MG6 and MG7 grassland *P. confinis* is a highly constant (class V) and on average subdominant species, on MG6 grassland even a dominant species. *Psammotettix confinis* is one of the few leafhopper species that show a clear preference for short turf compared with medium high or tall vegetation.

The results support the current knowledge on the ecology of the species. Habitat requirements in Britain do not seem to differ from the situation on the continent. However, it is possible that *P. confinis* is more eurytopic on the continent than in Britain, although this is difficult to judge not knowing so much about its habitat preferences outside the communities investigated here.

Monitoring Capacity: none

Psammotettix helvolus (Kirschbaum, 1868)

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: not mentioned so far, but possibly at least local

Distribution in Great Britain: Distribution in Britain not known so far.

Dispersal Capacity: good

Ecology: According to REMANE (1987) there are two morphologically and ecologically distinct forms of *Psammotettix helvolus*. The specimens found during this study probably belong to the form 'helvolus basiphilic' which is macropterous and lives on grasses in dry neutral to basic sites of lower altitudes (NICKEL 2003 *Psammotettix helvolus* inhabits on the continent mainly lean and dry grasslands, pastures, abandoned fields, forest clearings, open forests, roadsides and sometimes intensively managed meadows (NICKEL 2003). The habitat requirements range from dry to moist sites which can be intensively managed or unused, with a main distribution on moderately intensively or only extensively managed sites (NICKEL & ACHTZIGER 1999). *Psammotettix helvolus* can be among the dominant species of dry calcareous grassland in central Europe (SCHIEMENZ 1969, ROMBACH 1999). However, BORNHOLDT & REMANE (1993), who observed the species to be more abundant in improved grassland than adjacent unimproved calcareous grassland, suggest that the species is associated with nutrient rich conditions.

Food plants of *Psammotettix helvolus* form '*basiphilic*' are various grasses (NICKEL 2003).

Position within the chalk grassland Auchenorrhyncha communities: *Psammotettix helvolus* was found on 19 sites throughout all investigated regions, but was most frequently sampled in the South Downs. Only three of the sites with positive records belong to unimproved chalk grassland. It is most abundant and frequent on improved and arable reversion sites. *Psammotettix helvolus* can be classified as a preferential species of MG grassland, where it is on average a recedent species and can even become dominant. It is on MG grassland significantly more abundant than on CG grassland, where it is on average only a sporadic species, becoming as a maximum a recedent species. There are no major differences in the appearance within the CG grassland communities. On the mesotrophic grassland *P. helvolus* seems to avoid the MG1 grassland completely. Its highest frequencies (class III) and abundances (on average a subdominant species with a maximum status of a dominant species on some sites) were found on the MG6 community. No significant preferences for sward height can be recognized. *Psammotettix helvolus* is surprisingly widely distributed on chalk in southern England, considering that is has not been recognized as a species different from *P. confinis* and *P. cephalotes* so far. The results from this study underline the observations from central Europe, which indicate that *P. helvolus* is often a pioneer species of disturbed sites and can be found frequently on intensively managed grassland. On the other hand, it seems to be on the continent also a species of intact unimproved calcareous grassland in contrast to its rather rare appearance in this habitat in Britain.

Monitoring Capacity: none

Adarrus multinotatus **(Boheman, 1847)**

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree monophagous on *Brachypodium pinnatum*

Distribution status according to the BRC: local

Distribution in Great Britain: *Adarrus multinotatus* is widely distributed in England, Wales, Scotland and Ireland (Daltry 1932, Le Quesne 1969).

Dispersal Capacity: good

Ecology: In central Europe *Adarrus multinotatus* inhabits various types of dry grassland like calcareous grassland, steppe habitats, inland dunes, sunny slopes, as well as open forests of pine and oak, occasionally also moist meadows and bogs (Kuntze 1937, Wagner & Franz 1961, Müller 1978, Remane 1987, Nickel 1994, Nickel 2003). In Britain *A. multinotatus* is widely distributed and common on grasses, especially in rather rank herbage on calcareous substrates (Le Quesne 1969, Morris 1973, Brown et al. 1992, Cook 1996).

The species is regarded to be rather ubiquitous in dry to temporarily moist, sunny to moderately shady and mainly basic sites within central Europe (Wagner & Franz 1961, Schiemenz et al. 1996, Nickel 2003). It was among the dominant species on unmanaged limestone grassland in western and central Germany (Bornholdt & Remane 1993, Bornholdt & Tamm 1986). According to Rombach (1999) the preferred habitat is grazed lean and dry grassland, where it and can be regarded as a character species. In Poland *A. multinotatus* was equally a dominant species on intensively grazed calcareous grassland (Gebicki 1987). However, the phenology of the species seems not to be much influenced by the type of management (Rombach 1999).

The only known host plant is *Brachypodium pinnatum* (Schiemenz 1969, Remane & Wachmann 1993, Cook 1996, Nickel 2003).

Hibernation takes place in the egg-stage with two generations in central Europe (Schiemenz 1969).

Position within the chalk grassland Auchenorrhyncha communities: *Adarrus multinotatus* was only found with few specimens on one site of the Chilterns and the Isle of Wight each. One site was classified as unimproved chalk grassland belonging to the CG2a sub-community the other site as semi-improved grassland belonging to the MG6 community. Generally, *A. multinotatus* seems to be restricted to southeastern and central parts of England, mainly due to the distribution of its host plant *Brachypodium pinnatum* (Cook 1996). It is, however, here regarded as a rather widely distributed and common species. The rare appearance during this study is therefore surprising. *Adarrus multinotatus* may turn out to be more specialized than previously thought and, like *Eurysanoides douglasi* and *Ribautodelphax pungens*, should be taken into account when extensive stands of *Brachypodium pinnatum* become an issue during habitat management.

Monitoring Capacity: good indicator species for stage I

Errastunus ocellaris **(Fallén, 1806)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Errastunus ocellaris* is widely distributed and common in England, Wales, Scotland and Ireland (Whalley 1955, Le Quesne 1965a, 1969, Badmin 1981).

Dispersal Capacity: good

Ecology: This species has been reported from managed meadows, pastures, fields, moist and dry grassland, ruderal habitats, forest glades and clearings, inland dunes, sunny slopes, wet meadows, fens and even brackish sites of central Europe (Kuntze 1937, Wagner & Franz 1961, Schiemenz et al. 1996, Nickel 2003). In northern Germany *Errastunus ocellaris* is a species of the ‘Arrhenatherum elatioris’ (Marchand 1953). In Poland it is characteristic for dry psammophilous meadows (Szwedo 1998). In Britain *Errastunus ocellaris* is widely distributed and common on grasses, especially in rather rank herbage (Whalley 1955, Le Quesne 1965a, 1969). Here it is regularly found on acidic dry grassland including dry to damp ruderal sites, upland grass moor, *Calluna* heaths, and unmanaged damp, dense upland grassland (Waloff & Solomon 1973, Hollier 1987, Eyre et al. 2001). There are, however, also records from calcareous grassland, where it is even able to reach the status of a dominant species (Morris 1990c).

Errastunus ocellaris is a eurytopic and mesophilous species (Emmrich 1966, 1969, Schiemenz 1969, Nickel 2003). Habitat conditions can range in central Europe from sunny to slightly shaded stands of grasses, moderately dry to wet and unused to intensively managed sites (Nickel & Achtziger 1999, Nickel 2003). It is typically among the abundant species on nitrogen-rich and intensively managed meadows and pastures and can, therefore, be regarded as an indicator for eutrophic conditions (Andrzejewska 1976, Bornholdt & Tamm 1986, Bornholdt &

Remane 1993, Hildebrandt 1995, Walter 1996, Nickel 2003). In Germany it was more abundant on nutrient rich *Trisetum flavescens* grassland compared to leaner *Nardus stricta* grassland (Bornholdt 1996). A positive relationship between the amount of available nitrogen and abundance of *E. ocellaris* was again documented for *Trisetum* grassland (Bornholdt 2002). Mulching of this type of grassland led to even higher densities due to lack of nutrient drainage (Bornholdt 1996). In northern Germany the species can equally be dominant in damp *Molinia* grassland (Marchand 1953). In Britain *E. ocellaris* can be among the most abundant species on acidic grassland dominated by *Holcus mollis* (Waloff 1979, Waloff & Thompson 1980). On calcareous soil in England it was observed as one of the few leafhoppers which reacted positive to cutting (Morris 1981). It has been found colonising newly sown calcareous grassland in the second summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a). It was also a colonizer in early successional stages of acidic grassland (Hollier et al. 1994).

Host plants are various, usually taller growing grasses like *Holcus spp.*, *Calamagrostis spp.*, *Elymus repens* and *Dactylis glomerata* (Waloff 1979, Waloff & Thompson 1980, Remane 1987, Nickel 2003). Preferred host plants on acidic sites are *Holcus spp.* (Waloff & Solomon 1973, Waloff & Thompson 1980). On acidic grassland on experimental plots with sown grasses in Berkshire it was found almost exclusively on *Holcus lanatus* (Prestidge & McNeill 1983). *Holcus* is also the preferred substrate for egg-laying on acidic grassland (Thompson 1978).

Position within the chalk grassland Auchenorrhyncha communities: *Errastunus ocellaris* was only found on two sites of the Chilterns and North Downs each. Three of the sites were arable reversions and one was classified as semi-improved chalk grassland. Although the species was found in comparatively low numbers the differences in dominance between arable reversion sites and unimproved chalk grassland are significant. The species was exclusively sampled from mesotrophic grassland and here only from the MG1 community. However, numbers of individuals were to low to classify *E. ocellaris* as a preferential or even differential species of this community. The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from its known autecology on the continent.

Monitoring Capacity: indicator for disturbance

Turrutus socialis (Flor, 1861)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: The species is widely distributed in England. In Scotland *Turrutus socialis* has been recorded from Perthshire and Rhum. In Ireland it has been found in Clare and County Dublin (Le Quesne 1969, Payne 1979).

Dispersal Capacity: good

Ecology: On the continent *Turrutus socialis* lives mainly in dry grassland, meadows, pastures, calcareous grassland, submontane meadows, ruderal sites, roadsides, inland dunes, coastal dunes, sandy fields, sunny slopes, heaths, woods, glades, swampy meadows, mires and fens (Kuntze 1937, Wagner & Franz 1961, Schiemenz et al. 1996, Nickel 2003). According to Schiemenz (1969) it is a characteristic species of the submediterranean dry meadows. In Britain habitats with records of *T. socialis* are different types of grasslands, usually on calcareous soils, were it can become the most abundant species (Le Quesne 1969, Morris 1973, 1990a,c, Cook 1996). The species was also abundant on a heath with chalky sand in Norfolk (Le Quesne & Morris 1971).

On the continent *Turrutus socialis* is regarded to be a eurytopic but slightly xerophilous and heliophilous species (Remane & Wachmann 1993, Schiemenz 1969, Nickel et al. 2002). It inhabits sunny and oligotrophic, moderately dry to moderately wet, extensively managed to unmanaged, basic to acidic sites (Nickel & Achtziger 1999). *Turrutus socialis* was eudominant in the semi-dry but not dry calcareous grassland of Thuringia, Germany (Müller et al. 1978). On the other hand, the species was found in Germany even on heavily drained and xerothermic gypsum sites (Nickel et al. 2001). Equally *T. socialis* is an abundant and dominant species on intensively grazed calcareous grassland in Poland, which is much dryer and characterized by a much more continental climate compared to the average conditions in Britain and central Europe (Gebicki 1987). From Western Germany it is reported to have its main occurrence in mown dry grassland compared with grazed sites (Rombach 1999). However, the phenology of the population seems not to be much influenced by type of management (Rombach 1999). According to Remane (1987) both basic and acidic substrates are inhabited. For example, *T. socialis* occurs often in high abundance on acidic *Nardus stricta* grassland and in inland and coastal dunes (Remane & Wachmann 1993). It seems to avoid fertilized meadows adjacent to lean calcareous dry grassland (Bornholdt & Remane 1993). On the other hand, the species has been observed to colonize mesotrophic grassland from nearby dry calcareous grassland, where it was a dominant species (Bornholdt & Tamm 1986). In Britain *T. socialis* is a good indicator for established chalk grassland (Morris 1990c). The species is here apparently missing on acidic sites (Waloff & Solomon 1973). *Turrutus socialis* has been found colonising newly sown calcareous grassland in Britain in the second summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a). According to Gyorffy & Karsai (1991) *T. socialis* is a polyphagous species, which is adapted to respond to changing habitat conditions - in areas where it inhabits a mosaic of suitable habitats - with migration and rearrangements of the population on a landscape scale.

Turrutus socialis is polyphagous on grasses (Györffy & Karsai 1991, Cook 1996, Nickel 2003). Named food plants are *Festuca rubra*, *Bromopsis erecta*, *Nardus stricta*, *Helictotrichon pubescens* and *Brachypodium pinnatum* (Cook 1996, Nickel 2003). In the laboratory it fed on *Poa annua* (Witsack 1985).

Hibernation takes place in the egg-stage, with two generations in a year (Schiemenz 1969). Macropters are rare (Waloff 1980).

Position within the chalk grassland Auchenorrhyncha communities: *Turrutus socialis* was sampled throughout all investigated regions, on 54 sites altogether. Although found in at least low numbers and frequency on all compared landuse types, the species shows a significant preference for unimproved chalk grassland, where it was recorded from more than 80 % of all sites. On CG grassland *T. socialis* is a highly constant species (frequency class V), being here on average a subdominant species, which can become eudominant. It is here highly significantly more abundant than on MG grassland, where it only occurs in the frequency class II and is on average only a sporadic species. *Turrutus socialis* can, therefore, be classified as a valid character species for CG grassland. Within the CG grassland communities and sub-communities there are no preferences for any of the compared communities recognizable. On MG grassland *T. socialis* is most common within the MG5 community. Although the average dominance as a subrecedent species is relatively low, it reaches here frequency class IV. *Turrutus socialis* can be regarded as a preferential species of this community in comparison with the other communities of this grassland group. There is no distinct preference for a certain vegetation height recognizable.

In general, the results support the current knowledge about the ecology of this species. However, it seems that *T. socialis* is more specialized in Britain with a much stronger avoidance of improved grassland. Despite being a polyphagous grassfeeder, it does not easily colonize arable reversion sites. Considering that due to its common distribution on chalk grassland there is usually a sufficient recruitment pool to colonize new sites, this effect becomes even more obvious. *Turrutus socialis* is probably a good indicator to measure the success of chalk grassland restoration.

Monitoring Capacity: good indicator species for stage II

***Jassargus pseudocellaris* (Flor, 1861)**

Habitat-specialization in Great Britain: eurytopic grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Jassargus pseudocellaris* is common and widespread across England, Wales, Scotland and Ireland (Whalley 1955, Le Quesne 1969, Payne 1979, Eyre et al. 2001).

Dispersal Capacity: good

Ecology: In central Europe *Jassargus pseudocellaris* inhabits mainly lean, dry and damp meadows and pastures, heaths, abandoned fields, inland and coastal dunes, ruderal sites, sandy river banks, pine forests, forest margins, clearings, occasionally also salt-rich habitats (Kuntze 1937, Wagner & Franz 1961, Vilbaste 1974, Schiemenz et al. 1996, Nickel 2003). In Britain *J. pseudocellaris* is found in low growing stands of grass (Le Quesne 1969). It sometimes is reported from limestone (even as a dominant species), but more often from acidic grassland and heaths (Edwards 1920, Whalley 1955, Waloff & Solomon 1973, Whittaker 1977, Hollier 1987, Eyre et al. 2001). According to Waloff (1980) *J. pseudocellaris* is largely replaced on calcareous grassland in England by *Turrutus socialis*, but not on the calcareous grassland of the Burren in Ireland.

Jassargus pseudocellaris is a eurytopic species (Emmrich 1966, Hildebrandt 1995, Schiemenz et al. 1996). It prefers usually oligotrophic, more or less acidic, moderately dry to moist sites, which are only moderately intensively to extensively managed or unused (Schiemenz 1969, Nickel & Achtziger 1999, Nickel 2003). The species has been found colonising newly sown calcareous grassland in the third summer after sowing at a distance of one mile from semi-natural grassland (Morris 1990a). It was as well an early colonizer on acidic grassland (Waloff & Solomon 1973).

Host plants are grasses. It has been recorded mainly from *Agrostis capillaris* and *Festuca rubra*, other species are *Nardus stricta*, *Deschampsia sp.* and *Holcus mollis* (Schulz 1976, Nickel 2003). On acidic grassland in England the species fed on *Agrostis capillaris*, from which it was successfully bred and additionally on *Festuca rubra* and *Holcus mollis* (Waloff & Solomon 1973). On an acidic site in Teesdale *Jassargus pseudocellaris* was common on *Nardus stricta* (Whittaker 1964). According to Remane (1987) *J. pseudocellaris* feeds mainly on short growing grasses.

Position within the chalk grassland Auchenorrhyncha communities: *Jassargus pseudocellaris* was only found on one unimproved chalk grassland site in the Chilterns belonging to the CG2a sub-community. It was here a subrecedent species. Although it has been reported to be dominant species on limestone (Whittaker 1977), the results in this study support observations that *J. pseudocellaris* is probably much more typical of acidic grassland. It should, therefore, not be regarded as a typical part of the Auchenorrhyncha fauna on chalk in southern England.

Monitoring Capacity: none

Verdanus abdominalis (Fabricius, 1803)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: *Verdanus abdominalis* is widely distributed and often common in England, Wales and Scotland (Le Quesne 1969).

Dispersal Capacity: good

Ecology: In central Europe *Verdanus abdominalis* has been reported from lean meadows, particularly moist and peaty ones, mountain meadows, pastures, cultivated fields, coastal dunes, glades, clearings and the drier grassy patches of seashores (Kuntze 1937, Linnavuori 1952, Schiemenz et al. 1996, Nickel 2003). In Scandinavia it was typical for arable reversion sites developing into *Phleum pratense* dominated grassland (Huusela-Veistola & Vasarainen 2000). In Britain *V. abdominalis* is found on grasses, often among ranker vegetation (Le Quesne 1969). It is frequently found on acidic grassland throughout the country but has been recorded from calcareous grassland as well (Waloff & Solomon 1973, Prestidge 1982, Cook 1996, Eyre et al. 2001).

On the continent *Verdanus abdominalis* is a eurytopic, mesophilous to hygrophilous species (Emmrich 1966, Schiemenz 1969, Hildebrandt 1995). Habitat conditions can range here from moderately dry to wet on moderately intensively to extensively managed or even unused sites (Nickel & Achtziger 1999). In central Europe the species has its main distribution in mountainous areas occurring only locally on lowland sites (Remane & Wachmann 1993, Schiemenz et al. 1996). It can be among the more dominant species on calcareous grassland in western Germany (Bornholdt & Remane 1993). Additionally, *V. abdominalis* has been found to be a typical species of mesophilous grassland becoming eudominant on acidic *Trisetum flavescens* grassland in Germany (Bornholdt & Tamm 1986, Bornholdt 1996). On this type of grassland it reacts sensitively to early mowing (Bornholdt 2002). This explains an observed preference for ranker vegetation of unmanaged calcareous grassland in comparison with grazed sites (Bornholdt & Remane 1993). The species was significantly more abundant in tussocks and hummocks compared with even swards (Dennis et al. 1998).

Verdanus abdominalis is polyphagous on grasses (Raatikainen & Vasarainen 1976, Cook 1996, Schiemenz et al. 1996). In England at least on acidic sites there seems to be a preference for *Holcus* especially *H. lanatus*, which serves also as a substrate for oviposition (Waloff & Solomon 1973, Thompson 1978, Waloff & Thompson 1980, Cook 1996). Other host plants are *Festuca rubra*, *Agrostis capillaris*, *Deschampsia flexuosa* (Nickel 2003). In Chechia the species is also reported from *Deschampsia flexuosa* (Novotný 1995).

Verdanus abdominalis hibernates in the egg-stage (Müller 1957, Schiemenz 1969). The species is univoltine (Schiemenz 1969, Remane & Wachmann 1993).

Position within the chalk grassland Auchenorrhyncha communities: Despite being found on calcareous grassland in other parts of Britain sometimes even as a very abundant species, *Verdanus abdominalis* was not found during this study at all. It may be possible that the species does not find suitable climatic conditions in southern England on chalk. It therefore differs in its habitat requirements from other parts of its range especially central Europe and the midlands of England.

Monitoring Capacity: good indicator species for stage I

Arthaldeus striifrons (Kirschbaum, 1868)

Habitat-specialization in Great Britain: species mainly on calcareous grassland

Host specificity: 2nd degree monophagous on *Festuca spp.*

Distribution status according to the BRC: local

Distribution in Great Britain: *Arthaldeus striifrons* is locally found in England as far north as Leicestershire, Huntingdonshire and Cambridgeshire (Le Quesne 1965a, 1969).

Dispersal Capacity: good

Ecology: Main habitats of *Arthaldeus striifrons* in central Europe are meadows and pastures, but also abandoned fields and ruderal sites (Ossiannilsson 1983, Schiemenz et al. 1996, Nickel 2003). Other habitats with positive records are stands of *Trifolium spp.*, especially *T. repens*, *Juncus*-rich meadows belonging to the

'Arrhenatheretum' and dry meadows (LINDBERG 1947, SCHWOERBEL 1957, LINNAVUORI 1952, SCHIEMENZ ET AL. 1996). However, at least part of these records refer probably to a second species *Arthaldeus arenarius* (REMANE 1960). In central France the species apparently avoids drier habitats and is reported from humid grassland (NUSSILANT 2000b). In Britain *A. striifrons* is found locally on grasses, often in damper places, but also on calcareous hillsides (LE QUESNE 1969, MORRIS & PLANT 1983). The species was recorded from Huntingdonshire on grasses in a marshy area (LE QUESNE 1965a).

On the continent *A. striifrons* is a hygrophilous and moderately halophilous species (EMMRICH 1966, HILDEBRANDT 1995, NICKEL ET AL. 2002). On the continent *Arthaldeus striifrons* is locally fairly common along the coasts of the North and Baltic Sea, where it is usually found in sunny moderately saline sites. The species is here rather localized inland and lives on moderately saline or compacted substrates (NICKEL 2003). Otherwise, habitat conditions range from moderately dry to moderately or temporarily wet on moderately intensively to unused sites (NICKEL & ACHTZIGER 1999). In England it increases in number after cessation of grazing on calcareous soil (MORRIS & PLANT 1983).

The species feeds on *Festuca arundinacea*, probably also on *F. pratensis* and *F. rubra* (NICKEL & REMANE 2002, NICKEL 2003). Records from *Lolium perenne* (SCHIEMENZ ET AL. 1996) have to be treated with caution.

Arthaldeus striifrons is probably univoltine (REMANE 1960).

Position within the chalk grassland Auchenorrhyncha communities: *Arthaldeus striifrons* was found on three sites in the North Downs, seven sites in the South Downs and one site on the Isle of Wight. Although the species usually occurs in low numbers, which make statistical analysis difficult, there is a clear preference for unimproved grassland (nine sites). *Arthaldeus striifrons* is on average only a sporadic species on CG but can become subdominant. Occurring in frequency class II it is more widespread in this grassland type than MG grassland, where it never reaches a higher status than that of a subrecedent species and occurs only in frequency class I. On CG grassland *A. striifrons* is more typical of ranker sites belonging to the CG3, CG4 or CG5 communities. It occurs here in frequency class III and is on average a subrecedent species. Within the MG grassland there seems to be a slight preference of the MG1 grassland in comparison with the other communities of this group. *Arthaldeus striifrons* prefers higher swards compared with medium high or short vegetation.

Although MORRIS & PLANT (1983) reported already an increase in abundance after cessation of grazing, this study shows for the first time a significant positive relationship of the abundance of *A. striifrons* with vegetation height. In contrast to the habitat requirements on the continent, where the species is regarded to be hygrophilous, it seems to be fairly widespread on dry calcareous grassland in southern England. It may be able to widen or shift its niche into this grassland type due to a higher average humidity or rainfall compared with the conditions on equivalent habitats in central Europe.

Monitoring Capacity: good indicator species for stage I

Arthaldeus pascuellus (Fallén, 1826)

Habitat-specialization in Great Britain: dry grassland species

Host specificity: 1st degree oligophagous on Poaceae

Distribution status according to the BRC: common

Distribution in Great Britain: In Britain *Arthaldeus pascuellus* is widely distributed and common in England, Wales, Scotland and Ireland (WHALLEY 1955, LE QUESNE 1965a, 1969, 1974).

Dispersal Capacity: very good

Ecology: In central and northern Europe *Arthaldeus pascuellus* inhabits mesophilous meadows and pastures, also peaty grassland, wetlands, fens, tall-sedge bogs, abandoned fields, cultivated fields, ruderal sites, clearings, roadsides, salty areas, bogs, glades, woods and moderately saline marshes inland and near the coast (KUNTZE 1937, REMANE 1960, GÜNTHART 1987, RAATIKAINEN & YLÖNEN 1989, NICKEL 2003). It was also found in the '*Juncus gerardii-Festuca*' zone and drier meadow area of seashores (LINNAVUORI 1952, SCHAEFER 1973). In central France the species seems to avoid drier habitats and is abundant in humid grassland (NUSSILANT 2000b). In Britain *A. pascuellus* is widely distributed and common on grasses, especially in drier situations (LE QUESNE 1969). It is frequently found both on acidic and calcareous grassland including dry to damp ruderal sites, riversides, upland grass moor, *Calluna* heaths, and unmanaged damp, dense upland grassland (MORRIS 1973, 1982, WALOFF 1979, HOLLIER 1987, BROWN ET AL. 1992, COOK 1996, EYRE ET AL. 2001). Other records are from damp meadows, dry salix repens-heath and saltmarshes (WHALLEY 1955, LE QUESNE 1974a). It can be also a dominant species of flood meadows (MORRIS 1990c).

Arthaldeus pascuellus is a very eurytopic species often indicating eutrophic conditions (STRÜBING 1955, REMANE 1960, EMMRICH 1966, HILDEBRANDT 1995, WALTER 1996). Habitat conditions in central Europe range from damp to very wet on very intensively to unused sites (NICKEL & ACHTZIGER 1999). Its main distribution lies here within the mesotrophic, damp and nitrogen-rich grassland (REMANE 1960, SCHIEMENZ 1969, REMANE & WACHMANN 1993). In Scandinavia it is most numerous on grass leys, pastures and moist meadows on wasteland (RAATIKAINEN & VASARAINEN 1976). In Poland it has been observed as a dominant species in the 'Caricetum caespitosae' and the

‘Peucedano-caricetum paradoxae’ (Andrzejewska 1991). It is here also typical for drained, ploughed and sown grassland with a mixture of meadow grasses and for disturbed areas (Andrzejewska 1971, 1991). In Britain *A. pascuellus* can occasionally become the most dominant species on calcareous grassland (Morris 1990c). Although *Arthaldeus pascuellus* did not occur at all or only as a vagrant on intensively grazed calcareous grassland, it reacted rather indifferent to grazing intensity during a second experiment on limestone, both experiments located in England (Morris 1971a, Brown et al. 1992). Here it was also more abundant on arable reversion sites and rich Arrhenatheretum grassland on basic substrates than on old established calcareous grassland (Morris 1990c). Next to ungrazed plots densities were highest in autumn and winter grazed plots (Morris 1973). *Arthaldeus pascuellus* is a species of tall grass stands (Whittaker 1969, Morris 1982, Hollier 1989). It has been found colonising within the first summer after sowing on calcareous soil at a distance of one mile from semi-natural grassland (Morris 1990a). Equally, on acidic grassland in Berkshire it was an early colonizer of sown fields (Waloff & Solomon 1973).

Arthaldeus pascuellus feeds polyphagously on grasses (Prestidge & McNeill 1983, Cook 1996). Named host plants are *Festuca sp.*, *Lolium perenne*, *Poa sp.*, *Calamagrostis villosa*, *Calamagrostis sp.*, *Nardus stricta* and *Agrostis stolonifera* (Novotný 1995, Cook 1996, Nickel 2003). On acidic grassland in England it was successfully bred from *Agrostis capillaris*, *Festuca rubra* and *Holcus mollis* (Waloff & Solomon 1973). On experimental plots with sown grasses on acidic soil *A. pascuellus* fed mainly on *Lolium perenne* and *Festuca pratensis* (Prestidge & McNeill 1983). In the laboratory the species fed also on *Hordeum sp.* (Witsack 1985).

Arthaldeus pascuellus hibernates in egg-stage and is bivoltine in central Europe (Müller 1957, Remane 1958, Schiemenz 1969, Remane & Wachmann 1993).

Position within the chalk grassland Auchenorrhyncha communities: With records from 63 sites from all investigated regions, *Arthaldeus pascuellus* is another widespread and common leafhopper of chalk grassland in southern England. On a gradient from unimproved over semi-improved and improved grassland towards arable reversion sites *A. pascuellus* becomes increasingly more frequent and abundant. On arable reversion sites the average densities are actually more than 12 times higher than on unimproved sites. *Arthaldeus pascuellus* is a valid preferential species of MG grassland, being here significantly more abundant compared with CG grassland. On MG grassland it is a constant (frequency class V), on average subdominant species, becoming occasionally eudominant. In contrast, on CG grassland *A. pascuellus* occurs only in frequency class IV, is on average only a subrecedent species and can reach as a maximum the status of a subdominant species. Within the CG grassland *A. pascuellus* is more common and widespread in the CG2 community than in the ranker vegetation of the CG3, CG4 and G5 communities. Besides a trend showing a preference for the richer CG2c sub-community, there are no major differences within the CG2 grassland. On mesotrophic grassland there is a slight but not significant increase in abundance from the MG1 and MG5 communities towards the intensively used nitrogen-rich MG7 leys recognizable. Frequency and abundance increases sharply from short over medium towards tall vegetation.

The results support the current knowledge about the ecology of the species. Habitat requirements in Britain do not seem to differ from other parts of its range.

