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General Aviation Small Aerodrome Research Study

Aerodrome Categorisation
Using Secondary Aerodrome Data

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Introduction

This paper describes the process used to analyse secondary data from a number of different sources then reach conclusions about the different of aerodromes. Its objective is to reduce the apparent complex variety of aerodromes into a set of limited types or categories that reflect their economic importance, according to their general characteristics. It assumes the reader is familiar with the background and objectives of GASAR.

Economic importance is assumed to be directly related to levels of activity, where activity is measured in terms of quantity and type. However, there is no central depositary of such activity levels for UK aerodromes. The CAA does collate and publish data regarding the larger concerns, but it is of limited use regarding General Aviation. Not only is the breakdown not well defined, or consistently applied, but only movements are counted and no data is provided, for example, regarding tonnage or passengers on board. Movement data was collected via the *Aerodrome Operators Survey* and this will be cross referenced with the CAA data to provide reasonable estimates for the larger sites. However since neither the survey nor the CAA data is complete for all sites this still leaves a significant number of sites for which there is no usage or activity information.

For these and other research reasons, it was decided to categorise aerodromes. One process within the socio-economic model will be to apply data from sites with known levels of activity to others that are seen to be of a similar economic importance. At the simplest level, data from farm airstrips that completed the Aerodrome Operators' Survey should provide a reasonable estimate of activity at all farm strips. Equally it should be possible to estimate the activity at the larger sites from activity at others in the same category, provided some care is taken to weight any known differences.

There are over 480 sites published in the various flight guides and since it is impossible to visit each site to form an on-the- spot assessment, it was decided to establish the categorisation of aerodromes using public domain data, i.e. based on desk research. It soon found to be impossible to categorised aerodromes using a few simple parameters; for example, all those with grass runways, glider sites, or those fully CAA licensed. There are just too many exceptions. Yet experienced pilots will have a notion of sites that are similar or fit a certain type because they are able to take into account a range of different factors and perhaps intuitively rank sites. A more structured methodology was required to replicate this intuitive approach. A wide range of parameters need to be developed and both the position of the subject considered as well as the relative importance of the parameter. An analogy might be the evaluation of job grades or hotels that would provide a clear hierarchy of different levels of aerodrome. Not all the aerodromes in a group would have identical facilities but the overall impact of different features and attributes would place them in the same category. From the start it was seen that software would be necessary to execute the analysis phase and the technique of *Cluster Analysis* as provided by the statistical software package SPSS was identified.

Several sources of public domain data were identified and used. The most comprehensive sources were the three well known *Flight Guides*, Pooleys, AFE and Lockyears. Since the AFE guide listed details of the greatest number of sites it was used extensively, only details of sites not listed in AFE were added using the other two publications.

Pilots use these guides when intending to visit an aerodrome that is accessible to the public. They may also be used when trying to find somewhere to land in an emergency. In addition to the location of individual airfields these guides provide other data essential to the aviator, including circuit procedure, radio contact and runway details. It was recognised that for this research, such information has the potential to be used for modelling purposes, for example to be analysed as possible generators, attractors or detractors. Insufficient runway length and or an inadequate surface may, for example, be detractors for large aircraft whilst the existence of a café could be an attractor for the casual, leisure flyer.

Over a period of time, twenty possible parameters affecting aerodrome usage were developed from the Flight Guides. These were supplemented by another eight parameters from five other sources and the resulting database subjected to the rigours of the *Cluster Analysis* technique. After numerous attempts using different weights and settings, plus referral to a team of experienced flyers, six different types of aerodrome were mathematically identified.

The following will outline the methodology used before categorising each of the 374 sites involved and describing the six aerodrome types.

Method

The first task was to establish a database of all English sites listed in the three flight guides. Apart from names and addresses, longitude/latitude details were also extracted. It became necessary, however, to confirm the latter using the Internet (www.StreetMap.co.uk) as there was a number of surprising errors in the flight guides. Accurate longitude & latitude readings were important since not only were they used to eliminate duplicates (sites often have more than one name) but they will also be used to locate sites within a GIS database relative to local authority boundaries and population density. The list was further refined to eliminate forty two military airfields and, at a later stage, eight other sites known not to involve any General Aviation activity; Heathrow, Gatwick, Stanstead, Barrow, Brough, Chalgrove, Manchester Woodford and Warton.

Not all the sites listed in the guides were used in the subsequent Cluster Analysis. For example, Pooleys provides names and locations for 113 sites in England that are used by glider, microlight, balloon and parascending enthusiasts. However these sites are not described in detail and so could not be added to the full database. Pooleys also lists over 200 helipad sites, which typically are located within hotel grounds and considered to be a distinct category in their own right, so without any need for cluster analysis. Even so an allowance for activity at these sites will be necessary within the Socio-economic model. These 313 specialist sites, which may be referred to as *Other Flying Sites,* are not included in the following which concentrates on 374 more classical aerodromes located in England.

From the Flight Guides the following twenty parameters were chosen and codes defined:

Parameter	No. Codes	Range (from/to)
- Extent of Building Development	5	No buildings to large terminal facilities.
- Available Runway Directions	3	One, Two or >Three.
- Available Helicopter pads	3	None, One or >Two.
- Type of Runway Surface	3	Grass, Mixed or Hard
- Maximum Runway Length (TORA)	7	Less than 450M to >2,400M
- Runway Lighting	3	None, Partial or Full
- Outline of Taxiway & Apron	3	Grass, Part Hard, Both Hard Taxiway & Apron
- Navigational Aids	3	None, Basic Beacon, ILS etc.
- Air to Ground Communications	5	None to Full TWR and GND control
- Operating Hours	4	By Arrangement to Full 24*7
- Ease of Joining	5	Simple to Complicated
- Maintenance Facilities	3	None, One, >One Company
- Fuel	4	None to >One type of fuel
- Catering Facilities	5	None to Restaurant
- Customs Facilities	4	None to Full Customs
- Landing Charges	4	Not specified to Normal Charges
- Type of AD Operator	3	Individual, Club/School or Company/Charity
- Specialisation (Gliders etc)	4	None to >One main specialisation
- Aircraft Restrictions	4	None to >Two restrictions + One exclusion
- Flight Guide Recognition	3	Lockyears only to AFE or Pooleys only

The preceding table summarises the number and range of codes used within each parameter. For some there were only three coding levels (e.g. None, Partial or Full) and others had multiple codes (e.g. for different runway lengths). Consequently all data was coded from 0 to a maximum of 7.

In addition to these parameters, six more were developed from other secondary sources:

Source	Parameter	No. Codes	Range (from/to)
Flyer Supplement	Known Training Schools	6	None to >Seven Schools
CAA Request	CAA Aerodrome Licensing	2	Not Licensed or Licensed
CAA Movement Data	Level of GA Movements	8	5% to 100% assumed
Census Database	Population within 12 miles	6	<1/6 max to >5/6 maximum
Census Database	Population within 2 miles	6	<1/6 max to >5/6 maximum
Streetmap.co.uk	OS Map Visibility	3	None to OS Mapped.

The resulting database was then analysed using the *Hierarchical Cluster* option (*Average Linkage/ Between Groups*) within SPSS and a set of *Dendrograms* produced. Dendrograms show pictorially the progressive relationships between each aerodrome as it is compared to others and then paired off either individually or in groups. The software rapidly executes a number of such iterations until all aerodromes are grouped together in one large cluster. Appendix A shows the final dendrogram and illustrates how after only several iterations, clusters are formed of similar sites.

The objective was to produce a dendrogram and set of clusters that was in line with loosely held expectations. Based on a limited knowledge of a small proportion of the sites listed, it was expected that certain airfields should appear in the same cluster. Initially the results appeared encouraging as broadly speaking the software graduated sites from obvious farm strips to the large airports. However within the groups there were anomalies and a trial and error approach was taken to improve the results.

Cluster Analysis is normally used to bring clarity to data where there is no known pattern and so a trial and error approach would not be appropriate since no preconceived outcome is available. However on this occasion the results needed to be believable by those not familiar with the statistical technique and who already had preconceived notions of what to expect. Essentially the software was used to fill in the gaps, since no individual could be categorise with all the sites involved. Provided benchmark aerodromes were seen to be in the right category then the assumption is that the others were equally well categorised, at least accurately enough for the socio-economic model. By differentially weighting parameters until the results approached expectations, cluster analysis was essentially used to model reality, by identifying the more significant parameters and distinguishing between the less important ones.

