

# LEICESTERSHIRE ENTOMOLOGICAL SOCIETY

***Fleas (Siphonaptera) of  
Leicestershire and Rutland (VC55)***

***by***

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## **Fleas (Siphonaptera) of Leicestershire and Rutland (VC55)**

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***“Wie lust ook soo veel arbeyt, als ik aan dat kleyne veragte  
schepsel de Vloo hebbe besteet?”***  
**[“Who would like to carry out as much work as I have done  
concerning a small and despised creature, the flea?”]**

Antoni van Leeuwenhoek  
(Father of Siphonapterology)  
Delft, 15 October 1693



*Ctenophthalmus nobilis vulgaris* ♂

### **INTRODUCTION**

Fleas, generally, are a neglected order of insects with only sporadic recording by a few collectors. This is in contrast with, for example, Lepidoptera where there has been a constant recording effort over many years. Part of the reason for this is that fleas are small (<5mm), not easy to collect, although the presence of some species may be obvious, and not always easy to identify.

Fleas are holometabolous insects ectoparasitic on mammals and birds. Adult fleas usually spend only as much time on the host as it takes to obtain a blood meal - otherwise most of their life is spent with their eggs, larvae and pupae in the nest of their host. There are a few exceptions to this - for example sticktight fleas (*Echidnophaga*), where the female is sedentary burying her mouthparts into the skin of the host. In Great Britain species of this genus are found mainly in zoological collections although they have the potential to become pests of poultry.

### **COLLECTION AND PRESERVATION**

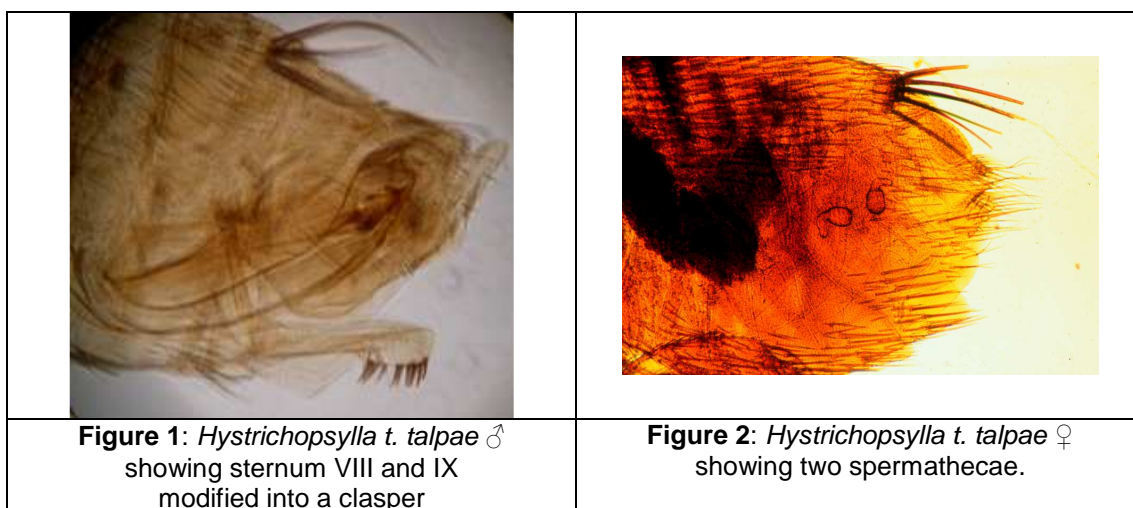
Adult fleas can be either collected directly from the host's body or from their nest. The majority of fleas are to be found in the nest of the host (*suprapopulation*) with comparatively few individuals found on the body of the host (*corporeal population*). A pooter may be employed to collect adult fleas but care should be taken not to suck up fine dust etc. from nest debris. Alternatively, a pooter which uses the venturi jet effect may be used as may be a fine paintbrush moistened with alcohol to pick up the fleas.

