

THE WASPS, ANTS AND BEES (HYM., ACULEATA) OF THORNE
AND HATFIELD MOORS IN WATSONIAN YORKSHIRE

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Thorne Moor (SE7115), to the east of Thorne, consists of raised lowland peat bog, *Sphagnum* hollows, dry heathery areas, bracken and birch woodland, extensive fen and reed bed and some old woodland. Hatfield Moor (SE7006), to the east of Doncaster, consists of a mosaic of raised lowland peat bog, dry sandy heath, dry sandy/calcareous grassland, carr, birch and oak woodland and open water. On both moors, drainage and peat cuttings, with gravel extraction on Hatfield Moor, have brought much destruction to the habitats (Eversham, 1991). Peat milling on Thorne Moor stopped during 2001 and largely ceased on the Site of Special Scientific Interest of Hatfield Moor during 2004. Thorne and Hatfield Moors with Crowle Moor are now known as The Humberhead Peatlands National Nature Reserve.

SAMPLING METHODS AND SOURCES OF RECORDS

Major sources of records, with information for each species only to the year, are given by Skidmore (2006, records to 2005). Additional records are available from the Yorkshire electronic database from Thorne Moor by J.T. Burn, R. Crossley, J.H. Flint, P.R. Harvey and C.W. Plant, and from Hatfield Moor by J.T. Burn, J.C. Dale and P. Seccombe. The records of J.C. Dale from 1827 to 1837 were made available by G.M. Spooner. Further records of P. Skidmore were found in the Doncaster Museum, but not mentioned by Skidmore (2006).

The author made seven visits to Thorne Moor between 1975 and 2010 and 24 visits to Hatfield Moor (22 visits to the western edge from 2005–2009, one visit to the northern section during 1995 and one visit to Lindholme Moor (private ownership in the centre of the moor)) during 2000. The Hatfield Moor visits, between 2005 and 2009 (called the Archer Hatfield visits), were distributed throughout the year as follows: April (4), May (4), June (5), July (5) and August (4). During each, approximately three hour visit, all species of aculeate wasps and bees were recorded and usually collected with a hand net for identification.

In the following account, the nomenclature can be related to that given by Kloet and Hincks (1978). An up-to-date check list can be found on the Bees, Wasps and Ants Recording Society (BWARS) web pages at <http://www.bwars.com/>.

SPECIES PRESENT

A full list of recorded species (with authorities) is given in the Appendix. At the family or subfamily level, Table 1 for Thorne Moor and Table 2 for Hatfield Moor, show, in three columns, the number of species

TABLE 1. — THE NUMBER OF RECORDED SPECIES FROM THORNE MOOR BY SKIDMORE (2006) AND OTHER RECORDERS

	Skidmore	Others	Total No. Species
Solitary Wasps			
Dryinidae (D)	4	2	6
Embolemyidae (E)	1	0	1
Bethylidae (B)	3	0	3
Chrysididae	3	1	4
Mutillidae	1	0	1
Sapygidae	0	1	1
Pompilidae	5	1	6
Eumeninae	8	0	8
Sphecidae	1	0	1
Crabronidae	26	3	29
Total solitary wasps (TSW)	52	8	60
TSW–DEB	44	6	50
Solitary bees			
Colletidae	5	1	6
Andrenidae	6	2	8
Halictidae	10	4	14
Megachilidae	4	2	6
Apidae	8	2	10
Total solitary bees	33	11	44
Total solitary species (TSS)	85	19	104
TSS–DEB	77	17	94
Social species			
Formicidae	10	0	10
Vespinidae	5	1	6
Apidae	12	1	13
Total social species	27	2	29
Total aculeate species	112	21	133

recorded by Skidmore (2006), additional recorded species by other recorders and the total number of species recorded. Twenty one species (15.8% of the total list) for Thorne Moor and 46 species (26.0% of the total list) for Hatfield Moor have been added to the lists of Skidmore (2006). *Ancistrocerus nigricornis* (Curtis) and *Bombus subterraneus* (Linn.) are now considered extinct in Yorkshire (Archer, 2002), having been recorded from Thorne Moor, respectively during 1966 and 1934. Of the solitary wasp and bee families, the families with the most species are the Crabronidae and the Halictidae. The total list from the two sites of 202 species represents 63.7% of the current Yorkshire list.

