

**REVISITING THE SOLITARY WASPS AND BEES
(HYMENOPTERA: ACULEATA) OF BURTON LEONARD
LIME QUARRIES AND DUNCOMBE PARK IN
WATSONIAN YORKSHIRE**

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Studies of the aculeate wasps and bees of Burton Leonard Lime Quarries and Duncombe Park have been published (Archer, 1993, 1997). Recording at these sites stopped when few new species were being found, the assumption being that as only a few species at most remained to be found, a write-up of the sites was appropriate. However, since publishing these two papers, non-parametric statistical procedures have become available for estimating how many as yet unrecorded species may be present on a site. Therefore, the first aim of this paper is to apply these statistical procedures to previous data (Archer, 1993, 1997) as well to data from further sampling carried out during 1999 and 2002-2003 to determine if the decision to stop recording at these sites was justified. Furthermore, since these two papers were published, a national quality scoring system has been developed (Archer 1999, 2002). Therefore, the second aim of this paper is to apply this scoring system to the full sets of data from the two sites.

Descriptions of the two sites are given in Archer (1993, 1997); no noticeable changes have been found at Burton Leonard while at Duncombe Park some dead wood has decayed and other dead wood resources have become available.

SAMPLING METHODS

The sampling methods are given in Archer (1993, 1997). For Burton Leonard, the dates for the first 16 visits between 1978 and 1994 are referred to as the first sample. During 1999, a further four monthly visits were made from April to July. The data from the 20 visits of the first sample and 1999 are referred to as the second sample. During 2002-2003, a further six monthly visits were made from March to August. The data from the 26 visits of the second sample and 2002-2003 are referred to as the third sample.

For Duncombe Park, the dates for the first 14 visits between 1985 and 1990 are referred to as the first sample. Archer (1993) indicated that only 13 visits were made; this is an error, since two visits were made during April. During 1999, a further five monthly visits were made from April to August. The data from the 19 visits of the first sample and 1999 are referred to as the second sample. During 2002-2003, a further five monthly visits were made from April to August. The data from the 24 visits of the second sample and 2002-2003 are referred to as the third sample.

NEW SPECIES RECORDED

Four new species were recorded from Burton Leonard during 1999 (*Pseudomalus auratus* (Linn.), *Crossocerus nigrinus* (Lepeletier & Brullé), *Andrena subopaca* Nylander & *Sphecodes gibbus* (Linn.)) and nine new species during 2002-2003 (*Priocnemis exaltata* (Fab.), *Crossocerus annulipes* (Lepeletier & Brullé), *C. elongatulus* (Van der Linden), *C. distinguendus* (Morawitz), *C. capitosus* (Shuckard), *Ectemnius sexcinctus* (Fab.), *Hylaeus confusus* Nylander, *Andrena synadelpha* Perkins & *Nomada rufipes* Fab.). The records of *C. rossocerus distinguendus* and *Andrena synadelpha* were new or recently new species for Watsonian Yorkshire.

Eight new species were recorded from Duncombe Park during 1999 (*Pseudomalus auratus* (Linn.), *Priocnemis schioedtei* Haupt, *Crossocerus nigrinus* (Lepeletier & Brullé), *Rhopalum coarctatum* (Scopoli), *Andrena cineraria* (Linn.), *Lasioglossum leucopus* (Kirby), *Sphecodes hyalinatus* von Hagens & *Nomada goodeniana* (Kirby)) and one new species during 2002-2003 (*Ectemnius ruficornis* (Zetterstedt)).

DAILY RATES OF RECORDING SOLITARY SPECIES

The daily rates of recording species of solitary wasps and bees per month are shown in Table 1. The month with the highest rate was June for Burton Leonard and July for Duncombe Park.

TABLE 1.

