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ACULEATE WASPS AND BEES (HYMENOPTERA: ACULEATA) OF BLAXTON COMMON IN WATSONIAN YORKSHIRE WITH THE INTRODUCTION OF A NEW NATIONAL QUALITY SCORING SYSTEM

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Blaxton Common has been found to be an excellent locality for aculeate wasps and bees, having 123 recorded species, six species of national importance and ten species of regional significance. The Common, an area of about 150ha, is situated to the north-east of Blaxton, near Doncaster (VC63, SE6901). The region has sandy acid soils worked by the sand and gravel extraction industry. After sand extraction, dry open horizontal sand and small sandy clifflets are left. Vegetation has invaded the open spaces, leading to the development of birch and oak woodland. Sheltered by the woodland the open areas become important nesting and foraging resources for the aculeate wasps and bees. Continued growth of the birch and oak will eventually shade out the open areas but at present many open areas are present.

Between 1980 and 1993, 17 visits were made to a sample area, about 25ha, of Blaxton Common along either side of the road from Finningly to Wroot. These visits were distributed throughout the year as follows: April (2 visits), May (4), June (3), July (3), August (3), September (2). During these three-hour visits all species of aculeate wasps and bees seen were recorded (Archer sample) and usually collected with a hand net for identification. In addition, I have had access to a small number of records from H. H. Corbett (June 1918), E. W. Aubrook (June 1969) and P. Skidmore (April 1967), a larger number of records from J. D. Coldwell (August 1991) and J. T. Burn (1972-78), to whom I am most grateful. In the following account biological names are according to Kloet and Hincks (1978).

Results

Species present at Blaxton Common

At the family level, Table 1 shows the taxonomic distribution. The 122 recorded species represent about 46% of the aculeate wasps and bees recorded from Watsonian Yorkshire. In addition, J. T. Burn recorded the dryinid wasp *Anteon jurineanum* during May 1980.

The Archer sample of solitary wasps and bees consists of 315 records derived from 91 species (Table 2). Fifty-eight species (63.7%) were recorded on one, two or three days (unusual species) while the other 33 species (36.3%) were recorded on from four to 15 days (common species) (Table 3). Solitary bee species are more equally represented in the common (21 species) and unusual (27) groups compared with the wasp species which are represented more in the unusual (31) than the common (12) groups of species. Thus solitary wasps species would seem to be more difficult to find than solitary bee species. With 29 species (31.9%) only being found on one visit, the recording of further species is very likely.

A further eighteen solitary species have been recorded as follows: *Dipogon subintermedius* (=*D. nitidus*), *Anoplius nigerrimus*, *Ancistrocerus gazella*, *Tachysphex unicolor*, *Trypoxylon attenuatum*, *Crabro peltarius*, *Crossocerus cetratus*, *C. megacephalus*, *Ectemnius cavifrons*, *E. cephalotes*, *Stigmus solskyi*, *Pemphredon inornatus*, *Diodontus luperus*, *Nysson dimidiatus*, *N. spinosus*, *N. trimaculatus*, *Argogorytes mystaceus*, *Andrena cineraria*. Seventeen of these 18 species not found in the Archer sample are wasps species, indicating again the smaller probability of finding the wasp compared with the bee species.

The following ant, social wasp, and bee species have been recorded: Formicidae: *Myrmica ruginodes*, *Formica fusca*, *Lasius niger*; Vespidae: *Dolichovespula sylvestris*, *Vespula rufa*, *Paravespula germanica*, *P. vulgaris*: Apidae: *Bombus lucorum*, *B. terrestris*,

B. lapidarius, *B. pratorum*, *B. hortorum*, *B. pascuorum*, *Psithyrus bohemicus*, *P. vestalis*, *Apis mellifera*.

Seasonal progression of solitary species

From the Archer sample the solitary wasp species were only recorded during the summer months (Table 4). August was the most productive month for the number of species and individuals, and June, the month when the solitary wasp species first emerged, the best month for recording new species. The subterranean nesting species of the open sandy areas were very evident including the spider-hunting *Pompilus cinereus*, the caterpillar-hunting sand-wasp *Ammophila sabulosa*, the fly-hunting *Crossocerus quadrimaculatus*, the grasshopper-hunting *Tachysphex pompiliformis* and *Evagetes crassicornis* which is a cleptoparasite on other spider-hunting wasps.