For the Archer Hatfield visits, the mean number of solitary species recorded per visit was 13.5 (range 4–24). Most solitary species were recorded during June (Table 3) with a gradual fall-off before and after

TABLE 2. — THE NUMBER OF RECORDED SPECIES FROM HATFIELD MOOR BY SKIDMORE (2006) AND OTHER RECORDERS

	Skidmore	Others	Total No. Species
Solitary Wasps			
Dryinidae (D)	10	2	12
Embolemyidae (E)	1	0	1
Bethylidae (B)	1	0	1
Chrysididae	4	2	6
Mutillidae	1	0	1
Sapygidae	0	0	0
Pompilidae	9	5	14
Eumeninae	5	1	6
Sphecidae	1	0	1
Crabronidae	26	10	36
Total solitary wasps (TSW)	58	20	78
TSW-DEB	46	18	64
Solitary bees			
Colletidae	4	1	5
Andrenidae	12	7	19
Halictidae	18	6	24
Megachilidae	2	4	6
Apidae	10	4	14
Total solitary bees	46	22	68
Total solitary species (TSS)	104	42	146
TSS-DEB	92	40	132
Social species			
Formicidae	10	0	10
Vespinae	6	2	8
Apidae	11	2	13
Total social species	27	4	31
Total aculeate species	131	46	177

June. For the Archer visits to Thorne Moor, solitary species were only recorded on five visits (April, May, June and July) with a mean number of 5 (range 1–11) species.

There are sufficient data to compare the solitary species recorded by Skidmore and Archer from Hatfield Moor. Nearly half (47.2%) of the species were common to both recorders. Skidmore recorded more solitary wasp species (26) than Archer (13) with Archer recording more solitary bee species (20) than Skidmore (7).

From the Archer Hatfield visits, the solitary species most frequently recorded were the caterpillar hunter, *Ammophila sabulosa*, the spider hunters, *Pompilus cinereus* and *Episyron rufipes*, the beetle larval hunter, *Odynerus spinipes*, the bees, *Andrena minutula*, *Lasioglossum leucozonium*, *L. villosulum* and the bee cleptoparasites *Sphecodes*

TABLE 3. — THE NUMBER OF SOLITARY SPECIES RECORDED PER MONTH FROM THE ARCHER HATFIELD SAMPLE

	April	May	June	July	August
Mean	7.8	10.5	21.2	14.0	12.5
Range	4–13	8–13	18–24	9–18	9–15

ephippius, *S. pellucidus* and *Nomada goodeniana*. All these species are subterranean nesters with the hosts of the cleptoparasites also being subterranean nesters.

SPECIES STATUS

Among the solitary species, according to Shirt (1987), three Red Data Book Species (*Philanthus triangulum*, *Andrena tibialis*, *Nomada robertjeotiana*) were recorded from Hatfield Moor and one species (*Pemphredon morio*) from Thorne Moor. Falk (1991) suggested that *Andrena tibialis* should be downgraded to national scarce status list A (Na) and *Pemphredon morio* to national scarce status list B (Nb). In addition, from Falk (1991) it can be suggested that from Hatfield Moor, *Nomada integra* should have a Na status and *Crossocerus palmipes*, *Nysson trimaculatus*, *Hylaeus signatus* (also from Thorne Moor), *Andrena humilis*, *A. varians* and *Sphecodes crassus* should have Nb status. Recent work carried out by the Bees, Wasps and Ants Recording Society suggests that *Philanthus triangulum* should lose its Red Data Book status and *Nysson trimaculatus* its Nb status.

To take account of these changes, Archer (1999, 2002) has developed a national quality scoring system of high and low quality scoring species. High quality species have a scarce (equivalent to Nb), rare (equivalent to Na) or very rare (equivalent to RDB) status while low quality species have a universal, widespread or restricted status. According to this national system, the high quality species recorded from Thorne Moor are two scarce species (*Pemphredon morio*, *Hylaeus signatus*) and from Hatfield Moor two rare species (*Nomada integra*, *N. robertjeotiana*) and eleven scarce species (*Chrysis viridula*, *Anoplius concinnus*, *A. viaticus*, *Crossocerus palmipes*, *Nysson dimidiatus*, *Hylaeus signatus*, *Andrena humilis*, *A. tibialis*, *A. varians*, *Sphecodes crassus*, *Nomada obtusifrons*).

