

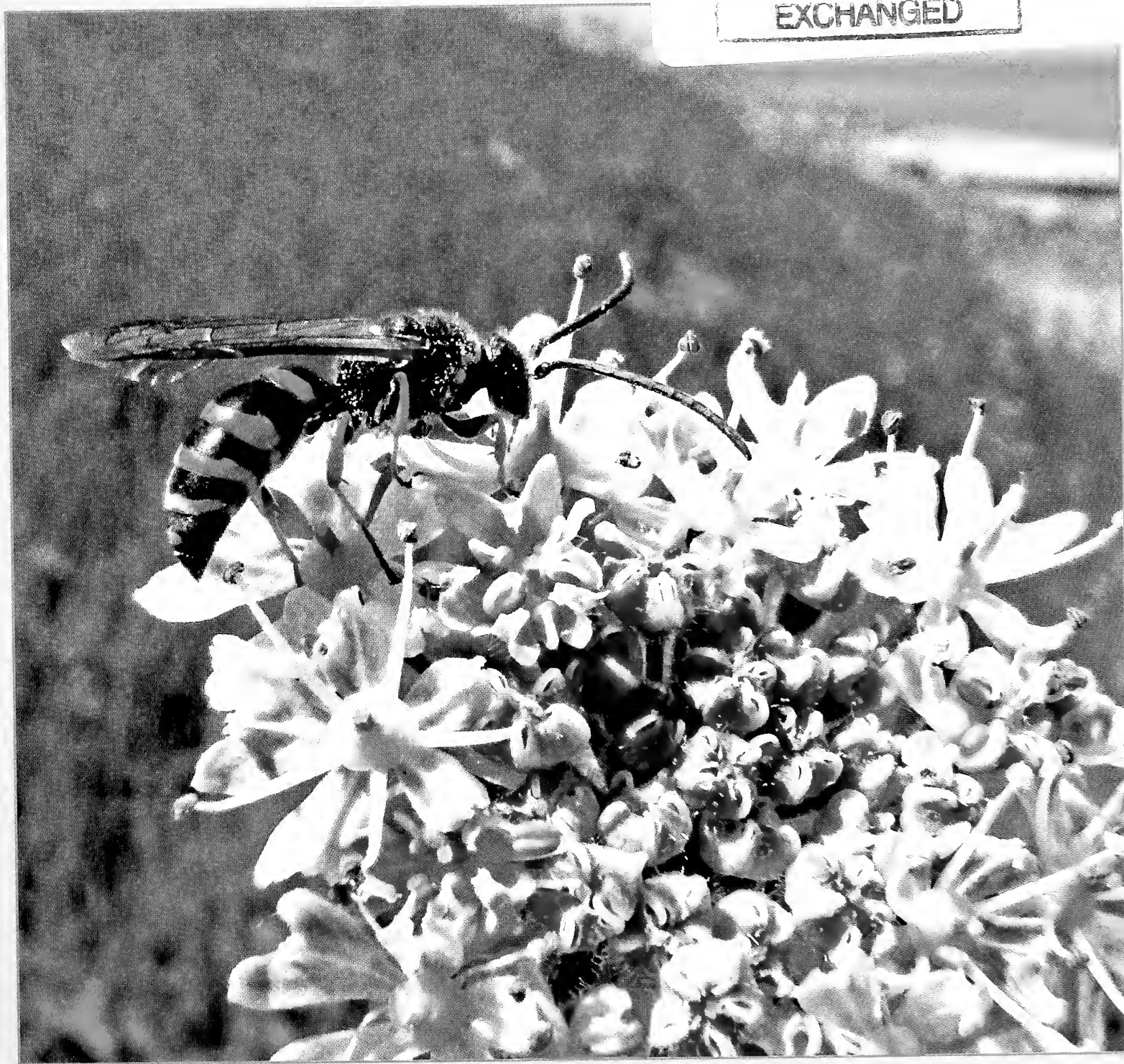
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TRANSACTIONS
of the
NORFOLK & NORWICH
NATURALISTS' SOCIETY

Volume 45 Part 1 2012

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TRANSACTIONS OF THE NORFOLK & NORWICH NATURALISTS' SOCIETY

Volume 45 Part 1 2012

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The Norfolk & Norwich Naturalists' Society has as a principal aim the investigation and recording of Norfolk's wildlife and to this end it publishes:

- An annual volume of *Transactions*, consisting of papers and notes on wildlife in the county.
- The *Norfolk Bird and Mammal Report* which contains systematic lists of observations on the county's birds and mammals, as well as relevant articles.
- *The Norfolk Natterjack*, a quarterly illustrated newsletter.

All of these publications are free to members, as are *Occasional Publications* on specific topics.

The Society also arranges lectures and field meetings which are planned to appeal to anyone interested in natural history. More specialist groups cover many aspects of the county's flora and fauna.

The subscription rate is £15 per year, which includes all members of a family living at the same address. Group affiliation is available at £15 per year.

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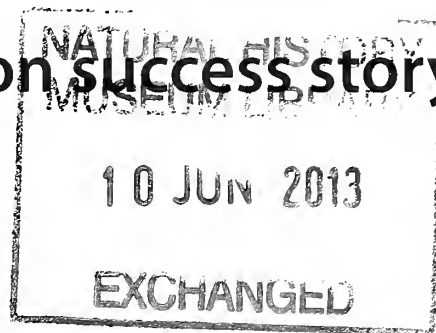
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From little acorns - a conservation success story in Norfolk

Don Dorling



A little acorn reached fertile ground in March 1926 and eighty-five years ago this summer took root. I am, of course, referring to the idea, largely fostered by Dr Sydney Long, then the secretary of this Society, who with his friends raised funds for the purchase of Cley Marsh. They then met at the George Hotel in Cley and agreed to create a Trust to hold it. I hope to show that it has now grown into a fine tree.

In 1944 Miss Constance Gay, who at the time was honorary secretary of the Trust, gave her Presidential Address to the Society under the title *The Work of the Norfolk Naturalists Trust* in which she dealt with the Trust's foundation and the progress made during the first eighteen years of its existence. The Trust having recently celebrated its eighty-fifth birthday, it seems a good time to have another look at its development as a protector of Norfolk's wildlife and wild places. For the sake of completeness I will cover some of the early developments that she dealt with but I will not repeat all her comments on the tremendous achievements of Dr Sydney Long in the field of nature conservation in Norfolk. There is a detailed review of his background and contribution to Norfolk's natural history in Eric Fowler's *Introduction to Nature in Norfolk – a Heritage in Trust*, published to mark the Trust's 50th Anniversary in 1976. Suffice to say that he was deeply involved in the purchase of Scolt Head Island which the Norfolk and Norwich Naturalists' Society (NNNS) formally handed over to the National Trust in June 1923, having launched an appeal for funds. Three years later Cley Marsh was put up for sale after the owners had

decided 'to retire from the unequal contest', following an inundation by the sea in January 1921 which caused severe damage to the north wall of the marsh. Dr Long was keen that this renowned area for breeding and migrant birds should be saved from falling into unwelcome hands. This time the NNNS was not directly involved in the fund-raising. Dr Long approached a number of friends sympathetic to the cause of protecting this marsh and secured sufficient promises of funds to enable him to attend the auction at the Royal Hotel, Norwich, on 6 March 1926. At the auction he was successful in purchasing the 407 acres of marsh and foreshore plus a building plot for the sum of £5,160.

Initially there was some speculation as to the future of this acquisition. On 8 March the *Eastern Daily Press*, when reporting the purchase, wrote:

Whatever the ultimate fate of the marshes, whether they will eventually pass into the possession of the National Trust like the other two sanctuaries or not, ornithologists all over the country will rejoice that they are at any rate safe for the undisturbed study of bird life.

The following day *The Times* commented:

Whether or not the funds of the Norfolk Wild Bird Protection Committee will admit of its taking over the extended liability of the protection of these marshes will rest with those who support this fund.

These questions were answered when, as mentioned earlier, the subscribers to the

appeal met at the George Hotel in Cley on 14 March 1926. At that meeting it was agreed that the marsh and the nearby building plot should be handed over to a Trust to be incorporated 'to hold the marsh in perpetuity as a Bird Breeding Sanctuary'.

That summer Robert Bishop was appointed as 'Watcher', as wardens were then known, at a weekly wage of £2. The winter shooting was let to a small syndicate consisting of four of the original subscribers. This syndicate paid an annual rent of £225 and met the expenses of the watcher during the five winter months of the shooting season, 15 September to 15 February. At that time it was not considered that there was any conflict of interest between conservation and legitimate shooting, even on a nature reserve. This attitude is well illustrated in Mr Colin McLean's book, *At Dawn and Dusk*, where he described a shoot held on 22 September 1927 as follows: 'When we got back to the marsh after breakfast, Bishop had taken down the rest of our bag to the roadside and got them neatly laid out. The final count amounted to 14 Mallard, 151 Teal, 2 Wigeon, one Gadwall, 10 Shoveler, 10 Snipe, 6 Coot, 2 Curlew, 2 Redshank, 2 Ruff and one plover – a total of 201 head. This was the best we made on the marsh during the years we had the shooting'!

The Trust was formally incorporated on 5 November 1926 as the Norfolk Naturalists Trust, a company limited by guarantee under the Companies Acts. At its first Council meeting on 30 November, it was resolved unanimously to 'accept the generous offer of the purchasers of the Cley Marsh property'. At the meeting Mr Russell Colman was appointed president and Dr Sydney Long as honorary secretary and treasurer. The other members present were Mr A.W. Carruthers, Mr Gerard H. Gurney, Dr Tom Longstaff and Mr Colin McLean. Mr B. Cozens-Hardy, Solicitor, was in attendance.

Miss Gay, in her address, referred to the similarity of names between the Norfolk and Norwich Naturalists' Society and the Trust and the confusion sometimes caused between the activities and responsibilities of the two organisations. However, it is not surprising that the founders used the word 'naturalist' in the name of the new body. Seven of the twelve subscribers and eighteen of the twenty-six other life members named at the first Council meeting, were also members of the NNNS and certainly would have considered themselves to be naturalists. Strangely, membership was initially restricted to a maximum of 100. Why this rule was adopted is not now clear.

The second reserve was acquired in 1928, giving a toehold in Broadland, when 26 acres at Starch Marsh, Martham, were purchased as a breeding ground for the Bittern, Bearded Tit and harriers. In April 1929 the Trust bought the Dial House at Brancaster Staithe, formerly the Victoria Inn, as a permanent dwelling for the Scolt Head watcher. This was an early example of co-operation between the bodies involved in the protection of the natural environment in the county, the accommodation for the watcher of a reserve owned by the National Trust being provided by the Naturalists Trust whilst the watcher was employed by the Wild Bird Protection Committee, administered at that time by this Society. The property was eventually sold to the National Trust in July 1968.

A further small addition to the land holdings occurred in June 1929 when Blo' Norton Wood was given to the Trust by Duleep Singh. A year later an opportunity to extend the interest in Broadland arose when Alderfen Broad came on the market. This was purchased for £2,200 in July 1930.

In the autumn of that year the Trust issued for sale its first Christmas card as a means of raising funds to meet the cost of the Alderfen purchase and future acquisitions.