TABLE 1

The number of species of aculeate wasps and bees recorded from Blaxton Common

	No. species
Solitary wasps	
Chrysididae	4
Mutillidae	1
Pompilidae	12
Eumenidae	3
Sphecidae	40
Total solitary wasps	60
Solitary bees	
Colletidae	6
Andrenidae	17
Halictidae	15
Megachilidae	3
Anthophoridae	8
Total solitary bees	49
Total solitary wasps & bees	109
Social wasps & bees	
Vespidae	4
Apidae	9
Total social wasps & bees	13

TABLE 2

The number of records and species of solitary wasps and bees recorded from Blaxton Common in the Archer sample

Family	No. species	No. records
Chrysididae	4	11
Mutillidae	1	4
Pompilidae	10	36
Eumenidae	2	2
Sphecidae	26	65
Collectidae	6	8
Andrenidae	16	94
Halictidae	15	62
Megachilidae	3	6
Anthophoridae	8	27

TABLE 3
The number of days on which each species of solitary wasp and bee was recorded at Blaxton Common in the Archer sample

No. records	No. days	Species	No. species
29	1	*Chrysis angustula*, *Priocnemis schioedtei*, *Ancistrocerus parietinus*, *A. trifasciatus*, *Trypoxylon clavicerum*, *Crabro cribrarius**, *Crossocerus tarsatus*, *C. nigritus*, *Psen lutarius*, *Psenulus pallipes*, *Pemphredon lethifer*, *Diodontus minutus**, *D. tristis**, *Passaloecus gracilis*, *P. singularis*, *Gorytes quadrifasciatus*, *G. tumidus*, *Colletes daviesanus*, *C. succinctus**, *Hylaeus communis*, *H. confusus*, *H.brevicornis*, *Andrena angustior*, *A. barbilabris**, *Halictus rubicundus*, *H. tumulorum*, *Lasioglossum fratellum*, *L. punctatissimum*, *Megachile circumcincta*.	29
34	2	*Hedychridium ardens**, *Arachnospila anceps*, *A. trivalis*, *Anoplius concinnus*, *Episyron rufipes*, *Trypoxylon figulus*, *Crossocerus palmipes*, *C. wesmaeli*, *Psen dahlbomi*, *Pemphredon lugubris*, *Andrena saundersella*, *A. varians*, *Lasioglossum nitidiusculum*, *Megachile versicolor*, *Nomada fabriciana*, *N. ruficornis*, *N. rufipes**.	17
36	3	*Chrysis impressa*, *Priocnemis exaltata*, *Arachnospila spissa*, *Ectemnius continuus*, *Colletes fodiens*, *Andrena denticulata**, *A. praecox*, *Lasiogalossum leucopum*, *Sphecodes gibbus*, *Megachile willughbiella*, *Nomada flavoguttata*, *Epeolus variegatus*.	12
36	4	*Myrmosa atra*, *Anoplius viaticus**, *Crossocerus ovalis*, *Entomognathus brevis*, *Oxybelus uniglumis**, *Mellinus arvensis**, *Lasioglossum leucozonium*, *Sphecodes puncticeps*, *Nomada goodeniana*.	9
35	5	*Trichrysis cyanea*, *Andrena clarkella**, *A. fulva*, *A. tibialis*, *Lasioglossum rufitarse*, *L. villosulum*, *Nomada leucophthalma**.	7
18	6	*Lasioglossum calceatum*, *Sphecodes pellucidus**, *Nomada marshamella*.	3
7	7	*Tachysphex pompiliformis**.	1
48	8	*Evagetes crassicornis*, *Crossocerus quadrimaculatus*, *Anmophila sabulosa**, *Andrena chrysosceles*, *A. scotica*, *A. subopaca*.	6
36	9	*Pompilus cinereus**, *Andrena haemorrhoa*, *A. nigroaenea*, *Sphecodes monilicornis*.	4
10	10	*Andrena bicolor*.	1
11	11	*Sphecodes fasciatus*.	1
15	15	*Andrena minutula*.	1

*Local species in Watsonian Yorkshire.

