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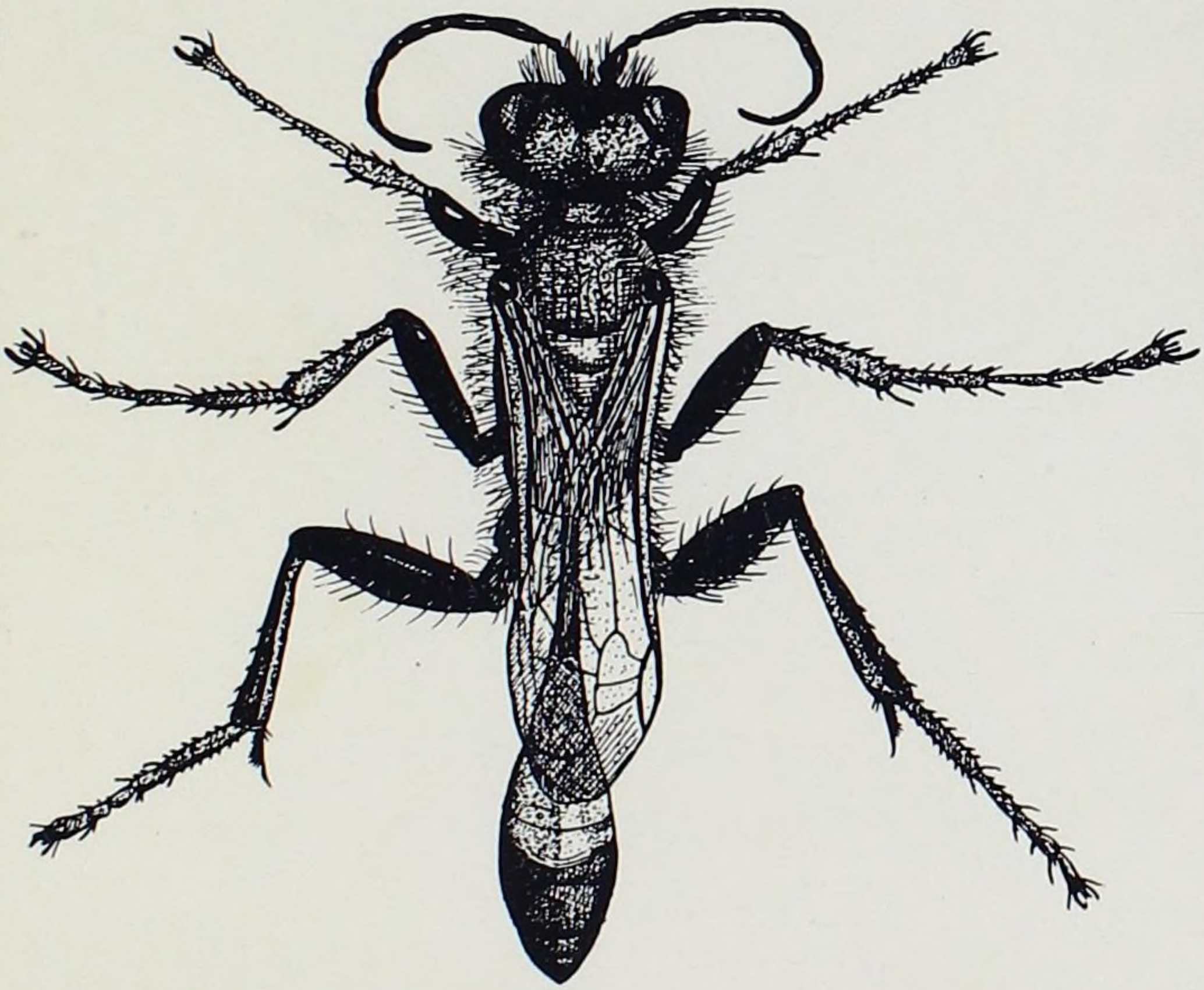

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SOLITARY WASPS AND ANTS (SPHECIDAE & FORMICIDAE) OF LANCASHIRE AND CHESHIRE

Steve Garland & Tracy Appleton

Bolton Museum & Art Gallery, Le Mans Crescent, Bolton BL1 1SE

Introduction

This paper summarises the current status and past records of all species of Sphecid wasps and ants for the counties of Lancashire and Cheshire. The geographical area includes the Vice-counties of Cheshire (58), South Lancashire (59) and West Lancashire (60). This excludes the Furness area of the old Lancashire county, but includes most of the modern counties of Merseyside and Greater Manchester.

No comprehensive summary of these two families of insects has been published for the region since Gardner (1901).

Methods

The authors have attempted to locate all published references to the Aculeate Hymenoptera for these counties. The Lancashire and Cheshire Fauna Society card index held at Manchester Museum was made available by Colin Johnson and all records extracted. The collection in Manchester Museum was carefully checked by the authors and that in the Liverpool Museum was checked by Carl Clee. Appeals were made to all local entomologists for their records and specimens.

All records were entered onto the biological recording software Recorder at the Bolton Museum Biological Records Centre. The detailed records are available from the Museum if required. The authors have managed to identify and locate most published sites and the database contains grid references for these, where possible.

These careful checks proved vital, because many specimens were incorrectly identified and there are unfortunately many published records that have been impossible to verify from voucher specimens. Identifications are usually the result of inadequate identification texts at the time.

The Cooke collection at Bolton Museum warrants a special mention. Cooke published a number of lists of insects for south Lancashire and his Aculeate Hymenoptera records are referred to in Gardner (1901). His collection resides at Bolton Museum, but contains very few specimens with any locality data. Nearly all specimens bear dates, mostly in the 1860s, but cannot be associated with published records because he usually only listed localities in his papers, with no dates! The authors have referred to this collection to attempt to verify old records. However, it is only possible to assess the presence of correctly identified specimens, not to confirm records for certain.

If anyone has further details of old specimens from the Lancashire or Cheshire areas, the authors would be pleased to hear about them.

Records with initials are from Steve McWilliam (SM), Simon Hayhow (SH), W Kenneth-Booker (KB), Steve Garland (SG), Patrick Waring (PW), Harry Britten (HB), Peter Flint (PF) and Malcolm Edmunds (ME).

Ants, Formicidae

Hypoponera punctatissima (Roger)

This tiny ant has been introduced to Britain and is found only inside buildings. There are two records, both recent. In an old peoples' home in Bury on 27 February 1985 and in Salford in April 1984.

Ponera coarcta (Latreille) Nationally Notable B

This rare southern species was recorded by Cooke for the Manchester area in the late 1800s (Gardner, 1901). This record seems unlikely and the only specimen present under this species in Cooke's collection in Bolton Museum was an incorrectly identified specimen of *Hypoponera punctatissima* with no data. This species should be deleted from the county lists.

Myrmica lobicornis Nylander

A distinctive, but very rare species in the region. There are only three records; a confirmed record from Bank End Woods, Nelson on 8 September 1946 (AB); and two unconfirmed records from Rainow, Cheshire in July 1920 by F. Neave and from Bowdon, Trafford in the late 1800s by B. Cooke (Gardner, 1901)

Myrmica rubra (Linnaeus) MAP 4

This is one of the most common ants in the region and is often found nesting under stones. It is a red ant and can sting. There are 60 records for the region including 18 post-1980 records.

Myrmica ruginodis Nylander MAP 5

Another very common red ant with a sting. There are 64 regional records including 13 post-1980 records.

Myrmica sabuleti Meinhert

A rare ant associated with dry, warm limestone grassland. It is a very difficult species to identify and is easily confused with *M. scabrinodis*. The only record for the counties is from the limestone in the extreme north at Warton Crag, where it was recorded by Mr. P. Flint on 10 August 1991.

Myrmica scabrinodis Nylander MAP 6

A widespread red ant which is often found even in boggy moorland areas. It is also frequently seen in mid-winter when specimens can be found near to the soil surface. There are 37 records for the two counties, with nine post-1980 records.

Leptothorax acervorum (Fabricius)

This very small dark red ant seems to be strangely rare in the region. There are only 15 records and only four since 1950. These are from Lancaster University by P Flint on 6 July 1987, two from Budworth Common on 21 February 1993 and Thurstaston Common on 20 March 1993 (SM). Other records are from Wilmslow in 1926, Freshfield in 1950, Thurstaston Common in 1917, Goyt Valley in 1946, Saltersley Moss in 1926, Delamere in 1939, Rudheath in 1926, Tegg's Nose in 1923, Mearley Moor in 1924 and Delamere Forest and Bidston Hill before 1901.

Tetramorium bicarinatum

A vagrant species that has been found on eight occasions in the region. The last record was from Oldham on 7 September 1954. All records are from the Greater Manchester area. It is probable that modern methods of transport and importation of produce have reduced the incidence of vagrant species such as this. Other records are from Broadbottom in 1921 and 1931; Belle Vue, Manchester in 1937; Altrincham in 1925; Hale in 1925; Ashton under Lyne in 1925 and Stockport in 1951.

Tetramorium simillimum (Smith F.)

Another vagrant species originally from Africa. The only record is a specimen iN Manchester Museum from Crank in Merseyside on 24 October 1919 (HB).

Monomorium pharaonis (Linnaeus)

Another introduced species from Africa. It is a very tiny ant and has been very successful in colonising heated buildings in many parts of Britain. It has become a pest in a few places.

There are eleven records from the region, all from the Greater Manchester area. They are from Crumpsall in 1935 and 1942; Oxford Road, Manchester in 1919; UMIST in 1977; Didsbury in 1925; West Didsbury in 1925 and 1930; Withington Hospital in 1928; Booth Hall Infirmary in 1924 and a record for the Manchester area in 1942.

Crematogaster scutellaris (Olivier)

Another introduced species recorded only once in the region at Stockport on 27 June 1933 by Harry Britten. The specimen is in Manchester Museum.

Iridomyrmex humilis (Mayr)

A further introduced species known in the region from two confirmed records at Broadbottom on 11 December 1921 by H Halkyard and Fallowfield, Manchester on 30 August 1922 (HB). Both specimens are in the Manchester Museum.

Tapinoma melanocephalum (Fabricius)

Another introduced species recorded once in the region from the Rochdale Canal at Miles Platting on 25 September 1922.

Formica cunicularia Latreille

This ant is a local species restricted in England to an area south of a line from Lincolnshire to South Wales. The only record is by Cooke in Gardner (1901) with a record of *Formica fusca* race *cunicularia* from Greenfield. In the Cooke collection in Bolton Museum there is one specimen of *F. cunicularia* with no data. The record must remain doubtful.

Formica fusca Linnaeus MAP 1

A medium-sized black ant which is very difficult to separate from *Formica lemani*, with which it was confused in early years. This explains the greater number of older records. Using recent records it seems to be rarer than *F. lemani* in the north-west. There are 24 records for the region with four post-1980 records from Warton Crag on 10 August 1991 by

P. Flint, Holcroft Moss in 1992, Cocks Moss in 1994 and Plumley Lime Beds in 1993 (all SM).

Formica lemani Bondroit MAP 2

A common medium-sized black ant. It can be common on open moorland under stones. The early records were often identified as F. fusca. There are 20 records with 11 post-1980 records.

Formica rufa Linnaeus

This is a large species of Wood Ant that builds large mound-shaped nests from leaves and twigs. They do not sting, but can squirt formic acid from their abdomens. It is known to occur in southern Cumbria and was recorded at Gait Barrows in 1968 by P. Flint. There are old pre-1901 records from Delamere Forest in Cheshire and Dunham Park in Trafford.

Lasius alienus

The only record is a published one for 9 August 1947 from Droylsden which is in the Manchester Museum and is misidentified, being in fact a specimen of *Lasius niger*.

Lasius flavus (Fabricius)

A small yellow ant that spends most of its time underground. In old grassland it may form large, hard earth anthills and is often associated with old unimproved calcareous grassland. There are surprisingly only six records for the region! Warton Crag 10 May 1991 (PF); Willaston Station 22 June 1994 (SM); Limestone Clough, Chorley 2 June 1975, A C Howell; Gait Barrows Wood 31 May 1968 (PF); Sinderland, Greater Manchester 1922 (HB) and Ing Point, Wharton 25 September 1907, J R Hardy.

Lasius fuliginosus (Latreille)

A southern species at its current northern limit on the Lancashire coast. There are several records from the Freshfield and Ainsdale dunes in 1934, 1941, 1946, 1963 and 1979. Other records are all before 1901 and are listed in Gardner (1901) from Bowdon, Trafford; Hoylake, Wirral; Delamere, Cheshire; West Kirby, Merseyside and Bolton in Greater Manchester.

Lasius brunneus

There is a published record of this species from Freshfield dunes which has been included on national distribution maps. The specimen is in the Manchester Museum and is *Lasius mixtus*, so *L. brunneus* should be deleted from the Lancashire list. It is an ancient woodland species which would be an unlikely find at Ainsdale.

Lasius mixtus (Nylander)

This ant parasitizes the nests of *Lasius niger* and *L. alienus*. The queen invades and slowly replaces the whole colony with her offspring. There are two confirmed records, one from Freshfield dunes on 14 May 1946 found by H. Britten and originally identified as *L. brunneus*, and a record, originally identified as *L. umbratus* from Hale in Trafford on 16 August 1923 by H. R. P. Collett. Both specimens are in Manchester Museum.

Lasius niger (Linnaeus) MAP 3

A common small black ant which is especially common in urban areas. It is the only native species that is a regular pest inside houses. Occasionally it forms loose soil anthills in grassland areas. There are 47 records of this species from the region, 26 of which are post-1980.

Lasius umbratus (Nylander)

The only record for the region is pre-1901 by Cooke from Bowdon in Trafford. There is a correctly identified specimen in Cooke's collection in Bolton Museum with no data.

Paratrechina longicornis (Latreille)

A vagrant species recorded once in the region by W. D. Hincks at Halsall on 7 July 1948.

Paratrechina vividula (Nylander)

A vagrant species recorded once in the region at Whitington, Preston on 12 February 1973 by D. Nutall.

Wasmannia auro-punctata Rog.

A vagrant species recorded once from Miles Platting on 25 September 1922, in Britten (1923)

Other Ant Records

An Atlas of ant distribution was published by the Biological Records Centre at Monks Wood in 1979. On this map are a number of records which do not correspond to any which the authors possess. Despite an approach to BRC these records appear to have been lost, so no further details can be included. For the record, we are including details of them below.

Leptothorax acervorum Pre-1960 : SJ30 & 96 : Post-1960 : SJ20, 73, 84, 36, 57, 88, 28
Myrmica lobicornis Pre-1960 : SJ24 & 83 : Post-1960 : SJ20, 77, 92, 76, 38, 49
Myrmica sabuleti Pre-1960 : SJ57 : Post 1960 : SJ73, 36, 56, 86, 31, 38, 48, 37, 59
Lasius mixtus Post-1960 : SJ38
Lasius alienus Post-1960 : SJ38

Species Which Should Occur in Lancashire & Cheshire

Formicoxenus nitidulus (Nylander)

A very tiny dark-red ant that nests within twigs inside the nests of the Wood Ant *Formica rufa*. It should be searched for in the north of Lancashire where its host occurs.

Myrmica sulcinodis Nylander

A red ant with darker head and abdomen. It is a moorland species found on uplands, but also on some lowland heaths and near bogs. It should be looked for on the West Pennines north of Bolton and Rochdale, on the Pennines east of Manchester, in the Bowland area and on the few remaining lowland mosslands. It is known on moors in the Peak district, near Sheffield.

Sphecidae.

Astata pinguis (Dahlbom) Local 25 June - 5 July

There are only three records for this wasp, none of which have been confirmed. The records date from the later part of the 19th Century and come from Southport (June 1879, 2 records) and Wallasey sandhills (July 1891). It is a species which generally breeds on sunny banks of sandy soil and preys on nymphs of Lygaeidae.

Tachyspex pompiliformis (Panzer) 17 May - 23 August (peak July)

A red and black wasp for which there are 11 records, 7 of which have been confirmed. Only one record is post 1980, Lytham St. Annes July 1991 (SH). The wasp nests in sandy areas and preys on grasshopper nymphs.

Tachyspex unicolor (Panzer) Nr 14 May - 23 Aug. (peak mid June)

A wasp of sandy places which preys on grasshopper nymphs and has been recorded in only two localities, Freshfield and Ainsdale. Of the four records, three have been confirmed and all are pre 1980; Freshfield May 1936 and 1946 (HB) and Ainsdale June 1976 (KB).

Trypoxylon attenuatum (Smith F.) 17 June - 12 September (and one on 2nd April)

There are 12 records for this black wasp, 10 of which have been confirmed. There are five post 1980 records; Birtenshaw Farm 1987 (SG), Philips Park July and August 1989 (PW), Ince Moss August 1993 and Halton Common June 1992 (both SM).

Trypoxylon clavicerum (Lepelitier)

There is only one confirmed record from Dunham Park on 10 June 1989 (SG) for this wasp which nests in hollow plant stems or beetle burrows in wood and preys on spiders.

Trypoxylon figulus (Linnaeus) 16 June - 1 July, (and one on 3 September)

A small black wasp which preys on spiders and nests in plant stems or beetle burrows. There are only seven records and all are pre 1950, of these five have been confirmed (Abbots Moss 1943, Cotterill Clough 1942 and 1944 and Meols 1919). The last record was on 1 July 1944 from Cotterill Clough.

Crabo cribrarius (Linnaeus) MAP 9 2 June - 20 August (and one on 16 April)

Of the 32 records for this black and yellow wasp 18 have been confirmed and 10 are post 1980.

Crabo peltarius (schreber) MAP 10 1 June - 31 August (peak June-July)

A large black and yellow wasp which preys on Diptera eg.Therevidae, Dolichopodidae and Muscidae. Of the 24 records, 12 are confirmed and four are post 1980; Lytham St. Annes 1992 (SH), Lundsfield Quarry (2 specimens) July 1991 (SH) and Lancaster University July 1987 (PF).

Crossocrus elongatus (vander Linden) MAP 12 23 May - 21 August

There are 22 records for this common wasp 13 of which have been confirmed. Five records are post 1980; Longworth Clough 10 August 1986 (SG), Bolton Town centre 20 July 1986 (SG), Daisyfield 25 June 1989 (PW), and Halton Common on 16 July and 2 August 1993 (SM).

Crossocerus ovalis (Lepeliter & Brulle) 15 May - 23 August

There are 15 records of which seven have been confirmed for this black wasp which preys on Empidid flies. Only two records are post 1980, Charters Moss 5 July 1987 (SG) and Halton Common on 4 June 1993 (SM).

Crossocerus palmipes (Linnaeus) Nb 27 May - 11 September

A small black wasp of sandy areas which has not been recorded in the area since 1942. Although there are 14 records only one has been confirmed; Heaton Park September 1927 (HB). Several specimens tagged as *C.palmipes* in Manchester Museum were reidentified as *C.pusillus* or *C.tasatus* by the authors. It seems likely that many other records will be incorrect and this is probably a very rare species in the counties.

Crossocerus tarsatus (Shuckard) MAP 16 16 June - 8 September

A black wasp nesting in sandy soil which preys on Diptera. There are 19 records, four are post 1980.

Crossocerus pusillus (Lepeletier & Brulle) MAP 14 27 June - 11 September

A common black wasp for which there are 35 records; seven of these are post 1980. The females of this species and *C.tarsatus* are extremely difficult to separate using current keys. The authors are not able to confirm all specimens of these. The males are however very distinct.

Crossocerus wesmaeli (Van der Linden) MAP 17 31 May - 1 September

A common black wasp which nests in sand and preys on Diptera. There are 17 records with one post 1980 record from Lytham St. Annes Nature Reserve on 22 July 1991 (SH).

Crossocerus annulipes (Lepeletier & Brulle) 16 June - 28 August

A small wasp which nests in rotting wood and preys on Homoptera. There are 14 records, eight of these are confirmed, Cotterill Clough 1942 and 1950, Hazlegrove 1944, Cuddington 1941 and two post 1980 records from Goosnargh Mill 1985 (ME) and Dunham Park in 1992 (SM).

Crossocerus capitosus (Shuckard)

A small black wasp which nests in plant stems. There is only one record which is confirmed from Cotterill Clough on 20 June 1944 (HB).

Crossocerus centratus (Shuckard) Nr 26 April - 31 August

Of the 12 records for this small black wasp seven are confirmed, three of which are post 1980; Dunham Park June 1989 and July 1992 (SG), and Goosnargh Mill in August 1985 (ME).

Crossocerus leucostroma (Linnaeus) Na 26 April - 31 August

A wasp which nests in dead wood and preys on small Diptera. Of the four records, three have been confirmed, Newchurch 1945, Cotterill Clough 1949 and North Rode 1945.

Crossocerus megacephalus (Rossius) MAP 13 5 May - 5 October (peak June)

There are 25 records for this common species, only five of which are post 1980; Dunham Park 1989 (SG), West Kirby 1986 (NKS), Elton 1988 (PW), Woolton Eyes 1992 (SM) and Dibbinsdale in 1992 (SM).

Crossocerus nigritus (Lepeletier & Brulle) 1 July - 24 August

A small black wasp which nests in dead wood or in branches of varius trees and shrubs. There are three unconfirmed records for Abbots Moss, Delamere and Rainow and one confirmed record for Cuddington in 1941.

Crossocerus styrius (Kohl) Nr 12 June - 19 September

There are five records, four of which have been confirmed. The records are all from the 1930's and 1940's; Dunham Park, Rostherne Mere, Arnfield and Hopwood Hall. The last record was on the 12 June 1948 at Hopwood Hall.

Crossocerus walkeri (Schuckard) Nb

A wasp for which there is only one record, from the Bollin Valley on the 7 September 1943 (HB). This is an unconfirmed record and specimens identified as *C.walkeri* in Manchester Museum were re-identified as *C.ovalis* which casts some doubt on this remaining record.

Crossocerus podagricus (Van der linden) 10 June - 5 August

There are only seven records for this wasp which nests in dead wood and three are post 1980. These were from Woolston Eyes 1993 (SM), Barnaby Sands Marsh in 1993 (SM) and Dunham Park in 1989 (SG).

Crossocerus quadrimaculatus (Fabricus) MAP 15 3 May - 7 September

A common black and yellow wasp which nests in sandy banks. The prey is mostly Diptera, but small Lepidoptera and Trichoptera may also be taken. Of the 39 records only three are post 1980, one from Conder Green in 1991 (SH) and two from Goosnargh Mill in 1985 (ME).

Crossocerus vagabundus (Panzer) RDB1

There are two unconfirmed records for this small black wasp which preys on Tipulidae. They are from Higher Bebbington 1901 and Delamere also in 1901.

Crossocerus binotatus (Lepeletier & Brulle) Na

A black and yellow wasp which nests in rotten wood and preys on Rhagionidae. There is only one record, for Rostherne Mere on 8 June 1940 (HB). This is a confirmed record, the specimen being present in Manchester Museum.

Crossocerus dimidiatus (Fabricus) MAP 11 3 July - 31 August

A black and yellow wasp which nests in decaying wood. There are 13 records, four of which are post 1980.

Ectemnius dives (Lepeliter & Brulle) Na

The only record is of a specimen collected by Miss Tomlin in the Chester district discussed in Hallet (1945). This is a species that should be looked for in the region.

Ectemnius cavifrons (Thomson) MAP 18 20 June - 16 August (and one on 5 October)

A common black wasp for which there is 40 records, 18 of these are post 1980. The wasp nests in rotting wood and preys of Diptera, especially Syrphidae.

Ectemnius lapidarius (Panzer) 7 April - 17 September

A large black and yellow wasp which nests in rotten wood. There are 19 records, only one of which is post 1980, from Gait Barrows on 17 September 1986 (C J Palmer).

Ectemnius sexcinctus (Fabricus) Nb

There are three records for this wasp, which nests in dead wood exposed to sunlight and preys on larger Syrphidae eg. *Syrphus ribesii*. Two of these records are post 1980, Halton Common on 28 July 1991 (SM) and Great Lever on 17 July 1987 (Bolton Museum). The earlier record is an unconfirmed one from Blackwood, Great Harwood identified from developed insects inside pupae found on 19 November 1949.

Ectemnius ruficornis (Zetterstedt) Nb

A large black and yellow wasp which preys on Syrphidae and nests in dead wood. The two records are post 1980 and are confirmed, Witton Country Park on 24 July 1984 (KB) and Higher Woodhill on 22 June 1989 (PW).

Ectemnius continuus (Fabricus) 27 May - 13 September

A black and yellow wasp which nests in decaying wood and preys off Diptera (eg. Syrphidae, Muscidae and Tabinidae). There are 14 records three of these are post 1980, Conder Green July 1991, Fleetwood Docks May 1991 and Lancaster University August 1986.

Ectemnius cephalotes (Olivier) MAP 19 27 July - 2 August,(and one on 5 October)

A medium sized black and yellow wasp which preys on Diptera eg. Syrphidae and Muscidae, and which nests in rotting or soft wood. Often groups of females use the same entrance tunnel to enter their own nests. There are 17 records, three of which are post 1980, Goosnargh Mill in August 1985, Halton Common in October 1993 and West Kirby in 1986.

Lindenius albilabris (Fabricus) Nr

A small wasp nesting in sandy soil which preys on Heteroptera and Diptera. There is only one unconfirmed record from Freshfield on 17th May 1948 (H.W. Daltry).

Rhopalum clavipes (Linnaeus) MAP 25 7 May - 28 August (one record for 7 October)

This is a small black wasp which nests in a wide variety of plant stems, eg. *Rubus*, *Phragmites* and may also nest in dead wood (such as at Dunham Park). The wasp preys mainly on Psocids, but smaller Diptera may also be taken. There are 20 records of which three are post 1980.

Rhopalum coarctum (Scopoli) Local MAP 26 26 April - 8 September (Peak June-August)

A small black wasp which has a widespread distribution throughout Lancashire and Cheshire. There are 27 records from 15 different sites; 5 of these are post 1980 records. The wasp nests in hollow stems and preys on Diptera. .

Oxybelus argentatus (Curtis) Na

A wasp of sandy coastal areas of which there are two unconfirmed published records for Wallasey Sandhills for dates preceeding 1836 and 1901.

Oxybelus mandibularis (Dahlbom) Na

A small black wasp with spots on its abdomen. There are two records, a confirmed record from Birkdale on 29 July 1923 (HB), which is in Manchester Museum and an unconfirmed record from Wallasey Sandhills in the period 1906-1908 (G Arnold).

Oxybelus uniglumis (Linnaeus) MAP 21 10 June - 18 August

This yellow and black wasp is a common species which has been fairly well recorded in Lancashire and Cheshire. Of the 22 records only four are post 1980, Lundsfield Quarry in 1991 (SH), Woolston Eyes in 1993 (SM) in 1993, Moore in 1992 (SM) and Dunham Park in 1994 (SG).

Psen dahlbomi (Wesmael) Nr 20 - 27 July

A black wasp which nests in decaying wood. It is an uncommon species for which there are only two records (both confirmed) , Cuddington in 1941 (HB) and Ince Moss in 1989 (PW).

Psen littoralis (Bondroit) RDB3 7 July - 17 August

A wasp of coastal dunes which nests in marram grass.There are two confirmed records for Ainsdale in 1976 (KB).

Psen bicolor Jurine RDB2

A red and black wasp of damp, sandy soils for which there is only one unconfirmed record from Parkbridge on 13 August 1922 (H Halkyard).

Psen bruxellensis (Bondroit) Na 31 July - 27 August

A species which nests at the roots of grasses in sandy areas. There are only two records for Lancashire, both are from Ainsdale, in 1979 and 1981 (KB).

Psen equestris (Fabricus) MAP 24 2 July - 5 September

A common red and black wasp of sandy locations which nets in tunnels that often go deep into the ground. There are 18 records of which five are post 1980 from two localities, Darcy Lever Sandpits in 1987 (SG), and Philips Park in 1988 and 1989 (PW).

Psen lutarius (Fabricus) 20 June - 10 August

A red and black wasp which nests in sandy locations and preys on bugs. There are four confirmed records (Abbots Moss in June and August 1941 and Cuddington July 1941) and two unconfirmed records for Cheshire (from Abbots Moss in 1908 and Hatchmere in 1941).

Psenulus concolor (Dahlbom) Local

A small black wasp that nests in broken plant stems and twigs. The first record for the counties was of a male caught at Halton Common on 10 June 1993 (SM)

Psenulus pallipes (Panzer) 3 July - 8 August

A black wasp which generally nests in hollw plant stem such as bramble or *Phragmites* but may also nest in old insect burrows. Although it is thought to be commonly distributed south of Cumbria only seven records exist for Lancashire and Cheshire. Only two records are confirmed, Ashton on Mersy 1929 and the most recent from Hale Bank July 1945 (HB).

Spilomena troglodytes (Vander Linden)

A small black wasp for which there are four records, three of these are confirmed (Wilmslow 1940, Freshfield 1941, Delamere 1940). The unconfirmed record is from Chorlton in 1952.

Spilomena differens (Bluthgen)

A small black wasp which preys on Thrips for which there is only one confirmed record from Cotterill Clough in July 1946 (HB).

Pemphredon lugubris (Fabricus) MAP 23 23 May - 15 September

A common and widespread wasp which nests in decaying wood. There are 39 records, 19 of which are confirmed.

Pemphredon inornatus (Say) MAP 22 22 June - 7 September

A wasp which nests in old wood or broken plant stems; the larva feed on aphids. There are 24 records, 15 of these are confirmed. There are four post 1980 records; Fleetwood Marsh in 1991 (SH), Ince Moss in 1993 and Halton Common in 1992 and 1993 (SM).

Pemphredon lethifer (Shuckard) 5 June - 1 September

A small common black wasp which usually nests in bramble stems. There are 16 records for Lancashire and Cheshire, 13 of which have been confirmed; five are post 1980 from Halton Common (4 records) and Woolston Eyes (both SM).

Pemphredon wesmaeli (Morawitz) RDB3

This wasp is thought to exist only in the Inverness area. The card index at Manchester Museum revealed four records for Lancahire and Cheshire, however, two specimens (both males) identified in the actual collections proved to be *P.lethifer*. This casts doubt on the two remaining records which must be considered very dubious.

Pemphredon morio (Vander Linden) RDB3

A small black wasp which nests in dead wood, the larva feed on aphids. There is only one record, which is confirmed, from Alderley Edge on 13 August 1949 (HB). The specimen is present in the collections at Manchester Museum.

Diodontus minutus (Fabricus) 11 June - 23 August

A small black wasp of sandy areas which preys on aphids. There are seven records, five of which have been confirmed; Sinderland August 1936 (HB two records), Ainsdale June and July 1976 (KB) and Lytham St. Annes 1992 (SH).

Diodontus tristis (Vander Linden) 10 June - 16 July and 11 October

Five records exist for this small black wasp, which generally nests in sandy soil but may also be found in crumbling mortar. Unconfirmed records are from Wilmslow in 1940 (GK) and Wallasey Sandhills in 1906-1908. The confirmed records are from Ainsdale in October 1931 (HB), Formby Point in July 1992 (SM) and Halton Common in June 1993 (SM).

Passaloecus corniger (Schukard) 16 June - 28 August

A small black wasp which nests in plant galls of *Lipara* and sometimes in old wood . Of the six records four are confirmed; Cotterill Clough June 1942, Delamere August 1941, Tatton Park July 1948 and the only post 1980 record Goosnargh Mill in August 1985.

Passaloecus gracillis (Curtis) 10 June - 6 August

All six pre 1980 records for this small black wasp have been confirmed and are held at Manchester Museum. Several of the specimens were originally identified as *P.insignis*. It was last recorded in August 1946 at Freshfield.

Passaloecus insignis (Van der Linden) 25 June - 23 August

There are three unconfirmed records for Dunham Park (June 1949) and Sinderland (August 1936) for this small wasp which nests in pithy plant stems or insect tunnels.

Passaloecus monilicornis (Dahlbom) 15 June - 24 August

Only one confirmed record exists from Cotterill Clough in June 1955 (HB). There are also three unconfirmed records for Abbots Moss (August 1941), Goyt Valley (July 1936) and Cotterill Clough (July 1943). This is a small black dead wood nesting species.

Passaloecus singularis (Dahlbom) 10 - 25 June

A small black wasp which preys on aphids and nests in plant stems. There are four confirmed post 1980 records, all from Halton Common in June 1992 and June 1993 (all SM).

Ammophilla pubescens (Curtis) 29 June - 31 August

A large black and red wasp of sandy heath areas which preys on larvae of Geometridae and occasionally Symphyta. The nest holes are closed with a plug of sand and the adult wasp continues to deposit paralysed prey in the nest until the larva is quite well advanced in its developement. There are seven records (none are post 1980),three of these have been confirmed, Abbots Moss 1941 and 1943, and Bury 1918.

Ammophilla sabulosa (Linnaeus) MAP 7 31 May- 13 September

A large red and black wasps of sandy heaths. It is fairly well recorded, 18 of the 32 records are confirmed. Of these five are post 1980.

Podalonia affinis (Kirby) RDB3 24 June - 16 August

A red and black wasp of sandy areas for which there is 12 records (all pre 1980), nine of these have been confirmed. It was last recorded in June 1976 at Ainsdale (KB).

Podalonia hirsuta (Scopoli) Nb 4 May - 16 September

There are 29 records from eight sites and of these, 19 have been confirmed (from Freshfield Ainsdale and Lytham St. Annes) and six are post 1980.

Mellinus arvensis (Linnaeus) MAP 20 1 July - 26 September (and one in April)

A large black and yellow wasp which preys on Tabanidae, Syrphidae and Muscidae. It nests in light dry soils and has been well recorded in Lancashire and Cheshire. Of the 53 records, 29 are confirmed and nine are post 1980.