This was achieved by normalising the parameters (each given a maximum score = 1) and weightings applied individually. Parameters regarding airfield facilities were weighted according to Question C6 of the Pilot Survey, which broadly identified the parameters considered important to pilots. Only two levels of weighting were used at this stage, for apparently significant versus less significant parameters - in the ratio of 1:2. That is, parameters such as *Runway Directions* were weighted twice as much as other, less definitive ones, like *Ease of Joining*. In June 2004, the results from this analysis were then circulated to ten members of GAAC for review. Each was asked to complete a spreadsheet to indicate levels of agreement with the mathematical process. Overall the results were encouraging but not sufficiently accurate. Out of 522 cases reviewed 17% were felt to be wrongly classified.

Based on the feedback from the review group, formed from GAAC members (particularly David Ogilvy - who was familiar with greatest number of individual sites, 155), it was decided to add at least one more parameter that would provide greater credibility of to the results. The rationale was that other factors affect the economic significance of an aerodrome that could not be provided from public domain sources. For example a site may be popular for because the operators were known to be helpful and friendly. Or perhaps the hangarage costs were low. To compensate for these other factors it was necessary to find a measure that reflected the popularity of a location. It was decided to measure Aircraft Presence using the aerial photographs available from *Multimap.co.uk*. As a result, two parameters were ultimately developed to allow for the obvious differences in aircraft size between the airliners and light aircraft.

Each location was viewed at maximum zoom and the number of visible aircraft noted. Like the other parameters, the actual numbers were then classified into six coding levels, from none to <25 large aircraft or >50 light aircraft. Coding was thought to be appropriate in this case in order to avoid placing too much significance to individual counts, as the counting process was recognised to be open to interpretation. A cross check with data from the Aerodrome Operators Survey showed that the number of aircraft visible using Multimap did relate to the number of aircraft reported to be based at each site. On average 58% of the number of aircraft said to be based at an aerodrome were visible using Multimap. However these were not necessarily the same aircraft as visitors would be included and for some sites it was obvious that good levels of hangarage enabled most aircraft to be hidden from view. Glider sites were also a problem as the extensive use of trailers tended to understate the number of aircraft using the site. However since the aircraft hidden in hangers could not be counted it was decided also not to attempt to

count trailers, particularly as from 5,000 feet or so, it was difficult to distinguish caravans from trailers.

Further trial and error changes were then made to the data used by the SPSS Cluster Analysis process. It was found that the two *Aircraft Presence* parameters need to be heavily weighted to overcome the anomalies mentioned earlier. Also that the *12 mile Population*, *CAA License* and *GA Movement* parameters needed to be distinguished from the other original parameters. Four levels of weighting (in the ratio 4:2:1.5:1) were eventually necessary to align the results with expectations that by now were benchmarked by the results of the review group.

A total of six clusters emerged from the cluster analysis. Only one site, London City, appeared not to fit well with its mathematically determined group and was reassigned from one cluster to another. Each cluster was assigned a category letter (A to F), its characteristics analysed and verbally summarised.

But before looking at the categories, it is worth commenting upon the terminology used. Whilst the writer has endeavoured to use the term *aerodrome* in the correct sense, that is any *formal flying site*, it was felt unavoidable when describing certain sites that the term *airfield* should not be restricted to its technical meaning. Technically only the military have airfields, but in the following it is given its more common meaning. Equally whilst an *airstrip* might strictly mean one landing strip without any supporting facilities the following uses the term loosely to describe a site with fewer facilities than an airfield.

Results

Category "A"

BIRMINGHAM
BLACKPOOL
BOURNEMOUTH (Hum)
BRISTOL
BRISTOL FILTON
CAMBRIDGE
COVENTRY
EAST MIDLANDS
EXETER
FARNBOROUGH
HUMBERSIDE
LEEDS BRADFORD
LIVERPOOL JOHN LENNON
LONDON LUTON
LONDON CITY
MANCHESTER
MANSTON (Kent International)
NEWCASTLE
NORWICH
SOUTHAMPTON
SOUTHEND
TEESSIDE

There are twenty two aerodromes within this category representing a group that are best described as *Regional Airports*. As such they are included in both Pooleys and AFE flight guides but not Lockyears. Most are located in the urban fringe where they provide the higher population areas with access to Commercial, Business and other General Aviation aircraft. Multimap aerial photographs suggested the average site in this group typically has at least twelve large aircraft and between ten and twenty five light aircraft parked in the open. Flight guides indicate that 40% have formal Helicopter landing pads. All the sites are shown on general purpose OS maps and all have hard runways and taxiways plus large terminal buildings and hangers. Slightly less than half have more than one runway direction and only Blackpool and Cambridge cover three directions. Cambridge is the only site with a mix of grass and hard runways. All have runway lengths in excess of 1800 metres that have either partial or full lighting. These airports are characterized by full navigational aids, including ILS and without exception have full air traffic control facilities. Most are open all hours with only a quarter operating restricted times. All have maintenance and fuel facilities and all apart from Farnborough have either restaurant or café facilities. All have full customs facilities apart from Farnborough and Bristol Filton. Flight schools are common in this group with the average site having between two and four identified companies offering training. All charge landing fees and are run by companies as against clubs or individuals. Unsurprisingly there was little evidence of specialisation with no glider or microlight activity and yet at some sites certain types of aircraft are specially excluded. Only Newcastle and Teeside are not CAA licensed aerodromes. On average between 40 and 80% of movements are reported to be GA related although Birmingham and Manchester have less than 5% and Luton has less than 20% GA movements.

Category "B"

BIGGIN HILL
BLACKBUSHE
CRANFIELD
DENHAM
ELSTREE
FAIROAKS
GLOUCESTERSHIRE (Staverton)
KEMBLE
MANCHESTER BARTON
OXFORD
REDHILL
SHOREHAM
STAPLEFORD
THRUXTON
WHITE WALTHAM
WOLVERHAMPTON (Halfpenny Green)
WYCOMBE AIR PARK (Booker)

Category B contains seventeen aerodromes that may be described as *Major GA Airports*. Like Category A, aerodromes in this category are also included in both Pooleys and AFE flight guides but not Lockyears and are likely to be on the urban fringe. However they do not provide facilities for Commercial Air Transport and but concentrate heavily on Business and other General Aviation aircraft. With two thirds of sites possessing Helicopter landing pads this category appears particularly focussed on business needs. At least twenty five light aircraft are likely to be parked in the open at any one time and some sites have more than one hundred. All the sites are shown on general purpose OS maps. Most have either hard or mixed hard & grass runways although Manchester Barton, Redhill and White Waltham are purely grass. Generally runways lay in two or three directions apart from Blackbush, Elstree and Fairoaks that have only one runway. All runway lengths are in excess of 900 metres apart from Manchester Barton which has a maximum TORA length of 621 metres. Indeed Barton is generally an exception with regard to infrastructure (buildings, taxiway and lighting development) but it appears to have a high level of resident light aircraft that qualifies it for this category. Apart from Barton all the sites have partial runway lighting and the majority has both basic navigational aids and formal air traffic control. They operate extended hours, have maintenance and fuel facilities and apart from Stapleford have either restaurant or café facilities. Only Biggin and Shoreham have full customs facilities, most operate on a 'by arrangement' basis, except from Kemble and Wolverhampton. Category "B" has the highest number of flight training schools with three to six schools at the average site. All charge landing fees and are generally run by companies except for Barton, Stapleford and White Waltham that are club based. Some sites support microlights and gliders but generally this category was more to exclude certain aircraft types. All are CAA licensed aerodromes and on average they report high levels (in excess of 95%) for General Aviation movements.