The number of species of solitary wasps and bees recorded per monthly visit for Burton Leonard Lime Quarries and Duncombe Park (range in brackets)

	March	April	May	June	July	August	September
Burton Leonard	2	8.5 (4-11)	9.8 (5-12)	17.8 (12-24)	11.6 (5-15)	9.8 (8-12)	3
Duncombe Park		5.5 (2-11)	11.6 (6-18)	11.6 (9-15)	16.8 (8-26)	13.5 (7-20)	13

ESTIMATING THE POTENTIAL NUMBER OF SOLITARY SPECIES

The non-parametric statistical procedures used were the presence/absence Chao (in Colwell & Coddington, 1994) and the first order Jackknife (Heltshe & Forrester, 1983). The presence/absence quantitative estimate of Chao is based on the number of species that are recorded in one (singletons) or two (doubletons) samples. The Jackknife estimate of Heltshe and Forrester is based only on singletons. Because some aculeate species are only active in the spring or summer it is advisable that sampling is distributed throughout the months of adult activity. The software to carry out these statistical procedures was provided by Pisces Conservation Ltd. In practice the software takes 1, 2, etc. samples at random, each time calculating a mean estimate of species richness. The procedures were repeated 50 times for the first, second and third samples from the two sites. With a small number of samples the estimates are erratic, but as more samples are selected these may stabilise, giving confidence in them.

The species diversities estimates for the two statistical procedures are given in Figs 1, 2, 3, 4 and the final species diversities estimates after all the visits are shown in Table 2, 3. For the first sample for Duncombe Park, the species diversity estimates stabilize, but the final species diversity estimates differ considerably from each other, indicating that recording should not have ceased with the first sample. The second samples, which include further visits, show on analysis that the species diversities stabilize, but at a higher level,

TABLE 2.

Non-parametric estimates of species richness at Duncombe Park

	Chao estimate	Jackknife estimate
First sample		
No. species recorded	62	62
No. species estimated	75	81
95% confidence limits	62-88	70-92
% estimated species recorded	82.7	76.5
Second sample		
No. species recorded	70	70
No. species estimated	86	90
95% confidence limits	70-102	79-101
% estimated species recorded	81.4	77.8
Third sample		
No. species recorded	71	71
No. species estimated	88	90
95% confidence limits	71-104	79-101
% estimated species recorded	80.7	78.9

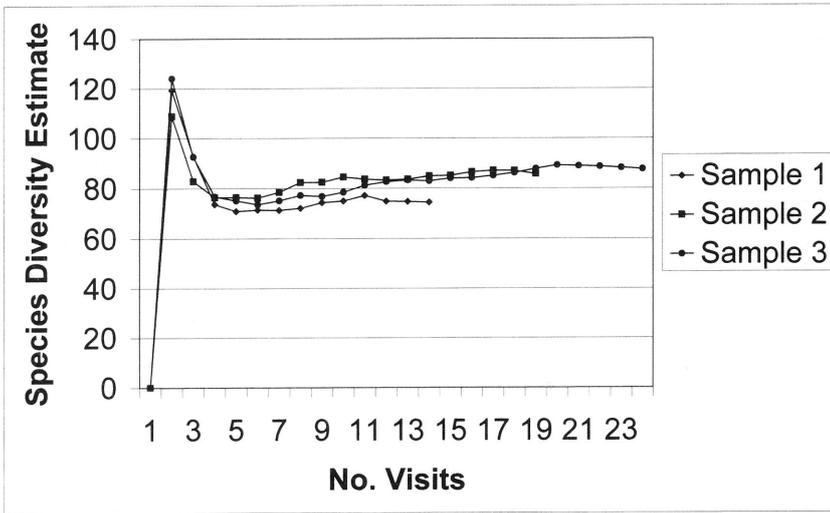


FIGURE 1.
Chao presence/absence estimates of species diversities for samples 1, 2 and 3 of Duncombe Park.