Nysson spinosus (Forster) 12 June - 1 July

A cleptoparasite of *Argogorytes mystaceus* and *A. fargeii* which lays eggs on prey collected by its hosts. There are six records, five of which have been confirmed, the only post 1980 record is from Bradshaw Brook in June 1989 (PW).

Gorytes tumidus (Panzer) Local

There is only one record for this red and black wasp with white spots from Wallasey Sandhills . This is a published record from G. Arnold in the period 1906-1908.

Argogorytes mystaceus (Linnaeus) Local MAP 8 13 June - 22 July

A black and yellow wasp which preys of froghopper nymphs. Of the 23 records, 15 have been confirmed and eight are post 1980.

Conservation Of Ants And Sphecids

Availability of nesting sites is critical for both ants and Sphecids. The comments here also apply to the conservation of most other Aculeate Hymenoptera.

Ants nest in a variety of places, but many need sites which area warmed by the sun. Short-grazed turf is especially good, although many nest under sun-baked stones and some, such as the wood ants (*Formica rufa*) nest in shade.

Sphecidae nest in burrows which they provision with prey ranging from spiders to bugs and flies. The sites of the burrows vary according to the species. Some nest in dead wood. These may use old wood-boring beetle burrows in hard dry wood, often baked by the sun. Others, especially the *Ectemnius* species, prefer softer dead wood which they excavate themselves. The sites are nearly always in the sun and in late summer they can easily be located by copious sawdust beneath the trees, excavated by the wasps.

Other species nest in hollow plant stems. Bramble stems are a favourite site for many species. Broken stems along rides and hedgerows in sunny localities are preferred. Sometimes broken reed stems may be used.

Other species are ground-nesters. They require well-drained, often sandy soil with a sunny aspect. A favourite microhabitat is the exposed soil created by slippage beside rivers, or along footpaths. On moorland, south-facing bare earth is often associated with areas where sheep rest. For these species a limited amount of soil erosion is valuable. However, the burrows have to survive intact until the following year, so excessive trampling or erosion by a river would be disastrous.

Summary

This paper provides details of the known status of ants and Sphecids in Lancashire and Cheshire, both past and present. It does however highlight the remarkable lack of recording over many years. This is true not only of the Hymenoptera. If it were not for the astonishing enthusiasm of Harry Britten, we would have a very poor knowledge of our north-west insect fauna.

Acknowledgements

The authors would like to thank many people for assistance with this paper. Carl Clee at Liverpool Museum has collected and identified many specimens and provided us with his records and details of those in the Liverpool Museum collection. Steve McWilliam in particular has collected many specimens and been very supportive of this project. Colin Johnson at Manchester Museum gave us access to the Lancashire and Cheshire Fauna Committee card index and the Museum's Hymenoptera collection. Records and/or specimens were also received from Simon Hayhow, Neil Robinson, Malcolm Edmunds, Peter Flint, Ian Rutherford, Patrick Waring and Brad Booker.

Sites Of Regional Importance

This table shows sites ranked in order by Invertebrate Site Register scores for species. These are 100 for all RDB species; 50 for Notable A; 40 for Notable B and Regionally Notable. All sites scoring 50 or higher are listed.

In addition there are sites listed at the foot of the table with more than ten species recorded.

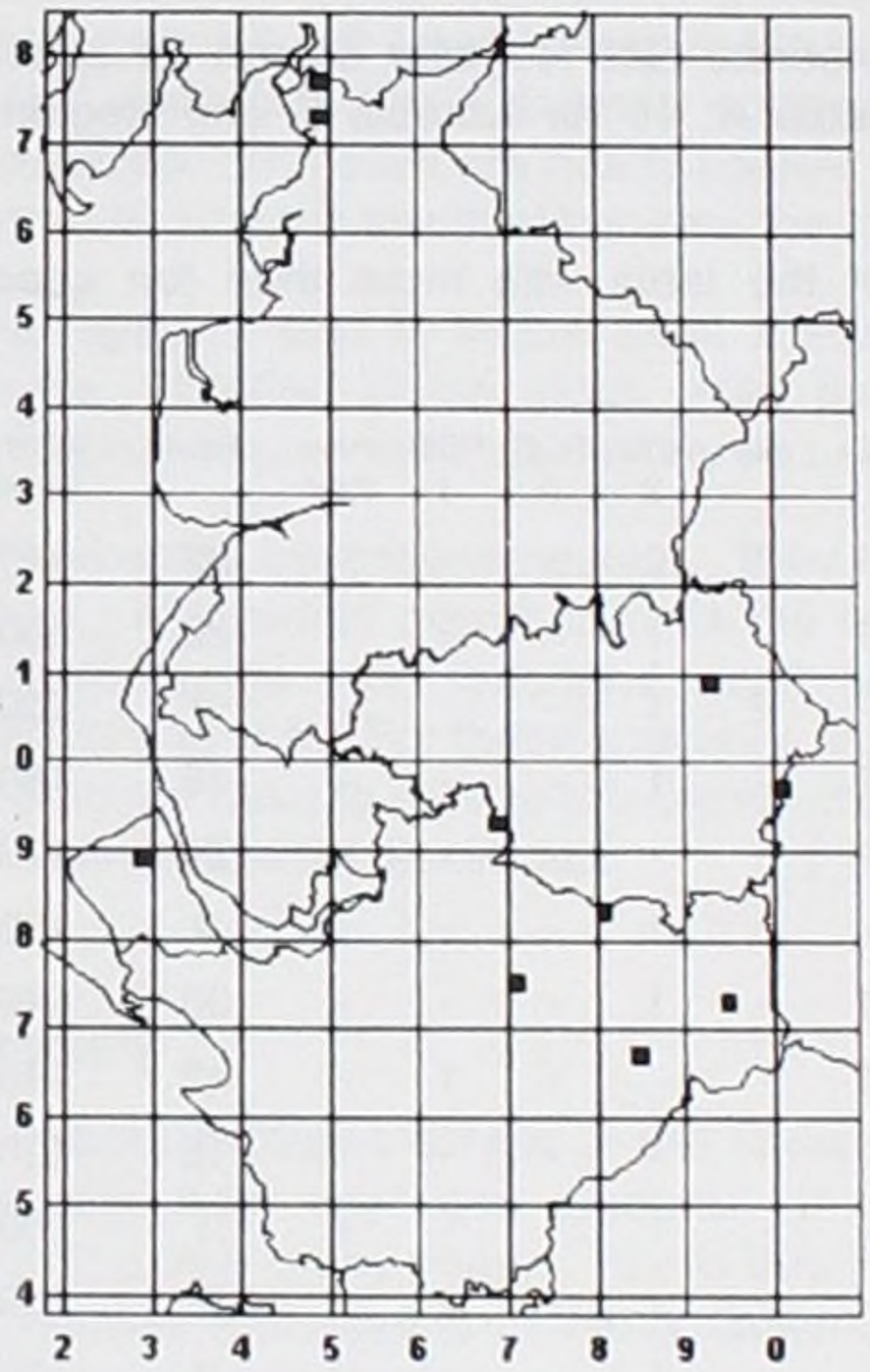
Site Name	Unkn	Com	Loc	Nr	Nb	Na	RDB 3	RDB 2	RDB 1	Intro Vagr	Total	ISR score
Ainsdale	-	8	7	3	1	1	2	-	-	-	22	410
Freshfield	-	12	4	4	1	-	1	-	-	-	22	300
Wallasey Sandhills	-	1	5	-	-	2	1	-	-	-	9	200
Alderley Edge	-	11	2	-	2	-	1	-	-	-	16	180
Cotterill Clough	1	10	9	3	-	1	-	-	-	-	24	170
Birkdale	-	5	2	-	-	1	1	-	-	-	9	150
Wilmslow	-	21	7	-	1	-	1	-	-	-	30	140
Delamere	-	26	14	-	1	-	-	-	1	-	42	140
Dunham Park	-	8	5	3	-	-	-	-	-	-	16	120
Blackpool Sandhills	-	-	-	-	-	-	1	-	-	-	1	100
Higher Bebington	-	-	1	-	-	-	-	-	1	-	2	100
Maghull	-	1	-	-	-	-	1	-	-	-	2	100
Parkbridge	-	2	-	-	-	-	-	-	1	-	3	100
Newchurch Common	-	8	4	-	1	1	-	-	-	-	14	90
Goosnargh Mill	-	5	4	2	-	-	-	-	-	-	13	80
Bowdon	-	6	2	2	-	-	-	-	-	-	10	80
Cheshire Sandhills	-	4	3	-	-	1	-	-	-	-	8	50
Holker Mosses	-	-	-	-	-	1	-	-	-	-	1	50
Ince (Cheshire)	-	1	1	-	-	1	-	-	-	-	2	50
North Rode	-	-	-	-	-	1	-	-	-	-	1	50
Rostherne Mere	-	1	4	-	-	1	-	-	-	-	6	50
Abbots Moss	-	14	9	-	1	-	-	-	-	-	24	40
Bollin Valley	-	7	2	-	1	-	-	-	-	-	10	40
Cuddington	-	6	6	-	1	-	-	-	-	-	13	40
Goyt Valley	-	8	4	-	1	-	-	-	-	-	13	40
Halton Common	-	11	3	-	1	-	-	-	-	-	15	40
Sinderland	-	11	5	-	-	-	-	-	-	-	16	-

The Distribution Maps

On the following pages are distribution maps for a number of species. Records are quite few for most species so it was decided to combine all records, old and new to produce the maps. Records are mapped at tetrad level. This does mean, however that many records from vague sites are not mapped at this level. The authors hope that the maps provide some useful information to promote further study of the groups in future.