It was a painting of a Bearded Tit executed by the well-respected Norfolk artist Mr J.C. Harrison and was published and sold from Dr Sydney Long's house in Surrey Street, Norwich. Five thousand cards were printed, raising £60 for the Trust's funds. The idea of a charity selling Christmas cards to raise funds was a novel idea at the time and was promoted in the national and local press. The Trust's cards became very popular and in 1932, after an article appeared in *The Spectator*, a reprint was necessary before all orders could be completed. By 1938 Dr Long was despatching 40,000 cards to customers throughout the country. That year the subject was an Avocet and the text included the phrase that 'every effort will be made to induce it to nest'. In the event that hope was not achieved in Norfolk for another thirty-nine years. Publication continued throughout the war years and in October 1943 *The Spectator* reported: 'Undeterred by the war, that precious body of bird preservation, the Norfolk Naturalists Trust, have produced their usual Christmas card.' Mr Harrison continued to provide a painting for the Trust's Christmas cards for fifty years, a remarkable achievement.

Having secured footholds at the coast and in the Broads, Dr Long was anxious to extend the Trust's protection to the Breckland heaths with their rare flora and breeding birds. In the early 1930s the Forestry Commission was rapidly planting vast areas of Breckland's poor soils with conifers. In 1932, in an effort to save some traditional Breckland heath from the forester, three cottages were purchased in the village of Lakenheath with commoners' rights over Lakenheath Warren, thus preventing the warren's afforestation. Unfortunately this protection was not long-lasting. With the onset of the Second World War the War Office requisitioned much of the area for the construction of the vast Lakenheath airfield. The cottages were disposed of in 1950.

A second potential opportunity to secure

a substantial Breckland reserve arose in 1935 when the Suffolk estate at Culford was broken up. The Forestry Commission bought a large area of Breckland heath for the purpose of planting conifers. A nearby landowner, in an attempt to secure an open area adjacent to his estate, offered to finance the purchase of 1,200 acres in the Icklingham/West Stow area if the Trust could persuade the Forestry Commission to lease or sell. Unfortunately, the Commission would not part with its new acquisition and created what is now The King's Forest. If this substantial area of Breckland heath had been acquired perhaps the trust would have had to become the Norfolk and Suffolk Trust!

In 1934 Sydney Long decided to resign as honorary secretary of the NNNS and concentrate on his work for the Trust. As he had been involved with the running of the Wild Bird Protection Committee since its inception in 1921, it was decided that the Trust would take over the responsibilities of this committee from the NNNS. This was, perhaps, the Trust's first step in becoming involved in conservation matters beyond the boundaries of its own reserves.

Early in 1936 Robert Bishop, the watcher at Cley, retired at the grand old age of 78 and in April was replaced as watcher by Cubitt Nunn, who came from Hickling. He obviously did not find life in north Norfolk agreeable and resigned after a few months in post. To fill this gap the Trust's Council appointed the 23-year-old W.F. (Billy) Bishop, Robert Bishop's grandson, from January 1937, a position he was to hold for 42 years until his retirement at the end of 1978 when he was succeeded by his son Bernard, the present warden. Billy and his wife Joyce took up residence in the recently completed 'Watcher's Cottage'. In 1937 the Cley watcher's domain was extended with the purchase of Salthouse Eye.

A further addition to the growing portfolio of properties was the gift of a small piece of

land adjacent to the mill at Burnham Overy known as 'The Duchess's Pightle'. This was given to the Trust in 1937 by the Duke of Bedford in memory of his wife. It was sold to the National Trust in March 1992.

As mentioned earlier, for some time Dr Long had been anxious to protect the Breckland breeding grounds of the Stone Curlew and other heathland specialties and another chance to do this occurred when the East Wretham estate came on the market in 1938. Although in failing health, he worked tirelessly in negotiating with the Forestry Commission and others for the purchase of areas of heathland including the two meres, Langmere and Ringmere. Unfortunately, Dr Long died on 15 January 1939 before these negotiations were successfully completed. The Forestry Commission did not finally convey the land to the Trust until 1940. Dr Long's ashes were scattered on Scolt Head Island but appropriately his memorial stone is located at East Wretham, overlooking Langmere.

Following Dr Long's death, Miss Constance Gay was appointed secretary of the Trust in August 1939. In her Presidential Address to the Society, she mentioned the effects of the war on the Trust's properties. At Cley Marsh many defensive constructions were erected upon the shingle bank and the War Office requisitioned the bungalow on Salthouse Little Eye. Parts of East Wretham and much of Lakenheath Warren were used as airfields. Nevertheless, interest in nature conservation was not completely overwhelmed by the problems of war. In April 1941 Miss Gay received a letter from a Mr Christopher Cadbury offering to help with the financing of the purchase of an area of Breckland heath. This offer resulted in 300 acres at Weeting being acquired in 1942, being 'of sufficient size to form an oasis for the Norfolk, ringed and green plovers to continue nesting there when the adjoining afforested land has grown into a conifer forest'. I believe this to be Christopher Cadbury's first offer of financial support; a

generous practice he continued for the rest of his life. The Norfolk plover is, of course, the Stone Curlew.

Other major additions to the Trust's interests in Broadland occurred before peace was finally achieved in 1945. Early that year 715 acres of the Whiteslea Estate at Hickling were purchased from the widow of Lord Desborough. This area had long been recognised as a major nature reserve under the control of Lord Desborough and his legendary keeper, Jim Vincent. It was here that the Bittern had returned to breed in 1911 and both Montagu's and Marsh Harriers had been found nesting in safety. Unfortunately, Jim Vincent died a few months before the transfer of ownership, so he never became an employee of the Trust. He was due to succeed Miss Gay as President of the Society at the time of his death. In addition to the Whiteslea holding, a further 500 acres were leased from other landowners, making this a substantial and important Broadland reserve. In April 1945 the Trust became involved with another major broad with the acquisition from a Mr L.H. Storey of a section of Barton Broad. This was followed later in the year with more land in the southern part of the Broad, which was a gift from Capt. C.B. Wilson.

The 25 acres at the eastern end of Scolt Head Island retained by the Earl of Leicester in 1923 were also purchased sometime in 1945. It is not clear to me why the Naturalists Trust decided to buy this small section of the island, the remainder being owned by the National Trust.

The year 1949 saw the next major extension of the Trust's reserves. Early in the year Col. H.J. Cator donated Ranworth and Cockshoot Broads with their surrounding marshes and carr woodlands. This event received much publicity, including a major feature in *The Times* of 1 April 1949. The gift was subject to the right of His Majesty the King to shoot over the Broad on one day each year, with no other shooting to be

permitted. I have not found any evidence that this option was ever taken up. Later in the year Christopher Cadbury purchased 225 acres of Thetford Heath from the Elveden Estate and presented it to the Trust as an addition to the Breckland holdings. This area of heathland is actually over the county boundary in Suffolk, which did not have a similar trust at that time. The property is still retained in the Norfolk portfolio notwithstanding that Suffolk has had its own wildlife trust for many years.

Part of the legacy of the wartime defences along the north Norfolk coast was a series of ruined fortifications. A prominent manifestation of these buildings was the collection of brick and concrete edifices left on the seaward side of Cley Marsh. In October 1949 some of these were put to use by the newly established Cley Bird Observatory founded by Richard Richardson. The Trust, which owned the site, became sponsors of the observatory; a situation that lasted until the observatory decided to become fully independent in 1959. However, long before that the observatory had been driven from the beach site by the destruction to the buildings caused by the 1953 sea surge and subsequent flooding. The observatory ceased its activities at the end of 1963 but Richard Richardson continued to live at Cley until his death in 1977. It would be wrong in a history of the Trust not to recognise that the relationship between the observatory, Richard Richardson, and the reserve and Trust management was sometimes strained. Problems occasionally arose largely because of the respective wardens' differing priorities and attitudes towards their conservation aims. For example, one rather public dispute arose over the question of reed cutting on the reserve. On this subject I believe that the anti-cutting stance was wrong but on balance I strongly believe that Cley Reserve in particular, and the Trust in general, benefited from Richard Richardson's involvement at Cley. His reputation as an artist and renowned bird

watcher, together with his regular presence along the East Bank, attracted many bird watchers to the area long before any visitor facilities were provided.

Miss Gay continued in post as secretary during the post-war expansion. As the Trust grew and the workload increased the Council authorised the first move to mechanisation with the purchase of a typewriter in November 1949. An office for the secretary was hired at the Assembly House in Norwich from November 1950. E.A. (Ted) Ellis succeeded Miss Gay as secretary in 1955.

The early 1950s seem to have been a period of consolidation, with the only addition to the reserves being the purchase, with the help of the Pilgrim Trust, of 201 acres of Surlingham Broad in August 1952. This joined the Bargate Fen at Surlingham, which had been given to the Trust by Judge Daynes in 1948. Later in the decade, in 1957, Mrs M.L. Anderson donated the Trust's first ancient woodland reserve, 25 acres at Thursford. At the end of 1959 the Trust was given "a circular piece of land with a diameter of 40 feet on which is growing an ancient tree known as the Hethel Thorn" – the Trust's smallest reserve, measuring approximately 1/8th of an acre.

The continuing growth in the number of reserves in the Trust's ownership created a perpetual burden of finding sufficient funds for their upkeep. The secretary published a leaflet in the 1950s listing the properties then held and including a plea for financial support by life or ordinary membership, donations and legacies. At that time the cost of life membership remained at the 1926 level of £10. A minimum annual payment of £1 secured ordinary membership. In June 1960 a list of members was published showing a total of 810 members, broken down into 334 life and 476 ordinary. By March 1964 the total had grown to 1,056 and the Annual Report contained an urgent plea for the support of

more new members to help meet the many calls on the Trust's finances. The problems of fund-raising and the ever-increasing burden of administration led the Council to appoint a full-time secretary and Group Captain Montgomery was appointed secretary designate in July 1962. He took over from Ted Ellis as secretary (in effect as the chief executive officer, to use the modern jargon) on 1 January 1963. On the same date the office was moved from the Assembly House to two rooms in No.4, The Cathedral Close, Norwich.

Whilst visitors had been welcomed to a number of reserves, an innovation at Cley occurred in April 1965 with the opening of hides on the marsh. Permits to use this new facility cost 10/- (50p) for adults and 5/- (25p) for children under the age of 18 and had to be obtained one week in advance from the secretary. Five years later, in May 1970, another visitor attraction was introduced, this time at Hickling, with the formal opening of the Water Trail by James Fisher, another former President of this Society. Over the years this summer facility has proven to be very popular. The provision of additional facilities for visitors has continued over the years and now forms a major part of the Trust's activities. At Ranworth the facilities include the innovative floating visitor centre and its board walk.

In 1981 the facilities for visitors at Cley were greatly enhanced with the development of the Dick Bagnall-Oakeley Visitor Centre. It was another ten years before a similar centre was opened at Hickling, this time in memory of Mr Ian Mackintosh, who had died a few years earlier. The last reserve to open a Visitor Centre was that at Weeting, overlooking a favourite heath for Stone Curlews. There had been hides at this site for a number of years with the accommodation for the summer warden being provided in a caravan. In May 1999 David Bellamy declared open a purpose-built Visitor Centre that also included a section for the

warden's accommodation. Jumping ahead several more years to 2007, the facilities at Cley were further enhanced by the opening of the innovative Visitor Centre there which includes catering facilities. This has proved very popular, thus proving the axiom that visitors will be attracted by 'A view, a brew and a loo'.

Turning back the years now to return to the continuing story of land acquisitions, in November 1965 a major coastal reserve was added to the Trust's estate with the purchase of 400 acres of dunes at Holme in the northwest corner of the county. Included in the purchase was the house known as The Firs, which provided both accommodation for the warden and in due course visitor facilities with a shop and display room in the house. Since the closure of the Cley Bird Observatory in 1963, Peter Clarke had operated an observatory at The Firs under the auspices of the Norfolk Ornithologists Association. The Trust needed the house for its warden and the observatory was asked to move. This it did to a parcel of land adjacent to the reserve. This close physical association has from time to time produced tensions resulting from the differing priorities of the two organisations.