Monitoring Capacity: none

7 Summary / Zusammenfassung

Summary

Due to their confinement to specific host plants or restricted habitat types, Auchenorrhyncha are suitable biological indicators to measure the quality of chalk grassland under different management practices for nature conservation. They can especially be used as a tool to assess the success of restoring chalk grassland on ex-arable land. One objective of this study was to identify the factors which most effectively conserve and enhance biological diversity of existing chalk grasslands or allow the creation of new areas of such species-rich grassland on ex-arable land. A second objective was to link Auchenorrhyncha communities to the different grassland communities occurring on chalk according to the NVC (National Vegetation Classification). Altogether 100 chalk grassland and arable reversion sites were sampled between 1998 and 2002. Some of the arable reversion sites had been under certain grazing or mowing regimes for up to ten years by 2002. Vegetation structure and composition were recorded, and Auchenorrhyncha were sampled three times during the summer of each year using a 'vortis' suction sampler.

Altogether 110 leafhopper species were recorded during the study. Two of the species, *Kelisia occirrega* and *Psammotettix helvolus*, although widespread within the area studied, had not previously been recognized as part of the British fauna. By displaying insect frequency and dominance as it is commonly done for vegetation communities, it was possible to classify preferential and differential species of distinct Auchenorrhyncha communities. The linking of the entomological data with vegetation communities defined by the NVC showed that different vegetation communities were reflected by distinct Auchenorrhyncha communities. Significant differences were observed down to the level of sub-communities.

The data revealed a strong positive relationship between the diversity of leafhoppers species and the vegetation height. There was also a positive correlation between the species richness of Auchenorrhyncha and the diversity of plant species. In that context it is remarkable that there was no correlation between vegetation height and botanical diversity.

There is a substantial decrease in Auchenorrhyncha species richness from unimproved grassland to improved grassland and arable reversion. The decline of typical chalk grassland and general dry grassland species is especially notable. Consequently, the number of stenotopic Auchenorrhyncha species which are confined to only a few habitat types, are drastically reduced with the improvement of chalk grassland. Improved grassland and arable reversion fields are almost exclusively inhabited by common habitat generalists. The decrease in typical chalk grassland plants due to improvement is mirrored in the decline of Auchenorrhyncha species, which rely monophagously or oligophagously on specific host plants. But even where suitable host plants re-colonize arable reversion sites quickly, there is a considerable delay before leafhoppers follow. That becomes especially obvious with polyphagous leafhoppers like *Turrutus socialis* or *Mocydia crocea*, which occur on improved grassland or arable reversion sites only in low frequency and abundance, despite wide appearance or even increased dominance of their host plants. These species can be considered as the most suitable indicators to measure success or failure of long term grassland restoration. A time period of ten years is not sufficient to restore species-rich invertebrate communities on grassland, even if the flora indicates an early success.

Zusammenfassung

Aufgrund ihrer Bindung an bestimmte Wirtspflanzen oder Biotoptypen stellen Auchenorrhyncha eine sehr gut geeignete Indikatorgruppe dar, um die Habitatqualitität von Kalkmagerrasen zu bewerten, die unterschiedlichen Pflegekonzepten für den Naturschutz unterliegen. Zikaden können insbesondere als Instrument zur Effizienzkontrolle von Renaturierungsmaßnahmen auf Kalkmagerrasen und wiederbegrünten Flächen herangezogen werden. Ein Ziel dieser Arbeit war es, Faktoren herauszuarbeiten, die möglichst effektiv die biologische Vielfalt bestehender Kalkmagerrasen erhalten oder fördern können, oder die eine Neuschaffung artenreichen Grünlandes auf ehemaligen ackerbaulich genutzten Flächen erlauben. Eine weitere Aufgabe war, den Zusammenhang zwischen Auchenorrhynchazönosen und verschiedenen Grünlandgesellschaften auf Kalk entsprechend der Klassifizierung von britischen Pflanzengesellschaften (NVC) darzustellen. Insgesamt 100 Kalkmagerrasen und neugeschaffene Grünlandflächen auf ehemaligen Ackerstandorten wurden zwischen 1998 und 2002 besammelt. Ein Teil der wiederbegrünten Flächen unterlag 2002 bereits bis zu zehn Jahren bestimmten Beweidungs- oder Mahdkonzepten. Dreimal pro Untersuchungsjahr wurden aktuelle Daten zur Vegetation erfaßt und die Auchenorrhyncha mittels eines ‘Vortis’-saugapparates gesammelt.

Insgesamt 110 Zikadenarten konnten im Rahmen des Projektes nachgewiesen werden. Zwei Arten, *Kelisia occirrega* und *Psammotettix helvolus*, wurden erstmals für Großbritannien festgestellt, trotzdem sie innerhalb des Untersuchungsraums weitverbreitet sind. Durch die Präsentation einer Insektengruppe in der gleichen Weise wie üblicherweise Pflanzengesellschaften unter der Verwendung von Frequenz- und Dominanzwerten dargestellt werden, war es möglich, Charakter- und Differentialarten für abgegrenzte Zikadenzönosen herauszuarbeiten. Die Verbindung von entomologischen Daten mit Vegetationsformationen, definiert nach dem britischen System der dort vorkommenden Pflanzengesellschaften (National Vegetation Classification; NVC), zeigte, dass die verschiedenen Vegetationseinheiten entsprechend unterschiedliche Auchenorrhynchazönosen aufweisen. Signifikante Unterschiede zwischen den einzelnen Zikadengemeinschaften konnten bis auf die Ebene von Assoziationen herunter beobachtet werden.

Aufgrund der gesammelten Daten konnte eine deutliche positive Korrelation zwischen der Artenvielfalt von Zikaden und der Vegetationshöhe festgestellt werden. Die Beziehung zwischen Artenreichtum der Auchenorrhyncha und Vielfalt an Pflanzenarten ist ebenfalls deutlich positiv korreliert. Es sei hier zu erwähnen, daß hingegen keine Korrelation zwischen Vegetationshöhe und botanischer Artenvielfalt festzustellen war.

Der Artenreichtum von Zikaden nimmt von traditionell genutzten Rasen zu melioriertem Grünland und neugeschaffenen Grünlandflächen deutlich ab. Diese Abnahme betrifft vor allem typische Kalkmagerrasenarten und Arten trockenen Grünlandes. Damit wird insbesondere die Zahl von

Zikadenarten auf Kalkmagerrasen, die stenotop auf nur wenige Biotoptypen beschränkt sind, drastisch durch Meliorationsmaßnahmen reduziert. Melioriertes Grünland wird fast ausschließlich von weitverbreiteten Generalisten besiedelt. In erster Linie zieht der Rückgang von charakteristischen Kalkmagerrasenpflanzen durch Melioration eine Abnahme von solchen Auchenorrhynchataxa nach sich, die mono- oder oligophag auf diese Arten als Wirtspflanzen angewiesen sind. Aber selbst wenn geeignete Wirtspflanzen neuangelegtes Grünland rasch wiederbesiedeln, folgen die Zikaden allenfalls mit einem deutlichen zeitlichen Abstand. Dies wird besonders deutlich am Beispiel von polyphagen Arten wie *Turrutus socialis* oder *Mocydia crocea*, die einen drastischen Rückgang auf meliorierten oder neuangelegten Grünland zeigen, obwohl ihre Wirtspflanzen hier weit verbreitet sind oder sogar mit erhöhter Dominanz vorkommen. Solche Arten sind möglicherweise die am besten geeigneten Bioindikatoren, um den Erfolg oder Mißerfolg von Grünlandrenaturierungen aufzuzeigen. Ein Zeitraum von zehn Jahren ist dabei wahrscheinlich nicht ausreichend, um artenreiche Invertebratengesellschaften im Grünland wiederherzustellen, auch wenn die Vegetation frühzeitige Erfolge indiziert.

8 References

ACHTZIGER, R. (1995): Zikaden (Homoptera, Auchenorrhyncha) an neu angelegten Waldrändern – Erste Ergebnisse zur Besiedlung und Sukzession in Strauch- und Krautschicht. – Mitt. 1. Auchenorrhyncha Tagung 23.9 bis 25.9. 1994, Halle/Saale: 45-59.

ACHTZIGER, R. (1998): Besiedlungsdynamik von Hemipteren-Gemeinschaften an regenerierten Waldrändern. – Verh. Ges. Ökol. **28**: 281-289.

ACHTZIGER, R. & NICKEL, H. (1997): Zikaden als Bioindikatoren für naturschutzfachliche Erfolgskontrollen im Feuchtgrünland. – Beitr. Zikadenkde. **1**: 3-16.

AJAHI, O. & PLUMB, R.T. (1986): Leafhopper occurrence on cereals and grasses at Rothamsted Experimental Station, U.K. – Samaru J. of Agric. Res. **4** (1/2): 101-106.

ALLEN, A.A. (1966): *Eupteryx tenella* Fall. (Hem., Cicadellidae) in South-east London - a probable addition to the Kent fauna. - Ent. Month. Mag. **101**: 194.

ANDOW, D.A. (1991): Vegetational diversity and arthropod population response. - Ann. Rev. Entomol. **36**: 561-586.

ANDRZEJEWSKA, L. (1962): *Macrosteles laevis* as an unsettlement index of natural meadow associations of Homoptera. – Bull. Acad. pol. Sci. Cl. II Ser. Sci. biol. **10**: 221-226.

ANDRZEJEWSKA, L. (1965): Stratification and ist dynamics in meadow communities of Auchenorrhyncha (Homoptera). – Ekologia Polska, Series A, **31**: 1-31.

ANDRZEJEWSKA, L. (1971): Productivity investigations of two types of meadows in the Vistula valley. VI. Production and population density of leafhopper (Homoptera – Auchenorrhyncha) communities. - Ekol. Polska **19**: 151-172.

ANDRZEJEWSKA, L. (1976): The effect of mineral fertilization of a meadow on the *Auchenorrhyncha (Homoptera)* Fauna. – Pol. Ecol. Stud. **2** (4): 111-127.

ANDRZEJEWSKA, L. (1979): Herbivorous fauna and its role in the economy of grassland ecosystems. I. Herbivores in natural and managed meadows. – Pol. Ecol. Stud **5** (4): 5-44.

ANDRZEJEWSKA, L. (1991): Formation of Auchenorrhyncha communities in diversified structures of agricultural landscape. – Pol. Ecol. Stud. **17** (3-4): 267-287.

BADMIN, J.S. (1981): Auchenorrhyncha (Homoptera) new to Kent. – Ent. Month. Mag. **116**: 176.

BADMIN, J. (1997): The biology of the grassland froghopper *Neophilaenus campestris* at Dungeness. - Dungeness Bird Observatory Report for 1996: 84-87.

BAKKER, J.P. & BERENDSE, F. (1999): Constraints in the restoration of ecological diversity in grassland and heathland communities. – Tree **14**: 63-67.

BEIRNE, B.P. (1956): Leafhoppers (Homoptera: Cicadellidae) of Canada and Alaska. - Can. Ent. **88**, Suppl. 2: 5-177.

BELOVSKY, G.E. (1987): Extinction models and mammalian persistence. – in: SOULÉ, M.E. (Ed.): Viable populations for conservation. – Cambridge, Cambridge University Press: 35-57.

BELSHAW, R. (1992): Tachinid (Diptera) assemblages in habitats of a secondary succession in southern Britain. – The Entomologist **111**: 151-161.

BICK, H. (1982): Bioindikatoren und Umweltschutz. – Beih. Decheniana **26**: 2-5.

BIEDERMANN, R. (2000): Metapopulation dynamics of the froghopper *Neophilaenus albipennis* (F., 1798) (Homoptera, Cercopidae) – what is the minimum viable matapopulation size? – J. Ins. Conserv. **4**: 99-107.

BIEDERMANN, R. (2002): Leafhoppers (Hemiptera, Auchenorrhyncha) in fragmented habitats. – Denisia **4**: 523-530.

BITTNER, C. & REMANE, R. (1977): Beitrag zur Kenntnis der Zikadenfauna (Homoptera, Auchenorrhyncha, Cicadina) des Roten Moores/Rhön. – Ber. Ver. Naturk. Fulda **11/12**: 141-162.

BLACKWOOD, J.V. & TUBBS, C.R. (1970): A quantitative survey of chalk grassland in England. – Biol. Cons. **3**: 1-5.

BLAKE, S., FOSTER, G.N., FISHER, G.E.J. & LIGERTWOOD, G.L. (1996): Effects of management practices on the carabid faunas of newly established wildflower meadows in southern Scotland. – Ann. Zool. Fennici **33**: 139-147.

BLAKE, S., MCCRACKEN, D.I., EYRE, M.D., GARSIDE, A. & FOSTER G.N. (2003): The relationship between the classification of Scottish ground beetle assemblages (Coleoptera, Carabidae) and the National Vegetation Classification of British plant communities. – Ecography **26**: 602-616.

BOBBINK, R. & WILLEMS, J.H. (1991): Impact of different cutting regimes on the performence of *Brachypodium pinnatum* in Dutch chalk grassland. - Biol. Conserv. **56**: 1-21.

BOOIJ, C.J.H. (1981): Biosystematics of the *Muellerianella* complex (Homoptera, Delphacidae), taxonomy, morphology and distribution. - Neth. J. Zool. **31** (3): 572-595.

BOOIJ, C.J.H. (1982): Biosystematics of the *Muellerianella* complex (Homoptera, Delphacidae), host-plants, habitats and phenology. - Ecol. Ent. **7**: 9-18.

BOOIJ, C.H.J., GULDEMOND, J.A. (1984): Distributional and ecological differentiation between asexual gynogenetic planthoppers and related sexual species of the genus *Muellerianella* (Homoptera, Delphacidae). - Evolution **38** (1): 163-175.

BORNHOLDT, G. (1991): Auswirkungen der Pflegemaßnahmen Mahd, Mulchen, Beweidung und Gehölzrückschnitt auf die Insektenordnungen Orthoptera, Heteroptera, Auchenorrhyncha und Coleoptera der Halbtrockenrasen im Raum Schlüchtern. - Marburger Ent. Publ. **2** (6): 1-330.

BORNHOLDT, G. (1996): Die Zikadenfauna unterschiedlich gepflegter Borstgrasrasen und Goldhaferwiesen in der Hohen Rhön. – Ber. 2. Auchenorrhyncha Tagung 15.9 bis 17.9. 1995 in Marburg: 5-14.

BORNHOLDT, G. (2002): Untersuchungen zum Einfluss von Düngung und Nutzungsaufgabe auf die Zikadenfauna von Borstgrasrasen und Goldhaferwiesen. – Beitr. Zikadenkde **5**: 14-26.

BORNHOLDT, G. & REMANE, R (1993): Veränderungen im Zikadenartenbestand eines Halbtrockenrasens in der Eifel (Rheinland-Pfalz) entlang eines Nährstoffgradienten. - Z. Ökol. Natursch. **2**: 19-29.

BORNHOLDT, G. & TAMM, J. (1986): Zur Wanzen- und Zikadenfauna einiger Trockenhänge bei Schlüchtern (Osthessen), 2. Teil. – Hessische Faunist. Briefe **2**: 20-35.

BOULARD, M. (1988): Taxonimie et nomenclature supériures des Cicadoidea. Histoire, Problèmes et solutions (2nd edition). - Travaux du Laboratoire Biologie et Evolution des Insects Hemipteroidea **1**: 89 pp.

BOURGOIN, T. & CAMPBELL, B.C. (2002): Inferring a Phylogeny for Hemiptera: Falling into the 'Autapomorphic Trap'. – Denisia **4**: 67-82.

BRAUN-BLANQUET, J. (1964): Pflanzensoziologie. – Wien, New York, 865 pp.

BRAUN-BLANQUET, J. & FURRER, E. (1913): Remarque sure l'etude des groupements des plants. – Bull. Soc. Languedoc. Geogr. **36**: 20-41.

BREM, D. & LEUCHTMANN, A. (2001): *Epichloe* grass endophytes increase herbivore resistance in the woodland grass *Brachypodium sylvaticum*. – Oecologia **126**: 522-530.

BRIEMLE, G. (1990): Reaktion eines artenreichen Kalkmagerrasens auf geringe Mineraldüngergaben. – Zeitschr. Kulturtech. Landentw. **31** (3): 152-163.

BRIEMLE, G. (1999): Auswirkungen zehnjähriger Grünlandausmagerung. Vegetation, Boden, Biomasseproduktion und Verwertbarkeit der Aufwüchse. – Naturschutz u. Landschaftsplanung **31** (8): 229-237.

BRIEMLE, G., FREI, W. & SCHICK, U. (1990): Umwandlung von Acker- in Extensivgrünland. – Erfahrungen zur landwirtschaftlichen Extensivierung am Beispiel einer Staatsdomäne in Baden-Württemberg. – Transformation of arable land into extensive grassland. – Landschaft + Stadt **22** (2): 68-72.

BROWN, V.K. (1986): Life cycle stategies and plant succession. – In: TAYLOR, F & KARBAN, R. (eds.): The Evolution of Insect Life Cycles, Springer, New York: 105-124.

BROWN, V.K., GIBSON, C.W.D. & KATHIRITHAMBI, J. (1992): Community organisation in leafhoppers. – Oikos **65**: 97-106.

BROWN, V.K., GIBSON, C.W.D. & STERLING, P.H. (1990): The mechanisms controlling insect diversity in calcareous grasslands. – in: (HILLIER, S.H., WALTON, D.W.H. & WELLS, D.A., eds.): Calcareous Grasslands - Ecology and Management. - Bluntisham Books, Huntingdon, pp. 79-87.

BROWN, V.K. & HYMAN, P.S. (1986): Successional communities of plants and phytophagous Coleoptera. – J. Ecol. **74**: 963-975.

Brown, V.K. & Southwood, T.R.E. (1983): Trophic diversity, niche breadth and generation times of exopterygote insects in a secodary succession. – Oecologia **56**: 220-225.

BROWN, V.K. & SOUTHWOOD, T.R.E. (1987): Secondary succession: Patterns and Stategies. – In: GRAY, A.J., CRAWLEY, M.J. & EDWARDS, P.J. (eds.): Colonisation, Succession and Stability. – Blackwell, Oxford: 315-337.

BRUCKHAUS, A. (1988): Biotopschutz durch extensive Beweidung am Beispiel der Enzian-Schillergrasrasen. – Schriftenr. Bayer. Landesamt f. Umweltschutz, Heft **84**: 125-133.

BUFFINGTON, M.L. & REDAK, R.A. (1998): A comparison of vacuum sampling versus sweep-netting for arthropod biodiversity measurements in California coastal sage scrub. – J. Ins. Cons **2**: 99-106.

BUSH, M.B. (1993): An 11,400 year paleoecological history of British chalk grassland. – J. Vegetation Science **4** (1): 47-66.

BUSH, M.B. & FLENLEY, J.R. (1987): The age of British chalk grassland. – Nature **329**: 434-436.

CHERRILL, A.J. & RUSHTON, S.P. (1993): The Auchenorrhyncha of an unimproved moorland in northern Englnd. – Ecol. Ent. **18**: 95-103.

CHERRILL, A.J. & SANDERSON, R.A. (1994): Comparison of sweep-net and pitfall samples of moorland Hemiptera: evidence for vertical stratification within vegetation. – Entomologist **113**: 70-81.

CHINA, W.E. (1929): The James Edwards collection of British Homoptera, with notes on certain genera and species. – Ent. Month. Mag. **65**: 223-231.

CHINA, W.E. (1938): Some Homoptera new to the British list. – Ent. Month. Mag. **74**: 235-244.

CHUDZICKA, E. (1989): Leafhoppers (*Homoptera, Auchenorrhyncha*) of moist meadows on the Mazovian lowland. – Memorabilia Zool. **43**: 93-118.

CLARIDGE, M.F. & WILSON, M.R. (1981): Host plant associations, diversity and species-area relationships of mesophyll-feeding leafhoppers of trees and shrubs in Britain. – Ecol. Entomol. **6**: 217-238.

COOK, A.A. (1996): The host plants of calcareous grassland Auchenorrhyncha (Hemiptera). – Ent. Month. Mag. **132**: 151-175.

COOK, A.A. (1997): Observations on the oviposition behaviour of Auchenorrhyncha (Hem.) from calcareous grassland. - Ent. Month. Mag. **133**: 251-254.

CORCKET, E., CALLAWAY, R.M. & MICHALET, R. (2003): Insect herbivory and grass competition in a calcareous grassland: results from a plant removal experiment. – Acta Oeologica **24**: 139-146.

CURRY, J.P. (1987): The invertebrate fauna of grassland and its influence on productivity. II. Factors affecting the abundance and composition of the fauna. - Grass and Forage Science **42** (3): 197-212.

CURRY, J.P. (1994): Grassland Invertebrates. Ecology, Influence on Soil Fertility and Effects on Plant Growth. Chapman & Hall, London.

DAVIES, B.N.K. (1973): The Hemiptera and Coleoptera of stinging nettle (*Urtica dioica* L.). - J. Appl. Ecol. **10**: 213-237.

DELLA GIUSTINA, W. (2002): Migration in Auchenorrhyncha. – Denisia **4**: 513-522.

DELLA GIUSTINA, W. (1989): Homoptères Cicadellidae, Vol. 3. Compléments aux ouvrages d'Henri Ribaut. - Faune de France 73, Paris, 353 pp.

DEN BIEMAN, C.F.M. (1984): Parthenogenesis in Delphacidae. - Mitt. Schweiz. ent. Ges. **57** (4): 411.

DEN BIEMAN, C.F.M. (1987): Host plant relations in the planthopper genus *Ribautodelphax* (Homoptera, Delphacidae). - Ecol. Ent. **12**: 163-172.

DENNIS, P., YOUNG, M.R. & GORDON, I.J. (1998): Distribution and abundance of small insects and arachnids in relation to structural heterogeneity of grazed, indigenous grasslands. – Ecol. Ent. **23**: 253-264.

DENNIS, P., YOUNG, M.R., HOWARD, C.L. & GORDON, I.J. (1997): The response of epigeal beetles (Col.: Carabidae, Staphylinidae) to varied grazing regimes on upland *Nardus stricta* grasslands. – J. Appl. Ecol. **34**: 433-443.

DENNO, R.F. (1976): Ecological significance of wing polymorphism in Fulgoroidea which inhabit tidal salt marshes. – Ecol. Ent. **1**: 257-266.

DENNO, R.F. (1977): Comparisons of the assemblages of sap-feeding insects (Homoptera-Hemiptera) inhabiting two structurally different salt marsh grasses of the genus *Spartina*. – Environ. Ent. **6**: 359-372.

DENNO, R.F. (1978): The optimum population strategy for planthoppers (Homoptera: Delphacidae) in stable marsh habitats. – Can. Ent. **110**: 135-142.

DENNO, R.F. (1994): Influence of habitat structure on the abundance and diversity of planthoppers. – In: DENNO, R.F., PERFECT, T.J. (Eds.): Planthoppers. Their Ecology and Management. – Chapman & Hall, New York, pp. 140-159.

DENNO, R.F., HAWTHORNE, D.J., THORNE , B.L. & GRATTON, C. (2001): Reduced flight capability in British Virgin Island populations of a wing-dimorphic insect: the role of habitat isolation, persistence, and structure. – Ecol. Ent. **26**: 25-36.

DENNO, R.F., RODERICK, G.K., OLMSTEAD, K.L. & DÖBEL, H.G. (1991): Density-related migration in planthoppers (Homoptera: Delphacidae): The role of habitat persistence. – American Naturalist **138** (6): 1513-1541.

DEPARTMENT OF ENVIRONMENT (1994): Biodiversity – The UK Action Plan. – London, 192 pp.

DI GIULIO, M., EDWARDS, P.J. & MEISTER, E. (2001): Enhancing insect diversity in agricultural grasslands: the roles of management and landscape structure. – J. Appl. Ecol. **38**: 310-319.

DLABOLA, J. (1954): Krisi - Homoptera Fauna CSR 1. – Prag, 340 pp.

DOLEK, M. (1994): Der Einfluß der Schafbeweidung von Kalkmagerrasen in der Südlichen Frankenalb auf die Insektenfauna (Tagfalter, Heuschrecken). – Agrarökologie **10**, 126pp.

DOUGLAS, J.W. (1874): Captures of Hemiptera on the west coast of Scotland, with descriptions of a new species. - Ent. Month. Mag. **11**: 118.

DOUGLAS, J.W. (1876): British Hemiptera-Homoptera. Additional species. - Ent. Month. Mag. **12**: 203-204.

DROSOPOULOS, S. (1977): Biosystematic studies on the *Muellerianella* complex (Delphacidae, Homoptera, Auchenorrhyncha). - Medel. LandbHoogesch. Wageningen, 77-14, 133 pp.

DUFFEY, E. (1962a): A population study of spiders in limestone grassland. Description of study area, sampling methods and population characteristics. – J. Anim. Ecol. **31**: 571-599.

DUFFEY, E. (1962b): A population study of spiders in limestone grassland. The field layer fauna. – Oikos **13**:15-34.

DUFFEY, E. (1975): The effects of human trampling on the fauna of grassland litter. – Biol. Cons. **7**: 255-274.

DUFFEY, E., MORRIS, M.G., SHEAIL, J., WARD, L. K., WELLS, D. & WELLS, T.C.E. (1974): Grassland Ecology and Wildlife Management. – Chapman & Hall, London.

DUFFIELD, C.A.W. (1926): *Pamera fracticollis* Schill. and other Hemiptera at Dungeness. – Ent. Month. Mag. **62**: 39-40.

DUFFIELD, C.A.W. (1931): Notes on Auchenorrhynchous Homoptera (I). – Ent. Month. Mag. **67**: 37-38.

EDWARDS, J. (1885): Notes on British Typhlocybinae with diagnosis of two new species. - Ent. Month. Mag. **21**: 228-231.

EDWARDS, J. (1915): On certain British Homoptera. - Ent. Month. Mag. **51**: 206-211.

EDWARDS, J. (1920): New or little-known species of British Cicadina. - Ent. Month. Mag. **56**: 53-58.

EDWARDS, J. (1924): On some new or little-known British Cicadina. - Ent. Month. Mag. **60**: 52-58.

EHRLICH, P.R. MURPHY, D.D. (1987): Conservation lessons from long-term studies of chekerspot butterflies. – Conservation Biol. **1**: 122-131.

EMMRICH, R. (1966): Faunistisch-ökologische Untersuchungen über die Zikadenfauna (Homoptera, Auchenorrhyncha) von Grünlandflächen und landwirtschaftlichen Kulturen des Greifswalder Gebiets. - Mitt. Zool. Mus. Berlin **42**(1): 61-126.

EMMRICH, R. (1969): Bodenfallenfänge von Zikaden aus nordostdeutschen Laub- und Kiefern-Mischwäldern. - Faun. Abh. Staatl. Mus. Tierkde. Dresden **2**: 279-294.

EMMRICH, R. (1973): Zur Zikadenfauna der Insel Hiddensee (Homoptera, Auchenorrhyncha). - Faun. Abh. Staatl. Mus. Tierkde. Dresden **20**: 171-176.

EMMRICH, R. (1980): Zur taxonomischen Gliederung sowie Verbreitung von *Aphrodes bicincta* (Schrk.) sensu Rib. (Homoptera, Auchenorrhyncha, Cicadellidae). - Faun. Abh. Staatl. Mus. Tierkde. Dresden **7**: 279-284.

EMMRICH, R. (1984): Vorkommen und Verbreitung von *Cicadetta montana* (SCOP.) im Gebiet der DDR, unter besonderer Berücksichtigung der Sächsischen Schweiz. - Faun. Abh. Staatl. Mus. Tierkde. Dresden **11** (5): 109-117.

ENGELMANN, H.D. (1978): Zur Dominanzklassifizierung von Bodenarthropoden. – Pedobiologia **18**: 378-380.

EYRE, M.D. & LUFF, M.L. (1990): A preliminary classification of European grassland habitats using carabid beetles. – In: STORK, N.E. (ed.): The role of ground beetles in ecological and environmental studies. – Intercept, Andover, pp. 227-236.

EYRE, M.D., LUFF, M.L., RUSHTON, S.P. & TOPPING, C.J. (1989): Ground beetles and weevils (Carabidae and Curculionoidea) as indicators of grasland management practices. – J. appl. Ecol. **107**: 508-517.

EYRE, M.D., LUFF, M.L. & WOODWARD, J.C. (2003): Habitat creation favouring invertebrates: An example from Allerton Bywater, urban West Yorkshire. – Br. J. Ent. Nat. Hist. **16** (4): 209-219.

EYRE, M.D., WOODWARD, J.C. & LUFF, M.L. (2001): The distribution of grassland Auchenorrhyncha assemblages (Homoptera: Cercopidae, Cicadellidae, Delphacidae) in northern England and Scotland. – J. Ins. Cons. **5**: 37-45.

FEWKES, D.W. (1961): Diel vertical movements in some grassland Nabidae (Heteroptera). – Ent. Month. Mag. **97**: 127-130.

FÖRSTER, H. (1961): Zur Zikadenfauna der Oberlausitz (Hemiptera-Homoptera). I. Typhlocybidae. - Natura Lusatica **5**: 61-72.

FRICKE, M. & VON NORDHEIM, H. (1992): Auswirkungen unterschiedlicher landwirtschaftlicher Bewirtschaftungsweisen des Grünlandes auf Heuschrecken (Orthoptera, Saltatoria) in der Oker-Aue (Niedersachsen) sowie Bewirtschaftungsempfehlungen aus Naturschutzsicht. – Braunschw. naturkdl. Schr. **4** (1): 59-89.

GEBICKI, C. (1987): Leafhopper Associations (Homoptera, Auchenorrhyncha) in Xerothermic Communities in the Vicinity of Pínczów. – Acta Biol. Silesiana **6** (23): 87-97.

GERSTMEIER, R. & LANG, C. (1996): Beitrag zu Auswirkungen der Mahd auf Arthropoden. – Zeitschr. Ökol. Natursch. **5** (1): 1-14.

