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Upland grassland Auchenorrhyncha at Glen Finglas, Perthshire

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ABSTRACT

Sweep-netting and D-vac suction sampling of Auchenorrhyncha (leafhoppers, planthoppers and related groups) was carried out at Glen Finglas in June and July 2007. Thirty three species were identified and these included *Paraliburnia clypealis* and *Paradelphacodes paludosa* which are both apparently new to Scotland. Also recorded were *Oncopsis subangulata* for which we know of just one previous Scottish record and an additional seven species that are scarce or local in the UK. A disproportionate number of the scarcer species were found in D-vac suction samples suggesting they may have been previously overlooked by more conventional sampling methods.

INTRODUCTION

Auchenorrhyncha (leafhoppers, planthoppers and related groups) can be abundant insects in grassland systems. Due to their numerical dominance they are a group that can have large functional significance as herbivores and as vertebrate and invertebrate prey items (Biedermann *et al.* 2005). They are entirely phytophagous insects that are usually closely associated with a narrow range of host foodplants. Hence Auchenorrhyncha assemblages can sensitively reflect land cover (Eyre *et al.*, 2001; Eyre *et al.*, 2005) and may therefore be a useful study group in assessments of management practices (e.g. Fisher Barham and Stewart 2005; Littlewood *et al.*, 2006a; Littlewood *et al.*, 2006b).

At Glen Finglas, Perthshire, a randomized replicated experiment was established in 2002/03 to investigate cascading trophic interactions of different grazing levels within an upland grassland system. Sampling of insects has shown strong responses of overall abundances and of species functional groups within different orders to different grazing treatments (Littlewood 2008; Dennis *et al.*, 2008). Here, we present a summary of the species found at Glen Finglas including discussions on records that are significant in a Scottish context. The response of Auchenorrhyncha assemblages to grazing treatments is being published elsewhere (Littlewood *et al.*, in press).

METHODS

Study Site

Glen Finglas, Perthshire, Scotland, is a 4085 ha estate grazed by sheep and cattle. A replicated, randomised block experiment was established consisting of 24 plots, each measuring 3.3 ha, with four treatments and six replicates. Littlewood (2008) and Dennis *et al.* (2008) give further details of the experimental set-up and treatments. Plots ranged in altitude from 220 m to 500 m. The dominant vegetation was acid grassland and mire. The most represented National Vegetation Classification (NVC) communities were M23 (*Juncus effusus/acutiflorus–Galium palustre* rush-pasture), M25 (*Molinia caerulea–Potentilla erecta* mire), U4 (*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland) and U5 (*Nardus stricta–Galium saxatile* grassland). Some areas were covered by bracken fern (*Pteridium aquilinum*, NVC group U20). A small number of isolated trees grew in lower plots comprising downy birch *Betula pubescens*, eared willow *Salix aurita* and rowan *Sorbus aucuparia*, while some plots had substantial patches of the shrub bog myrtle *Myrica gale*.

Sample Collection

Samples were collected between 1 June and 9 July 2007 from up to five randomly chosen locations within each plot. Two sampling methods were used: D-vac and sweep-netting. The D-vac (D-vac co., Ventura, California, USA) takes standard suction samples through a funnel with diameter of 34.3 cm. Samples at each location consisted of five pooled sub-samples of duration 45 seconds each. Sweep-netting was carried out along a 20 m × 0.5 m transect running north from the sample point. For further details see Dennis *et al.* (2008).

Auchenorrhyncha were identified, by dissection of genitalia where necessary, using Biedermann and Niedringhaus (2004) and Holzinger *et al.* (2003). Nomenclature follows Biedermann and Niedringhaus (2004). For potentially noteworthy species, Scottish records were extracted from the UK Auchenorrhyncha Recording Scheme.

RESULTS

In total 3319 adult Auchenorrhyncha were caught with 1244 collected by D-Vac and 2075 by sweep net. Of these 2310 were identified to a total of 33 species. Females of Delphacidae (1002 individuals), Cixiidae (6 individuals) and Aphrodinae (1 individual) were not identified to species (Table 1).

Two species, *Paraliburnia clypealis* and *Paradelphacodes paludosa* appear to be new species for Scotland. There is only a single previous Scottish record of a further species; *Oncopsis subangulata*. Seven additional species are classified in the UK as either "Local" or "Notable" with three of these each having just two previous Scottish records (Table 2).

DISCUSSION

Species richness of adult Auchenorrhyncha in Scotland usually peak somewhat later in the year than the sampling period covered by this study. Hence the results presented here are likely to represent a sub-set of grassland species present at the site. However the number of nationally rare and scarce species recorded indicates the potential for such sampling to add significantly to our knowledge of the Scottish fauna.