In 1972 there was a need for a larger head office and a move was made across The Close to No. 72. This was to remain the Trust's office for the next thirty years until, once again, pressure on space to accommodate the expanding staff made a further move inevitable. The level of rents required to meet the Trust's needs made the option of purchase a viable proposition and in December 2001 the office was moved to the recently purchased Bewick House, 22, Thorpe Road in Norwich. The expansion of the staff which caused the pressures on accommodation had begun with the appointment of Peter Stevens as conservation officer in 1972. He was the first member of the 'indoor staff' to be dedicated to conservation matters. Subsequently he

succeeded Group Captain Montgomery, who retired at the end of 1975, with the title Conservation Director and Secretary, a position he held for nearly four years.

The Trust's Golden Jubilee was celebrated in September 1976 with a Lord Mayor's Reception at the Castle Museum followed the next day by a Forum and a Golden Jubilee Dinner at the University of East Anglia. The celebrations reached their climax on 25 November 1976 when Her Majesty The Queen opened the recently completed Visitor Centre at Ranworth, having arrived at the centre by boat.

The year 1978 saw two significant developments in the encouragement of members to feel they were an active and valued part of the Trust. The first was the formation of three Regional Groups catering for members resident in the Norwich, Broadland and North Norfolk areas. These Groups are run by their own committees and arrange programmes of lectures and outdoor meetings. Subsequently other Groups were formed centred on Wymondham, Dereham, Fakenham, West Norfolk and South Norfolk. The second method of keeping in contact with the membership was the introduction of the members' magazine *Tern*, which was issued three times a year, initially under the editorship of John Fenton. After a short spell when Roger Washbourn held the fort, David Paull became the second honorary editor, a post he held until he handed over to John Cooper. Subsequently, production of *Tern* was taken 'in house' and later the magazine was changed to a tabloid newspaper format with the support of Eastern Counties Newspapers. Whilst some regretted this change it had the significant advantage of being distributed throughout the area as a supplement to the *Eastern Daily Press*, resulting in a county-wide circulation of some 80,000 copies.

The effect of these developments and a period of 'direct selling' had been a steady

growth in membership, which at the end of 1978 totalled 5,271 and six years later stood at 7,722. It was not until 1989 that the 10,000 milestone was reached. Currently membership has passed 35,000.

During this period of membership development the growth of the portfolio of reserves had not been ignored. In August 1973 Mr Osbert Lancaster donated the 80 acres of East Winch Common and in 1975 Stubb Mill was added to the Hickling Reserve. The acquisitions in the Upton area began in 1979 when 129 acres of fen and carr were bought at auction. Small additions at Cley and Salthouse were made to the Cley Reserve and Tony Hammerton, the charismatic local doctor at New Buckenham, donated the New Buckenham Common in early 1985.

The following year marked the Trust's Diamond Jubilee with a celebration lunch at the George Hotel at Cley, an open day at the Cley reserve and a public lecture in the autumn given by Dr David Bellamy in St Andrew's Hall, Norwich. The year saw the introduction of the Sydney Long Memorial Medal, which would be awarded in association with this Society 'not more than biennially' to people who had given significant service to conservation in the county. The first award was made posthumously to Ted Ellis who had died that summer.

For the first forty or fifty years of its existence the Trust had largely devoted all its energies to acquiring and looking after the nature reserves in its care. As mentioned earlier, the first tentative steps in looking beyond its own estate occurred in the 1930s when the work of the Wild Bird Protection Committee came under its wing. By the 1980s there was a view emerging amongst some active supporters that an organisation such as the Trust should concern itself with the rapidly increasing pressures on wildlife throughout the county and not just in the 'jewels in the crown' as its reserves were described by some of these protagonists.

A major step in this direction was made possible in the mid-1980s when financial support from the Manpower Services Commission enabled the Trust to employ a number of young people on short-term contracts to undertake a habitat survey of a large area of the county. From the mass of botanical information gathered, very many sites were identified as being of county significance for wildlife in Norfolk. Strict criteria were applied to ensure a minimum standard. They were designated as County Wildlife Sites and recognised as such by a partnership of the Trust, English Nature (now Natural England), Norfolk County Council and the District Councils. They are identified in the Norfolk Structure Plan and in all Local Plans with the intention that they are taken into account when planning applications are considered. In recent years many of the sites have been resurveyed. In all about 1,200 sites have been so designated.

From these modest beginnings in looking beyond the reserves, a team has been built as finances have permitted which devotes much time and effort to looking after specific conservation priorities such as otters and water voles, for example. This project was financed for two years by the local water supply companies and was run jointly with the Suffolk Wildlife Trust. Advice and encouragement is given to landowners, particularly to those considering changes in the way a County Wildlife Site is managed. Also, a watch is kept on planning applications that might have an unfavourable impact on wildlife habitats. Following on from this development has grown a market for advisory and survey services. Although a commercial activity such as this was considered to be outside the remit of the charity, the Trust has exploited this opportunity by the formation of a subsidiary company, Norfolk Wildlife Services Ltd. This company employs staff or contractors to meet the demand for specific surveys that are frequently required

by potential developers or planners. All profits from the operation are donated to the Trust.

Two other peripheral activities beyond the reserves have been an involvement in the churchyard scheme where parochial church councils are encouraged to allow flowers and other wildlife to prosper in at least part of the 'God's Acre' under their control by a careful management scheme for grass cutting, etc., and in a similar way, in co-operation with the County Council, some roadside verges are protected for their rich or rare flora with appropriate management regimes. This latter activity followed on from an initiative by members of this Society.

A significant addition to the Trust's holdings of ancient woodlands occurred in 1988 with the purchase of the 300 acres of Foxley Wood. This wood came into conservation hands just in time to stop the conifer planting that had been the initial practice of the Forestry Commission on this site and had already covered a considerable area of the wood at the time of acquisition. A programme to remove the close ranks of conifers was soon underway and much to the joy of the many devotees of ancient woodland there was a viable seed bank in the soil under the pines, which avoided the need to replant the cleared areas. The importance of this site and the value of the restorative work carried out by the Trust were recognised by English Nature (Natural England) when the wood was declared a National Nature Reserve on 22 May 2002. This wood, together with the others at Ashwellthorpe, Thursford and Wayland, impose on the Trust a great responsibility to look after these remnants of an ancient and irreplaceable habitat. Keeping the diversity of flora and fauna in these woods has involved the Trust in a considerable burden. The practice of coppicing had largely been abandoned many years ago in all the woods and to reintroduce this form of active management has been both

costly and time-consuming, involving the efforts of staff, contractors and volunteers. However, all the effort is well worthwhile when in spring the areas opened to sunlight burst forth in a wealth of flowers.

I will now turn briefly to the Trust's involvement beyond the county boundaries. As far back as 1927 Professor F.W. Oliver, at the annual meeting of the British Association held in Leeds that year, reported the formation of the Norfolk Naturalists Trust to hold the county's latest reserve, Cley Marsh. He said that it was felt that a territorial basis was ideal for such a venture because, with the aid of the local press, by lectures, meetings and other propaganda, the county could be kept informed of the general progress and its enthusiasm aroused. He went on to say that Norfolk was favourable ground for such an experiment in view of the traditional devotion to natural history pursuits combined with a strong local patriotism. He looked forward to the time when every county would have its county trust. It was not until after the Second World War that this hope was achieved. The Yorkshire Trust was formed in 1946 and with the prompting and encouragement of the Royal Society for Nature Conservation, as it was then known, the movement rapidly spread with the whole country being covered within the following twenty years.

The Norfolk Trust has worked closely with its neighbouring wildlife trusts in areas of common interests. As mentioned briefly earlier, one NWT reserve, Thetford Heath, is actually in Suffolk and similarly the Suffolk Trust has a reserve including a modern visitor centre at Lopham and Redgrave Fen, which is largely on the Norfolk side of the boundary. Over the years this co-operation between Trusts has become more formal under the umbrella of the RSNC, which has changed its name to The Royal Society of Wildlife Trusts to reflect its current role, and they are now working very closely together. Manifestations of

the closer working are the regular annual gathering of the directors of all the Trusts and quarterly meetings of the directors and chairmen of the regions, in our case with our colleagues from Suffolk, Cambridge, Essex and Bedfordshire. Twelve Trusts, including Norfolk, have recently joined together to lobby for protection of our wildlife heritage in the North Sea under the 'Living Seas' banner.

A consequence of this closer working was the national desire to have a common identity and similar names, hence the pressure to change names from *Naturalists* or *Nature Conservation* Trusts to *Wildlife* Trusts. This has largely been achieved but here in Norfolk not without some anxiety at the loss of a well-recognised and respected name. After much debate Norfolk kept up its reputation to 'do different'. A compromise solution was adopted at the Annual General Meeting in 1994 when the membership agreed that the name *Norfolk Wildlife Trust* should in future be used as the operating name with the original name being retained for legal purposes. Whilst this has worked reasonably well in practice, the dual naming has caused some minor confusion when dealing with legal matters. As indicated by Miss Gay all those years ago, there had also been a potential for confusion with this Society.

The Trust has also worked closely with the other main conservation organisations such as the National Trust, The Royal Society for the Protection of Birds, Natural England (and its earlier incarnations) and the Environment Agency. The National Trust owns Arnold's Marsh at Cley but this is managed as an integral part of Cley Reserve. During the Second World War there were two developments which, had they succeeded, would have made significant changes. In November 1942 an unsuccessful meeting was held with the National Trust in London that sought the transfer of ownership or management of both Blakeney Point and Scolt Head to

the Naturalists Trust. In September 1944 a merger between the Trust and this Society was considered but it was decided that it was not practicable. In more recent times the Trust has leased the Surlingham Broad reserve to the RSPB with the object of its being managed with that Society's other reserves in that area.

For very many years the Trust has operated a retail sales organisation selling, in addition to the Christmas cards, novelty items, books etc. At one time there was a 'shop' at the Head Office until pressure on space forced this to cease. However, all the Visitor Centres have a sales section where the goods can be obtained. At the new visitor centre at Cley hot food and drinks are available and proving very popular.

During the last fifteen years there has been a huge increase in the Trust's activities covering acquisitions, improving management regimes on reserves and education. Many of these developments have been a direct result of the availability of grants from the Heritage Lottery Fund. The largest project was entitled *Securing the Future*, involving major schemes of restoring habitats on the reserves, improvements to visitor facilities, the provision of interpretation information and monitoring. The grant was for £2.3 million for work spread over a planned five years. In the event the completion took longer than intended owing to the complexities of some of the operations. To achieve some of the clearing of scrub from wet sites, for example, special equipment had to be designed and built. A subsequent challenge has been to maintain all the improvements made to the various habitats that have benefited from this scheme.

Many of the reserves depend for the maintenance of their individual habitats on control of vegetation in one form or another. The grazing at some reserves, such as Cley, has traditionally been let to local farmers. But to widen the ability to

graze when necessary the Trust acquired a flock of sheep, 'The Flying Flock', which is moved around the estate as circumstances demand. To vary the nature of the grazing to meet particular habitat requirements, the Trust now also uses horses, ponies and some Highland cattle.

It has been long felt that education is an important tool in ensuring a long-term interest in protecting the environment. To this end the Trust has greatly increased its education activities as funds have become available, both at school and the wider public levels. An education manager, with permanent and seasonal staff, is now employed for this purpose. In addition to work with schools a number of events have been organised for adult participation. A recent manifestation in this field has been the *Natural Connections* project launched in June 2007, which, *inter alia*, provided a free wildlife information service.