It should be noted that collectors of fleas should be fully aware of the conservation status of the mammal or bird they are collecting from. This also applies to removing old bird's nests; this should not be done until September or October. Since birds will use nest boxes to roost in during the winter months (if the autumn cleaning is missed), February is the next best time to do it.

Once collected the adult fleas are usually stored in stoppered tubes containing 80% alcohol. In museum collections the tubes are often stored in jars containing 80% alcohol to prevent the alcohol in the tubes evaporating.

It is often necessary to desclerotise fleas in order to see the relevant taxonomic features. This is done by placing the fleas in water to wash out the alcohol (10 minutes), then transfer them to a 20% solution of potassium hydroxide (KOH) at room temperature for 24 hours or longer for the more heavily sclerotised specimens. The KOH is neutralised by transferring the specimens to water (a few minutes) and then 20% glacial acetic acid for 60 minutes. Specimens should then be transferred to water for 30 minutes and then into 80% alcohol.

Specimens may be examined under a compound microscope as wet mounts on a microscope slide under a coverslip or dehydrated through absolute alcohol (20 minutes) and cleared in HistoClear (12 hours) before permanently mounting in Euparal. This latter takes several weeks to harden whilst being heated on a hot plate at ~70°C. [HistoClear and Euparal may be purchased from Fisher Scientific UK, Bishop Meadow Road, Loughborough, Leics LE11 5RG; Telephone 01509-231166].



## IDENTIFICATION

As fleas are laterally flattened they are viewed, for the purposes of identification, from a lateral view. Identification to family is relatively easy but to species is more difficult relying on the shape of the modified VIII and IX sternites into a clasper in males (Figure 1). For females the shape of tergum VII and sternum VII and the spermatheca is of taxonomic importance. In some flea species, e.g. *Hystrichopsylla t. talpae*, two spermathecae are found (Figure 2), but in the majority of British flea species only a single spermatheca is present. Until recently, Smit (1957) was the only key available to the British species. This is shortly to be superseded by Brandt (*in press*) which gives an additional six species to the British fauna to those given by Smit.

## FLEAS IN VC55

Little has been written on fleas in VC55 since Stansfield (1961). Other published records for fleas in VC55 are contained in Clark (1978; 1999), Clark & McNeil (1981a,b; 1991) and Clark,

McNeil & Hill (1993) whilst Durden, Wilson & Lott (1991) recorded fleas from Mole (*Talpa europaea*) nests. George (1974) gives distribution maps for Siphonaptera for all of the British Isles. The New Walk Museum (Leicester) holds a collection of fleas from VC55, most of which had been identified by RS George. The majority of these fleas were collected in the 1960s and 1970s with relatively few collected in recent times.

The Appendices list the identified records with, where known, the initials of the recorder. RS George allowed access to his record cards for VC55 (marked \*). Specimens found in the New Walk Museum spirit collection are indicated by ‡. As some of the specimens in the New Walk Museum have no grid reference I have assigned a 1km grid reference to the locality given which only gives the approximate collection location. For many of the records it is not stated whether the fleas were from the body or in the nest of the host.

## NOMENCLATURE

The nomenclature for fleas follows that of Brandt (*in press*), for mammals Corbet & Southern (1977) and for birds from [www.rspb.org.uk/birds/guide](http://www.rspb.org.uk/birds/guide).

