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Nocturnal Ichneumonoidea (Hymenoptera) caught by the Rothamsted light trap at Rowardennan, Loch Lomondside

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INTRODUCTION

Since 1968 the Rothamsted Insect Survey (RIS) has operated a network of specially designed light-traps throughout the UK and the data obtained from them have been used to monitor the long term population trends of the most common and widespread British moths (Fox *et al.*, 2006). A trap located at the Scottish Centre for Ecology and Natural Environment (formerly known as the Glasgow University Field Station) has been operated continuously since 1968 and has added greatly to knowledge of the moth assemblage on east Loch Lomondside (Salama et al., 2007; Knowler and Gregory, 2008; Knowler, 2010). In addition to moths, light traps catch representatives of many other insect Orders and, during the years that the Rowardennan trap has been run, some of these have been collected and sent to relevant experts for identification. This paper presents an analysis of 2373 Ichneumonoidea recovered from the catch of the Rowardennan trap during 2004 and 2010.

METHODS

A standard Rothamsted light trap with a 200W tungsten filament is located at NS378960 in an extensive belt of semi-natural oak woods which covers much of the lower slopes of both the eastern and western shores of Loch Lomond. It comprises mostly *Quercus petraea x robor* hybrids. Other micro-habitats close to the trap are smaller quantities of alder (*Alnus glutosa*) and sallow (*Salix* sp.) that fringe the shore of Loch Lomond and the nearby Dubh Lochan. The area also contains patches of planted conifers and the upper loch-side slopes are characterised by more open habitats and birch (*Betula* sp.) wood.

The trap is operated by volunteers who until 2008 sent the catch to RIS staff to identify the macro moths. Since 2009 moth identification has been undertaken by the first author and this has given him access to the other insects caught by the trap.

From 7th May to 31st December 2004, Phil Gould, formerly of the Rothamsted light trap survey, separated Ichneumonoidea from the catch of the Rowardennan trap and sent them to the second author to identify. Information on the precise dates of capture of these insects was not retained as the insects were sent in a bulk sample. However, for the whole of 2010, J.T.K. separated the Ichneumonoidea from each day/weekend catch and separately packaged and dated them before sending them to G.R.B. for identification.

G.R.B. runs a recording scheme for nocturnal Ichneumonoidea (http://www.nhm.ac.uk/research-curation/about-science/staff-directory/life-sciences/g-broad/index.html) and the catches from the Rothamsted light trap network have proved particularly useful for their wide geographical coverage. Many of the ichneumonoid species recorded from the Rowardennan trap are typical of nocturnal species in that they are pale orange/testaceous with long antennae and large eyes, a morphology that has convergently evolved in several subfamilies of the two ichneumonoid families (Braconidae and Ichneumonidae) but which is particularly characteristic of the ichneumonid subfamily Ophioninae. These obviously nocturnal species can be identified using G.R.B.'s draft keys (http://www.nhm.ac.uk/research-curation/about-science/staff-directory/life-sciences/g-broad/index.html) and through several other sources (e.g. van Achterberg, 1979, 1984, 1992; Brock, 1982; Shaw, 2010). A few specimens of the species-rich and difficult braconid genus, Aleiodes, were identified by Dr Mark Shaw (Edinburgh) and some Lissonata (Ichneumonidae: Banchinae) were identified by Dr Jim Brock (Ely). Many other ichneumonoids (and other Hymenoptera) can be found at light traps. Many of these are not obviously nocturnal and were identified using a large body of literature and by comparison with specimens in the collections of the Natural History Museum. Vouchers of all species have been deposited in the Natural History Museum.

Table 1 shows the total nocturnal Ichneumonoidea identified from the catch of the Rothamsted trap at Rowardennan.

Table 1. Ichneumonoidea identified in the catch of the Rowardennan Light Trap 2004 and 2010.