The social species are all common and widespread species, although the record of *Myrmica lobicornis* should be noted. The extinct *Bombus subterraneus* was given a Na status by Falk (1981), but is now extinct in the British Isles (Edwards & Jenner, 2005). It is not possible to give a status to the species of the Dryinidae, Embolemidae and Bethyilidae (DEB species) as their national abundance and distribution are only beginning to be understood. However, *Embolemus ruddii* from Thorne and Hatfield Moors, *Bethylus dendrophilus* from Thorne Moor and *Aphelopus quercus*

from Hatfield Moor might be considered rare, at least, in a Yorkshire context.

By giving each of the solitary wasp and bee species an Archer national status, a national quality can be calculated for Thorne Moor (146) and Hatfield Moor (287) (Table 4) with species quality scores (SQS) for Thorne Moor (1.6) and Hatfield Moor (2.2).

ESTIMATING THE POTENTIAL NUMBER OF SOLITARY WASP AND BEE SPECIES

One of the problems in the study of any site is the difficulty of knowing how many more species are present at a site, but, as yet, unrecorded. Recent advances in non-parametric statistical procedures offer a way of addressing this problem. Two procedures have been used to estimate the potential number of species on a site: the presence/absence of Chao (in Colwell and Coddington, 1994) which is based on the number of species that are observed in one (singletons) or two (doubletons) samples or visits and the first order Jackknife (Heltshe and Forrester, 1983) which depends only on the singleton species. Because some aculeate species are only active in the spring or summer, it is advisable that samples be taken throughout the months of adult activity. The software to carry out the statistical procedure was provided by Pisces Conservation Ltd. To use these procedures species recorded on each visit (= sample) are needed. With the data available this is only possible with the Archer Hatfield visits.

The statistical procedures were run with the software, taking 1, 2, etc. samples at random 100 times for each procedure, each time calculating a mean estimate of species diversity. With a small number of samples the estimates vary, but as more samples are selected the estimates may stabilise giving confidence in them. The estimates for both procedures are approaching a stable level although still slightly increasing (Figs 1, 2). When all the samples (visits) are considered, the final estimates (Table 5) from both procedures are very similar to each other and with the aid of the 95% confidence limits, there is an indication that the actual number of solitary species recorded (132, Table 2) is probably near to the full list.

CLEPTOPARASITIC LOAD

The cleptoparasitic load (CL) is the percentage of aculeate species that are cleptoparasitic (or parasitoids) on other host aculeates. Weislo (1987) showed that parasite behaviour among aculeate Hymenoptera correlated with geographical latitude ($r = 0.66$, $N = 114$). Thus parasitic rates are higher in temperate regions, as host populations are more synchronised in their life-history characteristics than in tropical regions. This finding probably does not hold for desert regions where the occurrence of rainfall would tend to synchronise life history characteristics. From a review of the literature of Palaearctic species, Weislo found that the CLs for bees

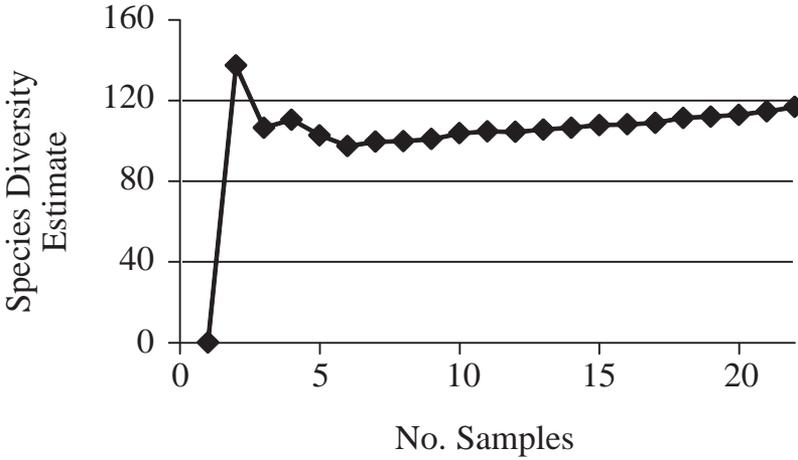


Fig. 1. — The presence/absence Chao estimates of species diversity of the solitary species from the Archer Hatfield sample.