New acquisitions in recent years have included substantial additions to existing reserves. In Broadland the first addition in December 1996 was the purchase of the 100 acres of the Ebb and Flow marshes at Horning, situated across the river from the large Ranworth and Cockshoot complex. There followed major additions to the Upton reserve, the first in February 2000 being 122 acres of the Boat Dyke marshes at Upton where the Trust is returning this formerly arable land back to grazing marsh. In June 2002 another 92 acres of nearby grazing marshes were acquired and in March 2003 Upton Broad and much of the Doles surrounding the broad, together with further grazing marshes, were bought from the Norwich Union Insurance Group. Further areas were added to the grazing marshes in 2008 and 2010.

Largely as a result of the generosity of a benefactor, two large areas of afforested land at Grimston Warren (the Tony Hallett Reserve), immediately adjacent to Roydon Common, were purchased in 1999 and 2004

and are in the process of being restored to lowland heath by the removal of their conifer plantations. Another small addition to this important lowland heath was acquired in 2010. Both the Grimston and Upton additions neatly fall into the 'large areas for wildlife' concept under which larger areas of the countryside are managed with wildlife mainly in mind.

Five or six such areas have been selected, representing a variety of habitats throughout Norfolk. One of these in the west of the county has resulted in a scheme to convert an area of poor arable land into a wetland habitat with grazing meadows, pools and reed beds. A recent purchase for this purpose is adjacent to the Hilgay holding. This was provided by the Environment Agency to create a reed bed habitat in compensation for the potential permanent loss of reed beds at Cley following the Agency's decision not to maintain the shingle bank there after 2006.

In 2001 the Trust celebrated its 75th Anniversary and, despite the limitations imposed by the outbreak of foot and mouth disease, a number of events were organised to mark the occasion, for example, an art exhibition and on 14 March, seventy-five years to the day the original subscribers met at Cley, an informal lunch was held at the George Hotel with the vice-patron, Sir Timothy Colman, in attendance. The highlight of the celebrations occurred in November when the Prince of Wales hosted a reception at Sandringham House, followed the next day by his visit to the Hickling Reserve.

The dangers of climate change with its associated sea level rise pose a major threat to the Trust's vulnerable coastal reserves at Cley and Holme. Cley has recently been the centre of major activity. For more than fifty years the Environment Agency has maintained the fragile shingle bank that protects the fresh water marsh but, following the 1996 flood, the Agency

decided that it would continue this process for only a further ten years. The shingle would then be allowed to establish a more natural profile, the result of which will be to allow the sea to flood the marsh more frequently than in the past. In 2006/7 new sluices and channels were built to facilitate the draining of future saltwater incursions as quickly as possible. This was put to the test for the first time in November 2007 when a high tide flooded both the Cley and Salthouse marshes.

The opportunity was taken to mark the Trust's eightieth anniversary by building, as mentioned earlier, a new state-of-the-art visitor centre at Cley from where the inevitable long term changes to the marsh can be observed and explained.

In 2011, former gravel extraction works at Thorpe St. Andrew on the outskirts of Norwich were leased to create the Trust's first urban nature reserve. It is hoped that this popular walking area can be used to encourage local residents and other visitors to become involved in recording wildlife they see and also become involved in the management of the site.

The many achievements of the last eighty-five years have been the result of the efforts and support of a large number of dedicated and determined people who have served on the staff, acted as volunteers or have been involved in the governance of the Trust. As we have seen earlier the very first employee was Robert Bishop, who was appointed watcher at Cley in the summer of 1926. The administration was dealt with at first by honorary secretaries, Sydney Long, Constance Gay and Ted Ellis. A full-time secretary or director has headed the administration since 1963, namely Group Captain Montgomery, Peter Stevens, Moira Warland, Richard Hobbs and the current incumbent, now entitled chief executive, Brendan Joyce. From those early beginnings the number of employees currently on the payroll has grown to 68.

In addition to the full-time staff, volunteers have always made a considerable contribution to the work of the Trust. They have provided valuable physical labour on reserves, manned the Visitor Centres, helped with fund-raising, organised and run the local groups and performed a variety of duties at Head Office. The local groups arrange a wide variety of fund-raising activities and represent the Trust at various shows and other organised events as well as providing regular programmes of lectures and walks for their members.

I have made little or no reference to the many individual species that have been saved, or whose habitat has been enhanced, by the efforts of the Trust. Some of the highlights include: The flowers of the ancient woods, Bitterns, Marsh Harriers and Bearded Tits in the various reed beds, Avocets returning to breed at Cley, Fen Orchids in the Broads, Common Cranes at Hickling, not forgetting Norfolk's special butterfly, and this Society's emblem, the Swallowtail.

Looking to the future, the Trust will face many threats to Norfolk's wildlife and wild places – the threats of climate change, changes in farming practices to feed the ever-increasing population, financial stringency in periods of recession, possible disposal of areas of Forestry Commission land and even National Nature Reserves. However, I am sure that it will be able to face these problems and continue all the good work through its 60 reserves totalling 10,500 acres and their management, its education activities, and a considerable contribution to the protection and understanding of the wildlife and wild places throughout the county. By the recent publication of its *Business Strategy 2011-16*, the Trust has demonstrated its firm determination to continue and enhance all these activities and face these future threats to our wildlife and wild places.

Thus I hope that you can all agree that the little acorn sown by Dr Long has flourished

and is now a substantial and growing tree, one, dare I say it, that stands proud amongst the many other similar 'trees' that have subsequently sprung up throughout the land, as Professor Oliver had hoped for all those years ago.

In conclusion I must thank the many people who have helped in the production of this Address. Particular thanks are due to Brendan Joyce and members of his staff who helped me during many visits to the basement of Bewick House, to my wife Mary who spent many hours sorting and recording the Trust's archives there, and to David Paull who has passed his expert editor's eye over the final draft readying it for publication.

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Butterfly-ant mutualism: *Lasius* ant-associates of Silver-studded Blue *Plebejus argus* in Norfolk, UK

Doreen Wells

Introduction

This is the first study to identify the *Lasius* ant species that are associating with the Silver-studded Blue butterfly *Plebejus argus* on Norfolk heaths and to document this interaction in detail. This research covered two years of observational fieldwork during 2010 and 2011 at Buxton Heath and adjoining Marsham Great Wood. The study was extended to Cawston Heath in 2011. Buxton Heath and Cawston Heath are managed by Norfolk Wildlife Trust and Marsham Great Wood by the Forestry Commission. Buxton Heath was selected for this research initially because it had a strong population of *P. argus* and three of the associate *Lasius* ant species were nesting on this site: *L. niger*, *L. platythorax* and *L. psammophilus*.

P. argus butterflies need to associate with one or more species of *Lasius* ant in order to survive. The relationship is obligate and mutualistic (Fiedler 2006), and occurs at all stages of the butterfly lifecycle, with the exception of the egg. The ants protect the butterfly from predators and parasites and in return receive sugars and amino acids secreted from the glands on the bodies of the larvae (Fiedler 1991; Jordano & Thomas 1992). There are also sugary droplets covering the body and wings of the emerging butterfly, which the ants harvest while the butterfly dries out its wings.

Research has shown that *P. argus* populations do associate with at least two species of *Lasius* ant in the UK, namely *L. niger* and *L. alienus* (Ravenscroft 1990). However, in 1992, Bernhard Seifert determined that those two species were actually four species, their sister species being *L. platythorax*

and *L. psammophilus* respectively (Seifert 1992). Since 1992, very little research has been carried out to establish whether these two sister species also associate with these butterflies and whether previous research actually referred to one of the sister species. As *L. alienus* is now identified as a chalk grassland specialist, it has been confirmed that some of the records for this species on sandy heaths refer to *L. psammophilus* and not *L. alienus*, as previously recorded, Wells (2009-11). Likewise, as *L. platythorax* is more commonly found nesting on wet heaths, previous records may refer to this sister species, rather than *L. niger*¹. The need to conduct research which might answer these questions was the driving force for this study.

Historical aspects

All current Norfolk populations of *P. argus* are descended from one isolated population at Horsford Rifle Range, where only *L. niger* nested. It has been suggested that some butterfly populations can develop specificity to one species of ant, particularly in relatively long periods of isolation (Thomas et al. 1999), and there is evidence to suggest that this may be the case in Norfolk.

The butterfly population had existed at Horsford Rifle Range from the 1950s, but only because of a far-sighted translocation from the original site in adjacent Horsford Woods, when the old heath was scheduled to be planted with conifers. Regrettably, the butterfly population at Horsford Rifle

¹ Since completing this research it has been confirmed that *L. psammophilus* are associating with *P. argus* on Suffolk heaths (Rob Parker, pers. comm. 2011) and *L. platythorax* on Sussex heaths (Crane 2010).

Range declined in recent years to probable extinction in 2010. An ant survey confirmed that *L. niger* was still nesting on this site, but in insufficient numbers to support a butterfly population (Wells 2010).

Until the mid-1980s, Horsford Rifle Range had the only surviving population of *P. argus* in Norfolk. Successful butterfly translocations from this population were made to two other heathland sites: a) to Buxton Heath in 1985-6 and b) Kelling Heath in 2001. On both sites the dominant ant species is *L. niger*.

In 2006 and 2007 Buxton Heath became the donor site for two translocations to Cawston Heath (Harris 2008), but butterfly numbers steadily declined there, despite the volume of ant nests in ideal pioneer stage habitat for ovipositing butterflies.

In 2009, it was reported that butterfly numbers had declined on the heathland to seven, but nine butterflies had been recorded for the first time in the 'Reversion Field' (Mandy Gluth, pers. comm. 2009). A gate at the southern boundary of the heath leads into a field which is actively being managed by Norfolk Wildlife Trust to revert to heathland, known as the 'Reversion Field'. At that point in time an ant survey was carried out to determine what *Lasius* species were nesting on this site. In the Reversion Field, *L. niger* dominated the landscape in sufficient numbers to support a butterfly population. Maximum nest density (one every 4 m) was achieved over more than 70% of the field (Wells 2009). In 2010 the number of *P. argus* recorded in the Reversion Field rose to thirty, but only four were recorded on the heath itself (Mandy Gluth, pers. comm. 2010).

Habitat preferences and life cycle

The habitat preferences of both nesting ants and ovipositing female butterflies are complementary. On dry heathlands, the preferred sites usually have warm microclimates, particularly at ground level,

in early successional stage habitats with bare disturbed ground and pioneer growth of heather species or gorse. In particular, there is a positive correlation with indicators of early successional stages of habitat and with the presence and density of the host ant nests. In such conditions, the female butterfly will usually lay her eggs singly on the larval food plant, close to the ground, near the nests of associated *Lasius* ant species, but on Buxton Heath eggs are also laid on bracken fronds, provided that they are in close proximity to host ant nests; there is evidence from Suffolk too that this plant is used by ovipositing *P. argus* females (Mendel & Parsons 1987). The eggs are laid in June or early July and over-winter on the plants, or in sheltered spots on the ground, until the following spring. The eggs hatch towards the end of March and the caterpillar is attractive to *Lasius* ants at quite an early age.

The food plants of the emerging caterpillar are usually young plants of Bell Heather *Erica cinerea*, Cross-leaved Heath *Erica tetralix* and Heather *Calluna vulgaris*, or the new growth of gorse (*Ulex* spp.). However, adult butterflies need the *Erica* species which are in flower in early June as their main source of nectar.

Methods

Site 1: Buxton Heath and Marsham Great Wood

Butterfly Conservation, Norfolk Branch, provided maps and statistics showing peak numbers of Silver-studded Blue butterflies recorded during 2008 and 2009 for each site, to enable research to focus on the areas of greatest population density (Dawson 2009).

Marsham Great Wood (TG1722) runs along the northern boundary fence of Buxton Heath and butterflies have been encouraged to spread to suitable habitat in the adjacent forest ride. *L. niger* colonies are widespread along this forest ride and support good numbers of *P. argus*.