GIBSON, C.W.D., BROWN, V.K., LOSITO, L. & MCGAVIN, G.C. (1992): The response of invertebrate assemblies to grazing. – Ecography **15** (2): 166-176.

GIBSON, C.W.D., WATT, T.A. & BROWN, V.K. (1987): The use of sheep grazing species-rich grassland from abandoned arable land. – Biol. Conserv. **42**: 165-183.

GOGALA, M. (2002): Gesänge der Singzikaden aus Südost- und Mittel-Europa. Denisia **4**: 241-248.

GOGALA, M. & TRILAR, T. (1998): Gibt es verschiedene „*Cicadetta montana*“-Arten in Slowenien? Eine bioakustische Untersuchung (Homoptera, Auchenorrhyncha). – Beitr. Zikadenkde. **2**: 67-68.

GOGALA, M. & TRILAR, T. (2004): Bioacoustic investigations and taxonomic considerations on the *Cicadetta montana* species complex (Homoptera: Cicadoidea: Tibicinidae). - Anais da Academia Brasileira de Ciencias **76** (2): 316-324.

GRAVESTEIN, W.H. (1953): Faunistische meddelingen over Cicaden 1. - Ent. Ber. **14**: 280-281.

GRAVESTEIN, W.H. (1965): New faunistic records on Homoptera-Auchenorrhyncha from the Netherlands North Sea Island Terschelling Zool. Beitr. (N.F.) **11**: 103-111.

GUGLIELMINO, A. (1993): I Cicadellidi dell' Etna. Studio tassonomico e note ecologiche e biogeografiche. - Estratt. Mem. Soc. ent. ital. **72**: 49-162.

GÜNTHART, H. (1974): Beitrag zur Kenntnis der Kleinzikaden (Typhlocybinae, Homoptera, Auchenorrhyncha) der Schweiz, 1. Ergänzung. - Bull. Soc. Ent. Suisse **47** (1-2): 15-27

GÜNTHART, H. (1984): Zikaden aus der alpinen Höhenstufe der Schweizer Zentralalpen. - Mitt. Schweiz. ent. Gesell. **57**: 129-130.

GÜNTHART, H. (1987): Für die Schweiz neue und wenig gesammelte Zikaden-Arten (Hom., Auchenorrhyncha), 2. Ergänzung. - Mitt. Schweiz. ent. Gesell. **60**: 83-105.

GÜNTHART, H. & THALER, K. (1981): Fallenfänge von Zikaden (Hom., Auchenorrhyncha) in zwei Grünlandparzellen des Innsbrucker Mittelgebirges (Nordtirol, Österreich). – Mitt. Schweiz ent. Ges. **56**: 33-44.

GYÖRFFY, GY. & KARSAI, I. (1991): Estimation of spatio-temporal rearrangement in a patchy habitat and ist application to some Auchenorrhyncha populations. – J. Anim. Ecol. **60**: 843-855.

HAHN, S. (1995): Untersuchung zur Besiedlung von mehrjährigen Ackerbrachen durch Zikaden (Auchenorrhyncha). – 2. Ackerbrachen auf Porphyr in der Nähe von Trockenrasen. – Mitt. 1. Auchenorrhyncha Tagung 23.9 bis 25.9. 1994, Halle/Saale: 33-39.

HAMILTON, K.G.A. (1983): Introduced and native leafhoppers common to the old and new worlds (Rhynchota: Homoptera: Cicadellidae). - Can. Ent. **115**: 473-511.

HAMILTON, K.G.A. (1996): Creteceous Homoptera from Brazil: implications for classification. – in: SCHAEFER, C.W. (ed.): Studies on hemipteran phylogeny. – Proc. Thomas Say Publ. in Entomology: 89-110.

HARNISCHMACHER, M. (1988): Möglichkeiten und Durchführung extensiver Nutzungs- und Pflegeformen auf Trockenhängen der Südlichen Frankenalb aus der Sicht des Naturschutzes. – Schriftenr. Bayer. Landesamt f. Umweltschutz, Heft **84**: 115-125.

HARTLEY, S.E. & GARDNER, S.M. (1995): The response of *Philaenus spumarius* (Homoptera: Cercopidae) to fertilizing and shading its moorland host-plant (*Calluna vulgaris*). – Ecol. Entom. **20**: 396-399.

HAUGHTON, A.J., BELL, J.R., GATES, S., JOHNSON, P.J., MACDONALD, D.W., TATTERSALL, F.H. & HART, B.H. (1999): Methods of increasing invertebrate abundance within field margins. – Aspects Appl. Biol. **54**: 163-170.

HAUPT, H. (1935): 2. Unterordnung: Gleichflügler, Homoptera In: BROHMER,P., EHRMANN, P., ULMER, G.: Die Tierwelt Mitteleuropas, Band 4, Teil 3 (10), pp. 115-221.

HAYNES, K.J. & CRONIN, J.T. (2003): Matrix composition affects the spatial ecology of a prairie planthopper. – Ecology **84** (11): 2856-2866.

HECTOR, A., SCHMID, B., BEIERKUHNLEIN, C., CALDEIRA, M.C., DIEMER, M., DIMITRRAKOPOULOS, P.G., FINN, J.A., FREITAS, H., GILLER, P.S., GOOD, J., HARRIS, R., HÖGBERG, P., HUSS-DANELL, K., JOSHI, J., JUMPPONEN, A., KÖRNER, C., LEADLEY, P.W., LOREAU, M., MINNS, A., MULDER, C.P.H., O'DONOVAN, G.O., OTWAY, S.J., PEREIRA, J.S., PRINZ, A., READ, D.J., SCHERER-LORENZEN, M., SCHULZE, E.-D., SIAMANTZIOURAS, A.-S.D., SPEHN, E.M., TERRY, A.C., TROUMBIS, A.Y., WOODWARD, F.I., YACHI, S. & LAWTON, J.H. (1999): Plant diversity and productivity experiments in European grasslands. – Science **286**: 1123-1127.

HIDVEGI, F. & BAUGNÉE, J.-Y. (1992): Faunistique et gestion des pelouses calcaires de Treignes: Etude de *Cicadetta montana* (Cicadidae), d'*Atypus affinis* (Aranae, Atypidae), de la faune des Megachilidae et mise en place d'un paturage ovin experimental. – Université Libre de Bruxelles: 1-23.

HILDEBRANDT, J. (1990): Phytophage Insekten als Indikatoren für die Bewertung von Landschaftseinheiten am Beipiel von Zikaden. - Natur u. Landschaft **65**: 362-365.

HILDEBRANDT, J. (1995): Zur Zikadenfauna im Feuchtgrünland – Kenntnisstand und Schutzaspekte. – Mitt. 1. Auchenorrhyncha Tagung 23.9 bis 25.9. 1994, Halle/Saale: 5-22.

HILL, M.G. (1976): The population and feeding ecology of five species of leafhopper (Homoptera) on *Holcus mollis*. – Ph.D. Thesis, University of London.

HILL, M.G. (1982): Feeding strategies of grassland leafhoppers (Homoptera). – Zool. Jb. **109**: 24-32.

HOLLIER, J.A. (1987): Grassland Hemiptera from Mitcham Common, Surrey. – Ent. Month. Mag. **123**: 77-81.

HOLLIER, J.A. (1989): Grassland Hemiptera from Exmoor. – Somerset Archaeology and Natural History (1988) **132**: 335-340.

HOLLIER, J.A. (2004): Observations sur les Hemiptera des prairies montagnardes du Jura. – Bulletin Romand d'Entomologie **22**: 3-14.

HOLLIER, J.A. & BELSHAW, R.D. (1992): Changes in Neuroptera assemblages in an old fiels succession in southern Britain. – Entomologist **111**: 187-194.

HOLLIER, J.A., BROWN, V.K. & EDWARDS-JONES, G. (1994): Successional leafhopper assemblages: Pattern and process. – Ecol. Res. **9**: 185-191.

HOLLIER, J.A., MACZEY, N., MASTERS, G.J. & MORTIMER, S.R. (in prep.): Labile population-consistant communities: a validation of multi-site studies of grassland Auchenorrhyncha assemblages as habitat indicators.

HOLZINGER, W.E., FRÖHLICH, W., GÜNTHART, H., LAUTERER, P., NICKEL, H., OROSZ, A., SCHEDL, W. & REMANE, R. (1997): Vorläufiges Verzeichnis der Zikaden Mitteleuropas (Insecta: Auchenorrhyncha). - Beitr. Zikadenkde **1**: 43-62.

HOLZINGER, W.E., KAMMERLANDER, I. & NICKEL, H. (2003): The Auchenorrhyncha of Central Europe. – Volume 1: Fulgoromorpha, Cicadomorpha excl. Cicadellidae. – Leiden, 673 pp.

HOVESTADT, T. (1990): Die Bedeutung zufälligen Aussterbens für die Naturschutzplanung. – Natur und Landschaft **65**: 3-8.

HULME, M., JENKINS, G.J., LU, X., TURNPENNY, J.R., MITCHELL, T.D., JONES, R.G., LOWE, J., MURPHY, J.M., HASSELL, D., BOORMAN, P., MCDONALD, R. & HILL, S. (2002): Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report. - Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK, 120 pp.

HURST, A. & JOHN, E. (1999): The biotic and abiotic changes associated with *Brachypodium pinnatum* dominance in chalk grassland in south-east England. – Biol. Cons. **88** (1): 75-84.

HUTCHINGS, M.J. & BOOTH, K.D. (1996a): Studies on the feasibility of re-creating chalk grassland vegetation on ex-arable land. I. The potential roles of the seed bank and the seed rain. – J. Appl. Ecol. **33**: 1171-1181.

HUTCHINGS, M.J. & BOOTH, K.D. (1996b): Studies on the feasibility of re-creating chalk grassland vegetation on ex-arable land. II. Germination and early survivorship of seedlings under different management regimes. – J. Appl. Ecol. **33**: 1182-1190.

HUTCHINSON, G.E. (1921): Two records of Hemiptera. – Ent. Month. Mag. **57**: 39.

HUUSELA-VEISTOLA, E. & VASARAINEN, A. (2000): Plant succession in perennial grass strips and effects on the diversity of leafhoppers (Homoptera, Auchenorrhyncha). – Agriculture Ecosystems & Environment **80** (1/2): 101-112.

HYMAN, P.S. & PARSONS, M.S. (1992): A review of the scarce and threatened Coleoptera of Great Britain, part 1. - UK Nature Conservation, No.3, JNCC, Peterborough, 484 pp.

IRMLER, U., SCHRAUTZER, J., GRABO, J., HANSSEN, U., HINGST, R. & PICHINOT, V. (1998): Der Einfluß von Nutzung und Bodenparametern auf die Biozönosen des Feuchtgrünlandes (The influence of use and soil parameters on the biocoenoses of wet grassland). – Zeitschr. f. Ökol. u. Natursch. **7** (1): 15-28.

JANZEN, D.H. (1968): Host plants as islands in evolutionary and contemporary time. – Amer. Natur. **102**: 592-595.

JONSEN, I.D. & FAHRIG, L. (1997): Response of generalist and specialist insect herbivores to landscape spatial structure. – Landscape Ecol. **12**: 185-197.

KAMITANI, S. & URANO, S. (2000): Species diversity and optimum sampling size of Auchenorrhyncha (Homoptera) in a homogeneous habitat. – Esakia **40**: 87-94.

KEYMER, R.J. & LEACH, S.J. (1990): Calcareous grassland - a limited resource in Britain. - in: (HILLIER, S.H., WALTON, D.W.H. & WELLS, D.A., EDS.): Calcareous Grasslands - Ecology and Management. - Bluntisham Books, Huntingdon, pp. 11-17.

KINNUNEN, H., JÄRVELÄINEN, K., PAKKALA, T. & TIUINEN, J. (1996): The effect of isolation on the occurrence of farmland carabids in a fragmented landscape. – Ann. Zool. Fennici **33**: 165-171.

KIRBY, P. (1992): A review of the scarce and threatened Hemiptera of Great Britain. – UK Nature Conservation, No. 2, 267 pp.

KIRBY, P. (2001): Habitat Management For Invertebrates - a practical handbook. - Royal Society for the Protection of Birds, Sandy, 150 pp.

KIRBY, P., STEWART, A.J.A. & WILSON, M.R. (2001): True bugs, leaf- and planthoppers, and their allies. – Changing Wildlife of Great Britain and Ireland **62**: 262-299.

KNEITZ, G. (1980): Möglichkeiten der Bioindikation in der Landschaftsplanung. – Waldhygiene **13** (5/8): 155-158.

KNEITZ, G. (1983): Aussagefähigkeit und Problematik eines Indikatorkonzepts. – Bioindicator concept – application and problems. – Verh. Dtsch.Zool.Ges. 1983, pp. 117-119.

KNIGHT, W.J. (1965): A preliminary list of leaf-hopper species (Homoptera: Cicadellidae) occurring on plants of economic importance in Great Britain. – Ent. Month. Mag. **101**: 94-109.

KONTKANEN, P. (1938): Zur Kenntnis der Zikadenfauna von Nord-Karelien (Hem., Hom.). - Ann. zool. Soc. Zool.-bot. Fenn. Vanamo **5** (7): 1-37.

KONTKANEN, P. (1950): Quantitative and seasonal studies on the leafhopper fauna on the field stratum on open areas in North Karelia. - Ann. zool. Soc. Zool.-Bot. Fenn. Vanamo **13**(8): 1-91.

KOPETZ, A. & KÖHLER, G. (1991): Sukzessionsbedingte Veränderungen von Arthropoden-assoziationen auf Kalktrockenrasen. – Zool. Jahrb., Abt. f. Sys., Ökol. u. Geogr. d. Tiere **118** (3-4): 391-407.

KORICHEVA, J., MULDER, C.P.H., SCHMID, B., JOSHI, J. & HUSS-DANELL, K. (2000): Numerical responses of different trophic groups of invertebrates to manipulations of plant diversity in grasslands. – Oecologia **125**: 271-282.

KÖRNER, M., NICKEL, H. & SAYER, M. (2001): Zikaden an Gräsern eines norddeutschen Kiefernforstes - Abundanz, Phänologie und ein Vergleich der Fangmethoden (Hemiptera: Auchenorrhyncha). - Beitr. Zikadenkde **4**: 33-43.

KRUESS, A. & TSCHARNTKE, T. (2002): Contrasting responses of plant and insect diversity to variation in grazing intensity. – Biol. Cons. **106**: 293-302.

KUNTZE, H.A. (1937): Die Zikaden Mecklenburgs, eine faunistisch-ökologische Untersuchung. - Z. wiss. Zool. Abt. B, Arch. Naturgesch. (N.F.) **6**: 299-388.

LAUTERER, P. (1983): *Fagocyba cerricola* sp. n. and new and interesting records of leafhoppers from Czechoslovakia (Homoptera, Auchenorrhyncha). - Acta Mus. Morav. **68**: 139-152.

LAUTERER, P. (1984): New and interesting records of leafhoppers from Czechoslovakia (Homoptera, Auchenorrhyncha) II. - Acta Mus. Morav. **69**: 143-162.

LAWTON, J.H. (1983): Plant architecture and the diversity of phytophagous insects. – Ann. Rev. Entomol. **28**: 23-39.

LE QUESNE, W.J. (1960a): Some modifications in the British list of Delphacidae (Hem.), including a new genus and a new species. - Entomologist **93**: 13-19, 29-35, 54-60.

LE QUESNE, W.J. (1960b): Hemiptera (Fulgoromorpha). - Handbooks for the Identification of British Insects, Vol. II, Part 3, London, 68 pp.

Le Quesne, W.J. (1965a): A preliminary list of the Auchenorrhyncha of Woodwalton Fen, Huntingdonshire. – Ent. Month. Mag. **100**: 252.

Le Quesne, W.J. (1965b): *Athysanus argentarius* Metcalf (Hem. Cicadellidae) in the Isle of Wight. – Ent. Month. Mag. **101**: 288.

LE QUESNE, W.J. (1965c): Hemiptera (Cicadomorpha) (excluding Deltocephalinae and Typhlocybinae). - Handbooks for the Identification of British Insects, Vol. II, Part 2 (a), London, 64 pp.

LE QUESNE, W.J. (1969): Hemiptera (Cicadomorpha - Deltocephalinae). - Handbooks for the Identification of British Insects, Vol. II, Part 2 (b), London, pp. 65-148.

LE QUESNE, W.J. (1974a): Hemiptera from Newton Nature Reserve, Isle of Wight. – Ent. Month. Mag. **110**: 122.

LE QUESNE, W.J. (1974b): *Eupteryx origani* Zakhvatkin (Hem., Cicadellidae) new to Britain, and related species. - Ent. Month. Mag. **109**: 203-206.

LE QUESNE, W.J. & PAYNE, K.R. (1981): Cicadellidae (Typhlocybinae) with a checklist of the British Auchenorrhyncha (Hemiptera, Homoptera). - Handbooks for the Identification of British Insects, Vol II, Part 2 (c), London, 95 pp.

LEWIS, T. & TAYLOR, L.R. (1965): Diurnal periodicity of flight by insects. – Trans. R. ent. Soc. , London **116**: 393-479.

LINDBERG, H. (1947): Verzeichnis der ostfennoskandischen Homoptera Cicadina. - Fauna Fennica **1**: 1-81.

LINNAVUORI, R. (1952): Studies on the ecology and phenology of the leafhoppers (Homoptera) of Raiso (S.W. Finland). - Ann. zool. Soc. Zool.-Bot. Fenn. Vanamo **14** (6): 1-32.

LUFF, M. (1965): The morphology and microclimate of *Dactylis glomerata* tussocks. – J. of Ecol. **53** (3): 771-787.

LUFF, M. (1966): The abundance and diversity of the beetle fauna of grass tussoks. – J. Animal Ecol. **35**: 189-208.

LUFF, M. (1996): Use of Carabids as environmental indicators in grasslands and cereals. – Ann. Zool. Fennici **33**: 185-195.

LUFF, M.L., EYRE, M.D. & RUSHTON, S.P. (1992): Classification and prediction of grassland habitats using ground beetles (Coleoptera, Carabidae). – J. Environ. Manag. **35**: 301-315.

MAILLET, P. (1959): Essai sur l'ecologie des Jassides praticoles du Périgord noir. - Vie et Milieu **10**: 117-134.

MARCHAND, H. (1953): Die Bedeutung der Heuschrecken und Schnabelkerfe als Indikatoren verschiedener Graslandtypen - Ein Beitrag zur Agrarökologie. - Beitr. Ent. **3** (1/2): 116-162.

MASTERS, G.J., BROWN, V.K., CLARKE, I.P., WHITTAKER, J.B. & HOLLIER, J.A. (1998): Direct and indirect effects of climate change on insect herbivores: Auchenorrhyncha (Homoptera). – Ecol. Entomol. **23**: 45-52.

MASTERS, G.J. (2004): Chalk grassland: Enhancement of plant and invertebrate diversity through the use of Environmental Land Management Schemes. - Final Project Report BD1414, DEPARTMENT for ENVIRONMENT, FOOD and RURAL AFFAIRS, London.

MATSUMURA, M. & SUZUKI, Y. (2003): Direct feeding-induced interactions between two rice planthoppers, *Sogatella furcifera* and *Nilaparvata lugens*: effects on dispersal capability and performance. – Ecol. Entomol. **28**: 174-182

MAY, Y.Y. (1971): The biology and population ecology of *Stenocranus minutus* (Fabricius) (Delphacidae, Hemiptera). – Ph.D. thesis, London.

MAY, Y.Y. (1975): Study of two forms of the adult *Stenocranus minutus*. - Trans. R. ent. Soc., London **127**: 241-254.

McClure, M.S. & Price, P.W. (1975): Competition among sympatric Erythroneura leafhoppers (Homoptera: Cicadellidae) on American sycomore. - Ecology **56**: 1388-1397.

McClure, M.S. & Price, P.W. (1976): Ecotype characteristics of coexisting Erythroneura leafhoppers (Homoptera: Cicadellidae) on sycomore. - Ecology **57**: 928-940.

MCLEAN, I.F.G. (1990): The fauna of calcareous grasslands. - in: (HILLIER, S.H., WALTON, D.W.H. & WELLS, D.A., EDS.): Calcareous Grasslands - Ecology and Management. - Bluntisham Books, Huntingdon, pp. 41-46.

MCNEILL, S. & PRESTIDGE, R.A. (1982): Plant nutritional strategies and insect herbivore community dynamics. – Proc. 5th int. Symp. Insect-Plant Relationships, Wageningen, 1982. – Pudoc. Wageningen 1982, pp. 225-235.

MCNEILL, S. & SOUTHWOOD, T.R.E. (1978): The role of nitrogen in the development of insect/plant relationships. – In: HARBORNE, J.B. (ed.): Biochemical aspects of plant and animal coevolution. – Academic Press, London, pp. 77-98.

MEYER-CORDS, C. & BOYE , P. (1999): Schlüssel-, Ziel-, Charakterarten, Zur Klärung einiger Begriffe im Naturschutz – Keystone, target or characteristic species, Clarifying generic concepts and terms in nature conservation. – Natur u. Landschaft **74** (3): 99-101.

MITCHLEY, J. (1988): Restoration of species-rich calcicolous grassland on ex-arable land in Britain. – Trends Ecology a. Evolution **3** (6): 125-127.

MORCOS, G. (1953): The biology of some Hemiptera - Homoptera (Auchenorrhyncha). - Bull. Soc. Faoud Ent. **37**: 406-439.

MORLEY C. (1941): The history of *Cicadetta montana* Scop. in Britain. – Ent. Month. Mag. **77**: 41-56.

MORRIS, M.G. (1967): Differences between the invertebrate faunas of grazed and ungrazed chalk grassland. - I. Responses of some phytophagous insects to cessation of grazing. - J. Appl. Ecol. **4**: 459-474.

MORRIS, M.G. (1971a): Differences between the invertebrate faunas of grazed and ungrazed chalk grassland. - IV. Abundance and diversity of Homoptera-Auchenorrhyncha. – J. Appl. Ecol. **8**: 37-52.

MORRIS, M.G. (1971b): The management of grassland for the conservation of invertebrate animals. – In: DUFFEY, E. WATT, A.S. (eds.): The Scientific Management of Animal and Plant Communities for Conservation. – 11th Symposium of the British Ecological Society, Blackwell, Oxford, pp. 527-552.

MORRIS, M.G. (1973): The effects of seasonal grazing on the Heteroptera and Auchenorrhyncha (Hemiptera) of chalk grassland. - J. Appl. Ecol. **10**: 761-789.

MORRIS, M.G. (1974): Auchenorrhyncha (Hemiptera) of the Burren, with special reference to species-associations of the grasslands. – Proc. R. Irish Acad. (B) **74**: 7-30.

MORRIS, M.G. (1979): Responses of grassland invertebrates to management by cutting. - II. Heteroptera. – J. Appl. Ecol. **16**: 417-432.

MORRIS, M.G. (1981a): Responses of grassland invertebrates to management by cutting. - III. Adverse effects on Auchenorrhyncha. – J. Appl. Ecol. **18**: 107-123.

MORRIS, M.G. (1981b): Responses of grassland invertebrates to management by cutting. - IV. Positive responses of Auchenorrhyncha. – J. Appl. Ecol. **18**: 763-771.

Morris, M.G. (1982): Some responses of *Arthaldeus pascuellus* (Hem. Cicadellidae) to change in an Arrhenatheretum grassland. – Zeitschr. f. angew. Ent. **94**: 351-358.

MORRIS, M.G. (1990a): The Hemiptera of two sown calcareous grasslands. - I. Colonization and early succession. – J. Appl. Ecol. **27**: 367-378.

MORRIS, M.G. (1990b): The Hemiptera of two sown calcareous grasslands. - II. Differences between treatments. – J. Appl. Ecol. **27**: 379-393.

MORRIS, M.G. (1990c): The Hemiptera of two sown calcareous grasslands. - III. Comparisons with the Auchenorrhyncha faunas of other grasslands. – J. Appl. Ecol. **27**: 394-409.

MORRIS, M.G. (1992): Responses of Auchenorrhyncha (Homoptera) to fertilizer and liming treatments at Park Grass, Rothamstead. – Agriculture, Ecosystems & Environment **41** (3-4): 263-283.

MORRIS, M.G. (2000): The effects of structure and its dynamics on the ecology and conservation of arthropods in British grassland. – Biol. Cons. **95** (2): 129-142.

MORRIS, M.G. & LAKHANI, K.H. (1979): Responses of grassland invertebrates to management by cutting. I. Species Diversity of Hemiptera. – J. Appl. Ecol. **16**: 77-98.

MORRIS, M.G. & PLANT, R. (1983): Responses of grassland invertebrates to managment by cutting. - V. Changes in hemiptera following cessation of management. – J. appl. Ecol. **20**: 157-177.

MORRIS, M.G. & RISPIN, W.E. (1987): Abundance and diversity of the coleopterous fauna of a calcareous grassland under different cutting regimes. - J. Appl. Ecol. **24**: 451-465.

MORRIS, M.G. & RISPIN, W.E. (1994): Rotational management of grasslands and invertebrate diversity. – Grassland management and nature conservation: Proceedings of a joint meeting between the British Grassland Society and the British Ecological Society held at Leeds University, 27-29 September 1993, pp. 205-209.

MORTIMER, S.R., BOOTH, R.G., HARRIS, S.J. & BROWN, V.K. (2002): Effects of initial site management on the Coleoptera assemblages colonising newly established chalk grassland on ex-arable land. – Biol. Cons. **104**: 301-313.

MORTIMER, S.R., HOLLIER, J.A. & BROWN, V.K. (1998): Interactions between plant and insect diversity in the restoration of lowland calcareous grasslands in southern Britain. - Appl. Vegetation Science **1**: 101-114.

MOUNTFORD, J.O., LAKHANI, K.H. & HOLLAND, R.J. (1996): Reversion of grassland vegetation following the cessation of fertilizer application. – J. Vegetation Science **7**: 219-228.

MÖSELER, B.M. (1989): Die Kalkmagerrasen der Eifel. – Beih. Decheniana **29**, 79 pp.

MUIR, F.A.G. (1923): On the classification of the Fulgoroidea (Homoptera). – Proc. Hawaii Ent. Soc. **5**: 205-247.

MÜLLER, H.J. (1942): Über Bau und Funktion des Legeapparates der Zikaden (Homoptera, Cicadina). - Z. Morph. Ökol. Tiere **38**: 534-629.

MÜLLER, H.J. (1957): Über die Diapause von *Stenocranus minutus* Fabr. (Homoptera-Auchenorrhyncha). - Beitr. Ent. **7**: 203-226.

MÜLLER, H.J. (1978): Strukturanalyse der Zikadenfauna (Homoptera, Auchenorrhyncha) einer Rasenkatena Thüringens (Leutratal bei Jena). - Zool. Jb. Syst. **105**: 258-334.

MÜLLER, H.J., BÄHRMANN, R., HEINRICH, W., MARSTALLER, R., SCHÄLLER, G. & WITSACK, W. 1978 Zur Strukturanalyse der epigäischen Arthropodenfauna einer Rasen-Katena durch Kescherfänge. - Zool. Jb. Syst. **105**: 131-184.

MÜLLER, N. (1990): Die Entwicklung eines verpflanzten Kalkmagerrasens. Erste Ergebnisse von Dauerbeobachtungsflächen in einer Lechfeldhaide. - Natur u. Landschaft **65**: 21-26.

MURRAY, J. (1935): Hemiptera-Homoptera in Dumfriesshire. – Ent. Month. Mag. **71**: 259-260.

MURRAY, J. (1940): Dumfriesshire Hemiptera. – Ent. Month. Mag. **76**: 179-180.

NAST, J. (1972): Palaearctic Auchenorrhyncha (Homoptera) an annotated check list. – Pol. Acad. Scien., Inst. Zool., Warszawa, 549 pp.

NEWBOLD, C. (1989). Semi-natural habitats or habitat recreation: conflict or partnership? In: G.P. BUCKLEY (ed.): Biological Habitat Reconstuction, London, Belhaven, pp. 9-17.

NICKEL, H. (1994): Wärmeliebende Zikaden (Homoptera, Auchenorrhyncha) im südlichen Niedersachsen. - Braunschw. naturkdl. Schr. **4**: 533-551.

NICKEL, H. (1997): Zur Verbreitung und Lebensweise einiger Zikadenarten in Niedersachsen und angrenzenden Gebieten (Homoptera, Auchenorrhyncha). - Göttinger naturkundl. Schrift. **4**: 151-172.

NICKEL, H. (1999): Zum Vorkommen einiger Zikadenarten in Bayern. - NachrBl. bayer. Ent. **48** (1/2): 2-19.

NICKEL, H. (2002): Zur Zikadenfauna mitteleuropäischer Binnenland-Sandlebensräume. – http://www.gwdg.de/~hnickel/lsb.htm

NICKEL, H. (2003): The leafhoppers and planthoppers of Germany (Hemiptera, Auchenorrhyncha): Patterns and strategies in a highly diverse group of phytophagous insects. – Sofia and Moskau, 460 pp.

NICKEL, H. & ACHTZIGER, R (1999): Wiesen bewohnende Zikaden (Auchenorrhyncha) im Gradienten von Nutzungsintensität und Feuchte. – Beitr. Zikadenkde **3**: 65-80.

NICKEL, H., ACHTZIGER, R., LAUTERER, P., MALENOVSKÝ, I., WEIS, A. & WITSACK, W. (2001): Zur Fauna der Zikaden, Wanzen, Blattflöhe und Augenfliegen des Kyffhäusergebirges (Hemiptera: Auchenorrhyncha, Heteroptera et Psylloidea; Diptera: Pipunculidae). - Beitr. Zikadenkde **4**: 75.-80.

NICKEL, H., HOLZINGER, W.E., WACHMANN, E. (2002): Mitteleuropäische Lebensräume und ihre Zikaden (Insecta: Hemiptera: Auchenorrhyncha). - Denisia **4**: 279-328.