**Table 1: Number of flea records from each host**

Mammals		Birds	
Species	Records	Species	Records
Mole ( <i>Talpa europaea</i> )	244	Blue Tit ( <i>Parus caeruleus</i> )	48
Hedgehog ( <i>Erinaceus europaeus</i> )	36	Great Tit ( <i>Parus major</i> )	22
Common Shrew ( <i>Sorex araneus</i> )	13	Marsh Tit ( <i>Parus palustris</i> )	2
Water Shrew ( <i>Neomys fodiens bicolor</i> )	1	Willow Tit ( <i>Parus montanus</i> )	1
Leisler's Bat ( <i>Nyctalus leisleri</i> )	1	Long tailed Tit ( <i>Aegithalos caudatus</i> )	1
Noctule Bat ( <i>Nyctalus noctula</i> )	1	Greenfinch ( <i>Carduelis chloris</i> )	1
Pipistrelle Bat ( <i>Pipistrellus pipistrellus</i> )	7	House Sparrow ( <i>Passer domesticus</i> )	13
Long-eared Bat ( <i>Plecotus auritus</i> )	2	Tree Sparrow ( <i>Passer montanus</i> )	2
Daubenton's Bat ( <i>Myotis daubentoni</i> )	1	Chaffinch ( <i>Fringilla coelebs</i> )	3
Bank Vole ( <i>Clethrionomys glareolus</i> )	72	Blackbird ( <i>Turdus merula</i> )	13
Field Vole ( <i>Microtus agrestis</i> )	52	Song Thrush ( <i>Turdus ericetorum</i> )	2
Water Vole ( <i>Arvicola terrestris</i> )	7	Starling ( <i>Sternus vulgaris</i> )	4
Wood Mouse ( <i>Apodemus sylvaticus</i> )	45	Robin ( <i>Erithacus rubecula</i> )	4
Brown Rat ( <i>Rattus norvegicus</i> )	13	Wren ( <i>Troglodytes troglodytes</i> )	5
House Mouse ( <i>Mus musculus</i> )	1	Dunnock ( <i>Prunella modularis</i> )	1
Grey Squirrel ( <i>Sciurus carolinensis</i> )	78	Spotted Flycatcher ( <i>Muscicapa striata</i> )	1
Rabbit ( <i>Oryctolagus cuniculus</i> )	7	Feral Pigeon ( <i>Columba livia</i> )	2
Brown Hare ( <i>Lepus europaeus</i> )	4	Woodpigeon ( <i>Columba palumbus</i> )	1
Dog ( <i>Canis familiaris</i> )	79	Collared Dove ( <i>Streptopelia decaocto</i> )	1
Cat ( <i>Felis domesticus</i> )	79	Jackdaw ( <i>Corvus monedula</i> )	1
Fox ( <i>Vulpes vulpes</i> )	16	Swallow ( <i>Hirundo rustuca</i> )	1
Badger ( <i>Meles meles</i> )	34	Sand Martin ( <i>Riparia riparia</i> )	12
Weasel ( <i>Mustela nivalis</i> )	18	House Martin ( <i>Delichon urbica</i> )	437
Stoat ( <i>Mustela erminea</i> )	10	Pied Wagtail ( <i>Motacilla alba</i> )	1
Ferret ( <i>Mustela furo</i> )	2	Little owl ( <i>Athene noctua</i> )	1
Mink ( <i>Mustela vison</i> )	1	Domestic fowl ( <i>Gallus domesticus</i> )	1
Man ( <i>Homo sapiens</i> )	20		

## RESULTS

Of the 63 species of flea recorded in Britain 33 have been recorded in VC55 with 1,420 records from 53 host species and 133 miscellaneous records. The numbers of records for each mammalian and avian host are detailed in Table 1. In addition, records from miscellaneous sites have been examined: houses (21), pitfall traps (81), a work's canteen (1), gardens (6), clothing (1), small mammal nest (2), pig house (1), flagging (1), nest box (1), car (1), hedge bottom debris (1) and where the host was unknown (16). All records located for VC55 are listed in the appendices.

## FLEA SPECIES RECORDED IN VC55

### Mammal Fleas

#### Pulicidae

*Archaeopsylla erinacei erinacei* (Bouché) - this species is specific to the Hedgehog (*Erinaceus europaeus*) although occasionally found as a straggler on other species particularly Dog and Fox. Records for VC55 demonstrate this: Hedgehog (35), Fox (4), Dog (15), Cat (1), Man (4), house (1) and garden (1).

*Ctenocephalides canis* (Curtis) - Once a common species on the Dog it has now been largely replaced by *Ct. f. felis* and it is now most likely encountered on dogs in rural areas. There is some evidence that this species copes less well than *Ct.f.felis* in the dry conditions found in centrally heated houses (Clark, 1993). Only 9 records for VC55 all from Dog.