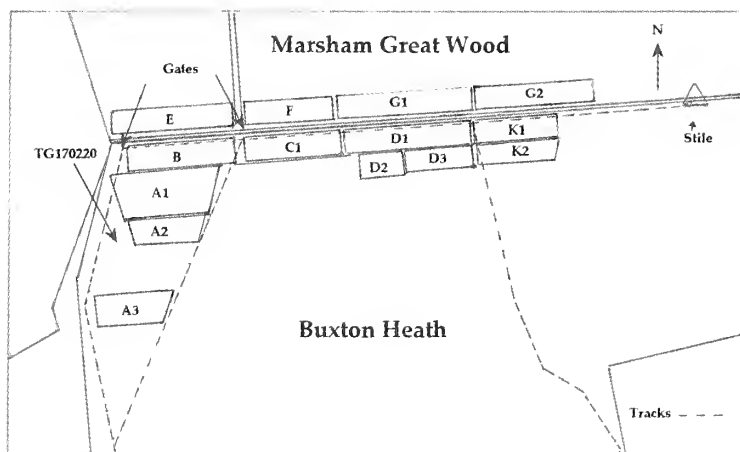


Figure 1. *L. niger* research areas. Based on the Silver-studded Blue butterfly *P. argus* butterfly recording areas used in this research. Map not to scale.

Six research areas were chosen for the first year of research along the northern boundary: areas A1, B and D1 on Buxton Heath and E, F and G1 on the other side of the fence in Marsham Great Wood (Figure 1). Ten *L. niger* nests within these areas were closely observed during the research period for signs of ant-butterfly association.

The research areas selected were the most productive areas on the heath for butterfly numbers (Dawson 2009), as well as having the greatest concentration of *L. niger* nests (Wells 2009-11), but it was regrettable that only *L. niger* nests occurred in these areas. As a consequence, ant recording was extended into other *P. argus* areas, such as A2, A3, D2, G2 and K1, in an attempt to achieve a better balance of *Lasius* species. *L. platythorax* was recorded in A3 and D2 and *L. psammophilus* in K1, but not in sufficient numbers or in ideal conditions to warrant a change in research sites.

Site 2: Cawston Heath

To test the hypothesis that our Norfolk populations of *P. argus* had a specific association with *L. niger*, fieldwork was also undertaken at Cawston Heath (TG1623) where the dominant *Lasius* species is *L. psammophilus*.

The research area followed the recorded butterfly flight areas A – F, (Figure 2) along the sandy path at the southern end of the site, between TG165236 – TG159237, where

L. psammophilus were nesting in some numbers.

General approach

Direct search methods and honey baits were used to find all the *Lasius* ant species nesting within *P. argus* territories at Buxton Heath and Marsham Great Wood and specimens were taken for identification.

Ant research nests were selected in each year of research at Buxton Heath and Marsham Great Wood, on the basis of the following criteria: location of nest within areas of highest butterfly numbers, the age and maturity of nest and suitability of habitat for ovipositing butterflies.

Direct search methods were used to find all the ant species nesting on Cawston Heath within and beyond the butterfly flight areas, with specimens taken for identification.

The research area at Cawston Heath was selected on the basis of the following criteria: nest identified as *L. psammophilus*, location of nest within butterfly flight areas, the age and maturity of nest and the suitability of habitat for ovipositing butterflies.

Five key phases of butterfly development were identified to enable the ant-butterfly association to be observed in all phases except the pupal stage. This latter phase did not form part of this research, as it would have meant disturbing the ant nest chambers.

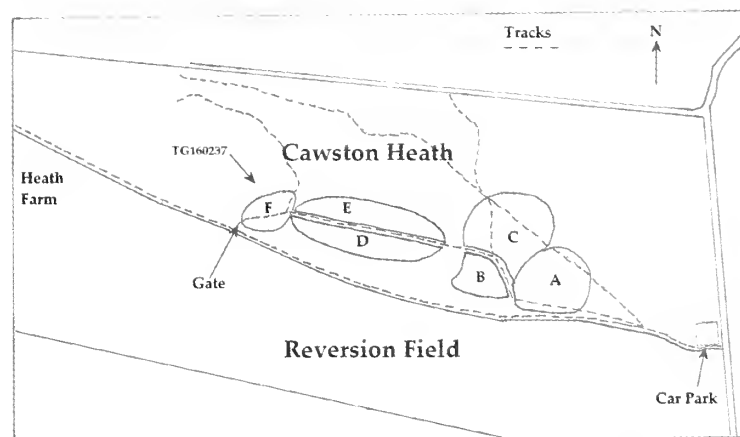


Figure 2. *L. psammophilus* research areas. Based on the Silver-studded Blue butterfly *P. argus* butterfly recording areas used in this research. Map not to scale.

Phase 1 - collection and protection by worker ants of the early instar caterpillars and safe keeping of these caterpillars in the nest chambers during March and April.

Phase 2 - protection of the caterpillar(s) by worker ants when the caterpillars emerge from the nest to feed during April and May.

Phase 3 - protection of the pupae from parasites entering the nest, from end of May to mid June (not directly observed).

Phase 4 - preparation by the ants for adult butterfly emergence, by enlarging exit holes or digging new ones to facilitate the butterflies reaching the surface, from early June onwards.

Phase 5 - protection by the worker ants of the adult butterflies as they emerge from the nest, including cleaning every surface of the butterfly as it dries, from early June until July.

Within the five phases of butterfly development from late March until late June, the following were undertaken each year:

- Selection of ant research nests.
- Close observation throughout the season of all *Lasius* research nests.
- Observation and recording of larval interactions with ants.
- Detailed observation and recording of *L. niger* workers actively preparing nests for butterfly emergence.
- Attempts to observe and record actual butterfly emergence from research nests.
- In the absence of observing actual butterfly emergence, recording the state of research nests post-emergence

Results

The first year's research identified *L. niger* as being the only *Lasius* species associating

with *P. argus* on Buxton Heath and adjacent Marsham Great Wood and this was confirmed by research in the second year. *Lasius* ants in warm locations usually start to be active around the second week in March. However, in 2010 the weather was unusually cold and wet in March and most nests were not fully active before the beginning of April although fieldwork and preliminary assessments started on the 17 March 2010.

Year 1: Buxton Heath and Marsham Great Wood

By 10 April 2010 ant activity in all areas had increased and research nests were patrolled regularly for signs of any interaction between ants and larvae. At 14.00 hrs, when approaching the research nest in F, a *L. niger* worker was observed emerging from short heather, on the edge of the forest ride, carrying in its mandibles an early instar *P. argus* caterpillar. It crossed into the centre of the forest ride with the caterpillar and both disappeared amongst the pioneer *Calluna vulgaris* into a *L. niger* nest entrance.

On 20 May 2010 further interaction was observed, but not until late in the day. No caterpillars were seen emerging from research nests until late afternoon and research in 2011 confirmed that caterpillars do not emerge to feed earlier in the day. At 17.27 hrs, the first one emerged from a research nest in area B, with nine *L. niger* workers in attendance, to feed on young growth of *Calluna vulgaris*. The late instar caterpillar was a pink-brown colour with dark brown stripes outlined in white, unlike the early instars which are green.

Fieldwork during the period 16 – 24 June 2010 was discontinuous, but all research nests were patrolled during the morning hours over this period. *L. niger* workers were observed to enlarge existing exit holes and excavate several new ones in research nests in A1, B, E, F and G1. Exits were

enlarged to 1 cm to facilitate the passage of the adult butterfly to the surface.

On returning to the research site on 22 June, (after a day's absence) it was obvious that the butterflies had already emerged from the nests and ant activity had ceased. After emergence the holes were considerably expanded where the butterflies had pushed their way out and the holes measured 1.5 – 2 cm. It was estimated that the first mass emergence took place on 21 June 2010, but regrettably I was not present to observe it.

With the exception of the nest colony in D1, all *L. niger* research nests exhibited ant activity and behaviour consistent with those nests containing *P. argus* pupae and from which adult butterflies would emerge.

Although butterflies were not actually seen emerging from the research nests, all the post-emergent indicators confirmed that they had in fact done so.

Year 2: Buxton Heath and Marsham Great Wood

Having proved the ant-butterfly association in the first year, the second year's research at Buxton Heath and Marsham Great Wood focused in particular on observing worker ant activity at research nests and recording this in detail. The number of research nests was reduced to six, because research was also taking place at Cawston Heath.

Six *L. niger* nests were chosen in areas A3, A1 and E, which were fairly close together and easy to patrol for one researcher. The research nests in A3 were newly selected, because of the high butterfly count in that area in 2010. The heathland at Buxton Heath was also surveyed for *L. psammophilus* nests, but none were recorded that year.

Fieldwork started on 11 April 2011 and was completed on 23 June 2011.

Further ant-larvae interaction was observed from a research nest in A3 on 13 May 2011 at 21.30 hrs. A final instar caterpillar emerged from the nest to feed at night with

several *L. niger* workers in attendance. It had the same pink-brown colouring as that observed in 2010.

Fieldwork for phase 4 started one week earlier than 2010, because the butterflies were on the wing in the first week of June.

The results from close observation of research nests during the period of ant activity in preparation for butterfly emergence are as follows:

P. argus larvae grow to the adult stage inside the nest of *L. niger* ants.

L. niger nests usually have one or two main entrance/exit holes for each nest and these are enlarged considerably in July or August for the alates to emerge from the nest for their mating flight, but workers do not create new exits for this purpose.

In contrast, worker ants do excavate new exits from their nest to enable emerging butterflies to reach the surface. The exits generally reflect the distribution of the pupae underground.

Underground nest passages of a *L. niger* nest can reach up to two metres in length. Consequently, in many cases the butterfly larvae do not pupate near an existing exit and new exits have to be created.

Sometimes pupae are located in clusters, as can be seen by the number of expanded holes in one location after butterfly emergence, but pupae may also be widespread in underground passages particularly in larger nests. One research nest in Marsham Great Wood had ten exit holes.

Adult male butterflies emerge before females, resulting in staggered emergence for the ant colony.

Preparation for each emergence takes three days from start to finish. Several new exits are excavated initially and then enlarged, with worker ants alternating between exit holes. They bring up grains of sandy soil at a fairly steady rate for the first two days. Then on the third day ant activity increases

at one or more of the exits with twenty or so ants working furiously to expand the exits where emergence is imminent. Holes typically measure 1 cm in diameter before emergence and 1.5 – 2 cm in diameter after emergence, the butterfly expanding the hole on emergence.

It is not known from this research what triggers this process, but it is assumed that the pupae provide a signal (possibly acoustic) to the ants that generates responsive behaviour. Research into the parasitic larvae of the lycaenid butterfly Mountain Alcon Blue *Maculinea rebeli* has revealed that sounds produced by the pupae and larvae of this butterfly mimic those of queen ants (Barbero 2009), so acoustic communication is possible in this case.

After the butterfly has emerged from the nest with worker ants in attendance, the ants will proceed to clean all parts of the butterfly until its wings are dry and it flies away, thus protecting it at its most vulnerable stage².

All ant excavation activity then ceases until, and if, further butterfly emergence is imminent.

The first butterflies emerged two weeks earlier in 2011 after a period of very warm weather, but this was followed by a period of very wet weather in late June, which had an impact on butterfly emergence.