NICKEL, H. & REMANE, R. (2002): Artenliste der Zikaden Deutschlands, mit Angaben zu Nährpflanzen, Nahrungsbreite, Lebenszyklen, Areal und Gefährdung (Hemiptera, Fulgoromorpha et Cicadomorpha). – Beitr. Zikadenkde **5**: 27-64.

NICKEL, H. & HILDEBRANDT, J. (2003): Auchenorrhyncha communities as indicators of disturbance in grasslands (Insecta, Hemiptera) – a case study from the Elbe flood plains (northern Germany). – Agric. Ecosys. Env. **98**: 183-199.

NIEDRINGHAUS, R. (1991): Analyse isolierter Artengemeinschaften am Beispiel der Zikadenfauna der ostfriesischen Düneninseln (Hemiptera: Auchenorrhyncha). - Dissertation Oldenburg: 153 S.

NIEDRINGHAUS, R. (1999): Bewertung des Renaturierungserfolges in einer Agrarlandschaft Nordwestdeutschlands anhand der Zikadenfauna (Auchenorrhyncha). – Beitr. Zikadenkde **3**: 49-64.

NIEDRINGHAUS, R. (2002): Leafhoppers (Hemiptera, Auchenorrhyncha) from the perspective of insular biogeography. – Denisia **4**: 531-540.

NIEDRINGHAUS, R. & BRÖRING, U. (1990): Zur Besiedlung von Kraut-Gras-Flächen in naturnah gestalteten Grünanlagen am Beispiel von Heuschrecken, Wanzen und Zikaden. - Verh. Ges. Ökol. (Osnabrück 1898) XIX/II: 108-115.

NOVOTNÝ, V. (1990): Are the parameters of leafhopper (Auchenorrhyncha) and plant communities confluent? A case study on grass and sedge vegetation. – Acta Ent. Bohem. **87** (6): 459-369.

NOVOTNÝ, V. (1991): Responses of Auchenrrhyncha communities to selected characteristics of littoral and meadow vegetation. – Ekológia CSSR **10** (3): 271-282.

NOVOTNÝ V. (1992): Vertical distribution of leafhoppers (Hemiptera, Auchenorrhyncha) within a meadow community. – Acta Ent. Bohem. **89**: 13-20.

NOVOTNÝ, V. (1994a): Association of polyphagy in leafhoppers (Auchenorrhyncha, Hemiptera) with unpredictable environments. – Oikos **70**: 223-232.

NOVOTNÝ, V. (1994b): Relation between temporal persistence of host plants and wing length in leafhoppers (Hemiptera: Auchnorrhyncha). – Ecol. Entomol. **19**: 168-176.

NOVOTNÝ, V. (1995): Relationships between life histories of leafhoppers (Auchenorrhyncha – Hemiptera) and their host plants (Juncaceae, Cyperaceae, Poaceae). – Oikos **73**: 33-42.

NOVOTNÝ, V. & BASSET, Y. (2000): Rare species in communities of tropical insect herbivores: pondering the mystery of singletons. – Oikos **89**: 564-572.

NUSILLARD, B. (2000a): *Rhopalopyx adumbrata* (C. Sahlberg, 1842), une Cicadelle nouvelle pour la faune de France (Hem., Cicadellidae). - Bull. Soc. entomol. France **105** (4): 394.

NUSILLARD, B. (2000b): La Faune des Cicadellidae et des Cercopidae de la Drome (Hemiptera, Cicadomorpha). - Bull. Soc. entomol. France **105** (5): 505-510.

OBERDORFER, E. (1957): Süddeutsche Pflanzengesellschaften. – Jena, 564 pp.

OCHSE, M. & MICHELS, C. (1999): Effizienzkontrolle im Feuchtgrünlandschutz. Ein Beispiel aus dem NSG "Dingdener Heide" (Nordrhein-Westfalen). – Naturschutz u. Landschaftsplanung **31**: 238-243.

ODUM, E.P. (1969): The stratecy of ecosystem development. – Science **164**: 262-270.

ODUM, E.P. (1971): Fundamentals of Ecology. - Saunders, Philadelphia.

OKÁLI, I. (1960): Homoptera Auchenorrhyncha einiger Biotope in der Umgebung von Bratislava. - Acta Fac. Rerum nat. Univ. comen., Bratislava, Zoologia 4-6-8: 353-363.

OSSIANNILSSON, F. (1946): Halvvingar. Hemiptera. Stritar Homoptera Auchenorrhyncha. - Svensk. Insektfauna **7**: 1-150.

OSSIANNILSSON, F. (1978): The Auchenorrhyncha (Homoptera) of Fennoscandia and Denmark - Part I: Introduction, infraorder Fulgoromorpha. - Fauna ent. scand. **7** (1): 1-222.

OSSIANNILSSON, F. (1981): The Auchenorrhyncha (Homoptera) of Fennoscandia and Denmark - Part II: Infraorder Cicadomorpha. - Fauna ent. scand. **7** (2): 223-593.

OSSIANNILSSON, F. (1983): The Auchenorrhyncha (Homoptera) of Fennoscandia and Denmark - Part 3: The Family Cicadellidae: Deltocephalinae, Catalogue, Literature and Index. - Fauna ent. scand. **7** (3): 594-979.

PÄRTEL, M. & ZOBEL, M. (1999): Small-scale plant species richness in calcareous grasslands determined by the species pool, community age and shoot density. - Ecography **22**: 153-159.

PAYNE, K. (1979): Auchenorrhyncha (Homoptera) in Cumbria and Perthshire. – Ent. Month. Mag. **114**: 198.

PAYNE, K. (1982): A comparison of the catches of Auchenorrhyncha (Homoptera) obtained from sweep netting and pitfall trapping. – Ent. Month. Mag. **117**: 215-233.

PEUSER, S. (1987): Ökologisch-faunistische Untersuchungen an Tagfaltern auf Halbtrockenrasen der Nördlichen Frankenalb (unter besonderer Berücksichtigung der Erfassungsmethoden und Auswirkungen der Schafbeweidung). – Diplomarbeit (unveröff.), Universität Erlangen – Nürnberg.

PINCHEN, B.J. & WARD, L.K. (2002): The history, ecology and conservation of the New Forest Cicada. – British Wildlife **13** (4): 258-266.

PORT, G.R. (1981): Auchenorrhyncha on roadside verges. A preliminary survey. - Acta Ent. Fenn. **38**: 29-30.

PRESTIDGE, R.A. (1982): The influence of nitrogeneous fertilizer on the grassland Auchenorrhyncha (Homopter). – J. Appl. Ecol. **19**: 735-749.

PRESTIDGE, R.A. & MCNEILL, S. (1983): Auchenorrhyncha – host plant interactions: leafhoppers and grasses. – Ecol. Ent. **8**: 331-339.

PYWELL, R., BULLOCK, J.M., HOPKINS, A., WALKER, K.J., SPARKS, T.H., BURKES, M.J.W. & PEEL, S. (2002): Restoration of species-rich grassland on arable land: Assessing the limiting processes using a multi-site approach. – J. Appl. Ecol. **39**: 294-309.

QUINN, J.F. & HARRISON, S.P. (1988): Effects of habitat fragmentation and isolation on species richness: evidence from biogeographic patterns. – Oecologia **75**: 132-140.

RAATIKAINEN, M. (1971): Seasonal aspects of leafhoppers (Hom., Auchenorrhyncha) fauna in oats. - Ann. Agric. Fenn. **10**: 1-8.

RAATIKAINEN, M. (1972): Dispersal of leafhoppers and their enemies to oatfields. - Ann. Agric. Fenn. **11**: 146-53.

RAATIKAINEN, M. & VASARAINEN, A. (1973): Early and high-summer flight periods of leafhoppers. - Ann. Agric. Fenn. **12**: 77-94.

RAATIKAINEN, M. & VASARAINEN, A. (1976): Composition, zonation and origin of the leafhopper fauna of oatfields in Finland. - Ann. Zool. Fenn. **13**: 1-24.

RAATIKAINEN, M. & YLONEN, H. (1988): The hopper fauna of various biotypes in northern Finland and northern Norway. – Ann. Ent. Fenn. **54** (3): 73-88.

REICH, M. (1988): Streuobstwiesen und ihre Bedeutung für den Artenschutz. – Schriftenr. Bayer. Landesamt für Umweltsch., Heft **84**: 89-99.

REMANE, R. (1958): Die Besiedlung von Grünlandflächen verschiedener Herkunft durch Wanzen und Zikaden im Weser-Ems-Gebiet. - Z. ang. Zool. **42**: 353-400.

REMANE, R. (1960): Zur Kenntnis der Gattung *Arthaldeus* Ribaut. - Mitt. münch. ent. Ges. **50**: 72-82.

REMANE, R. (1961): Revision der Gattung *Mocydiopsis* RIBAUT (Homoptera Cicadellidae). - Abhandl. math.-naturwissenschaftl. Klasse d. Mainzer-Akad. Wiss. **4**: 101-149.

REMANE, R. (1987): Zum Artenbestand der Zikaden (Homoptera: Auchenorrhyncha) auf dem Mainzer Sand. - Mainzer Naturw. Arch. **25**: 273-349.

REMANE, R. & FRÖHLICH, W. (1994): Beiträge zur Chorologie einiger Zikaden-Arten (Homoptera Auchenorrhyncha) in der Westpaläarktis. - Marburger Ent. Publ. **2** (8): 131-188.

REMANE, R. & WACHMANN, E. (1993): Zikaden kennenlernen - beobachten. - Naturbuch Verlag, Augsburg, 288 pp.

REMANE, R. & GUGLIELMINO, A. (2002): Female ectodermal genitalia of the taxa of the *Kelisia guttula* – group (Homoptera Fulgoromorpha Delphacidae): not only an example for specialized coorganization with male genitalia without obvious reasons, but also a character set apt for species discrimination in westpalearctic taxa? – Marburger Ent. Publ. **3** (2): 21-38.

REMMERT, H. (1980): Ökologie. – Ein Lehrbuch. – Springer, Berlin-Heidelberg-New York, 304 pp.

RENGELSHAUSEN, B., STEFFAN-DEWENTER, I. & TSCHARNTKE, T. (1997): Die Fragmentierung von Kalkmagerrasen und die Folgen für Tagschmetterlinge und Widderchen. – Mitt. d. Deutschen Ges. f. Allg. u. Angew. Ent. **11** (1): 83-86.

RIBAUT, H. (1936): Homoptères Auchénorhynchques (I. Typhlocybidae). - Faune de France **31**, Paris, 231 pp.

RIBAUT, H. (1952): Homoptères Auchénorhynques. (II. Jassidae). - Faune de France **57**, Paris, 474 pp.

ROBINSON, R.A. & SUTHERLAND, W.J. (2002): Post-war changes in arable fareming and biodiversity in Great Britain. – J. Appl. Ecol. **39**: 157-176.

RODWELL, J.S. (ed.), C.D. PIGOTT, D.A. RATCLIFFE, A.J.C. MALLOCH, H.J.B. BIRKS, M.C.F. PROCTOR, D.W. SHIMWELL, J.P.HUNTLEY, E. RADFORD, M.J. WIGGINGTON & P. WILKINS (1998): British Plant Communities, Volume 3, Grasslands and montane communities. – Cambridge Univ. Press, 540 pp.

ROFF, D.A. (1990): The evolution of flightlessness in insects. - Ecol. Monographs **60** (4): 389-421.

ROMBACH, R. (1999): Auswirkungen verschiedener Formen der Bewirtschaftung von Halbtrockenrasen auf die Zikaden (Homoptera, Auchenorrhyncha) am Beispiel der Enzian-Schillergras-Rasen (Gentiano-Koelerietum) der Nordeifel (Nordrhein-Westfalen). – Dissertation, Universität Bonn, 142 pp.

ROSE, D.J.W. (1972): Dispersal and quality in populations of Cicadulina species (Cicadellidae). – J. Anim. Ecol. **41**: 589-609.

ROTHSCHILD, G.H.L. (1966): A study of natural population of *Conomelus anceps* (Germar) (Homoptera: Delphacidae) including observations on predation using the precipitin test. - J. Anim. Ecol. **35**: 413-434.

SACHTELEBEN, J. (2000): Naturschutzfachliche Bedeutung von Modellen der Inselökologie für Invertebraten und Gefässpflanzen auf Kalkmagerrasen in Süddeutschland. - Agrarökologie **36**, 173 pp.

SAHLBERG, J. (1871): Öfversigt af Finlands och den Skandinaviska halföns Cicadariae. - Notis. Sällsk. Fauna. Fl. fenn. Förh. (n.s.) **9** (12): 1-506.

SALMON, M.A. (1959): On the rediscovery of *Athysanus argentarius* (Fab.) (Hom. Cicadellidae) in the Isle of Wight. – Entomologist's Gazette **10**: 51-53.

SALMON, M.A. & CHAPMANN, H. (2000): On the history and distribution of *Athysanus argentarius* Metcalf (Hem.: Cicadellidae) in Britain. – Brit. J. Ent. Nat. Hist. **13**: 91-93.

SAMU, F., NÉMETH, J. & KISS, B. (1997): Assessment of the efficiency of a hand-held suction device for sampling spiders: improved density estimation or oversamling? – Ann. appl. Biol. **130**: 371-378.

SANDERSON, R.A. (1992): Hemiptera of naturally vegetated derelict land in north-west England. – Entomologist's Gazette **43** (3): 221-226.

SCHAEFER, M. (1973): Untersuchungen über Habitatbindung und ökologische Isolation der Zikaden einer Küstenlandschaft (Homoptera: Auchenorrhyncha). - Arch. Natursch. Landschaftsforsch. **13**: 329-352.

SCHAEFER, M. (1992): Wörterbuch der Ökologie. 3.Auflage. – Gustav Fischer, Jena, 433 pp.

SCHIEMENZ, H. (1964a): Zikaden (Homoptera Auchenorrhyncha) von einer tertiären Rohbodenkippe des Braunkohlentagebaus Böhlen. - Abh. Ber. Naturkundemus. Görlitz **39** (16): 1-8.

SCHIEMENZ, H. (1964b): Beitrag zur Kenntnis der Zikadenfauna (Homoptera, Auchenorrhyncha) und ihrer Ökologie in Feldhecken, Restwäldern und den angrenzenden Fluren. - Arch. Natursch. Landschaftsforsch. **4**: 163-189.

SCHIEMENZ, H. (1969): Die Zikadenfauna mitteleuropäischer Trockenrasen (Homoptera, Auchenorrhyncha). Untersuchungen zu ihrer Phänologie, Ökologie, Bionomie und Chorologie. - Ent. Abh. Mus. Tierkde. Dresden **36** (6): 201-280.

SCHIEMENZ, H. (1975): Die Zikadenfauna der Hochmoore im Thüringer Wald und im Harz (Homoptera, Auchenorrhyncha). - Faun. Abh. staatl. Mus. Tierkde. Dresden **5** (7): 215-233.

SCHIEMENZ, H. (1976): Die Zikadenfauna von Heide- und Hochmooren des Flachlands der DDR (Homoptera, Auchenorrhyncha). - Faun. Abh. staatl. Mus. Tierkde. Dresden **6**: 39-54.

SCHIEMENZ, H. (1987): Beitrag zur Insektenfauna der DDR: Homoptera – Auchenorrhyncha (Cicadina) (Insecta). Teil 1: Allgemeines, Artenliste, Uberfamilie Folgoroidea. - Faun. Abhandl. Staatl. Mus. Tierkde. Dresden **15** (8): 41-108.

SCHIEMENZ, H. (1988): Beiträge zur Insektenfauna der DDR: Homoptera – Auchenorrhyncha (Cicadina) (Insecta). Teil II. Überfamilie Cicadoidea excl. Typhlocybinae et Deltocephalinae. - Faun. Abhandl. Staatl. Mus. Tierkde. Dresden **16** (5): 37-93.

SCHIEMENZ, H., EMMRICH, R. & WITSACK, W. (1996): Beiträge zur Insektenfauna Ostdeutschlands: Homoptera – Auchenorrhyncha (Cicadina) (Insecta) Teil IV: Unterfamilie Deltocephalinae. - Faun. Abh. Staatl. Mus. Tierkde. Dresden **20** (10): 153-258.

SCHOTZKO, D.J. & O'KEEFFE, L.E. (1989): Comparison of Sweep Net, D-vac, and Absolute Sampling and Diel Variation of Sweep Net Sampling Estimates in Lentils for Pea Aphid (Homoptera: Aphidae), Nabids (Hemiptera: Nabidae), Lady Beetles (Coleoptera: Coccinellidae), and Lacewings (Neuroptera: Chrysopidae). – J. Economic Ent. **82** (2): 491-506.

SCHULZ, K. & MEIJER, J. (1978): Migration of leafhoppers into a new polder. – Holarctic Ecology **1**: 73-78.

SCHWOERBEL, W. (1957): Die Wanzen und Zikaden des Spitzberg bei Tübingen, eine faunistisch-ökologische Untersuchungen (Hemipteroidea: Heteroptera und Cicadina = Homoptera Auchenorrhyncha). - Z. Morph. Ökol. Tiere **45**: 462-560.

SCOTT, J. (1870): On certain British Hemiptera-Homoptera. Revision of the family Delphacidae and descriptions of several new species of the genus Delphax of authors. - Ent. Month. Mag. **7**: 22-29.

SEDLACEK, J.D., BARRETT, G.W. & SHAW, D.R. (1988): Effects of nutrient enrichment on the Auchenorrhyncha (Homoptera) in contrasting grassland communities. – J. Appl. Ecol. **25** (2): 537-550.

SERGEL, R. (1988): Species packing, community structure, and resources: relations in middle European meadow-colonizing Auchenorrhyncha guilds. – Proc. 6th Auchenorrhyncha Meeting, Turin, Italy, 163-169.

SHAFFER, M.L. (1981): Minimum population sizes for species conservation. – BioScience **31**: 131-134.

SHANNON, C.E. (1948): A mathematical theory of communiction. – Bell System Techn.J. **27**: 379-423 and 623-656.

SIEPEL, H. (1996): Decision-support systems for nature management. – Biodiversity Letters **3** (4/5): 157-161.

SIEPEL, H., MEIJER, J., MABELIS, A.A. & DEN BOER, M.H. (1989): A tool to assess the influence of management practices on grassland surface macrofaunas. - J. Appl. Ent. **108**: 271-290.

SMITH, C.J. (1980): The Ecology of the English Chalk. - Academic Press, London.

SÖDERSTRÖM, B., SVENSSON, B., VESSBY, K. & GLIMSKÄR, A. (2001): Plants, insects and birds in semi-natural pastures in relation to local habitat and landscape factors. – Biodiversity and Conservation **10**: 1839-1863.

SOUTHWOOD, T.R.E., BROWN, V.K. & READER, P.M. (1979): The relationships of plant and insect diversities in succession. - Biological Journal of the Linnean Society **12**: 327-348.

SPANG, W. (1992): Methoden zur Auswahl faunistischer Indikatoren im Rahmen raumrelevanter Planungen. – Natur u. Landschaft **67** (4): 158-161.

STACE, C. (1997): New Flora of the British Isles - second edition. – Cambridge, 1130 pp.

STANDEN, V. (2000): The adequacy of collecting techniques for estimating species richness of grassland invertebrates. – J. Appl. Ecol. **37**: 884-893.

STEVENSON, M.J., J.M. BULLOCK & L.K. WARD (1995): Re-creating semi-natural communities: effect of sowing rate on establishment of calcareous grassland. – Restoration Ecology **3** (4): 279-289.

STEWART, A.J.A. (1986): Description and key to the nymphs of *Eupteryx* (Curtis) leafhoppers (Homoptera: Cicadellidae) occuring in Britain. – Systematic Entomology **11**: 365-376.

STEWART, A.J.A. (1988): Patterns of host-plant utilization by leafhoppers in the genus Eupteryx (Hemiptera: Cicadellidae) in Britain. - J. Nat. Hist. **22**: 357-379.

STEWART, A.J.A. (1999): Twenty years of recording the distribution of Auchenorrhyncha in Britain and Ireland: progress, achievements and prospects (Hemiptera). – Reichenbachia **33** (26): 207-214.

STEWART, A.J.A. (2002): Techniques for sampling Auchenorrhyncha in grasslands. – Denisia **4**: 491-512.

STEWART, K.E.J., BOURN, N.A.D. & THOMAS, J.A. (2001): An evaluation of three quick methods commonly used to assess sward height in ecology. - J. Appl. Ecol. **38**: 1148-1154.

STILING, P.D. (1980a): Host plant specifity, oviposition behavior and egg parasitism in some leafhoppers of the genus Eupteryx (Hemiptera: Cicadellidae). - Ecol. Entomol. **5**: 79-85.

STILING, P.D. (1980b): Colour polymorphism in nymphs of the genus Eupteryx (Hemiptera: Cicadellidae). - Ecol. Entomol. **5**: 175-178.

STINSON, C.S.A. & BROWN, V.K. (1983): Seasonal changes in the architecture of natural plant communities and its relevance to insect herbivores. – Oecologia (Berlin) **56**: 67-69.

STRÜBING, H. (1955): Beiträge zur Ökologie einiger Hochmoorzikaden (Homoptera - Auchenorrhyncha). - Österr. zool. Z. **6**: 566-596.

STRÜBING, H. (1956): Über Beziehungen zwischen Ovidukt, Eiablage und natürlicher Verwandschaft einheimischer Delphaciden. - Zool. Beitr. (N.F.) **2**: 331-357.

STRÜBING, H. (1995): Artentstehung und -verdrängung am Beispiel dreier Kleinzikadenarten (Homoptera, Auchenorrhyncha). – Mitt. d. Deutsch. Ges. f. Allg. u. Angew. Ent. **10**: 619-624.

SZWEDO, J. (2002): Ulopidae of the Palaearctic – the state of the art (Hemiptera: Clypaeorrhyncha: Membracoidea). – Denisia **4**: 249-262.

TAYLOR, R.A.J. (1985): Migratory behavior in the Auchenorrhyncha. – In: NAULT, L.R. & J.G. RODRIGUEZ (eds.): The leafhoppers and planthoppers, pp. 259-288.

TAYLOR, R.A.J., NAULT, L.R. & STYER, W.E. (1993): Experimental analysis of flight activity of three *Dalbulus* leafhoppers (Homoptera: Auchenorrhyncha) in relation to migration. – Ann. Ent. Soc. Am. **86** (5): 655-667.

TER BRAAK, C.J.F. & SMILAUER, P. (1998): CANOCO for Windows, Version 4. – Centre for Biometry, Wageningen.

THOMAS, J.A., THOMAS, C.D., SIMCOX, D.J. & CLARKE, R.T. (1986): Ecology and declining status of the Silver-spotted Skipper butterfly (*Hesperia comma*) in Britain. - J. Appl. Ecol. **23**: 365-380.

THOMPSON, P. (1978): The oviposition sites of five leafhopper species (Hom.: Auchenorrhyncha) on *Holcus mollis* and *H. lanatus*. – Ecol. Ent. **3**: 231-240.

THOMPSON, S., LARCOM, A. & LEE, J.T. (1999): Restoring and enhancing rare and threatened habitats under agri-environment agreements: a case study of the Chiltern Hills Area of Outstanding Natural Beauty, UK. – Land Use Policy **16** (2): 93-105.

TISCHLER, W. (1977): Einführung in die Ökologie. – Fischer, Stuttgart.

TISHECHKIN, D.YU. (1998): Acoustic Signals and Morphological Characters of Leafhoppers Belonging to *Aphrodes bicinctus* Group (Homoptera, Cicadellidae) from European Russia. – Entomological Review **78** (3): 370-377.

TÖRMÄLÄ, T. (1982): Evaluation of 5 methods of sampling field layer arthropods, particularly the leafhopper community, in grassland. – Ann. Ent. Fenn. **48** (1): 1-16.

TRAUTNER (ed.) (1992): Arten- und Biotopschutz in der Planung: Methodische Standards zur Erfassung von Tierartengruppen. - Weikersheim, Margraf, 252 pp.

TRÜMBACH, H. (1959): Die Zikaden und Psylliden der Umgebung Erlangens, eine systematisch-ökologische Untersuchung. - Sitzungsbericht der physikalisch-medizinischen Sozietät Erlangen **79**: 102-151.

TULOWITZKI, I. (1990): Einfluß der Beweidung auf die Populationsstruktur der Kleinzikade *Psammotettix putoni* (Hom. Auch.) in der Salzwiese der Schleswig-Holsteinischen Westküste. - Verh. Ges. Ökol. (Osnabrück 1898) XIX/II, pp. 152-162.

UK BIODIVERSITY GROUP (1998): Tranche 2 Action Plans - Vol. II - terrestrial and freshwater habitats. - English Nature (publ.), 86 pp.

VAN WINGERDEN, W.K.R.E., VAN KREVELD, A.R. & BONGERS, W. (1992): Analysis od species composition and abundance of grasshoppers (Orth., Acrididae) in natural and fertilized grasslands. – J. Appl. Ent. **113**: 138-152.

VIDANO, C. (1965): A contribution to the chorological and oecological knowledge of the european Dikraneurini (Homoptera Auchenorrhyncha). - Zoologische Beiträge, Berlin (N.F.) **11** (2): 343-367.

VIDANO, C., ARZONE, A. & COBBEN, R.H. (1998). Typhlocybinae on officinal plants. - Abstracts of Auchenorhyncha Workshop 23-25th August 1978, Wageningen, the Netherlands. - Auchenorrhyncha Newsletter **1**: 27-28.

VILBASTE, J. (1962): Über die Arten *Rhopalopyx preyssleri* (H.-S.) und *Rh. adumbrata* (C.R. Sahlberg) (Homoptera, Iassidae). - Notul. ent. **42**: 62-66.

VILBASTE, J. (1974): Preliminary list of Homoptera-Cicadinea of Latvia and Lithuania. - Eesti NSV Tead. Akad. Toim. **23**: 131-163.

VON NORDHEIM, H. (1992): Auswirkungen unterschiedlicher Bewirtschaftungsmethoden auf die Wirbellosenfauna des Dauergrünlandes. – Nordeutsche Naturschutz Akademie (NNA)-Berichte **4**: 13-26.

WAGNER, W. (1939): Die Zikaden des Mainzer Beckens. Zugleich eine Revision der Kirschbaumschen Arten aus der Umgebung von Wiesbaden. - Jb. nassau. Ver. Naturkde. **86**: 77-212.

WAGNER, W. (1941): Die Zikaden der Provinz Pommern. - Dohrniana **20**: 95-184.

WAGNER, W. & FRANZ, H. (1961): 34. Ordnung Rhynchota, Unterordnung Homoptera, Überfamilie Auchenorrhyncha (Zikaden) - Die Nordost-Alpen im Spiegel ihrer Landtierwelt **2**: 74-158.

WALOFF, N. (1973): Dispersal by flight of leafhoppers (Auchenorrhyncha: Homoptera). - J. Appl. Ent. **10**: 705-730.

WALOFF, N. (1979): Partitioning of resources by grassland leafhoppers. - Ecol. Entomol. **4**: 379-385.

WALOFF, N. (1980): Studies on grassland leafhoppers (Auchenorrhyncha, Homoptera) and their natural enemies. - Adv. Ecol. Res., **11**: 81-215.

WALOFF, N. (1994): Observations on *Zyginidia scutellaris* (Herrich-Schaeffer), Auchenorrhyncha: Typhlocybinae, Cicadellidae. – The Entomologist **113** (1): 20-27.

WALOFF, N. & SOLOMAN, M.G. (1973): Leafhoppers (Auchenorrhyncha: Homoptera) of acidic grassland. - J. appl. Ent. **10**: 189-212.

WALOFF, N. & THOMPSON, P. (1980): Census data of populations of some leafhoppers (Auchenorrhyncha, Homoptera) of acid grassland. – J. Anim. Ecol. **49**: 395-416.

WALTER, S. (1996): Zikaden als Indikatoren für die Bewertung von Landschaftseinheiten – Ein Beispiel zur Charakterisierung der Drömlingsniederung (Sachsen-Anhalt). – Berichte 2. Auchenorrhyncha-Tagung 15.9. bis 17.9. 1995 in Marburg. (Halle 1996), pp. 15-24.

WARD, L.K. & JENNINGS R.D. (1990): Succession of disturbed and undisturbed chalk grassland at Aston Rowant National Nature Reserve: Details of changes in species. – J. Appl. Ecol. **27**: 913-923.

WHALLEY, P.E.S. (1955): Notes on some Homoptera Auchenorrhyncha found in Caernarvonshire and Anglesey. – Ent. Month. Mag. **91**: 243-245.

WHITCOMB, R.F., COAN, M.E., KRAMER, S. & ROSS, H.H. (1973): Host relationshops of cicadellids in the grassland biome. – First International Congress of Systematics and Evolutionary Biology, Boulder, Colorado.

WHITCOMB, R.F., HICKS, A.L. & LYNN, D.E. (1987): Geographic variation in host relationships of leafhoppers (Homoptera: Cicadellidae) in North American grasslands. – In: WILSON, M.R. & NAULT, L.R. (eds.) (Proc. 2nd Int. Workshop on Leafhoppers and Planthoppers of Economic Importance, Provo, Utah, USA, 28 July – 1 Aug. 1986. – CIE, London, pp. 293-325.

WHITCOMB, R.F., HICKS, A.L. & LYNN, D.E. (1988): Host specifity: A major mechanism enhancing insect diversity in grasslands. – In: Davis, A. & Stanford, G. (eds.): Proc. 10th N. Am. Prairie Conf., Denton, Texas, June 22-26, 1986, Native Praerie Ass. of Texas, Dallas.

WHITTAKER, J.B. (1964): Auchenorrhyncha (Homoptera) of the Moor House Nature Reserve, Westmorland, with notes on *Macrosteles alpinus* (Zett.), a species new to Britain. – Ent. Month. Mag. **100**: 168-171.