Species	Family	Subfamily	Total collected	Earliest and latest dates
Charmon cruentatus Haliday	Braconidae	Charmontinae	1 female	2004
Macrocentrus nitidus (Wesmael)	Braconidae	Charmontinae	1 female	02/09
Ascogaster consobrina (Curtis)	Braconidae	Cheloninae	2 male	16/06
Pygostolus otiorhynchi (Boudier)	Braconidae	Euphorinae	2 female	16/08-26/08
Pygostolus sticticus (Fabricius)	Braconidae	Euphorinae	25 female	15/06-12/08
Syntretus idalius (Haliday)	Braconidae	Euphorinae	1 male	17/06
Syntretus xanthocephalus (Marshall)	Braconidae	Euphorinae	1 female	20/08
Homolobus flagitator (Curtis)	Braconidae	Homolobinae	118 female, 34 male	16/06-10/10
Homolobus infumator (Lyle)	Braconidae	Homolobinae	14 female	06/09-13/10
Macrocentrus nidulator (Nees)	Braconidae	Macrocentrinae	1 female	06/10
Macrocentrus nitidus (Wesmael)	Braconidae	Macrocentrinae	1 female	09/10
Meteorus pendulus (Müller)	Braconidae	Meteorinae	1 female	2004
Zele albiditarsus Curtis	Braconidae	Meteorinae	9 female, 2 male	25/06-17/10
Zele chlorophthalmus (Spinola)	Braconidae	Meteorinae	1 female	17/08
Zele deceptor (Wesmael)	Braconidae	Meteorinae	65 female, 1 male	25/05-07/10
Aleiodes nigriceps (Wesmael)	Braconidae	Rogadinae	I male	2004
Aleiodes nigricomis (Wesmael)	Braconidae	Rogadinae	2 female, 1 male	07/10-08/10
Aleiodes pictus agg.	Braconidae	Rogadinae	1 male	2004
Heterogamus dispar (Haliday)	Braconidae	Rogadinae	7 female, 2 male	29/07-20/08
Agrypon flaveolatum (Gravenhorst)	Ichneumonidae	Anomaloninae	13 female	2004
Lissonota biguttata (Holmgren)	Ichneumonidae	Banchinae	2 female	30/06-21/07
Lissonota tenerrima (Thomson)	Ichneumonidae	Banchinae	1 female	27/08
Gelis albipalpus (Thomson)	Ichneumonidae	Cryptinae	1 female	20/08
Gnotus macrurus (Thomson)	Ichneumonidae	Cryptinae	1 female	2004
Orthizema triannulatum (Thomson)	Ichneumonidae	Cryptinae	1 female	26/07

Absyrtus vicinator (Thunberg)	Ichneumonidae	Ctenopelmatinae	9 female, 11 male	09/07-07/10
Alexeter nebulator (Thunberg)	Ichneumonidae	Ctenopelmatinae	2 female	20/08-29/09
Hadrodactylus idari (Kasparyan & Shaw)	Ichneumonidae	Ctenopelmatinae	1 female	06/06
Himerta sepulchralis (Holmgren)	Ichneumonidae	Ctenopelmatinae	2 female, 2 male	10/09-13/09
Opheltes glaucopterus (Linnaeus)	Ichneumonidae	Ctenopelmatinae	2 females	2004
Perilissus ?pallidus (Gravenhorst)	Ichneumonidae	Ctenopelmatinae	17 female, 1 male	2004
Allomacrus arcticus (Holmgren)	Ichneumonidae	Cylloceriinae	16 female	25/06-02/07
Sussaba cognata (Holmgren)	Ichneumonidae	Diplazontinae	1 female	29/09
Woldstedtius sp.	Ichneumonidae	Diplazontinae	1 female	2004
Euceros serricornis (Haliday)	Ichneumonidae	Eucerotinae	1 male	2004
Achaius oratorius (Fabricius)	Ichneumonidae	Ichneumoninae	1 female	20/09
Aoplus ochropis (Gmelin)	Ichneumonidae	Ichneumoninae	1 female	20-Aug
Astiphromma granigerum (Thomson)	Ichneumonidae	Mesochorinae	1 female, 2 male	09/09
Astiphromma splenium (Curtis)	Ichneumonidae	Mesochorinae	3 female, 1 male	07/05-13/09
Cidaphus areolatus (Boie)	Ichneumonidae	Mesochorinae	10 female, 1 male	22/07-29/09
Cidaphus atricillus (Haliday)	Ichneumonidae	Mesochorinae	2 female	18/08
Enicospilus adustus (Haller)	Ichneumonidae	Ophioninae	1 female	2004
Enicospilus ramidulus (Linnaeus)	Ichneumonidae	Ophioninae	2 female	16/09 – 19/09
Ophion ?pteridis (Kriechbaumer)	Ichneumonidae	Ophioninae	1 female	08/09
Ophion brevicornis (Morley)	Ichneumonidae	Ophioninae	1 male	23/06
Ophion costatus (Ratzeburg)	Ichneumonidae	Ophioninae	21 female, 41 male	18/05-30/06
Ophion crassicornis (Brock)	Ichneumonidae	Ophioninae	1 female, 3 male	04/06-23/06
Ophion minutus (Kriechbaumer)	Ichneumonidae	Ophioninae	15 female, 2 male	05/05-17/06
Ophion mocsaryi (Brauns)	Ichneumonidae	Ophioninae	13 female, 1 male	28/05-11/07
Ophion obscuratus (Fabricius)	Ichneumonidae	Ophioninae	7 female, 4 male	18/04-08/06
Ophion ocellaris (Ulbricht)	Ichneumonidae	Ophioninae	3 female, 1 male	07/05-21/07
Ophion parvulus (Kriechbaumer)	Ichneumonidae	Ophioninae	19 female, 3 male	04/06-06/10
Ophion scutellaris (Thomson)	Ichneumonidae	Ophioninae	3 female	12/04-02/05
Ophion ventricosus (Gravenhorst)	Ichneumonidae	Ophioninae	11 female	04/06-17/06