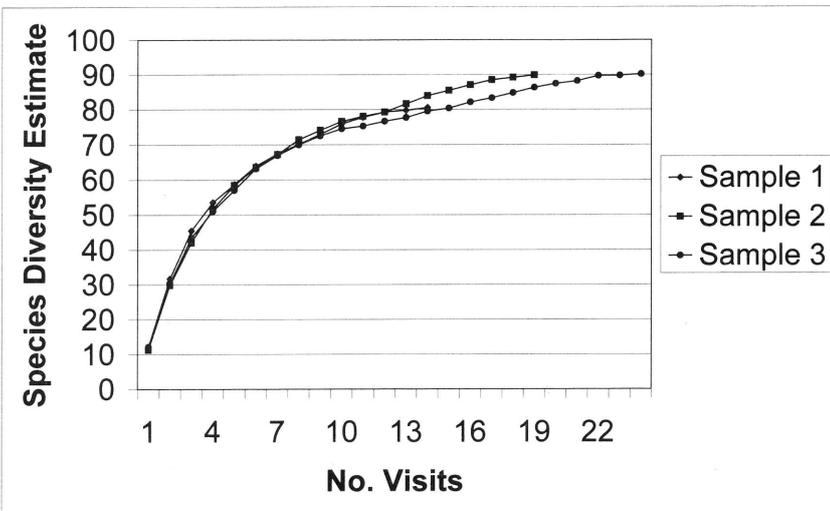


FIGURE 2.
First order Jackknife estimates of species diversities for samples 1, 2 and 3 of Duncombe Park.

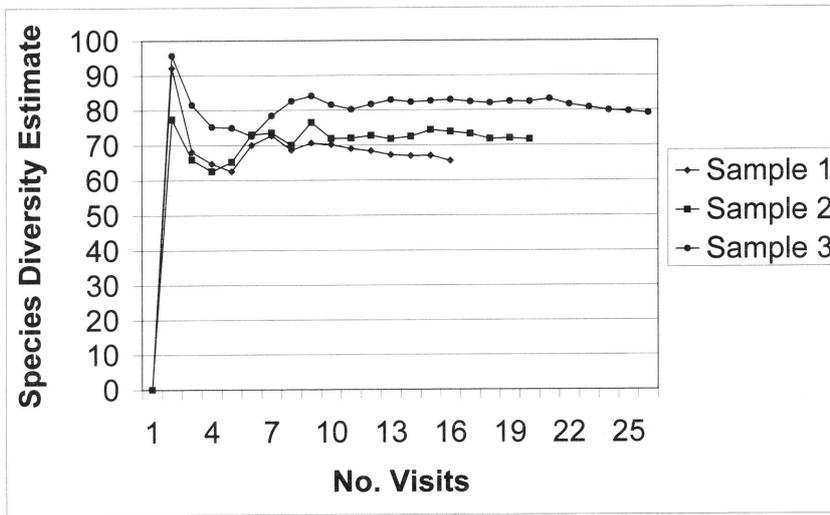


FIGURE 3.

Chao presence/absence estimates of species diversities for samples 1, 2 and 3 of Burton Leonard Lime Quarries.

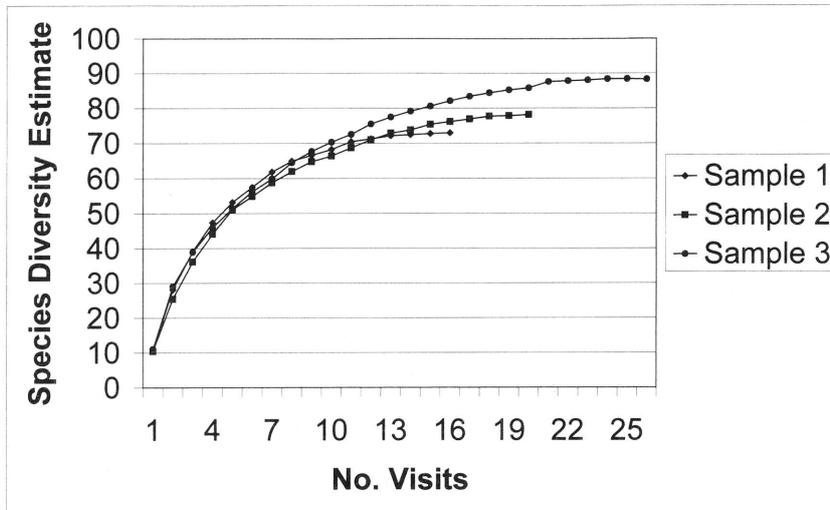


FIGURE 4.