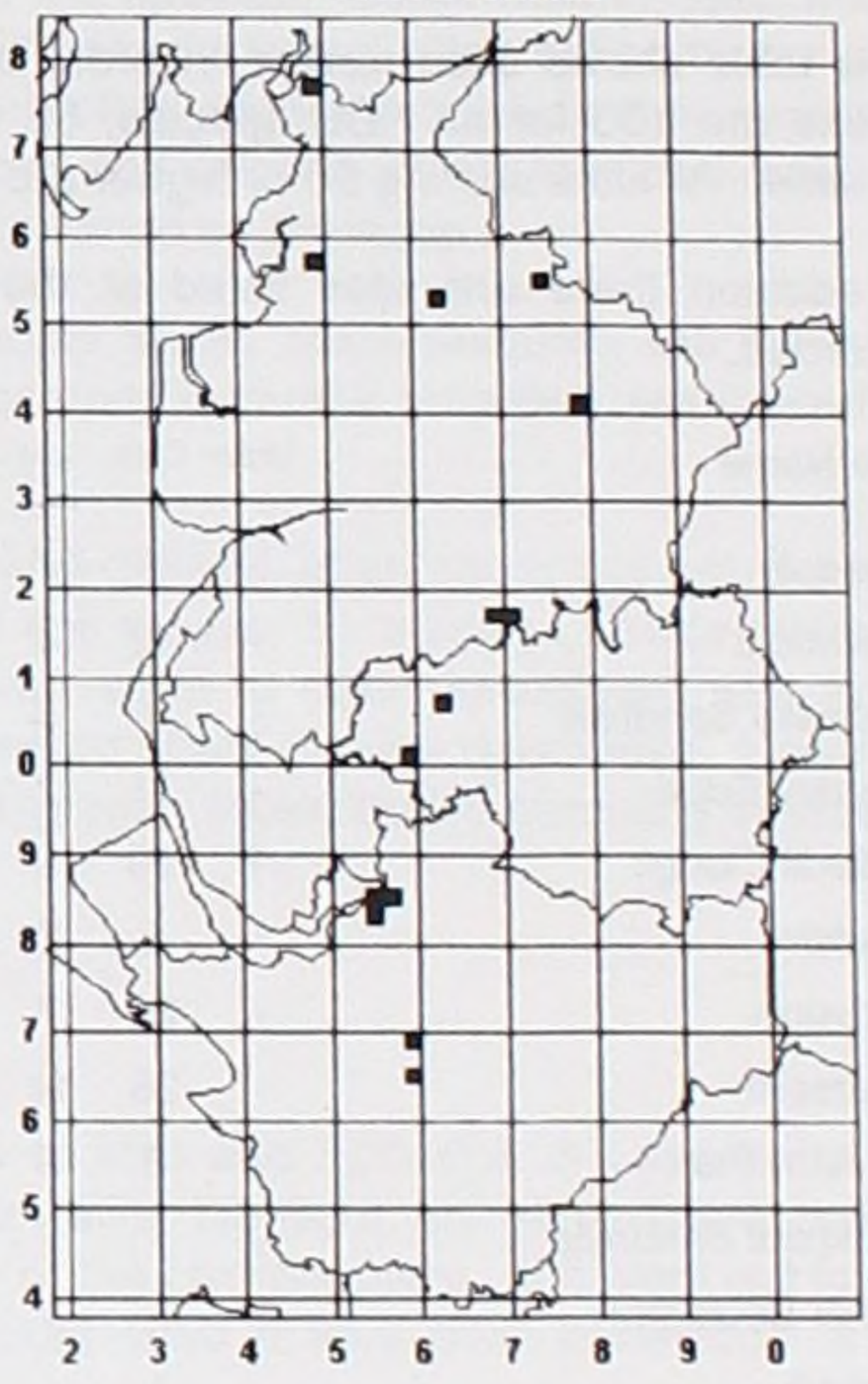
1

Formica fusca



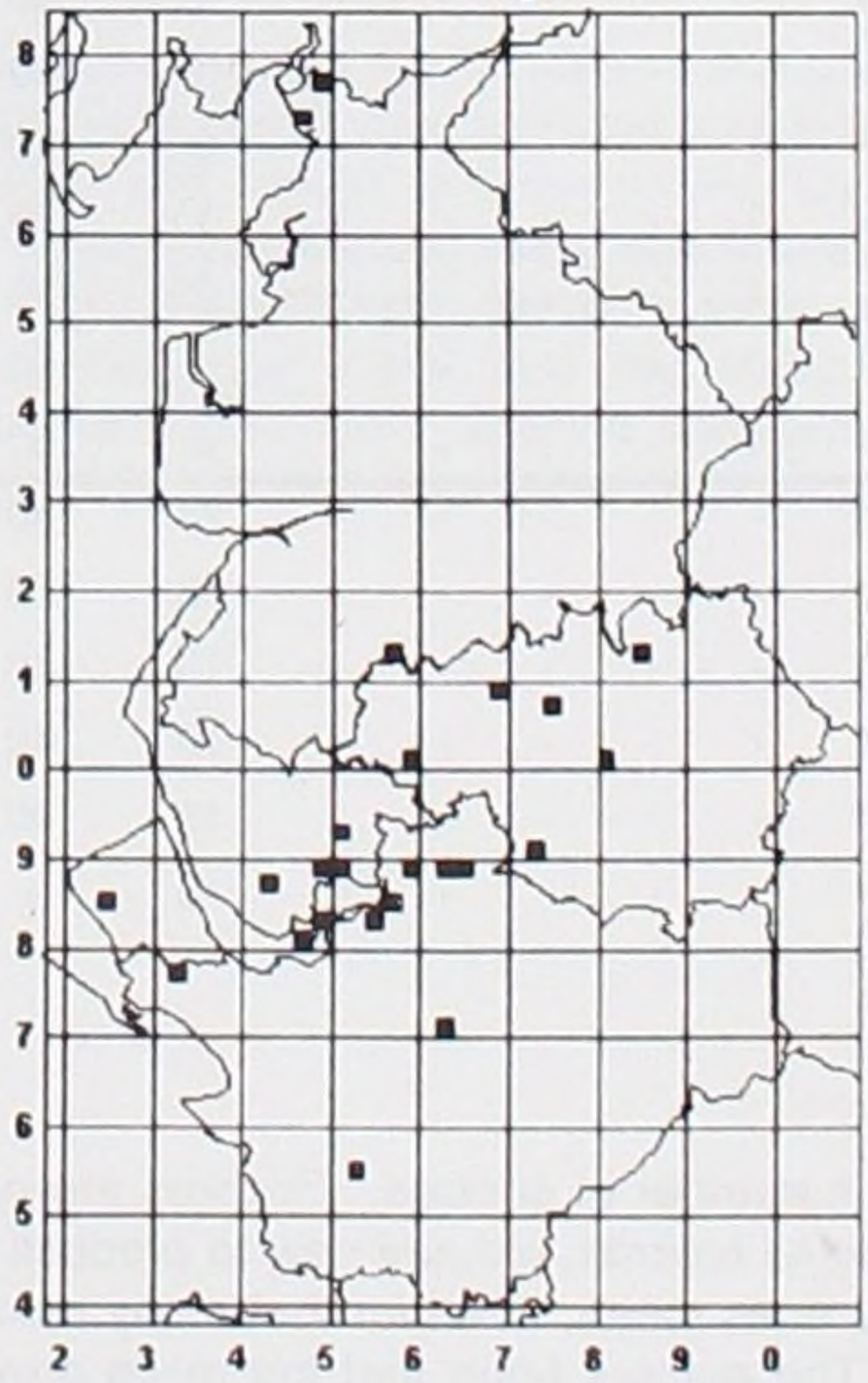
2

Formica lemani



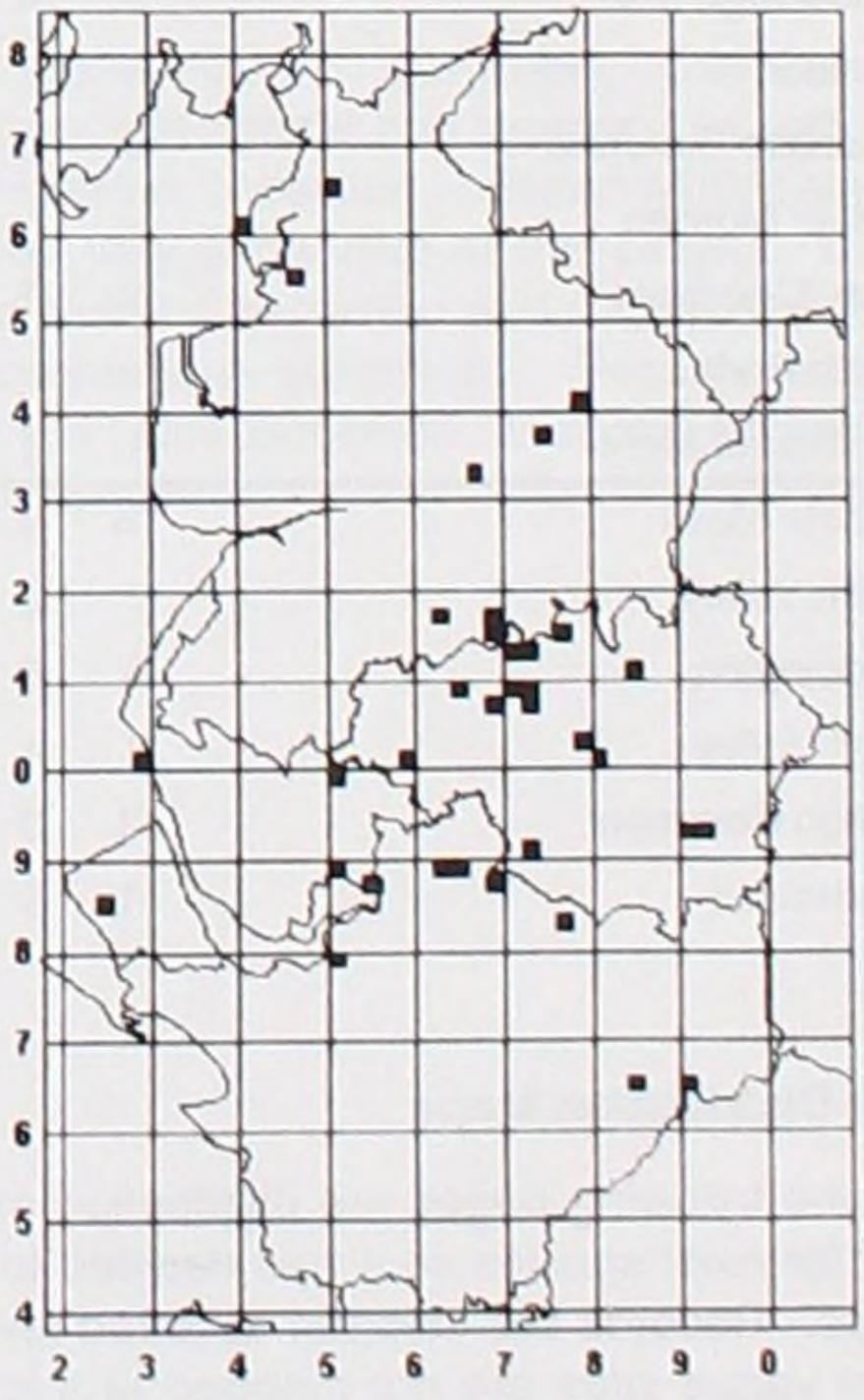
3

Lasius niger

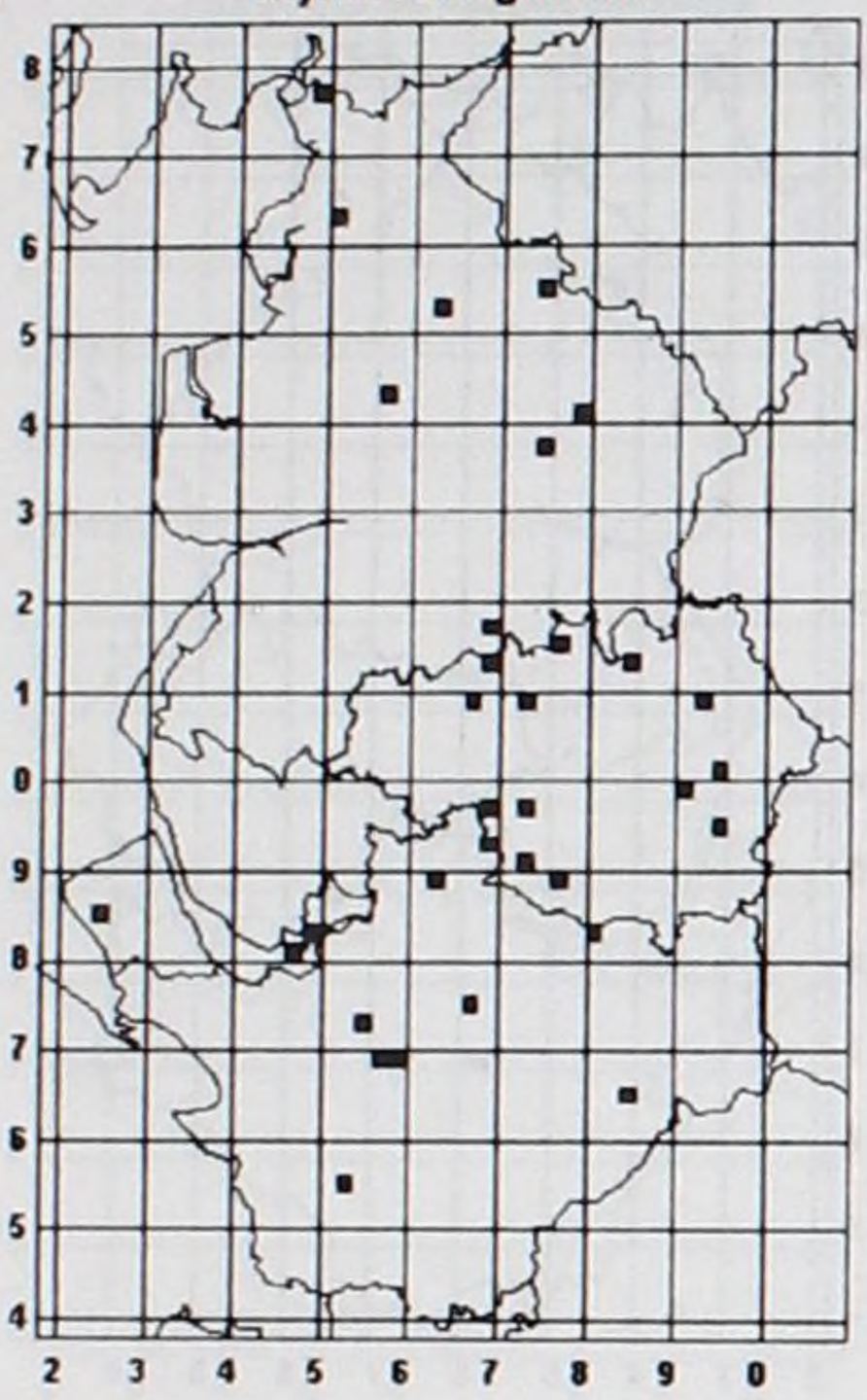


4

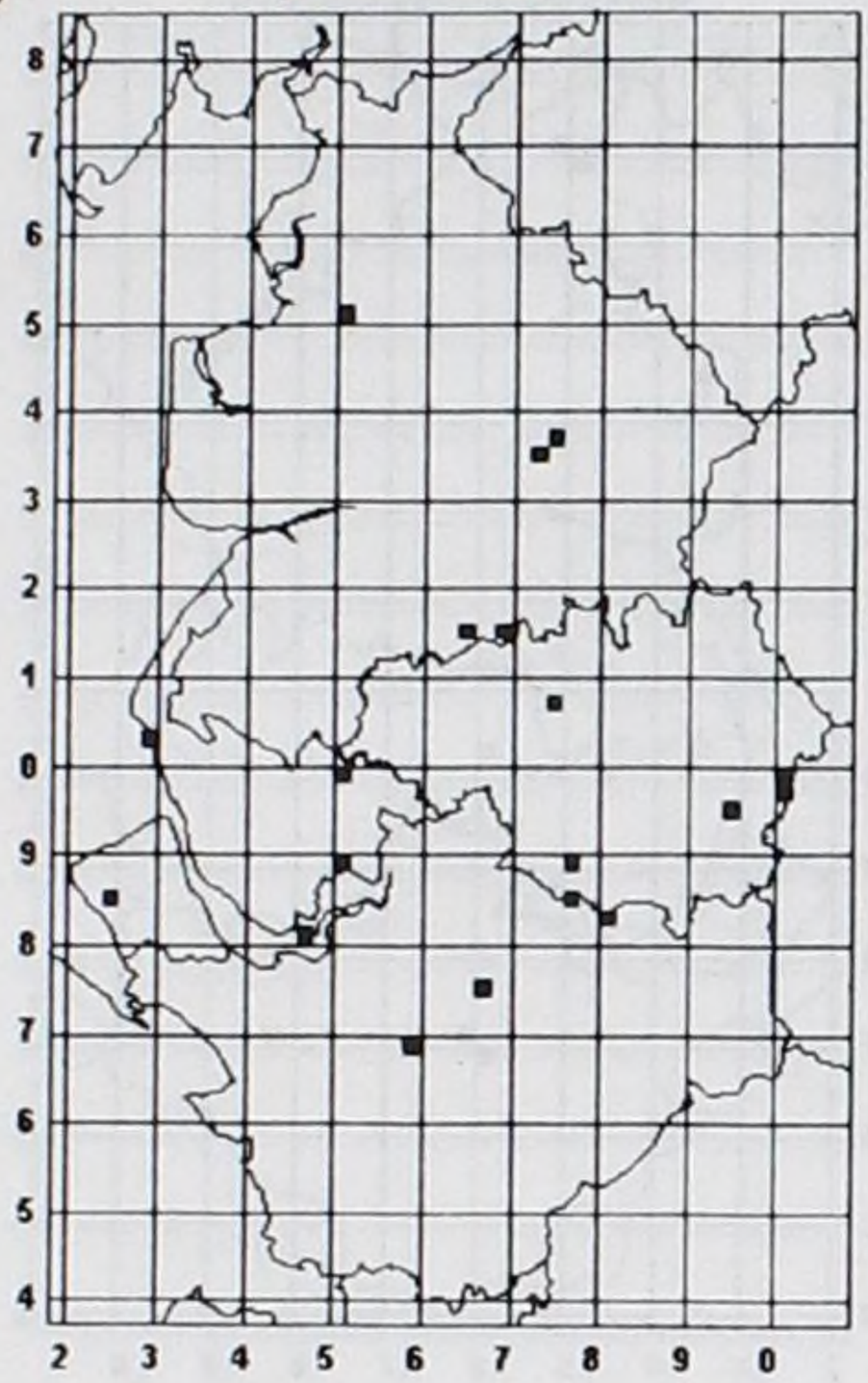
Myrmica rubra



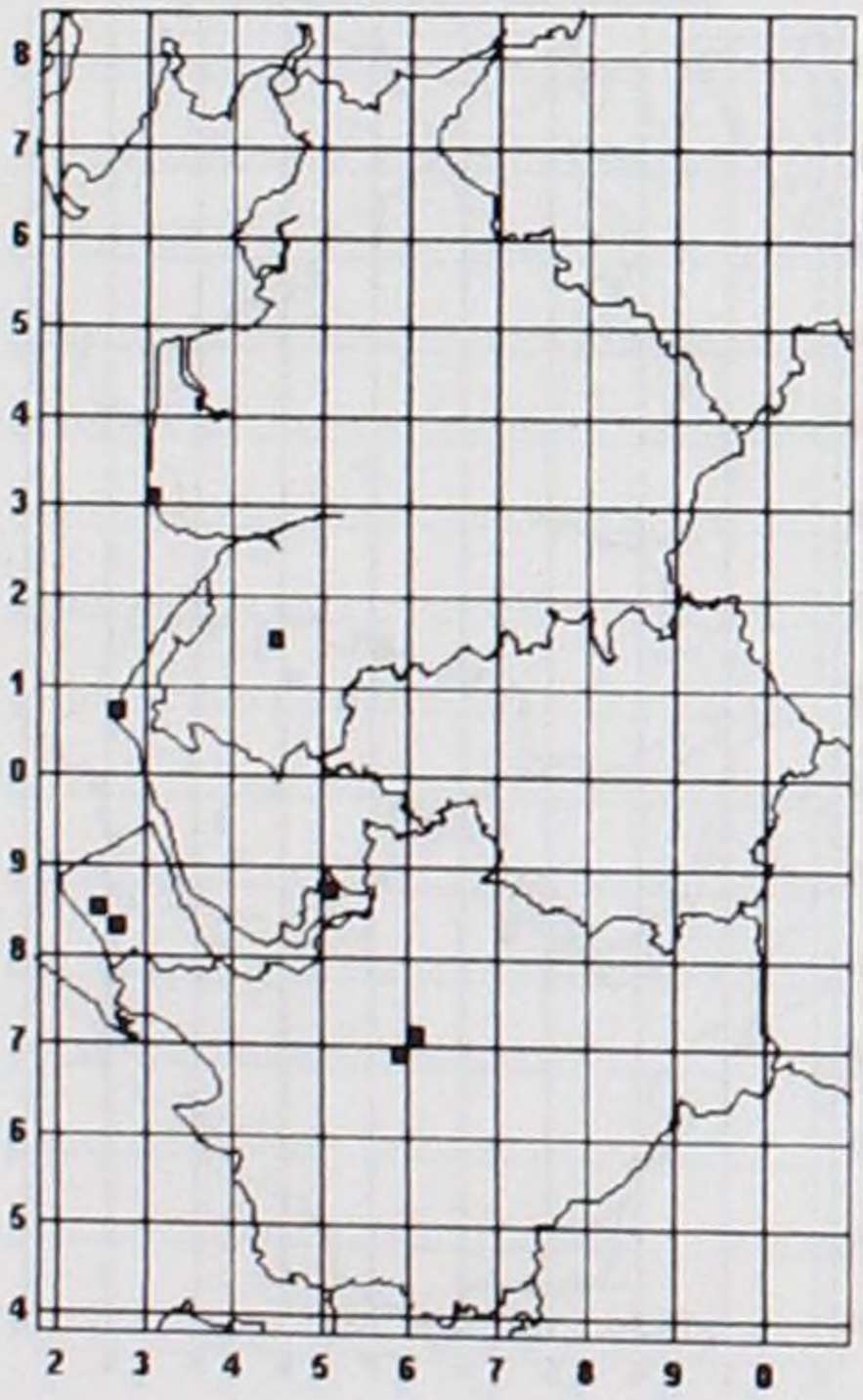
5 **Myrmica ruginodis**



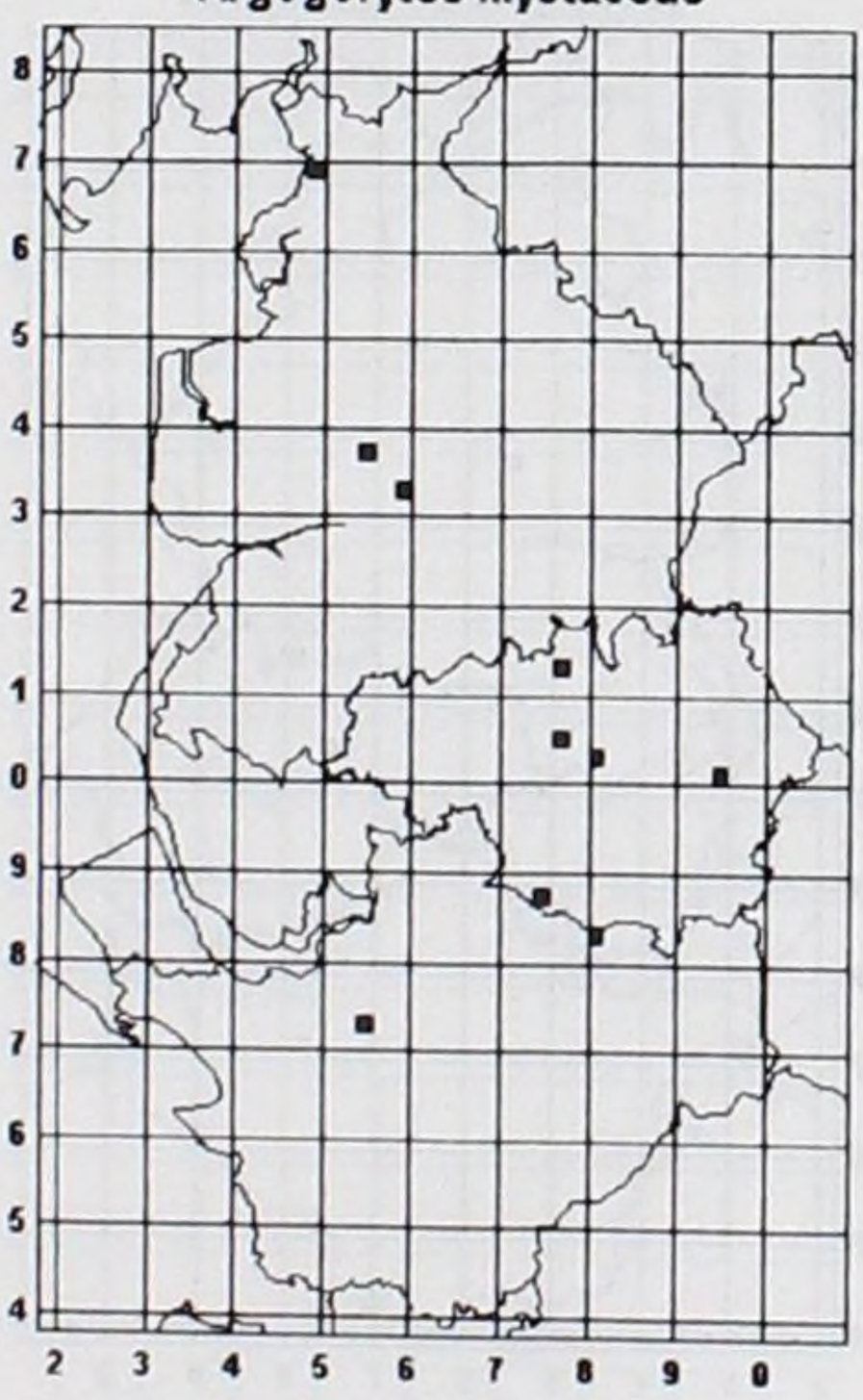
6 **Myrmica scabrinodis**



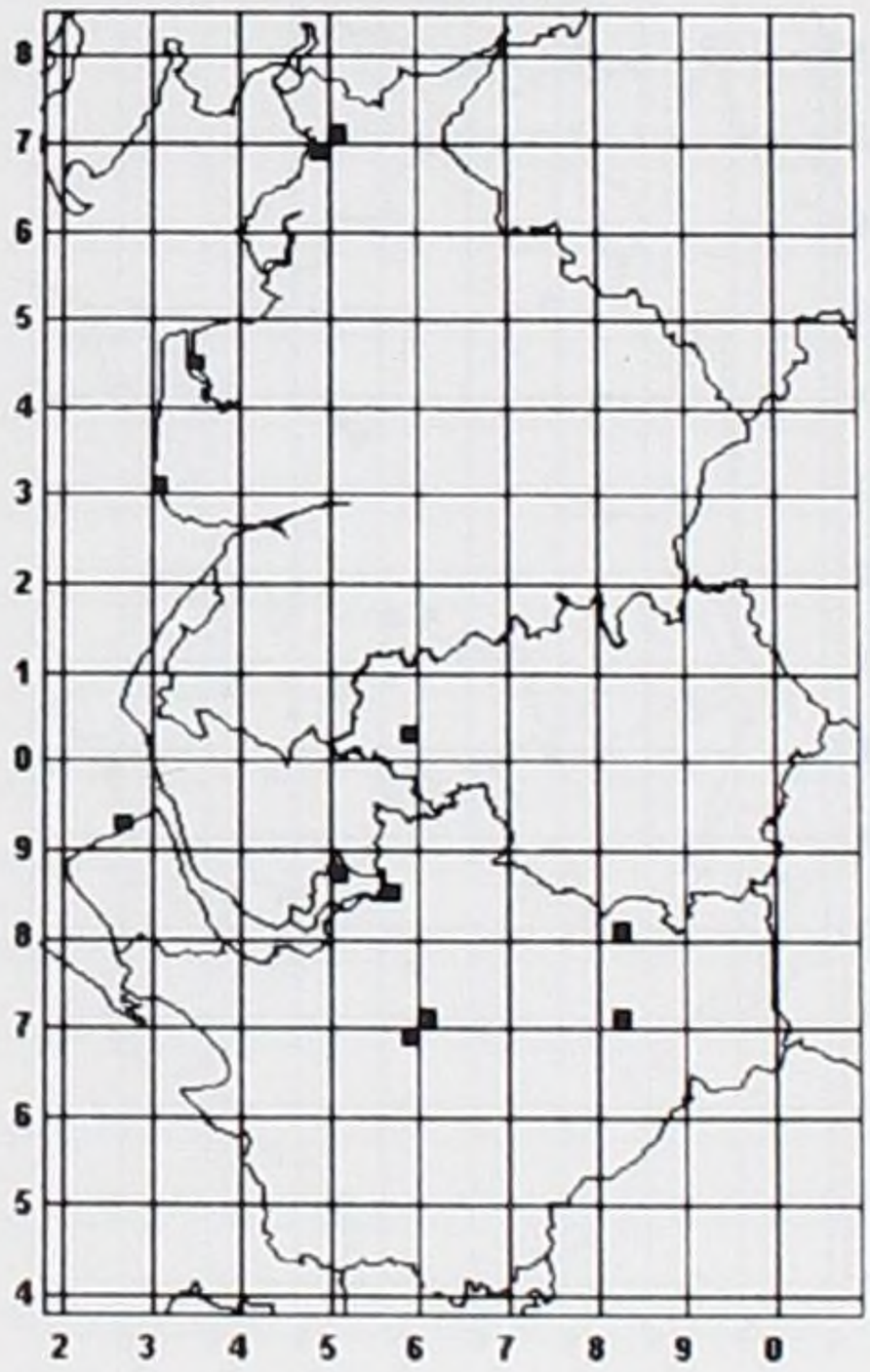
7 **Ammophila sabulosa**



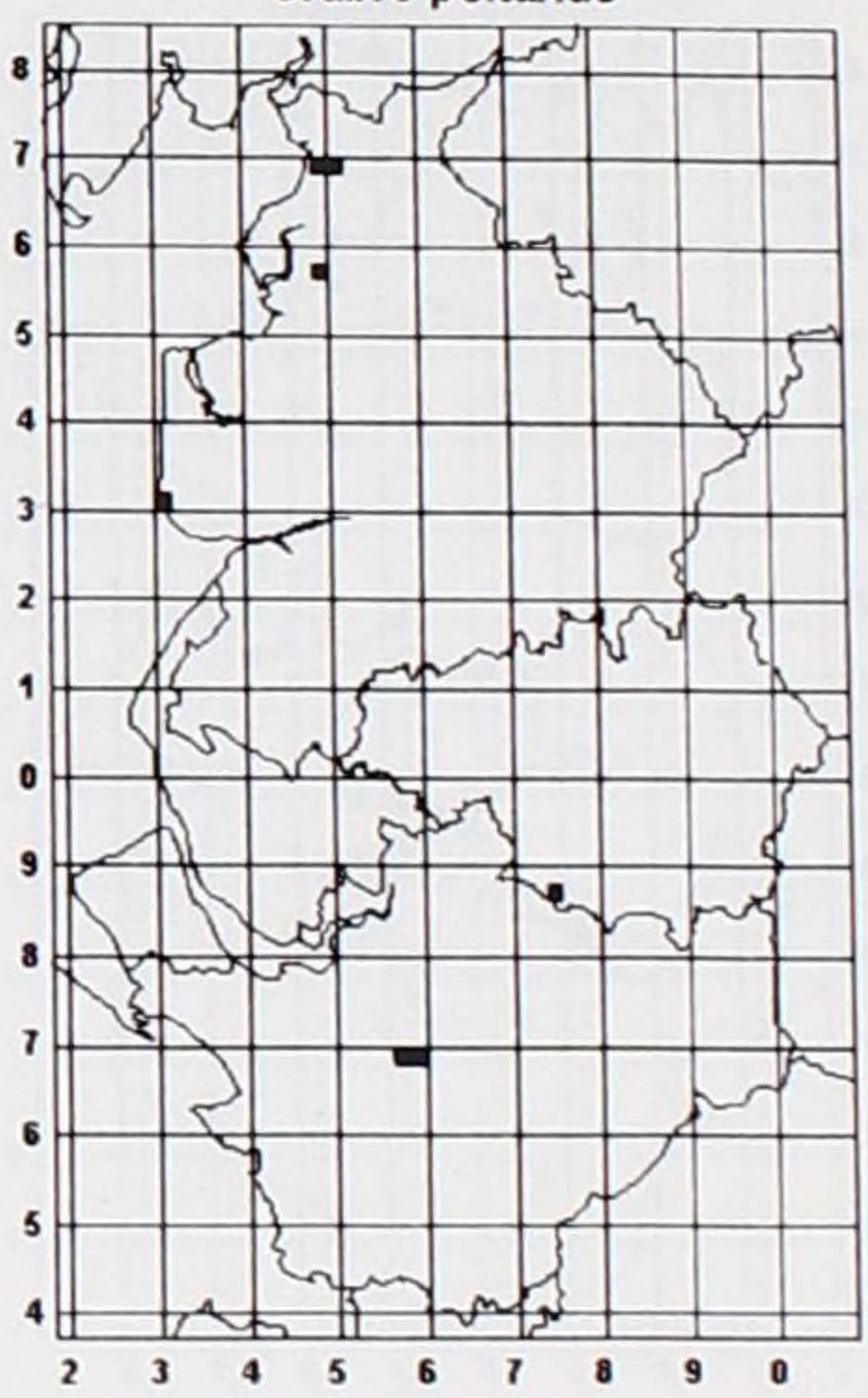
8 **Argogorytes mystaceus**



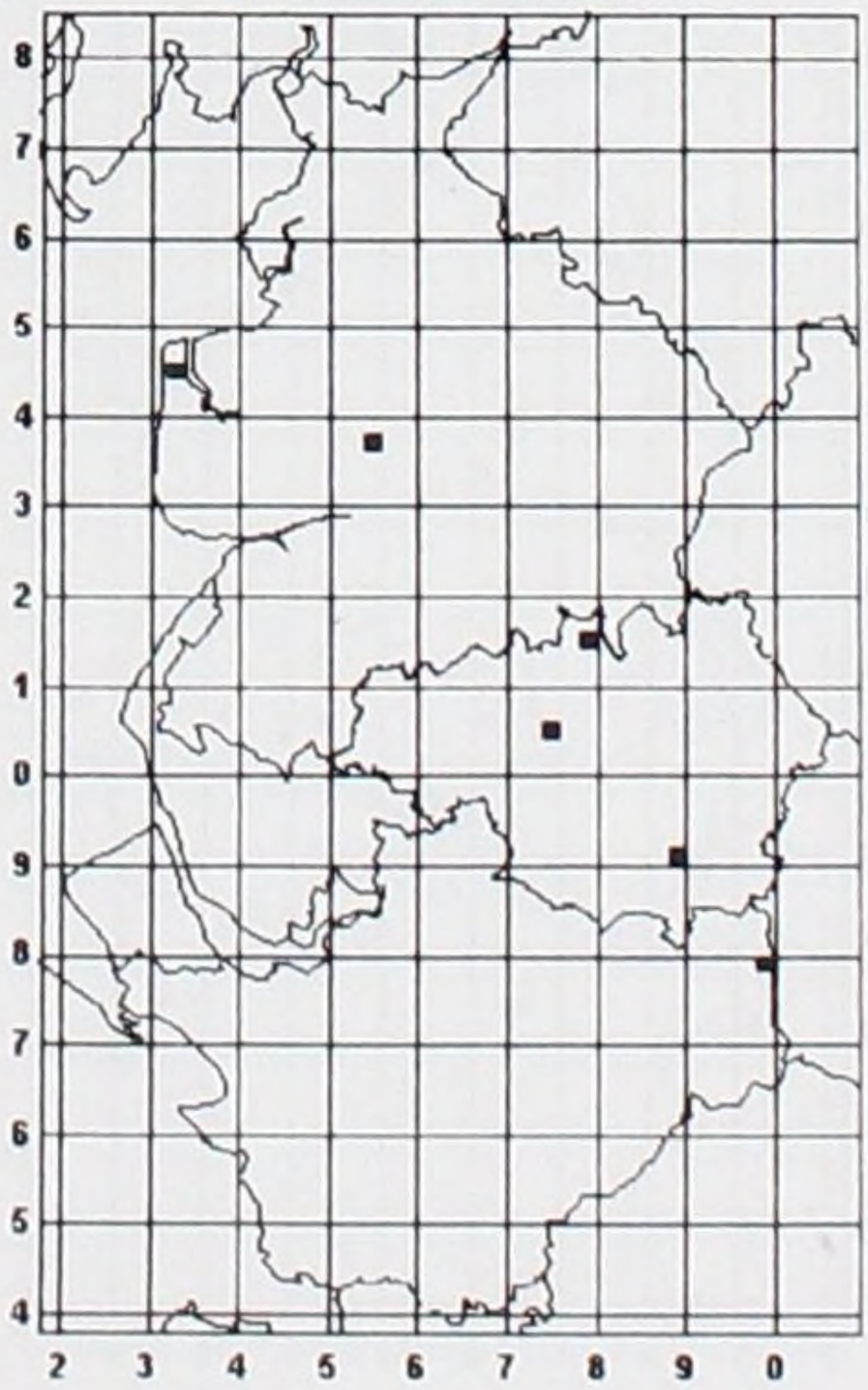
9 **Crabro cribrarius**



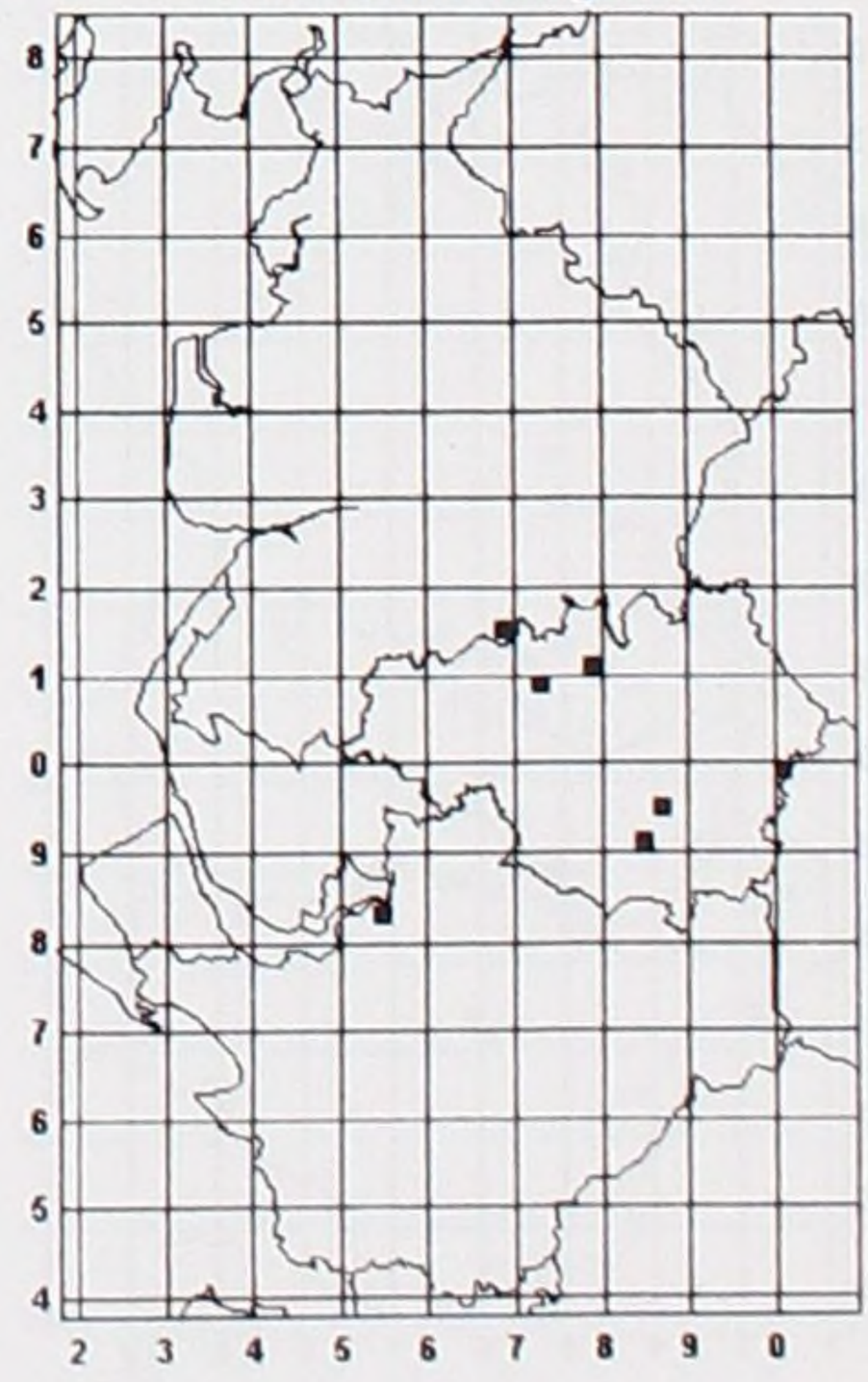
10 **Crabro peltarius**



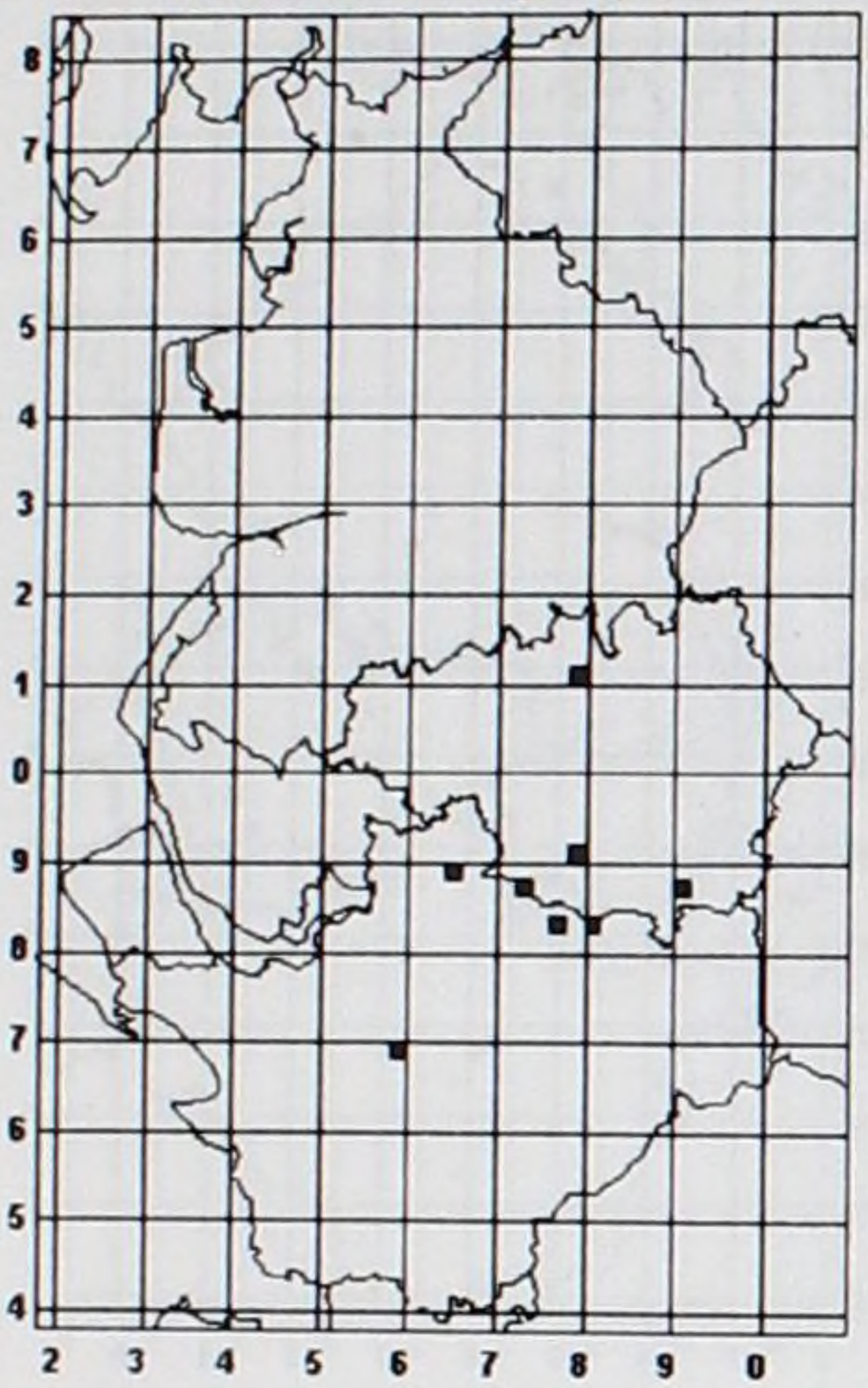
11 **Crossocerus dimidiatus**



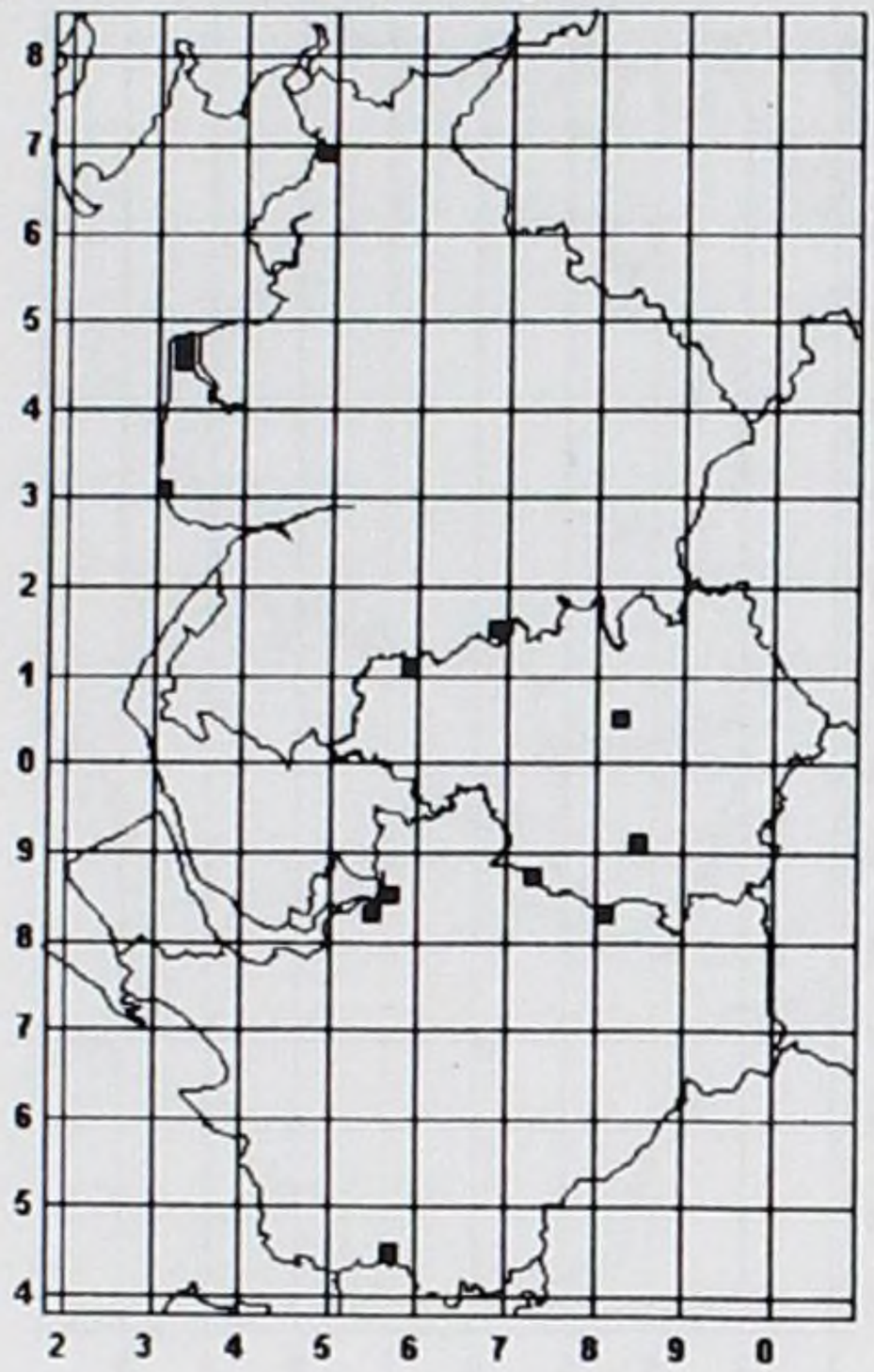
12 **Crossocerus elongatulus**



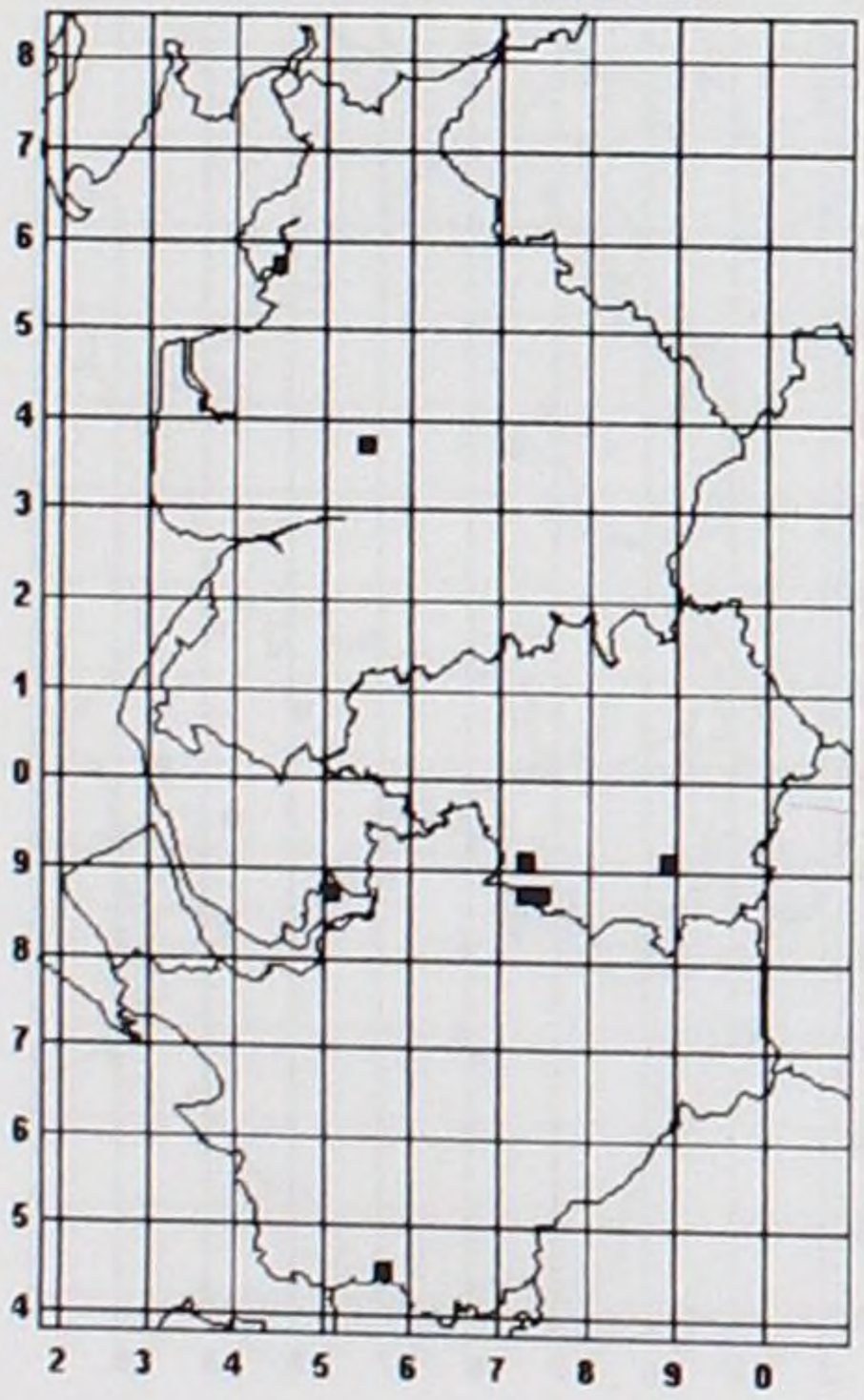
13 **Crossocerus megacephalus**



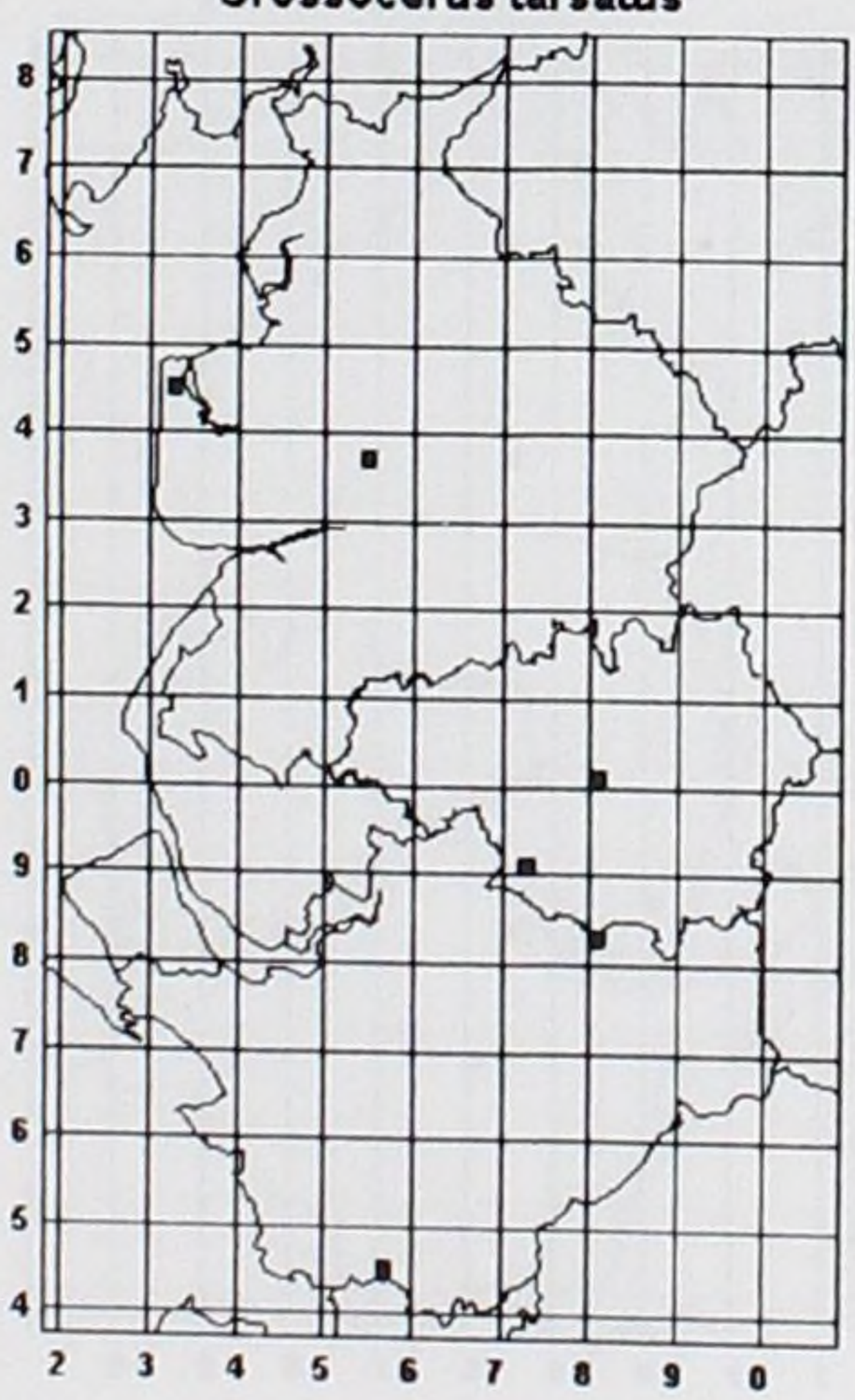
14 **Crossocerus pusillus**



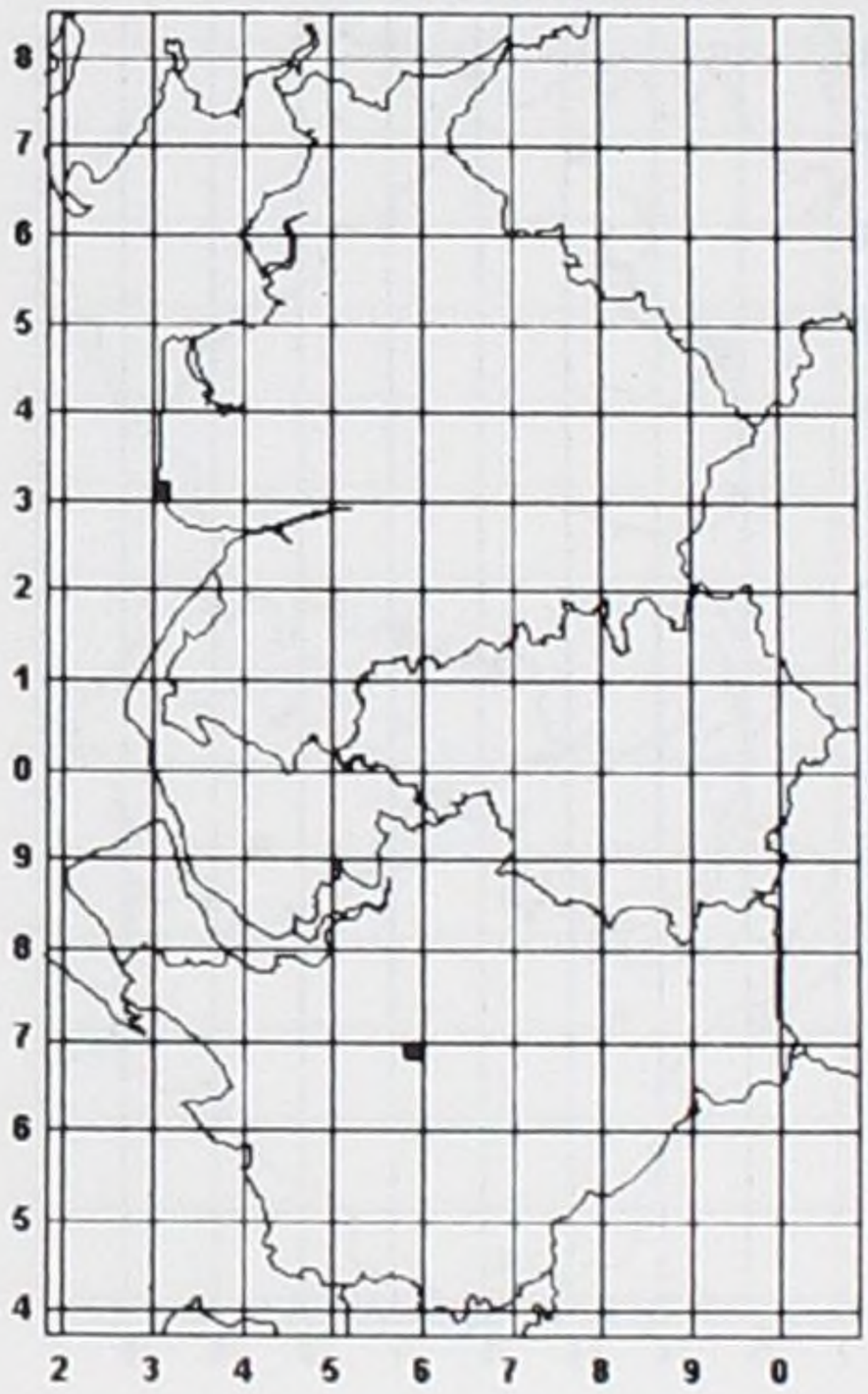
15 **Crossocerus 4-maculatus**



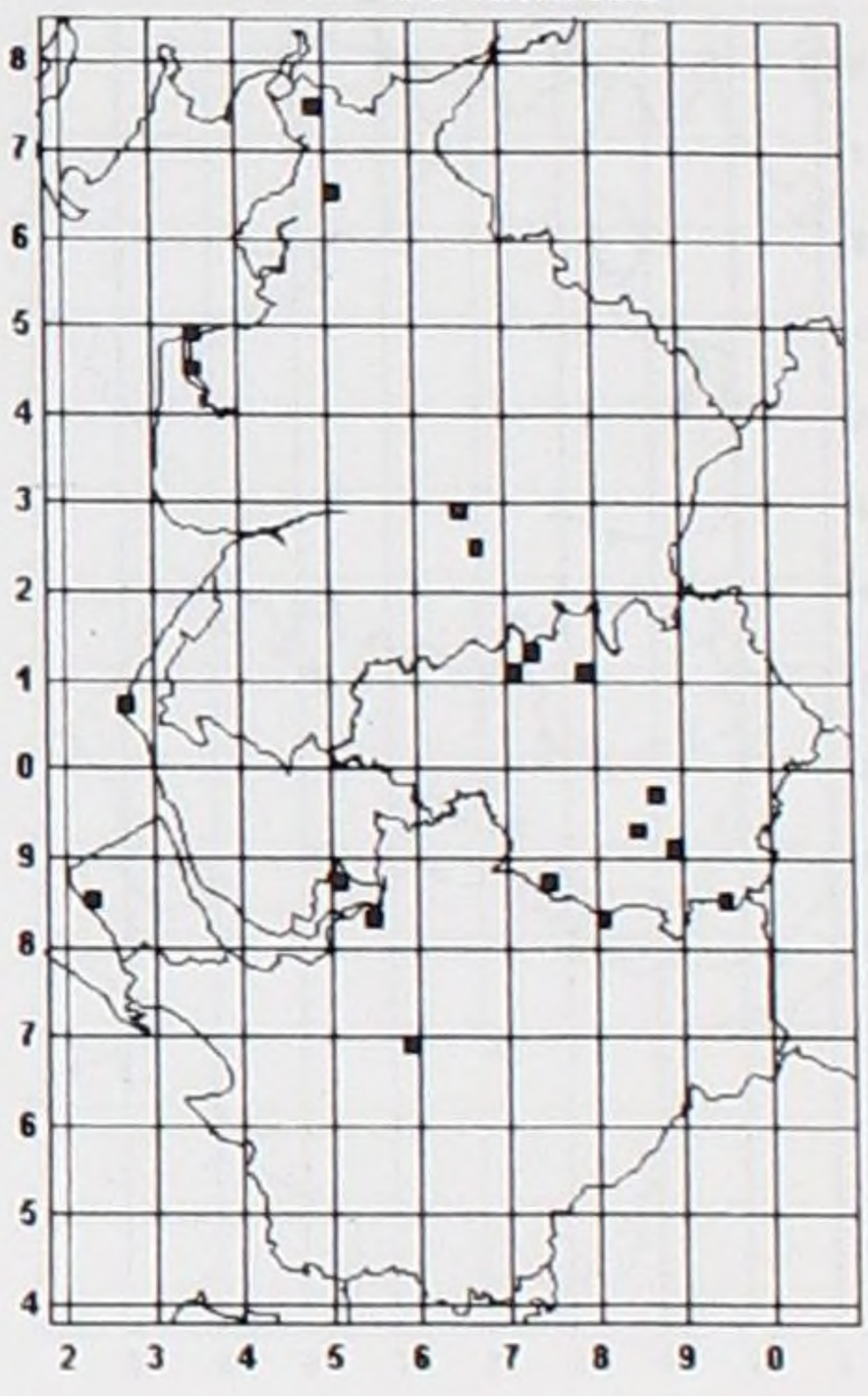
16 **Crossocerus tarsatus**



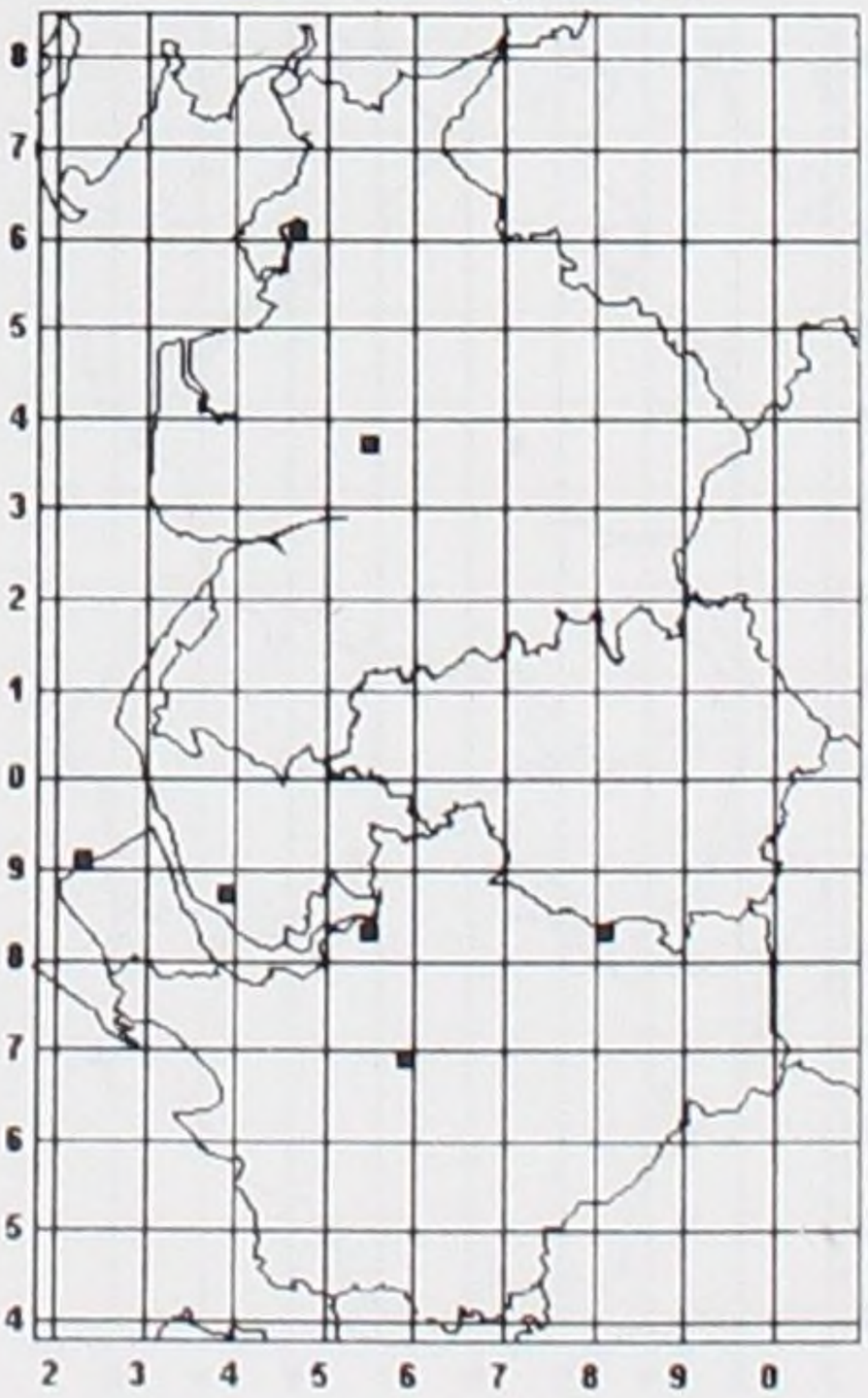
17 **Crossocerus wesmaeli**



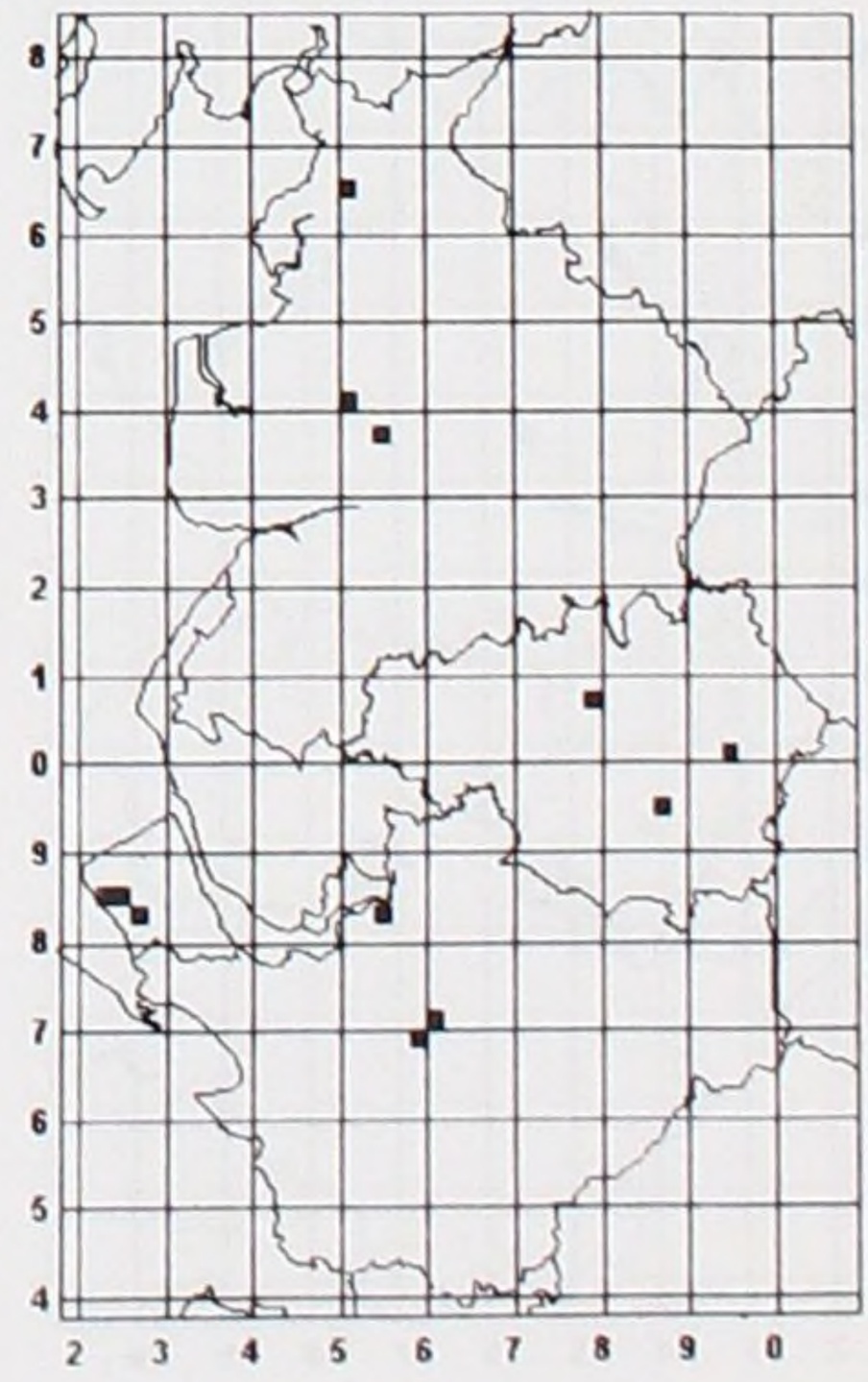
18 **Ectemnius cavifrons**



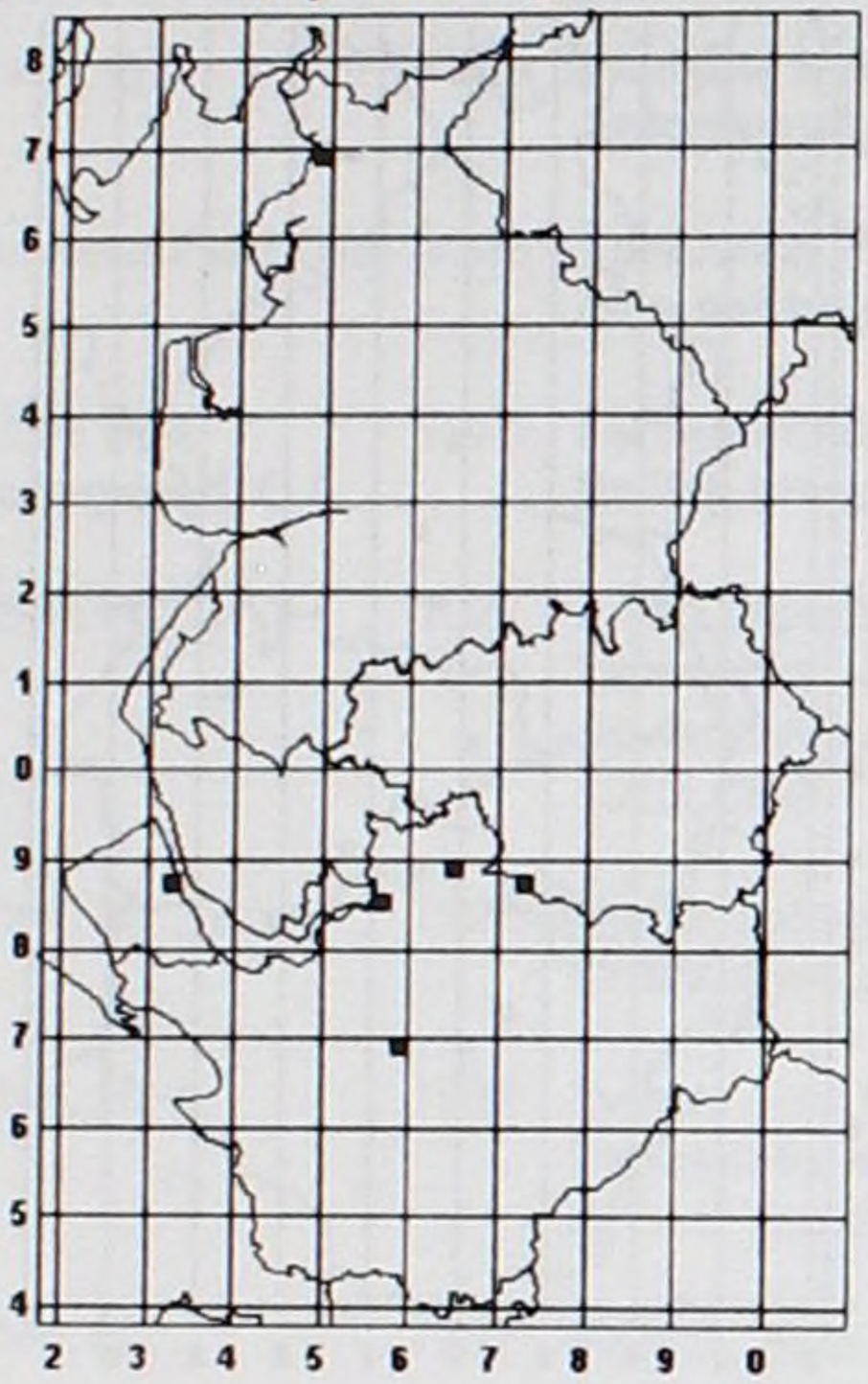
19 **Ectemnius cephalotes**



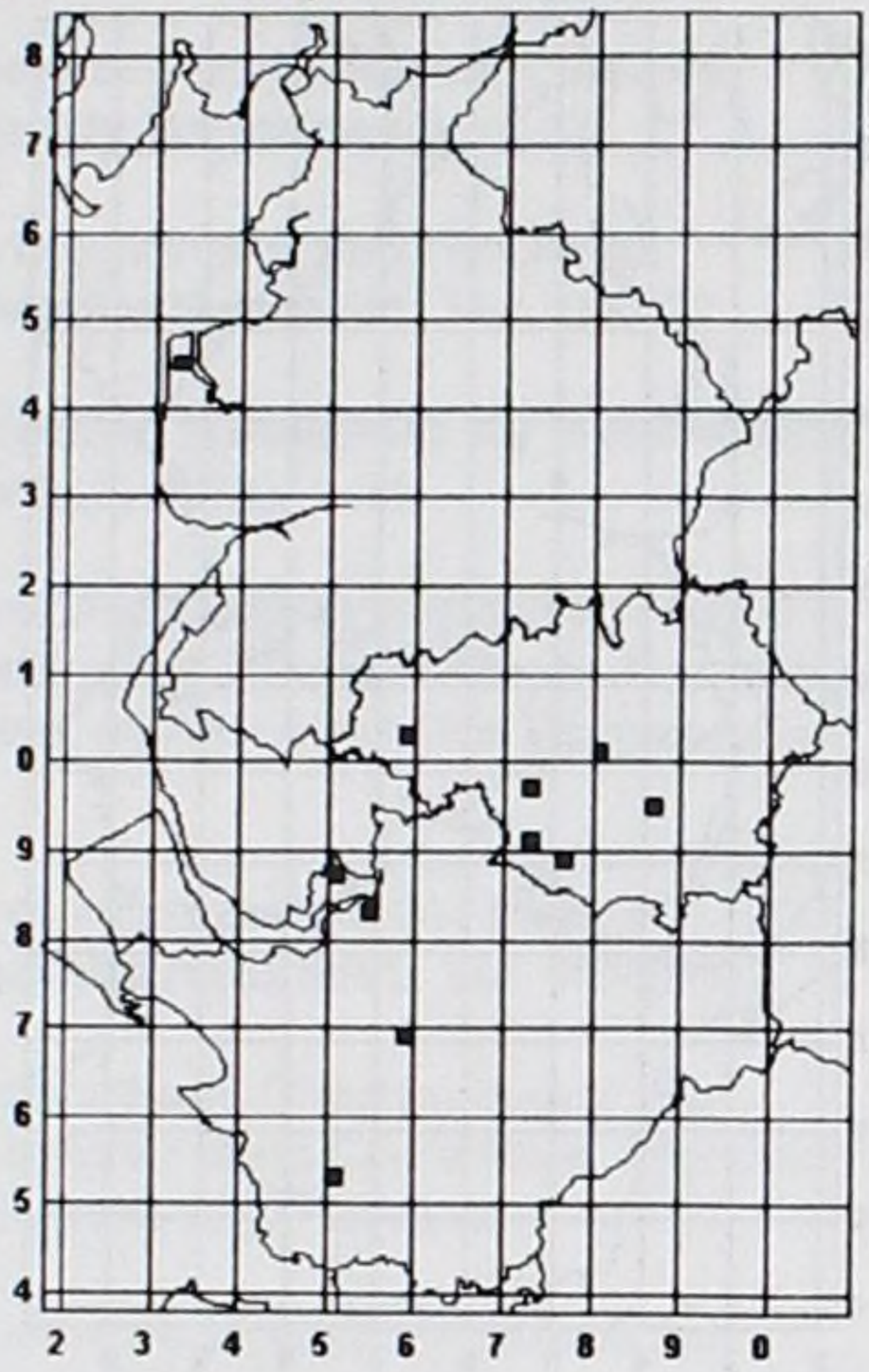
20 **Mellinus arvensis**



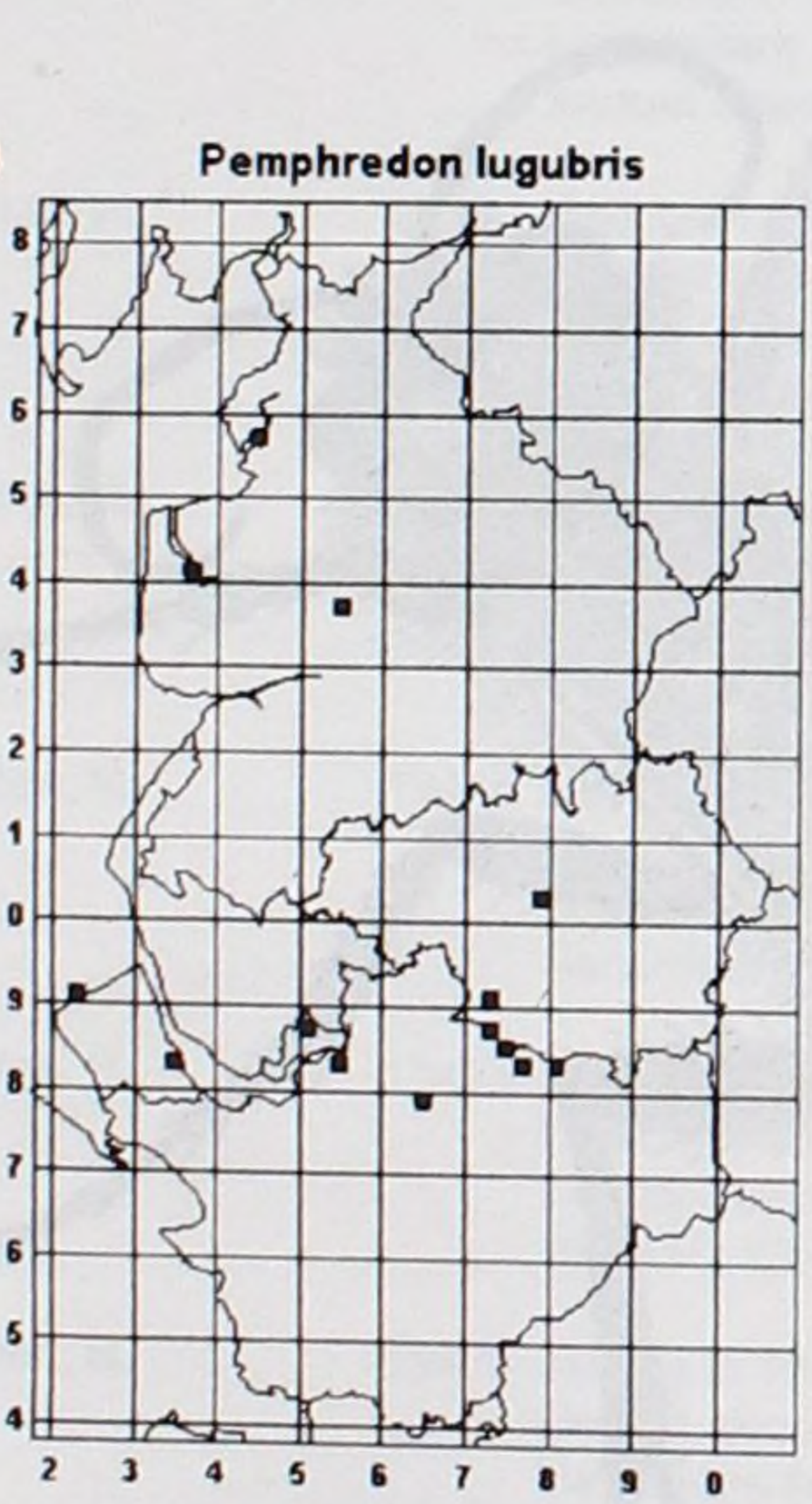
21 **Oxybelus uniglumis**



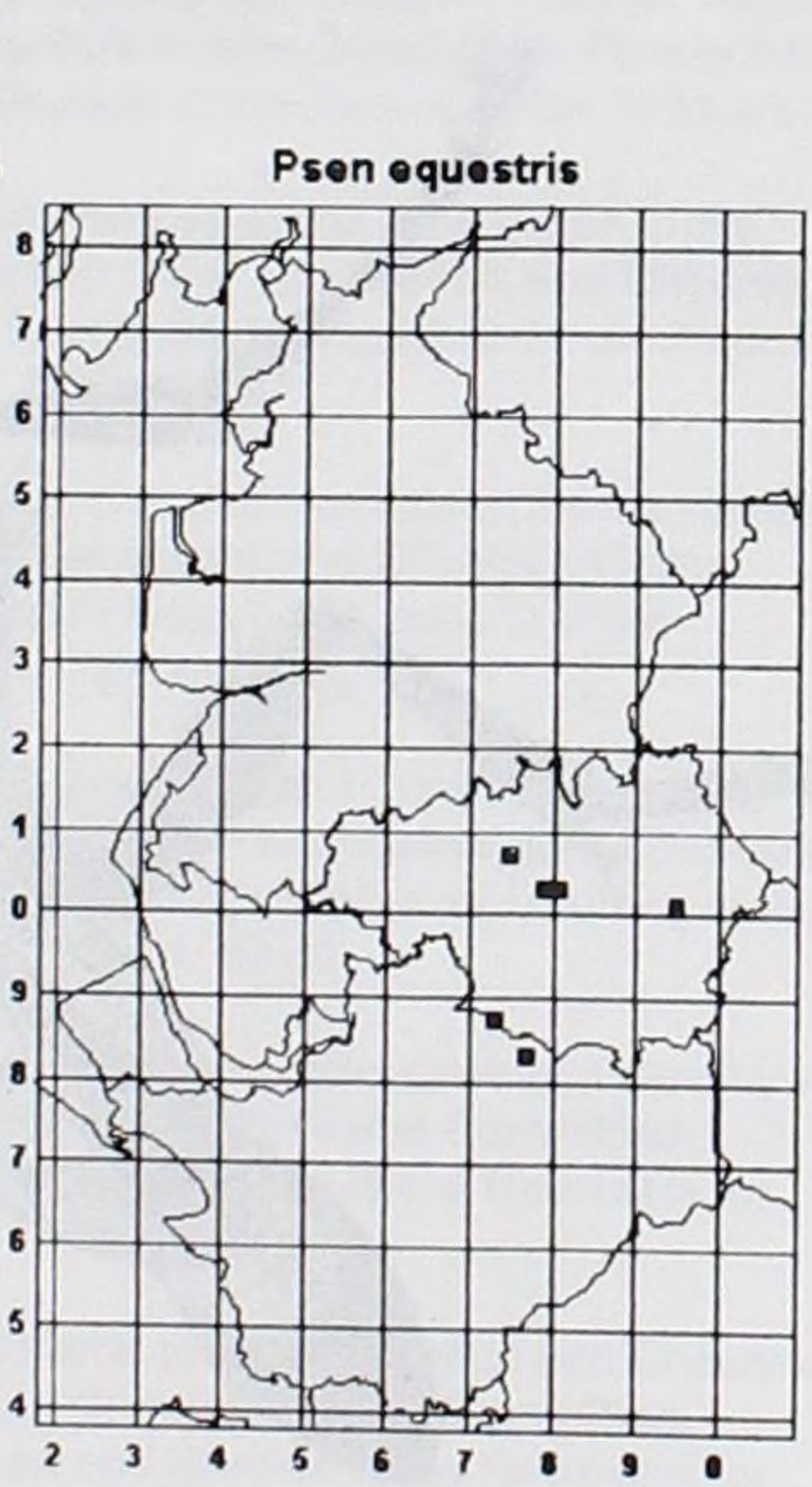
22 **Pemphredon inornatus**



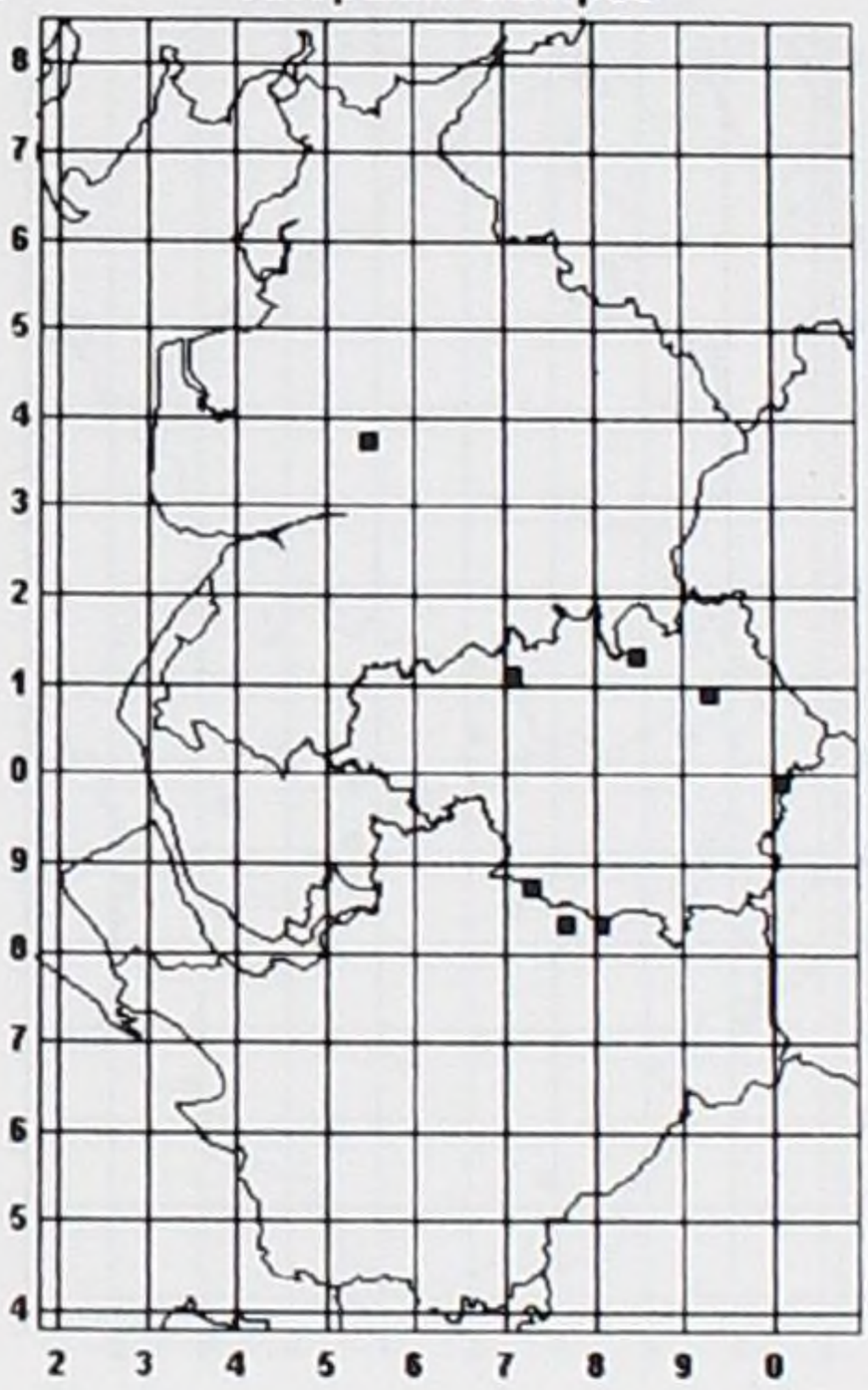
23 **Pemphredon lugubris**



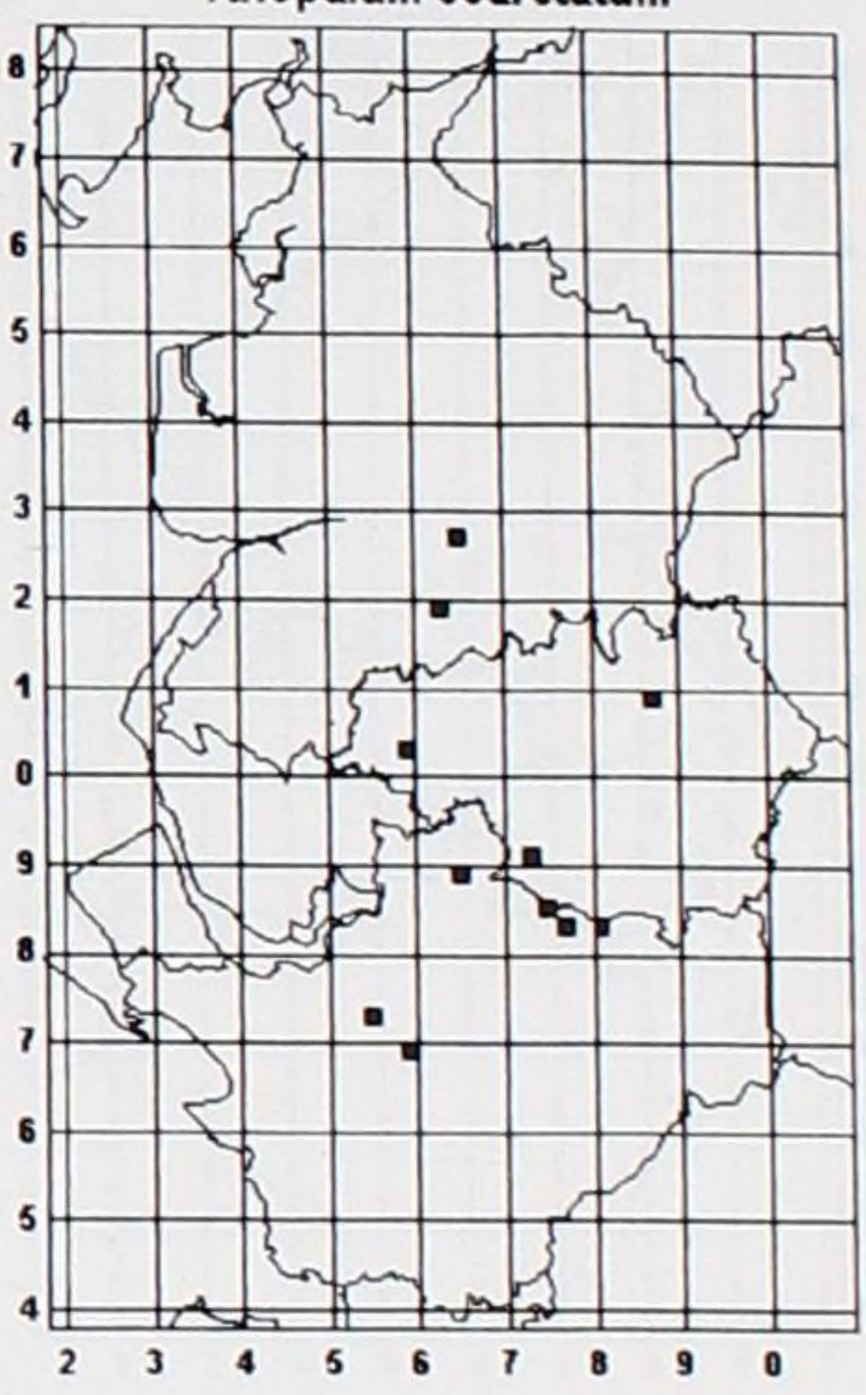
24 **Psen equestris**

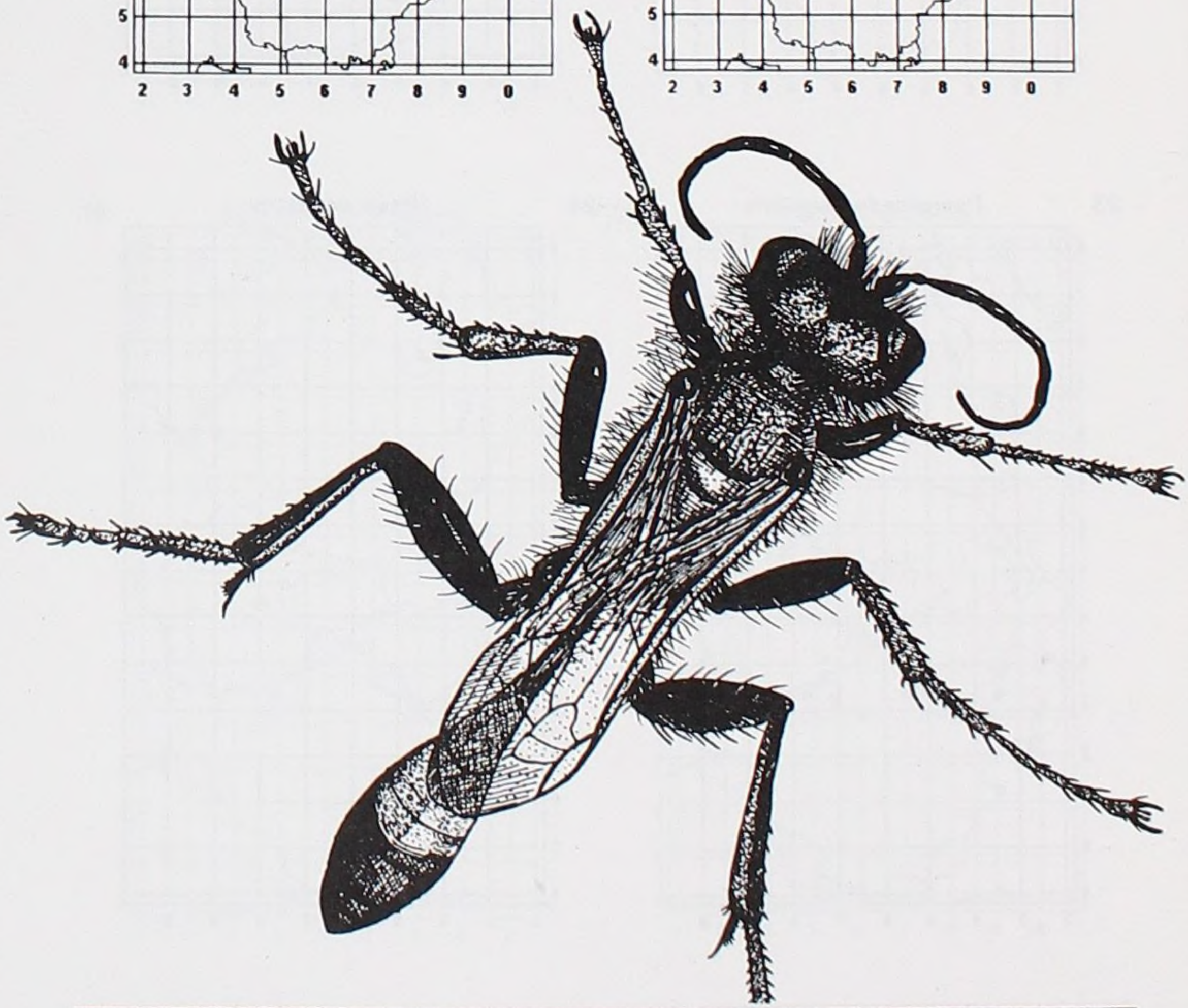


25 **Rhopalum clavipes**



26 **Rhopalum coarctatum**





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UPDATE ON BATS IN THE CHORLEY AREA

Angela Graham

(Bat Warden for English Nature; Chair, South Lancs. Bat Group)

Prescott (1993) reported the probable sighting, in Chorley, of the first recorded Serotine bat (*Eptesicus serotinus*) in the area covered by the South Lancashire Bat Group. (The group covers approximately an area from Manchester to Burnley and Wigan to Oldham).

The bat was seen clearly and its ultrasound calls heard well on a Skye SBR 2100 bat detector, in August 1992.

Since then we have seen or heard other bats which may have been Serotines but , whilst I was reasonably certain about our identification of the first bat, within the obvious limitations of a brief sighting backed up only by ultrasound detector, I can not say with any confidence that the record has been repeated since.

A preliminary study undertaken with the help of Chorley and District Natural History Society, in June 1993, failed to locate a roost. A more thorough survey is required, and we shall continue to monitor the site.

Chorley has continued to be an interesting area for the South Lancs. Bat Group. In March 1994 the first Natterers bat (*Myotis nattereri*) was found in our area, roosting in Brinscall Woods, which lie between Chorley and Blackburn. The presence of old bat droppings at the roost site when it was visited in 1992 indicate that it has been used for at least 2 years and probably much longer.

In the Bat Conservation Trust's 'Action Plan for the Conservation of Bats in the UK', produced in 1993, the UK Natterers population has been identified potentially as being of international importance. In England the Natterers bat is described as being widespread; vulnerable, but fairly common. However, previously we had been unable to locate any Natterers bats in our area, even with the help of ultrasonic detectors.

In comparison, the report describes the Serotine bat as being on the edge of its range in the UK, vulnerable but relatively common in the South. It may be extending its range.

The Bat Conservation Trust recommend that the bat conservation effort in the UK be concentrated on those species that are either on the edge of their range or that have internationally important populations. For both Serotines and Natterers it is important to try to find buildings used as roosts and then give accurate information to roost owners to allay any fears that they may have, so they will allow their bats to stay. Also, in conjunction with English Nature, we need to advise them on how to undertake any work planned to the building in a bat-friendly way. Likewise, both species need their habitat requirements investigating.

It is thought that Serotines may be heavily reliant on pasture in the autumn. This may be of significance in Chorley, as pasture land seems to be being lost increasingly to housing developments near the Birkacre site where we believe we have encountered the species.

Other species of bat on the edge of their range in Britain, that we house found or are likely to find in the Chorley/South Lancs. area are the Noctule (*Nyctalus noctula*), Leislers (*N. leisleri*), Whiskered (*Myotis mystacinus*) and Brandts (*M. brandtii*). Injured specimens of

Noctule and Whiskered have been found in the South Lancashire area and we have detector records for them both at Birkacre, though any bat identified as Whiskered from detector sounds alone may be Brandts, as the two species are very hard to distinguish from each other. To date we have detector records for Leislers only in the very south of our area at Dunham Massey Park. In mentioning detector records I must re-emphasise the difficulty often involved in identifying bats to species level from detector sounds only.

For further information on the status of, and conservation recommendations for, bats in the UK please consult :

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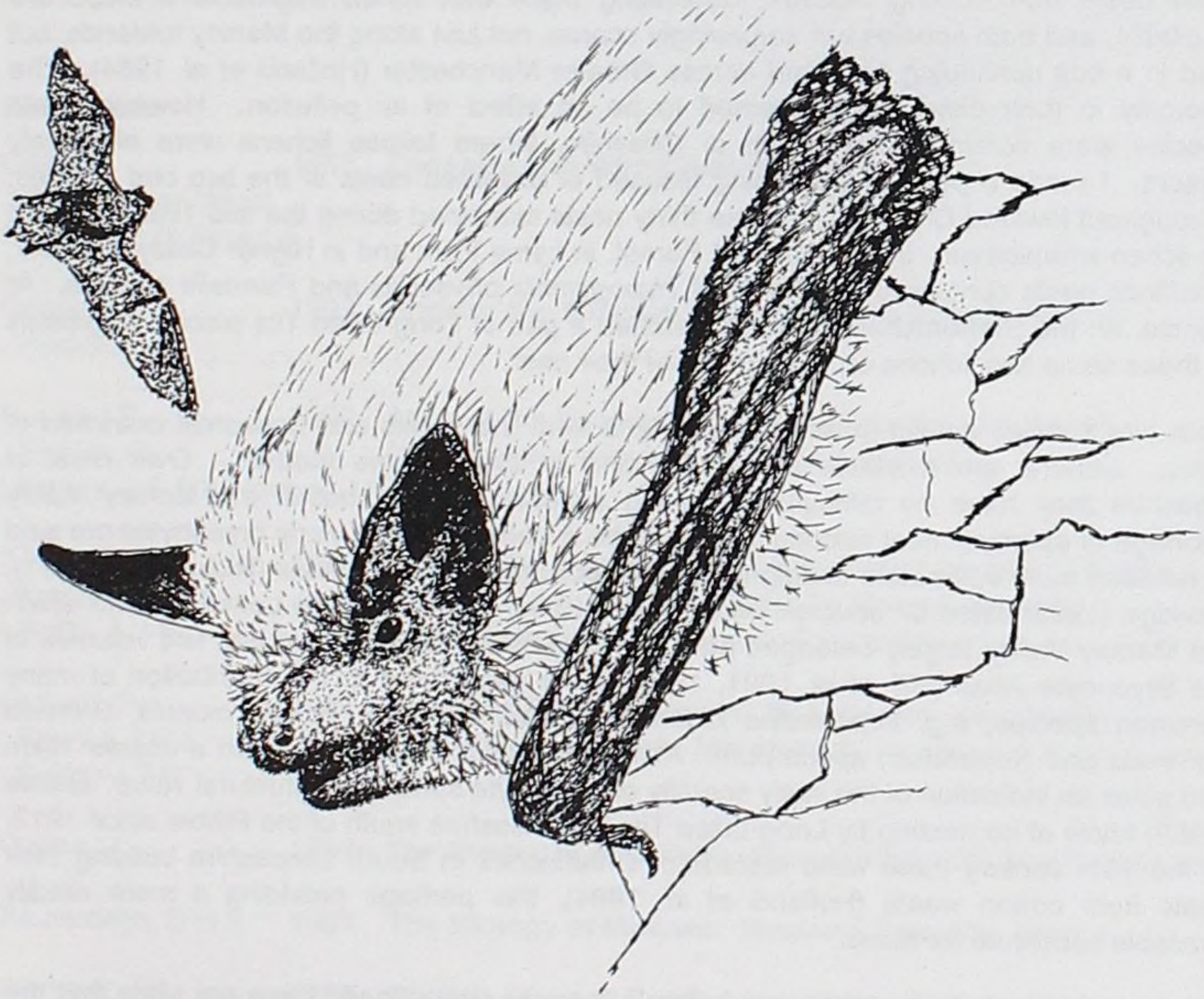

AN INDIRECT EFFECT OF AIR POLLUTION IN LIMITING BIRD DISTRIBUTION

Jonathan Guest

47 Marlston Avenue, Chester, Cheshire CH4 8HE

Any newcomer to bird-watching soon learns that Chaffinches (*Fringilla coelebs*) and Long-tailed Tits (*Aegithalos caudatus*) build their nests in part from lichens. Textbooks tell them so. Hollom (1952) states that the Chaffinch's nest is 'decorated externally with lichens fastened together by spider's webs'. Campbell and Ferguson-Lees (1972) describe the nest of the Long-tailed Tit as 'covered with grey lichen', and Cramp and Perrins (1993) state that it is 'covered on outside with camouflaging greyish lichen'. Lichenologists, on the other hand, are aware that in industrial areas of Britain, despite recent improvements in air quality, foliose lichens, structurally useful to the birds, remain scarce or absent.

In preparing the text for 'A Breeding Bird Atlas of Cheshire and Wirral', I was puzzled for some time by the scarcity of Chaffinches in the Mersey Valley eastward from Ellesmere Port. I realised why when the map for the Long-tailed Tit became available. Both species build nests from forking mosses, decorating them with lichen fragments if these are available, and both species are surprisingly scarce, not just along the Mersey lowlands, but also in a belt continuing eastward across Greater Manchester (Holland *et al.* 1984). The anomaly in their distributions seemed to be an effect of air pollution. However, both species were common over much of Cheshire, where foliose lichens were effectively absent. I made a point of examining disused or predated nests of the two bird species. Throughout lowland Cheshire, in some thirty nests examined during the mid-1980s, I found no lichen whatsoever. In Macclesfield Forest, in Lyme Park and in Higher Disley however, Chaffinch nests contained fragments of *Hypogymnia physodes* and *Parmelia saxatilis*. At Wincle, on the Staffordshire border, I watched a pair of Long-tailed Tits placing fragments of these same two lichens on the outside of their nest.