Megastylus cruentator (Schiødte)	Ichneumonidae	Orthocentrinae	1 female	15/11
Megastylus pectoralis (Förster)	Ichneumonidae	Orthocentrinae	5 female	16/09-25/10
Plectiscus impurator (Gravenhorst)	Ichneumonidae	Orthocentrinae	8 female, 6 male	09/09-06/10
Symplecis bicingulata (Gravenhorst)	Ichneumonidae	Orthocentrinae	1 male	21/09
Oxytorus armatus (Thomson)	Ichneumonidae	Oxytorinae	4 male	28/07-15/08
Oxytorus luridator (Gravenhorst)	Ichneumonidae	Oxytorinae	5 Male	01/07-26/07
Acrodactyla degener (Haliday)	Ichneumonidae	Pimplinae	1 female	20/08
Pimpla flavicoxis (Thomson)	Ichneumonidae	Pimplinae	6 female, 3 male	16/07-10/10
Pimpla insignatoria (Gravenhorst)	Ichneumonidae	Pimplinae	1 female	22/10
Scambus inanis (Schrank)	Ichneumonidae	Pimplinae	1 male	20/08
Schizopyga frigida (Cresson)	Ichneumonidae	Pimplinae	2 female	01/10-10/10
Dyspetes luteomarginatus (Habermehl)	Ichneumonidae	Tryphoninae	1 male	03/09
Hercus fontinalis (Holmgren)	Ichneumonidae	Tryphoninae	5 female, 4 male	25/06-14/09
Netelia ?fuscicarpus (Kokujev)	Ichneumonidae	Tryphoninae	2 female	2004
Netelia ?ocellaris (Thomson)	Ichneumonidae	Tryphoninae	2 female	2004
Netelia cristata (Thomson)	Ichneumonidae	Tryphoninae	131 female,41 male	01/05-13/10
Netelia fulvator Delrio	Ichneumonidae	Tryphoninae	1 male	10/08
Netelia inedita (Kokujev)	Ichneumonidae	Tryphoninae	1 female	2004
Netelia infractor Delrio	Ichneumonidae	Tryphoninae	1 male	09/09
Netelia latungula (Thomson)	Ichneumonidae	Tryphoninae	25 female,13 male	07/05-25/06
Netelia pallescens (Schmiedeknecht)	Ichneumonidae	Tryphoninae	3 female,14 male	04/06-14/10
Netelia tarsata (Brischke)	Ichneumonidae	Tryphoninae	477 female, 79 male	07/05-13/10
Netelia virgata (Geoffroy)	Ichneumonidae	Tryphoninae	658 female,179 male	21/05-01/11
Oedemopsis scabricula (Gravenhorst)	Ichneumonidae	Tryphoninae	21 females, 19 males	30/06-22/08
*Polyblastus melanostigmus (H*olmgren)	Ichneumonidae	Tryphoninae	1 male	2004
Polyblastus wahlbergi (Holmgren)	Ichneumonidae	Tryphoninae	1 male	2004
Thymaris tener (Gravenhorst)	Ichneumonidae	Tryphoninae	1 male	14/09
Ischnoceros caligatus (Gravenhorst)	Ichneumonidae	Xoridinae	1 female	14/09