*Ctenocephalides felis felis* (Bouché) - Although principally found on the cat (*Felis domesticus*), this species is responsible for most flea infestations in houses. It is also now the commonest flea found on dogs. Records for VC55 are: Dog (44), Cat (78), Stoat (1), Man (5), host unknown (5), house (9), garden (1) and pitfall trap (1).

*Pulex irritans* (Linnaeus) - This is now a rare flea in Great Britain. Principally a flea of swine, it was once commonly found in human dwellings but with changes in agricultural practices and domestic living conditions this species has declined. There are 10 records for this species in VC55 the last record being in 1972. Records are as follows: Dog (1), Man (1), host unknown (3), pig house (1), house (3) and garden (1).

*Spilopsyllus cuniculi* (Dale) - This species is specific to the Rabbit being the vector of myxomatosis. Occasionally it can be found on other mammals particularly the Fox. Although a cosmopolitan species on the rabbit there are only four rabbit records for this flea in VC55 with others from Hare (4) and Fox (7).

#### Histrichopsyllidae

*Ctenophthalmus bisoctodentatus heselausi* (Oudemans) - Common throughout Great Britain on the Mole (66 records for VC55). Also recorded on Stoat (1) and Weasel (1).

*Ctenophthalmus nobilis* (Rothschild) - Mole (14), Common Shrew (2), Bank Vole (9), Field Vole (7), Water Vole (2), Wood Mouse (16), Brown Rat (2), Wren (1), Pied Wagtail (1), host unknown (1) and pitfall trap (16).

*Ctenophthalmus nobilis nobilis* (Rothschild) - *Ctenophthalmus n. nobilis* and *Ctenophthalmus nobilis vulgaris* are the commonest species of flea encountered on small rodents and insectivores. The females of these two subspecies cannot be separated. Records for *Ctenophthalmus n. nobilis* in VC55 are: Mole (17), Common Shrew (2), Bank Vole (12), Field Vole (8), Water Vole (1), Wood Mouse (15), Brown Rat (2), Rabbit (1), small mammal nest (1), Weasel (3), Stoat (1), Blackbird (1), pitfall trap (11), host unknown (1) and small mammal nest (2).

*Ctenophthalmus nobilis vulgaris* (Smit) - Mole (10), Bank Vole (3), Field Vole (3), Wood Mouse (1), Weasel (1), Stoat (1) and pitfall trap (7).

*Doratomyia dasyncnema dasyncnema* (Rothschild) - Common throughout Great Britain on shrews with few VC55 records: Common Shrew (2) and pitfall trap (3).

*Hystrichopsylla talpae talpae* (Curtis) - Although principally a flea of the Mole it is commonly found on the bodies and in the nests of a number of species of small mammal. This is the largest species of flea in Great Britain (3.5-5mm). Records in VC55 are: Mole (23), Bank Vole (5), Field Vole (2), Water Vole (1), Wood Mouse (2), Common Shrew (4), Water Shrew (1), Weasel (1), host unknown (1) and pitfall trap (4).

*Palaeopsylla minor* (Dale) - A common species on the Mole (*T. europaea*) with 102 records for VC55. Also recorded from Weasel (3) and Hedgehog (1).

*Rhadinopsylla isacantha* (Rothschild) - A rare species in Great Britain on the Bank Vole with only one record for VC55 from the nest of a Mole. *R. isacantha* appears to be found as an adult only in the winter months. Also a single record from Bank Vole.

*Rhadinopsylla pentacantha* (Rothschild) - A common species of flea on the body and in the nest of the Bank Vole in the British Isles. Records for VC55 are: Bank Vole (2), Field Vole (1), Wood Mouse (2), Mole (6), Stoat (2), Weasel (3).

*Palaeopsylla soricis soricis* (Dale) - Common throughout Great Britain on the Common Shrew and to a lesser extent on the Pygmy Shrew (*Sorex minutus*). Records for this species in VC55: Common Shrew (3), Wood mouse (1), Mole (3), host unknown (1), hedge bottom (1) and pitfall trap (12).