WHITTAKER, J.B. (1965): The distribution and population dynamics of *Neophilaenus lineatus* (L.) and *N. exclamationis* (Thunb.) (Homoptera, Cercopidae) on Pennine moorland. - J. Anim. Ecol. **34**: 277-297.

WHITTAKER, J.B. (1969): Quantitative and habitat studies of the frog-hoppers and leaf-hoppers (Homoptera, Auchenorrhyncha) of Wytham Woods, Berkshire. - Ent. Month. Mag. **105**: 27-37.

WHITTAKER, J.B. (1977): Homoptera from the Cow Green (Teesdale) plant communities with reference to the effects of fertilizer treatments. – Ent. Month. Mag. **113**: 159-163.

WHITTAKER, J.B. & TRIBE, N.P. (1998): Predicting numbers of an insect (*Neophilaenus lineatus*: Homoptera) in a changing climate. – J. Anim. Ecol. **67**: 987-991.

WILLEMS, J.H. (2001): Problems, approaches and results in restoration of Dutch calcareous grassland during the last 30 years. – Restoration Ecol. **9** (2): 147-154.

WILLMS, W.D., SMOLIAK, S. & DORMAAR, J.F. (1985): Effects of stocking rate on a rough fescue grassland vegetation. – J. Range Managem. **38** (3): 220-225.

WITSACK, W. (1985): Dormanzformen bei Zikaden (Homoptera Auchenorrhyncha) und ihre ökologische Bedeutung. – Zool. Jb. Syst. **112**: 71-139.

WITSACK, W. (1995): Untersuchung zur Besiedlung von mehrjährigen Ackerbrachen durch Zikaden (Auchenorrhyncha). – 1. Ackerbrachen auf Lößschwarzerde entfernt von naturnahen Habitaten. – Mitt. 1. Auchenorrhyncha Tagung 23.9 bis 25.9. 1994, Halle/Saale, pp. 23-32.

WITSACK, W., ENGLER, I., SCHNEIDER, K. & SCHNITTER, P. (1997): Zur zoozönotischen Strukturentwicklung auf neunjährigen Acker- und Grünlandbrachen. – Mitt. Deut. Ges. Allg. u. Ang. Ent. **11** (1): 95-98.

WOODROFFE, G.E. (1967): Further notes on some Hemiptera and Coleoptera from the Isles of Scilly. – Ent. Month. Mag. **102**: 285-286.

WOODROFFE, G.E. (1972): Hemiptera from the Braemar area (Aberdeenshire) including the first British record of *Dikraneura contraria* Ribaut (Hem., Cicadellidae). – Ent. Month. Mag. **107**: 172-173.

WOODROFFE, G.E. (1974): Notes on some Hemiptera from Caithness, Sutherland and Inverness-Shire. – Ent. Month. Mag. **109**: 223-225.

ZABEL, J. & TSCHARNTKE, T. (1998): Does fragmentation of *Urtica* habitats affect phytophagous and predatory insects differentially? – Oecologia **116**: 419-425.

9 Annex

9.1 Annex 1: Site Descriptions

a) Environmentally Sensitive Area Scheme Sites

South Downs

Site 100 (Grid reference: TQ22073):

This is an 11ha, unimproved field on a southwest facing slope in West Sussex, situated just north of the A27 near Shoreham-by-sea. The vegetation comprises a mosaic of grass/forb sward of variable height interspersed with scrub, classified as MG1 at point A of the sampling transect and CG3b at points B-E.

Site 101 (Grid reference: TQ314134):

This is a 13ha, unimproved field on a north-west facing slope, lying on the West/East Sussex border, north of Brighton and west of the A23. The transect lies between two archaeological mounds and has been classified as CG2b.

Site 102 (Grid reference: TQ 277113):

This is a 1ha, unimproved field on a south-west facing slope in West Sussex, east of the village of Saddlescombe and adjacent the Sussex Border Path. The vegetation comprises a short sward with occasional patches of scrub, classified as CG3d along the sampling transect.

Site 110 (Grid reference: TQ 174073):

This is a 9ha, unimproved field on a north-east facing slope in West Sussex, situated north of Worthing and just north of the A27. The vegetation comprises a medium height sward and is classified as CG5a along the sampling transect. The field lies directly above an arable field in the valley bottom.

Site 111 (Grid reference: TQ 189087):

This is an 18ha, unimproved field on a north-west facing slope in West Sussex, situated south of the small town of Steyning and west of the River Adur. The vegetation comprises a short-medium height sward, classified as CG4c, surrounded by shrubs and large patches of Urtica spp. on the upper slope and a dirt track in the valley immediately below the site.

Site 112 (Grid reference: TQ 335131):

This is a 16ha, unimproved field on a north-east facing slope in East Sussex, situated on the northern edge of a Nature Reserve and south of the village of Westmeston. The transect vegetation is classified as CG2a and the area has numerous archaeological sites (tumuli, mounds and field systems) suggesting some protection from disturbance.

Site 117 (Grid reference: TQ 454062):

This is a 49ha, unimproved field on a north-east facing slope in East Sussex, situated north of Newhaven on Beddingham Hill, just north of the South Downs Way. The transect vegetation is classified as CG5a along the sampling transect and the area has a number of archaeological sites (tumuli, mounds and settlements) suggesting some protection from disturbance. Site 303 lies in the same field.

Site 119 (Grid reference: TV 569967):

This is a 24ha, unimproved field on a north-east facing slope in East Sussex, situated south-east of Friston near the Sheep Centre and below a tumulus. The vegetation comprises a medium height sward and is classified as CG2c along the sampling transect.

Site 210 (Grid reference: TQ 166113):

This is a 10ha, semi-improved field on a gently sloping, north-east facing slope in West Sussex, situated on the eastern fringe of Steyning with woodland to the west. The vegetation comprises a short, patchy sward and is classified as CG2c along the sampling transect.

Site 211 (Grid reference: TQ 392063):

This is a 10ha, semi-improved field on a south-east facing slope in East Sussex, situated east of Brighton and accessible only by a bridleway or footpaths. The site is surrounded by arable farmland and has been classified as MG6a along the sampling transect.

Site 215 (Grid reference: TQ 413052):

This is a 5.5ha, semi-improved field on a south facing slope in East Sussex, situated east of Brighton adjacent a small village called Rodmell but accessible only by bridleway or track. The site is surrounded by farmland, mainly arable and improved and has been classified as MG5b along the sampling transect.

Site 216 (Grid reference: TQ 477019):

This is a 9.5ha, semi-improved field on a north-west facing slope in East Sussex, situated north of Seaford. The vegetation comprises a short, tussocky sward, classified CG2c along the sampling transect, with scrub lining the upper part of the slope.

Site 217 (Grid reference: TQ 513029):

This is a 7ha, semi-improved field on a south facing slope in East Sussex, situated on the western fringe of Alfriston. The vegetation comprises a short, patchy sward, classified as CG2c along the sampling transect, with scrub along the western side of the site.

Site 300 (Grid reference: TQ 170083):

This is a 15ha, improved field on a north-west facing slope in West Sussex, situated north of Worthing and accessed from the village of Coombes by footpath. The vegetation comprises a short, patchy sward, classified as MG6c along the sampling transect and the site is surrounded by farmland.

Site 301 (Grid reference: TQ 187082):

This is a 15ha, improved field lying in an east facing valley in West Sussex, situated north of Worthing and accessed from the village of Coombes by footpath. The vegetation comprises a short, patchy sward, classified as MG7a along the sampling transect and the site is surrounded by farmland.

Site 302 (Grid reference: TQ 294130):

This is a 13ha, improved field on a south-east facing slope in West Sussex, situated in the fork of the A23 and A273 north of Brighton. The vegetation has been classified as MG7a along the sampling transect and the surrounding area includes farmland and a rifle range.

Site 303 (Grid reference: TQ 456065):

This is a 49ha, improved field lying in a north facing valley in East Sussex, situated north of Newhaven on Beddingham Hill, just north of the South Downs Way. The transect vegetation is classified as MG6c along the sampling transect and the area has a number of archaeological sites (tumuli, mounds and settlements) suggesting some protection from disturbance. Site 117 lies in the same field.

Site 312 (Grid reference: TQ 393054):

This is a 5.5ha, improved field on an east facing slope in East Sussex, situated east of Brighton and accessible only by a bridleway and footpath. The site is surrounded by arable farmland and has been classified as MG6a along the sampling transect.

Site 314 (Grid reference: TQ 412043):

This is a 21.5ha, improved field on a north-west facing slope in East Sussex, situated east of Brighton near the small village of Telscombe. The site is surrounded by farmland, mainly arable and improved and has been classified as MG5b along the sampling transect.

Site 317 (Grid reference: TV 570970):

This is a 5.5ha, improved field on a south-west facing slope in East Sussex, situated south-east of Friston near the Sheep Centre. The vegetation comprises a short sward, classified as MG6c along the sampling transect and the upper edge of the site is flanked with scrub.

Site 318 (Grid reference: TV 571983):

This is an 11.5ha, improved field on a north-west facing slope in East Sussex, situated on the eastern fringe of Friston. The vegetation comprises a variable height sward, classified as MG6c along the sampling transect, with patches of Urtica spp.

Site 319 (Grid reference: TV 574967):

This is a 24ha, improved field on a north-west facing slope in East Sussex, situated east of Friston near the Sheep Centre. The vegetation comprises a short-medium height sward, classified as MG6 along the sampling transect and the site is edged by scrub.

Site 710 (Grid reference: TQ 146074):

This is a 6ha, arable reversion field on a south facing slope in West Sussex, situated north of Worthing adjacent a golf course, Cissbury Ring and ancient flint mines. The vegetation has been classified as MG7b along the sampling transect.

Site 711 (Grid reference: TQ 163088):

This is a 7.5ha, arable reversion field on a south-west facing slope in West Sussex, situated north of Worthing approximately 1.5 miles north-east of site 710 on the edge of the South Downs Way. The vegetation comprises a fairly uniform sward, which has been classified as MG7b along the sampling transect.

Site 712 (Grid reference: TQ 183084):

This is a 17ha, arable reversion field on a north-east facing slope in West Sussex, situated west of Coombes and the River Adur. The vegetation comprises a short-medium sward, interspersed with small patches of Cirsium spp and classified as MG7b along the sampling transect.

Site 713 (Grid reference: TQ 185069):

This is a 23.5ha, arable reversion field on a north-east facing slope in West Sussex, situated just north of Lancing and approximately 1 mile due south of site 712. The vegetation has been classified as MG7b along the sampling transect.

Site 715 (Grid reference: TQ 465058):

This is a 12ha, arable reversion field on a south facing slope in East Sussex, situated north-east of Newhavern and adjacent Males Burgh tumulus on the South Downs Way. The vegetation has been classified as MG7b along the sampling transect.

Site 716 (Grid reference: TQ 472058):

This is a 11.6ha, arable reversion field on a south facing slope in East Sussex, situated north-east of Newhavern to the right of site 715. There are a number of tumuli and Long Barrows in the area and a plantation just north of the field. The vegetation has been classified as MG7b along the sampling transect.

Site 717 (Grid reference: TQ 508029):

This is a 16ha, arable reversion field on a south-east facing slope in East Sussex, situated on the western fringe of Alfriston and accessible only by by-way and footpath. The vegetation comprises a short-medium height sward, with occasional Cirsium patches and has been classified as MG5a along the sampling transect.

Site 718 (Grid reference: TV 511978):

This is an 8ha, arable reversion field on an east facing slope in East Sussex, situated on the coast to the east of Seaford at the mouth of the Cuckmere River, on the other side of which lies Seven Sisters Country Park. The vegetation comprises a tall, fairly uniform sward and has been classified as MG7a along the sampling transect.

Site 719 (Grid reference: TQ 575009):

This is a 5ha, arable reversion field on a west facing slope in East Sussex, situated on the western fringe of Eastbourne. A belt of woodland separates the town and the site, which lies on the edge of the South Downs Way in an area of tumuli and ancient field systems. The vegetation comprises a tall, fairly uniform sward with occasional scrub patches has been classified as MG7a along the sampling transect.

South West Downs

Site 2 (Grid reference: ST 829335):

This is a 70.5ha, unimproved field on a south-east facing slope in Wiltshire, just north of Mere. The site lies in one of a series of narrow side valleys (Ashfield Bottom) with a strip of woodland joining the head of Ashfield Bottom to its neighbouring valley. All the valleys have well preserved examples of Strip Lynchets. The vegetation is of variable height with occasional patches of scrub and has been classified as CG2a along the sampling transect.

Site 3 (Grid reference: ST 955213):

This is a 24.5ha, unimproved field on an east facing slope in Wiltshire, south-east of the small village of Berwick St John. The site lies on a steep slope with woodland on the slope to the north and on the opposing slope. The vegetation has been classified as CG2b along the sampling transect.

Site 6 (Grid reference: ST 972363):

This is an 8.5ha, unimproved field on a north facing slope in Wiltshire, south of the village of Stockton near Warminster. The transect lies on a slope topped by earthworks. The vegetation comprises a short sward, classified as CG2c along the sampling transect, with occasional patches of scrub and Cirsium spp and some ant hills.

Site 8 (Grid reference: ST 919204):

This is a 7ha, improved field on a north-west facing slope in Wiltshire, south-east of Shaftesbury. The site lies adjacent a Roman Road and Ox Drove track, along which there are a number of archaeological features such as tumuli and earthworks. The vegetation has been classified as MG6a along the sampling transect.

Site 9 (Grid reference: ST 803345):

This is an 18ha, unimproved field on a south-west facing slope in Wiltshire, just north of Mere. The site lies above a small plantation and beneath a set of earthworks and a covered reservoir. The vegetation comprises a short sward with occasional patches of scrub and has been classified as CG2b along the sampling transect.

Site 10 (Grid reference: ST 920207):

This is a 37ha, unimproved field on a steep, north-east facing valley slope in Wiltshire, south-east of Shaftesbury. The site lies adjacent a Roman Road and the Ox drove track, along which there are a number of archaeological features such as tumuli and earthworks. The vegetation comprises a short-medium, fairly uniform sward, classified as CG2c along the sampling transect, with a thin belt of woodland along the lower edge of the site.

Site 12 (Grid reference: ST 811354):

This is a 28.5ha, improved field on a south facing slope in Wiltshire, just north of Mere in a complex valley system accessible only by Ox Drove track and foot. The area has numerous archaeological features such as tumuli and earthworks. The vegetation has been classified as CG2c along the sampling transect.

Site 13 (Grid reference: ST 898208):

This is a 13.5ha, unimproved field on a steep, north facing valley slope in Wiltshire, south-east of Shaftesbury and north of Melbury Wood. The site lies adjacent the Ox Drove track and is surrounded by tumuli. The vegetation comprises a short-medium, fairly uniform sward with occasional livestock scrapes and has been classified as CG2c along the sampling transect.

Site 14 (Grid reference: SU 003259):

This is a 12ha, improved field on a south facing slope in Wiltshire, south-west of Salisbury in a shallow valley on Fifield Down, just west of the small village of Broad Chalke. The site lies in a shallow, curving valley with broken belts of scrub along the upper slopes. The vegetation comprises a short, fairly uniform sward dotted with Cirsium, which has been classified as CG2b along the sampling transect.

Site 15 (Grid reference: SU 012251):

This is a 15ha, unimproved field on a south-west facing slope in Wiltshire, east of Shaftesbury on the fringe of the small village of Fifield Bavant. The site lies in an area of mainly arable farmland interspersed with a few small patches of woodland. The vegetation comprises a short, fairly uniform sward with occasional livestock scrapes and has been classified as CG3c along the sampling transect.

Site 17 (Grid reference: ST 823368):

This is a 14.5ha, unimproved field on a north facing slope in Wiltshire, east of Kingston Deverill and above the River Wylye. The site lies immediately above a belt of woodland (Truncombe Wood) and in an area of archaeological features such as tumuli and earthworks. The vegetation comprises a tussocky sward, dotted with Cirsium and has been classified as CG2c along the sampling transect.

Site 18 (Grid reference: ST 909207):

This is a 4.5ha, improved field on a steep, north-east facing slope in Wiltshire, south of the village of Ludwell near Shaftesbury. Farmland, arable and pasture, lies at the foot of the slope and there are patches of woodland on surrounding slopes. The vegetation comprises a fairly uniform sward classified as MG7a along the sampling transect.

Site 20 (Grid reference: SU 111247):

This is a 12ha, unimproved field on a west facing slope in Wiltshire, south of Coombe Bissett near Salisbury. The site is edged by scrub patches and the vegetation comprises a fairly uniform, medium to tall sward classified as CG2c along the sampling transect.

Site 22 (Grid reference: SU034263):

This is a 22ha, improved field on a south-west facing slope in Wiltshire, on the outskirts of Broad Chalke, south-west of Salisbury. The site is covered with old and new scrub patches, including along the sampling transect where the tall sward has been classified as MG1.

Site 23 (Grid reference: SU 034272):

This is a 12.5ha, improved field on a west facing slope in Wiltshire, just north of Broad Chalke and south-west of Salisbury. The transect lies in a shallow valley beneath a belt of woodland. The vegetation comprises a tall, fairly uniform sward classified as MG5b along the sampling transect.

Site 27 (Grid reference: SU 024268):

This is an 11.5ha, improved field on a north-east facing slope in Wiltshire, on the edge of Knapp Down just north of Broad Chalke. A belt of woodland lies adjacent the field and patches of Urtica are dotted across its slope. The vegetation comprises short sward classified as MG5b along the sampling transect.

Site 28 (Grid reference: ST 800047):

This is a 24.5ha, unimproved field on a south facing slope in Dorset, east of Winterborne Houghton in a valley mostly surrounded by woodland. The vegetation comprises a short sward, classified as CG2b along the sampling transect, with occasional livestock scrapes and patches of Cirsium.

Site 29 (Grid reference: ST 998267):

This is a 12ha, unimproved field on a steep, west facing slope in Wiltshire, south of the village of Fovant and accessible only by byway and foot. The transect lies below a narrow belt of trees and the valley floor below the site is used for farmland. The vegetation has been classified as CG2c along the sampling transect.

Site 30 (Grid reference: ST 949242):

This site comprises two unimproved fields of 14ha each, on a steep, south-east facing slope in Wiltshire, north of the village of Berwick St John and accessible only by byway and foot. The transect skirts an area of scrub in one field and the vegetation has been classified as CG2a along the sampling transect.

Site 31 (Grid reference: ST 880176):

This is a 3.5ha, unimproved field on a south-east facing slope in Dorset and is part of Fontmell Down SSSI owned by the National Trust. There is an extensive area of woodland running south east from the SSSI. The vegetation comprises a short-medium height sward, classified as CG2a along the sampling transect and there are patches of scrub edging the site.

Site 35 (Grid reference: SU 061239):

This is a 3.5ha, unimproved field on a north facing slope in Wiltshire, south-west of the village of Broad Chalke. The site lies in a shallow valley in which there are well preserved archaeological features of a field system and an enclosure. The vegetation comprises a medium height sward, classified as CG2b along the sampling transect and there are patches of scrub around the site.

Site 38 (Grid reference: SY 639999):

This is an 8ha, unimproved field on a west facing slope in Dorset, on the fringe of the village of Sydling St Nicholas and immediately below a tumuli. The site is surrounded with belts of scrub and hedges of trees and shrubs. The vegetation comprises a short sward, classified as CG2a along the sampling transect and there are patches of exposed chalk.

Site 40 (Grid reference: ST 809088):

This is an 11.5ha, unimproved field on a south-east facing slope in Dorset, on Turnworth Down between the small village of Belchalwell Street and Blandford Forest. The transect lies amongst scrub and trees and the vegetation comprises a tall sward, classified as MG5b along the sampling transect.

b) Countryside Stewardship Scheme Sites

Site C1 (Grid reference: TL098244):

This is a 6ha, unimproved site of common land on the eastern edge of Luton, in Bedfordshire. The site lies on a westerly slope with evidence of Strip Lynchets running north – south and is surrounded by residential buildings, playing fields and some farmland. There is heavy scrub invasion across the site, meaning the vegetation along the transect, which has been classified as CG2c, is extremely variable both in height and composition.

Site C2 (Grid reference: TL007209):

This is a 2.5ha, unimproved flat site on the top of Dunstable Down, in Bedfordshire. Land use around and on the Downs includes residential, a gliding club and a golf course. The site itself is in an area of trees, scrub and chalk grassland. The transect straddles a fence so that sample points D and E lie in a more frequently traversed, short sward area adjacent a shallow dry ditch and the remaining three points lie in a narrow strip of cleared, but rapidly re-invading scrub. The vegetation has been given a general classification of CG3b along the transect.

Site C3 (Grid reference: TL006211):

This is a 12.5ha, unimproved site on the top of Dunstable Down, in Bedfordshire, situated close to site C2. This is a cross-shaped transect, with sampling points close to the entrance gate, between and either side of two tumuli and a final sampling point down-slope towards the gliding site. A footpath dissects the transect. The vegetation comprises a variable sward and has been classified as CG3b along the sampling transect.

Site C4 (Grid reference: SP959168):

This is a 19ha, unimproved site on a south facing slope in Buckinghamshire, east of Ivinghoe. The site is on Beacon Hill, one of the Ivinghoe Hills and is owned by the National Trust. The Ridgeway Path runs close to the transect and there are several tumuli in the vicinity. The vegetation comprises a variable sward with some scrub re-growth and has been classified as CG3a along the sampling transect.

Site C5 (Grid reference: SP960157):

This is a 12ha, unimproved site on a steep, south facing valley slope in Buckinghamshire, east of Ivinghoe. Situated on Steps Hill, the site lies in a valley, accessible only by foot, which is dotted with Crataegus trees in the bottom. The vegetation comprises a medium to tall sward and has been classified as CG2a along the sampling transect.

Site C6 (Grid reference: SP961154):

This is a 4ha, improved field on a gentle, south-west facing slope in Buckinghamshire, east of Ivinghoe. The site is part of National Trust land and can be reached from the road by the Icknield Way Path. It is edged by woodland on two sides and is situated adjacent a small, deep valley of intact chalk grassland. The vegetation comprises a medium height, fairly uniform sward, classified as CG3d along the sampling transect.

Site C7 (Grid reference: SP917035):

This is a 3ha, arable reversion field on a south facing slope in Buckinghamshire, on the outskirts of Ballinger Common north of Amersham. The lower part of the site is edged by woodland and the vegetation comprises a tall sward, classified as MG6a along the sampling transect.

Site C8 (Grid reference: SP918033):

This is a 3ha, semi-improved field on a north facing slope in Buckinghamshire, on the outskirts of Ballinger Common north of Amersham. The site is surrounded by woodland and tree belts and the vegetation comprises a tall sward, classified as MG6a along the sampling transect.

Site C9 (Grid reference: SU919904):

This is a 2.5ha, unimproved site on a north-west facing slope in Buckinghamshire, on the outskirts of Beaconsfield. The area below the site is a disused industrial wasteground, now much overgrown, whilst at the upper end, a belt of woodland separates a residential area from the site. The vegetation, comprising a patchy sward with some scrub re-growth, has been classified as CG3b along the sampling transect.

Site C10 (Grid reference: SU572815):

This is a 10.5ha, arable reversion field at the base of a slope in Berkshire, on the outskirts of Goring, south of Oxford. The site lies adjacent an old ridgeway and field system, amongst farmland. A belt of trees runs along the field edge and the vegetation comprises a short to medium sward, classified as MG6a along the sampling transect.

Site C11 (Grid reference: SU572818):

This is an 11.5ha, semi-improved field on a south-west facing slope in Berkshire, on the outskirts of Goring, south of Oxford, on the hill above site C10. The vegetation comprises a short to medium sward, classified as MG6a along the sampling transect.

Site C12 (Grid reference: SU633757):

This is a 10.5ha, flat, arable reversion field in Berkshire, on the outskirts of Pangbourne. It is a single, privately-owned field, managed with much enthusiasm by the owner to restore wildflowers. The site is edged with trees, mostly planted and including fruit trees and incorporates a purpose-built pond and waterfall. The vegetation comprises a variable height sward, classified as MG5b along the sampling transect.

Site C13 (Grid reference: SU371293):

This is a 14ha, arable reversion field on a west facing slope in Hampshire, on the edge of the small village of Kings Somborne, west of Winchester. The site is surrounded by farmland, mostly arable and woodland. The vegetation comprises a fairly uniform sward, classified as MG6a along the sampling transect.

Site C14 (Grid reference: SU378290):

This is a 4ha, semi-improved field on a south-west facing slope in Hampshire, on the edge of the small village of Kings Somborne, west of Winchester. The site is surrounded by farmland, mostly arable and woodland. The vegetation comprises a fairly uniform sward, classified as MG1a along the sampling transect.

Site C15 (Grid reference: SZ432811):

This is a 5ha, arable reversion field on a south facing cliff top in the Isle of Wight. The site lies on the south-west facing coast above Brighstone Bay, surrounded by arable farmland and without any tree cover so is completely exposed to onshore winds. The vegetation comprises a fairly uniform sward with little floral interest, which has been tentatively classified as MG6a along the sampling transect.

Site C16 (Grid reference: SZ496758):

This is a 1ha, improved field on an undulating, west facing valley floor, situated on the coast at St. Catherine's Point, the most southerly point on the Isle of Wight. The valley faces the sea and is edged by a very high, steep cliff along its north side, with scrubby woodland at the far end and along its southern side. The vegetation, classified as MG5 along the sampling transect, comprises a short, tussocky sward with patches of Cirsium and Dioica.

Site C17 (Grid reference: SZ546774):

This is a 2ha, unimproved field on a shallow south-west facing slope, on the edge of Ventnor, Isle of Wight. The site is coastal, situated adjacent a sports field, with woodland on the upper valley slopes and a residential area below. The vegetation comprises a variable height sward with much re-growth of cleared areas and has been classified as M1a along the sampling transect.

Site C18 (Grid reference: SZ620862):

This is a 6ha, semi-improved field near the coast on Bembridge Down at Culver Cliffs, Isle of Wight. The site lies beneath a National Trust owned Fort and the vegetation comprises a short, patchy sward dotted with Cirsium and classified as MG6c along the sampling transect.

Site C19 (Grid reference: TQ026489):

This is a 3ha, arable reversion field on a south facing, very gentle slope in Surrey on the edge of Guildford, adjacent the North Downs Way and sandwiched between housing and woodland. The site is edged with trees and scrub and the vegetation comprises a short, tussocky sward, classified as MG6a along the sampling transect.

Site C20 (Grid reference: TQ085489):

This is a 3.5ha, unimproved field on a gentle, south-east facing slope in Surrey, north of the A25 mid way between Dorking and Guildford. The site is surrounded by farmland, mostly semi-improved and woodland. The vegetation comprises a short to medium height sward interspersed with small, scrubby bushes and classified as CG2a along the sampling transect

Site C21 (Grid reference: TQ164539):

This is a 0.5ha, semi-improved field on a gentle, east facing slope in Norbury Park, just south of Leatherhead in Surrey. The site is surrounded by trees and trackways and has a rail tunnel cut beneath it. The vegetation comprises a variable height sward, classified as MG1d along the sampling transect.

Site C22 (Grid reference: TQ154541):

This is a 1ha, semi-improved flat field on top of a small hill in Norbury Park, just south of Leatherhead in Surrey. The site is surrounded by trees and trackways and the vegetation has been classified as MG1a along the sampling transect.

Site C23 (Grid reference: TQ257616):

This is a 1ha, unimproved flat site, situated within Banstead Downs, north of the A23 mid way between Croydon and Leatherhead. The site lies in a large clearing near an old schooling ring for horses, crossed with footpaths and much used by dog walkers. The vegetation comprises a variable height sward with some scrub, classified as CG2a along the sampling transect.

Site C24 (Grid reference: TQ258615):

This is a 2ha, unimproved flat site, which is situated close to site 23 within Banstead Downs, north of the A23 mid way between Croydon and Leatherhead. The transect, classified as CG2a, lies in a strip of tall, dense vegetation, alongside a well used, rutted dirt track.

Site C25 (Grid reference: TQ441615):

This is a 1.5ha, unimproved field on a gentle, west facing slope, south-west of Orpington in Kent and close to the small airport at Biggin Hill. The site, which is reached by farm track, is situated downslope of a long belt of woodland with arable fields on the valley floor below. The transect, classified as CG2c, lies in small glades amongst new and old scrub.

Site C26 (Grid reference: TQ514619):

This is a 4.5ha, improved field on a steep, east facing slope in Kent, overlooking the village of Shoreham. The site lies amongst farmland and there is a large area of woodland, Meenfield Wood, on the hilltop above. The vegetation has been classified as MG7b along the sampling transect.

Site C27 (Grid reference: TQ513616):

This is a 5.5ha, improved field on a steep, east facing slope in Kent, overlooking the village of Shoreham and situated adjacent site C26. The vegetation has been classified as MG7a along the sampling transect.

Site C28 (Grid reference: TQ509617):

This is a 4ha, arable reversion field on a north-west facing slope in Kent, near the village of Shoreham. The site lies amongst farmland - pasture and other arable reversion fields - and woodland. The vegetation has been classified as MG6a along the sampling transect.

Site C29 (Grid reference: TQ508616):

This is a 7ha, arable reversion field on a north-east facing slope in Kent, near the village of Shoreham. The site lies adjacent site 28 and the vegetation has been classified as MG6a along the sampling transect.

Site C30 (Grid reference: TQ645612):

This is a 4.5ha, unimproved field on a south facing slope, just north of junction 3 of the M20/M26 between Sevenoaks and Maidstone. The site lies amongst woodland in Troseley Country Park, which is situated on the North Downs Way. The vegetation has been classified as CG3a along the sampling transect.

Site C31 (Grid reference: TQ642611):

This is a 3ha, unimproved field on a south facing slope, just north of junction 3 of the M20/M26 between Sevenoaks and Maidstone. The site lies close to site 30 amongst the woodland of Troseley Country Park. The vegetation has been classified as CG3a along the sampling transect.