Category "C"

ANDREWSFIELD
BECCLES
BEMBRIDGE
BEVERLEY (Linley Hill)
BODMIN
BOURN
CHICHESTER (Goodwood)
CLACTON
COMPTON ABBAS
DERBY
DUNKESWELL
EAGLESCOTT
EARLS COLNE
ELMSETT
FENLAND
FULL SUTTON
HUCKNALL
HUDDERSFIELD (Crossland Moor)
ISLE OF WIGHT (Sandown)
LANDS END (St Just)
LASHAM
LASHENDEN (Headcorn)
LEICESTER
LITTLE GRANSDEN
LYDD
NETHERTHORPE
NORTHAMPTON (Sywell)
NOTTINGHAM
OLD BUCKENHAM
OLD SARUM
PANSHANGER
PERRANPORTH
PETERBOROUGH CONINGTON
PETERBOROUGH SIBSON
PLYMOUTH
POPHAM
RETFORD (Gamston)
ROCHESTER
SANDTOFT
SCILLY ISLES (St Mary's)
SEETHING
SHEFFIELD CITY
SHERBURN IN ELMET
SHOBDON
SLEAP
TATENHILL
TRURO
TURWESTON
WELLESBOURNE MOUNTFORD
WICKENBY
YEOVIL (Westland)

There are fifty-one aerodromes in this category, representing a group best described as *Developed GA Airfields*. Like Categories A & B, aerodromes in this category are also included in both Pooleys and AFE flight guides but nearly a half are also included in Lockyears.

All are located in rural areas. Generally this category is similar to B but with less infrastructure and therefore less likely to be used by Business Aviation. The average site will have between ten to twenty five light aircraft parked in the open. In several sites these aircraft are likely to be Gliders and associated with large numbers of trailers rather than hangars. Only 15% of aerodromes in this category have formal Helicopter pads. Most but not all are shown on general purpose OS maps. The majority have at least two runway directions but 40% are unidirectional. Half have purely grass runways and nearly 40% hard runways, the balance being a mixture. Runway lengths encompass the complete spectrum but the average TORA length is 600 – 900 metres. A fifth have full runway lighting and a third partially lighting, leaving under a half with not night time capability. 40% have basic navigational aids and all have basic ground to air communication although 7% only operate this occasionally. A similar percentage only operates weekends or weekdays, with the majority being open all week between sunrise and sunset. Equally 7% provide no fuel on site and 30% do not offer any maintenance facility. 90% however can provide beverages to the pilots and two thirds have either restaurant or café facilities. Nearly 8% have full customs facilities, for example Lydd and Plymouth, whilst for many sites customs can be arranged. However, nearly 30% are not recognised customs entry points. A third of sites have no training school, a third have one and the rest have two or three. Most charge landing fees and only three suggest a donation or do not charge with fuel. Unlike Category B, 44% are operated by clubs and the rest by companies. However, nearly all are CAA licensed aerodromes, the exceptions being Popham, Lasham and Huddersfield. All are highly dependent upon General Aviation movements. A third of sites specifically mention gliding and microlight activity.

Category "D"

BAGBY (Thirsk)
BIDFORD
BREIGHTON
BRIMPTON
BROOKLANDS
BRUNTINGTHORPE
BURN (SELBY)
CAMPHILL
CARLISLE
CASTLE BYTHAM
CHATTERIS
CHILBOLTON
CLUTTON HILL FARM
DAVIDSTOW MOOR
DEANLAND (Lewes)
DUNSTABLE DOWNS
DUXFORD
ENSTONE
ESHOTT
FOWLMERE
HENSTRIDGE
HINTON IN THE HEDGES
HUSBANDS BOSWORTH (Rugby)
INCE
LANGAR
LONG MARSTON
MAYPOLE
MILFIELD
NAYLAND
NORTH WEALD
NYMPSFIELD (Stroud)
OTHERTON
POCKLINGTON
SALTBY
SHENNINGTON (Edgehill)
SILVERSTONE
SPANHOE
STOKE
STURGATE
SUTTON BANK (Thirsk)
TARN FARM
TIBENHAM
WESTON ON THE GREEN
WOODLANDS (Roche)
YORK (Elvington)
YORK (Rufforth)

With forty-six flying sites in this category, it may be described as the *Basic GA Airfields* group. All aerodromes in this category are included in either Pooleys or AFE flight guides (but not necessarily both) and two thirds are also included in Lockyears. Almost all are located in rural areas, apart from Brooklands. Although all factors considered Brooklands is best assigned to this group, as a low movement museum site (unlike Duxford) it is an obvious exception, and will not be further highlighted in the following. Generally this category is similar to C but with even less infrastructure and less evidence of usage. The typical site will have between three to ten aircraft parked in the open, although a quarter may have up to twenty five aircraft visible. 80% of aerodromes in this category do not have formal Helicopter pads. A fifth of sites are not shown on general purpose OS maps. Again important gliding sites are included. Compared to Category C, runways are more likely to be in one direction only and be shorter, and less likely to be hard as a half have only one runway direction, 20% have a TORA less than 450 metres and less than 30% have hard runways. Equally runway lighting and navigational aids are unusual. A quarter do not provide basic ground to air radio communication, even occasionally. A third cannot provide fuel and nearly a half do not offer maintenance facilities. Other facilities are also

limited. A third do not provide on-site beverages and 93% are not listed for customs clearance. One fifth can provide training but as this is usually by only one school and it is likely to be limited to one type of flying. Conversely nearly a half either charge no landing fee or waive it if fuel is purchased. On complete contrast to Category C, licensed aerodromes are the exception as only Silverstone and Duxford are licensed in this group. Whilst the majority, over a half, are operated by clubs and more than a third by companies, this groups also contains a few sites operated by individuals. This group was also distinguished as 70% of sites specifically mention microlight and/or gliding activity.

Category "E"

ABBOTS BROMLEY (Yeatsall Farm)
ASHCROFT
AUDLEY END
AYLESBURY (Thame)
BADMINTON
BAKERSFIELD
BATTLEFLAT FARM
BAXTERLEY
BELLE VUE
BOONES FARM
BOSTON
BOUGHTON (North)
BOURNE PARK
BROOK FARM (Garstang)
BUCKNALL
CARK
CHILTERN PARK
CLENCH COMMON
COAL ASTON
COTTERED (Buntingford)
CRAYSMARSH FARM
CROFT FARM (Defford)
CROMER (Northrepps)
CROWFIELD
CROWLAND (Spalding)
CUCKOO TYE FARM
CURROCK HILL
DEENETHORPE
DITTON PRIORS (Bridgenorth)
DRAYCOTT FARM (Swindon)
DRAYTON ST LEONARD
EASTBACH (Spence)
EASTON MAUDIT
EDDISFIELD
EGGESFORD
FADMOOR (Moors National Park)
FARTHING CORNER (Stoneacre Fm)
FARWAY COMMON
FELIXKIRK
FELTHORPE
FINMERE
FINNINGLEY VILLAGE
FISHBURN
FRAMLINGHAM
GARFORTH
GARSTON FARM
GARTON FIELD
GERPINS FARM
GREAT MASSINGHAM
GREAT OAKLEY
HALWELL
HANLEY (Hanley William)
HARDWICK (Norwich)
HAXEY
HAYDOCK PARK (Newton-le-Willows)
HOLLYM (Home Farm)
HOME FARM
HOUGHAM
HULL (Mount Airey)
KIRKBRIDE
KIRKBYMOORSIDE
KNOCKIN (Oswestry)
LADDINGFORD
LAMBLEY (Jericho Farm)
LANGHAM
LARK ENGINE FARMHOUSE
LEDBURY (Velcourt)
LEE ON SOLENT
LITTLE SNORING
LITTLE STAUGHTON
LONG ACRES FARM (Sandy)
LONG STRATTON
LOUTH HALL FARM (North Reston)
LUDHAM
MARSHLAND
MELBOURNE (Melrose Farm)
MILSON (Cleobury Mortimer)
MITCHELLS FARM
MONEWDEN (Cherry Tree Farm)
NEW YORK
NEWBURY RACE COURSE
NEWMARKET HEATH
NEWNHAM (Baldock)
NEWTON PEVERIL
NORTH COATES
NORTH MOOR (Scunthorpe)
NUTHAMPSTEAD (Royston)
OAKSEY PARK
PEPLOW
PETERLEE
PLAISTOWS
POUND GREEN
RAYNE HALL FARM
REDLANDS (Swindon)
REDNAL
RODDIGE
ROSERROW
ROSSENDALE (Lumb)
ROTHWELL
ROUGHAM
RUSH GREEN (Hitchin)
SACKVILLE FARM (Riseley)
SALCOMBE
SANDHILL FARM
SEIGHFORD
SHEEPWASH
SHERLOWE
SHIPDHAM
SHOTTESWELL
SHUTTLEWORTH (Old Warden)
SITTLES FARM (Lichfield)
SKEGNESS (Water Leisure Park)
ST MICHAELS
STALBRIDGE
STOODLEIGH BARTON
STRETTON
STRUBY (Gliding & Old Heliport)
SUTTON MEADOWS
SWANTON MORLEY
SWINFORD
TEMPLE BREUER
THORNE
THURROCK
TIBENHAM (Priory Farm)
TILSTOCK
TOP FARM
TOWER FARM
TRULEIGH FARM
WAITS FARM
WALTON WOOD
WESTBURY SUB MENDIP
WESTON UNDERWOOD
WESTONZOYLAND
WEYBOURNE (Muckleburgh)
WHARF FARM
WOMBLETON (Pickering)
WOOBURN
WOONTON
WROUGHTON
YEARBY

