Mortality of Orthoptera caused by mechanised mowing of grassland. – Orders such as Orthoptera are prey for bird and spider species (Joern, 1986; Belovsky & Slade, 1993; Oedekoven & Joern, 1998) and are known to be an important component of the diet of late season Cirl bunting *Emberiza cirlus* chicks (Evans *et al*., 1997). Therefore the decline of this species may be directly attributable to the loss of invertebrate diversity and abundance, particularly of Orthoptera, from farmland. Gardiner *et al*. (2002) and Gardiner & Hill (2003) found that Orthoptera were scarce in many agricultural grasslands that were heavily grazed or cut for silage, perhaps because of the short swards created by such management, which do not afford grasshoppers shelter from predation or inclement weather. However, the physical process of silage cutting is likely to have significant effects on grasshoppers that are in the sward when mowing occurs.

A study by Gardiner & Hill (2005) found that male and female Meadow Grasshopper *Chorthippus parallelus* Zetterstedt adults resided for the majority of time in the ground zone (sward height: < 20 cm) and that this may lead to high mortality when grass cutting occurs. Grasshoppers are however very mobile and can jump large distances to escape from predators (Clarke, 1948; Richards & Waloff, 1954) and as a consequence may be able to escape damage or death during harvesting of silage.

Further to the study outlined in Gardiner & Hill (2005), laboratory examinations of cut hay (on 10 July 2004) and silage herbage (on 20 May and 10 July 2004; two-cut strategy determined by local climate and soil conditions) on the Writtle College Estate (site grid reference: TL664067) were undertaken to determine whether mechanised cutting caused mortality of Orthoptera. The hay and silage treatments were cut using a ride-on rotary mower (cutting height: 90 mm). Herbage from 80 randomly located 10×10 cm quadrats was collected from the hay and silage treatments (total area of herbage collected for each treatment: 0.8 m^2) two hours after cutting. The cut herbage within the quadrat boundaries was collected and transported back to the laboratory in plastic bags. The contents of each sample were then emptied onto a white tray and searched for two minutes in an effort to locate dead and live Orthoptera.

Three dead adult *C. parallelus* individuals were found in the hay herbage collected on 10 July (Table 1). Mowing on 10 July also caused mortality of nymphs, two dead *C. parallelus* nymphs each were collected from the hay (both fourth instar) and silage (both second instar) treatments. A dead third instar nymph of the Lesser Marsh Grasshopper *C. albomarginatus* (De Geer) was found in the silage herbage on 10 July, but no dead or live individuals of any species were collected from the silage herbage after cutting on 20 May. In contrast to recording dead *C. parallelus* individuals, a total of five live adults (3 ♀, 2 ♂) of this species were collected from the

Table 1. Total number of dead and live grasshoppers in herbage of the hay and silage treatments mown on 10 July 2004

	Hay		Silage		Total	
Species/life stage	Dead	Live	Dead	Live	Dead	Live
Chorthippus parallelus adult	3	2	2	3	5	5
C. parallelus nymph	2	0	2	1	4	1
C. albomarginatus nymph	0	0	1	1	1	1

cut herbage, of which three were collected from the silage treatment. One live nymph of both *C. parallelus* (second instar) and *C. albomarginatus* (second instar) were also observed in the cut silage herbage.

Although only a small scale investigation of cut hay and silage herbage, the study does show that Orthoptera of all developmental stages were killed by rotary cutting blades or contact with machinery during the process of hay and silage mowing. Dead individuals of two species were identified from the cut herbage in this experiment: *C. albomarginatus* and *C. parallelus*, both common grasshopper species on farmland at Writtle College (Gardiner *et al*., 2002). The latter species is known to inhabit the ground zone (<20 cm sward height) of hay meadows where it primarily exhibits resting and basking behaviour (Gardiner & Hill, 2005) making it vulnerable to disturbance and mortality from cutting blades which pass through the vegetation at approximately 10 cm height. The initial response to disturbance of species such as *C. parallelus* is to jump (Clarke, 1948); this means that individuals which become trapped under the mower are likely to jump into the rotary blades as an initial response to the disturbance caused by cutting. No assessment was made of the scale of mortality of grasshoppers on the swards, although it is likely that the mortality rate was fairly high as 10 dead individuals were identified from a relatively limited area of herbage (1.6 m^2) with an average population density of 0.50 adult grasshopper (*Chorthippus* spp.) individuals per m^2 in the sward (Gardiner *et al*., 2002).

Wagner (2004) concluded that mortality of *Metrioptera bicolor* Philippi due to cutting was high in German hay meadows (mortality rate: 42% of marked individuals). Other species such as Large Marsh Grasshopper *Stethophyma grossum* L. and Speckled Bush-cricket *Leptophyes punctatissima* Bosc are also susceptible to injury or death by cutting blades (Oppermann & Krismann, 2001). These authors showed that injury rates of adult Orthoptera from rotary mowers were dependent on body size; larger individuals being more prone to injury. Therefore, large mature nymphs (fourth instar) and adults that are frequent in early July (Marshall & Haes, 1988) may be particularly prone to death or injury from hay and silage cutting that is undertaken at this time of year.

Perhaps as interesting as the confirmation of dead individuals from both hay and silage herbage, was the presence of live individuals. Live individuals of *C. albomarginatus* and *C. parallelus* were present in the cut herbage (Table 1), indicating that transfer of cuttings from one site to another (hay strewing) may transport species between sites. Wagner (2004) suggests that sexually active females of *M. bicolor* that survive cutting of hay can be transported to donor sites in the cut herbage.

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***Exochomus quadripustulatus* (L.) (Coleoptera: Coccinellidae) as a host of *Dinocampus coccinellae* (Schrank) (Hymenoptera: Braconidae).** – During an extended study of mortality of pine ladybirds *Exochomus quadripustulatus* (L.), mainly in Sheffield, the bulk of parasitoids that emerged from the ladybird pupae, were identified as the chalcid *Aprostocetus neglectus* (Domenichini) (Hymenoptera: Eulophidae). In early May, 2004 a pine ladybird imago was observed in a crack of bark on a sycamore tree in Millhouses Park (VC 63, SK3383) which was immobile for at least a week. It was removed on 18th May and seen to be attached to the tree by a cocoon. Kept in a fairly warm place, a wasp emerged on 24th May which appeared to be a small *Dinocampus coccinellae* (Schrank). This was confirmed by Dr Mark Shaw.

Majerus (1997, *Br. J. Ent. Nat. Hist.* **10**: 15–24) detailed his observations of the parasitoid *Dinocampus coccinellae* predating various British coccinellid species. This parasitoid, which develops within the ladybird imago and pupates below it, was not observed on c. 3000 specimens of *E. quadripustulatus* nor any other members of the sub-family Chilocorinae. Majerus quotes the non-inclusion of any of the British chilocorines as hosts of the braconid in the list of Hodek (1973, *Biology of Coccinellidae*, Junk/Academic Press). Neither do Klausnitzer & Klausnitzer (1977, *Marienkafer*, Westarp Wissenschaften, Magdeburg) include chilocorines as hosts. However, Hodek does include a record of *D. coccinellae* parasitizing *Exochomus concavus* Fursch in Transvaal, South Africa. This therefore appears to be the first record of *E. quadripustulatus* as prey and possibly the first palaearctic record from any chilocorine.

I thank Dr Shaw for his advice. The organisms and cocoon are deposited in the Royal Museum of Scotland. – PAUL R. MABBOTT, 49 Endowood Road, Millhouses, Sheffield, S7 2LY. mabbott@blueyonder.co.uk