THE BARKLICE (PSOCOPTERA) ASSOCIATED WITH AN OLD-FIELD SUCCESSION IN SOUTHERN BRITAIN

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ABSTRACT

Data on the barklice collected from experimental old-field succession plots at Silwood Park, Berkshire are presented. The population density of barklice increased with successional age and the development of tussocks. Two of the five species encountered were field-layer specialists, and one of these, *Kolbia quisquiliarum* Bertkau, dominated the assemblage. This species is shown to be bivoltine in southern Britain.

INTRODUCTION

The barklice or barkflies (Psocoptera) are a relatively small group that feed on algae, lichens, fungal hyphae, spores and fragments of plant or insect (New, 2005). As the names imply, they are almost exclusively found on trees and shrubs, living on the bark, foliage or leaf-litter. A few species are associated with more open habitats.

Changes in the insect fauna through secondary plant succession in temperate regions have been discussed by Southwood, Brown & Reader (1979) and Hendrix, Brown & Dingle (1988). More specific studies have been made of old-field succession habitats in groups such as the phytophagous beetles (Brown & Hyman, 1986) and leafhoppers (Hollier, Brown & Edwards-Jones, 1994), but the barklice have been largely ignored by ecologists.

METHODS

The data presented come from a long-term study of secondary vegetational succession carried out at Silwood Park, Berkshire. In successive years, starting in 1977, areas of a fenced experimental field at Silwood Bottom (SU944688) were taken out of arable cultivation, ploughed, harrowed and abandoned to old-field succession. The sites were $35\,m \times 25\,m$ and subdivided into $3\,m^2$ sampling plots, only data from control plots are presented. The sites were all at one end of the experimental field, which was surrounded by rabbit-grazed grassland. The experimental area is on Berkshire Sand, and the succession sites develop as relatively species-poor acid grasslands eventually becoming oak woodland. Closed oak canopies were present within 50m of all sites.

In 1987, six sites aged between one and eleven years were sampled (four dates, five or ten sample plots per site), while two other sites were sampled in both 1988 and 1989 (five dates, eight sample plots per site). Because the number of plots sampled varied, the density of psocids per square metre was calculated for site comparisons.

Vegetation data were recorded using point quadrat pins marked at 5 cm intervals, a method providing information about vegetation structure as well as species composition. The insects were sampled using a D-Vac suction apparatus with a 30 cm diameter head, the sample comprising three 30-second sucks in each plot. The catch was stored in 70% alcohol and sorted to Order. The adult barklice were identified using the keys of Lienhard (1998), but the nomenclature follows New (2005).

RESULTS

A total of 241 barklice were captured, most of them juveniles. The oldest sites had the greatest population density (Fig. 1). There was considerable between-year variation for the sites sampled in two years, presumably because of differences in the timing of the sampling or differences in the weather. On the oldest sites the density was relatively uniform across sampled plots, but some of the intermediate-aged sites were much less equitable, with all of the individuals being recorded from two or three plots.

Of the 54 adults, only 49 could be identified to species, the others being too damaged by their passage through the collection process. Three of the others were identified to genus; two *Valenzuela* spp. and one *Lachesilla* sp. The rest belonged to just five species:

Kolbia quisquiliarum Bertkau (Amphipsocidae) was the most abundant species, accounting for some two-thirds of the adults captured. It was most abundant on older sites, and many of the juveniles were of this species. All of the males were macropterous, and all of the females micropterous (see New, 2005: p.91). One of the few barklouse species to primarily inhabit the herb layer, *K. quisquiliarum* is typically found in tussocky vegetation (Lienhard, 1998). The distribution at Silwood conforms to this; the sites on which this species was abundant being characterised by tussocks, principally of *Dactylis glomerata* (cock's-foot). As Figure 2 shows, the captures, although relatively few in number, indicate that *K. quisquiliarum* is bivoltine in southern Britain, as it is on the continent (Lienhard, 1998). The species was regarded as rare in Britain, but recent observations suggest that it has been under-recorded (Saville *et al.,* 2005, Saville *et al.,* 2007), and can be very abundant in grassland

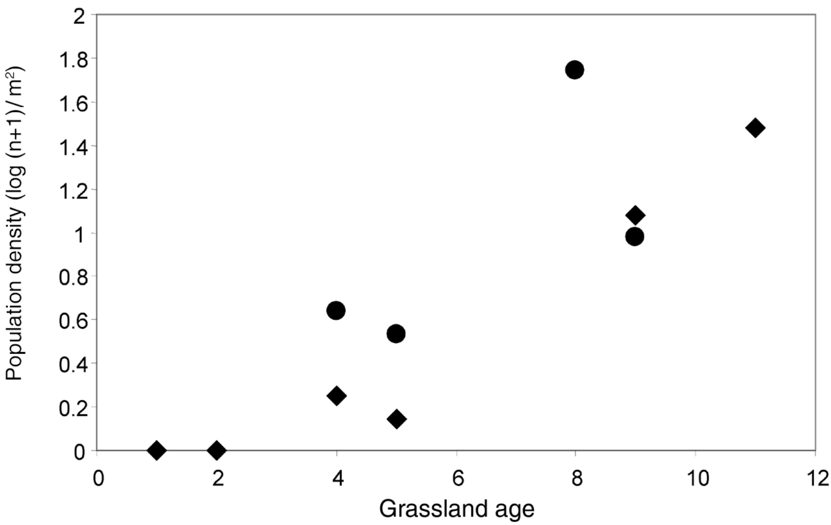

Fig. 1. Population density of barklice (log(n + 1) number per square metre) on 10 grasslands of different age (years since cultivation) at Silwood Park, southern England; sites sampled in 1987 represented by diamonds, sites sampled in 1988 and 1989 represented by circles.