Category E contains the largest number of flying sites. The 140 sites identified represent aerodromes that might be best described as *Developed Airstrips*. 5% of aerodromes in this category are not included in either Pooleys or AFE flight guides and 76% are to be found in Lockyears. Almost all are located in rural areas. Examination by aerial photography revealed it is rare to see more than one aircraft parked in the open and many sites show no evidence of aircraft parking. Hangers are not however unusual, with three quarters of sites having one or several buildings. Even so, three quarters are not identifiable on general purpose OS maps. 80% are grass only sites and two thirds have limited to one runway direction with only 5% having more than two directions. Compared to category D, runways are shorter as over 90% (verses 60%) are less than 900 metres. Only Fadmoor, Lee on Solent and Marshland have runway lighting and only Nuthampstead has any form of navigational aid. 60% do not operate a basic ground to air radio communication, even on occasions. 80% provide no maintenance and 60% cannot enable refueling. Two thirds do not cater for on-site beverages, only three sites could arrange for customs clearance and the existence of a known training school is limited to only four locations. In common with category D however over half either do not charge for landings or give free landings with fuel. Not surprisingly none of these aerodromes are CAA licensed. Nearly two thirds are operated by individuals, many as obvious farm strips, and the balance is shared equally between clubs and companies.

Category "F"

ALCESTER
ALLENSMORE
ASHLEYS FIELD
BEDFORD (Castle Mill)
BENINGTON STRIP
BERROW
BINSTEAD
BOUGHTON
BOWERSWAINE FARM
BOWLDOWN
BROMSGROVE (Stoney Lane)
BROOK FARM (Boylestone)
BROOKFIELD FARM
CALCOT PEAK
CAUNTON
CHALLOCK
CHILSFOLD FARM
CLAYBROOKE FARM
CLIFFE
CLIPGATE
COLEMAN GREEN
CROFT
DOWLAND
EAST WINCH
ETTINGTON
EXNING
FANNERS FARM
FOLKESTONE (Lyminge)
FOREST FARM
FOUR LANES
GORRELFARM
GRANGEWOOD
GRASSTHORPE GRANGE
GRAVELEY
GREEN FARM
GROVE FARM
GUNTON PARK (Hanworth)
HAYWOOD (Broadmeadow Farm)
HENSCOTT FARM
HERMITAGE
HOLLY MEADOW FARM
HOOK
JACKRELLS FARM
JUBILEE FARM (Wisbech)
KEYSTON
KIMBOLTON (Stow Longa)
KINGFISHERS BRIDGE
KINGS LYNN (Tilney St Lawrence)
LAINDON
LITTLE CHASE FARM
LODGE ROAD AIRSTRIP
LOUTH STEWTON
LOW FARM
LOWER BOTREA
LUNDY ISLAND
LYDEWAY FIELD
LYMM DAM
MANOR FARM
MANOR FARM(Compton Chamberlayne)
MANOR FARM AIRFIELD
MANOR FARM PRIVATE STRIP
MANTON
MELBURY
MILDEN
MILTON
MOORLANDS (Hull)
NEWARK (Beeches Farm)
NEWNHAM GROUNDS
OAKLANDS
OLD HAY AIRFIELD
ORANGE GROVE - CHAVENAGE
OXENHOPE
PARK FARM (Eaton Bray)
PAYDEN STREET
PEAR TREE FARM (Cheshire)
PEAR TREE FARM (Oxon)
PENT FARM
RAYDON WINGS
REDMOOR FARM
SHEPTON MALLET (Lower Withail Farm)
STONES FARM
STOW
SWANBOROUGH FARM
THORNBOROUGH GROUNDS
THORPE LE SOKEN
TRENDERWAY FARM
TRENHOLME FARM
TWYCROSS (Gopsall House Farm)
UPPER HARFORD
VALLANCE BY WAYS(Gatwick Museum)
WADSWICK STRIP
WALLIS INTERNATIONAL
WATCHFORD FARM
WELLCROSS FARM
WEST HORNDON
WHITBY (Egton)
WILLOW FARM
WING FARM (Warminster)

The final category contains ninety-eight flying sites that may be best described as *Basic Airstrips*. 95% of aerodromes in this category are listed in Lockyears and only a third are to be found in either Pooleys or AFE flight. Aerial photography rarely reveals any aircraft parked

in the open and less than half show any sign of hangarage. All sites in this category are grass, 87% have only one direction and 97% have TORA lengths less than 900 metres. As might be expected 90% are consequently not identifiable on general purpose OS maps. None have runway lighting or navigational aids and only Caunton has occasional ground to air radio. Facilities are very limited. Only one offers maintenance, only four fuel and only three can provide a cup of coffee. Customs and training schools are non existent. These sites are 90% owned by individuals although eight are listed as run by companies and only one by a club. Since data for this category was mainly dependent upon Lockyears and Lockyears does not indicate landing fees the assumption is that most sites are either free or open to donations.

Apart from the detailed inclusion of these sites in the Flight Guides, *Basic Airstrips* are thought to be very similar in economic terms to *Other Flying Sites*, a category referred to earlier although not described here due to the absence of firm data.

Conclusion

Six categories of general aviation aerodrome have been identified (excluding the *Other flying sites* mentioned and the non GA sites of the military, Heathrow, Gatwick etc.).

Although some refinement of the results may still be necessary the foregoing illustrates that it is possible to categorise aerodromes, despite their apparent complexity, using public domain information. It also shows that apart from the obvious factors of infrastructure, runways and site development, other factors must act as generators, attractors and detractors. Population density is clearly a determinant, whilst other parameters, like the granting of a CAA licence, may be indicators of success rather than drivers.

The lists contained within this report are however not considered to be absolute. The categorisation process using cluster analysis has been undertaken as a means to an end, but although there is a high degree of confidence in the final output, it could not be argued that every single aerodrome is correctly classified. The analogy of Job Evaluation was used in the beginning, and like that technique this one must also be open to different opinions, some of which will prove justified, particularly around the boundary lines drawn between each group.

The next stage of GASAR will be to take the categorisation lists and to apply them to the data collected from the Local Authority and Aerodrome Operators' surveys.

Acknowledgements:

AFE, 2002 – UK VFR Flight Guide, Compiled by L Southern, Camber Publishing Ltd.

Pooleys, 2004 – Pooleys Flight Guide, Editors R Pooley & R Patel, Pooleys Flight Equipment Ltd. Elstree, Herts.