Paraliburnia clypealis

With fifty-six individuals identified this was the tenth most abundant species in the samples. It is the most surprising of the species caught. Until 1980 it was known in Britain only from Wicken Fen, Cambridgeshire but has since been recorded from fens in Norfolk, Huntingdonshire and Somerset (Kirby 1992). There is however a previous report in Scotland as Kirby (1992) lists Cally Pallace, Kircudbrightshire, as a location for this species though we have no further information on this record. *P. clypealis* was thought to be restricted to acid wetlands and to feed primarily on *Calamagrostis canescens* (Nickel and Remane 2002; Biedermann and Niedringhaus 2004) though apparent associations have been reported in the Netherlands with *Rhynchospora* spp. and *Eriophorum* spp. (Nickel 2003). However a population was recently found in Ireland in field margins within dairy grassland and although the foodplant was not identified there it was thought likely to be one of the common grasses such as *Agrostis* sp., *Alopecurus geniculatus*, *Dactylis glomerata*, *Holcus lanatus*, *Holcus mollis* or *Lolium perenne* (Helden and Sheridan 2006). The foodplant used at Glen Finglas is not known but *Calamagrostis canescens* is absent from the glen and *Rhynchospora* spp. and *Eriophorum* spp. are absent in the vicinity of the sample points. The British status of *P. clypealis* is listed as "insufficiently known" (Kirby 1992).

Paradelphacodes paludosa

This species inhabits wetlands, especially sphagnum bogs, spring mires and fens (Nickel 2003). Nine individuals were recorded in this study: eight from D-vac sampling and one from sweep-netting. One D-vac sample, from a marshy part of the site, contained seven specimens indicating a local concentration. Kirby (1992) lists records from scattered counties in southern England and Wales and also Cumberland in northern England. We know of no previous Scottish records. The species is thought to feed on *Carex*. sp. (Biedermann and Niedringhaus 2004), possibly *C. rostrata* or *C. panicea* (Nickel and Remane 2002) and lives very low in the vegetation and therefore may be under-recorded (Kirby 1992).

Oncopsis subangulata

A single male was sweep-netted. The species feeds on *Betula pendula* and *B. pubescens* (Claridge and Nixon 1986; Nickel and Remane 2002; Biedermann and Niedringhaus 2004). There are scattered stands of *B. pubescens* at Glen Finglas and this individual is presumed to have been displaced from one of these. Hence, the species may be more numerous at the site than this single record would indicate. Although not classified as notable or local in the UK, the only other Scottish record that we know of is of one in Aberdeenshire in 1970. However difficulties of identification within this genus may cause the species to be overlooked.

Seven further species recorded are classified as Notable or Local in the UK. The habitat requirements for the species vary but all can tolerate wet or, at least, damp sites as found at Glen Finglas. *Delphacinus mesomelas*, *Acanthodelphax denticauda*, *Dicranotropis divergens* and *Javesella forcipata* are essentially species of meadows that feed on grasses (Nickel 2003). Of these *D. mesomelas* can, in addition, be found on dryer sand sites including heaths whilst *A. denticauda* also occurs in forests (Eyre *et al*., 2001; Nickel 2003). *Xanthodelphax straminea* is also a grass-feeder which is found across a range of meadows, mires and bogs. *Oncodelphax pullula* and *Nothodelphax distincta* are more typical species of mires, especially bogs and feed on sedges (Eyre *et al*., 2001; Nickel 2003). The status of these species are detailed along with previously recorded Scottish locations in Table 2.

Overview

The Auchenorrhyncha are a very under-recorded insect group in Scotland and much remains to be discovered about the species that occur and their distributions. The specimens identified in this study comprised a few common species, such as *Neophilaenus lineatus*, *Javesella discolor and J. dubia*, which are typical constituents of a wide range of grasslands, especially non-intensively managed sites (e.g. Eyre *et al*., 2001). The list also includes species such as *Macustus grisescens*, *Streptanus marginatus* and *Jassargus pseudocellaris* that are typical elements of upland sites and *Dikraneura variata* and *Verdanus abdominalis* which are especially typical of wetter grass moorland (Eyre 2005).

Identification of specimens collected at Glen Finglas has revealed a high proportion of apparently scarce and local species. Two of the species previously not recorded from Scotland, *Paraliburnia clypealis* and *Paradelphacodes paludosa*, were recorded primarily from D-vac samples (53 out of 56 and 8 out of 9

specimens respectively). This is in contrast to the pattern for the catch as a whole within which only 37% of specimens were collected by D-Vac. Because it is relatively inexpensive and easy to do, sweep-netting is probably the most widely used method for collecting herbivorous insects from vegetation (Stewart 2002). In this study, as well as catching more individuals, a greater number of species was recorded by sweep-netting (31) than with the D-vac (21). This is in contrast to other studies on grassland Auchenorrhyncha in which D-vac sampling produced the greatest abundance and species richness (e.g. Standen 2000). However some species that dwell close to the ground may be under-recorded if sweep-netting alone is used, giving a false impression of rarity. Indeed pitfall sampling for Auchenorrhyncha may reveal further species that are missed by more commonly applied sampling methods (Stewart 2002).