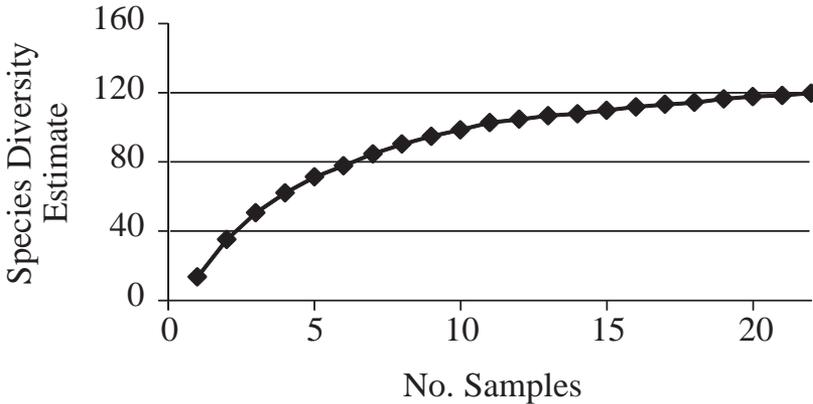


Fig. 2. — The presence/absence Jackknife estimates of species diversity of the solitary species from the Archer Hatfield sample.

varied between 12% (Iran) and 33% (Finland), with a range of 21%. The CLs from 27 Yorkshire sites varied between 25.0–40.0%, a range of 25% (Archer, 2010). The CLs for Thorne and Hatfield Moors fall within this range (Table 6).

Wcislo (1987) also reviewed the wasp literature, reaching the same conclusion, as for the bees, but did not carry out a numerical analysis. The CLs for solitary wasps from 27 Yorkshire sites varied between

TABLE 4. — THE ARCHER NATIONAL QUALITY SCORES OF THE SOLITARY SPECIES FROM THORNE AND HATFIELD MOORS

	Score	No. species		Species Quality	
		Thorne	Hatfield	Thorne	Hatfield
Universal	1	54	71	54	71
Widespread	2	38	48	76	96
Scarce	8	2	11	16	88
Rare	16	0	2	0	32
Total		94	132	146	287

Species Quality Score (SQS): Thorne Moor: $146/94 = 1.6$; Hatfield Moor: $287/132 = 2.2$

TABLE 5. — ESTIMATES OF SPECIES RICHNESS ON HATFIELD MOOR FROM THE ARCHER HATFIELD SAMPLE USING CHAO PRESENCE/ABSENCE AND FIRST ORDER JACKKNIFE PROCEDURES

	Chao	Jackknife
No. spp. recorded	92	92
No. spp. estimated	118	120
95% confidence limits	97–138	106–135
% of estimated spp. recorded	78.0	76.7

TABLE 6. — THE RELATIVE FREQUENCY OF THE CLEPTOPARASITIC (OR PARASITOID) SPECIES AMONG THE SOLITARY SPECIES FROM THORNE AND HATFIELD MOORS

	No. possible hosts (H)		No. cleptoparasites (C)		Cleptoparasitic Load CL = $100 \times C / (H + C)$	
	Thorne	Hatfield	Thorne	Hatfield	Thorne	Hatfield
Solitary wasps	44	54	6	10	12.0%	15.6%
Solitary bees	29	45	15	23	31.4%	33.8%

10.3–25.0%, a range of 14.7% (Archer, 2010), so Weislo's proposition also may apply to the solitary wasps. The CLs for Thorne and Hatfield Moors fall within this range (Table 6).

AERIAL NESTER FREQUENCY

The aerial-nester frequency (AF) is the percentage of aculeate species that have aerial nest sites. Aerial nesters use old beetle burrows in dead

TABLE 7. — THE NESTING HABITS OF THE SOLITARY SPECIES FROM THORNE AND HATFIELD MOORS

	No. aerial nesters (A)		No. subterranean nesters (S)		Aerial Nester Frequency AF = 100 x A/(A + S)	
	Thorne	Hatfield	Thorne	Hatfield	Thorne	Hatfield
Solitary wasps	27	19	17	35	61.4%	35.2%
Solitary bees	9	8	20	37	31.0%	17.8%

wood, central stem cavities (e.g. bramble), old snail shells, or crevices in cob walls, old mortar or exposed on the surface of rock or other hard material. Subterranean nesters nest in the soil, usually in burrows dug by them, but sometimes holes and crevices are used after being altered.

The AFs for the solitary species are given in Table 7. The AFs for all the British species of solitary wasps is 46.2% and solitary bees is 17.9%. The AFs for the solitary wasps are higher for Thorne Moor and lower for Hatfield Moor and the solitary bees are higher for Thorne Moor.