First order Jackknife estimates of species diversities for samples 1, 2 and 3 of Burton Leonard Lime Quarries.

for both statistical procedures, and the final species diversity estimates are now more similar to each other. With this information, a decision could have been taken to cease further recording. The analyses of the third sample, which include further visits, justifies this decision since the species diversities still stabilize, and the final species diversities of the second and third samples closely agree with each other.

TABLE 3.
Non-parametric estimates of species richness at Burton Leonard Lime Quarries.

	Chao estimate	Jackknife estimate
First sample		
No. species recorded	58	58
No. species estimated	66	73
95% confidence limits	56-75	65-81
% estimated species recorded	87.9	79.5
Second sample		
No. species recorded	62	62
No. species estimated	72	78
95% confidence limits	61-82	71-85
% estimated species recorded	86.1	79.5
Third sample		
No. species recorded	71	71
No. species estimated	79	88
95% confidence limits	70-88	79-98
% estimated species recorded	89.9	80.7

The analyses of the first, second and third samples from Burton Leonard show that while the species diversity estimates stabilize, the final species diversity estimate gradually increases from the first to the third sample. In addition, the final species diversities estimates from the two statistical procedures always show too great a difference which increases, rather than decreasing, from the first to the third samples. Clearly recording should not have ceased after the first sample was obtained. Should recording continue after the third sample had been completed?

The statistical procedures have been helpful in determining when recording could cease for Duncombe Park but not for Burton Leonard. Why should this be so? A major difference between the two sites is that Duncombe Park has an area of 103ha which is nearly five times larger than Burton Leonard with an area of 22ha. Tourist species could therefore be more likely to be found at Burton Leonard. Tourist species live in the geographical area of the site under study but do not normally obtain their resources, mainly nest sites and food, from that site. From the species list for Burton Leonard, at least four could be considered tourist species: *Andrena clarkella* and *A. fucata* nest in sandy habitats which are not present at Burton Leonard; the hosts of the cleptoparasite *Nomada rufipes*, which were not recorded, also nest in sandy habitats; the nests of *Odynerus spinipes* are usually found in aggregations and no such aggregation was found. On removing these four species, analysis shows that the two species diversity estimates, besides stabilizing, also indicate the same final species diversity estimate of 68 species. Recording can now cease at Burton Leonard, although a case could be made for its continuance as a means of sampling further tourist species from the surrounding countryside.

SPECIES QUALITY

Archer (1999, 2002) developed a national quality scoring system of high and low quality species. High quality species have a scarce (\equiv Nb), rare (\equiv Na) or very rare (\equiv RDB) status, while low quality species have a universal, widespread or restricted status. By giving an

Archer national status to each of the 71 species of solitary wasps and bees from Burton Leonard and Duncombe Park, national quality scores and national species quality scores (SQSs) can be calculated (Table 4). The two Scarce species from Burton Leonard are *Monosapyga clavicornis* (Linn.) and *Sphecodes crassus* Thomson. From Duncombe Park, the Very Rare species is *Crossocerus leucostomus* (Linn.), the Rare species is *C. walkeri* (Shuckard) and the Scarce species are *Pseudomalus violaceus* (Scopoli) and *Pemphredon morio* Van der Linden.