Arriving at dawn on a single day (23 June 2011) with Mandy Gluth from Butterfly Conservation, it was the last attempt to observe and photograph butterfly emergence for this research. Ant activity was observed at research nests in A1 and E, but the nest in A1 became the focus for detailed observation. Ant activity increased

² This was observed by me on 6 July 2010 in heathland at East Ruston Common. A *P. argus* male emerged at 11.45 am accompanied by twelve *L. niger* workers, from a nest near pioneer growth gorse. This process took approximately 45 mins. from beginning to end.

considerably during the morning, with five exits being expanded. Showers and heavy rain came and went, with workers repairing the damage to exit holes. Feverish ant activity to expand two exits in the period between 13.00 and 14.00 hrs signalled that butterfly emergence was imminent. At 14.00 hrs a thunderstorm and torrential rain obliterated the surface structure of the nest and effectively sealed all the exits with wet mud; the rain was so heavy that a footpath close to the nest became a fast flowing stream. The butterflies failed to emerge. Further thunderstorms continued during the afternoon and evening.

Summary

- No ant-butterfly association was observed with any other species of ant apart from *L. niger*.
- The highest butterfly numbers were correlated with the greatest concentration of *L. niger* nests.
- The five key phases of butterfly development were confirmed as useful measures of butterfly-ant interaction.
- *L. niger* ants were observed to be involved at all stages of butterfly development.
- Caterpillars only emerged from *L. niger* nests to feed in the evening or at night.
- Worker ants play a crucial role in preparing for butterfly emergence.

Year 2: Cawston Heath

The research was extended in 2011 to Cawston Heath, where *L. psammophilus* is the dominant species, but where butterfly numbers had steadily declined, since translocation from Buxton Heath in 2006 and 2007, despite ideal habitat for ovipositing butterflies. No association with *L. psammophilus* was found.

Fieldwork commenced on 13 April 2011 and was concluded on 13 June 2011 with negative results. No caterpillars, pupae or butterflies were observed on this site.

Phase 1 - by 13 April worker ants were active around nests in the research area. *L. psammophilus* nests were patrolled for signs of any interaction between ants and larvae. None were found.

Phase 2 - fieldwork continued until 13 May 2011, as it was estimated that the very warm spring would mean early pupation. Nests were patrolled to record any caterpillars emerging to feed. The areas of heather surrounding *L. psammophilus* nests were also searched for larvae left in 'holding cells' or in surface areas of nests. *L. psammophilus* nest deeper underground than *L. niger* and their nests have a smaller surface area, with a narrow entrance hole. This nest structure may preclude taking the larvae underground into their nest. On one evening I stayed until 21.30 hrs to see possible night-time emergence. No caterpillars were seen emerging to feed.

Phases 3 & 4 - butterflies were emerging two weeks earlier this year and so these phases were truncated into one. All nests were checked during day-time hours over a three-day period: 11 – 13 June 2011. *L. psammophilus* research nests were checked for worker ant activity preparing for butterfly emergence and for pupae that might be hidden in surface areas around the nest. No ant activity was observed in preparation for butterfly emergence, nor any pupae found.

Discussion

The purpose of this research was to investigate the theory that the Norfolk populations of *P. argus* butterflies have a specific association with *L. niger* ants.

At Buxton Heath and Marsham Great Wood, the *L. niger* and *P. argus* association is proven. Considerable knowledge of the timing and nature of this association has been revealed by this research. The importance of *Lasius* ants in the life cycle and survival of this rare butterfly cannot be underestimated.

The historical evidence supports the hypothesis that the Norfolk populations of *P. argus* have a specific association with *L. niger*.

At Cawston Heath, no evidence was found that the butterflies were associating with *L. psammophilus*. Specificity would be an explanation for the rapid decline of butterfly numbers after two translocations at Cawston Heath, numbers increasing only in the Reversion Field in the presence of large numbers of nesting *L. niger*.

On the basis of these observations it seems reasonable to conclude that the original donor race at Horsford was exclusively associated with *L. niger* and the same is true at all the translocation sites.

A thought provoking question was put to me by Neil Ravenscroft in 2011. "If *P. argus* will not associate with *L. psammophilus*, despite its abundance, then is it the ant that will not associate with the larva, or the other way around?" The answer, of course, remains to be determined by future research, but evidence does exist for oviposition preference, Fraser et al (2002). They report that butterflies in the family *Lycaenidae* that have obligate associations with ants, frequently exhibit ant-dependent egg laying behaviour and that this probably has a genetic basis.

Recommendations

It is essential to ensure that future translocations follow a simple rule: the *Lasius* ant species associating with *P. argus* on the donor site, must also be the ant species dominating the receptor site. In terms of the Norfolk populations that species is *L. niger*.

Acknowledgements

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Gluth, who first introduced me to the Silver-studded Blues on Buxton Heath, for her encouragement and, in particular, her moral support during our 'dawn raid' and final attempt to record butterflies emerging from research nests in 2011. My thanks also to Rob Parker for discussions on *Plebejus argus* larvae and the butterfly populations on the Suffolk Sandlings, to Neil Ravenscroft for copies of his research and last, but not least, to those people who very kindly read and commented on a draft of this paper: Alan & Chris Dawson, Bernard Watts and Mandy Gluth.

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The aculeate wasps of Norfolk: a provisional county list

Tim Strudwick

Introduction

The aculeate (i.e. sting-bearing) wasps are a pragmatic taxonomic grouping, comprising, of the three Hymenoptera Aculeata superfamilies, the Chrysoidea and parts of the Vespoidea (all but the ants) and Apoidea (all but the bees). Aculeate wasps range in size from the queen Hornet *Vespa crabro*, which may reach 40 mm in length, to some rarely encountered Dryinids under 2 mm long. Most have wings, but a few are wingless. Most hunt invertebrate prey to provide food for their larvae, and lay their eggs in a nest which may be built by the wasp from woodpulp or mud, excavated in soft wood or soil or placed in an existing cavity. The social wasps (Vespinae) and a few others provide food repeatedly as the larvae grow (*progressive provisioning*) but most species assemble a store of paralysed prey and seal this with a single egg within a nest cell (*mass provisioning*). All except the Vespinae are *solitary* nesters, with each female provisioning her own nest. A significant number are *cleptoparasites*, their larvae living off the food store in the nest of another species of wasp or a bee, or *parasitoids*, their larvae living in or on the larva of a wasp, bee or other insect and eventually killing it. Many species, including the Common Wasp *Vespula vulgaris*, are prolific predators of phytophagous insects, and are important in controlling many garden, farm and forestry pests; some have been used as biological pest control agents. Few people appreciate these benefits to human life, though most are very familiar with the irritating activities of two or three social wasp species which have given wasps as a whole a bad name.

This paper follows an earlier account of

Norfolk's bees (Strudwick 2012) and much that was written in that paper about our limited knowledge of bees in Norfolk also applies to wasps. There was a spate of recording and published accounts in the 40 years up to 1910 (e.g. Bridgman 1879, 1881, 1889; Barrett 1905; Atmore 1909) but this taxonomic group has received only sporadic attention in this county since then. The few published accounts of wasps in Norfolk have mainly concerned the arrival and spread of new species (e.g. Irwin 1990, 1991) or site surveys (e.g. Archer, 1987). Solitary wasps may be a little better recorded in Norfolk than solitary bees, but the information provided here is undoubtedly incomplete and it is very likely that species have been overlooked. A map of recorded species richness for the county (Figure 1) tells us more about the distribution of recording effort than that of species richness. Only for a few of the more conspicuous and better recorded species does the recorded distribution give an indication of actual distribution (see

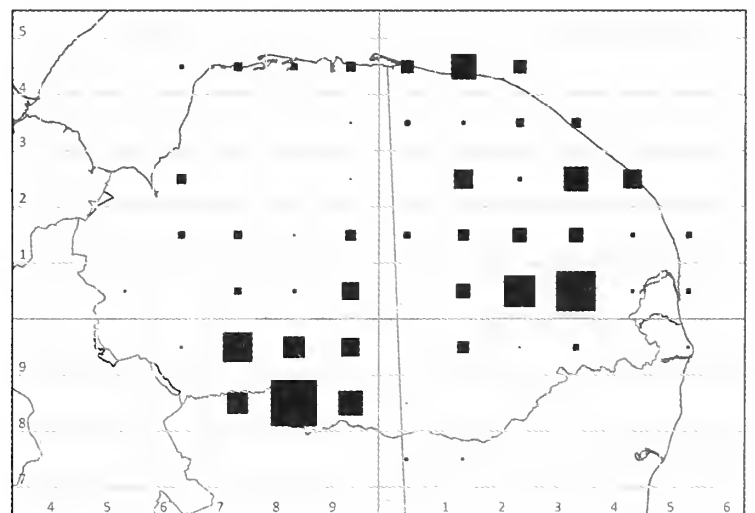


Figure 1. Recorded species richness of aculeate wasps in 10 km squares in Norfolk. Recording effort has been very unevenly distributed, with south Norfolk, The Fens and NW Norfolk particularly neglected.

Table 1. The families, sub-families and genera of British Aculeate wasps, excluding Dryinidae, Embolemidae and Bethylidae (based on Baldock, 2010), with the number of species recorded in the UK (excluding the Channel Islands) and Norfolk from 1970 onwards.

Family	Subfamily	Genus	No. of UK species	No. spp. recorded in Norfolk	
Chrysididae	Cleptinae	<i>Cleptes</i>	2	2	
		Elampinae	<i>Elampus</i>	1	1
	Chrysidinae	<i>Omalus</i>	2	1	
		<i>Philoctetes</i>	1	0	
		<i>Pseudomalus</i>	2	2	
		<i>Hedychridium</i>	4	3	
		<i>Hedychrum</i>	1	1	
		<i>Chrysis</i>	13	8	
		<i>Chrysurra</i>	2	1	
		<i>Trichrysis</i>	1	1	
<i>Pseudospinolia</i>	1	0			
Tiphidae	Tiphinae	<i>Tiphia</i>	2	2	
	Methochinae	<i>Methocha</i>	1	1	
Mutillidae	Mutillinae	<i>Mutilla</i>	1	0	
		<i>Smicromyrme</i>	1	0	
	Myrmosinae	<i>Myrmosa</i>	1	1	
Sapygidae		<i>Sapyga</i>	1	1	
		<i>Monosapyga</i>	1	1	
Pompilidae	Pepsinae	<i>Cryptocheilus</i>	1	0	
		<i>Priocnemis</i>	12	12	
		<i>Caliadnrgns</i>	1	1	
		<i>Dipogon</i>	3	3	
		<i>Anplops</i>	1	0	
		Pompilinae	<i>Agemoidens</i>	2	1
			<i>Pompilus</i>	1	1
			<i>Homonotus</i>	1	0
			<i>Episyron</i>	2	1
			<i>Anoplus</i>	5	5
		<i>Arachnospila</i>	6	5	
		<i>Evagetes</i>	3	2	
		<i>Aporns</i>	1	0	
		Ceropalinae	<i>Ceropales</i>	2	1
			Eumeninae	<i>Eumenes</i>	1
<i>Euodynerus</i>	1	0			
<i>Odynerus</i>	3	2			
<i>Gymnomerns</i>	1	1			
<i>Microdynerus</i>	1	1			

Family	Subfamily	Genus	No. of UK species	No. spp. recorded in Norfolk
		<i>Ancistrocerus</i>	8	6
		<i>Symmorphus</i>	4	3
	Polistinae	<i>Polistes</i>	1	0
	Vespinae	<i>Vespa</i>	1	1
		<i>Dolichovespula</i>	4	4
		<i>Vespula</i>	4	3
Sphecidae	Sphecinae	<i>Ammophila</i>	2	2
		<i>Podalonia</i>	2	2
Crabronidae	Astatinae	<i>Astata</i>	1	1
		<i>Dryudella</i>	1	1
	Larrinae	<i>Tachysphex</i>	3	2
		<i>Miscophus</i>	3	1
		<i>Nitela</i>	2	0
		<i>Trypoxylon</i>	4	4
	Crabroninae	<i>Crabro</i>	3	3
		<i>Crossocerus</i>	22	17
		<i>Ectemnius</i>	10	9
		<i>Lindenius</i>	2	2
		<i>Entomognathus</i>	1	1
		<i>Rhopalum</i>	3	3
		<i>Oxybelus</i>	3	3
	Pemphredoninae	<i>Mimumesa</i>	5	2
		<i>Mimesa</i>	4	4
		<i>Pseuulus</i>	3	2
		<i>Spilomena</i>	4	1
		<i>Stigmus</i>	2	2
		<i>Peuphredon</i>	5	4
		<i>Diodontus</i>	4	3
		<i>Passaloecus</i>	8	6
	Mellinae	<i>Mellinus</i>	1	1
	Nyssoninae	<i>Nyssou</i>	4	4
		<i>Didineis</i>	1	0
		<i>Gorytes</i>	2	2
		<i>Lestiphorus</i>	1	1
		<i>Harpactus</i>	1	1
		<i>Argogorytes</i>	2	2
	Philanthinae	<i>Cerceris</i>	5	4
		<i>Philanthus</i>	1	1
		Total species	223	170

Figures 2 to 4). As well as geographical biases, certain habitats, mainly within SSSIs, have been targeted by invertebrate surveys and thus heathland, dune and fen species are perhaps better recorded than species of other habitats.