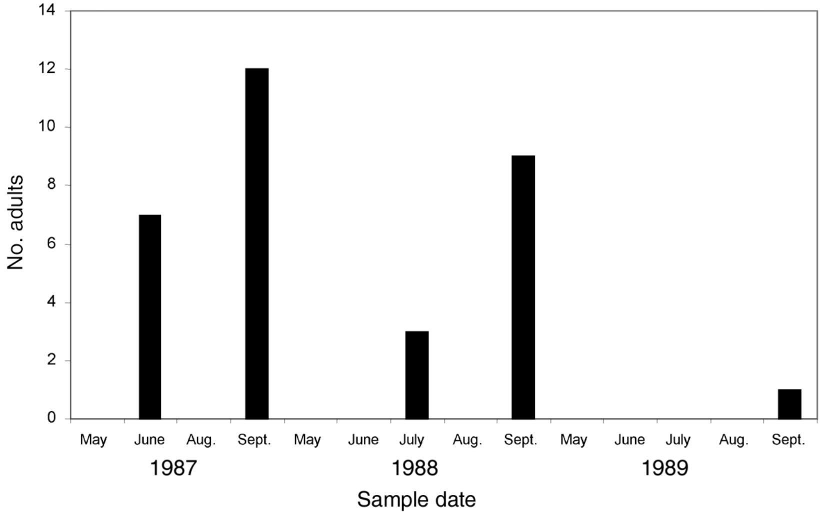

Fig. 2. The phenology of *Kolbia quisquiliarum*: total number of individuals captured on each of the 14 sampling dates between May 1987 and September 1989 at Silwood Park in southern England.

(Plant, 1979). It is interesting that New (1969) did not encounter this species in his study of the barklice living in leaf-litter at Silwood Park even though it had been reported from the estate (New, 1968), suggesting that *K. quisquiliarum* is a true grassland species, rather than simply a species inhabiting the field layer in many habitats.

Bertkauia lucifuga (Rambur) (Epipsocidae) was the second most abundant species, and is also a species normally found at ground level. Specimens were taken from two of the oldest sites. However, it is normally associated with woodland biotopes with leaf-litter or rotting wood (Lienhard, 1998), and not usually found in grasslands. The species is regarded as scarce in Britain (Saville, 2008), but was very common in litter at Silwood Park according to New (1968, 1969).

Ectopsocus petersi Smithers (Ectopsocidae) was present on five sites, though generally as singletons. This species lives on the leaves of a wide range of trees and shrubs, and is not infrequently found in the herb layer (Lienhard, 1998). It is common in Britain.

Ectopsocus briggsi McLachlan (Ectopsocidae) was present as a single individual on one of the older sites. This species has a similarly wide range of hosts to *E. petersi,* but is not normally found in the field layer (Lienhard, 1998). The regular presence of *E. briggsi* in leaf-litter samples at Silwood Park was reported by New (1968), but at that time *E. petersi* had not yet been described, and the material may well have been of that species. *Ectopsocus briggsi* is common in Britain.

Peripsocus subfasciatus (Rambur) (Peripsocidae) occurred as a singleton on the oldest site. A bark-dwelling species (Lienhard, 1998), it can be assumed to be a vagrant in grassland. The species is considered common in Britain.

DISCUSSION

The barklice of the grasslands sampled showed a successional trend, both in terms of overall population density and the distribution of the most abundant species. The trend most obviously associated with this increase is vegetation structure, which becomes more complex during succession and the increase in litter associated with this (see Southwood, Brown & Reader, 1979).

Two species inhabiting the field layer dominated the assemblage, both being most abundant on the same two sites, and apparently associated with tussocky vegetation. These sites have been shown to support other insect species dependent on this kind of vegetation structure (Hollier, 2006). The species more casually associated with the herb layer showed no such habitat preference, being found on sites of most ages.

Since the females of *Kolbia quisquiliarum* and *Bertkauia lucifuga* are micropterous, what makes the findings interesting is the young age of the grasslands in question. Clearly, the chances of long-distance dispersal are very low, and previous records of *K. quisquiliarum* tend to be associated with ancient, calcareous grassland (Saville *et al.*, 2005). In the present study, the youngest site colonised by *K. quisquiliarum* was only four years old, while one of the 9-year-old sites and the 11-year-old site supported considerable populations. Similarly, *B. lucifuga* had colonised this 9-year-old site as well as the 11-year-old one.