RESULTS & DISCUSSION

Those insects caught in 2004 can only be identified as having been caught between 7th May (when ichneumonoids started to be separated from the rest of the catch) and the end of the year. Those caught in 2010 were known to be caught on a precise day, over a three day weekend or a four day Bank holiday.

Based on G.R.B.'s experience of the British fauna, many of the recorded Ichneumonoidea are widespread and common. Distribution and abundance data are mostly lacking for parasitoid Hymenoptera, although several publications by Mark Shaw and co-workers have started to assess the abundance of some ichneumonoids on the basis of numbers of specimens in the collections of the National Museums of Scotland, mostly assembled by Mark Shaw and often reared from known hosts (Schwarz & Shaw 1998, 1999; Shaw, 2010). We can be fairly certain that some of the more recognisable species, such as *Cidaphus areolatus* and *Euceros serricornis*, have genuinely restricted ranges and are rarely encountered. Rowardennan is one of very few sites in Britain where *C. areolatus* is known to occur, despite the fact it is nocturnal and readily comes to light. *Gnotus macrurus* is very poorly known and this is the only recent Britishspecimen known to us. The numbers of *Netelia* species trapped at Rowardennan are unusually high compared to other light traps for which there is a good data series. *Netelia* are all, where known, koinobiont ectoparasitoids of Lepidoptera larvae (that is, the parasitoid egg is attached externally on the host, which continues its development normally until it is overwhelmed by the *Netelia* larva after the caterpillar has prepared its pupation retreat). Although the taxonomy and host relations of *Netelia* species have been much confused in the literature, G.R.B. and Mark Shaw are completing a paper revising the British species and we can confidently describe the broader patterns of host ranges for many of our species. Whilst *Netelia* were, on the whole, abundant in the samples, some species, such as *N. infractor*, that mainly attack noctuid or notodontid hosts, were very uncommonly caught relative to some other sites. Also noteworthy was the capture of a single male *Netelia* specimen that represents an undescribed species (Broad & Shaw, in prep).

It is noteworthy that many species of Ichneumonoidea were consistently recorded over a protracted period of up to nearly six months. In the case of *Netelia tarsata* and *Netelia cristata* their abundance rose to a peak over a prolonged period of weeks and then fell off, again over several weeks (fig1). These species are plurivoltine (the exact number of generations is impossible to ascertain) but build up to a peak population late in the season. Many species however, show no discernible pattern in abundance but have a protracted flight season. Thus, the153 *Homolobus flagitator* that were recorded between 16th June and 10th October showed no evidence of a peak flight period, being recorded in ones, twos and threes on many days throughout the period. Similarly the 66 *Zele deceptor* were caught regularly in small numbers between 25th May and 7th October. It is unsurprising that plurivoltine parasitoids were much more numerous than univoltine species, such as most of the *Ophion* species. The host ranges of these plurivoltine species tend to be fairly broad (e.g. van Achterberg, 1979, 1984; Shaw, 2010) and the prolonged flight time indicates that on Loch Lomondside they use multiple hosts over several months. *Netelia cristata* has a very broad host range, utilising host caterpillars of several different families, in different feeding niches (Broad & Shaw, in prep.). All of the most abundant ichneumonoids in these samples are parasitoids of Geometridae, although none are host specialists. The most abundant species, *Netelia tarsata* and *N. virgata*, have host ranges centred on, respectively, pug larvae (Geometridae: Larentiinae: Eupitheciini) and *Hydriomena* species (Geometridae: Larentiinae) (Broad & Shaw, in prep.). July highflyer (*Hydriomena furcata*) is common, sometimes abundant, on Loch Lomondside, and is also one of the hosts of *Homolobus flagitator* (Shaw, 2010), which was caught in much greater number than in other Rothamsted light trap samples that have been examined by the second author. Other moths that serve as hosts for several of the commonly collected ichneumonoids, and which can be very common at the site, include mottled umber (*Erannis defoliaria*), the November moths (*Epirrita* spp.) and spring usher (*Agriopis leucophaearia*) (Knowler, 2010).