Site C32 (Grid reference: TQ830574):

This is a 21ha, arable reversion field on a south-west facing slope in Kent, east of Maidstone. Situated on the North Downs Way, the site lies amongst small villages and patches of woodland. The vegetation comprises a tall, uniform sward, classified as MG5b along the sampling transect.

Site C33 (Grid reference: TR229380):

This is an 8ha, unimproved field on a steep, south facing slope on Creteway Down, an AONB on the outskirts of Folkestone, Kent. The vegetation comprises a mix of tussocky grass, scrub and gorse and the transect has been classified as CG2b.

Site C34 (Grid reference: TR236378):

This is a 10.5ha, unimproved field on a steep, south facing slope on Creteway Down, an AONB on the outskirts of Folkestone, Kent. The transect, classified as CG4c, lies close to two pill boxes, a large patch of gorse and piece of rough grassland.

Site C35 (Grid reference: TR283394):

This is a 4.5ha, semi-improved field on a steep, north-west facing slope in Kent, just north of the A20 on the edge of Dover. The site is situated amongst farmland, pasture and arable and north of Samphire Hoe Country Park. The vegetation, classified as CG2c along the sampling transect, comprises a tussocky sward with occasional scrub patches and mature trees.

Site C36 (Grid reference: TR294401):

This is a 4ha, unimproved field near the top of a steep, north facing slope in Kent two fields along from site C35. It is a scrubby, uneven site with slumped patches of bare earth; the transect, classified as CG2c, runs between two pill boxes.

Site C37 (Grid reference: TR293402):

This is a 4ha, arable reversion field on a north-west facing slope in Kent, situated below site C36. The vegetation comprises a variable, patchy sward, classified as MG1 along the sampling transect.

Site C38 (Grid reference: TR301403):

This is a 5.5ha, unimproved field on a steep, north facing slope in Kent adjacent sites C36 and C37. The vegetation, classified as CG2c along the sampling transect, comprises a very patchy sward, some of which is regrowth following clearance.

Site NC1 (Grid reference: SZ636855):

This is an 8ha, unimproved field on a south facing cliff top on Bembridge Down at Culver Cliffs, Isle of Wight, close to site C18. On, or adjacent, the site are a monument, battery and gun emplacements, some tumuli and coastguard cottages. The site is used regularly by walkers. The vegetation is mostly a short sward, taller towards sampling point A and has been classified as CG2a along the sampling transect.

Site NC2 (Grid reference: SZ481838):

This is a 3.5ha, unimproved field on a steep, south-east facing slope on the edge of the village of Chillerton in the centre of the Isle of Wight. The site is surrounded by farmland, mainly arable, a number of disused quarries and an ancient earthwork. The vegetation comprises a short sward and has been classified as CG2a along the sampling transect.

Site NC3 (Grid reference: SP962164):

This is a 5ha, improved field on a gentle, east facing slope in Buckinghamshire, east of Ivinghoe. The site, Ivinghoe Hills, is part of National Trust land and can be reached from the road by the Icknield Way Path. The vegetation comprises a fairly uniform sward, classified as MG7a along the sampling transect.

Site NC4 (Grid reference: TQ513622):

This is a 3ha, improved field on a gentle, north facing slope in Kent, near the village of Shoreham. The site lies amongst farmland - pasture and other arable reversion fields – and woodland and close to sites C26, C27, C28 and C29. The vegetation was classified as MG7a along the sampling transect from the first year of sampling, however, further sampling was discontinued as the field had been returned to crop.

Annex 2a: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715	SD716	SD717	SD718	SD719
NGR	TQ 212073	TQ 314134	TQ 277113	TQ 174073	TQ 189087	TQ 335131	TQ 454062	TV 569967	TQ 166113	TQ 392063	TQ 413052	TQ 477019	TQ 513029	TQ 170083	TQ 187082	TQ 294130	TQ 456065	TQ 393054	TQ 412043	TV 570970	TV 571983	TV 574967	TQ 146074	TQ 163088	TQ 183084	TQ 185069	TQ 465058	TQ 472058	TQ 508029	TV 511978	TQ 575009
species																															
Tachycixius pilosus (OLIVIER, 1791)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelisia guttula (GERMAR, 1818)	4	3	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelisia occirrega REMANE & GUGLIELMINO, 2002	18	9	0	20	12	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stenocranus minutus (FABRICIUS, 1787)	23	1	5	1	115	8	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1
Eurysa lineata (PERRIS, 1857)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Eurysanoides douglasi (SCOTT, 1870)	0	0	0	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delphacinus mesomelas (BOHEMAN, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyledelphax elegantula (BOHEMAN, 1847)	19	29	0	4	45	63	3	0	1	1	0	2	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0
Megamelodes quadrimaculatus (SIGNORET, 1865)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muellerianella fairmairei (PERRIS , 1857)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kosswigianella exigua (BOHEMAN, 1847)	1	47	128	0	0	0	0	5	7	1	0	54	31	1	0	2	1	0	0	0	8	0	0	0	0	0	0	0	17	0	0
Dicranotropis hamata (BOHEMAN, 1847)	1	0	0	0	0	0	4	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xanthodelphax straminea (STAL, 1858)	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Criomorphus albomarginatus CURTIS, 1833	1	0	1	0	22	19	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Javesella pellucida (FABRICIUS, 1794)	1	5	7	2	7	3	2	1	8	3	5	1	1	2	4	4	9	7	3	4	5	0	4	51	1	4	34	10	5	0	6
Javesella dubia (KIRSCHBAUM, 1868)	0	1	26	0	1	11	0	0	18	0	0	0	0	0	0	2	0	0	0	0	1	0	0	3	0	0	3	0	0	2	3
Javesella obscurella (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautodelphax angulosa (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautodelphax pungens (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophilaenus exclamationis (THUNBERG, 1784)	1	18	0	0	0	0	55	3	0	0	0	35	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Neophilaenus lineatus (LINNAEUS, 1758)	3	2	2	8	2	55	4	0	1	1	0	2	0	1	0	0	0	2	0	0	1	0	0	6	0	1	1	0	0	0	1
Aphrophora alni (FALLEN, 1805)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philaenus spumarius (LINNAEUS, 1758).	3	1	0	1	1	9	1	0	1	0	1	3	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Centrotus cornutus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utecha trivia (GERMAR, 1821)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megophthalmus scanicus (FALLÉN, 1806)	2	7	1	1	14	7	6	4	0	0	4	1	4	0	0	0	0	0	0	3	0	12	0	0	0	0	0	0	3	1	5
Megophthalmus scabripennis EDWARDS, 1915	2	4	0	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Macropsis fuscula (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia brachyptera (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia consobrina CURTIS, 1833	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anaceratagallia ribauti (OSSIANNILSSON, 1938)	45	0	3	0	0	0	0	1	13	97	72	0	2	0	10	0	0	1	1	0	0	0	29	24	1	1	0	0	1	0	0
Anaceratagallia venosa (FOURCROY, 1785)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 2a continued: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715	SD716	SD717	SD718	SD719
NGR	TQ 212073	TQ 314134	TQ 277113	TQ 174073	TQ 189087	TQ 335131	TQ 454062	TV 569967	TQ 166113	TQ 392063	TQ 413052	TQ 477019	TQ 513029	TQ 170083	TQ 187082	TQ 294130	TQ 456065	TQ 393054	TQ 412043	TV 570970	TV 571983	TV 574967	TQ 146074	TQ 163088	TQ 183084	TQ 185069	TQ 465058	TQ 472058	TQ 508029	TV 511978	TQ 575009
Batracomorphus irroratus LEWIS, 1834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupelix cuspidata (FABRICIUS, 1775)	7	10	1	0	0	0	11	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Aphrodes bicincta (SCHRANK, 1776)	3	2	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Aphrodes makarovi ZAKHVATKIN, 1948	2	1	2	2	3	1	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Planaphrodes bifasciata (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoscopus albifrons (LINNAEUS, 1758)	15	14	4	20	19	10	6	5	2	1	1	26	0	0	0	0	0	0	2	0	0	1	0	2	0	0	0	0	0	0	1
Anoscopus flavostriatus (DONOVAN, 1799)	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Anoscopus serratulae (FABRICIUS, 1775)	1	8	1	0	0	0	0	1	1	2	4	0	0	0	0	0	0	1	4	1	11	12	35	8	0	0	0	2	3	1	48
Evacanthus acuminatus (FABRICIUS, 1794)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evacanthus interruptus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cicadella viridis (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emelyanoviana mollicula (BOHEMAN, 1845)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dikraneura variata HARDY, 1850	0	6	0	0	9	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipata citrinella (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notus flavipennis (ZETTERSTEDT, 1828)	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fagocyba cruenta (HERRICH-SCHÄFFER, 1838)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edwardsiana crataegi (DOUGLAS, 1876)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautiana tenerrima (H.-S., 1834)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx aurata (LINNAEUS, 1758)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx origani ZAKHVATKIN, 1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx urticae (FABRICIUS, 1803)	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx stachydearum (HARDY, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx vittata (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0
Eupteryx notata CURTIS, 1937	27	6	0	13	0	0	41	0	1	1	10	5	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Alnetoidea alneti (DAHLBOM, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zyginidia scutellaris (H.-S., 1838)	208	38	57	14	99	56	120	0	56	41	20	25	10	3	0	29	3	1	1	1	1	0	6	16	1	0	2	4	24	2	3
Zygina flammigera (GEOFFROY, 1785)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zygina hyperici (HERRICH-SCHÄFFER, 1836)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arboridia parvula (BOHEMAN, 1845)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balclutha punctata (FABRICIUS, 1775)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrosteles laevis (RIBAUT, 1927)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Macrosteles viridigriseus (EDWARDS, 1922)	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Deltocephalus pulicaris (FALLÉN, 1806)	0	1	75	0	0	5	1	131	259	0	37	5	21	362	260	124	462	251	339	49	172	570	5	5	4	12	65	12	103	315	15

Annex 2a continued: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715	SD716	SD717	SD718	SD719
NGR	TQ 212073	TQ 314134	TQ 277113	TQ 174073	TQ 189087	TQ 335131	TQ 454062	TV 569967	TQ 166113	TQ 392063	TQ 413052	TQ 477019	TQ 513029	TQ 170083	TQ 187082	TQ 294130	TQ 456065	TQ 393054	TQ 412043	TV 570970	TV 571983	TV 574967	TQ 146074	TQ 163088	TQ 183084	TQ 185069	TQ 465058	TQ 472058	TQ 508029	TV 511978	TQ 575009
Recilia coronifera (MARSHALL, 1866)	0	3	0	2	8	14	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doratura stylata (BOHEMAN, 1847)	0	10	4	0	0	0	3	5	0	0	0	0	3	0	0	0	0	0	6	0	9	5	0	0	0	0	0	0	13	0	0
Allygus mixtus (FABRICIUS, 1794)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allygus modestus SCOTT, 1876	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Graphocraerus ventralis FALLÉN, 1806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhytistylus proceps (KIRSCHBAUM, 1868)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Rhopalopyx adumbrata (SAHLBERG, 1842)	0	1	0	1	1	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Elymana sulphurella (ZETTERSTEDT, 1828)	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cicadula persimilis (EDWARDS, 1920)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mocydia crocea (HERRICH-SCHÄFFER, 1837)	20	12	0	14	114	1	82	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mocydiopsis attenuata (GERMAR, 1821)	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speudotettix subfusculus (FALLEN, 1806)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thamnotettix dilutior (KIRSCHBAUM, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macustus grisescens (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Athysanus argentarius METCALF, 1955	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conosanus obsoletus (KIRSCHBAUM, 1858)	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	21	0	0	1	0	25	0	0	0	0	0	0	0	0	0	1
Euscelis incisus (KIRSCHBAUM, 1858)	0	0	26	3	1	1	0	2	31	12	1	1	30	1	5	1	1	4	12	1	0	1	2	1	2	12	0	0	2	2	3
Euscelis lineolatus BRULLE, 1832	0	0	4	4	5	0	0	43	1	1	26	0	0	5	5	0	1	3	7	103	11	4	19	24	15	43	118	49	0	77	68
Streptanus aemulans (KIRSCHBAUM, 1868)	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptanus sordidus (ZETTERSTEDT, 1828)	0	0	3	0	3	35	1	0	4	1	0	1	0	0	1	22	19	0	0	5	11	0	0	4	1	0	0	0	0	2	10
Arocephalus punctum (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix albomarginatus WAGNER, 1941	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix cephalotes (H.-S., 1834)	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix confinis DAHLBOM, 1850	0	0	22	0	0	0	0	52	59	12	20	10	10	69	11	7	95	15	35	46	112	42	37	13	1	6	9	26	228	139	16
Psammotettix helvolus (Kirschbaum, 1868)	0	0	0	0	0	0	0	0	0	62	1	0	3	0	0	0	1	0	0	59	4	0	5	11	0	0	33	0	13	5	5
Adarrus multinotatus (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Errastunus ocellaris (FALLÉN, 1806)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turrutus socialis (FLOR, 1861)	35	12	15	4	0	1	18	7	0	0	4	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jassargus pseudocellaris (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jassargus flori (FIEBER, 1869)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthaldeus pascuellus (FALLÉN, 1826)	3	3	3	1	0	4	1	0	2	0	0	0	0	0	0	1	1	0	0	0	78	0	1	324	0	0	3	0	6	0	0
Arthaldeus striifrons (KIRSCHBAUM, 1868)	14	0	1	0	20	3	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 2a continued: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40	Bac	Brush	Whin1	Whin2
NGR	ST 829335	ST 955213	ST 972363	ST 919204	ST 803345	ST 920207	ST 811354	ST 898208	SU 003259	SU 012251	ST 823368	ST 909207	SU 111247	SU 034263	SU 034272	SU 024268	ST 800047	ST 998267	ST 949242	ST 880176	SU 061239	SY 639999	ST 809088	SP860073	SP819035	TR294417	TR292415
species																											
Tachycixius pilosus (OLIVIER, 1791)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelisia guttula (GERMAR, 1818)	1	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	2	4	0	1	12	7	0	1	0	1	14
Kelisia occirrega REMANE & GUGLIELMINO, 2002	0	0	0	0	0	0	0	0	0	0	0	0	1	13	0	0	1	0	6	1	2	3	0	3	9	3	10
Stenocranus minutus (FABRICIUS, 1787)	0	0	0	0	0	0	0	0	0	0	0	0	41	46	0	0	0	0	1	0	5	0	0	8	0	29	6
Eurysa lineata (PERRIS, 1857)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Eurysanoides douglasi (SCOTT, 1870)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Delphacinus mesomelas (BOHEMAN, 1850)	3	8	2	0	0	6	2	2	0	0	0	0	6	0	7	0	0	4	0	0	3	0	0	0	0	0	0
Hyledelphax elegantula (BOHEMAN, 1847)	3	0	0	0	0	208	0	0	0	0	6	0	95	48	8	35	1	56	35	4	44	0	40	7	46	100	41
Megamelodes quadrimaculatus (SIGNORET, 1865)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muellerianella fairmairei (PERRIS , 1857)	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	6	0	0	0	0	20	0	0	0	0	5	0
Kosswigianella exigua (BOHEMAN, 1847)	27	80	9	0	89	14	55	9	48	36	0	1	9	0	6	4	91	2	35	95	25	15	6	1	0	3	0
Dicranotropis hamata (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Xanthodelphax straminea (STAL, 1858)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Criomorphus albomarginatus CURTIS, 1833	0	0	0	0	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Javesella pellucida (FABRICIUS, 1794)	0	3	0	7	0	2	0	4	2	0	0	5	2	1	11	2	4	0	2	0	6	0	16	6	3	3	1
Javesella dubia (KIRSCHBAUM, 1868)	0	1	0	10	0	3	1	2	0	0	1	17	0	0	3	2	0	0	0	0	0	0	16	0	1	3	0
Javesella obscurella (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautodelphax angulosa (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Ribautodelphax pungens (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophilaenus exclamationis (THUNBERG, 1784)	95	22	15	1	113	14	5	59	7	0	0	0	0	0	0	0	10	16	0	12	2	43	1	5	0	0	0
Neophilaenus lineatus (LINNAEUS, 1758)	0	1	0	0	0	0	1	2	1	1	0	0	14	0	1	0	0	0	0	0	3	1	0	1	0	2	1
Aphrophora alni (FALLEN, 1805)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2	1	1	0
Philaenus spumarius (LINNAEUS, 1758).	12	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	2	4	11	3	2	4	4	2
Centrotus cornutus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Utecha trivia (GERMAR, 1821)	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	24	0	0	0	0	0	0	0	0
Megophthalmus scanicus (FALLÉN, 1806)	0	1	0	1	8	16	0	0	0	0	0	0	120	3	2	0	0	0	3	3	1	3	0	0	0	0	2
Megophthalmus scabripennis EDWARDS, 1915	1	0	0	0	34	16	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	15	0	0	24	1	4
Macropsis fuscula (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia brachyptera (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia consobrina CURTIS, 1833	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Anaceratagallia ribauti (OSSIANNILSSON, 1938)	0	0	0	0	0	2	0	0	0	12	0	0	0	11	0	0	0	0	0	4	0	0	0	1	1	6	25
Anaceratagallia venosa (FOURCROY, 1785)	2	0	1	0	1	3	0	0	1	0	0	0	0	0	0	0	0	0	3	5	0	1	0	0	7	0	0

Annex 2a continued: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40	Bac	Brush	Whin1	Whin2
NGR	ST 829335	ST 955213	ST 972363	ST 919204	ST 803345	ST 920207	ST 811354	ST 898208	SU 003259	SU 012251	ST 823368	ST 909207	SU 111247	SU 034263	SU 034272	SU 024268	ST 800047	ST 998267	ST 949242	ST 880176	SU 061239	SY 639999	ST 809088	SP860073	SP819035	TR294417	TR292415
Batracomorphus irroratus LEWIS, 1834	0	1	0	0	2	0	0	0	0	0	0	0	0	5	0	0	4	0	57	0	0	0	0	0	0	0	3
Eupelix cuspidata (FABRICIUS, 1775)	4	13	0	0	4	0	1	0	33	30	0	0	0	0	0	0	14	0	6	4	0	3	1	15	0	3	1
Aphrodes bicincta (SCHRANK, 1776)	2	40	0	0	0	2	0	0	0	2	0	0	2	3	1	0	2	0	1	0	21	0	4	0	0	1	4
Aphrodes makarovi ZAKHVATKIN, 1948	2	4	0	0	0	7	0	1	0	1	0	0	10	4	2	0	1	0	11	2	3	1	3	11	1	1	6
Planaphrodes bifasciata (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoscopus albifrons (LINNAEUS, 1758)	2	8	1	4	2	23	0	3	1	0	1	1	7	7	13	0	6	6	2	8	27	8	3	23	16	17	10
Anoscopus flavostriatus (DONOVAN, 1799)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	3
Anoscopus serratulae (FABRICIUS, 1775)	0	0	0	0	0	0	0	1	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	1	0	11	1
Evacanthus acuminatus (FABRICIUS, 1794)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2
Evacanthus interruptus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1	0	0
Cicadella viridis (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emelyanoviana mollicula (BOHEMAN, 1845)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0
Dikraneura variata HARDY, 1850	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Forcipata citrinella (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notus flavipennis (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fagocyba cruenta (HERRICH-SCHÄFFER, 1838)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edwardsiana crataegi (DOUGLAS, 1876)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautiana tenerrima (H.-S., 1834)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx aurata (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx origani ZAKHVATKIN, 1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	11	0
Eupteryx urticae (FABRICIUS, 1803)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx stachydearum (HARDY, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Eupteryx vittata (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0
Eupteryx notata CURTIS, 1937	133	37	39	1	0	67	9	34	77	18	2	2	40	0	6	2	15	32	38	40	53	5	2	7	42	0	3
Alnetoidea alneti (DAHLBOM, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zyginidia scutellaris (H.-S., 1838)	18	422	0	1	27	50	8	2	4	173	0	2	74	139	64	5	37	2	32	90	41	122	13	15	11	99	126
Zygina flammigera (GEOFFROY, 1785)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Zygina hyperici (HERRICH-SCHÄFFER, 1836)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arboridia parvula (BOHEMAN, 1845)	0	0	0	0	49	0	0	0	0	0	0	0	0	535	0	1	4	0	52	0	2	9	0	6	2	11	11
Balclutha punctata (FABRICIUS, 1775)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Macrosteles laevis (RIBAUT, 1927)	0	0	0	2	0	0	5	2	0	0	0	14	0	0	0	1	36	3	1	0	0	0	22	0	0	0	0
Macrosteles viridigriseus (EDWARDS, 1922)	0	0	0	19	0	2	15	2	0	0	2	50	3	0	0	1	1	0	3	0	0	0	8	0	0	0	0
Deltocephalus pulicaris (FALLÉN, 1806)	1	8	6	1	1	6	130	5	0	0	29	12	0	0	2	9	24	0	41	1	3	0	239	0	0	38	1

Annex 2a continued: Auchenorryncha of sites sampled in 1998 and 2000

Site code	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40	Bac	Brush	Whin1	Whin2
NGR	ST 829335	ST 955213	ST 972363	ST 919204	ST 803345	ST 920207	ST 811354	ST 898208	SU 003259	SU 012251	ST 823368	ST 909207	SU 111247	SU 034263	SU 034272	SU 024268	ST 800047	ST 998267	ST 949242	ST 880176	SU 061239	SY 639999	ST 809088	SP860073	SP819035	TR294417	TR292415
Recilia coronifera (MARSHALL, 1866)	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	1	1	0	0	11	3	0	0
Doratura stylata (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
Allygus mixtus (FABRICIUS, 1794)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allygus modestus SCOTT, 1876	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Graphocraerus ventralis FALLÉN, 1806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhytistylus proceps (KIRSCHBAUM, 1868)	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
Rhopalopyx adumbrata (SAHLBERG, 1842)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Elymana sulphurella (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Cicadula persimilis (EDWARDS, 1920)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mocydia crocea (HERRICH-SCHÄFFER, 1837)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	6	31	41
Mocydiopsis attenuata (GERMAR, 1821)	0	0	0	0	4	0	0	0	0	1	0	0	15	53	1	0	0	0	0	0	1	0	0	9	4	1	0
Speudotettix subfusculus (FALLEN, 1806)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thamnotettix dilutior (KIRSCHBAUM, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Macustus grisescens (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Athysanus argentarius METCALF, 1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conosanus obsoletus (KIRSCHBAUM, 1858)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	6	0	0	0	0
Euscelis incisus (KIRSCHBAUM, 1858)	7	48	9	8	0	3	20	10	5	34	10	62	3	1	50	18	40	5	32	10	14	0	94	0	0	24	2
Euscelis lineolatus BRULLE, 1832	0	0	0	2	0	0	5	0	0	1	0	3	0	1	4	1	0	0	2	0	0	0	1	0	0	0	0
Streptanus aemulans (KIRSCHBAUM, 1868)	0	0	0	1	0	0	0	0	0	0	1	3	2	0	1	6	0	0	0	0	0	0	2	0	0	6	0
Streptanus sordidus (ZETTERSTEDT, 1828)	0	0	0	6	0	1	6	2	0	0	0	2	2	0	0	1	0	0	0	0	3	0	17	0	0	9	0
Arocephalus punctum (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Psammotettix albomarginatus WAGNER, 1941	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix cephalotes (H.-S., 1834)	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	7	0	0	0	2	0
Psammotettix confinis DAHLBOM, 1850	0	1	1	8	1	3	126	0	1	3	0	4	0	0	6	4	6	0	10	4	0	0	5	0	0	3	0
Psammotettix helvolus (Kirschbaum, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adarrus multinotatus (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Errastunus ocellaris (FALLÉN, 1806)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turrutus socialis (FLOR, 1861)	12	28	7	2	28	24	2	13	32	19	0	0	0	0	2	1	34	5	28	62	15	26	1	70	1	3	42
Jassargus pseudocellaris (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Jassargus flori (FIEBER, 1869)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0
Arthaldeus pascuellus (FALLÉN, 1826)	0	0	0	9	0	2	0	1	0	0	1	5	32	3	10	9	0	0	0	1	5	1	14	2	0	22	6
Arthaldeus striifrons (KIRSCHBAUM, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5

Annex 2b: Auchenorryncha of sites sampled in 1999 and 2002

Site code	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
NGR	TL098244	TL007209	TL006211	SP959168	SP960157	SP961154	SP917035	SP918033	SU919904	SU572815	SU572818	SU633757	SU371293	SU378290	SZ432811	SZ496758	SZ546774	SZ620862	TQ026489	TQ085489	TQ164539	TQ154541	TQ257616	TQ258615	TQ441615	TQ514619	TQ513616	TQ509617	TQ508616	TQ645612	TQ642611	TQ830574	TR229380	TR236378	TR283394	TR294401	TR293402	TR301403	SZ636855	SZ481828	SP962164	TQ513622
species																																										
Tachycixius pilosus (OLIVIER, 1791)	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelisia guttula (GERMAR, 1818)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	20	4	0	1	0	0	0	0	0	0	0	0	0
Kelisia occirrega REMANE & GUGLIELMINO, 2002	16	52	8	8	1	0	0	0	21	0	0	0	0	16	0	0	4	0	1	15	0	1	46	32	0	0	0	0	0	1	8	0	15	1	2	0	0	3	0	0	0	0
Stenocranus minutus (FABRICIUS, 1787)	52	16	25	3	0	17	0	2	1	0	1	2	0	5	0	2	11	0	0	2	3	4	18	3	9	0	5	0	0	0	0	0	4	3	3	4	0	2	0	0	3	0
Eurysa lineata (PERRIS, 1857)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eurysanoides douglasi (SCOTT, 1870)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delphacinus mesomelas (BOHEMAN, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Hyledelphax elegantula (BOHEMAN, 1847)	10	8	1	0	0	0	0	0	6	0	0	4	0	1	0	0	3	0	2	8	3	59	16	0	47	4	1	1	0	0	1	0	4	8	0	1	1	4	11	0	1	0
Megamelodes quadrimaculatus (SIGNORET, 1865)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muellerianella fairmairei (PERRIS , 1857)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	5	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kosswigianella exigua (BOHEMAN, 1847)	0	0	0	0	4	1	2	0	0	1	19	27	11	22	71	1	0	7	0	4	1	1	2	0	0	0	0	3	1	14	42	46	1	11	0	0	0	3	0	194	20	0
Dicranotropis hamata (BOHEMAN, 1847)	3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	8	9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	1	0	0	0	0
Xanthodelphax straminea (STAL, 1858)	0	0	0	0	0	6	2	3	0	0	11	0	4	0	887	2	0	1	1	0	0	0	0	0	2	62	11	0	0	0	0	2	0	0	0	0	0	0	3	0	44	0
Criomorphus albomarginatus CURTIS, 1833	13	13	2	0	0	1	0	1	2	1	0	1	0	0	0	0	24	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	2	0
Javesella pellucida (FABRICIUS, 1794)	4	9	11	1	3	11	20	59	4	20	13	5	37	6	6	30	8	4	10	0	4	12	2	1	3	6	5	33	40	0	0	1	1	3	8	0	1	3	2	2	13	37
Javesella dubia (KIRSCHBAUM, 1868)	1	0	2	0	0	4	1	5	0	0	0	0	1	0	1	32	1	13	1	0	0	0	0	0	3	8	5	0	0	0	0	0	0	0	0	2	3	10	0	0	14	0
Javesella obscurella (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautodelphax angulosa (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautodelphax pungens (RIBAUT, 1953)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
Neophilaenus exclamationis (THUNBERG, 1784)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neophilaenus lineatus (LINNAEUS, 1758)	12	7	21	6	0	17	8	0	0	0	0	2	4	1	129	0	0	0	0	2	0	13	2	0	0	1	2	0	0	3	1	15	5	1	8	17	24	1	0	0	3	0
Aphrophora alni (FALLEN, 1805)	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3	2	1	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Philaenus spumarius (LINNAEUS, 1758).	12	3	23	11	0	1	0	2	0	0	0	0	0	0	3	22	3	2	0	3	6	4	0	0	4	1	1	0	0	0	0	11	0	0	2	14	16	2	0	0	0	0
Centrotus cornutus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utecha trivia (GERMAR, 1821)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0
Megophthalmus scanicus (FALLÉN, 1806)	0	0	0	0	12	8	0	0	0	0	1	34	0	1	0	0	2	0	0	1	9	43	3	1	12	0	0	0	1	0	1	0	0	0	5	4	2	1	0	0	0	0
Megophthalmus scabripennis EDWARDS, 1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	9	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	5	0	1	6	0	0	0
Macropsis fuscula (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia brachyptera (BOHEMAN, 1847)	4	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agallia consobrina CURTIS, 1833	18	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Anaceratagallia ribauti (OSSIANNILSSON, 1938)	0	9	7	0	9	0	0	0	5	13	6	42	8	7	0	0	45	22	0	22	7	5	0	0	109	32	15	15	6	4	1	0	27	22	0	0	0	0	7	0	0	0
Anaceratagallia venosa (FOURCROY, 1785)	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Batracomorphus irroratus LEWIS, 1834	0	182	26	3	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Annex 2b continued: Auchenorryncha of sites sampled in 1999 and 2002