Both bird species collect mosses and lichens from the trunks and horizontal branches of trees. Lichens are available in quantity only in the Pennine foothills. Over most of Cheshire they have no difficulty in finding suitable mosses, but in the Mersey Valley shortage of epiphytic nest material seems to be a limiting factor. Many bryophytes are said to be even more vulnerable to sulphur dioxide pollution that are lichens (Richardson. 1981). Savidge (1963) listed 67 species which had not been seen in South Lancashire (to which the Mersey Valley largely belonged prior to 1974) since 1900 and the first two volumes of the Bryophyte Atlas (Hill *et al.* 1991, 1992) show gaps there in the distribution of many common species, *e.g. Lophocolea bidentata, Pellia epiphylla, Tortula muralis, Grimmia pulvinata* and *Schistidium apocarpum*. Absence of such species on such a coarse 10km grid gives an indication of the likely scarcity of bryophyte species of structural value. Oakes (1953) know of no nesting by Long-tailed Tits in Lancashire south of the Ribble since 1912. In the 19th century there were records of Chaffinches in South Lancashire building their nests from cotton waste (Holland *et al.* 1984), this perhaps providing a more readily available substitute for moss.

Lichen and bryophyte floras are improving in the area and already there are signs that the birds are responding. Willows at the Wildfowl and Wetland Trust site at Martin Mere now have a rich lichen flora including such pollution-sensitive species as *Parmelia caperata*, *P. revoluta*, *P. subrudecta* and *Physcia aipolia*. The British Trust for Ornithology's Atlas showed Long-tailed Tits to have bred in some 17 Lancastrian 10 km squares south of the

Ribble between 1968 and 1972. In 1987 there were several reports of Long-tailed Tits in Runcorn, where the species has long been uncommon or absent (CAWOS, 1987), and in 1984 a pair nested at Pennington Flash, Leigh, for the first time on record (Wilson, 1985). Birds have since returned to the Mersey Valley around Sale (A. Davison pers. comm.). In 1990 I was shown a Long-tailed Tit nest at Rostherne Mere NNR by Steve and Gill Barber. This had various lichen species fastened on to its exterior including *Parmelia sulcata* and the first record of *P. revoluta* from the reserve.

Various questions arise. How widespread is the use of lichens by birds in lowland Britain? Why do they use lichens? If for camouflage, this certainly does not work where lichen growth is suppressed by pollution. One Chaffinch nest built in a fork of a Hawthorn bush at Higher Disley was conspicuously spotted with grey fragments collected from Oak or Ash trees nearby - very few lichens yet grow on Hawthorn locally. The nest was ripped out by a predator within two days. How complete will epiphytic lichen cover have to be before the use of lichens in successful nests becomes widespread? I have also found *Physica adscendens* built into a Long-tailed Tit nest in Derbyshire, and *Evernia prunastri* is said to be a favourite subject elsewhere. What other lichen species are used by birds?

One big part of the picture is missing. Which mosses are used by Long-tailed Tits and Chaffinches returning to the Mersey lowlands? Is a large-scale improvement in the bryophyte flora of that area now occurring?

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PRESUMED *SCUTIGERA COLEOPTERA* AT BLACKPOOL, LANCASHIRE

M Ainscough

At 10.45p.m. on 11 August 1994, whilst watching the television, Sandie McQueen alerted me to a far more eye-catching spectacle on the bare plaster wall to one side of the television. The wall had earlier been stripped of its wallpaper and about one metre above the floor on its now dry, smooth plaster surface was a large immobile arthropod. The animal's bulk and situation momentarily brought to mind an encounter over 15 years ago when in a urinal at the Mermaid 'pub' on the Isles of Scilly I first saw a sea-slater *Ligia oceanica* similarly positioned, though far more vulnerably so, on the ceramic wall. With a tall glass tumbler I approached the creature alongside the television for a better view and hopefully to capture it. Its apparent bulk was now seen to be due to the side span, 25 mm or so, of its 'myriapodal' legs. The total body length was judged to be the same but the paired extensions 'fore and aft' of antennae and hind-most legs approximately tripled its length. Its colour was pale but difficult to assess in the television light.

Having captured it in the glass tumbler, I was taking it back to my girlfriend for a better view when it suddenly scaled the smooth glass tumbler wall and fell to the coffee table where it disappeared under a pile of exercise books. When refound it fell to the carpet and nimbly sped off. I succeeded in recapturing it using a brown paper envelope into which it ran. Neither Sandie nor the centipede was as enthralled with the exercise as much as I , and the creature was promptly released outside the house. Additional points now noted were its long 'elbowed' legs and colour.

Although I have not yet been able to see a comprehensive work on the Chilipoda, the brief entry and illustration in M. Chinery 1986 Collins Guide to the Insects of Britain and Western Europe leave little doubt as to its having been *Scutigera coleoptera*. Compared with the illustration therein, the Blackpool individual seemed slightly more orange, less yellow-grey, and when resting on the wall, its antennae and more especially hind-most legs, were slightly more splayed. The tibial portion of its legs was possibly fractionally thicker. The thin, darker, median line along the dorsal surface was not noticed but this was perhaps due to its hyperactive state except when initially observed closed to the television glare.

S McQueen has lived in the house for about 5 years but has not previously seen the species. A close relative of hers had recently been staying at an army camp on Aldershot, Hampshire and possibly conveyed it back unknowingly; alternatively the house at Seathwaite Avenue, O.S. ref. SD342342 is but a few hundred metres away from the M55 and slightly closer to a thin scatter of industrial premises and shops.

Steve Garland advises me of a recent record of *S. coleoptera* in the Merseyside area but I should be interested to know of its occurrence elsewhere in the North West.

TRANSLOCATION OF ISLE OF MAN CABBAGE AT BLUNDELLSANDS AND CROSBY, MERSEYSIDE.

P. H. Smith

Introduction

In recent years, the endemic Isle of Man Cabbage *Coincya monensis s.sp. monensis* has been known from only three localities in South Lancashire (Vice County 59). One of these was an unmade sandy footpath at 60m in length at Park Drive, Blundellsands (Grid Reference SJ 302 999). In June 1989 the colony here consisted of 35 plants in flower, together with many non-flowering rosettes (Smith & Hall 1991).

Unfortunately, in the summer of 1992, it became known that the land-owners, the residents association of the adjacent block of flats, intended to strip and turf over the footpath, thereby eliminating the habitat for *Coincya*. Negotiations with the owners resulted in a delay in these works until the end of July 1992 so that a rescue operation could take place (Rooney 1992). This included three main approaches. First, a large number of seed pods were collected from second-year and older plants for storage and propagation at the University of Liverpool Botanical Gardens at Ness, Wirral. Secondly, top-soil was stripped from the site and transferred to a prepared area within the adjacent Blundellsands Key Park. Finally, it was also decided to attempt translocation of young plants to nearby sand dunes sites. This paper records the results of this latter operation as monitored in the summer of 1994.