The dispersal factor suggests that these old-field sites must have been colonised from existing populations of the two species relatively close to the experimental area. At first sight this is complicated by the fact that the two species typically inhabit different biotopes, but Silwood Park is part of the Windsor Great Park and Windsor Forest system of parkland and pasture woodland, which has supported both open and wooded habitats in a historically stable landscape. Although the results may therefore represent something of a special case, it is clear that colonisation is more rapid than might have been expected *a priori,* and that the barklice can be a significant component of grassland ecosystems.

ACKNOWLEDGEMENTS

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Spread of *Ophelimus ?maskelli* Ashmead (Hymenoptera: Eulophidae) in south-east England. – The occurrence of a gall-inducing eulophid wasp new to the UK and as yet not fully identified was reported by Tilbury & Jukes (2006). The first specimens of damaged foliage were reported from a garden in Lambeth, London in April 2005. I noticed a specimen tree of *Eucalyptus gunnii* heavily infested by this species at Gunnersbury Cemetery, west London on 3 April 2007 (det. Andrew Halstead). Most of the lower leaves were infested and each supported c. 80–120 galls of varying sizes (see Fig. 1).

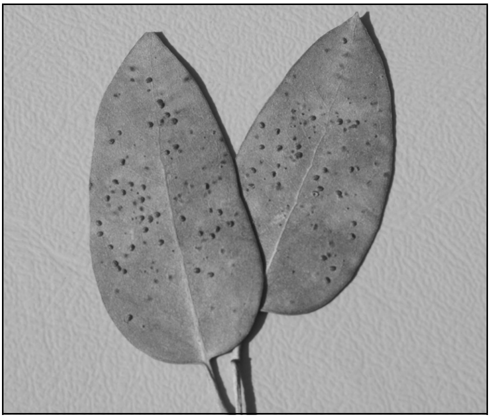

Fig. 1. Eucalyptus leaf with *Ophelimus* galls.

At present it is not known how many of these galls reach maturity, but if only half are successful this represents a very heavy infestation of this new species. A quick search of *Eucalyptus* collections at Lullingstone Castle and Selling, Kent in July 2007 failed to show any evidence of this species. However a moderate infestation of the eulophid was discovered on a long-leaved eucalypt at Hyde Hall Gardens in Essex, a similar distance east from London on 1 June 2008 indicating that the gall wasp is spreading as predicted. – JOHN BADMIN, Coppice Place, Selling, Kent ME13 9RP.

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BOOK REVIEW

Behavioral Ecology of Insect Parasitoids: from theoretical approaches to field application. (Eds) Wajnberg, É., Bernstein, C. & van Alphen, J. Blackwell Publishing, 2008. xvi + 445 pp. Hardback, ISBN 9781405163477. £45.00.

Most insect parasitoids are parasitic wasps, and this book is essentially about investigating and understanding the behaviour of parasitic wasps in an evolutionary context. As well as being highly speciose and constituting an immensely important component of practically all terrestrial ecosystems, parasitic wasps have been of special relevance to the development of theoretical and behavioural ecology, because of their numerically simple (for most, one offspring per parasitized and thereby killed host) yet behaviourally highly complex and specialised host relationships. Their haplo-diploidy offers further riches for research in this field, as mothers can choose the sex of their offspring. Thus the responses of parasitic wasps to varying conditions can be measured and their decisions modelled, and the extent to which their behaviour has been optimised by natural selection for lifetime reproductive success ("inclusive fitness") can be tested, in a more direct way than is the case for most organisms.

Each of the book's 18 chapters is written by a pair of authors, mostly well-known names with long experience and acknowledged expertise (some have co-authored more than one chapter), and between them they analyse pretty well all aspects of this rather wide, complex and challenging field – including optimal foraging, fitness, chemical ecology, nutritional physiology, competition, tritrophic interactions and, in a final section, issues concerning the rigorous methodology needed for behavioural research. One practical aim of such work on parasitoids is to be able to apply predictive models to field and/or mass culture conditions so as to improve their efficacy as biological control organisms, and this stream is well-developed in the book, with some chapters entirely devoted to it.

The editors are to be congratulated for the clear organisation of the book. Each chapter has an abstract followed by a review of the particular aspect – typically marrying theory, empirical evidence, modelling and so on – with a final section giving an invaluable critique of how well the theoretical framework describes the real world, what remains unknown, and what research directions might be taken. Each chapter has its own bibliography, and the work as a whole is well indexed.

It almost goes without saying that the book will be invaluable to anyone with a serious interest in the behavioural ecology of parasitoids or biological pest control, for its comprehensive and authoritative analysis of an important and dynamic field. But it has more general value too. While the mathematical expression of parts of most chapters might seem off-putting to some, its excellent layout and index will make it easy to use by general entomologists wanting a current overview of an included topic, a substantive definition or explanation of an oft-encountered term, or to trace seminal references in this key area of evolutionary biology. At only £45 it should provide excellent value to most academic entomologists, however passing their interest in parasitoids might be.

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