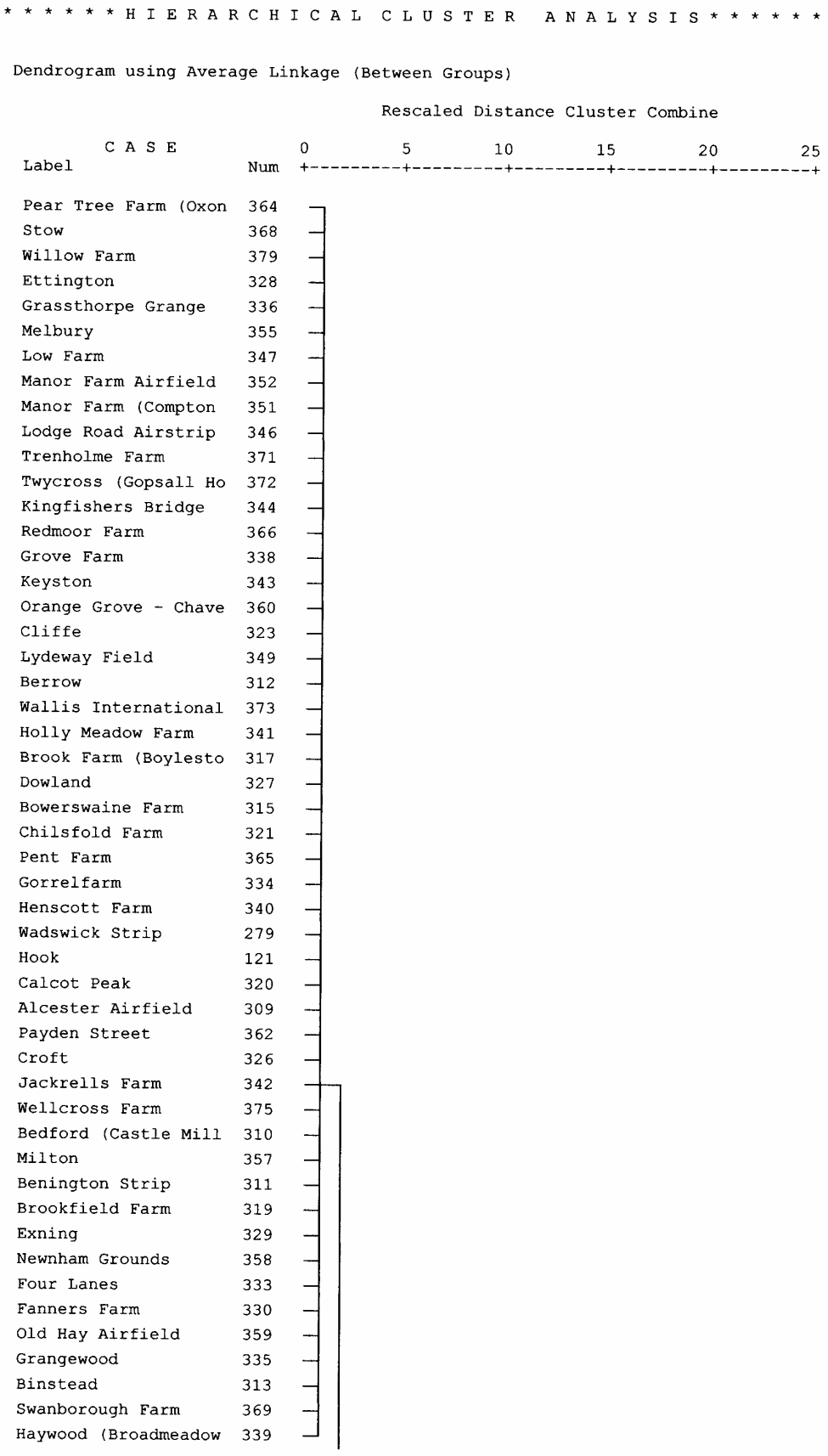
Lockyears, 4th Ed. – Farm 'Strips' and Private Airfields Flight Guide, Editors Brian & J M Lockyear, Stockport, Cheshire.

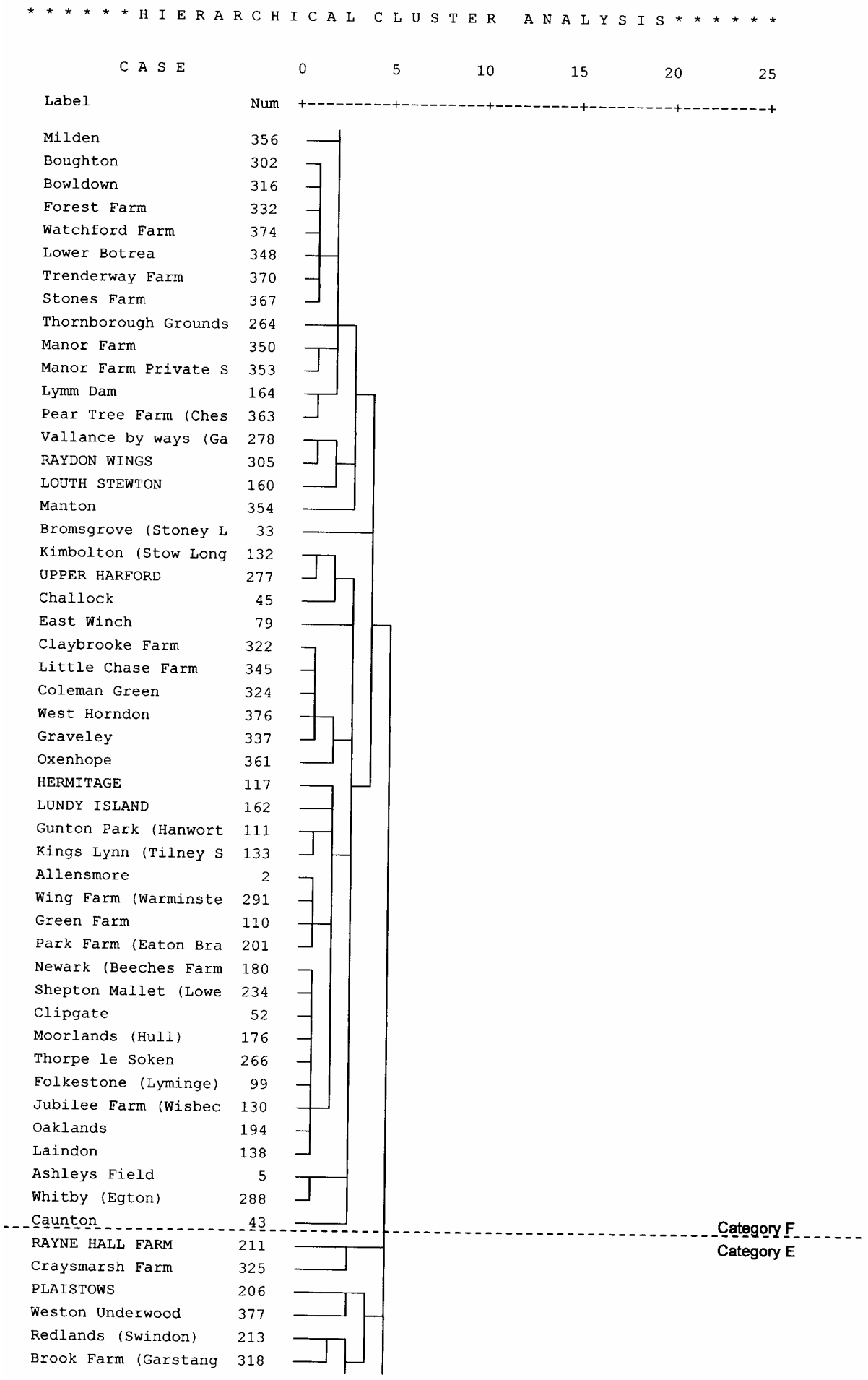
Streetmap – www.streetmap.co.uk

Multimap – www.Multimap.com

And the following members of GAAC who volunteered to act as a review group and assess the computer generated output: David Ogilvy, Jack Wells, John Stainer, Keith Jillings, Harry Bott, Chris Boulton and Philip Whiteman.