Methods

Choice of translocation sites

Six sites were identified as apparently suitable for translocation as near as possible to the Park Drive locality. Three were at Hall Road (SD 300 006) and three at Crosby Marine Park (SJ 305 993). All are on the leeward slopes of the sand dunes close to the sea and are characterised by an open sward subject to an intermittent rain of blown sand from the west. These conditions are similar to those described by Smith & Hall (1991) as characteristic of the South Lancashire colonies of *C. monensis* which appears to act as a ruderal species here.

Translocation

All works were completed on 22 and 23 July 1992 by Sefton Ranger Service. The plants were heavily watered before being dug up with as much as possible of the tap-root and surrounding soil being kept intact. About 385 first-year plants were removed, 270 being transferred to Hall Road and 115 to Crosby. Transported in fish boxes, the plants were inserted at about 15 cm intervals and watered in thoroughly (Rooney 1992).

Monitoring

The introduction sites were recorded photographically at the time of translocation. In June and July 1994, all sites were relocated and the number of surviving *Coincya* plants counted. In addition, NVC methodology was used to characterise the vegetation at each site. A 2m x 2m quadrat was put down on a representative sward containing *Coincya*

plants, the relative cover of all vascular species present being recorded on the Domin Scale.

Results

Survival of translocated plants.

The numbers of *Coincya* plants found at the 6 translocation sites are shown in Table 1. A total of only 29 plants was counted, compared with about 385 translocated two years earlier, representing an overall survival of 7.5%. Survival of plants at Crosby averaged 13.9% compared with 5.2% at Hall Road. All the plants found were probably three year old specimens from 30 cm to 100 cm diameter, bearing several inflorescences with many flowers and seed-pods. As *Coincya* is a biennial or short-lived perennial (Stace 1991), it is possible that more of the one year old transplants could have survived to 1993 when no monitoring took place. However, no young plants were found in 1994.

Vegetation of translocation sites.

The NVC quadrat data are shown in Table 2. A total of 22 vascular plant associates with *C.m.monensis* was recorded. Hot, dry conditions prior to the sampling may well mean that several other species, particularly dune annuals, were missed. The most constant associates are *Hypochaeris radicata, Crepis capillaris, Elytrigia juncea, Anthyllis vulneraria, Elymus arenaria* and *Taraxacum* Sect. *Ruderalia*. *Festuca rubra* is confined to the three Hall Road sites, while *Elytrigia juncea* has a much higher frequency at the Crosby sites. A high percentage of bare ground was recorded at all sites, except no. 3 (Hall Road) where mosses covered much of the sand surface. Slopes were gentle in all cases and mean sward height ranged from 15 cm to 30 cm.

Discussion

Although the vegetation is ostensibly similar in the two main areas, these were mapped as different communities by Edmondson *et al* (1988/9). The Hall Road sites lie within a zone described as SD9, *Ammophila arenaria-Ononis repens* dune, though the authors point out that the community just north of Hall Road is unusual in having *A. arenaria* largely replaced by *Elymus arenarius*. In contrast, the Crosby translocation sites are mapped as SD7a, *Elymus arenarius* dune, *Elytrigia juncea* sub-community, which represents an earlier stage in sand-dune succession.

These differences seem to be borne out by the quadrat data (Table 2), especially in the higher frequency of *E. juncea* in samples 4-6 (Crosby) and of *A. arenaria* and *L. arenarius* in samples 1-3 (Hall Road).

The translocated *Coincya* seems to have survived better at Crosby (Table 1), perhaps reflecting its preference for a more disturbed, earlier stage in sand-dune succession with much bare ground (Smith & Hall 1991). However, survival has been poor at all sites and it is a matter for concern that no first year plants were detected during the monitoring exercise. Hopefully, the few large plants still present will produce enough viable seed to sustain the new populations. Further monitoring in 1995 will be necessary to confirm this.

Table 1. Survival of Isle of Man Cabbage plants at six introduction sites.

Site & area		No of plants introduced in 1992	No of plants 1994	% survival
Hall Road	1	60	1	1.67
	2	90	6	6.67
	3	120	7	5.83
Crosby	4	50	4	8.00
	5	35	6	17.14
	6	30	6	20.00
TOTAL		385	30	7.50

Table 2. Domin Scale Values For Quadrats At Translocation Sites

Species	Site 1	2	3	4	5	6
Agrostis capillaris						2
A. stolonifera				2		
Ammophila arenaria	3	3				
Anthyllis vulneraria	3	4	4			3
Carex arenaria						4
Cirsium arvense				3		
Coincya m. monensis	1	2	4	3	3	3
Crepis capillaris	2	1		2	1	2
Elytrigia juncea		2	3	7	5	5
Equisetum arvense		2			3	
Festuca rubra	8	6	5			
Hypochaeris radicata	4	2	2	3	2	4
Elymus arenarius		4	3	1		1
Lolium perenne						2
Medicago lupulina				2		
Phleum arenarium		2				
Plantago coronopus	1					1
P. lanceolata			3	1		
Poa pratensis	2	2		2		
Rumex acetosella						2
Sedum acre	3					
Taraxacum sect. Ruderalia	2			3	3	2
Tragopogon pratensis		1				
Bare ground	6	7	4	7	8	7
Sward av. height (cm)	30	20	15	20	15	18
Slope and aspect	5°E	5°E	2°E	3°E	2°E	2°E

Samples 1-3 Hall Road, Blundellsands; 4-6 Crosby Marine Park.

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BEETLE DIVERSITY AND LAND USE IN THE ECCLES AREA OF GREATER MANCHESTER

C Terrell-Neild

Dept of Life Sciences, The Nottingham Trent University, Clifton Lane,

Nottingham NG11 8NS

Summary

The effects of current and past land use on the beetles of the Eccles area of Greater Manchester are described, similarity analyses indicating that the fauna divides into woodland and non-woodland groups. Species richness is reduced with increasing penetration into the town, being affected by degree of urbanisation, amount of disturbance, geology, soil wetness and ground cover. The family Staphylinidae is more adversely affected than the Carabidae, within which 'culture-favoured' species predominate in the town and its surroundings. Many urban species are those expected in the agricultural environment prior to town expansion.

Introduction

This paper investigates how urbanisation affects the distribution and abundance of Coleoptera, especially the families Carabidae or ground beetles, and Staphylinidae, or rove beetles. These families were chosen because there is considerable literature on their ecology and distribution, particularly the Carabidae (*e.g.* Thiele, 1977, Erwin *et al*, 1979, Stork, 1990.

Davis (1978) and Kegel (1990) examined carabid distribution in relation to urbanisation, as did Czechowski (1981). Working in London, Davis found that older urban sites had poorer carabid faunas. In Berlin, Kegel observed a similar reduction in diversity, small carabids predominating in urban areas. Earlier, Czechowski noted that urban areas of Warsaw had a lower proportion of carnivorous species than suburban sites.

Work on the Staphylinidae has been more limited. Lazenby (1983) collected the family on demolition sites in Sheffield, and Nield (1976) commented on soil type as a factor in the distribution of *Staphylinus olens* (Mull.). Shaefer (1982) found that *Lesteva longelytra* (Goeze) and *Philonthus decorus* (Grav.) were frequent in urban areas of Kiel, northern Germany where arthropod diversity was generally low.

The aim of the present work is to see if a similar decline in beetle species richness occurs in the margins of Manchester, and to suggest some explanations for the observed distribution patterns.