The above geometrid moth species show considerable year to year variation in their abundance on Loch Lomondside (Knowler, 2010). Given the large numbers of parasitoids that use these species and can be readily sampled in a light trap, the Rowardennan site could prove fruitful for investigators wishing to model the interactions of non-host-specific parasitoid species in relation to cyclical population dynamics of their hosts.

Some parasitoids collected in the Rowardennan trap in good numbers are more characteristic of southern woodlands, e.g. *Ophion costatus* and *O. ventricosus*. Their presence in Loch Lomondside but absence from much of the rest of Scotland is probably testament to the loss of much of the old, oak-dominated woodland.

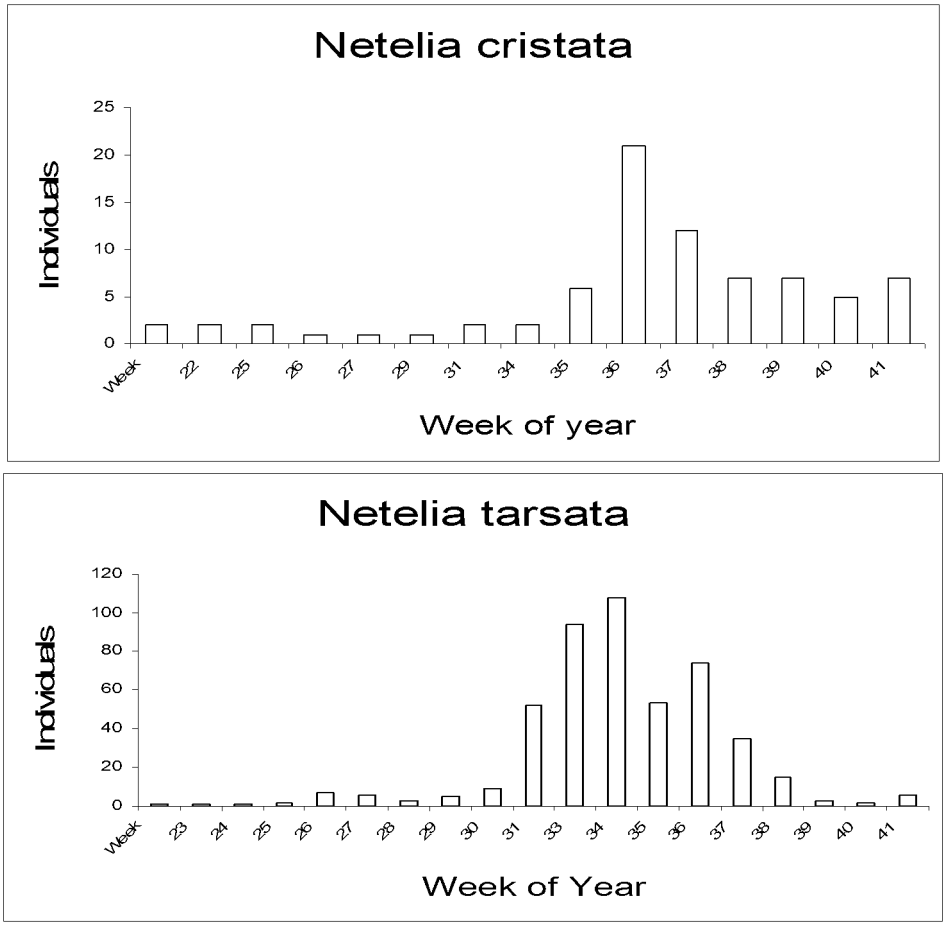

Fig.1. Numbers of *Netelia cristata* and *Netelia tarsata* trapped in 2010.

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