From the information available it is possible to say that at least 170 aculeate wasp species (excluding the barely-recorded families Dryinidae, Embolemidae and Bethyridae), or 76% of the UK fauna, have occurred in Norfolk since 1970 (Table 1). Comparing this with published totals for a handful of other counties (Baldock 2010), Norfolk sits in the top 4 or 5 in the UK for recorded wasp diversity. The species that are absent from this county are largely those restricted to the very south of England. Norfolk has gained at least eight wasp species in the past 40 years and with a warming climate we might expect a few more to arrive in Norfolk in the near future.

It is hoped this publication will stimulate further recording and encourage new recorders to develop an interest in this group. Wasps have been better served than bees by recent identification literature with keys to social wasps (e.g. Else 1984) and many solitary species (Yeo and Corbett 1995; Day 1988; Morgan 1984) readily available. Some of the larger species can be identified by careful observation in the field or from good photographs, but for most of the smaller species a microscope is still essential for reliable determination. Up-to-date keys for some of the smaller species are not easy to obtain. The author is very happy to provide advice to new recorders and to identify species, as far as is possible, from emailed photos, or to determine specimens collected in Norfolk (addresses below).

Notes on the systematic list

Sources of records

The species accounts below draw upon records from the databases of the Norfolk

Biodiversity Information Service (NBIS), National Biodiversity Network (NBN) and the Bees, Wasps and Ants Recording Society (BWARS), collections held at the Castle Museum, various published sources, an unpublished list by G.M.Spooner (c. 1980) and records supplied by individual recorders. Some published records were undoubtedly overlooked and hopefully this publication will help draw these out, along with any unsubmitted records.

Verification of records

All species reliably recorded in Norfolk are included in the list, with names of species only recorded before 1970 in square brackets. In the preparation of this list a few records were judged to be doubtful or erroneous and have been disregarded. These were records of species which have since been subject to taxonomic revision, in unlikely locations, very difficult species where it seems unlikely the recorder had access to up-to-date identification keys or reference specimens or where a voucher specimen was found to have been misnamed. It is acknowledged that some of these may yet prove to be good records.

County boundaries

Biological recording tradition favours use of Watsonian vice-counties, but with the importance of biodiversity data in the planning process and the role of local government in biodiversity, modern county boundaries are arguably now more useful for a county list. For the purposes of this work, Norfolk is defined as the post 1976 administrative area. Where species have occurred only in VC27 (East Norfolk) or VC28 (West Norfolk) this is noted.

Nomenclature

Scientific nomenclature follows Archer (2005) though in a few cases where a revised or alternative name is in current use, this is also given in brackets. English names are given only where these are in general use. The species are presented by

superfamily, family, subfamily and genus, but for simplicity superfamily names are not given.

Status

UK conservation status follows Falk (1991), though it should be noted that this is well out of date and a revised list is likely to be published in the near future. The Norfolk status given for each species is based on the author's own experience and interpretation of the available records, taking into account likelihood of being encountered and ease of identification. Details, including recorders, of records of the rarer species are given where known.

Notes on genera and species

Brief notes on characteristics of each genus and species are provided. This information draws heavily on Baldock (2010), Yeo and Corbett (1995) and NBN distribution data (<http://data.nbn.org.uk>).

Recorders mentioned in the species accounts:

AGI	Tony Irwin
APF	Andy Foster
BE	Bill Ely
CS	Clive Sheppard
DL	David Lester
EAA	E.A. Atmore
GN	Geoff Nobes
IM	Ian McClean
JBB	John Bridgman
JCF	Jeremy Field
JW	Jonathan Webb
KD	Ken Durrant
LR	Lee Rudd
ME	Mike Edwards
MEA	Michael Archer
MD	Martin Drake
NBN	NBN Gateway (where recorder's name unavailable)
NWO	Nick Owens
PL	Paul Lee
SP	Stuart Paston
TS	Tim Strudwick

[p.] page references in bold refer to illustrations.

A systematic List of the aculeate wasps of Norfolk

DRYINIDAE - tiny parasitoids of Homopteran nymphs and adults; females are sometimes wingless; although not uncommon, they are rarely found with an insect net or water trap, so are under-recorded nationally and barely at all in Norfolk; of the 27 UK species, just four have been recorded in Norfolk and many others undoubtedly occur (2-5 mm).

Subfamily ANTEONINAE

Anteon - parasitoids of leaf-hopper (*Cicadellidae*) nymphs.

Anteon fulviventre Norfolk status: one record, Strumpshaw 1988 (APF).

Anteon gaullei Norfolk status: one record, TL98 2006 (NBN).

Subfamily GONATOPODINAE

Gonatopus - parasitoids of leaf-hoppers (*Cicadellidae*); females are wingless and ant-like.

Gonatopus clavipes Norfolk status: one record, Wells-next-the-Sea 1975 (JCF).

Haplogonatopus - parasitoids of leaf-hoppers (*Delphacidae*).

Haplogonatopus oratorius A very rare species with just four UK records. Norfolk status: one record, TG14 2009 (NBN).

BETHYLIDAE - these very small wasps are external parasitoids of beetle or Lepidoptera larvae, rarely encountered, spending their time amongst vegetation or leaf litter; of 19 UK species, one has been recorded in Norfolk (3-6 mm).

Subfamily BETHYLINAE

Bethylus - parasitoids of various micromoth larvae.

Bethylus fuscicornis Norfolk status: four records, East Walton Common 1983 (BE), Horsey 1988 (NBN), Woodbastwick 1998 (NBN), Strumpshaw Fen 2009 (TS).

CHRYSIDIDAE – the ruby-tailed or jewel wasps, with their beautiful metallic red, gold, green, blue or purple colouration, are largely parasitoids of wasps, bees and other insects; they are most often encountered around the nest sites of their hosts.

Subfamily CLEPTININAE

Cleptes – parasitoids of sawfly larvae which are attacked in the cocoon (5-7 mm).

Cleptes nitidulus Nationally Scarce. A parasitoid of tenthredinid sawflies, usually found in sandy grassy habitats. Norfolk Status: rare, only at Santon Warren 1982 & 1986 (JCF).

Cleptes semiauratus Nationally Scarce. A parasitoid of the common currant sawfly *Nematus ribesii*. Norfolk Status: rare, Santon Warren 1986 (JCF).

Subfamily ELAMPINAE

Elampus – easily recognisable by a tongue-like projection at the rear of the thorax (3-6 mm).

Elampus panzeri A parasitoid of *Mimesa* wasps, restricted to sandy habitats. Norfolk Status: local, recorded widely in the Brecks and also at Roydon Common, Cawston Heath and Caistor Quarry.

Hedychridium – parasites of ground-nesting crabronid wasps (3-6 mm).

Hedychridium ardens A parasitoid of *Tachysphex pompiliformis*. Norfolk Status: common.

Hedychridium cupreum Nationally Scarce. A parasitoid of *Dryudella pinguis*. Norfolk Status: rare, only at Santon Warren 1986 (JCF), with an old record from King's Lynn (EAA).

Hedychridium roseum A parasitoid of *Astata boops* found mainly in sandy habitats and easily recognised by its matt, rather than metallic, red abdomen. Norfolk Status: local, less common than

the host, with 19 records from eight widely scattered sites. [p.34]

Hedychrum - parasites of ground-nesting crabronid wasps (3-7 mm).

Hedychrum niemelai RDB3. A parasitoid of *Cerceris* species. Norfolk Status: local, with records from several Breck sites, Bowthorpe and Caistor Quarry. [p.34]

Omalus - parasitoids of deadwood and stem-nesting wasps including *Passaloecus* and *Pemphredon* species (3-6 mm).

Omalus puncticollis Nationally Scarce. Norfolk Status: rare, with one recent record from East Wretham Heath 1993 (NBN).

Pseudomalus - parasitoids of deadwood and stem-nesting wasps including *Passaloecus* and *Pemphredon* species; probably very much under-recorded (3-6 mm).

Pseudomalus auratus A blue and red species, active June-August in scrub and wooded habitats. Norfolk Status: just four records, Weybourne 2011 (NWO), Norwich 2011, Brundall 2005 (both TS) and East Winch Common 1983 (BE).

Pseudomalus violaceus Nationally Scarce. A dark violet-green species, active June-August in scrub and wooded habitats. Norfolk Status: scarce, with seven records from four locations: Santon Warren, TL89, East Walton Common, Strumpshaw Fen.

Subfamily CHRYSIDINAE

Chrysis – most species are blue-green with a red-gold or red and blue abdomen and have four sharp or blunt teeth along the tip of the abdomen; hosts are mainly Eumenid wasps (4-11 mm)

The *Chrysis ignita* complex: the following five species are extremely difficult to separate and are considered by some authorities to be variants within a single species; the status given for each is very tentative as most records have referred to *Chrysis ignita s.l.*

Chrysis angustula A parasitoid of *Ancistrocerus trifasciatus* and probably other related species. Norfolk Status: widespread.

Chrysis ignita s.s. A parasitoid of *Ancistrocerus parietum* and probably other related species. Norfolk Status: widespread. [p.34]

Chrysis impressa A parasitoid of *Ancistrocerus trifasciatus* and *A. parietinus*. Norfolk Status: widespread.

Chrysis mediata A parasitoid of *Odynerus spinipes* and *Ancistrocerus trifasciatus*. Norfolk Status: scarce.

Chrysis rutiliventris A parasitoid of *Ancistrocerus oviventris* and probably *A. scoticus*. Norfolk Status: rare, only at South Acre 2004 (NBN).

Chrysis gracillima RDB2. A parasitoid of *Microdynerus exilis*. Norfolk Status: rare, only at St. James Hill, Norwich, with the host, in 2007 (TS).

Chrysis illigeri Nationally Scarce. A parasitoid of *Tachysphex pompiliformis*. Norfolk Status: widespread in open sandy habitats.

Chrysis viridula A parasitoid of *Odynerus* mason wasps. One of the more distinctive *Chrysis* species, with the last abdominal segment blue. Norfolk Status: rare; recorded with *O. spinipes* from cliffs at Overstrand 2007 and Gimingham 2008 (both TS).

Chrysura – rather large blue/red species with a smoothly curved tip to the abdomen (6-10 mm).