From the Archer sample, the solitary bee species were recorded during the spring and summer months, being more frequent during the spring months (Table 4). May (for the

spring species) and August (for the summer species) were the most productive months for the number of species and individuals. The number of new species was most frequent during the first month of emergence: April for the spring species and June for the summer species. Typical spring species were the mining bees, *Andrena*, with their cleptoparasites, *Nomada*, e.g. *A. haemorrhoa* with *N. ruficornis* and *A. nigroaenea* with *N. goodeniana*. Typical summer species were the mining bees, e.g. *Colletes fodiens* with its cleptoparasite *Epeolus variegatus*, *Andrena denticulata* with *Nomada rufipes*, *Lasioglossum villosulum* with *Sphecodes puncticeps* and the aerial nesting *Megachile willughbiella*. Some bee species were found in the spring and the summer having passed through two generations, e.g. *Andrena minutula* with *Nomada flavoguttata*, *A. bicolor* with *N. fabriciana* and *Lasioglossum calceatum* with *Sphecodes monilicornis*.

TABLE 4
The number of species, new species and individuals of solitary wasps and bees recorded per month at Blaxton Common from the Archer sample

	April	May	June	July	August	September
Wasps						
No. species	0	0	19	20	32	7
No. new species	0	0	19	9	15	0
No. individuals	0	0	28	31	50	9
Bees						
No. species	22	24	21	11	17	13
No. new species	22	6	8	4	6	2
No. individuals	32	56	32	24	31	22

Quality Assessment of Solitary Species

Six species are nationally scarce species (Falk, 1991). One species, *Andrena tibialis*, which is a category A scarce species, reaches the northern boundary of its British distribution in Watsonian Yorkshire. The other five species, which are category B scarce species, are either at the northern boundary of their distribution (*Priocnemis schioedtei*, *Nysson trimaculatus*, *Andrena varians*) or are more widespread in Britain (*Crossocerus palmipes*, *Nysson dimidiatus*). No nationally rare species (Falk, 1991) have been found.

Ten species are rare in the context of Watsonian Yorkshire (Archer, 1993) (*Episyron rufipes*, *Tachysphex unicolor*, *Crossocerus palmipes*, *Psen lutarius*, *Diodontus luperus*, *Nysson dimidiatus*, *N. trimaculatus*, *Hylaeus brevicornis*, *Andrena tibialis*, *Sphecodes puncticeps*).

There are 27 species of solitary wasps and bees, which although not rare in Watsonian Yorkshire, have a local distribution, being more or less restricted to sandy habitats (Archer, 1994a). Eighteen of these local species are found at Blaxton Common and except for *C. peltarius* are indicated in Table 3.

The 109 species of solitary wasps and bees can be considered to have a common, frequent, occasional or rare status in Watsonian Yorkshire (Archer, 1993) (Table 5). By giving each species a score depending on the above statuses, including a higher score for the nationally scarce species, a quality score of 341 can be calculated (Table 6). Dividing the quality score by the 109 species gives a species quality score of 3.1.

Ball (1992) proposed a status category scheme for invertebrates in a national context (Table 7). Since such a status coding has not previously been applied solely to the aculeate Hymenoptera of a particular locality the following proposals can be made. The nationally rare and scarce statuses will remain the same as previously considered. The regionally notable species are equated with the regionally rare species. Ball (1993, *pers. comm.*) defined the term "local" as a species either restricted to a particular habitat type or to a particular geographical area, or to widespread species which are intermediate in status

between common and scarce species. At present there is no objective way of assigning a common or local status to the species of the British aculeate Hymenoptera. From personal experience I have therefore assigned common or local status based upon abundance and distribution within England and Wales. Ireland was excluded as little information is available on Irish distributions, as were the Channel Islands, since their fauna relates more to France than to the British Isles, and Scotland, because its cooler climate has a profound effect in reducing the diversity of aculeate Hymenoptera. Using the Ball national status scheme a quality score of 209 and a species quality score of 1.9 can be calculated (Table 7).

TABLE 5
The regional coding of the 109 species of solitary wasps and bees recorded from Blaxton Common

Status	No. species
Common	42
Frequent	34
Occasional	23
Rare	10

TABLE 6
The regional quality score of the species of solitary wasps and bees recorded at Blaxton Common

Status	Status Score (A)	No. species (B)	Quality Score (A*B)
Common	1	41	41
Frequent	2	34	68
Occasional	4	22	88
Rare	8	6	48
Nationally Scarce	16	6	96

TABLE 7
The Ball national quality score of the species of solitary wasps and bees recorded at Blaxton Common

Status	Status Score (A)	No. species (B)	Quality Score (A*B)
Common	1	65	65
Local	2	32	64
Regionally notable	4	6	24
Scarce B	8	5	40
Scarce A	16	1	16

Two objections can be raised against the Ball national status scheme. Firstly, since regionally notable species are unknown for many parts of England, Ball's scheme cannot be applied. Secondly logically a national scheme should give a species status based upon that species' importance in a national and larger geographical setting but not in a smaller or regional distribution.