Sampling Area And Methods

The study area was based on Eccles, in Greater Manchester. Fig. 1 shows the 34 sampling sites and the current land uses of the area (the sites are described in Appendix I). The Eccles area presents contrasting geology and land use, and is well documented. Lumb (1958) described the history of the town, and Hardman (1961) detailed the origin and

Figure 1

Land use in the Eccles area

W/WE = woodland centre & edge
F = fields
All = allotments, garden sites
EG = town edge
WC = west town centre
SC = south town centre
NC = north town centre

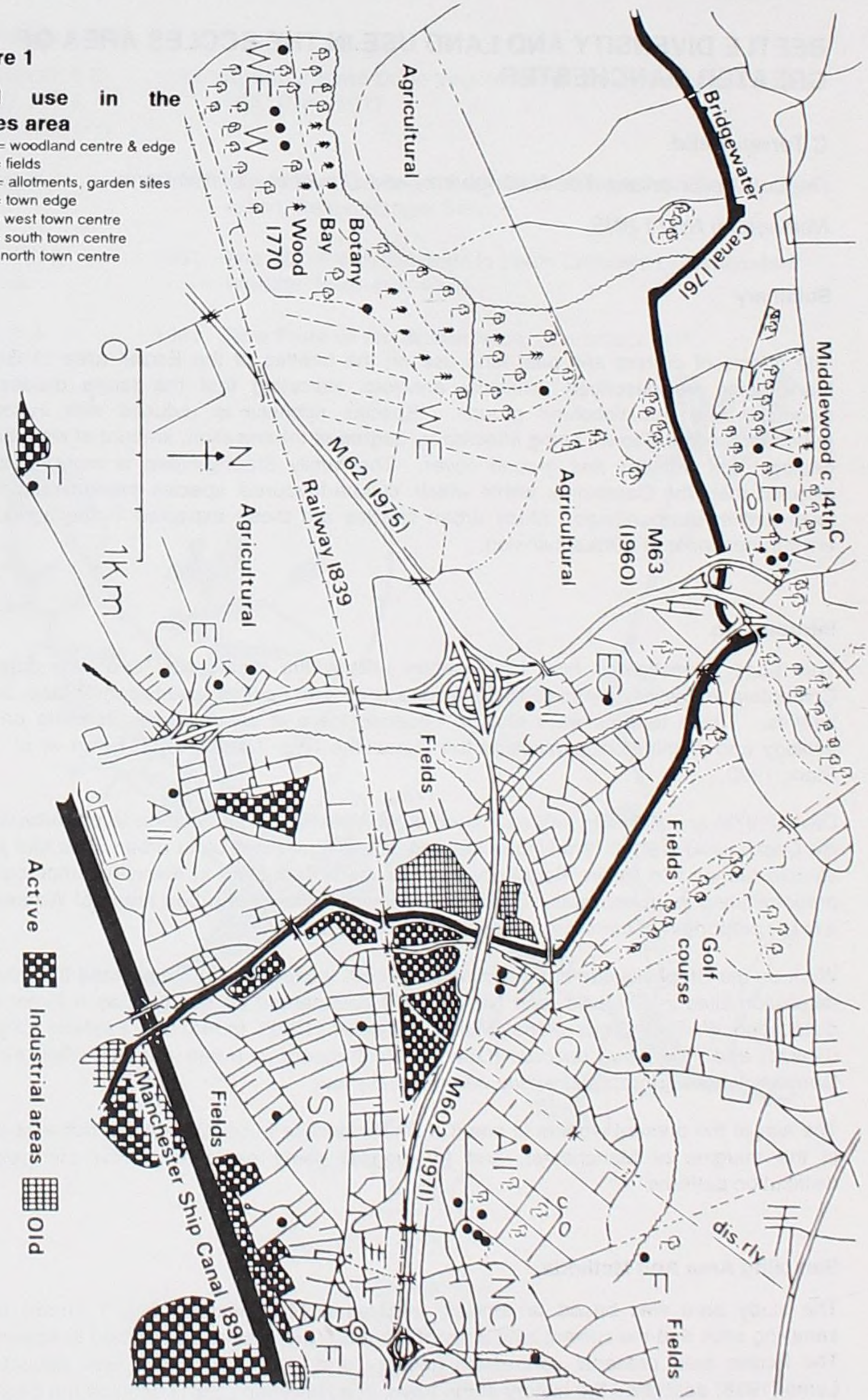
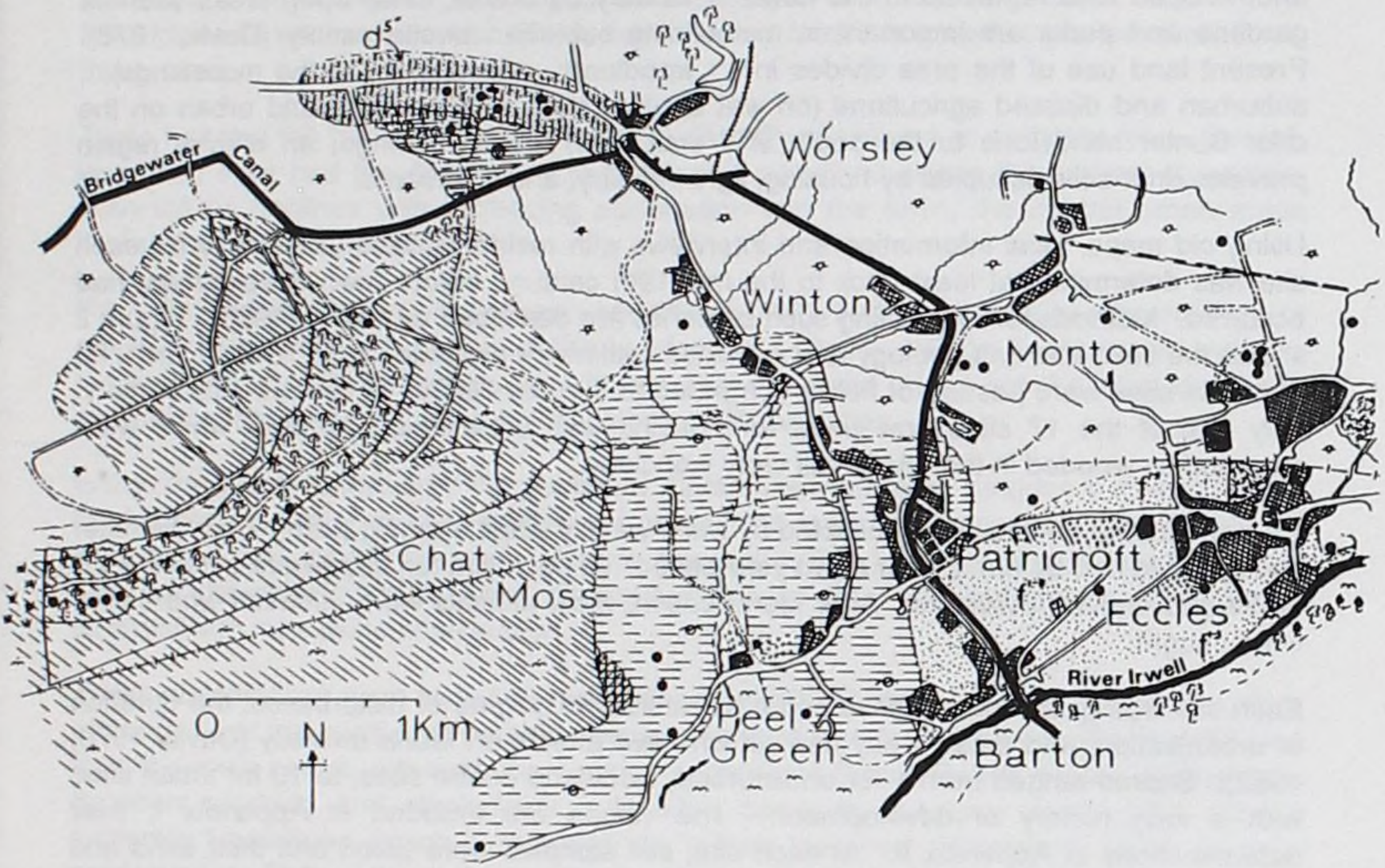


Figure 2

Solid & drift geology of Eccles area, with 1845 town and industrial development overlaid



Peat

Coal measures

Boulder clay

Sand and gravel

Alluvium

Bunter sandstone

Glacial flood gravels

Laminated clay

Orchards

Housing / Industry

development of the mossland areas. Industrial origins were examined by Johnson (1967) and others.

Settlement dates from Saxon times, isolated villages fusing in the 19th century as the population increased. Town expansion was constricted by the unstable mosslands to the west and the River Irwell to the south, so infilling was common and by the 1950s little undeveloped land remained in the town. This may be critical, since open areas such as gardens and parks are important in maintaining suburban beetle variety (Davis, 1978). Present land use of the area divides into : woodland; agricultural (on the mosslands); suburban and disused agricultural (on wet boulder clays to the north), and urban on the drier Bunter sandstone to the south and east. On the town fringe, an alluvial region provides drier soils occupied by housing, light industry, and allotments.

Using old maps, local information and interviews with residents, land use history for each site was determined at least back to the mid 19th century, before town development had occurred. Methods for conducting such searches are described by Sheail (1980). Figure 2 shows the solid and drift geology and indicates settlement patterns of the 1840s. Then, 22 of the 34 sites were pasture or fields, compared to 5 in the 1980s. In the mid 19th century, only one of the 17 sites now used for housing was urbanised. All sites which were recorded as wooded in the 1840s still carry woodland.

Ground running beetles were collected by twice-weekly pitfall trapping (using 7 cm diameter plastic cups) and by hand, over a two year period. At each site ten traps were set in a 4 x 1 metre grid and left overnight. After identification, most animals were released where they were caught.

Each site was given a descriptive score by ranking its degree of disturbance, the duration of urbanisation, and present-day use, which have effects on fauna diversity (Davis, 1979, 1982). Scores ranged from 1 for undisturbed, woodland centre sites, to 10 for urban sites with a long history of development. The values are included in Appendix I, their determinations in Appendix II. At each site, soil samples were taken and their sand and clay content determined by hydrometry. Measurements were made of the cover of ground vegetation, litter and solid materials within a 12.5m radius, or to the nearest major barrier if this was closer. The distance of each site from the town centre (Eccles Cross) was determined from maps.

The beetle data was first analysed by application of techniques taken from numerical taxonomy (Sneath & Sokal, 1963). By this means Cook *et al* and Terrell-Nield (1985) analysed land snail distributions and cave invertebrate communities respectively.

Beetle distribution was examined by calculation of Chi-squared values, using presence/absence data for all possible pairs of sites, and a dendrogram of site similarities was constructed using nearest-neighbour clustering. Species diversities were calculated from pitfall data using an alpha diversity measure (Margalef 1951), rather than a more complex method such as Shannon-Wiener, because of the unequal efficiency of pitfall traps in catching different beetle species (Luff, 1975). Factors affecting the distribution of beetles were quantified by correlation and regression analysis.

Results

Altogether, 191 beetles species were collected in the survey. This included 58 species of Carabidae, 78 species of Staphylinidae, and 55 species from 19 other families, especially

the Cholevidae, Byrrhidae, Elateridae, and Curculionidae. A full species list is shown in Appendix 3.

The similarity dendrogram for all species (Fig 3) shows two major site clusters. One contains all the woodland sites, whether deciduous or coniferous, and one woodland edge site (at Botany Bay Wood), the other all the non-woodland sites. Within the second cluster, there is a strong sub-group, with highly similar sites, all of which are gardens, allotments or fields close to the town centre. Fields farther away from the town have a low similarity to this group.

Table 1 shows the total number and average diversity of species at each site type. Overall, woodland sites had the richest beetle fauna and woodland edges the highest diversities. Both values declines with increasing penetration into the town, the central urban areas having the lowest diversities.

Fig 4 shows the relationship between species diversity and length of site urbanisation - a result in agreement with data from the London area (Davis, 1978). Table 1 also includes family and subfamily diversities. It indicates that woodland edges are the most diverse in carabids, allotments having the highest staphylinid diversities.

Within the family Carabidae, the subfamily Carabinae was more prominent in woodlands, the Harpalinae better represented in and around the town. Only four out of 16 Carabinae were found throughout the town : *Nebria brevicollis* (Fab.), *Notiophilus biguttatus* (Fab.), *Loricera pilicornis* (Latreille), and *Carabus violaceus* (L). Staphylinid species richness declined with increasing urbanisation.

These observations were tested by regression analysis (Table 2). Neither the total number of species nor the number of carabid species changed significantly with increasing distance from the town centre, although the species richness of Staphylinidae did, as did the ratio between carabids and staphylinids. At sites closer to the town centre, the carabid subfamily Harpalinae, which is regarded as 'culture favoured' (Hammond, 1974) became predominant. Both of the major families became more diverse farther away from the town, particularly in arable and woodland regions.

Table 2 also shows the regression of species richness on the seven factors determined for each site. There were significantly less species at sites with a longer history of town development. Increasing solid cover (mainly paving materials) means decreasing species numbers, although greater vegetation cover was associated with more staphylinids and more beetle species overall. Leaf litter appeared to have little effect. The amount of sand in the topsoil affected staphylinids, although the relationship is questionable, since the oldest town areas are sandy. There were more carabid species at more disturbed sites. The multiple regression coefficients indicate a stronger relationship between site factors and staphylinid richness than with carabid richness.

Fig 5 shows the site similarities for Carabidae and Staphylinidae, each point on the nomogram indicating a significant site pair similarity. A diffuse pattern is shown by Carabidae, with a high degree of similarity within the town, extending to fields and allotments outside. There is also some similarity between woodland and non-woodland sites, involving yew and larch at Middlewood, the latter planted in the last 30 years on fields. Overall, 24% of the significant site pairs are within the designated site types, with, for example, 9/24 of the woodland pairs similar.

The Staphylinidae show a clearer pattern, with woodlands dissimilar to the town and fields and allotments showing slight similarity with woodland edges. 37% of the significant pairs

Figure 3

Cluster diagram of sites, based on chi-squared analysis of presence/ absence data for all Coleoptera

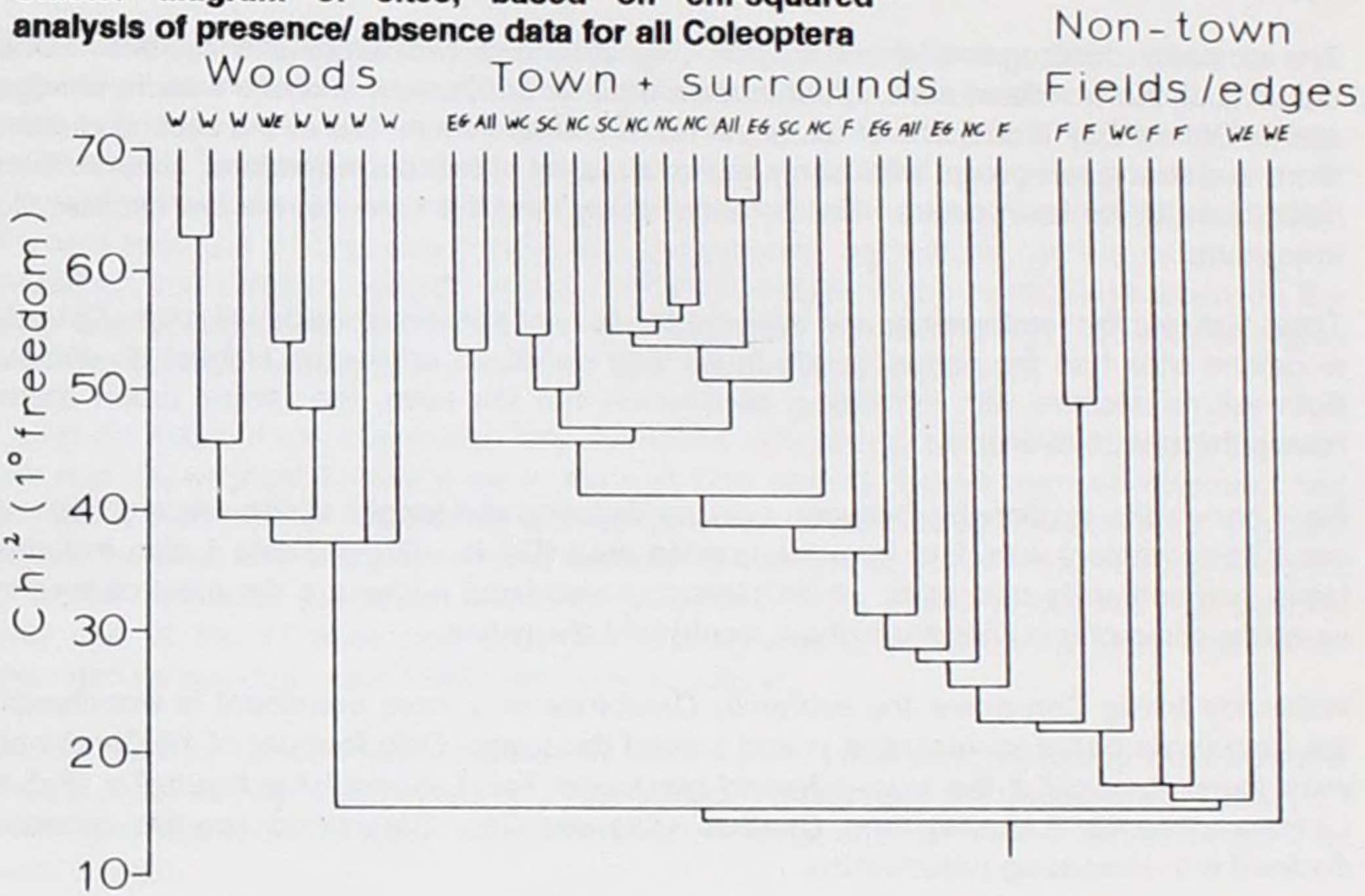
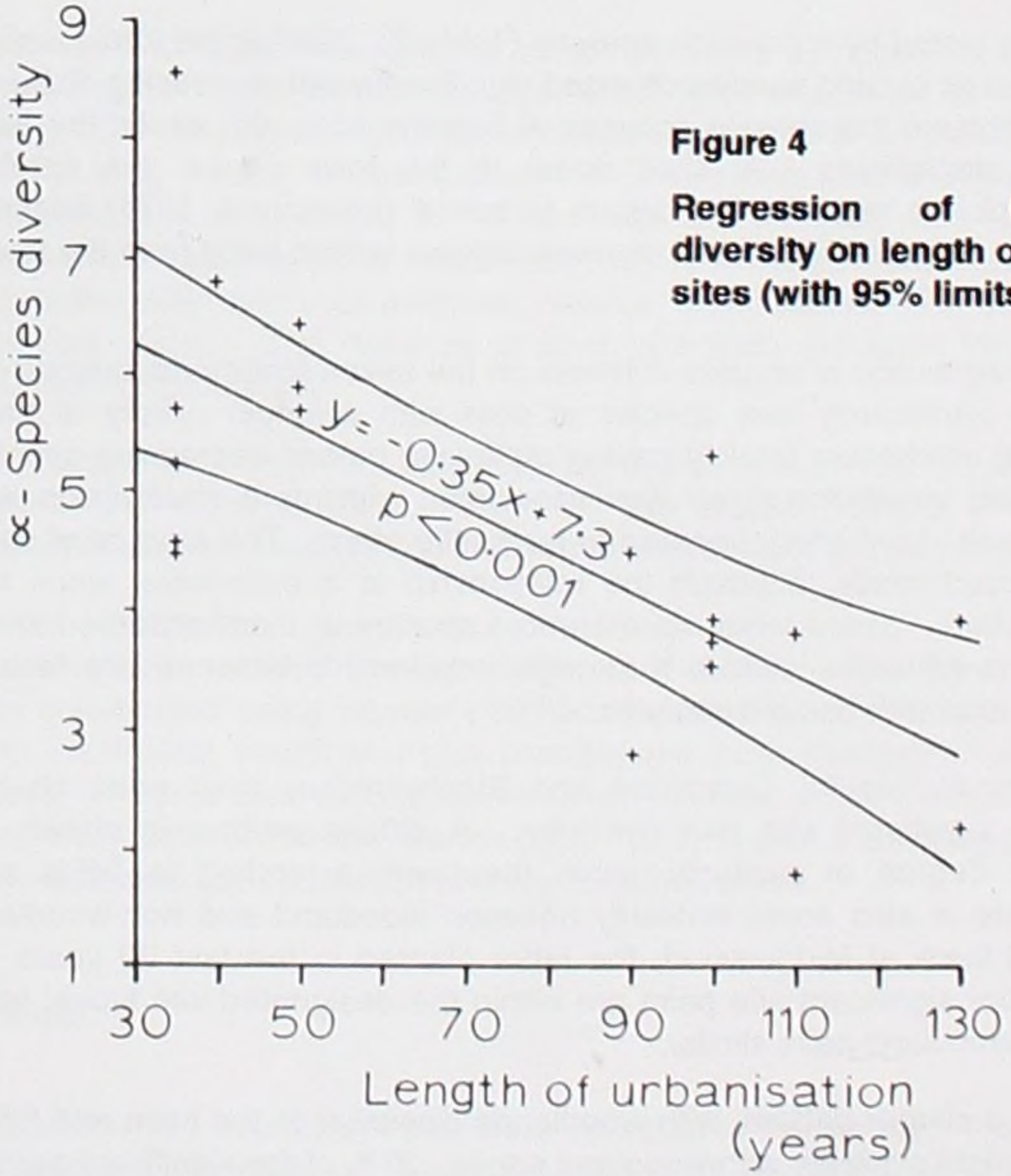


Figure 4

Regression of Coleoptera species diversity on length of urbanisation of town sites (with 95% limits)



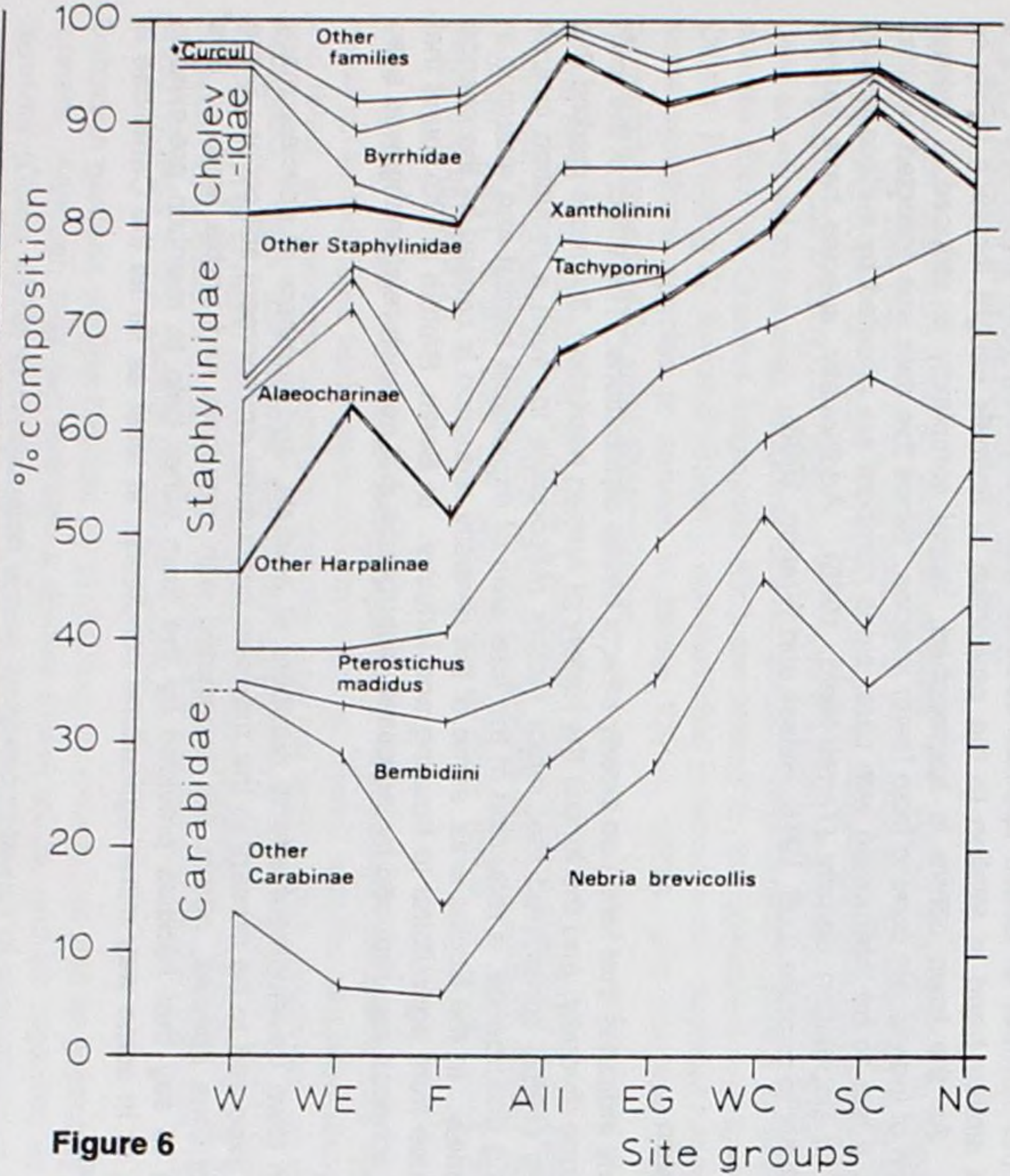


Figure 6

Relationship between site type and percentage abundance of major Coleoptera families. Some frequently trapped species are indicated separately

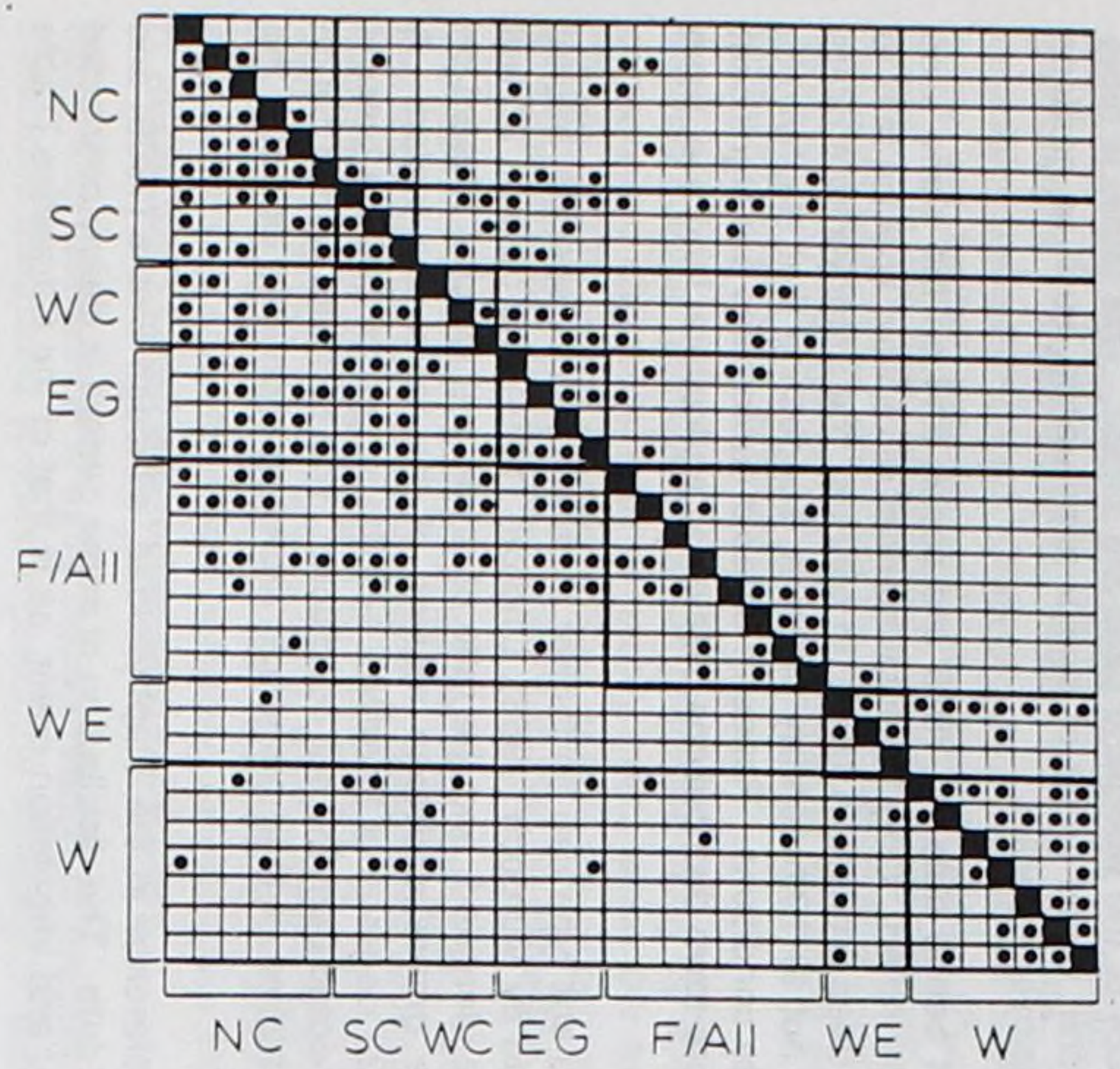


Figure 5

Similarity of sites in terms of Coleoptera species presence/ absence (● = p<0.01, chi-squared, 1 d. f. = 6.64) Lower half : Carabidae; Upper half : Staphylinidae

are within the site types, and 18/24 of the woodland pairs are similar. This family is more site-specific outside the town, within which areas of similar appearance, such as gardens north of the town centre have dissimilar species.

Table 3 presents regressions of beetle data on 1985 site codes and on the same sites whose use in 1845 could be determined. Only the total number of carabid species fails to relate to 1985 land use; neither does it relate in 1845. In contrast, the Staphylinidae relate closely to current land use, but not to 19th century patterns, suggesting that staphylinids are more affected by modern site conditions. Ratios of carabid subfamilies are significant for either time, suggesting that pre-town distributions, related to agricultural land use, have persisted.

Carabid distribution in relation to soil type can be further examined, since species' habitat preferences have been described by Murdoch (1963), Lindroth (1974) and others. 26 wet and 27 dry habitat species were identified, and the ratio of dry to wet species present on the boulder clay sites and the gravel/sandstone regions of the town was tested. A significant relationship ($t=3.24$, 22 degrees of freedom, $p<0.01$) suggests that the present distribution is what would be expected from the soil conditions. This test was carried out on the presence and absence of species, if their numerical representation was included, the relationship was non-significant.

Less is known about habitat preference in the Staphylinidae, although Evans (1969) and Hammond (1974) provide some data. The distribution of some genera is clearly connected with habitat factors such as litter and vegetation cover, as is that of the Carabidae (Table 2).

Just as the number of beetle species declines with increasing town penetration, Fig 6 shows a similar trend in relation to the proportion of animals caught for each family or species. As the town centre is approached, faunal complexity is reduced, a greater proportion of individuals coming from fewer species. Since this data was collected by pitfall trapping, it has to be interpreted with care, since numbers are affected by surface activity as well as population density (Terrell-Nield, 1986). Additionally, species have varying susceptibility to capture (Luff, 1975, Halsall and Wratten, 1988).

Discussion

This study indicates that land use clearly affects beetle distributions. The effect of the town is to reduce diversity, and the longer the history of human habitation, the more marked this is. Davis (1982) considered that major factors responsible for such a reduction include increasing disturbance, a reduction in the total area of exploitable habitat and reduction in niche variety. In the Eccles area, some of the diversity reduction is caused by the change of land use from agricultural to housing and industry. In Berlin, Bruttke (1990) found that species richness was reduced by increased disturbance, but no such relationship was seen here.

Although town development affects numbers of animals, and numbers of species, many beetles expected to be present in the pre-town agricultural environment still occur. Some are ubiquitous species, others are associated with meadows and arable land, so it is possible to say that habitats provided by the town either help to maintain pre-existing species, or in some way mimic agricultural conditions, at least as far as the Carabidae is concerned.

Many of the open habitat Carabids found probably inhabited the pre-agricultural environment : those living by rivers, in wet habitats, and woodland clearings quickly colonising agricultural land. Originally, the mosslands would have had a typical fauna, and some wet habitat species such as *Agonum ericeti* (Panz) and *Carabus granulatus* (L) persist. In the 19th century the mosses were drained and marled before cultivation, releasing agricultural land near the town for housing (Hardman, 1961). Many town areas, especially off the sandstone, were cultivated for about 600 years, so the persistence of open habitat beetles is not surprising.

Carabid species distribution can be predicted partly by soil type. Most Carabids are more common on clay soils than on sandy ones, since the micro-climate is more favourable (Thiele, 1977). In the present survey, soils in the oldest part of the town tend to be sandy, so some naturally lower species richness may be expected.

The distribution of some species agrees with Schaefer's observations (1982) whose work in Kiel showed that *Nebria brevicollis* (F.), *Asaphidion flavipes* (L.) and *Bembidion tetracolum* (Say.) were dominant town species. In Eccles, *N. brevicollis* was present at all town sites, along with *Bembidion lampros* (Hbst.), which prefers open ground. *Pterostichus madidus* (F.) occurred at all town sites, but was replaced by *P. melanarius* (Ill.) in wet fields. Species associated with agricultural land, including *Amara aulica* (Panz.), *Harpalus aeneus* (F.) and *H. rufipes* (DeG.) were well represented in the town.

Staphylinid distribution is more closely related to modern land use, although as with the Carabidae ubiquitous species improve the similarity of town and non-town sites. Species like *Acrotona fungi* (Gr.), *Tachinus rufipes* (DeG.), *Tachyporus hypnorum* (F.) and *T. chrysomelinus* (L.) are all common in grasslands, woodland edges and town-edge gardens, but less frequent in areas of poor ground cover.

Some larger Staphylini such as *Staphylinus olens*, with pupae susceptible to flooding, are limited to dry soils (Nield, 1976), but species of *Philonthus* are represented at al sites with some ground cover. Unusually, the most common is *Philonthus rotundicollis* (Men.), rare in most part of the country, but replacing the more frequent *Philonthus decorus* (Gr.) at 21/34 sites examined in this area, including all woodlands. Some Quediini, except for widespread species such as *Quedius fuliginosus* (Gr.) are limited to the grassland and town areas. Others, including *Q. fumatus* (Steph.), are restricted to woodlands. Artificial habitats help some woodland species to survive in towns (Davis, 1978), and compost heaps are particularly important for small Staphylinidae.

In the town, the distribution of some Carabidae was probably maintained by hedgerows. These are important in sustaining woodland species like the carabid *Nebria brevicollis* (Pollard, 1968), which was the only forest species found at urban sites in Berlin (Weighmann, 1982).

19th century maps show that disappearance of hedgerows paralleled the spread of housing, as individual fields were sold for building. Some hedges persisted along tracks and roads, so ostensibly woodland species were left with a wide distribution as the town expanded. With few normal woodland competitors, such species have been very successful, but in many cases few members of a tribe persisted. The Nebriini, for example, contains five species of *Leistus*, none of which has penetrated far into the town. Schaefer (1982) noted a similar trend in the genus *Carabus* in Kiel.

Suburban gardens provide habitats for phytophagous insects, as well as predatory ground runners. Although they can maintain a diverse insect fauna, and be regarded as 'nature reserves' (Owen, 1978) its composition is now weighted in favour of phytophagous beetles,

Diptera, and Lepidoptera, plus their predators and parasites. This fauna is probably controlled more by introduced, often exotic, plant species, than by the historical and geological background of the site.

What will happen in the future? The town is expanding westwards and northwards, onto derelict agricultural land, and there has been continued infilling, properties with large gardens being demolished to make way for higher density housing. The result could be continual impoverishment of the original fauna, or a more static situation, with adaptable species becoming more widespread. Considering the pressure on open spaces for development, and the tendency to 'improve' sites by eliminating patches of rough grassland and derelict land, an increase in the diversity of ground running beetles in Eccles is unlikely.

Table 1: Number of beetle species collected at each site-type over a two year period.

Site type	Total species	Total Carabidae	Carabidae Carabinae	Carabidae Harpalinae	Total Staphylinidae
Woodland	101	35	12	23	41
Wood edge	88	29	12	17	37
Fields	96	34	8	26	39
Allotments	76	35	8	27	26
EG gardens	77	35	6	29	30
WC gardens	61	23	3	20	30
SC gardens	34	18	4	14	12
NC gardens	57	24	5	19	20
Total for sampling area	190	58	15	41	83

Site type	Species ratios C:H	C:S	Mean *diversity	Carabid diversity	Staphylinid diversity
Woodland	0.52	0.83	6.2	4.0	3.5
Wood edge	0.70	0.78	7.5	4.8	4.2
Fields	0.31	0.87	6.8	3.9	4.3
Allotments	0.30	1.35	5.7	3.7	4.9
EG gardens	0.21	1.17	6.0	3.7	3.7
WC gardens	0.15	0.77	5.0	3.0	3.5
SC gardens	0.29	1.50	3.4	2.2	3.2
NC gardens	0.26	1.20	3.8	2.6	2.9

Note: WC, SC and NC are gardens west, south and north of the town centre. EG are town edge gardens. C:H is ratio of Carabid sub-families Carabinae and Harpalinae, C:S is ratio of families Carabidae and Staphylinidae.

$$* \text{ diversity} = \frac{\text{No of species - 1}}{\text{1n no of individuals}}$$

Table 2: Linear regressions of Coleoptera species and diversity on distance from town centre (Eccles Cross), and of species richness on site factors.