DISCUSSION

There are some differences between the recorded aculeates of Thorne and Hatfield Moors. Hatfield Moor has more recorded species (Tables 1, 2), a higher recording rate for the solitary species (13.5 versus 5.0 species per visit) and a higher species quality score with more nationally scarce and rare species (Table 4). These differences probably result from the drier nature of Hatfield Moor (Skidmore, 1997). The relative higher solitary wasp and bee aerial nester frequencies for Thorne Moor would support such a speculation. The lower solitary wasp aerial nester frequencies for Hatfield Moor is probably a consequence of its the drier soil conditions.

Using the wasp and species data, except for the Dryinidae, Embolemidae and Bethyridae which are often not recorded, Thorne and Hatfield Moors can be compared with other Yorkshire sites. Both Thorne (111 species) and Hatfield (153 species) Moors, each with over 100 species (Tables 1 & 2) may be considered excellent sites in a Yorkshire context. Few other Yorkshire sites have this informal designation: Allerthorpe Common (142 species; Archer, 1989 updated), Strensall Common (141 species, Archer, 2011), Crow Wood (119 species; Archer & Burn, 1995), Pollington Quarry (122 species, Archer, 2006) and two sites on Blaxton Common (together 131 species; Archer 1995, 2010). The data from Allerthorpe Common are from its pre-coniferous period. With afforestation, there was much species loss (100 species; Archer, 1989 updated) with a few species gained recently with the removal of some trees (108 species; Archer, unpublished).

An attempt can be made to explain the lack of agreement, just less than 50%, of the solitary species recorded by Skidmore and Archer from

Hatfield Moor. The main recording method of Skidmore was by sweep netting and of Archer by netting of individual aculeates. Perhaps, the generally small size of the solitary wasps makes them more likely to be recorded by sweep netting than visual recording. The new species of bees found by Archer were mainly only recorded on one or two occasions, so could easily have been missed by Skidmore. However, other bee species were more frequently found (*Andrena barbilabris*, *A. humilis*, *A. scotica*, *Halictus tumulorum*, *Sphecodes pellucidus*) and probably are new additions to Hatfield Moor since 2005 (Skidmore, 2006).

CONCLUSIONS

The number of aculeate species recorded from Thorne (133) and Hatfield (177) Moors means that both can be considered excellent sites within a Yorkshire context.

More species were recorded from Hatfield Moor compared with Thorne Moor, probably because it is a drier site.

Two species of national importance were recorded from Thorne Moor and 13 species from Hatfield Moor, resulting in the Species Quality Score (2.2) for Hatfield Moor being higher than for Thorne Moor (1.6).

The solitary species diversity estimate for Hatfield Moor from the smaller Archer data successfully supported the actual number of species that have been recorded.

The higher aerial nester frequency of solitary species from Thorne Moor is probably a consequence of it being a wetter site, while the relative lower aerial nester frequency from Hatfield Moor is a consequence of it being a drier site.

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APPENDIX

THE LIST OF SPECIES RECORDED FROM THORNE (T) AND HATFIELD (H) MOORS.

DRYINIDAE: *Aphelopus atratus* (Dalman) (H), *A. melaleucus* (Dalman) (H), *A. quercus* Olmi (H), *A. serratus* Richards (H,T), *Anteon arcuatum* Kieffer (T), *A. flavicorne* (Dalman) (H,T), *A. fulviventre* (Haliday) (T), *A. infectum* (Haliday) (H), *A. jurineanum* Latreille (H,T), *A. pubicorne* (Dalman) (H,T), *A. scapulare* (Haliday) (H), *Lonchodryinus ruficornis* (Dalman) (H), *Gonatopus bicolor* (Haliday) (H), *G. distinctus* Kieffer (H).

EMBOLEMIDAE: *Embolemus ruddii* (Westwood) (H,T).

BETHYLIDAE: *Bethylus cephalotes* Förster (T), *B. dendrophilus* Richards (T), *B. fuscicornis* (Jurine) (H,T).

CHRYSIDIDAE: *Pseudomalus auratus* (L.) (H,T), *Hedychridium ardens* (Latreille in Coquebert) (H), *Chrysis ignita* (L.) (H,T), *C. impressa* Schenck (H,T), *C. viridula* L. (H), *Trichrysis cyanea* (L.) (H,T).

MUTILLIDAE: *Myrmosa atra* Panzer (H,T).