Appendix A: The Cluster Dendrogram

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Label
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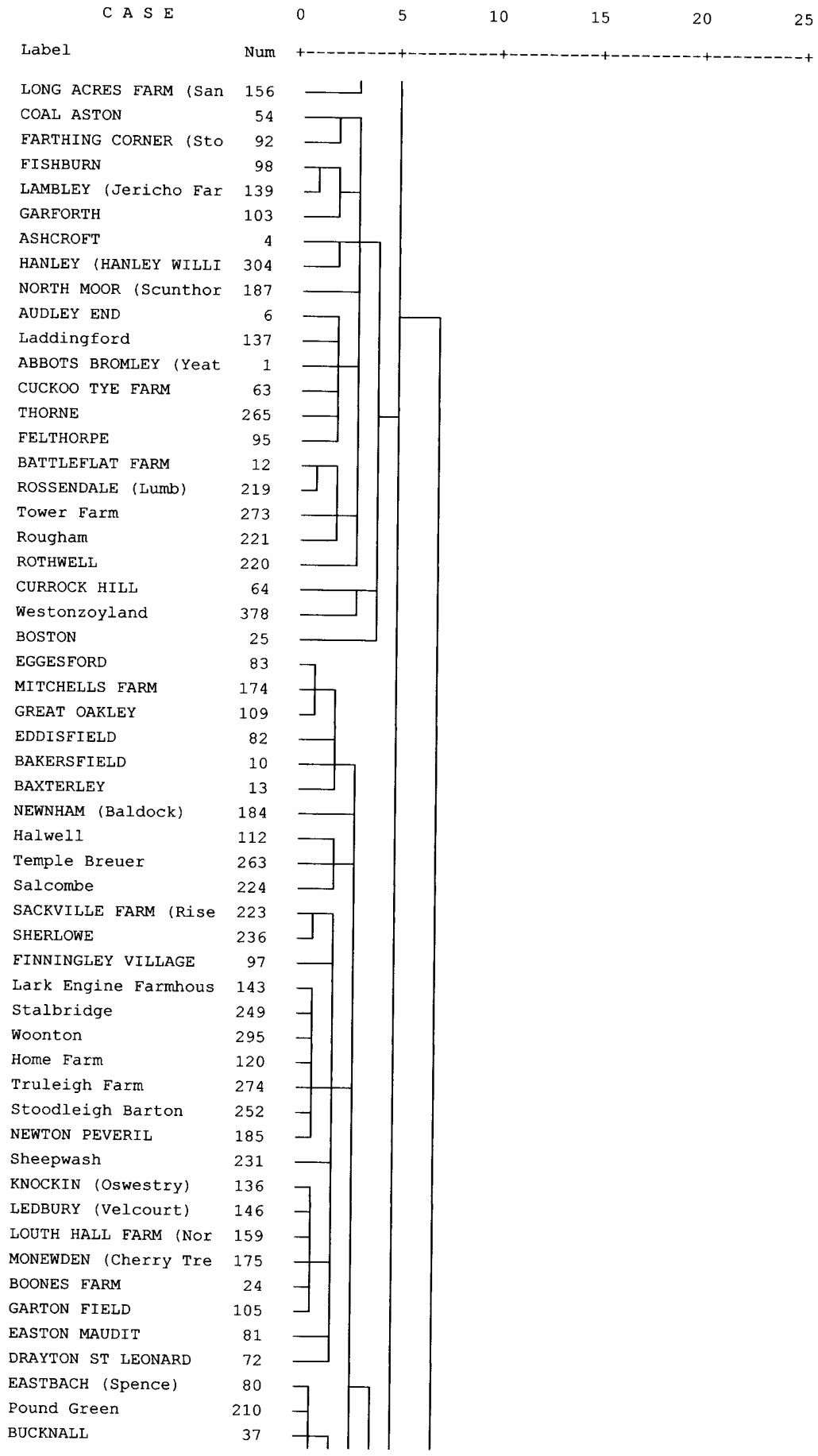
10
15
20
25
Milden 356
Boughton 302
Bowldown 316
Forest Farm 332
Watchford Farm 374
Lower Botrea 348
Trenderway Farm 370
Stones Farm 367
Thornborough Grounds 264
Manor Farm 350
Manor Farm Private S 353
Lymm Dam 164
Pear Tree Farm (Ches 363
Vallance by ways (Ga 278
RAYDON WINGS 305
LOUTH STEWTON 160
Manton 354
Bromsgrove (Stoney L 33
Kimbolton (Stow Long 132
UPPER HARFORD 277
Challock 45
East Winch 79
Claybrooke Farm 322
Little Chase Farm 345
Coleman Green 324
West Horndon 376
Graveley 337
Oxenhope 361
HERMITAGE 117
LUNDY ISLAND 162
Gunton Park (Hanwort 111
Kings Lynn (Tilney S 133
Allensmore 2
Wing Farm (Warminste 291
Green Farm 110
Park Farm (Eaton Bra 201
Newark (Beeches Farm 180
Shepton Mallet (Lowe 234
Clipgate 52
Moorlands (Hull) 176
Thorpe le Soken 266
Folkestone (Lyminge) 99
Jubilee Farm (Wisbec 130
Oaklands 194
Laindon 138
Ashleys Field 5
Whitby (Egton) 288
Caunton 43
RAYNE HALL FARM 211
Craysmarsh Farm 325
PLAISTOWS 206
Weston Underwood 377
Redlands (Swindon) 213
Brook Farm (Garstang 318
Category F
Category E

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * * * * * *



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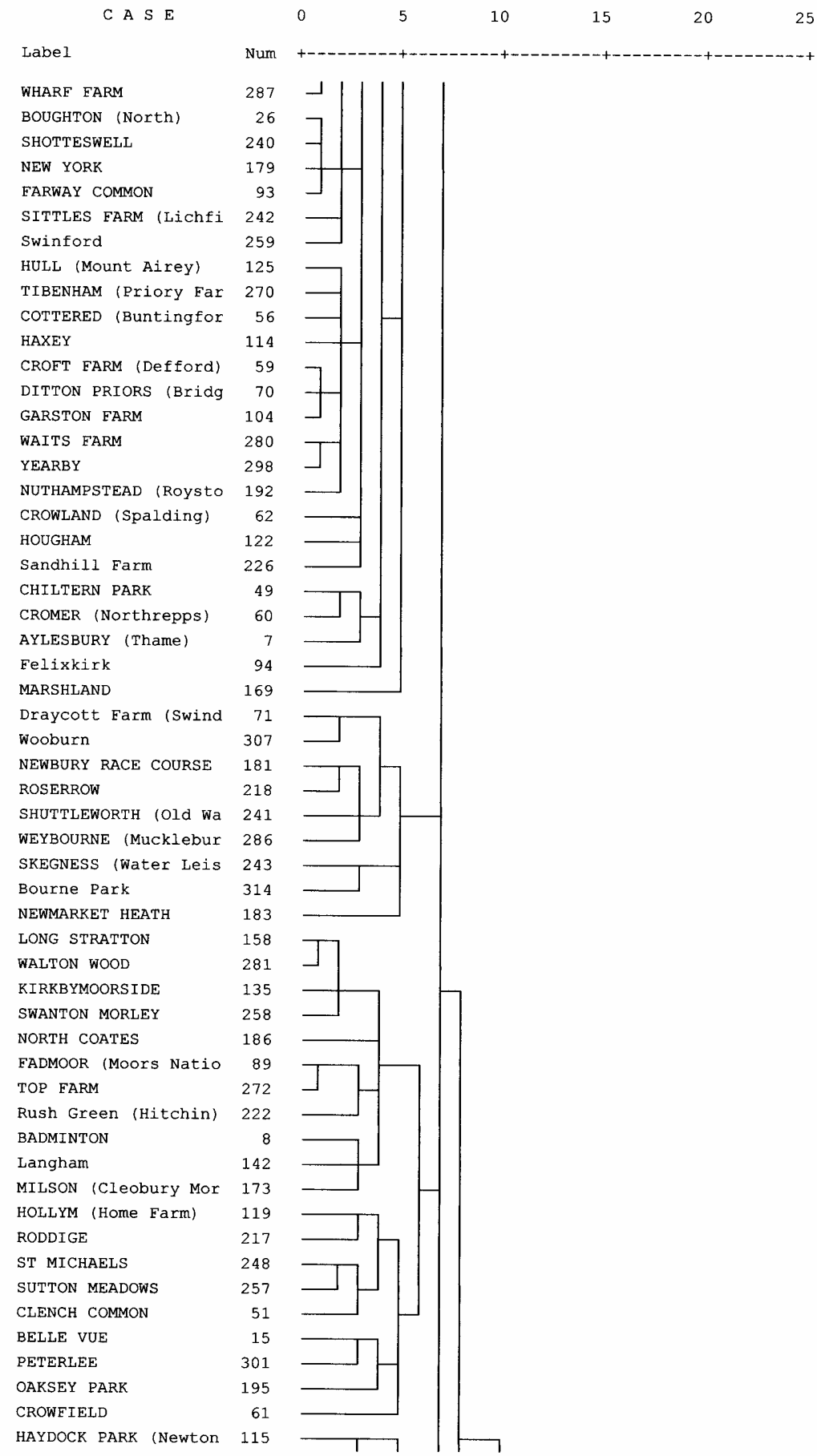