#### Ischnopsyllidae

*Ischnopsyllus octactenus* (Kolenati) - This is the only species of bat flea having been recorded in VC55 on the Pipistrelle (7), Long-eared (2) and Noctule (1). A common species throughout Great Britain on the Pipistrelle and occasionally on other species of bat. Not found on cave bats.

#### Leptopsyllidae

*Leptopsylla segnis* (Schönherr) - A flea usually associated with the House Mouse but few records for VC55: House Mouse (1), Wood Mouse (3) and Bank Vole (2).

*Peromyscopsylla spectabilis spectabilis* (Rothschild) - Uncommon in Great Britain mainly being associated with Bank and Field Vole. Records for VC55: Field Vole (12), Bank Vole (1) and pitfall trap (2).

#### Ceratophyllidae

*Amalaraeus penicilliger mustelae* (Dale) - Common throughout Great Britain on Bank and Field Voles and occasionally on Wood Mouse. Records for VC55: Bank Vole (29), Field Vole (8), Wood Mouse (1), Weasel (1), Wren (1) and pitfall trap (4).

*Ceratophyllus sciurorum sciurorum* (Schränk) - Once common on its principal host the Red Squirrel (*Sciurus vulgaris*) but becoming rarer as its host declines. In VC55 it has been recorded on Grey Squirrel (6) although the last record was in 1964.

*Megabothris turbidus* (Rothschild) - A common flea on Bank Vole and Wood Mouse. Records for VC55: Bank Vole (6), Field Vole (1), Wood Mouse (1), Blackbird (1), pitfall trap (6).

*Megabothris walkeri* (Rothschild) - Common throughout Great Britain on Bank, Field and Water Voles. In VC55 recorded on Field Vole (9), Water Vole (3), Mole (1), Weasel (2), Stoat (3), Dog (1), Blackbird (1), host unknown (1) and pitfall trap (8).

*Nosopsyllus fasciatus* (Bosc) - Common throughout Great Britain on the Brown Rat and occasionally on Wood Mouse. Records for VC55: Brown Rat (8), Wood Mouse (3), Bank Vole (2), Field Vole (1), Rabbit (2), Mink, (1), Ferret (1), Stoat (2), Weasel (3), Chaffinch (1), pitfall trap (5) and works canteen (1).

*Orchopeas howardi howardi* (Baker) - This species was introduced into Great Britain on its true host the Grey Squirrel. As is the case with its host it has been extremely successful in establishing itself in Great Britain. Commonly found on the body and in the drey of Grey Squirrel in VC55 (69 records) and once in a nest box.

*Paraceras melis melis* (Walker) - Common throughout Great Britain on the Badger. Although specific to the Badger it has been occasionally recorded as a straggler from the Dog and Fox. Records for VC55: Badger (34), Dog (3), Fox (5), Ferret (1) and Mole (1).

### Bird Fleas

All bird fleas recorded in VC55 belong to the Ceratophyllidae family.

*Ceratophyllus columbae* (Gervais) - Common throughout Great Britain in the nests of domestic and wild pigeons (*Columba livia* and *C.palumbus*). Only four records for this species in VC55 which I am sure reflects the paucity of collectors rather than the rarity of the flea. Feral Pigeon (2), Collared Dove (1) and Jackdaw (1).

*Ceratophyllus farreni farreni* (Rothschild) - A commonly encountered flea in nests of the House Martin, frequently occurring with *C. h. hirundinis* and, similar to this species, has been recorded throughout VC55 (141 records). Also once from House Sparrow.

*Ceratophyllus fringillae* (Walker) - A flea specific to the House Sparrow but occasionally encountered in other bird nests particularly those of House Martin that have been occupied by the House Sparrow. Records for this species in VC55: Blue Tit (1), House Sparrow (3) and House Martin (7).