		Correlation (r)	Regression coeff. (b)	Prob.
a)	Distance from Eccles Cross			
	Total species	+0.11	+0.82	N/S
	Species of Carabidae	+0.10	+0.03	N/S
	Species of Staphylinidae	+0.51	+2.03	<0.01**
	Carabinae:Harpalinae	+0.50	+0.09	<0.01**
	Carabidae:Staphylinidae	-0.52	-0.20	<0.01**
	Total species diversity	+0.80	+0.62	<0.001***
	Diversity of Carabidae	+0.64	+0.41	<0.001***
	Diversity of Staphylinidae	+0.49	+0.24	<0.01**

b) Species richness in relation to site factors

Factor	All Coleoptera r	prob	Carabids r	prob	Staphylinids r	prob
1 Years urbanised	-0.65	<0.01**	-0.67	<0.01**	-0.63	<0.01**
2 Disturbance index	0.04	N/S	0.34	<0.05*	0.01	N/S
3 Solid cover (sq m)	-0.53	<0.01**	-0.28	N/S	-0.45	<0.01**
4 Litter (sq m)	0.11	N/S	-0.15	N/S	0.12	N/S
5 Veg (sq m)	0.38	<0.05*	0.29	N/S	0.35	<0.05*
6 % sand in topsoil	-0.36	<0.05*	-0.10	N/S	-0.34	<0.05*
7 % clay in topsoil	0.08	N/S	-0.25	N/S	0.21	N/S
Multiple regression factors 2 to 7	F = 5.35 p <0.001 r^2 0.54		F = 2.79 p <0.05 r^2 0.38		F = 3.99 p <0.001 r^2 0.47	

*significant, ** very significant, *** highly significant
Correlation tested at 32 d.f. except for (1) at 17 d.f.

Table 3: Regressions of animal species numbers, ratios, and diversities on 1845 and 1985 site codes (average of site scores 1-3)

Category	1845 b	r	prob.	1985 b	r	prob.
Total species	-2.50	-0.35	<0.05*	-2.11	-0.51	<0.01**
Total Carabidae	-0.19	-0.07	N/S	-0.13	-0.08	N/S
Total Staphylinidae	-1.22	-0.31	N/S	-1.14	-0.50	<0.01**
Carabinae:Harpalinae	-0.11	-0.61	<0.001*	-0.08	-0.08	<0.001***
Carabidae:Staphs	+0.14	+0.37	<0.05*	+0.12	+0.55	<0.01**
Total diversity	-0.44	-0.44	<0.01**	-0.34	-0.60	<0.001***
Carabid diversity	-0.26	-0.42	<0.05*	-0.23	-0.63	<0.001***
Staph diversity	-0.14	-0.28	N/S	-0.17	0.61	<0.011***

*significant, **very significant, ***highly significant
Correlation tested at 32 d.f.

Appendix 1

A classification of the collecting sites as they appeared in 1985, with comparable land use in 1845, and descriptive codes.

Site Type	1985 land use	Code	1845 land use	Code	Last Change
W	Beech/oak wood	1	Beech/oak wood	1	1775
W	ditto	1	ditto	1	1775
W	Beech/birch wood	1	Oak/beech wood	1	1775
WE	Oak/birch/grassland	3	Birch/grassland	3	1900
WE	Birch/bracken/wheat	3	ditto	3	1775
WE	Sycamore/alder wood	2	Wet alder wood	3	1775
W	Yew/rhododendron	1	Yew plantation	2	1883
W	Sycamore coppice	1	Sycamore plant'n	2	1883
F	Wet grassland (Holcus)	4	Formal garden	5	1936
F	Grassland (Deschampsia)	4	ditto	5	1936
W	Larch plantation	2	Parkland	4	1958
W	ditto	2	ditto	4	1958
EG	Garden, mostly lawn	7	Sandpit	7	1955
EG	ditto	7	Derelict land	6	1936
WC	Garden/apple trees	8	Brickworks	8	1938
WC	Garden/birch/grass	8	Pasture	6	1938
ALL*	Holcus grass/cultiv.	6	Wet pasture	5	1883
F	Field (Holcus/Agrostis)	5	ditto	5	1958
SC	Garden/paved/lawn	10	Field/orchard	6	1890
SC	Garden, mostly lawn	10	Race course	6	1912
NC	Mature gdn/sycamore	9	Kitchen garden	8	1870
NC	Ditto	9	Wet Pasture	5	1873
NC	Garden/ash/lawn	9	ditto	5	1873
NC	ditto	9	ditto	5	1873
NC	Garden/ash/sycamore	9	ditto	5	1873
ALL	Cultivated/bare ground	6	Arable	6	1936
ALL	Holcus/cultivated	6	Wet pasture	5	1958
EG	Garden/Agrostis/bare	7	Sandpit	7	1938
EG	Garden/Agrostis/privet	7	Arable	6	1960
SC	Garden/Agrostis/bare	10	Arable	6	1890
WC	Garden/beech/Holcus	8	Pasture/scrub	5	1908
NC	Garden/paved/sycamore	9	Wet pasture	5	1895
F	Derelict pasture	5	Parkland	4	1895
F	Holcus/Arrhenatherium grassland	4	Arable	6	1958

Site types: W = woodland WE = woodland edge F = field
ALL = allotment EG = town edge garden
WC = west town centre garden
SC = south town centre garden
NC = north town centre garden
* Now (1993) suburban garden

Appendix 2 Determination of Site Scores

1 Disturbance Index

Assessment is based on a) perceived disturbance, including ground and vegetation disruption during the trapping period b) on-site evidence of recent disturbance, such as plants of disturbed ground and stages in seral succession to woodland and c) discussions with landowners and householders.

Effects of disturbance are assumed to reduce logarithmically, so the index can be calculated by addition from:

	Disturbance frequency						
Degree of disturbance	Day	Week	Month	6-month	1 yr	5 yr	10yr
Much	10	1.429	0.333	0.0556	0.0273	0.0055	0.00274
Medium	1	0.143	0.333	0.0065	0.0030	0.0006	0.00027
Little	0.1	0.014	0.003	0.0006	0.0003	0.0001	0.00002

eg: if a site is disturbed little in a day, a week, a month but medium every 6 months and year, but little on a 5 or 10 yearly basis, it scores:

0.1 + 0.014 + 0.003 + 0.0065 + 0.003 + 0.0001 + 0.00002 = 0.25262

Sites were then given scores according to the following :

Disturbance Index	<0.1180 = 1,	0.118-0.122 = 2,	0.123-0.201 = 3,
	0.202 -0.283 = 4,	0.290-1.177 = 5,	1.180-1.567 = 6,
	1.57-2.500 = 7,	2.501-10.20 = 8,	10.201-11.5 = 9,
	>11.5 = 10		

Thus 0.25262 scores as 4

2 Length Of Time Site Urbanised

Assessed by examination of maps and records since 1845 (1st edition Ordnance Survey publication date). Sites were ranked from 10 (oldest) to 1 (newest), changes within the same decade being grouped together. Sites already urbanised in 1845 score 10, those since 1960, 1.

3 Exact Nature Of Site

The overall land use at a site was given a 1 to 10 score as follows:

Woodland (mature hardwood)	1	Derelict land	5
" (immature hardwood)	2	Allotment	4
" (mixed)	3	Garden, suburban	8
(coniferous)	4	Garden, urban	10
Permanent pasture	2	Industrial	10
Ley	4		
Arable (roots/cereals)	6		

Appendix 3 Species recorded from each site

Family / Species	Botany Bay Wood						Middlewood				Fields					Allotments			Suburban and urban gardens											
	B	B	B	B	B	B	MD	MD	MC	MC	MF	MF	P	EP	LF	P	W	EP	W	P	P	P	M	M	M	EC	EC	EC	EP	EP
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Carabidae																														
Carabus nemoralis																		+												
C. granulatus		+			+	+		+			+																			
C. violaceus	+	+	+		+	+					+				+		+			+							+		+	+
C. problematicus	+	+	+		+	+					+																			
Cychrus caraboides			+		+	+				+																				
Leistus rufescens	+	+	+		+			+	+	+		+	+				+	+												
L. fulvibarbis						+	+	+									+										+			
L. spinibarbis	+	+	+	+																										
Nebria brevicollis	+	+	+		+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
N. salina											+	+		+						+										
Notiophilus rufipes	+	+	+	+																										
N. substriatus													+	+				+												+
N. biguttatus	+	+	+	+	+	+	+						+	+	+	+		+	+	+	+	+		+		+	+	+	+	+
N. palustris		+		+																										
Loricera pilicornis	+				+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+		+	+		+		+	+
Clivina fossor											+		+	+			+							+						
Dyschirus globosus	+				+																									
Asaphidion flavipes	+	+	+			+	+									+	+	+		+	+		+			+	+	+		+
Bembidion biguttatum										+												+						+		
B. aeneum											+																			
B. tetracolum																+	+			+			+	+	+			+		
B. quadrimaculatum																+	+			+										+
B. lampros		+									+		+	+	+	+	+	+	+	+	+	+		+		+	+	+	+	+
B. fibiale																														+
Trechus quadristriatus														+	+	+	+	+						+						
Patrobus excavatus	+				+										+		+				+	+		+	+				+	
Harpalus aeneus									+						+	+		+	+	+				+			+		+	
H. rufipes					+						+	+			+	+		+	+	+	+	+	+	+		+	+		+	+
Bradycellus harpalinus											+			+	+			+	+			+				+				
B. verbasci		+				+					+			+	+	+		+	+			+				+			+	
B. similis												+												+						
Amara plebeja		+	+								+	+		+	+	+		+	+		+	+	+			+	+			+
A. eurynota																+				+										
A. similata					+													+	+											
A. bifrons				+	+										+	+			+	+	+			+				+		
A. lunicollis				+							+	+			+		+													
A. familiaris					+																			+						
A. aenea		+							+		+				+				+			+		+		+	+		+	+
A. fulva																				+		+								
A. apricaria														+																
A. aulica															+	+								+					+	
Stomis pumicatus	+																					+						+		
Abax parallelopipedus					+	+		+	+				+		+		+	+		+	+	+		+	+	+	+	+	+	+
Pterostichus madidus	+	+	+		+	+	+	+	+	+	+	+	+		+	+		+	+	+	+	+		+	+	+	+	+	+	+
P. oblongopunctatus	+			+	+	+			+	+							+											+		
P. strenuus				+	+						+	+	+		+		+					+								

Family / Species	Botany Bay Wood						Middlewood				Fields					Allotments			Suburban and urban gardens															
	B	B	B	B	B	B	MD	MD	MC	MC	MF	MF	P	EP	LF	P	W	EP	W	P	P	P	M	M	M	EC	EC	EC	EP	EP	EP	EP	EP	EP
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Pterostichus niger	+		+	+	+	+			+		+	+		+	+	+	+			+		+											
P. melananus		+			+	+					+						+			+		+											
P. nignta					+	+								+			+			+		+											
Agonum assimile	+					+		+											+	+	+		+							+	+	+	+	+
A. dorsale															+	+		+	+	+														
A. ruficorne										+									+															
A. mulleri							+							+	+	+	+	+	+	+			+											
Calathus piceus	+	+	+				+																								+	+		
C. melanocephalus								+						+	+					+		+							+	+		+		
C. fuscipes								+							+		+			+		+												
Synuchus nivalis																				+		+	+											
Dromius lineatus													+							+														
Staphylinidae																																		
Stenus clavicornis					+						+	+	+	+			+	+																
S. fuscicornis															+																			
S. boops														+					+												+		
Alaeochara bipustulatus																				+														
Oxypoda lividipennis	+	+	+	+				+	+		+			+																				
O. vittata																																		
Ocalea picata	+	+	+										+																		+	+		
Chilopoda longitarsus																								+										
Callicerus rigidicornis			+																															
Sipalia circellaris	+	+	+	+	+	+	+	+	+	+	+	+		+			+	+																
Megastia graminicola							+			+		+																						
Atheta xanthopus								+											+					+										
A. hygrobia					+																													
Acrotona fungi	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+			+	+	+
Metaxya hygrotopora					+																													
M. granigera	+				+					+																							
Mycetoporus splendidus																		+																
M. clavicornis				+								+																						
M. rufescens																				+														
M. brunneus	+	+			+				+	+	+	+	+	+						+	+				+									
Bryocharis inclinans	+																								+									
Bolitobius thoracicus		+		+																														
Conosoma marshami	+						+										+		+	+				+										
C. lividum				+										+				+	+	+			+						+					
Tachyporus obtusus					+														+	+			+	+										
T. nitidulus				+																+														
T. hypnorum			+		+							+	+	+	+			+	+	+			+	+			+	+						
T. pusillus				+	+									+					+	+				+			+	+				+		
T. chrysomelinus			+	+	+								+	+					+	+			+	+			+	+				+		
Tachinus collaris					+														+	+			+		+		+	+	+		+	+	+	
T. marginellus					+								+							+														
T. laticollis			+	+	+	+							+	+				+	+				+	+									+	
T. subterraneus															+	+		+	+	+			+	+		+		+				+	+	
T. rufipes	+	+			+			+	+	+			+		+	+	+	+	+	+	+	+		+			+		+		+	+	+	+

Family / Species	Botany Bay Wood						Middlewood				Fields					Allotments			Suburban and urban gardens											
	B	B	B	B	B	B	MD	MD	MC	MC	MF	MF	P	EP	LF	P	W	EP	W	P	P	P	M	M	M	EC	EC	EC	EP	EP
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Olophrum piceum	+		+			+	+	+	+		+	+	+																	
Lathrimaeum unicolor		+									+													+						
L. atrocephalum	+	+	+			+		+	+	+																				
Lesteva longelytra																							+							
L. heeri			+																											
Phloenomus pusillus																													+	
Acidota crenata	+					+																								
A. cruentata	+	+		+	+	+			+	+	+							+		+									+	
Oxytelus rugosus			+		+							+		+		+		+		+	+	+	+	+						
O. sculpturatus							+		+	+										+				+						
Quedionuchus cinctus						+												+												
Quedius molochinus							+				+	+		+											+					
Q. schatzmayri			+	+							+	+		+			+	+		+			+		+					
Q. attenuatus															+															
Q. fuliginosus	+			+							+		+	+	+	+		+		+			+				+			
Q. fumatus	+																			+										
Q. maurorufus			+																											
Q. lateralis	+		+																											
Q. mesomelinus																		+												
Gabrius nigritulus											+																			
Philonthus laminatus				+	+	+				+	+						+	+	+											+
P. marginatus															+															
P. addendus																								+						+
P. decorus																		+												+
P. varius											+	+		+			+	+	+	+			+	+			+			+
P. fuscipennis																	+	+												
P. fimetarius														+				+											+	+
P. rotundicollis	+	+	+	+	+	+	+	+	+	+		+	+	+		+			+	+	+		+						+	+
P. carbonarius			+																					+						
Staphylinus olens											+	+	+	+	+	+		+		+		+	+	+			+	+	+	
S. aenocephalus											+	+	+																	
S. globulifer	+	+			+																									
Baptolinus affinis	+	+	+																											
Othius punctulatus	+	+	+		+			+	+	+	+																			
O. melanocephalus																								+						
O. myrmecophilus	+	+	+	+	+	+	+		+	+	+	+	+																	
Xantholinus linearis	+	+	+	+	+						+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	
X. longiventris				+	+						+	+	+	+	+		+		+	+	+	+	+	+			+			
Lathrobium brunnipes	+	+			+	+																								
L. fulvipenne	+	+	+	+							+	+		+				+	+			+								
L. multipunctum															+							+	+							
L. elongatum														+										+						
L. geminum					+																	+								
Stilichus rufipes			+																											
Ptiliidae																													+	
Acrotrichis intermedia	+	+	+	+	+			+	+	+			+	+																+
A. danica			+						+	+																				

Family / Species	Botany Bay Wood						Middlewood				Fields					Allotments			Suburban and urban gardens											
	B	B	B	B	B	B	MD	MD	MC	MC	MF	MF	P	EP	LF	P	W	EP	W	P	P	P	M	M	M	EC	EC	EC	EP	EP	EP	EP	EP	EP
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Ptiliolum spencei																																+		
Scydmaenidae																																		
Neuraphes elongatulus	+				+	+	+			+		+							+														
Stenichnus collaris						+																												
Pselaphidae																																		
Bryaxis puncticollis														+																				
Silphidae																																		
Nicrophorus vespilloides			+																															
N. vespillo											+																							
N. investigator											+																							
Cholevidae (Leiodidae)																																		
Choleva agilis						+	+	+			+		+																					
C. jeanelli					+																													
Nargus velox	+	+	+	+	+	+	+	+	+	+			+	+				+																
N. wilkini	+	+	+		+	+			+	+																								
Catops fuliginosus		+	+		+																													
C. fuscus						+	+		+																									
C. tristis		+																																
Histeridae																																		
Hister cadaverinus								+												+														
Hydrophilidae																																		
Helophorus grandis										+							+							+										
H. brevipalpis																	+																	
Megasternum obscurum	+		+	+	+							+	+				+	+					+	+	+									
Cercyon analis																														+		+		
Leiodidae																																		
Liodes dubia											+	+	+	+	+		+													+				
L. calcarata																				+														
Agathidium sp.													+																						
Scarabaeidae																																		
Aphodius rufipes							+				+																							
A. prodromus																														+				
Serica brunnea																				+														
Byrrhidae																																		
Simplocaria semistriata	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cytilus sericeus														+	+			+								+	+							
Byrrhus fasciatus				+																														
B. pilula				+							+	+																						
Elatendae																																		
Hypnoides riparius											+	+	+	+	+			+		+		+												
Agriotes linearis										+										+														
Athous hirtus	+																																	
A. haemorrhoidalis				+																														
Dalopius marginatus					+			+																										
Corymbites incanus				+																														
Cantharidae																																		
Rhagonycha fulva											+			+			+													+				

Family / Species	Botany Bay Wood						Middlewood				Fields					Allotments			Suburban and urban gardens											
	B	B	B	B	B	B	MD	MD	MC	MC	MF	MF	P	EP	LF	P	W	EP	W	P	P	P	M	M	M	EC	EC	EC	EP	EP
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Nitidulidae																														
Epuraea melanocephala								+																						
Colydiidae																														
Rhizophagus depressus																														
Cryptophagidae																														
Cryptophagus lycoperdi		+	+	+	+																									
Coccinellidae																														
Thea 22-punctata																				+				+						
Adalia 10-punctata										+																				
Coccinella septempunctata											+	+						+											+	+
Lathridiidae																														
Lathridius lardarius														+					+											
Enicmus transversus					+																									
Chrysomelidae																														
Lochmaea capreae				+																										
Chaetocnema concinna		+																												
Apionidae																														
Apion nigritarse																								+						
Curculionidae																														
Sitona griseus	+														+		+							+						
S. lepidus															+			+												
Otiorrhynchus singularis				+							+						+												+	
O. sulcatus					+				+	+		+			+	+			+			+					+		+	+
Barypithes araneiformis	+	+	+	+	+	+		+	+	+		+			+		+							+	+	+	+		+	+
Barynotus obscurus																				+										

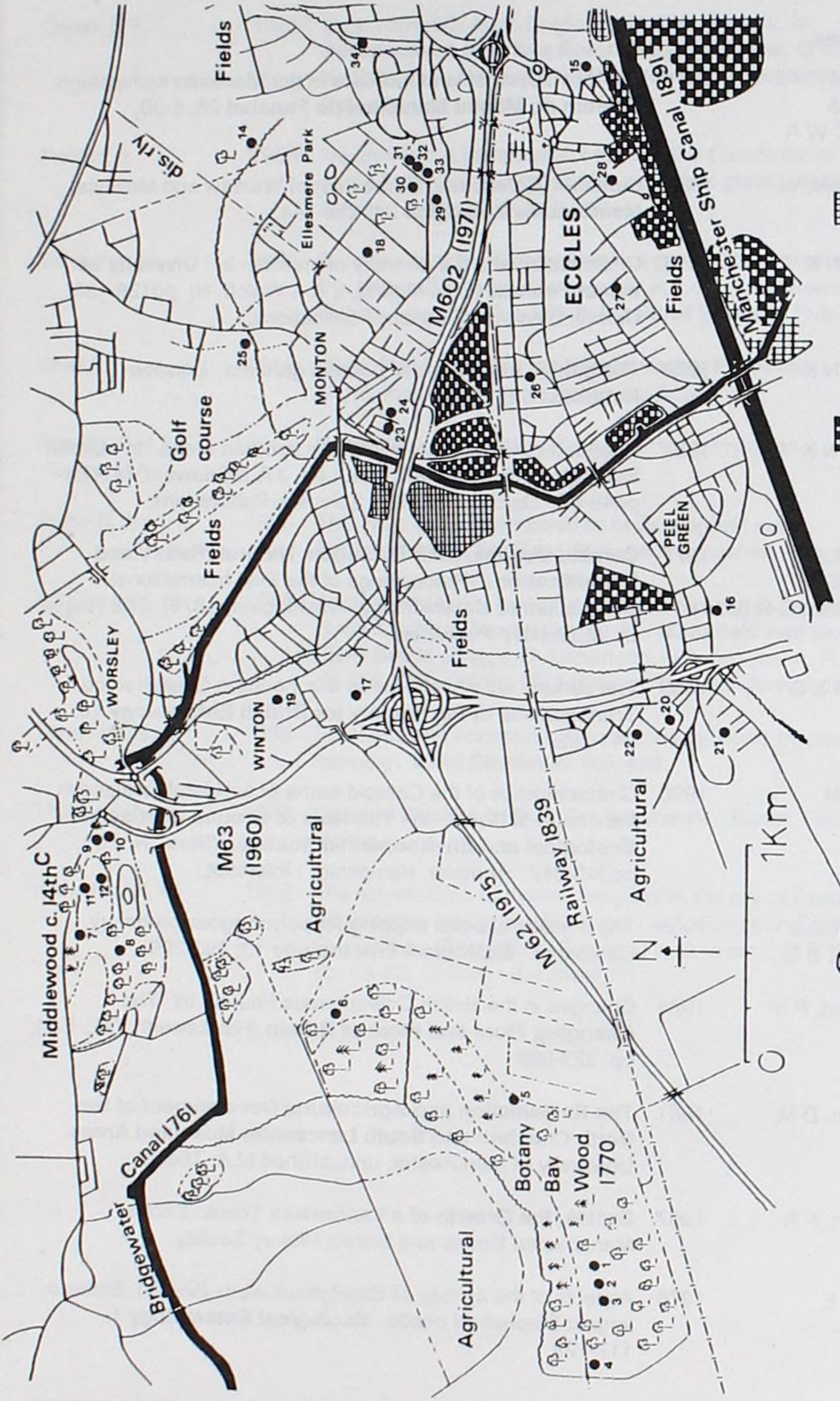


Figure 7

Map showing location of sampling sites

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RECENT PROGRESS WITH STUDIES OF BRAMBLES (*RUBUS*) IN LANCASHIRE

David P Earl

The boundaries of Lancashire have changed on numerous occasions. Botanically, Lancashire can be divided into five main regions.

Furness - This is included in the vice-county of Westmoreland v.c. 69. *Rubus* records at tetrad level will no doubt soon be published in G Halidays Flora of Cumbria for this region.

West Lancashire - v.c. 60. Eric Greenwood has kindly forwarded *Rubus* records for the vice county, numerous tetrad records are listed in Livermore and Livermore (1987). The majority of the modern day records are from the western fringes of the Bowland Fells and the Lune Valley.

On a visit to Lytham in 1993, *Rubus newbouldii* and *R. adenanthoides* were found to be locally abundant and this provided a stimulus for further forays in 1994. Many additional records have been made whilst walking the coastal path, Ribble Way, Wyre Way and a short stretch of the Lancaster Canal. *R. warrenii* appears to be common about Ribchester, but is yet to be confirmed as new to West Lancashire as a specimen has yet to be gathered.

South Lancashire - Mention of J J Zawadzki's (1978) study of Rubi must be made here. Eleven species of bramble are listed in the flora, together with the main areas where these species can be found in the Bury district. Since 1991 the author has undertaken a major study of the Rubi in South Lancashire. All records are made at a 1km square level. By the summer of 1994, all quadrants (5x5 km) had been visited on at least one occasion. The ultimate aim is to visit each tetrad in South Lancashire.

The main new vice county records are:

R. elegantispinosus at Horwich
R. echinatus at Formby Point
R. intensior at Chorlton-cum-Hardy
R. pallidus above Jumbles Reservoir
R. leightonii at Wigan
R. moylei at Ellesmere Park, Eccles
R. cumbrensis, a record from moorland fringes of Winter Hill.

New vice county records awaiting confirmation are *R. adenanthoides* from Whittle-le-Woods and *R. mucronulatus* from Padiham Heights.

A small area of South West Yorkshire around Earby - It is hoped to study this area in 1995.

A large area of Mid-west Yorkshire about the Forest of Bowland, Gisburn and Barnoldswick - Little has been done in this area, but brief visits have produced new records for *R. errabundus* at Dunsop Bridge and *R. wiralensis* near Edisford Hall to the west of Clitheroe.

Updates of progress made should appear in future editions of the Journal.

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***Rubus pallidus* from Jumbles Reservoir, near Bolton. 26 July 1993**

A SHORT-TERM STUDY ON THE BEHAVIOUR OF MALLARD (*ANAS PLATYRHYNCHOS*) BELONGING TO DIFFERENT SOCIAL GROUPS.

A. Mark Langan

Department of Environmental and Geographical Sciences,

Manchester Metropolitan University, Chester Street, M1 5GD.

Summary

The mallard (*Anas platyrhynchos*) is commonly considered to be monogamous despite the common occurrence of mixed mating strategies including females associated with more than one male (polyandry), lone individuals and groups of males. This study investigates the general behaviours of both genders belonging to different social groups concentrating on female feeding rates, as the build up of food reserves have been attributed to greater success in laying and incubating eggs.

From the different social groups studied it was found that females in monogamous breeding pairs had a much higher feeding rate which may be a result of male protection, reducing disturbance from other males. Females from polyandrous groups recorded lower feeding rates despite the presence of more than one male. This may be a consequence of disturbance caused by male competition for access to the female. Lone females had the lowest feeding rates, possibly because of the absence of a male.

Males in male pairs preened and fed for longer periods than other groups which may be directly attributed to their abstention from the role of mate protection. Such males did not have immediate access to a female and the reproductive benefits of this strategy are questionable. Forced extra pair copulations (or 'rapes') have been reported in literature on mallard for over 70 years. The implications of this strategy are discussed.

Introduction

Often birds which are members of the family Anatidae are termed 'waterfowl', a group containing 143 species, of which 40 are dabbling ducks (Owen & Black 1990). The mallard (*Anas platyrhynchos*) is the largest and most common dabbling duck in Europe and the ancestor of the farmyard duck (Heinzel *et al.* 1979).

The drake is distinguished by it's green head, narrow white collar, purple-brown breast and grey back. The mottled brown female has a distinctive blue spectrum. The domestic mallard is found in a wide variety of forms (eg the White Aylesbury) and can breed with wild mallard.

The omnivorous diet of the mallard consists mainly of seeds and crustaceans sieved from the water. Mallard spend about 35% of their time feeding, some of which is at night (Jorde *et al* 1984). Olney (1965) suggested niche specialisation had occurred in many species of dabbling duck due to the large overlap in diet between species. The similarity in bill and gut morphology between mallard and Black Duck may have caused competition, forcing the mallard to spread westwards (Owen & Black 1990).

In waterfowl pair formation takes place in winter (November), some months before the breeding season (April). Like many waterfowl, mallard have a skewed sex ratio, biased

towards males, as the females tend to suffer higher mortality (Perrins & Birkhead 1983). This leads to a variety of social groupings; single individuals, breeding pairs, females with more than one male (polyandry) and male groups (although only male pairs were recorded in this study). The lack of females may encourage males to pair early (Perrins & Birkhead 1983). Rohwer and Anderson (1988) rejected this hypothesis in mallard and provided some evidence that the pre-laying defence of the females allowed the storage of nutrients for maintenance and laying. Female Eider Duck (Ashcroft 1976) and Arctic Nesting Geese (Teunissen *et al* 1985) have been shown to benefit from male protection and the males benefit from a higher chance of paternity.

In many ducks, including mallard, males actively discourage other males (mate guarding) particularly when their associated female is receptive. They remain close to their mate during breeding and the initial stages of incubation, usually deserting shortly after, leaving the female to care for the young (Owen & Black 1990) and allowing the male to attempt extra-pair copulations.

In polyandrous groups the benefit to the female may be an increase in the number of young that can be successfully raised. Co-operative polyandry in Dunnocks (*Prunella modularis*) has been shown to improve the reproductive success in females (Davies 1985). The strategy encourages intense behavioural conflict between male Dunnocks as they attempt to increase their own breeding success.

A widespread reproductive strategy in wild and urban mallard is forced extra pair copulation (FEPC), and occurs most frequently, after a male's previous mate has started to incubate her clutch (McKinney *et al* 1983). 'Gang rapes' have been suggested to be highly successful in mallard (Evarts & Williams 1987) and current research supports the view of Heinroth (1911) that FEPC is a secondary tactic commonly performed by paired males to fertilise females other than their partner. Urban mallard populations commonly consist of individuals from game-farms and/or domestic stocks and a number of authors have suggested that their behaviour is atypical of wild populations (for review see McKinney *et al.* 1983).

FEPC's were not witnessed during the recording time in this study, although two copulatory attempts of this kind occurred while on site. The second attempt ended when the recipient female ejected an egg, possibly signalling the female's temporary non-fertility.

The gender ratio and the type and quality of habitat are major selecting factors that affect mating systems (Oring 1982). This makes waterfowl "an excellent group of birds to make mating system comparisons to test the ecological consequences of different mating strategies" (Owen & Black 1990). The current study was conducted to determine the difference between the general behaviours of individuals from different sizes of social groups.

Methods

The study was carried out at Platt Fields boating lake (see Fig 1) which is situated about 5 km south of Manchester, from March 10th to March 24th 1992 (shortly before females lay their eggs). This man-made lake contains an island which provides nesting sites/shelter for large densities of waterfowl, including the abundant *Anas platyrhynchos.*

Each individual was recorded for 10 minutes and attempts were made to avoid recording the same bird more than once daily. All recordings were made between 1000 and 1600 GMT.

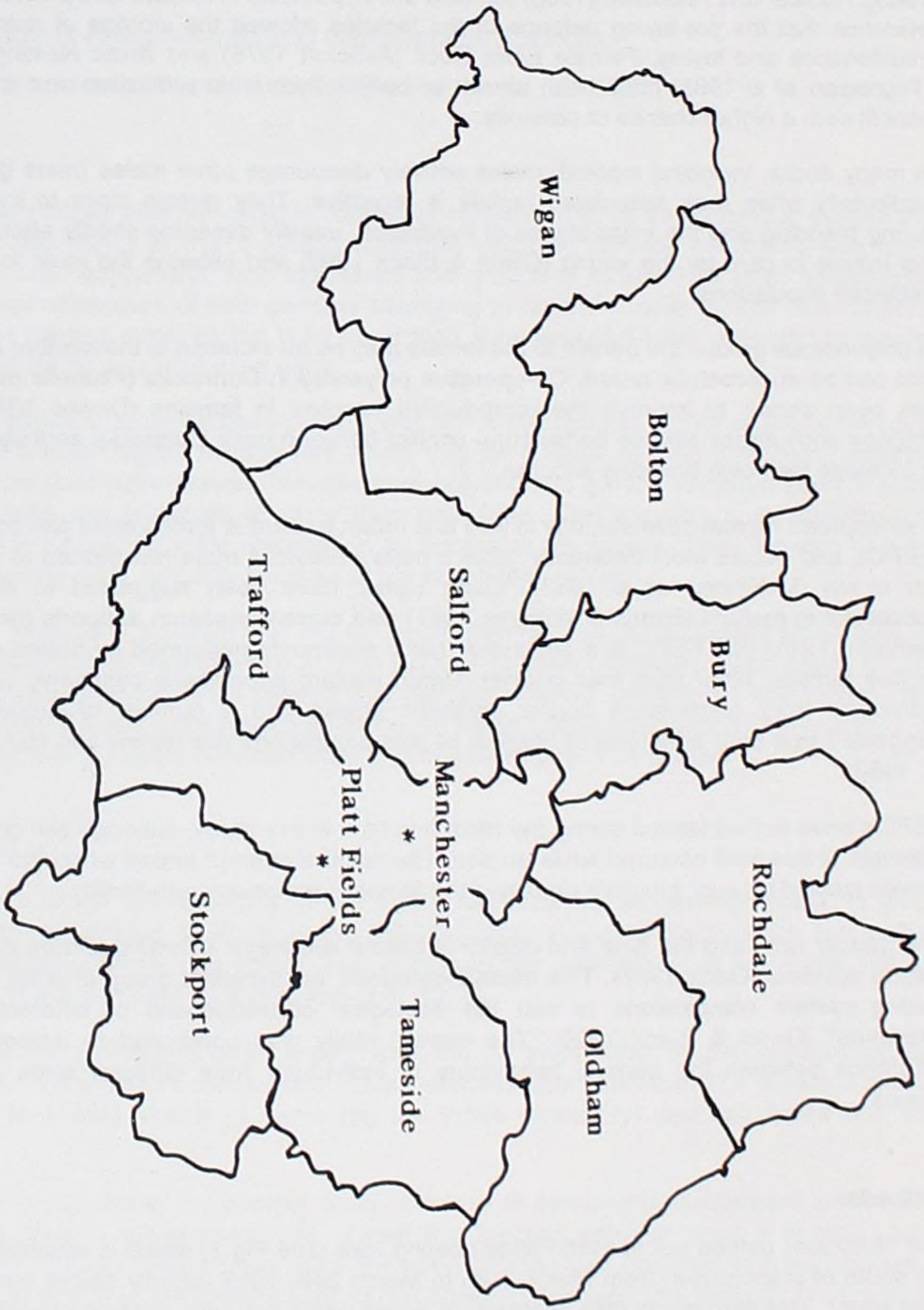


Figure 1 Greater Manchester. Platt Fields boating lake (OS 851 944) situated approximately 5km south of Manchester centre.