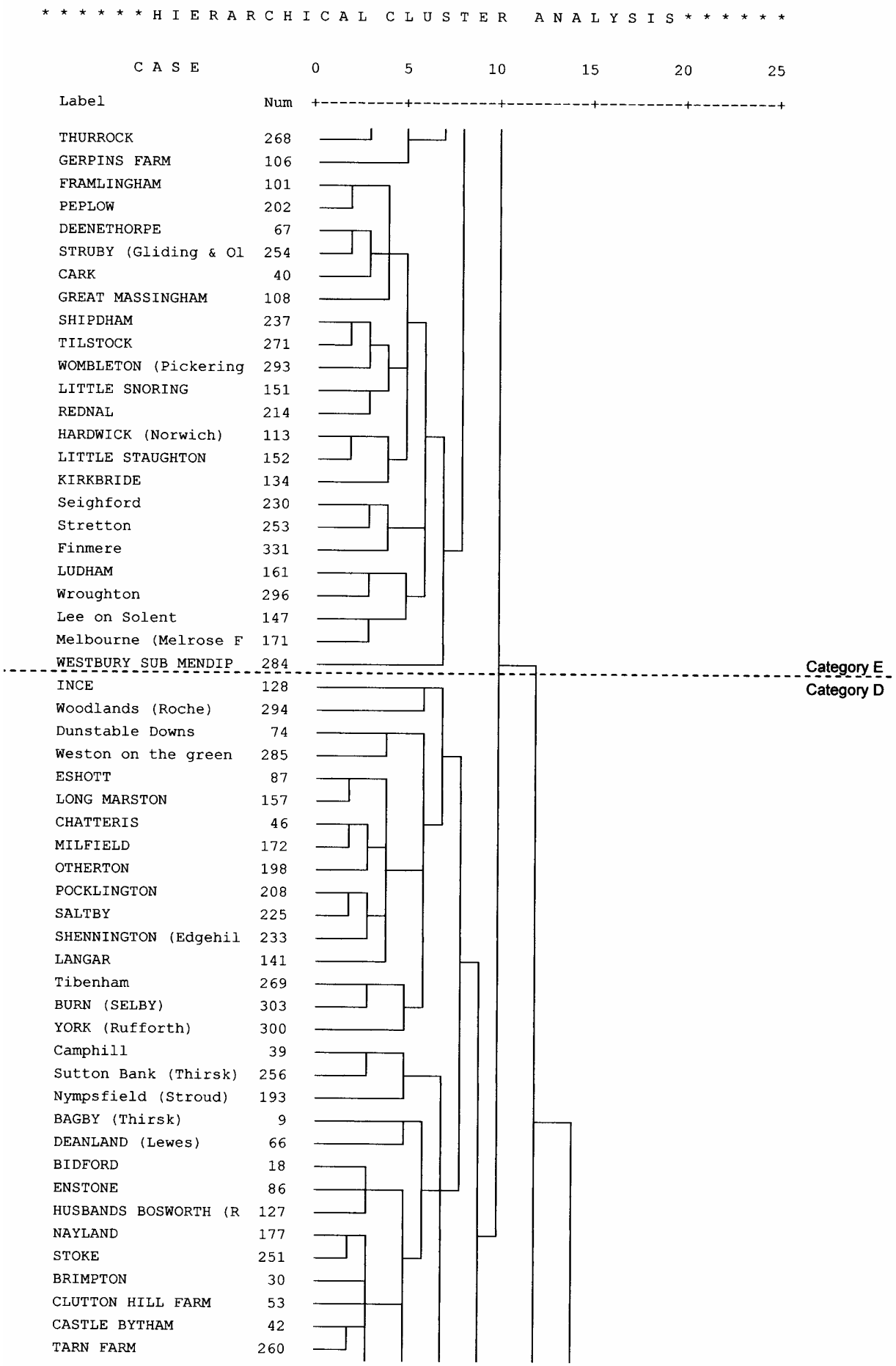
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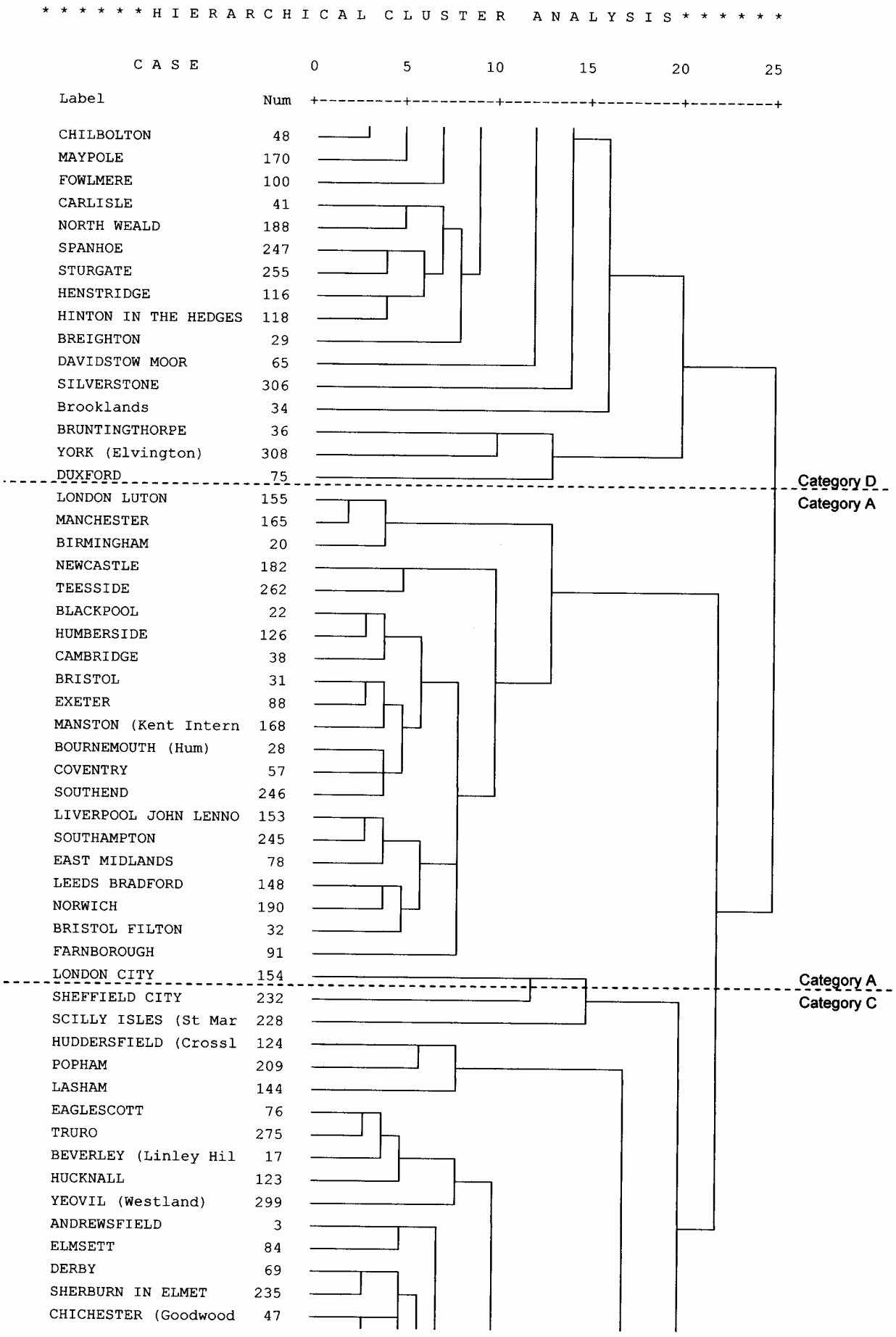
GERPINS FARM 106
FRAMLINGHAM 101
PEPLOW 202
DEENETHORPE 67
STRUBY (Gliding & Ol 254
CARK 40
GREAT MASSINGHAM 108
SHIPDHAM 237
TILSTOCK 271
WOMBLETON (Pickering 293
LITTLE SNORING 151
REDNAL 214
HARDWICK (Norwich) 113
LITTLE STAUGHTON 152
KIRKBRIDE 134
Seighford 230
Stretton 253
Finmere 331
LUDHAM 161
Wroughton 296
Lee on Solent 147
Melbourne (Melrose F 171
WESTBURY SUB MENDIP 284
Category E
Category D
INCE 128
Woodlands (Roche) 294
Dunstable Downs 74
Weston on the green 285
ESHOTT 87
LONG MARSTON 157
CHATTERIS 46
MILFIELD 172
OTHERTON 198
POCKLINGTON 208
SALTBY 225
SHENNINGTON (Edgehil 233
LANGAR 141
Tibenham 269
BURN (SELBY) 303
YORK (Rufforth) 300
Camphill 39
Sutton Bank (Thirsk) 256
Nympsfield (Stroud) 193
BAGBY (Thirsk) 9
DEANLAND (Lewes) 66
BIDFORD 18
ENSTONE 86
HUSBANDS BOSWORTH (R 127
NAYLAND 177
STOKE 251
BRIMPTON 30
CLUTTON HILL FARM 53
CASTLE BYTHAM 42
TARN FARM 260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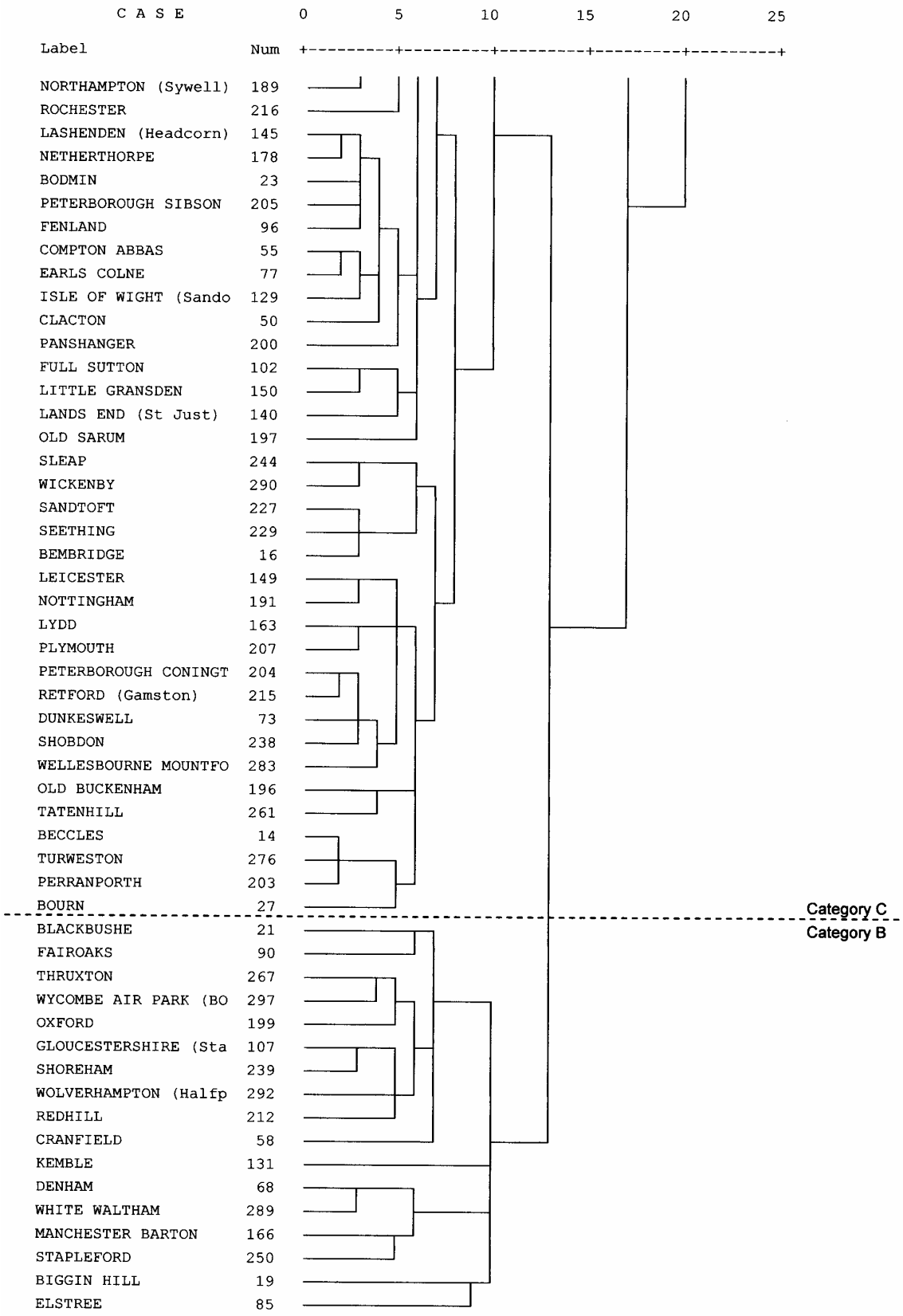
MAYPOLE 170
FOWLMERE 100
CARLISLE 41
NORTH WEALD 188
SPANHOE 247
STURGATE 255
HENSTRIDGE 116
HINTON IN THE HEDGES 118
BREIGHTON 29
DAVIDSTOW MOOR 65
SILVERSTONE 306
Brooklands 34
BRUNTINGTHORPE 36
YORK (Elvington) 308
DUXFORD 75
Category D
Category A
LONDON LUTON 155
MANCHESTER 165
BIRMINGHAM 20