*Ceratophyllus gallinae* (Schrank) - This species has been recorded on more hosts, both mammal and bird, than any other British flea. This species generally prefers dry bird nests and is particularly common in nest boxes. Records for VC55: Blue Tit (38), Great Tit (15), Willow Tit (1), Marsh Tit (1), Greenfinch (1), Chaffinch (1), Robin (3), House Sparrow (8), Tree Sparrow (2), Wren (1), Dunnock (1), House Martin (18), Blackbird (7), Starling (3), Wood Pigeon (1), Chicken (1), Little Owl (1), Leisler's Bat (1), Daubenton's Bat (1), Brown Rat (1), Grey Squirrel (3), Dog (6), Man (9), host unknown (4), house (8), garden (2), clothing (1) and car (1).

*Ceratophyllus garei* (Rothschild) - Only two records exist in VC55 for this common species. It is a flea predominantly of ground nesting birds. The two records are House Sparrow (1) and Man (1).

*Ceratophyllus hirundinis* (Curtis) - A commonly encountered flea in the nests of the House Martin. Recorded throughout VC55 (187 records). Also garden (1).

*Ceratophyllus rusticus* (Wagner) - Found in the nests of the House Martin often with *C.h.hirundinis* and *C.f. farreni* although not quite as common as these two species. However, frequently found in House Martin nests in VC55 (84 records).

*Ceratophyllus styx jordani* (Smit) - One of two subspecies, *C.s. jordani* is found on the body and in the nests of the Sand Martin. This subspecies has a northern distribution in Great Britain whilst the other sub-species, *C. s. styx*, has a continental distribution and has only been recorded in south and south-east England. *C.s. jordani* has been recorded in a number of localities in VC55 in Sand Martin nests (12 records).

*Dasypsyllus gallinulae gallinulae* (Dale) - A common flea found in the nests of a number of bird species. Often found in nest boxes with *C. g. gallinae* and also in open nests e.g.

Blackbird. Records for VC55: Blue Tit (9), Great Tit (7), Marsh Tit (1), Long-tailed Tit (1), Chaffinch (1), Blackbird (3), Song Thrush (2), Spotted Flycatcher (1), Robin (1), Starling (1), Wren (2), Swallow (1), Stoat (1), flagging (1) and pitfall trap (2).

## DISCUSSION

Although approximately 50% of British species of flea have been recorded in VC55, some are notable for their scarcity or absence from the records. Amongst the bird fleas are *Ceratophyllus garei* (Rothschild) and *C. vagabundus insularis* (Rothschild). The former is a common flea in the nests of ground-nesting birds for which there are only two records and the latter is abundant in Jackdaw (*Corvus monedula*) nests and has yet to be recorded. The crow flea, *Ceratophyllus rossittensis rossittensis* (Dampf) has been recorded in a few localities in the British Isles (Fairley & Clark, 1972) but this is almost certainly because both Carrion and Hooded Crow (*Corvus corone* & *C. cornix*) nests are difficult to obtain. It is likely that if enough crow nests were examined in VC55 this species would be found.

Amongst the mammal fleas, *Typhloceras poppei* (Wagner) is common on the body and in the nest of the Wood Mouse but it is unclear why this species, so far, has not been found in VC55. Similarly, *Doratopsylla dasyncnema dasyncnema* (Rothschild) is a common species on shrews in Great Britain and, although there are eight records of fleas from the Common Shrew, there are only two records for this particular flea species. Only one of the six species of bat flea has been recorded in VC55 and, since the five remaining species are common on their hosts and widespread in Great Britain, this paucity must reflect the lack of collecting from bats. I am confident that if material were collected from roosts and a closer examination of bats in the hand, several of these species would be added to the list.

Lastly, *Xenopsylla cheopis* (Rothschild) has been recorded on the Brown Rat (*R. norvegicus*) in Oxfordshire (Webster & MacDonald 1995) where it appears to be confined to rats on farms. Although *X. cheopis* is a tropical rat flea, it would be worth looking at many more Brown Rats from farms in VC55.

The paucity of flea records, for the most part, reflects the lack of collecting rather than species rarity or absence in VC55. There is clearly a great deal of collecting and recording still to be done on this insect order.