To overcome the above objections I suggest the following scheme in which the statuses of "Common" "Local" and "Regionally Notable" of Ball are replaced by: "Universal" "Widespread" and "Restricted". These new statuses are assigned from personal experience of a species' abundance and distribution within England and Wales. Universal species would be common species found throughout England and Wales, which usually extend into

Scotland. Widespread species would be found in about three-quarters of England and Wales, usually with a distribution in Wales, southern and midland England or in northern and western England and Wales. Widespread species also may be found throughout England and Wales but either with a local distribution or a less than common abundance. Restricted species would mainly be found in about one-half of England and Wales, usually confined to southern England and East Anglia. Using this new national status scheme, a quality score of 205 (Table 8) and a species quality score of 1.9 can be calculated for Blaxton Common.

Cleptoparasitic Load

The cleptoparasitc load (CL) is the percentage of aculeate species that are cleptoparasites on other host aculeates (Table 9). At Blaxton Common the CL for the species of solitary bees is higher than the CL for the species of solitary wasps.

Aerial Nester Frequency

The aerial nester frequency (AF) is the percentage of host aculeate species that have aerial nest sites. Aerial nests are often in old beetle burrows in dead wood or the central cavities of stems such as those of bramble. Subterranean nesters nest in the soil, usually in burrows dug by themselves but sometimes in crevices or pre-formed burrows (Table 10). The AF for the species of solitary wasps is higher than the AF for the species of solitary bees at Blaxton Common.

TABLE 8

The Archer national quality score of the species of solitary wasps and bees recorded at Blaxton Common

Status	Status Score (A)	No. species (B)	Quality Score (A*B)
Universal	1	59	59
Widespread	2	43	86
Restricted	4	1	4
Scarce B	8	5	40
Scarce A	16	1	16

TABLE 9

The relative frequency of the cleptoparasitic species among the solitary wasps and bees from Blaxton Common

	No. hosts (H)	No. cleptoparasites (C)	Cleptoparasitic Load CL=100*C/(H+C)
Solitary Wasps	51	9	15.0
Solitary Bees	36	13	26.5

TABLE 10

The nesting habits of the host solitary wasp and bee species from Blaxton Common

	No. aerial nesters (A)	No. subterranean nesters (B)	Aerial nester frequency AF=100*A/(A+S)
Solitary Wasps	22	29	43.1
Solitary Bees	5	31	13.9

TABLE 11

A comparison of the quality scores of sandy habitats in Watsonian Yorkshire and elsewhere in England based on the species of solitary wasps and bees.

	Sherwood Forest	Pre-coniferized Allerthorpe Common	Charnwood Forest	Strensall Common	Coniferized Allerthorpe Common	Pompocali	Blaxton Common	Risby Warren	Swincarr Plantation	Skipwith Common
Area (ha)	390	2030	11,650	690	2030	1.7	150	170	0.05	312
No. species	100	129	147	91	75	51	109	63	35	69
Regional scheme										
Quality score	–	514	–	289	212	136	341	–	74	149
Species quality score	–	4.0	–	3.2	2.8	2.7	3.1	–	2.1	2.2
Ball's national scheme										
Quality score	290*	381	402**	213	167	112	209	119*	57	105
Species quality	2.9	3.0	2.7	2.3	2.2	2.2	1.9	1.9	1.6	1.5
Archer's national scheme										
Quality score	296	379	402	225	175	115	202	114	62	109
Species quality score	3.0	2.9	2.7	2.5	2.3	2.3	1.9	1.8	1.8	1.6

* Regional notable species based on Watsonian Yorkshire
** Regional notable species based on Archer (1990)

Discussion

Quality Assessment

The regional and national status schemes of Ball and Archer can be applied to other sandy localities in Watsonian Yorkshire (Archer, 1984, 1985, 1988, 1989, 1992b), Lincolnshire (Risby Warren, Archer, 1994b), Nottinghamshire (Sherwood Forest, Archer, in press) and Leicestershire (Charnwood Forest, Archer, 1992a) (Table 11). The sandy habitats vary greatly in size from the sand pit at Swincarr Plantation to the eroded Precambian mountain range of Charnwood Forest. The number of species of aculeate wasps and bees varies from 35 species at Swincarr Plantation to 147 species at Charnwood Forest.