NEWCASTLE 182
TEESSIDE 262
BLACKPOOL 22
HUMBERSIDE 126
CAMBRIDGE 38
BRISTOL 31
EXETER 88
MANSTON (Kent Intern 168
BOURNEMOUTH (Hum) 28
COVENTRY 57
SOUTHEND 246
LIVERPOOL JOHN LENNO 153
SOUTHAMPTON 245
EAST MIDLANDS 78
LEEDS BRADFORD 148
NORWICH 190
BRISTOL FILTON 32
FARNBOROUGH 91
LONDON CITY 154
Category A
Category C
SHEFFIELD CITY 232
SCILLY ISLES (St Mar 228
HUDDERSFIELD (Crossl 124
POPHAM 209
LASHAM 144
EAGLESCOTT 76
TRURO 275
BEVERLEY (Linley Hil 17
HUCKNALL 123
YEOVIL (Westland) 299
ANDREWSFIELD 3
ELMSETT 84
DERBY 69
SHERBURN IN ELMET 235
CHICHESTER (Goodwood 47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NETHERTHORPE 178
BODMIN 23
PETERBOROUGH SIBSON 205
FENLAND 96
COMPTON ABBAS 55
EARLS COLNE 77
ISLE OF WIGHT (Sando 129
CLACTON 50
PANSHANGER 200
FULL SUTTON 102
LITTLE GRANSDEN 150
LANDS END (St Just) 140
OLD SARUM 197
SLEAP 244
WICKENBY 290
SANDTOFT 227
SEETHING 229
BEMBRIDGE 16
LEICESTER 149
NOTTINGHAM 191
LYDD 163
PLYMOUTH 207
PETERBOROUGH CONINGT 204
RETFORD (Gamston) 215
DUNKESWELL 73
SHOBDON 238
WELLESBOURNE MOUNTFO 283
OLD BUCKENHAM 196
TATENHILL 261
BECCLES 14
TURWESTON 276
PERRANPORTH 203
BOURN 27
Category C
Category B
BLACKBUSHE 21
FAIROAKS 90
THRUXTON 267
WYCOMBE AIR PARK (BO 297
OXFORD 199
GLOUCESTERSHIRE (Sta 107
SHOREHAM 239
WOLVERHAMPTON (Halfp 292
REDHILL 212
CRANFIELD 58
KEMBLE 131
DENHAM 68
WHITE WALTHAM 289
MANCHESTER BARTON 166
STAPLEFORD 250
BIGGIN HILL 19
ELSTREE 85