Site code	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
NGR	TL098244	TL007209	TL006211	SP959168	SP960157	SP961154	SP917035	SP918033	SU919904	SU572815	SU572818	SU633757	SU371293	SU378290	SZ432811	SZ496758	SZ546774	SZ620862	TQ026489	TQ085489	TQ164539	TQ154541	TQ257616	TQ258615	TQ441615	TQ514619	TQ513616	TQ509617	TQ508616	TQ645612	TQ642611	TQ830574	TR229380	TR236378	TR283394	TR294401	TR293402	TR301403	SZ636855	SZ481828	SP962164	TQ513622
species																																										
Eupelix cuspidata (FABRICIUS, 1775)	0	1	3	12	25	0	1	0	22	1	0	0	0	2	6	0	8	0	0	10	1	0	14	5	19	0	0	0	1	16	95	75	31	140	0	0	0	1	0	5	0	0
Aphrodes bicincta (SCHRANK, 1776)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4	0	5	0	0	0	0	3	15	0	8	2	0	4	0	2	0	0	0	0
Aphrodes makarovi ZAKHVATKIN, 1948	7	10	7	2	8	0	2	0	0	1	1	8	3	0	0	60	18	5	3	0	23	0	7	1	7	0	8	8	5	19	17	3	12	2	2	15	16	7	5	1	0	2
Planaphrodes bifasciata (LINNAEUS, 1758)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoscopus albifrons (LINNAEUS, 1758)	2	10	33	5	5	44	4	1	3	0	0	12	5	2	159	12	6	1	0	5	4	4	14	4	1	5	0	1	2	4	5	16	15	65	9	8	15	7	19	17	6	0
Anoscopus flavostriatus (DONOVAN, 1799)	10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	1	0	7	0	4	0	0	0	0
Anoscopus serratulae (FABRICIUS, 1775)	3	1	1	1	1	39	8	1	0	17	32	106	87	106	32	3	4	22	0	0	2	2	0	0	22	78	131	4	36	2	0	92	3	12	12	11	9	1	39	1	92	4
Evacanthus acuminatus (FABRICIUS, 1794)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evacanthus interruptus (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cicadella viridis (LINNAEUS, 1758)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emelyanoviana mollicula (BOHEMAN, 1845)	3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	1	3	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dikraneura variata HARDY, 1850	25	6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipata citrinella (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notus flavipennis (ZETTERSTEDT, 1828)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fagocyba cruenta (HERRICH-SCHÄFFER, 1838)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edwardsiana crataegi (DOUGLAS, 1876)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribautiana tenerrima (H.-S., 1834)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx aurata (LINNAEUS, 1758)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Eupteryx origani ZAKHVATKIN, 1948	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	27	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Eupteryx urticae (FABRICIUS, 1803)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Eupteryx stachydearum (HARDY, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx vittata (LINNAEUS, 1758)	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupteryx notata CURTIS, 1937	0	4	1	0	23	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	3	2	1	0	26	0	0	1	1	1	4	2	2	0	0	0	0	0	0	0	0	0
Alnetoidea alneti (DAHLBOM, 1850)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Zyginidia scutellaris (H.-S., 1838)	75	18	9	18	46	71	6	5	29	2	1	9	6	89	60	19	159	1	3	58	85	34	78	31	56	27	75	0	1	37	60	24	100	42	46	81	53	60	0	54	13	0
Zygina flammigera (GEOFFROY, 1785)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zygina hyperici (HERRICH-SCHÄFFER, 1836)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arboridia parvula (BOHEMAN, 1845)	54	103	21	82	171	0	0	0	1	0	0	0	0	1	0	2	1	0	0	2	162	4	8	1	14	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balclutha punctata (FABRICIUS, 1775)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrosteles laevis (RIBAUT, 1927)	0	0	0	0	0	3	35	9	0	0	0	4	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	7	1
Macrosteles viridigriseus (EDWARDS, 1922)	0	0	0	0	0	2	5	93	0	0	8	0	0	0	0	2	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Deltocephalus pulicaris (FALLÉN, 1806)	1	0	3	1	3	214	142	97	2	105	455	3	225	40	3	65	0	243	126	0	2	10	0	0	0	532	282	85	80	0	0	22	2	1	70	22	22	121	3	2	363	16
Recilia coronifera (MARSHALL, 1866)	1	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	59	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0

Annex 2b continued: Auchenorryncha of sites sampled in 1999 and 2002

Site code	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
NGR	TL098244	TL007209	TL006211	SP959168	SP960157	SP961154	SP917035	SP918033	SU919904	SU572815	SU572818	SU633757	SU371293	SU378290	SZ432811	SZ496758	SZ546774	SZ620862	TQ026489	TQ085489	TQ164539	TQ154541	TQ257616	TQ258615	TQ441615	TQ514619	TQ513616	TQ509617	TQ508616	TQ645612	TQ642611	TQ830574	TR229380	TR236378	TR283394	TR294401	TR293402	TR301403	SZ636855	SZ481828	SP962164	TQ513622
species																																										
Doratura stylata (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	3	0	0	0	0	3	11	0	0
Allygus mixtus (FABRICIUS, 1794)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allygus modestus SCOTT, 1876	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Graphocraerus ventralis FALLÉN, 1806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rhytistylus proceps (KIRSCHBAUM, 1868)	0	11	17	4	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	9	11	11	0	5	0	0	0	0	0	1	1	0
Rhopalopyx adumbrata (SAHLBERG, 1842)	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elymana sulphurella (ZETTERSTEDT, 1828)	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Cicadula persimilis (EDWARDS, 1920)	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Mocydia crocea (HERRICH-SCHÄFFER, 1837)	5	12	18	36	5	1	0	0	16	0	0	1	0	1	0	0	93	0	0	6	4	20	48	98	3	0	0	0	0	20	39	1	33	53	10	16	3	5	0	0	0	0
Mocydiopsis attenuata (GERMAR, 1821)	15	7	10	3	0	0	0	0	4	0	0	8	1	7	1	0	12	0	0	0	18	0	16	2	0	1	1	0	0	0	1	3	0	0	1	0	0	0	0	0	0	0
Speudotettix subfusculus (FALLEN, 1806)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thamnotettix dilutior (KIRSCHBAUM, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macustus grisescens (ZETTERSTEDT, 1828)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Athysanus argentarius METCALF, 1955	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	5	0	0	0	0	0
Conosanus obsoletus (KIRSCHBAUM, 1858)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euscelis incisus (KIRSCHBAUM, 1858)	0	0	0	0	1	0	25	16	2	25	4	21	89	21	2	33	1	34	20	4	1	3	2	0	18	2	4	53	15	0	0	10	0	6	5	10	16	21	1	2	2	3
Euscelis lineolatus BRULLE, 1832	0	0	0	0	0	0	6	3	0	13	1	1	0	0	2	0	0	7	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Streptanus aemulans (KIRSCHBAUM, 1868)	1	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1	0	0	0	0	1
Streptanus sordidus (ZETTERSTEDT, 1828)	2	1	4	0	0	12	1	11	0	0	0	2	22	0	11	49	1	62	6	0	4	5	1	0	1	0	0	0	0	0	0	1	0	0	1	5	28	14	1	0	12	2
Arocephalus punctum (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix albomarginatus WAGNER, 1941	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix cephalotes (H.-S., 1834)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammotettix confinis DAHLBOM, 1850	2	0	0	2	1	22	59	0	0	135	227	0	13	6	176	15	2	36	14	0	0	1	0	1	0	98	119	4	13	2	0	18	1	0	9	5	68	4	13	22	70	12
Psammotettix helvolus (Kirschbaum, 1868)	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	5	0	0	1	0
Adarrus multinotatus (BOHEMAN, 1847)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Errastunus ocellaris (FALLÉN, 1806)	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0
Turrutus socialis (FLOR, 1861)	1	6	13	3	33	0	0	1	42	1	0	1	0	0	0	0	0	1	0	5	0	3	50	51	0	0	0	0	0	303	310	1	117	31	0	0	1	18	0	0	0	0
Jassargus pseudocellaris (FLOR, 1861)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jassargus flori (FIEBER, 1869)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthaldeus pascuellus (FALLÉN, 1826)	24	1	0	0	1	22	77	67	0	20	7	21	171	25	50	2	2	36	18	1	1	3	4	0	7	27	30	17	20	0	0	162	7	0	5	2	15	16	0	0	55	47
Arthaldeus striifrons (KIRSCHBAUM, 1868)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Annex 3: site facts

site code	NGR	agrienvironmental scheme	region	landuse category	NVC code	no. plants per site	no. grasses per site	no. forbs per site	proportion grasses/forbs	plant diversity index (Sha-Wie)	average veg. height (cm)	STDEV-veg.height	community variance (H)	field size (ha)	distance to nearest unimproved grassl.
SD100	TQ 212073	ESA	SD	U	CG3b	37	11	26	0,42	2,36	14,77	3,87	0,01	11	no data
SD101	TQ 314134	ESA	SD	U	CG2b	25	8	17	0,47	1,95	6,27	1,77	0,06	13	no data
SD102	TQ 277113	ESA	SD	U	CG3d	41	15	26	0,58	2,82	12,49	2,74	0,01	1	no data
SD110	TQ 174073	ESA	SD	U	CG5a	40	10	30	0,33	2,52	8,54	1,96	0,02	9	no data
SD111	TQ 189087	ESA	SD	SI	CG4c	46	14	32	0,44	2,17	14,89	4,11	0,02	18	0
SD112	TQ 335131	ESA	SD	U	CG2a	28	12	16	0,75	1,61	15,14	2,63	0,08	16	no data
SD117	TQ 454062	ESA	SD	U	CG5a	41	12	29	0,41	2,22	8,31	2,25	0,01	49	no data
SD119	TV 569967	ESA	SD	U	CG2c	37	14	23	0,61	2,15	6,99	1,97	0,04	24	no data
SD210	TQ 166113	ESA	SD	SI	CG2c	48	19	29	0,66	1,89	7,96	1,67	0,03	10	>2000
SD211	TQ 392063	ESA	SD	I	MG6a	34	10	24	0,42	1,39	11,82	2,72	0,09	7	300
SD215	TQ 413052	ESA	SD	SI	MG5b	34	9	25	0,36	2,20	5,88	1,57	0,05	5,5	0
SD216	TQ 477019	ESA	SD	SI	CG2c	36	13	23	0,57	2,14	4,53	0,93	0,02	9,5	1000
SD217	TQ 513029	ESA	SD	SI	CG2c	34	9	25	0,36	2,35	5,12	1,07	0,02	7	400
SD300	TQ 170083	ESA	SD	I	MG6c	26	12	14	0,86	1,92	6,11	1,46	0,01	15	1000
SD301	TQ 187082	ESA	SD	I	MG7a	23	11	12	0,92	1,21	8,03	1,51	0,02	15	1650
SD302	TQ 294130	ESA	SD	I	MG7a	23	10	13	0,77	2,14	5,92	0,96	0,02	13	750
SD303	TQ 456065	ESA	SD	I	MG6c	29	11	18	0,61	1,84	5,05	1,12	0,02	49	0
SD312	TQ 393054	ESA	SD	I	MG6a	25	10	15	0,67	1,79	4,19	1,01	0,07	5,5	450
SD314	TQ 412043	ESA	SD	SI	MG5b	31	9	22	0,41	2,57	6,42	1,74	0,04	21,5	0
SD317	TV 570970	ESA	SD	I	MG6c	26	9	17	0,53	2,01	3,20	0,64	0,04	5,5	0
SD318	TV 571983	ESA	SD	I	MG6c	31	12	19	0,63	1,64	6,03	1,46	0,06	11,5	2150
SD319	TV 574967	ESA	SD	I	MG6c	30	7	23	0,30	2,36	3,31	0,75	0,04	24	600
SD710	TQ 146074	ESA	SD	AR	MG7b	28	9	19	0,47	2,28	12,78	3,01	0,02	6	400
SD711	TQ 163088	ESA	SD	AR	MG7b	16	9	7	1,29	0,84	14,53	3,12	0,02	7,5	600
SD712	TQ 183084	ESA	SD	AR	MG7b	14	8	6	1,33	0,76	5,23	1,17	0,00	17	1700
SD713	TQ 185069	ESA	SD	AR	MG7b	20	7	13	0,54	0,78	8,91	2,34	0,02	23,5	0
SD715	TQ 465058	ESA	SD	AR	MG7b	10	8	2	4,00	0,75	10,11	1,90	0,01	12	500
SD716	TQ 472058	ESA	SD	AR	MG7b	10	5	5	1,00	0,81	13,11	2,64	0,01	11,6	400
SD717	TQ 508029	ESA	SD	AR	MG5a	36	11	25	0,44	2,20	8,41	1,86	0,02	16,5	0
SD718	TV 511978	ESA	SD	AR	MG7a	30	10	20	0,50	1,45	9,26	1,57	0,04	8	0
SD719	TQ 575009	ESA	SD	AR	MG7a	27	9	18	0,50	1,10	9,95	2,23	0,04	5	0
SWD2	ST 829335	ESA	SWD	U	CG2a	33	6	27	0,22	2,30	6,34	1,66	0,05	70,5	no data
SWD3	ST 955213	ESA	SWD	U	CG2b	41	13	28	0,46	2,42	6,72	1,50	0,02	24,5	no data
SWD6	ST 972363	ESA	SWD	U	CG2c	46	14	32	0,44	2,25	4,22	0,80	0,02	8,5	no data
SWD8	ST 919204	ESA	SWD	I	MG6a	29	15	14	1,07	1,72	13,40	2,33	0,01	7	0
SWD9	ST 803345	ESA	SWD	U	CG2b	36	15	21	0,71	2,53	6,77	1,72	0,02	18	no data
SWD10	ST 920207	ESA	SWD	U	CG2c	45	17	28	0,61	2,24	11,64	2,30	0,02	37	no data
SWD12	ST 811354	ESA	SWD	I	CG2c	45	15	30	0,50	2,42	5,86	1,34	0,02	28,5	250
SWD13	ST 898208	ESA	SWD	U	CG2c	44	17	27	0,63	2,01	5,80	1,32	0,03	13,5	no data
SWD14	SU 003259	ESA	SWD	I	CG2b	48	15	33	0,45	2,53	3,67	0,76	0,02	12	850
SWD15	SU 012251	ESA	SWD	U	CG3c	40	12	28	0,43	2,40	4,04	0,80	0,02	15	no data
SWD17	ST 823368	ESA	SWD	U	CG2c	34	13	21	0,62	2,08	5,83	1,31	0,02	14,5	no data
SWD18	ST 909207	ESA	SWD	I	MG7a	14	5	9	0,56	1,09	9,00	1,58	0,02	4,5	0
SWD20	SU 111247	ESA	SWD	U	CG2c	42	12	30	0,40	2,40	17,92	4,20	0,04	12	no data
SWD22	SU 034263	ESA	SWD	I	MG1	44	13	30	0,43	2,05	24,55	7,04	0,02	22	1650
SWD23	SU 034272	ESA	SWD	I	MG5b	43	16	27	0,59	2,67	11,61	3,01	0,02	12,5	850
SWD27	SU 024268	ESA	SWD	I	MG5b	36	14	22	0,64	2,08	5,09	1,37	0,05	11,5	1150
SWD28	ST 800047	ESA	SWD	U	CG2b	40	14	26	0,54	2,24	5,07	0,92	0,02	24,5	no data

Annex 3 continued: site facts

site code	NGR	agrienvironmental scheme	region	landuse category	NVC code	no. plants per site	no. grasses per site	no. forbs per site	proportion grasses/forbs	plant diversity index (Sha-Wie)	average veg. height (cm)	STDEV-veg.height	community variance (H)	field size (ha)	distance to nearest unimproved grassl.
SWD29	ST998267	ESA	SWD	U	CG2c	33	14	19	0,74	2,37	6,51	1,52	0,02	18	no data
SWD30	ST 949242	ESA	SWD	U	CG2a	41	13	28	0,46	2,18	7,29	1,73	0,02	28	no data
SWD31	ST 880176	ESA	SWD	U	CG2a	25	10	15	0,67	2,35	5,34	1,10	0,01	3,5	no data
SWD35	SU 061239	ESA	SWD	U	CG2b	43	15	28	0,54	2,64	10,24	2,67	0,03	19	no data
SWD38	SY 639999	ESA	SWD	U	CG2a	33	11	22	0,50	2,46	6,77	1,50	0,01	8	no data
SWD40	ST 809088	ESA	SWD	U	MG5b	41	15	25	0,60	1,95	8,21	2,07	0,06	11,5	no data
CS1	TL098244	CS	Chilterns	U	CG2c	47	13	34	0,38	1,94	20,10	5,85	0,04	6	no data
CS2	TL007209	CS	Chilterns	U	CG3b	46	10	36	0,28	2,03	10,94	4,73	0,01	2,5	no data
CS3	TL006211	CS	Chilterns	U	CG3b	45	14	31	0,45	2,27	12,71	3,89	0,01	12,5	no data
CS4	SP959168	CS	Chilterns	U	CG3a	48	11	37	0,30	1,64	10,26	2,68	0,02	19	no data
CS5	SP960157	CS	Chilterns	U	CG2a	47	16	31	0,52	2,15	4,78	1,33	0,01	12	no data
CS6	SP961154	CS	Chilterns	I	CG3d	36	14	22	0,64	2,12	8,37	3,01	0,01	4	300
CS7	SP917035	CS	Chilterns	AR	MG6a	30	11	19	0,58	1,15	15,08	3,68	0,01	3	200
CS8	SP918033	CS	Chilterns	SI	MG6a	28	13	15	0,87	1,67	10,08	2,75	0,01	3	0
CS9	SU919904	CS	Chilterns	U	CG3b	41	10	31	0,32	2,25	9,31	2,98	0,01	2,5	no data
CS10	SU572815	CS	Chilterns	AR	MG6a	29	10	19	0,53	1,66	5,94	2,04	0,00	10,5	no data
CS11	SU572818	CS	Chilterns	SI	MG6a	29	10	19	0,53	1,62	7,73	1,98	0,01	11,5	no data
CS12	SU633757	CS	Chilterns	AR	MG5b	36	9	27	0,33	1,52	20,04	9,35	0,01	1	no data
CS13	SU371293	CS	SWD	AR	MG6a	34	14	20	0,70	1,95	8,45	1,96	0,01	14	>2000
CS14	SU378290	CS	SWD	SI	MG1a	33	11	22	0,50	1,86	16,12	3,85	0,01	4	>2000
CS15	SZ432811	CS	SD	AR	n.a.	20	10	10	1,00	1,55	11,66	2,09	0,01	5	>2000
CS16	SZ496758	CS	SD	I	MG5	41	10	31	0,32	1,98	8,22	2,17	0,01	1	350
CS17	SZ546774	CS	SD	U	M1a	63	14	49	0,29	2,47	12,88	3,90	0,01	2	no data
CS18	SZ620862	CS	SD	SI	MG6c	36	15	21	0,71	1,56	7,05	1,82	0,02	6	0
CS19	TQ026489	CS	ND	AR	MG6a	31	10	21	0,48	1,38	4,63	1,83	0,02	3	>2000
CS20	TQ085489	CS	ND	U	CG2a	47	14	33	0,42	1,89	7,80	1,73	0,02	3,5	no data
CS21	TQ164539	CS	ND	SI	MG1d	46	10	36	0,28	2,37	10,96	3,63	0,01	0,5	no data
CS22	TQ154541	CS	ND	SI	MG1a	44	13	31	0,42	2,45	12,30	3,94	0,01	1	no data
CS23	TQ257616	CS	ND	U	CG2a	43	19	24	0,79	2,34	14,02	3,76	0,02	1	no data
CS24	TQ258615	CS	ND	U	CG2a	38	12	26	0,46	1,75	19,09	3,89	0,03	2	no data
CS25	TQ441615	CS	ND	U	CG2c	52	12	40	0,30	2,53	12,73	6,20	0,01	1,5	no data
CS26	TQ514619	CS	ND	I	MG7b	24	7	17	0,41	1,61	8,34	1,68	0,01	4,5	1000
CS27	TQ513616	CS	ND	I	MG7a	30	11	19	0,58	1,65	6,77	1,38	0,01	5,5	750
CS28	TQ509617	CS	ND	AR	MG6a	34	9	25	0,36	1,94	5,18	1,78	0,01	4	350
CS29	TQ508616	CS	ND	AR	MG6a	40	11	29	0,38	2,05	5,47	2,15	0,01	7	0
CS30	TQ645612	CS	ND	U	CG3a	43	13	30	0,43	1,55	6,10	1,27	0,01	4,5	no data
CS31	TQ642611	CS	ND	U	CG3a	40	9	31	0,29	1,64	7,30	2,89	0,01	3	no data
CS32	TQ830574	CS	ND	AR	MG5b	34	13	21	0,62	1,10	10,28	2,59	0,04	21	>2000
CS33	TR229380	CS	ND	U	CG2b	39	7	32	0,22	1,18	14,35	3,91	0,03	8	no data
CS34	TR236378	CS	ND	U	CG4c	57	14	43	0,33	2,28	18,29	4,81	0,03	10,5	no data
CS35	TR283394	CS	ND	SI	CG2c	49	16	33	0,48	2,51	6,13	2,18	0,02	4,5	0
CS36	TR294401	CS	ND	U	CG2c	55	17	38	0,45	1,68	11,95	3,51	0,01	4	no data
CS37	TR293402	CS	ND	AR	MG1	29	9	20	0,45	1,77	7,46	2,37	0,02	4	0
CS38	TR301403	CS	ND	U	CG2c	63	17	46	0,37	2,38	9,49	2,40	0,01	5,5	no data
NC1	SZ636855	none	SD	U	CG2a	49	18	31	0,58	2,37	5,30	1,44	0,01	8	no data
NC2	SZ481828	none	SD	U	CG2a	36	16	20	0,80	2,34	5,77	1,94	0,01	3,5	no data
NC3	SP962164	none	Chilterns	I	MG7a	24	10	14	0,71	1,19	8,79	2,30	0,01	5	1400
NC4	TQ513622	none	ND	I	MG7a	22	8	14	0,57	1,00	6,55	1,38	0,01	3	1000

Annex 4: Auchenorryncha data per site

site code	sum Auchenorrhyncha species	sum indentif. specim. (excl. nymphs)	all specimens (incl. nymphs)	sum chalk grassland species	sum dry grassland species	sum euryoecic species	sum nitrophilic species
SD100	28	465	1253	5	10	6	5
SD101	29	256	1155	4	10	9	5
SD102	22	391	2180	2	6	7	7
SD110	21	119	611	5	5	5	4
SD111	27	564	2823	3	5	6	4
SD112	29	356	2677	2	4	10	9
SD117	29	391	898	5	9	10	6
SD119	15	264	597	1	5	4	3
SD210	18	467	2443	1	3	5	4
SD211	18	249	1092	2	4	4	4
SD215	15	208	815	3	4	4	4
SD216	17	192	1024	2	4	4	3
SD217	14	121	2633	3	5	3	2
SD300	8	444	839	1	1	1	2
SD301	9	298	527	1	2	1	2
SD302	11	216	790	1	2	3	4
SD303	14	597	882	2	3	2	3
SD312	9	285	592	1	2	2	3
SD314	12	415	1072	1	3	5	4
SD317	10	272	764	2	2	2	3
SD318	18	458	2233	2	6	7	4
SD319	11	651	1091	0	1	4	3
SD710	12	145	544	2	3	5	5
SD711	20	501	1927	2	5	5	5
SD712	9	27	110	1	2	1	2
SD713	7	79	381	0	1	1	2
SD715	9	268	806	2	3	2	2
SD716	6	103	518	1	1	2	2
SD717	14	422	1187	2	4	4	5
SD718	10	546	920	2	3	2	3
SD719	18	192	610	2	4	5	6
SWD2	18	330	1195	3	6	5	4
SWD3	19	741	2658	4	8	3	3
SWD6	11	92	663	1	3	2	2
SWD8	19	86	559	2	4	5	4
SWD9	15	365	1876	4	8	2	1
SWD10	24	477	2649	3	7	6	5
SWD12	17	393	1459	2	6	1	2
SWD13	18	154	523	2	4	5	5
SWD14	14	216	834	3	5	1	1
SWD15	14	332	1016	4	6	1	2
SWD17	9	53	754	0	1	5	3
SWD18	16	186	1986	1	2	4	3
SWD20	24	516	2978	3	4	8	6
SWD22	21	881	2259	4	6	6	5
SWD23	20	200	1743	3	5	6	4
SWD27	19	109	1118	2	3	5	4
SWD28	21	337	1697	6	8	4	3
SWD29	11	135	1015	3	3	2	1
SWD30	26	430	1452	5	9	6	4

Annex 4 continued: Auchenorryncha data per site

site code	sum Auchenorrhyncha species	sum indentif. specim. (excl. nymphs)	all specimens (incl. nymphs)	sum chalk grassland species	sum dry grassland species	sum euryoecic species	sum nitrophilic species
SWD31	22	384	1427	4	8	7	5
SWD35	27	319	2703	5	6	6	6
SWD38	18	281	728	4	6	4	3
SWD40	25	523	2640	2	7	8	5
CS1	38	394	1364	5	9	9	7
CS2	28	509	1246	5	10	7	5
CS3	30	285	793	7	11	8	5
CS4	21	205	519	6	8	4	4
CS5	25	436	722	6	10	6	5
CS6	23	506	1215	1	3	7	5
CS7	20	408	962	1	4	7	5
CS8	18	377	1708	2	4	6	6
CS9	21	166	437	5	7	4	5
CS10	14	355	886	2	4	5	6
CS11	16	788	1177	1	2	5	7
CS12	26	322	996	3	7	9	7
CS13	19	691	2059	2	5	6	5
CS14	20	360	865	3	6	5	5
CS15	18	1600	5584	2	5	6	4
CS16	24	427	1288	1	3	7	6
CS17	31	452	1460	4	7	7	7
CS18	22	519	2063	3	7	7	6
CS19	14	233	599	2	3	5	4
CS20	25	171	525	3	7	5	4
CS21	36	452	893	3	9	9	8
CS22	36	314	1048	4	9	9	8
CS23	30	353	1165	6	10	7	5
CS24	14	232	543	4	6	2	2
CS25	29	396	1534	2	7	8	6
CS26	17	886	1593	3	6	7	4
CS27	18	703	1508	2	4	7	6
CS28	13	226	1443	0	1	6	5
CS29	15	223	700	2	4	5	5
CS30	17	459	692	4	7	3	2
CS31	20	620	1168	5	8	4	1
CS32	26	528	1806	4	7	8	6
CS33	27	398	998	5	9	6	5
CS34	24	419	761	3	9	8	6
CS35	22	205	378	4	4	7	7
CS36	20	235	472	1	3	6	7
CS37	23	311	783	2	5	7	6
CS38	27	318	1056	4	8	7	7
NC1	16	154	492	1	3	7	4
NC2	13	313	2423	1	4	5	4
NC3	23	747	1608	2	4	7	6
NC4	10	125	436	0	0	5	5
Bac	29	235	655	5	9	6	5
Brush	29	236	680	5	10	7	4
Whin1	39	478	1473	5	9	11	9
Whin2	31	386	989	6	10	8	6