The quality and species quality scores of the Ball and Archer national status schemes for each locality are of a very similar or even of the same value (Table 11). Blaxton Common on its species quality score is ranked seventh on the Archer scheme and equal seventh with Risby Warren on the Ball scheme out of the ten data sets. Both schemes would seem suitable as a national status scheme but the Archer scheme is preferred for reasons given earlier.

For the seven Yorkshire localities the regional and Archer national species qualities scores show a significant linear positive relationship (correlation coefficient, $r = 0.87$, $p<0.02$). Similarly the regional and Archer national quality scores show a highly significant linear positive relationship ($r = 0.98$, $p<0.001$). At present these relationships cannot be explored outside Watsonian Yorkshire as regional statuses for other parts of England are not yet available. The regional species quality and quality scores are higher for each locality than the Archer national scores (Table 11) because there are four, rather than three, statuses before the national scarce species (Tables 6, 8).

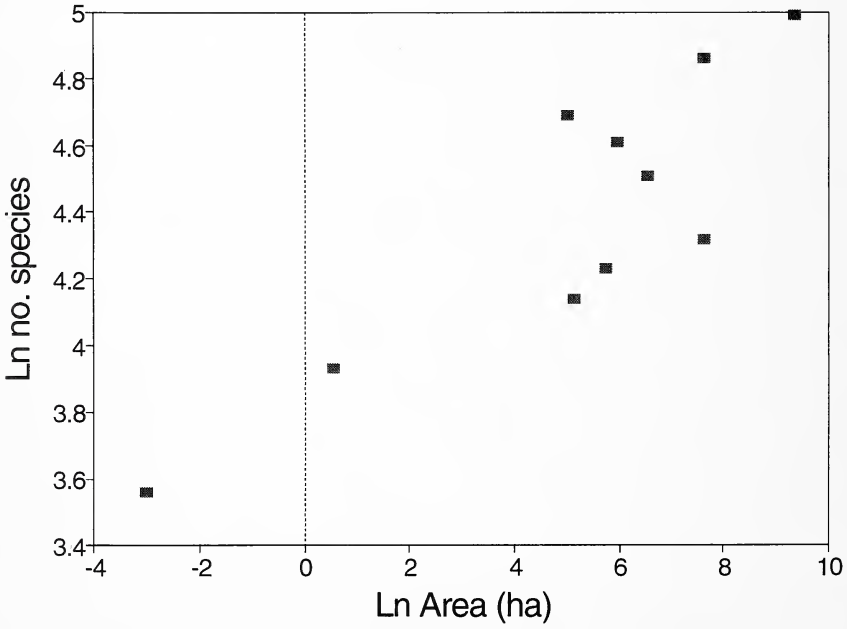

FIGURE 1

The Ln number of species versus Ln area (ha) of the species of solitary wasps and bees recorded from sandy habitats in Watsonian Yorkshire and elsewhere in England.

For each locality the Archer national quality score shows a highly significant linear positive relationship with the number of species ($r = 0.95$, $p=0.001$). This relationship is a reflection of a species-area relationship. Thus the larger the area of the locality the more species are present, including an increased chance of nationally scarce and rare species being found. A plot of Ln number of species versus Ln area in hectares gives a highly significant relationship ($r = 0.87$, $p=0.001$) (Figure 1). Removing the data for coniferized Allerthorpe Common, which is a damaged habitat (Archer, 1989), increases the significance of the species-area relationship ($r = 0.92$, $p<0.001$) and gives the species-area equation: $LnS = 3.85 + 0.11\ LnA$, where S = number of species and A = area in hectares.

Cleptoparasitic Load & Aerial Nester Frequency

The wasp and bee cleptoparasitic loads are similar to values from other sandy localities (Archer, 1992b, 1993).

Likewise, the wasp and bee aerial nester frequencies are similar to lowland heaths such as pre-coniferised Allerthorpe and Strensall Commons (Archer, 1992b).

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