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## RECORDERS

AB – A. Botterill	JEE – N. J. & J. E. Edwards	ZB – Z. Brombery
Abe – A. Beck	JEP – J.E. Pritchard	
ADL A.D. Lomas	JF – J. Fraser	
AES – A.E. Squires	JFP – J.F. Pickering	
AH - A. Hunt	JG – J. Greaves	
AM – A. Marchant	JH – J. Harris	
AMB – A. Mead Briggs	JK – J. Kew	
ATS – A.T. Summerfield	JKB – J.K. Bates	
AW – A. Williams	JM – J. Maunder	
BAB – B.A. Burbridge	Jma – J. Mathias	
BAC – B.A. Cooper	JMcL – J. McLoughlin	
BE – B. Elliot	Jmo – J. Mowsley	
BJ – B. Jeeves	JPT – J.P. Thompson	
BMM – B. M. Morris	JRAG – J. R. A. Gray	
BS – B. Simpson	JT – J. Thompson	
CD – C. Dixey	JTC – J.T. Clark	
CGRB – C.G.R. Bowden	JW – J. Walsron	
CH – C. Holt	KD – K. Dunn	
CMJ – C.M. Jones	KEB – K.E. Bishop	
CV – C. Verspeak	KH – K. Hockridge	
D & JM – D & J. Marlow	KL – K. Larkin	
DAL - D.A. Loft	KS – K. Squire	
DF – D. Falkner	KTP - K.T. Piper	
DG – D. Goddard	LC – L. Collingwood	
DL – D. Lechfield	LiM – Liverpool Museum	
DL – D. Lott	LKH – L.K. Holeworth	
DM – D. Maguire	MAFF – Min Ag Fish &Food	
DR – D. Reid	MB – M. Bottrill	
DRT – D.R. Thurston	McN – D.A.C. McNeil	
DSF – D.S. Fieldhouse	MD – M. Dobson	
DTG – D.T. Grewcock	MJC – M.J. Cotton	
EMG – E.M. Green	MKR – M.K. Riley	
ES – E. Stanniforth	ML – M. Langham,	
EW – E. Weston	MS – M. Sercombe	
EW – E. Wilson	MTG – M.T. Greenwood	
FC – F. Clark	MV – M. Von Bresen	
FJS – F.J. Smith	MW – M. Wagstaff	
GAC – G.A. Chinnery	NAM – N.A. Martin	
GC – G. Collis	NMcG – N. McGovern	
GD – J. Derby	NSF – N & S Findley	
GH – G. Hancock	NWM – New Walk Museum	
GLW – G.L. Wint	PAHM – P.A.H. Muschamp	
GO – G. Overton	PAM – P.A.Morris	
GP – G. Palmer	PB – P Barr	
GRM – G.R.Moore	PK – P. Kuhfeld	
GS – G. Stansfield	PML – P.M. Lenten	
GSS - G.S. Smith	PP – P. Pandra	
GTM – G.T. May	RADH – R.A.D. Hickling	
HABC - H.A.B. Clements	RAS – R.A. Sheridan	
HB – H. Beattie	RF – R. Freeman	
HC – H. Clements	RS – R. Storer	
HG – H. George	SG – S. Gregory	
HL – H. Lowe	SM – Sheffield Museum	
HRG - H.R. Ginns	SMcG – S. McGovern	
IME – I.M. Evans	SMS – S.M. Scott	
JA – J Ayling	TWS – T.W. Sparow	
JaD – J. Dawson	VAJ – V.A. Jacques	
JB – J. Betts	VRW – V.R. Webb	
JB – J. Bonnington	WC – W. Crup	
JB – J. Brown	WEH – W.E. Hollingworth	
JC – J. Cole	WJ – W. Johnson	
JC – J. Cooke	WL – W. Leverton	
JD – J. Dawes	WM – W. Mason	

## **APPENDICES**

The three appendices (available separately on request) detail all the located records for fleas in VC55. Tables 2 and 3 summarise the occurrence of species recorded on mammalian and avian hosts while Table 4 summarises records from miscellaneous locations.