SAPYGIDAE: *Sapyga quinquepunctata* (Fab.) (T).

FORMICIDAE: *Formica fusca* L. (H,T), *F. lemami* Bondroit (H,T), *Lasius flavus* (Fab.) (H,T), *L. niger* (L.) (H,T), *Leptothorax acervorum* (Fab.) (H,T), *Myrmica lobicornis* Nylander (H,T), *M. rubra* (L.) (H,T), *M. ruginodis* Nylander, (H,T), *M. sabuleti* Meinert (H,T), *M. scabrinodis* Nylander (H,T).

POMPILIDAE: *Priocnemis exaltata* (Fab.) (H), *P. fennica* Haupt (H,T), *P. parvula* Dahlbom (H), *P. perturbator* (Harris) (H), *Dipogon subintermedius* (Magretti) (H), *Pompilus cinereus* (Fab.) (H,T), *Episyron rufipes* (L.) (H,T), *Anoplius concinnus* (Dahlbom) (H), *A. nigerrimus* (Scopoli) (H,T), *A. viaticus* (L.) (H), *Arachnospila anceps* (Wesmael) (H), *A. infuscatus* (Van der Linden) (H), *A. spissa* (Schiödte) (H,T), *A. trivialis* (Dahlbom) (T), *Evagetes crassicornis* (Shuckard) (H).

VESPIDAE: *Odynerus spinipes* (L.) (H,T), *Ancistrocerus gazella* (Panzer) (H,T), *A. nigricornis* (Curtis) (T), *A. oiventris* (Wesmael) (H,T), *A. parietinus* (L.) (T), *A. parietum* (L.) (H), *A. scoticus* (Curtis) (T), *A. trifasciatus* (Müller) (H,T), *Symmorphus bifasciatus* (L.) (H,T), *Vespa crabro* L. (H), *Dolichovespula media* (Retzius) (H,T), *D. norwegica* (Fab.) (H,T), *D. saxonica* (Fab.) (H), *D. sylvestris* (Scopoli) (H,T), *Vespula germanica* (Fab.) (H,T), *V. rufa* (L.) (H,T), *V. vulgaris* (L.) (H,T).

SPHECIDAE: *Ammophila sabulosa* (L.) (H,T).

CRABRONIDAE: *Dryudella pinguis* (Dahlbom) (H), *Tachysphex pompiliformis* (Panzer) (H,T), *Trypoxylon attenuatum* Smith (H,T), *T. clavicerum* Lepeletier & Serville (T), *T. figulus* (L.) (H,T), *Crabro cribrarius* (L.) (H,T), *C. peltarius* (Schreber) (H), *Crossocerus annulipes* (Lepeletier & Brullé) (H,T), *C. capitatus* (Shuckard) (H,T), *C. megacephalus* (Rossi) (T), *C. nigritus* (Lepeletier & Brullé) (H,T), *C. ovalis* Lepeletier & Brullé (H,T), *C. palmipes* (L.) (H), *C. podagricus* (Van der Linden) (T), *C. pusillus* Lepeletier & Brullé (H,T), *C. quadrimaculatus* (Fab.) (H,T), *C. tarsatus* (Shuckard) (T), *C. wesmaeli* (Van der Linden) (H), *Ectemnius cavifrons* (Thomson) (H,T), *C. continuus* (Fab.) (H,T), *E. lapidarius* (Panzer) (H,T), *Lindenius albilabris* (Fab.) (H), *Entomognathus brevis* (Van der Linden) (H), *Rhopalum clavipes* (L.) (T), *R. coarctatum* (Scopoli) (H,T), *Oxybelus uniglutinis* (L.) (H), *Mimumesa dahlbomi* (Van der Linden) (H,T), *Mimesa equestris* (Fab.) (H), *M. lutaria* (Fab.) (H), *Psenulus pallipes* (Panzer) (T), *Pemphredon inornatus* Say (H,T), *P. lugubris* (Fab.) (H), *P. morio* Van der Linden (T), *Diodontus luperus* Shuckard (H), *D. minutus* (Fab.) (H), *Passaloeus gracilis* (Curtis) (T), *P. insignis* (Van der Linden) (T), *P. singularis* Dahlbom (T), *Mellinus arvensis* (L.) (H,T), *Nysson dimidiatus* Jurine (H), *N. trimaculatus* (Rossi) (H), *Gorytes quadrifasciatus* (Fab.) (H,T), *Harpactus tumidus* (Panzer) (H), *Argogorytes mystaceus* (L.) (H,T), *Cerceris arenaria* (L.) (H), *Philanthus triangulum* (Fab.) (H).