TABLE 4.
Archer national quality scores of solitary species recorded from Burton Leonard Lime Quarries (BL) and Duncombe Park (DP)

National status	Status value (A)	No. of species (B)		Quality scores (A x B)	
		BL	DP	BL	DP
Universal	1	43	39	43	39
Widespread	2	26	28	52	56
Scarce	8	2	2	16	16
Rare	16	0	1	0	16
Very rare	32	0	1	0	32
Total		71	71	111	159
Species Quality Score for Burton Leonard 111/71 = 1.6 and for Duncombe Park 159/71 = 2.2					

Archer (1999) showed that although quality scores are influenced by the area of sites, the SQSs are relatively independent of site areas so SQSs can be used to compare sites without regard to site areas. Archer (2003), on the basis of their SQS, divided Watsonian Yorkshire sites into first class (SQS 2.4-2.9), second class (SQS 1.8-2.3) and third class (SQS 1.2-1.7) sites. Burton Leonard is a third class site and Duncombe Park a second class site, just failing from becoming a first class site. Few Watsonian Yorkshire sites are first class sites. Currently the first class sites are Strensall Common, Crow Wood and Pollington Common and previously Spurn Point and Allerthorpe Common before it was coniferized.

SUMMARY

1. Non-parametric statistical procedures for determining when to cease recording from a site was helpful for Duncombe Park, but not for Burton Leonard until some tourist species had been removed from the analysis.
2. Within a Watsonian Yorkshire context based on Species Quality Scores, Burton Leonard is a third class site and Duncombe Park a second class site.
3. Two species of national importance were recorded from Burton Leonard and four species of national importance from Duncombe Park.

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FORGOTTEN HISTORICAL RECORDS OF THE SMALL BLUE BUTTERFLY, *CUPIDO MINIMUS*, IN YORKSHIRE, AND THEIR RELEVANCE TO SOME BIOLOGICAL CONUNDRUMS

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In *The Butterflies of Yorkshire* (2005), the Small, or Little, Blue, *Cupido minimus* (Fuessly) is listed as "Former resident now probably extinct". An historical review given there by Howard Frost reports that, as recorded by Porritt (1883), the earliest find, published in 1842, was from a site about 10 miles from York, subsequent to which there were scattered records from central and southern parts of the county and others from the Yorkshire Wolds and the Scarborough and Pickering areas, with an outlier at Buckden in Wharfedale. Buckden was the last place at which, in 1908, it is known to have occurred in Yorkshire. The statement by Ford (1945) that "it exists in Yorkshire" is unsubstantiated. Frost, however, provided information which suggests that there may have been a colony near Sedbergh as recently as 1949. Apart from this, one of the most recent records was from the Wetherby area, reported in Porritt (1904) who cites B.B.Thompson as his authority. It is therefore appropriate to draw attention to what appear to be other overlooked records of its occurrence and former status in that area, not least because they also provide information on controversial aspects of its ecology and behaviour.

A brief note by Lees (1901a) refers to the presence of the Small Blue in the vicinity of Wetherby and gives information on its life history. As this is brief, concise and informative, it is reproduced in full: "The best insect regularly occurring in the district is the Little Blue Butterfly (*Chrysophanus minimus*), always common on the rough banks of road and rail about Wetherby and Collingham. It flies in late May, but the pinky larvae will now be found in the flower heads of the Lady's Finger Vetch, where they persist unchanging till the pupation-time of Spring's first sunny days. *Anthyllis* is common and a few hundred heads can be carried home for examination at leisure".

The writer of the note was F. Arnold Lees, better known as a botanist and the author of *The Flora of West Yorkshire* (1888) and, with J. W. Davis, of *West Yorkshire: An Account of its Geology, Physical Geography, Climatology and Botany* (1878), of whose work an account is given by Seaward in the introduction to a reprint of the *Flora* in 1978. The Vetch concerned, *Anthyllis vulneraria*, is now referred to as the Kidney Vetch.

As Lees, who resided for some time in the Wetherby area and paid particular attention to its flora between 1879 and 1881, refers to the Small Blue as "regularly occurring" and "always common" there, it is reasonable to assume that this status still prevailed in 1901. That this was indeed the case is made clear in an account that is even less likely to be read than his note, but in which he gives further valuable information on its status at that time and place. He did so in the report of a Yorkshire Naturalists' Union excursion in the Wetherby area (Lees 1901b). This was held in July 1901, too late to expect to find adults of