The behaviours recorded were -

i) Feeding by sieving
ii) Feeding by ducking
iii) Time spent calling
iv) Time spent preening
v) Time spent guarding
vi) Time spent attacking
vii) Time spent flying
viii) Distance from the nearest member of the opposite sex

To facilitate data collection sieving was recorded using a tally system. Every 'short' sieve was assumed to take half a second. Longer sieves were timed. All behaviours were timed to the nearest half second.

Guarding was defined as 'obvious' none-attacking intervention by the male to separate the breeding partner from other males and attacking as an active attack (snapping) towards other ducks.

Results

A total of 74 individuals were recorded, each individual was categorised into one of six social groups; lone males (M) and females (F), breeding pairs (MF) male pairs (MM) and two types of polyandrous groups (MMF) and (MMMF). Most individuals (44) belonged to breeding pairs. Throughout the results the individual studied is abbreviated first, for example FM refers to the female from a breeding pair.

The results were analysed using 'SPSS-X' statistics package. All graphs show a multiple range test (Duncan), the stars (*) denote which pairs of groups were significantly different at the 0.050 level.

Sieving (see Fig 2)

Females from breeding pairs sieved for the longest, significantly longer than paired males. Though lacking significance trends suggest females in the multi-male groups sieved for longer than the males, and single males and females sieved for the shortest time of all. MM pairs recorded the second longest sieve rate.

Ducking (see Fig 3)

This behaviour was rarely observed and consequently there were no significant differences between groups although trends were apparent. Females from breeding pairs appeared to feed by ducking for longer than their associated males. Lone males and MM pairs were observed ducking but lone females and individuals from a multi-male group were not.

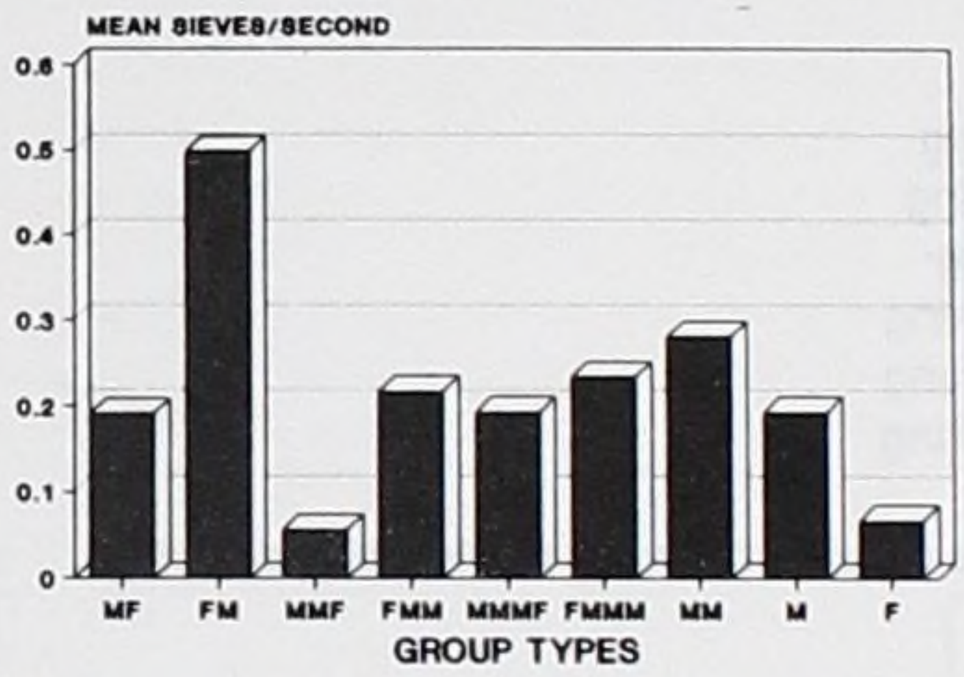
Calling (see Fig 4)

Calling was predominantly associated with males. There was no significant correlation between attacking (combined) and calling ($r=0.0145$, $p=0.216$).

MMMF males called for significantly longer than any other group and MF, MMF and MM males called for significantly longer than females from a breeding pair. The females from multi-male groups did not call during the observation time.

Figure 2

MEAN SIEVE RATE



DUNCAN MULTIPLE RANGE TEST

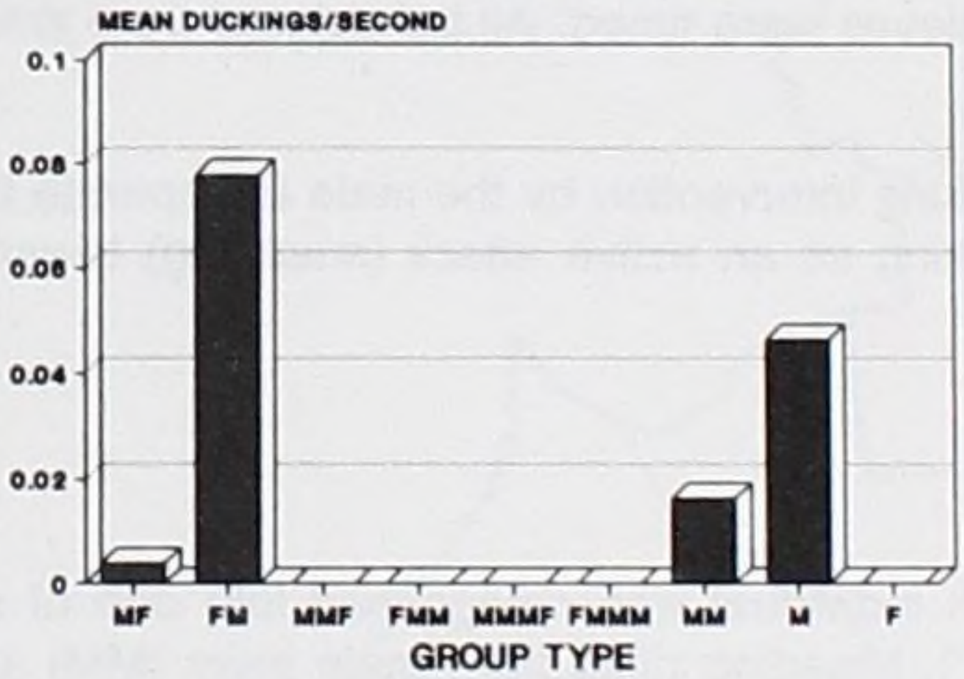
N	GROUP
1	F
3	MMF
4	MMMF
22	MF
3	M
1	FMM
2	FMMM
16	MM
22	FM

			•					
F	M	M	M	M	F	F	M	F
	M	M	F		M	M	M	M
	F	M			M	M		
		F				M		

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 3

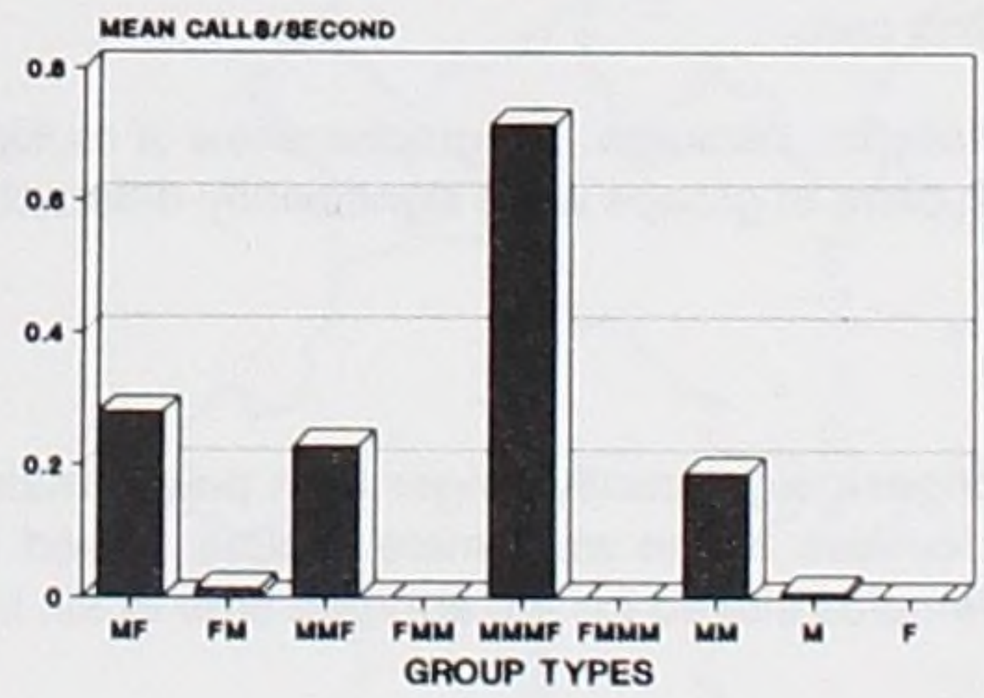
MEAN DUCK RATE



THERE WAS NO SIGNIFICANT DIFFERENCE FOUND BETWEEN ANY PAIRS OF GROUPS WHEN ANALYSED BY A MULTIPLE RANGE TEST.

Figure 4

MEAN CALL RATE



DUNCAN MULTIPLE RANGE TEST

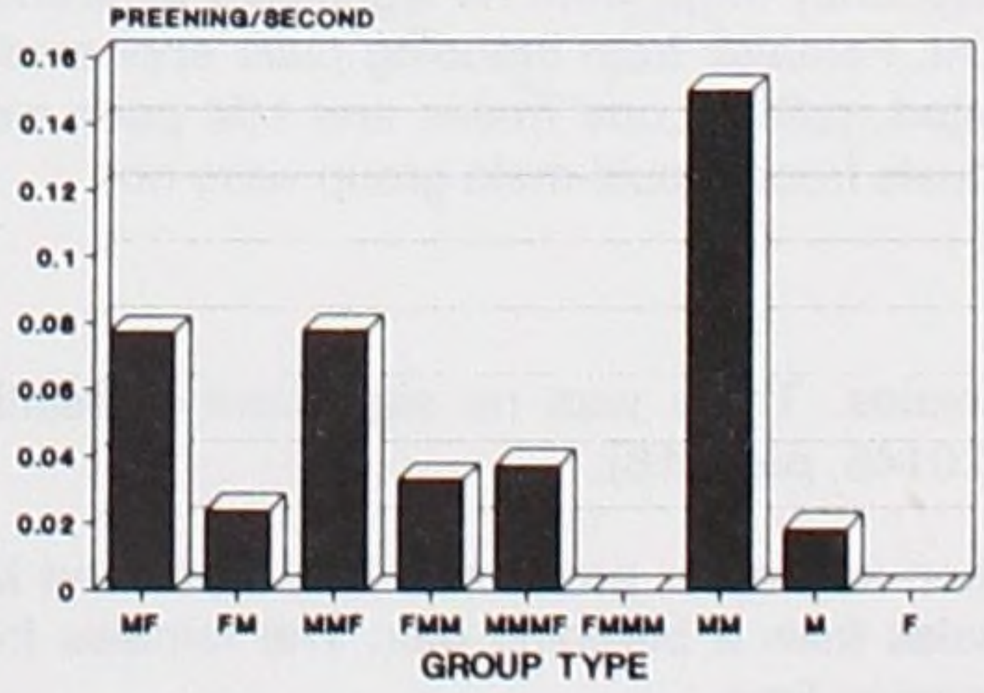
N	GROUP
1	FMM
2	FMMM
1	F
3	M
22	FM
16	MM
22	MF
3	MMF
4	MMMF

					•				
					•				
					•				
•	•	•	•	•	•	•	•		
F	F	F	M	F	M	M	M	M	
M	M			M	M	F	M	M	
M	M						F	M	
	M							F	

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 5

MEAN PREEN RATE



DUNCAN MULTIPLE RANGE TEST

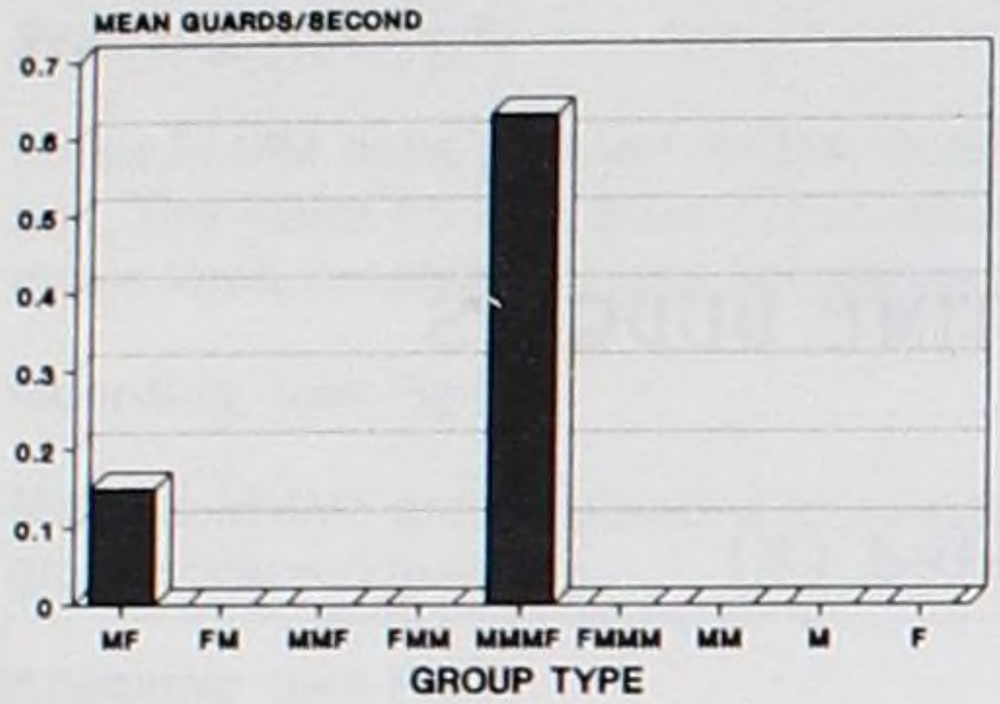
N	GROUP
4	MMMF
2	FMMM
1	F
3	M
22	FM
1	FMM
22	MF
3	MMF
16	MM

					•		•		
M	F	F	M	F	F	M	M	M	
M	M			M	M	F	M	M	
M	M				M		F		
F	M								

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 6

MEAN GUARD RATE



DUNCAN MULTIPLE RANGE TEST

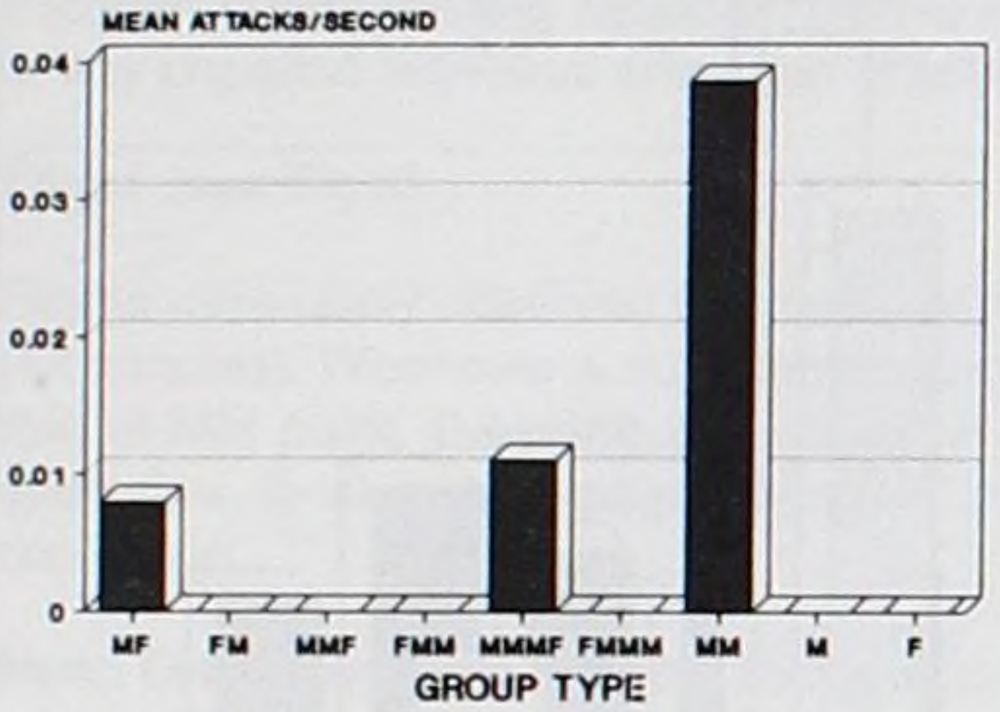
N	GROUP
3	MMF
1	FMM
2	FMMM
16	MM
3	M
1	F
22	FM
22	MF
4	MMMF

•	•	•	•	•	•	•	•		
M	F	F	M	M	F	F	M	M	
M	M	M	M			M	F	M	
F	M	M						M	
		M						F	

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 7

MEAN ATTACK RATE



DUNCAN MULTIPLE RANGE TEST

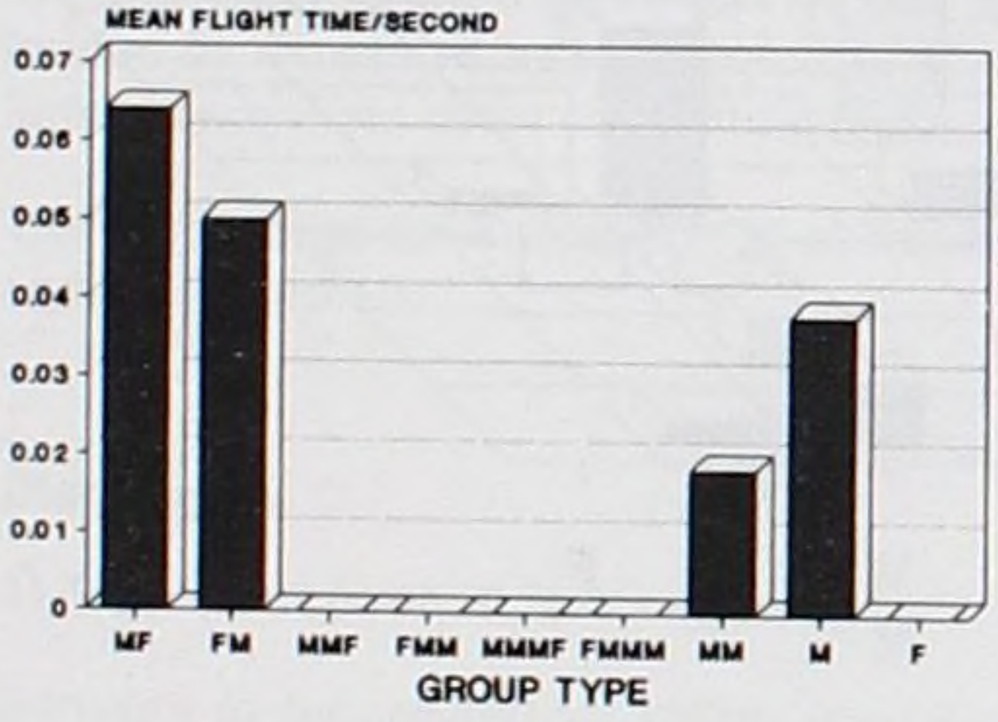
N	GROUP
22	FM
1	FMM
2	FMMM
3	M
1	F
3	MMF
4	MMMF
22	MF
16	MM

•								
F	F	F	M	F	M	M	M	M
M	M	M			M	M	F	M
	M	M			F	M		
		M				F		

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 8

MEAN FLIGHT TIME

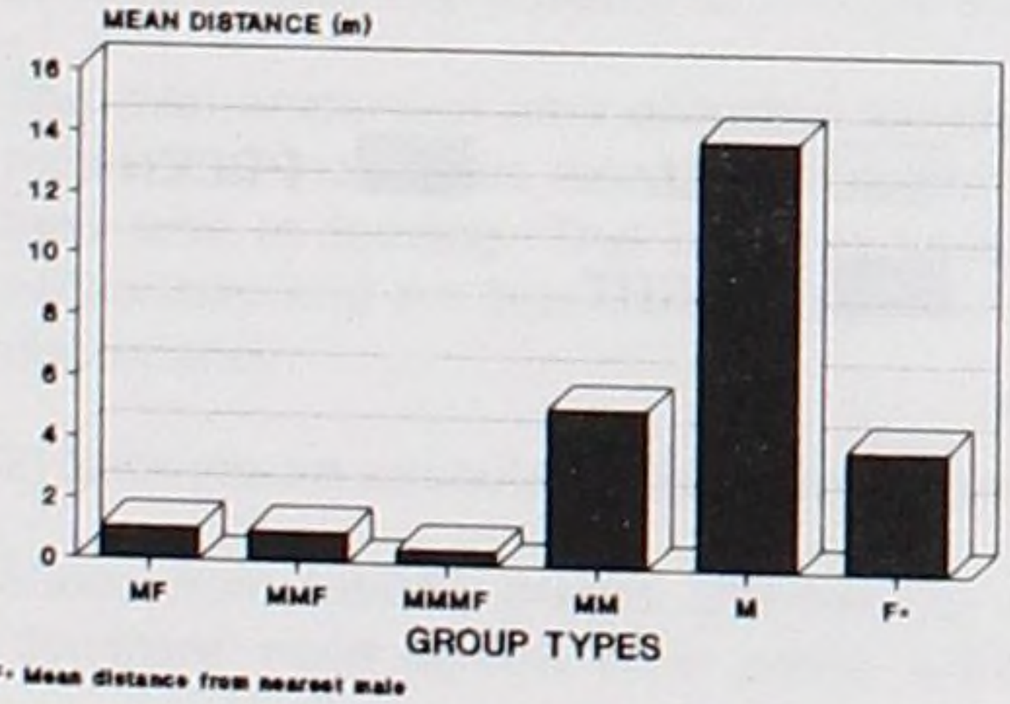


DUNCAN MULTIPLE RANGE TEST

THERE WAS NO SIGNIFICANT DIFFERENCE FOUND BETWEEN ANY PAIRS OF GROUPS WHEN ANALYSED BY A MULTIPLE RANGE TEST.

Figure 9

MEAN DISTANCE FROM NEAREST FEMALE



F• Mean distance from nearest male

DUNCAN MULTIPLE RANGE TEST

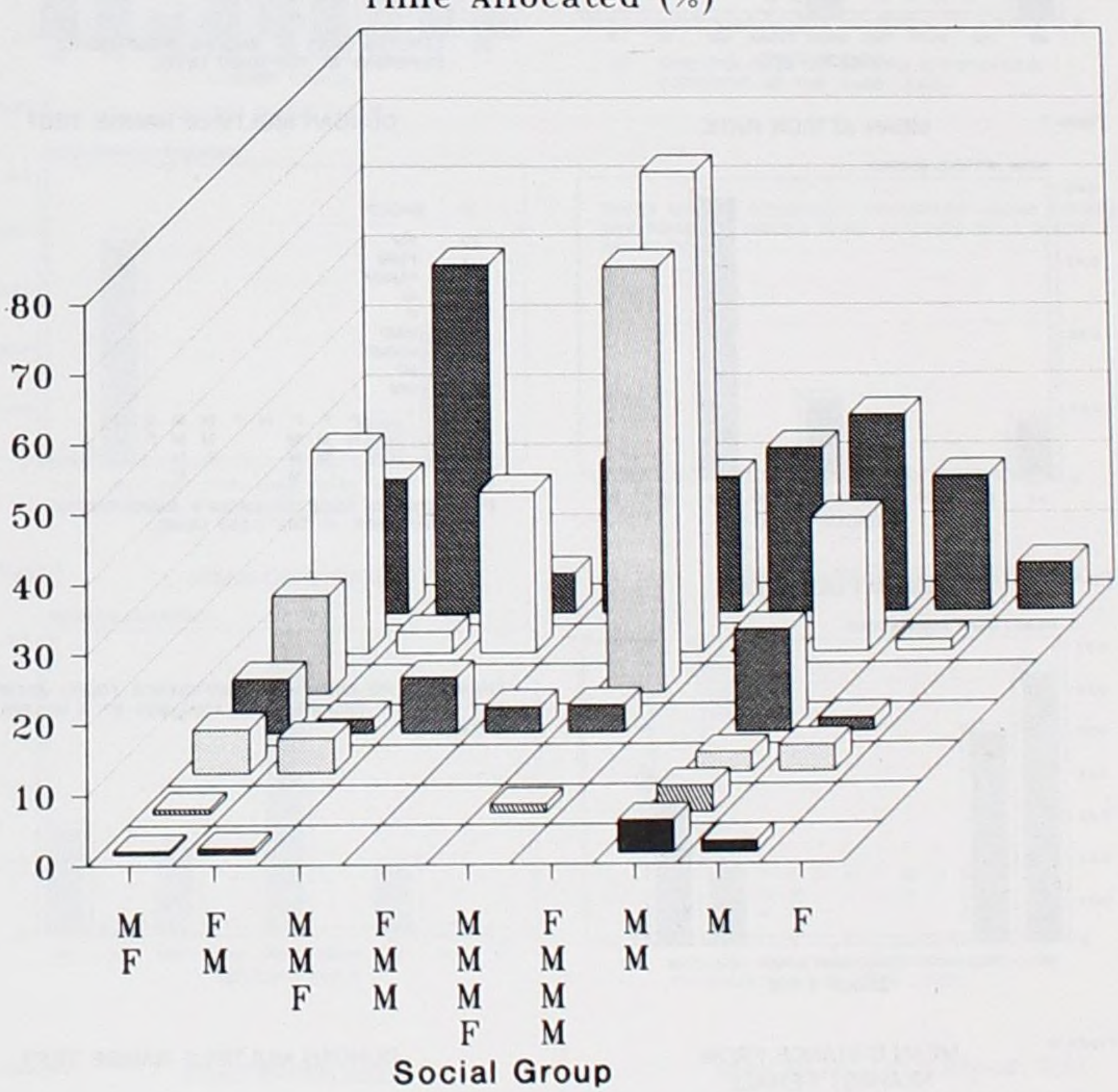
N	GROUP
16	MMMF
3	MMF
22	MF
1	F
16	MM
3	M

•	•	•				
•	•	•	•	•	•	
M	M	M	F	M	M	
M	M	F		M		
M	F					
F						

(•) DENOTES PAIRS OF GROUPS SIGNIFICANTLY DIFFERENT AT THE 0.050 LEVEL.

Figure 10

BEHAVIOUR TIME BUDGETS



Preening (see Fig 5)

Males in MM pairs preened for the longest, significantly longer than ducks in a breeding pair. The males from all groups preened more than their associated females although lone males rarely preened. No lone females or FMMM females were recorded preening.

Guarding (see Fig 6)

Males in MMMF groups guarded for longest. Males from breeding pairs were the only other group observed guarding.

Attacking (see Fig 7)

MM pairs attacked the most followed by males from MMMF and MF groups. Most attacking occurred during feeding sessions, almost exclusively so in the case of MM pairs. No female or any unpaired individual was seen attacking.

Flight (see Fig 8)

Flights were rarely observed and most were either very short (<10 seconds) or much longer (>2 minutes). Whenever a duck from a breeding pair flew its partner followed, this was also true of MM pairs. Breeding pairs flew for the longest, followed by lone males. The latter often flew to pursue females, none of these flights were seen to lead to courtship or copulation.

Mean Distances from Nearest Female (see Fig 9)

Single males remained significantly further from females than males from any other group. MM pairs also spent a great deal of time away from other ducks, unlike lone females which tended to remain close to males. Breeding pairs often separated for longer and travelled further away from other ducks than individuals from multi-male groups.

The percentage time allocation to all behaviours of individuals from all social groups can be seen in Figure 10.

Discussion

1) The differences in feeding behaviour between groups

Females in groups fed for longer than their associated males and females from breeding pairs fed for longest. The possible increase in male protection of females belonging to a polyandrous groups did not encourage female to feed for longer. MM pairs fed for the second longest time possibly as a result of their abstention from mate guarding.

The total amount of time allocated to feeding depended on gender and social group. A mean of all individuals recorded showed that 'on average' mallard allocate 23% (N=74) of their time to feeding. This figure is lower than found by Jorde *et al.* (1984), although seasonality and the bias towards the recording of specific social groups may explain the discrepancy.

2) Behaviours associated with female defence

Males from MMMF groups guarded for longest and the protection was often by the 'dominant' male against other males within the group and seldom from external males.

Intra-group competition between males in multi-male groups contributed to their high attack/guard rate. Males from breeding pairs guarded their females primarily from lone males, although instances of the smallest male from a MMMF group attempting courtship with females from breeding pairs were observed. The highest attack rate was by MM pairs although this occurred predominantly during feeding bouts and may not be 'mate protection' *per se*.

Males associated with females called the most and, as with guarding, MMMF males called for the longest, being subject to both strong intra-group and some inter-group competition.

3) Other Behaviours

Males from MM pairs preened for longest (almost twice as long as any other group) this again may be because these males were not mate-guarding and could allocate more time to personal grooming.

Short flights were often undertaken by breeding pairs to change location often after having been disturbed by lone males. This may be a reason for their low guard/attack rates. These flights were most frequently initiated by the male. Generally single males flew to pursue females and MM males flew to feed.

Males associated with females (MF, MMF and MMMF) remained in close proximity to females. The results suggest that polyandrous males stayed closer to their associated female than monogamous males. Males from breeding pairs often strayed considerable distances (>10m) from their partners (personal observation). Females straying may be a result of the absence of intra-group male competition for the female in breeding pairs and may encourage FEPC. This may support the possibility that re-nest clutches are frequently fertilised by FEPC (Milstein 1979). MM pairs remained distant from other females most of the time possibly as all females were closely guarded.

The Advantages Of Mixed Social Groups

Pre-nuptial feeding is important for reproductive success (Rohwer & Anderson 1988) and females from breeding pairs fed for longest i.e. longer than those in polyandrous groups. Females generally fed for longer than males supporting the work of Rohwer & Anderson (1988).

Mating strategies of males without a single partner are to either associate with other males, join a polyandrous group or to remain alone. The results suggest that pairing with another male means that little time/energy is allocated to guarding or competing for a female allowing the males to feed and preen for longer. This study provides no information about the mating success, if any, of these individuals. MM pairs spent most of their time away from other ducks and only competed with other ducks during feeding sessions when they called persistently. As far as I know the success of individuals during these frenzied feeding bouts induced by humans 'feeding the ducks' have not been studied.

The suggestion that forced copulations are a successful breeding strategy in waterfowl (McKinney *et al.* 1983) may mean that some males not associated with females lead a less competitive lifestyle and fertilise females through forced copulation. Other authors have assumed unpaired males are mainly responsible for FEPC (Barash 1977, Wittenberger 1981) although there is little evidence to support this. Unpaired gamefarm mallards primarily attempt to form pair bonds not FEPC (Titman & Lowther 1975).

Both monogamy and polyandry are of less benefit to males if forced copulations are continually more successful than mate-guarding. In highly skewed sex ratios there are a number of strategies open to males. The extreme competition to be the successful male during forced copulations may keep more males in monogamous and polyandrous groups.

The function and effects of polyandry may be further complicated in this artificial environment due to lower population densities and fewer predators than a natural environment. Behavioural studies on waterfowl inhabiting man-made ponds may reveal the benefits of polyandrous, monogamous and forced copulation mating strategies. Future research incorporating genetic analysis of offspring by DNA fingerprinting may help to elucidate this as with the Dunnock (Burke *et al.* 1989) .

Conclusions

Gender and social grouping strongly influence the behaviour of urban mallard. Females from breeding pairs allocate more time to feeding than other ducks and may avoid competition by making short flights with their mate when disturbed by other males. Males from polyandrous groups generally remain close to their associated female and are subject to intra-group competition. Males not associated with a female are subject to little competition and spend more time away from other ducks feeding and preening. The hierarchy of males in polyandrous groups is currently being investigated.

Acknowledgements

I am grateful to Louise Hussey, Paul Robinson and Glyn Cotton for their assistance in the collection of the data. I would also like to thank Dr Peter Dunleavy, Dr Philip Wheater and Dr Martin Jones for their comments on the paper.

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EDITORIAL

Steve Garland

157 Tudor Avenue, Bolton BL1 4NB

This Issue

Thank you for buying the latest issue of the Lancashire Wildlife Journal. This is another full issue with quite an emphasis on insects. Enclosed is a slip to register your interest in future issues and to order back-issues. Thanks to several competitive quotes, I have been able to hold the price exactly as last year at £2.50!

Future Articles

Please make an effort to contribute something in 1995. The success of the Journal depends on both you as a reader and you as an active naturalist, keen to share your findings with others in the region. People often ask me what would constitute an acceptable article. It can range from a definitive article showing the distribution of a group of species in the region to a few paragraphs outlining a piece of original observation, such as the discovery of a new species to your neighbourhood, or some unusual animal behaviour, or something found where you would not expect it.

Illustrations

I made a plea in the last Issue for aspiring artists to contact me, without much success. Surely someone would like to see their drawings in print? Please contact me if you know of anyone.

Acknowledgements

I would like to thank all of the authors for their contributions; Anne Magee for typing some of the articles; Geoff Yates for the bat illustrations; my employers, Bolton Museum, for their support; Patricia Francis for providing photocopies of suitable herbarium specimens for illustrations and all people who pre-ordered this issue.

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Front cover illustration
Ammophila sabulosa, Sand Wasp