COLLETIDAE: *Colletes fodiens* (Geoffroy in Fourcroy) (H,T), *C. succinctus* (L.) (H,T), *Hylaeus brevicornis* Nylander (H,T), *H. confusus* Nylander (T), *H. communis* Nylander, (H,T), *H. signatus* (Panzer) (H,T).

ANDRENIDAE: *Andrena angustior* (Kirby) (H), *A. barbilabris* (Kirby) (H), *A. bicolor* Fab. (H,T), *A. cineraria* (L.) (H), *A. clarkella* (Kirby) (H,T), *A. denticulatus* (Kirby) (H), *A. fuscipes* (Kirby) (H), *A. haemorrhoea* (Fab.) (H,T), *A. humilis* Imhoff (H), *A. lapponica* Zetterstedt (H,T), *A. minutula* (Kirby) (H,T), *A. nigroaenea* (Kirby) (H,T), *A. ovatula* (Kirby) (H), *A. praecox* (Scopoli) (H), *A. scotica* Perkins (H,T), *A. semilaevis* Pérez (H,T), *A. tibialis* (Kirby) (H), *A. varians* (Kirby) (H), *A. wilkella* (Kirby) (H).

HALICTIDAE: *Halictus rubicundus* (Christ) (H,T), *H. tumulorum* (L.) (H), *Lasioglossum albipes* (Fab.) (H,T), *L. calceatum* (Scopoli) (H,T), *L. cupromicans* (Pérez) (H,T), *L. fratellum* (Pérez) (H,T), *L. fulvicorne* (Kirby) (H), *L. lativentre* (Schenck) (H), *L. leucopus* (Kirby) (H), *L. leucozonium* (Schränk) (H,T), *L. minutissimum* (Kirby) (H), *L. morio* (Fab.) (H,T), *L. nitidiusculum* (Kirby) (H), *L. punctatissimum* (Schenck) (H), *L. rufitarse* (Zetterstedt) (H,T), *L. smeathmanellum* (Kirby) (T), *L. villosulum* (Kirby) (H,T), *Sphecodes crassus* Thomson (H), *S. ephippius* (L.) (H,T), *S. geoffrellus* (Kirby) (H), *S. gibbus* (L.) (H,T), *S. hyalinatus* von Hagens (H,T), *S. monilicornis* (Kirby) (H), *S. pellucidus* Smith (H), *S. puncticeps* Thomson (H,T).

MEGACHILIDAE: *Chelostoma florissomme* (L.) (H), *Osmia rufa* (L.) (H), *Megachile centuncularis* (L.) (H,T), *M. ligniseca* (Kirby) (T), *M. versicolor* Smith (H,T),

M. willughbiella (Kirby) (H,T), *Coelioxys elongata* Lepeletier (T), *C. inermis* (Kirby) (H,T).

APIDAE: *Nomada fabriciana* (L.) (H,T), *N. flava* Panzer (H), *N. flavoguttata* (Kirby) (H,T), *N. goodeniana* (Kirby) (H,T), *N. integra* Brullé (H), *N. leucophthalma* (Kirby) (H,T), *N. marshamella* (Kirby) (H,T), *N. obtusifrons* Nylander (H), *N. panzeri* Lepeletier (H,T), *N. robertjeotiana* Panzer (H), *N. ruficornis* (L.) (H,T), *N. rufipes* Fab. (H), *Epeolus cruciger* (Panzer) (H,T), *E. variegatus* (L.) (H,T), *Anthophora furcata* (Panzer) (T), *Bombus hortorum* (L.) (H,T), *B. jonellus* (Kirby) (H,T), *B. lapidarius* (L.) (H,T), *B. lucorum* (L.) (H,T), *B. pascuorum* (Scopoli) (H,T), *B. pratorum* (L.) (H,T), *B. subterraneus* (L.) (T), *B. terrestris* (L.) (H,T), *B. bohemicus* (Seidl) (H,T), *B. campestris* (Panzer) (H,T), *B. rupestris* (Fab.) (H), *B. sylvestris* (Lepeletier) (H,T), *B. vestalis* (Geoffroy in Fourcroy) (H,T), *Apis mellifera* L. (H,T).