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Taxon	Sex	Quantity
Fulgoromorpha		
Cixiidae		
Cixius nervosus (L., 1758)	♂	1
Cixiidae sp. ♀		6
Delphacidae		
Delphacinus mesomelas (BOH., 1850)	♂	1
Paraliburnia clypealis (J.SHLB., 1871)	♂	56
Acanthodelphax denticauda (BOH., 1847)	♂	6
Nothodelphax distincta (FL., 1861)	♂	3
Dicranotropis divergens KBM., 1868	♂	2
Florodelphax leptosoma (FL., 1861)	♂	10
Xanthodelphax straminea (STÅL, 1858)	♂	9
Paradelphacodes paludosa (FL., 1861)	♂	9
Oncodelphax pullula (BOH., 1852)	♂	6
Criomorphus albomarginatus CURT., 1833	♂	20
Javesella discolor (BOH., 1847)	♂	310
Javesella dubia (KBM., 1868)	♂	158
Javesella forcipata (BOH., 1847)	♂	692
Delphacidae sp.	♀	1002
Cicadomorpha		
Aphrophoridae		
Neophilaenus lineatus (L., 1758)	♂ & ♀	301
Philaenus spumarius (L., 1758)	♂ & ♀	84
Cicadellidae - Ulopinae		
Ulopa reticulata (F., 1794)	♀	2
Cicadellidae - Macropsinae		
Oncopsis subangulata (J. SHLB., 1871)	♂	1
Cicadellidae - Aphrodinae		
Planaphrodes bifasciata (L., 1758)	♂	4
Aphrodinae sp. ♀		1
Cicadellidae - Cicadellinae		
Evacanthus interruptus (L., 1758)	♂	2
Cicadellidae - Typhlocybinae		
Dikraneura variata HARDY, 1850	♂ & ♀	31
Forcipata citrinella (ZETT., 1828)	♂ & ♀	5
Notus flavipennis (ZETT., 1828)	♂ & ♀	28
Eupteryx notata CURT., 1837	♂	1
Cicadellidae - Deltocephalinae		
Balclutha punctata (F., 1775)	♀	4
Macrosteles sexnotatus (FALL., 1806)	♂ & ♀	5
Deltocephalus pulicaris (FALL., 1806)	♂	5
Thamnotettix confinis (ZETT., 1828)	♂	5
Macustus grisescens (ZETT., 1828)	♂ & ♀	121
Streptanus marginatus (KBM., 1858)	♂ & ♀	196
Jassargus pseudocellaris (FL., 1861)	♂ & ♀	118
Jassargus sursumflexus (THEN, 1902)	♂	1
Verdanus abdominalis (F., 1803)	♂ & ♀	113

Table 1. Quantity and sex of adult Auchenorrhyncha species and selected genera and families recorded at Glen Finglas in 2007.

Species	UK status	Scottish Records (from UK Auchenorrhyncha Recording Scheme)
Delphacinus mesomelas	local	Fifeshire (Tentsmuir); Perthshire (Pitlochry)
Paraliburnia clypealis	Insufficiently known	none
Acanthodelphax denticauda	local	Perthshire (Perth). Morayshire (Nethy Bridge).
Nothodelphax distincta	local	Lanarkshire (North Bellstane Moor). West Lothian (Lochcote Marsh). Perthshire (Loch Monaghan; Lochan Buidhe). Moray (Abernethy; Craggan). Inverness-shire (Loch Garten). West Ross (Inverpolly).
Dicranotropis divergens	Nb	East Lothian (Camelshiel Castle). Midlothian (Edinburgh; Balerno). West Lothian (Faucheldean). Perthshire (Struan; Ballinluig Island). Aberdeenshire (Crathie Wood). Moray (Aviemore; Craigellachie; Granish; Grantown-on-Spey; Nethy Bridge). Invernesshire (Loch Garten; Northern Corries SSSI; Alvie).
Paradelphacodes paludosa	Nb	none
Xanthodelphax straminea	local	Morayshire (Nethy Bridge; Aviemore)
Oncodelphax pullula	Nb	Perthshire (Lochan Buidhe; Rannoch). Morayshire (Aviemore; Abernethy Forest). Invernesshire (Northern Corries SSSI). North Ebudes (Rum).
Javesella forcipata	local	Midlothian (Balerno); Perthshire (Logierait Pond, Ballinluig Island, Rannoch, Killin, Kindrogan); Moray (Craigellachie, Aviemore, Nethy Bridge, Grantown-on-Spey); Invernesshire (Loch Garten); Rum; West Ross (Beinn Eighe, Inverpolly); East Ross (Moniack Burn)
Oncopsis subangulata		Aberdeenshire (Dinnet).

Table 2. UK status and previous Scottish records of noteworthy Auchenorrhyncha species recorded at Glen Finglas in 2007. Nb means "Nationally Scarce category B" and indicates species thought to occur in fewer than 100 ten km squares in the UK.