Annex 5a: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715
Achillea millefolium	0	0	2	1	2	0	0	0	1	0	0	2	9	2	1	2	3	0	1	0	0	0	0	0	0	0	0
Agrimonia eupatoria	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis capillaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Agrostis gigantea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Agrostis stolonifera	0	0	3	0	0	0	0	0	3	0	0	0	0	3	0	1	0	0	1	0	0	1	1	2	0	0	0
Anacamptis pyramidalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anagallis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anisantha sterilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthoxanthum odoratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthriscus sylvestris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthyllis vulneraria	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphanes arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctium minus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arenaria serpyllifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arrhenatherum elatius	14	0	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artemisia vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asperula cynanchica	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare ground	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bellis perennis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Blacstonia perfoliata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachypodium pinnatum	0	0	0	22	50	0	40	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachypodium sylvaticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Briza media	2	0	0	3	0	0	6	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromopsis erecta	30	0	7	11	0	0	3	5	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromus hordeaceus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	1	0	0	3	0	0	1	0
Campanula glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Campanula rotundifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capsella bursa-pastoris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carduus nutans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex caryophyllea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex flacca	10	1	0	5	1	0	8	1	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex humilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centaurea nigra	4	1	2	0	4	1	1	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centaurea scabiosa	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centaurium erythraea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cerastium fontanum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cirsium acaule	7	0	0	0	0	0	2	1	1	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirsium arvense	0	0	0	0	3	0	0	0	1	0	0	0	1	0	1	0	4	0	1	0	0	1	1	0	0	0	0
Cirsium vulgare	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	2	0	0	2	0
Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinopodium vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Convolvulus arvensis	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cornus sanguinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crataegus monogyna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crepis capillaris	0	0	2	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	1	5	1	0	0	0
Cruciata laevipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cynosurus cristatus	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
Dactylis glomerata	1	1	6	0	2	1	0	0	5	0	0	1	6	2	1	5	3	1	0	1	1	0	14	1	0	1	1
Dactylorhiza fuchsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Danthonia decumbens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daucus carota	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elytrigia ssp. Repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphrasia nemorosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphrasia officinalis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca arundinacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca gigantea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca ovina	14	1	0	18	17	0	27	12	51	0	1	58	34	22	1	29	2	0	1	8	6	5	1	0	0	0	0
Festuca rubra	3	0	19	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca rubra/ovina	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filipendula vulgaris	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fragaria vesca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium mollugo	1	0	0	2	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium verum	1	1	0	1	3	0	2	0	1	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geranium dissectum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geranium molle	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Annex 5a: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715
Glechoma hederacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Gymnadenia conopsea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helianthemum nummularium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helictotrichon pratense	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helictotrichon pubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heracleum sphondylium	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocrepis comosa	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holcus lanatus	0	0	7	1	2	0	1	0	4	1	0	1	6	1	0	0	0	0	1	0	1	3	0	0	0	0	0
Hordeum secalinum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum perforatum	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypochaeris radicata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inula conyzae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knautia arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koeleria macrantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lathyrus pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon autumnalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon hispidus	2	0	1	3	1	0	3	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucanthemum vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Linum catharticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lolium perenne	0	0	4	0	0	0	0	1	0	1	0	0	0	33	58	17	45	1	0	5	3	0	14	71	71	71	71
Lotus corniculatus	1	1	2	3	1	0	1	0	0	0	0	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Luzula campestris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medicago lupulina	0	0	3	2	0	0	1	1	0	0	0	2	3	1	1	0	2	0	0	1	0	1	4	0	0	1	0
Moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myosotis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odontites vernus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ononis repens	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophrys apifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Origanum vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orobanche elatior	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orobanche minor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pastinaca sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phleum bertolonii	0	0	1	0	1	0	0	1	2	0	0	3	1	4	2	0	8	0	0	1	1	1	0	0	0	0	0
Phleum bertolonii/pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phleum pratense	0	0	3	0	0	0	0	0	0	0	1	0	1	0	1	0	4	0	0	0	1	1	0	2	0	0	1
Phleum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyteuma orbiculare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picris echioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picris hieracioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilosella officinarum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pimpinella saxifraga	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago lanceolata	4	0	9	5	4	1	1	2	0	0	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Plantago major	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Plantago media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa annua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Poa pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	13
Poa pratensis/trivialis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa trivialis	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	1	0
Polygala vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla anserina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla reptans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primula veris	0	0	0	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primula vulgaris	0	0	1	2	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0
Prunella vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quercus robur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus acris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus bulbosus	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ranunculus repens	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	1	3	0	0	0	0
Ranunculus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reseda lutea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinanthus minor	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rosa spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus L. agg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rumex acetosa	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rumex crispus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5a: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD100	SD101	SD102	SD110	SD111	SD112	SD117	SD119	SD210	SD211	SD215	SD216	SD217	SD300	SD301	SD302	SD303	SD312	SD314	SD317	SD318	SD319	SD710	SD711	SD712	SD713	SD715
Sanguisorba minor	5	1	2	0	1	1	10	2	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scabiosa columbaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio erucifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio jacobaea	0	0	2	1	0	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0
Sherardia arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sonchus asper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stachys officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stellaria graminea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stellaria media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Succisa pratensis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taraxacum sect. Ruderalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	1	0	2	0
Teucrium scorodonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thymus polytrichus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torilis nodosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tragopogon pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium campestre	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium dubium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium pratense	0	0	3	1	3	0	5	2	3	0	0	1	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Trifolium repens	0	0	3	0	0	0	0	1	1	0	0	3	3	10	22	2	23	1	0	3	1	0	7	13	34	9	6
Trisetum flavescens	0	0	6	0	0	0	0	0	0	0	1	1	1	2	0	0	0	0	1	1	0	0	1	0	0	0	0
Umbel spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Veronica arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica chamaedrys	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viburnum lantana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia cracca	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viola hirta	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viola spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5a cont.: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD716	SD717	SD718	SD719	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40
Achillea millefolium	0	0	0	0	0	0	2	8,5	0	1	3	2,5	2,5	1,5	0	0	0,5	2	3	0	4	0	0	0	0,5	0	2,5
Agrimonia eupatoria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0,5
Agrostis capillaris	0	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis gigantea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Agrostis spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis stolonifera	0	5	1	0	0	0	2,5	30	4	2	17	0,5	2	0	2	13	0	0	0,5	0	0,5	0	0	0	0	0	0
Anacamptis pyramidalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anagallis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anisantha sterilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Anthoxanthum odoratum	0	0	0	0	0	0	0	0,5	0	1	0	0,5	0	0	1,5	0	0	0	0	1,5	0	0,5	1,5	0	2,5	0	2
Anthriscus sylvestris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0
Anthyllis vulneraria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	1,5	0	0
Aphanes arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctium minus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arenaria serpyllifolia	0	0	0	0	0	0	0	0	0	0	0	0	1	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0
Arrhenatherum elatius	0	0	0	0	0	0	0	0	0	3,5	0	0,5	0	0	0	0	1	40	1	1,5	0,5	2	0	0,5	0,5	0	0,5
Artemisia vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asperula cynanchica	0	0	0	0	1,5	1,5	0	0	8	0,5	0,5	0	4,5	0	0	0	0	0	0	0	3	0	1	0	0,5	3	0
Bare ground	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bellis perennis	0	0	0	0	0	2	1	0,5	6,5	2,5	1	8,5	6	8	0	2	0	0	0,5	0	0	1,5	0	0	0,5	2	1
Blacstonia perfoliata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachypodium pinnatum	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,5	0,5	11	0	0,5	0	0
Brachypodium sylvaticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0
Briza media	0	0	0	0	2,5	21	15	0	25	19	5,5	12	25	18	9,5	0	2,5	0,5	0	0	23	10	17	22	2,5	26	1,5
Bromopsis erecta	0	0	0	0	0	0	0	0	7	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromus hordeaceus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Campanula glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Campanula rotundifolia	0	0	0	0	0	0	0	0	0	0	2,5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Capsella bursa-pastoris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carduus nutans	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0,5	0	5	0	0	0	0	0	0	0	0
Carex caryophyllea	0	0	0	0	0	2,5	6	0	0,5	0	0	0	0	0	0	0	0	0	0	0	1,5	0	4	0	0	0,5	0
Carex flacca	0	0	0	0	2,5	21	30	0	26	22	11	24	15	10	8	0	2,5	11	0	0,5	31	28	16	35	2,5	31	0
Carex humilis	0	0	0	0	0	0	0	0	0	0	0	0	1,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centaurea nigra	0	0	0	0	0	3	0	0	0	0	0	0	0	4	0	0,5	1	23	4,5	0	0,5	0,5	0	0	1	0	0
Centaurea scabiosa	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2,5	4,5	0	0	0	0	0	0	0	0	0
Centaurium erythraea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cerastium fontanum	0	0	1	0	0	0	0,5	2	0	0,5	1,5	1	1	2	2,5	0	0,5	0	1,5	1,5	0	0	1	0	0	0	0,5
Cirsium acaule	0	0	0	0	2,5	6,5	5	0	6,5	1	7	1,5	2,5	4	0	0	0,5	2	0	1	21	2,5	5	22	2	31	0,5
Cirsium arvense	0	0	0	0	0	0	0	3	0	0	2,5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	2
Cirsium vulgare	1	0	1	1	0	0	0	0	0	0	6,5	0	0,5	0	0,5	0	0	2	2	0,5	0	0	0	0	0	0	2
Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinopodium vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	2	0	0	0
Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cornus sanguinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crataegus monogyna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Crepis capillaris	0	4	0	0	0	0,5	0	0,5	0	0	2	0,5	2,5	0,5	2	0	0	0	3,5	1	0	0,5	0	0	0	0	1
Cruciata laevipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cynosurus cristatus	0	0	0	0	0,5	1,5	2,5	2,5	5,5	12	13	7	0,5	2	25	0	2	0	16	2,5	8,5	3,5	0,5	0	2,5	2	2,5
Dactylis glomerata	0	9	0	0	0	5	8,5	18	9,5	12	12	7	8,5	7	10	12	2,5	10	10	2,5	4	10	10	0	2	12	2
Dactylorhiza fuchsii	0	0	0	0	2,5	0	0	0	0	0,5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Danthonia decumbens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0
Daucus carota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16	0	0	0	0	1	0	0	0	0
Elytrigia ssp. Repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphrasia nemorosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphrasia officinalis	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	8	0	0,5	0
Festuca arundinacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0
Festuca gigantea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca ovina	0	0	0	0	2,5	34	42	21	39	41	39	42	41	39	43	0	2,5	35	33	2,5	41	36	42	38	2,5	36	2,5
Festuca rubra	0	0	0	1	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	2,5	0	0	0	0	0	0	0	0
Festuca rubra/ovina	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filipendula vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	6,5	4	0	0	1	3	2	0	0	0	0	0	2	0	0
Fragaria vesca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium mollugo	0	0	0	0	0	0	0	0	0	1	0	0,5	0	0,5	0	0	0	5,5	0	0	5,5	0	1,5	0	0	0	0
Galium verum	0	0	0	0	1	0,5	0,5	0	3,5	5,5	0	3	2,5	1	4,5	0	2	20	2,5	0	5	0,5	13	0	2,5	1,5	1,5
Geranium dissectum	0	0	0	0	0	0	0	1,5	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Geranium molle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5a cont.: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD716	SD717	SD718	SD719	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40
Glechoma hederacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnadenia conopsea	0	0	0	0	1	0	0	0	0	0,5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1,5	0	0
Helianthemum nummularium	0	0	0	0	0	6	0	0	19	0	6	0	10	0	2,5	0	0	11	0	0	8	0	21	0	0	0	0
Helictotrichon pratense	0	0	0	0	2,5	8,5	8	2	2,5	5,5	5	7	8,5	4	3,5	0	2,5	2	3,5	1	4	25	10	11	2,5	13	1,5
Helictotrichon pubescens	0	0	0	0	0	4	0,5	0	2,5	4	0,5	0	2	0	4	0	0	0	0	1,5	0	2,5	0	2	0	0	0
Heracleum sphondylium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0
Hippocrepis comosa	0	0	0	0	2	2,5	0,5	0	1	0,5	0	0,5	7	0	0	0	0	0	0	0	1	0	8	28	0	12	0
Holcus lanatus	0	4	0	0	0	1	4,5	8,5	2,5	4	15	4	0,5	0	16	16	2	4	13	2	0	5,5	6	2	2	2,5	2
Hordeum secalinum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum perforatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypochaeris radicata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,5
Inula conyzae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knautia arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	1	1	0	0	0	0	0	0	0	0	0
Koeleria macrantha	0	0	0	0	1	12	2,5	0	1,5	5,5	0,5	1,5	22	10	0	0	2	0	0	0	1,5	0,5	3	0	0	0	0
Lathyrus pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon autumnalis	0	0	0	0	0	0	0	0	0	0	0	0	8,5	0,5	0	0	0	0	2	0,5	0	0	2	0	0	0	0
Leontodon hispidus	0	0	0	0	2,5	16	22	0	20	26	5	16	23	7	0	0	2,5	17	16	2	27	34	28	27	2,5	27	2
Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucanthemum vulgare	0	0	0	0	1,5	2,5	0,5	0	0	0	0	1	0	6	0	0	2	2	0	0	2,5	0	0	0	1	0	0
Linum catharticum	0	0	0	0	1	1	0,5	0	1	1,5	0,5	1,5	0	0	0	0	2	0	0	0	0,5	0,5	0	0	1,5	2,5	0
Lolium perenne	71	1	13	17	0	0,5	7	38	0,5	1	19	5,5	6,5	12	17	43	0	0	36	1,5	0	0	0,5	0	1	0	2,5
Lotus corniculatus	0	2	0	0	0,5	7	5,5	0	16	8,5	2	7	1	0,5	4	0	2,5	0	1	0,5	6	4	13	16	2,5	8,5	1,5
Luzula campestris	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0,5	0	0
Medicago lupulina	0	2	0	0	0	1	12	0	6,5	8,5	6	15	4	3	0	2	2,5	0,5	2,5	0	4,5	16	3,5	2	2,5	2	0,5
Moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myosotis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odontites vernus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ononis repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophrys apifera	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Origanum vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orobanche elatior	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Orobanche minor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0
Pastinaca sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0,5	0	0	0	0
Phleum bertolonii	0	2	0	0	0	0	2	2	2	0	4	0,5	2,5	0	0	0	0	2	19	0	0	0	2	0,5	0	0	0
Phleum bertolonii/pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phleum pratense	0	0	0	0	0	0	0	1,5	0	1	1	1,5	0	1,5	0	0	2,5	1,5	2	1,5	0	0,5	0	0	1,5	0	1
Phleum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyteuma orbiculare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picris echioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picris hieracioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0
Pilosella officinarum	0	0	0	0	1,5	6	0,5	0	3,5	0	0	5	10	20	0	0	0	0	0	0	1	0	11	6	0	4,5	0
Pimpinella saxifraga	0	0	0	0	1	0,5	0,5	0	0	2,5	0,5	3,5	1	2	0	0	1,5	2	1	0,5	0	0	0	0	0,5	0	0
Plantago lanceolata	0	2	0	0	2	16	11	0	16	25	3	28	27	24	19	7	1,5	14	19	1,5	6,5	13	12	13	1,5	22	2,5
Plantago major	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago media	0	0	0	0	2	10	22	0	5	4	2,5	9,5	2	5	1	0	1	0	0,5	0,5	2,5	8,5	0	8	2,5	8,5	0,5
Poa annua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa pratensis	6	1	0	0	0	0	0	1	0	0	2	0	0	0	1	11	0	0	0,5	0	0,5	0	0	0	0	0	0,5
Poa pratensis/trivialis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa trivialis	18	0	1	1	0	0	0	2,5	0	0	0	1,5	0	0	0	0	0	0,5	2	1	0	0	0	0	0	0	0,5
Polygala vulgaris	0	0	0	0	1,5	0,5	1,5	0	0,5	0	0	0	0	0	0,5	0	0	0	0	0	2	0	0,5	0	1,5	1,5	0
Potentilla anserina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla reptans	0	5	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0
Primula veris	0	0	0	0	1,5	1,5	8,5	0	0	2	2	1,5	1	5,5	0	0	2,5	0	2,5	2	6,5	5,5	0	0	2,5	0	0
Primula vulgaris	0	2	0	0	0,5	3,5	5	0	3,5	6	2,5	5,5	2	6,5	3	5	1,5	0	0	1	8,5	6,5	2,5	10	1,5	8,5	1
Prunella vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quercus robur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus acris	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus bulbosus	0	1	0	0	0,5	5	2	1	1,5	8	2,5	10	8	8	2,5	0	0,5	0	7	2,5	2	4,5	0	0	2	1,5	2
Ranunculus repens	0	0	0	0	0	0,5	2	1	0	0	0	0,5	0	0	6	8,5	0	2	5	0	0	4	1	0	0	0	0,5
Ranunculus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reseda lutea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinanthus minor	0	0	0	0	2	0	0,5	0	0	0	0	0	0	0	0	0	0	0	1,5	0	0	0	0	0	0	0	0
Rosa spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus L. agg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex acetosa	0	0	0	0	0	0	1	2	0	1	0	0	2,5	0	1,5	0	0,5	4	2	1,5	0	0	0,5	0	0	0	1,5
Rumex crispus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5a cont.: average % coverage of plant species from 5 veg.-quadrates per sites (sampled in 1998 and 2000)

Site code species	SD716	SD717	SD718	SD719	SWD2	SWD3	SWD6	SWD8	SWD9	SWD10	SWD12	SWD13	SWD14	SWD15	SWD17	SWD18	SWD20	SWD22	SWD23	SWD27	SWD28	SWD29	SWD30	SWD31	SWD35	SWD38	SWD40
Sanguisorba minor	0	2	0	0	2,5	30	20	0	32	27	5,5	0	19	15	30	0	2	18	7,5	2,5	33	0	26	22	2,5	28	1,5
Scabiosa columbaria	0	0	0	0	1,5	3,5	0,5	0	3,5	3,5	2	8	0,5	1	0	0	0,5	0	0	0,5	1	2	1	0	1	1	0
Senecio erucifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio jacobaea	0	0	0	1	0	1,5	2,5	3	0	5	0,5	6,5	7,5	1,5	0,5	0	0	2,5	8,5	0,5	0	0,5	1,5	0	1,5	0,5	1
Sherardia arvensis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,5	0	0	0	0	0	0	0	0	0
Sonchus asper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stachys officinalis	0	0	0	0	0,5	0	0	0	0	0	0	0	8,5	0	0	0	0	0	0	0	0	0	0	0	2,5	0	0
Stellaria graminea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Stellaria media	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Succisa pratensis	0	0	0	0	2,5	10	16	0	2,5	0	5	2	6,5	0	4,5	0	0	6	0	0,5	7	0	0	0	1	2	0
Taraxacum sect. Ruderalia	0	0	0	0	0	0	2,5	3	0	0,5	2,5	2	2,5	0	0,5	2	0	0	8	0,5	0	3	0	0	0	0	0
Teucrium scorodonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thymus polytrichus	0	0	0	0	2,5	4,5	1,5	0	19	0,5	0,5	2	7,5	9	0	0	0	0,5	0	0	4,5	0	2	8	0,5	1,5	0
Torilis nodosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tragopogon pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0
Trifolium campestre	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium dubium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Trifolium pratense	0	0	0	0	2	17	5	0	8	10	9,5	10	1,5	0	13	2	2	0	17	2,5	6,5	23	5	4	2	9	2
Trifolium repens	1	1	5	5	0	0	9,5	25	0	0	20	0	0	0	24	26	1	0	13	2,5	0	0	0	0	0	0	2,5
Trisetum flavescens	0	0	0	0	0	1,5	0	0,5	2,5	4	0	2	2	1,5	8,5	0	1	2	2,5	2,5	3	1,5	0	2	0,5	0,5	1,5
Umbel spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0
Veronica arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0
Veronica chamaedrys	0	0	0	0	0,5	0	0,5	1,5	0	0,5	5	0	0	0	2,5	0	0	3,5	3	1,5	0,5	0	6	0	0	0	0,5
Veronica officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viburnum lantana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia cracca	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viola hirta	0	0	0	0	0	0	2	0	0	0	0,5	0	0,5	0	0	0	0	0	0	0	0,5	0	0,5	4	0	0	0
Viola spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5b: average % coverage of plant species from five vegetation quadrates per sites (sites sampled in 1999 and 2002)

Site code species	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
Achillea millefolium	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	10	1	0	0	0	0	1	1	0	0	0	0	0	0	0
Agrimonia eupatoria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis capillaris	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0
Agrostis gigantea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agrostis stolonifera	3	1	3	3	4	47	34	25	0	58	58	3	30	14	44	20	5	40	64	3	6	12	4	0	5	31	30	4	37	0	0	5	0	1	9	13	45	12	10	16	51	10
Anacamptis pyramidalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anagallis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anisantha sterilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Anthoxanthum odoratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthriscus sylvestris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthyllis vulneraria	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphanes arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctium minus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arenaria serpyllifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arrhenatherum elatius	15	3	5	7	0	8	0	0	2	0	0	0	0	58	0	0	15	0	0	0	8	32	2	1	8	0	0	0	0	0	0	0	0	3	0	6	14	21	8	0	0	1
Artemisia vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asperula cynanchica	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare ground	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
Bellis perennis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blacstonia perfoliata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachypodium pinnatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	71	60	11	64	0	13	0	0	0	0
Brachypodium sylvaticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	5	3	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Briza media	1	3	3	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3	4	0	1	2	1	0	0	0	6	4	0	0
Bromopsis erecta	1	38	34	71	23	1	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	51	64	0	0	0	0	0	58	51	0	0	0	0	5	0	0	0	0	0	0
Bromus hordeaceus	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Campanula glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Campanula rotundifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Capsella bursa-pastoris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carduus nutans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex caryophyllea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex flacca	1	23	6	3	7	0	0	0	10	0	0	0	0	0	0	0	6	0	0	12	0	0	4	3	0	0	0	0	0	9	15	0	5	4	4	2	0	2	4	5	0	0
Carex humilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centaurea nigra	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Centaurea scabiosa	0	0	1	3	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Centaurium erythraea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cerastium fontanum	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cirsium acaule	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	0	0	0	2	7	0	0
Cirsium arvense	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	3	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0
Cirsium vulgare	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0
Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinopodium vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	2	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Convolvulus arvensis	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cornus sanguinea	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	14	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crataegus monogyna	0	1	0	4	2	0	0	0	1	0	0	0	0	0	0	0	2	0	0	1	1	1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Annex 5b cont.: average % coverage of plant species from five vegetation quadrates per sites (sites sampled in 1999 and 2002)

Site code species	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
Crepis capillaris	0	0	0	0	0	1	1	0	0	8	3	0	1	1	0	0	0	0	1	0	1	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	5	0	0	0	1	0
Cruciata laevipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cynosurus cristatus	0	0	2	0	0	0	1	28	0	0	0	0	1	0	21	0	0	0	0	0	0	0	0	0	0	0	0	9	11	0	0	0	0	0	0	0	0	0	0	8	0	0
Dactylis glomerata	2	1	6	3	2	21	1	3	1	0	4	0	1	10	1	19	3	1	2	1	0	1	1	2	1	0	8	0	0	0	0	0	1	3	2	1	1	5	1	2	4	0
Dactylorhiza fuchsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Danthonia decumbens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daucus carota	1	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Elytrigia ssp. Repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Euphrasia nemorosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0
Euphrasia officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca arundinacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca gigantea	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca ovina	0	0	0	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	1	0	0	0	0	0	12	40	0	0	0	1	15	0	0
Festuca rubra	4	1	31	0	1	36	64	28	25	17	12	58	38	38	20	3	0	47	1	0	51	11	4	3	1	0	0	40	25	0	0	29	4	0	0	30	0	26	0	0	45	15
Festuca rubra/ovina	0	47	0	14	0	0	0	0	0	0	0	0	0	0	0	8	18	0	0	71	0	14	0	0	0	0	0	0	11	30	45	0	0	0	0	0	0	14	37	44	0	0
Festuca spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filipendula vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fragaria vesca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium mollugo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	2	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium verum	0	3	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	8	1	2	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	2	0	0
Geranium dissectum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geranium molle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glechoma hederacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnadenia conopsea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helianthemum nummularium	0	6	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	0	0	0
Helictotrichon pratense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Helictotrichon pubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heracleum sphondylium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocrepis comosa	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0
Holcus lanatus	4	0	0	0	1	10	1	1	1	0	0	0	0	3	0	45	10	1	1	1	13	18	3	0	0	0	0	0	0	0	0	0	0	2	5	3	5	5	0	0	1	0
Hordeum secalinum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum perforatum	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypochaeris radicata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	1	0	0	0	0	0	0	0
Inula conyzae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knautia arvensis	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Koeleria macrantha	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	2	0	0
Lathyrus pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Leontodon autumnalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon hispidus	0	7	1	3	2	0	0	0	0	0	0	0	0	0	1	0	5	0	0	2	0	0	1	3	5	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	0	0
Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucanthemum vulgare	0	0	0	0	0	0	0	0	1	0	0	28	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Linum catharticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Lolium perenne	0	0	1	0	0	17	3	7	0	28	24	5	34	2	0	1	0	1	16	0	0	0	0	0	0	50	47	34	13	0	0	1	0	0	8	0	0	0	1	0	2	71
Lotus corniculatus	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	2	1	0	2	1	0	0	0	2	0	1	2	0	0	2	2	0	0	0	1	2	0	0
Luzula campestris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 5b cont.: average % coverage of plant species from five vegetation quadrates per sites (sites sampled in 1999 and 2002)

Site code species	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
Medicago lupulina	0	0	0	0	0	2	0	0	1	0	3	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1	0	2	0	0
Moss	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myosotis arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odontites vernus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ononis repens	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Ophrys apifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Origanum vulgare	0	0	0	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	2	11	0	0	0	8	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0
Orobanche elatior	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orobanche minor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pastinaca sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phleum bertolonii	0	0	2	0	0	8	0	0	0	0	2	0	15	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	3	0	0	1	0	0	2	0
Phleum bertolonii/pratensis	0	0	0	0	0	0	0	0	0	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phleum pratense	0	0	8	0	0	0	0	2	0	10	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	2	0	3
Phleum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyteuma orbiculare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picris echioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	0	0
Picris hieracioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilosella officinarum	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0
Pimpinella saxifraga	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Plantago lanceolata	0	1	1	1	2	0	0	0	0	0	0	4	0	0	0	1	1	0	0	0	1	1	2	2	2	0	0	0	0	0	0	0	0	1	3	2	0	3	1	1	0	0
Plantago major	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa annua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	7	2	2	5	0	0	0	0	0	0	0	4	0	0	1	0	0
Poa pratensis/trivialis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Poa trivialis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Polygala vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla anserina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla reptans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primula veris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primula vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prunella vulgaris	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0	0	0
Quercus robur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus acris	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus bulbosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0
Ranunculus repens	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	0	2	0	0	1	0	0	0	0	0	3	1	2	0	0	0	0	0
Ranunculus spp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reseda lutea	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinanthus minor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rosa spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus L. agg.	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	6	5	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Rumex acetosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rumex crispus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanguisorba minor	0	1	1	2	13	0	0	0	6	0	0	0	0	0	0	0	4	0	0	7	5	0	6	7	1	0	0	0	0	2	3	0	1	2	0	1	0	1	7	5	0	0

Annex 5b cont.: average % coverage of plant species from five vegetation quadrates per sites (sites sampled in 1999 and 2002)

Site code species	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12	CS13	CS14	CS15	CS16	CS17	CS18	CS19	CS20	CS21	CS22	CS23	CS24	CS25	CS26	CS27	CS28	CS29	CS30	CS31	CS32	CS33	CS34	CS35	CS36	CS37	CS38	NC1	NC2	NC3	NC4
Scabiosa columbaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio erucifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio jacobaea	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0
Sherardia arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sonchus asper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stachys officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Stellaria graminea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stellaria media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Succisa pratensis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taraxacum sect. Ruderalia	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Teucrium scorodonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thymus polytrichus	0	0	0	0	3	0	0	0	8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	0	0	0	0	1	0	0
Torilis nodosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tragopogon pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium campestre	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium dubium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium pratense	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	2	0	0	0	0
Trifolium repens	0	0	0	0	0	8	0	1	0	24	2	4	28	4	4	0	0	2	10	0	0	0	0	0	0	4	3	40	23	0	0	0	0	0	0	0	0	0	0	0	4	1
Trisetum flavescens	1	0	0	0	0	0	0	1	4	0	0	0	3	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	10	2	0	0
Umbel spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica chamaedrys	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Veronica officinalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viburnum lantana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia sativa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Viola hirta	0	0	0	0	1	0	0	0	4	0	0	0	0	0	0	0	1	0	0	3	2	0	0	1	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Viola spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

9.8 Annex 6: Plants on arable reversion sites

Species	no sites (n = 19)
Agrostis capillaris	4
Agrostis stolonifera	16
Anisantha sterilis	3
Anthoxanthum odoratum	1
Arrhenatherum elatius	4
Bromus hordeaceus	13
Cynosurus cristatus	10
Dactylis glomerata	14
Elytrigia ssp. Repens	3
Festuca gigantea	1
Festuca ovina	4
Festuca rubra	10
Festuca rubra/ovina	3
Holcus lanatus	13
Holcus mollis	1
Lolium perenne	18
Phleum bertolonii	6
Phleum bertolonii/pratensis	4
Phleum pratense	16
Poa annua	1
Poa pratensis	11
Poa pratensis/trivialis	4
Poa trivialis	12
Trisetum flavescens	8
Achillea millefolium	6
Agrimonia eupatoria	1
Anagallis arvensis	1
Anthyllis vulneraria	2
Aphanes arvensis	1
Arenaria serpyllifolia	2
Bare ground	1
Bellis perennis	5
Blacstonia perfoliata	1
Carduus nutans	4
Centaurea nigra	3
Centaurea scabiosa	3
Centaurium erythraea	3
Cerastium fontanum	11
Cirsium arvense	11
Cirsium spp.	3
Cirsium vulgare	15
Clinopodium vulgare	2
Convolvulus arvensis	4
Crepis capillaris	16
Daucus carota	2
Galium mollugo	1
Galium verum	3
Geranium dissectum	8
Geranium molle	9
Glechoma hederacea	1
Heracleum sphondylium	1
Hypericum perforatum	4
Hypochaeris radicata	5
Leontodon autumnalis	1
Leontodon hispidus	4
Leontodon saxatilis	1
Leucanthemum vulgare	5
Lotus corniculatus	6
Medicago lupulina	13
Myosotis arvensis	1
Odontites vernus	1
Origanum vulgare	2
Orobanche minor	1
Picris echioides	1
Pimpinella saxifraga	1
Plantago lanceolata	8
Plantago major	6
Plantago media	2
Potentilla reptans	5
Primula veris	1
Prunella vulgaris	7
Ranunculus bulbosus	7
Ranunculus repens	11
Rumex crispus	1
Sanguisorba minor	4
Scabiosa columbaria	1
Senecio erucifolius	1
Senecio jacobaea	10
Sherardia arvensis	4
Silene vulgaris	1
Sonchus asper	3
Succisa pratensis	1
Taraxacum sect. Ruderalia	10
Tragopogon pratensis	2
Trifolium campestre	10
Trifolium dubium	5
Trifolium pratense	6
Trifolium repens	17
Urtica dioica	4
Veronica arvensis	2
Veronica chamaedrys	3
Vicia cracca	1
Vicia sativa	2
Viola hirta	1

9.9 Annex 7: Auchenorrhyncha of tall grassland vegetation

Species preferring tall grassland vegetation in Great Britain (MORRIS 1971a, 1981a, MORRIS & PLANT 1983, BROWN ET AL 1992, HOLLIER 1989).

Stenocranus minutus
Aphrodes makarovi
Arthaldeus pascuellus
Muellerianella fairmairei
Hyledelphax elegantulus
Conosanus obsoletus
Neophilaenus lineatus
Anoscopus albifrons
Anoscopus flavostriatus
Philaenus spumarius
Arthaldeus striifrons
Elymana sulphurella
Cicadula persimilis
Dikraneura variata
Agallia consobrina
Arboridia parvula
Adarrus multinotatus

9.10 Annex 8: Auchenorrhyncha with high dispersal ability

Species with recognized high dispersal abilities in Great Britain and Central Europe (WALOFF 1973, 1980, MORRIS 1990a,b, HAHN 1995, WITSACK 1995)

Anoscopus flavostriatus
Anoscopus serratulae
Aphrodes makarovi
Arboridia parvula
Arthaldeus pascuellus
Cicadula persimilis
Conosanus obsoletus
Criomorphus albomarginatus
Deltocephalus pulicaris
Dikraneura variata
Errastunus ocellaris
Eupelix cuspidata
Eupelix cuspidata
Euscelis incisus
Javesella pellucida
Macrosteles laevis
Macrosteles sexnotatus
Neophilaenus lineatus
Philaenus spumarius
Psammotettix cephalotes
Psammotettix confinis
Recilia coronifera
Rhopalopyx adumbrata
Stenocranus minutus
Streptanus sordidus
Zyginidia scutellaris

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