Chrysura radians Nationally Scarce. The hosts are bees of the genus *Osmia* and *Chelostoma*. Norfolk Status: local, with 16 recent records, all in the Norwich area 2009-11.

Trichrysis – metallic blue-green wasps with three blunt teeth at tip of the abdomen (3-8 mm)

Trichrysis cyanea A very common species

throughout the UK. Hosts include *Trypoxylon*, *Pemphredon* and other wasp genera. Norfolk Status: widespread and common. [p.34]

TIPHIIDAE

Methocha – small wasps with ant-like wingless females; parasitoids of tiger beetle (*Cicindela*) larvae (4-10 mm).

Methocha articulata Nationally Scarce. A heathland species usually associated with the Green Tiger Beetle *Cicindela campestris*, only common in a few southern counties. Norfolk Status: local, with records from seven widely scattered sites. [p.34]

Tiphia – rather distinctively shaped parasitoids of scarabaeid beetle larvae (5-14 mm).

Tiphia femorata A widespread species found in various habitats on sandy and chalky soils, often on Wild Carrot *Daucus carota* flowers, and active June to September. The female has distinctive red legs. Norfolk Status: widespread and locally abundant.

Tiphia minuta Much smaller than the preceding species, also found in sandy habitats and mainly active June to July. Norfolk Status: rare, three Breckland records and Leziate, but possibly overlooked.

MUTILLIDAE

Subfamily MUTILLINAE

Mutilla – the velvet ants, robust parasitoids of bumble-bees with wingless females (7-14 mm).

[*Mutilla europea*] Nationally Scarce. A large and very distinctive species with a mainly southern distribution. Much declined in recent years. Recorded in the Norwich area in the 1870s (JBB).

Smicromyrme – small velvet ants, the wingless females more ant-like than *Mutilla* (3-7 mm).

[*Smicromyrme rufipes*] Nationally Scarce. A parasitoid of ground-nesting wasps and bees. Confined to southern England and recorded around Norwich in the late 1800s (JBB).

Subfamily MYRMOSINAE

Myrmosa – small wasps with wingless reddish ant-like females (3-11 mm).

Myrmosa atra A widespread parasitoid of ground-nesting wasps and bees. The winged, black males are more frequently encountered than females. Norfolk Status: widespread, recorded at about 20 sites. [p.34]

SAPYGIDAE – medium-sized, slender-bodied cleptoparasites of solitary bees.

Monosapyga – black, with yellow spots or bands on the abdomen (7-10 mm).

Monosapyga clavicornis Nationally Scarce. A cleptoparasite of *Chelostoma* and *Osmia* species. Norfolk Status: rare, only recorded at Downham Market 2011 (CS).

Sapyga – similar to the preceding genus, but the female has red on the front half of the abdomen (9-13 mm).

Sapyga quinquepunctata A cleptoparasite of mason bees (*Osmia* spp.), and frequently seen around artificial 'bee boxes'. Norfolk Status: widespread in VC27, scarcer in VC28. [p.34]

POMPILIDAE – the spider-hunting wasps are slender, long-legged insects which often run along the ground rather than fly, flicking their wings and antennae in a nervous fashion; there is often great size variation within a species; a few can be identified in the field but most are very difficult to determine; they are also hard to catch with a net so are relatively under-recorded except where water traps have been used.

Subfamily PEPSINAE

Dipogon – black wasps associated with deadwood.

Dipogon bifasciatus RDB3. A rare species associated with deadwood, preying upon *Xysticus* spp. Norfolk Status: rare, the only recent record from TG23 1993 (NBN).

Dipogon subintermedius A common species of woodland and hedgerows, nesting in deadwood, stems or walls, and preying solely upon *Segestria senoculata*. Norfolk Status: fairly common, with 15 records from 10 sites.

Dipogon variegatus A fairly common species with similar habits to *D. subintermedius*, but preying upon *Xysticus cristatus*. Norfolk Status: local, with 9 records from 5 sites.

Caliadurgus – red/black ground-nesting wasps with a distinctively shaped thorax.

Caliadurgus fasciatellus A widespread species in southern Britain, found in sandy places and hunting orb-web spiders (Araneidae). Norfolk Status: locally common, with 19 records from 14 sites, mostly in the Brecks.

Priocnemis – red/black ground-nesting wasps, many showing a pale spot on the darkened wing-tips; some females are very difficult to determine.

Priocnemis agilis Nationally Scarce. A poorly known species, found mostly on dry grassy slopes in SE England. Norfolk Status: 1 or 2 records from Santon Warren in 1996 (NBN).

Priocnemis coriacea Nationally Scarce. A species of grassy, often wooded places in southern England and active from April to June. One of three large spring-flying species, with *P. perturbator* and *P. susterai*. Norfolk Status: local, with 18 records, all but three from the Brecks.

Priocnemis exaltata A widespread species found in a variety of habitats, active June to early September. Norfolk Status: local, with 11 widely scattered records.

Priocnemis fennica A small species of damp or wooded places, mainly in southern

Britain, and active from mid-May to late September. Norfolk Status: common, with 30 records from 11 sites.

Priocnemis gracilis (confusus) Nationally Scarce. A species of dry, sandy habitats, active June to August. Norfolk Status: scarce, only recorded at Grimes Graves 2009 (TS), Santon Warren 1986 (JCF), Felbrigg 2003 (NBN) and Marsham Heath 2009 (TS).

Priocnemis hyalinata Nationally Scarce. Mainly found in dry, open or lightly wooded habitats, especially heathland. Active July to September. Norfolk Status: local, with 11 records, 7 of which are from the Brecks.

Priocnemis parvula A widespread species of dry, open habitats, usually on sandy soils, and active May to early October. Norfolk Status: common, with 30 records from widely scattered sites.

Priocnemis perturbator The largest of the genus and a common species of open woodland and scrubby places, active late March to July. Norfolk Status: fairly common with 41 records widely distributed across the county. [p.34]

Priocnemis pusilla A southern species associated with sandy habitats. Norfolk Status: rare, only at Santon Warren 1986 (JCF) and 2011 (TS).

Priocnemis schioedtei Nationally Scarce. A widespread species associated with sandy habitats. Norfolk Status: rare, only at Santon Warren 1982 and 1986 (JCF).

Priocnemis susterai A local species, mainly found in lightly wooded habitats in southern Britain, and active from April to July. Norfolk Status: local, with 16 records, all but one in the Brecks and 11 of these from a water trapping study in forestry rides in 2011 (LR).

Subfamily POMPILINAE

Agenioideus – small species with pale markings on the head and thorax.

Agenioideus cinctellus A common southern species which preys upon jumping spiders (Salticidae), nesting in deadwood and other cavities and active May to September. Norfolk Status: fairly common with 16 records from 9 locations. [p.34]

Anoplius – black or red/black medium–large species.

Anoplius caviventris Nationally Scarce. An all-black species, very similar to *A. nigerrimus* and *A. concinnus*, usually found in waterside habitats where it nests in reeds and other hollow stems. Active June to August. Norfolk Status: rare, with three Broadland records, at Sutton Fen 2007 (MD), How Hill 2009 (TS) and Woodbastwick 2010 (PL).

Anoplius concinnus A widely-distributed but rather scarce all-black species, usually found by water where it hunts wolf spiders (Lycosidae) and nests under stones. Active June to September. Norfolk Status: scarce, recorded only from Salthouse Beach 1985 and 1987 (KD), Santon Warren 1986 (JCF) and Great Hockham 2010 (GN).

Anoplius infuscatus A widespread red and black species of dunes, heaths and other sandy places. It hunts wolf-spiders, nests in sandy soil and is active June to August. Norfolk Status: widespread, with 28 widely-scattered records.

Anoplius nigerrimus A widespread and common all-black species found in various habitats, including gardens, and nesting in all kinds of cavities. Active May to September. Norfolk Status: very common, with 55 records. [p.35]

Anoplius viaticus A widespread species of heaths and other sandy places where it nests in the ground and hunts mainly wolf spiders. The female is large and conspicuous and easily recognisable by the black and red banded abdomen. Active April to September. Unusually for a pompilid, mated females over-

winter, males emerging in June and July and new females from July onwards. Norfolk Status: common in suitable habitat. One of the most frequently recorded solitary wasps with 99 records. [p.35]

Arachnospila – red and black ground-nesting wasps.

Arachnospila anceps A widespread species found in many habitats but usually on light soils, active April to October. Norfolk Status: very common, with 89 records.

Arachnospila consobrina RDB3. A species restricted to a few coastal dunes in England and Wales and active July to August. Norfolk Status: rare, recorded at Winterton 1993 (NBN).

Arachnospila minutula A rather scarce species of southern Britain, found in a variety of habitats, and active June to September. It is very similar to *A. spissa*, and, like that species, paralyzes a female spider in her own nest retreat, rather than digging a nest burrow. Norfolk Status: local, with about 15 widely scattered records.

Arachnospila spissa A very widespread species found in various habitats, including woodland, active May to August. Norfolk Status: local, with 24 records, all but 6 in the Brecks. [p.35]

Arachnospila trivialis A widespread species of bare sandy habitats, active May to September. Norfolk Status: local, with 31 records, all but 4 in the Brecks.

Arachnospila wesmaeli Nationally Scarce. A species of coastal dunes and heath with loose sand, active June to August. Norfolk Status: rare, Santon Warren 1996 (JCF) and Mousehold Heath 2007 (TS).

Episyron – ground-nesting species .

Episyron rufipes A common species of dunes, heath and other open sandy places. A distinctive species, the female

having red legs and both sexes with paired white spots on the abdomen. Active May to September. Norfolk Status: widespread. [p.35]

Evagetes – red and black wasps which cleptoparasitise other pompilids, digging into and laying an egg in the completed nest of the host.

Evagetes crassicornis A widespread species, most numerous on sandy soils in southern Britain, active May to September. Norfolk Status: common, with 68 widely scattered records.

Evagetes dubius Nationally Scarce. This small species is confined to heathland in SE England, active June to September. Norfolk Status: local, with 14 records, all in the Brecks except for Roydon Common in 1997 and 1998 (NBN).

Pompilus – a ground-nesting species with fine pubescence giving a greyish appearance.

Pompilus cinereus A very widespread species of dunes, heath and sand pits, active May to September. Norfolk Status: widespread in suitable habitat, with 59 records. [p.35]

Subfamily CEROPALINAE

Ceropales – small and exceptionally long-legged, and the only pompilids with pale markings on the head, thorax and abdomen; cleptoparasites of other pompilids that ambush the host pompilid with a captured spider, quickly lay an egg in the spider then leave the host to complete her nest.

Ceropales maculata Nationally Scarce. This widespread species has become much scarcer in recent years. Active July to August. Norfolk Status: rare, with recent records only from Santon Warren 1982 and 1986. There are old records from Norwich, Easton and Wheatfen.

VESPIDAE – the social, potter and mason wasps; longitudinally folded wings are a consistent feature of this family.

Subfamily **EUMENIDAE** – *the potter and mason wasps, all solitary species.*

Ancistrocerus – *black and yellow*

(occasionally white) mason wasps, mainly hunting Lepidoptera larvae, nesting in vertical banks, walls, deadwood and hollow stems, and sealing the nest with soil;

identification to species level is difficult (9-15 mm).

[*Ancistrocerus antilope*] 100 years ago this, the largest species of the genus, was scarce but widespread in the UK, but now it is very rare. There are a few old Norfolk records, the last in 1939.

Ancistrocerus gazella A widespread species, most abundant in open and dry habitats. This species was only separated from *A. parietum* in 1954. Active mid-May to September. Norfolk Status: common, with 25 records from 18 sites.

Ancistrocerus nigricornis Widely distributed in the southern half of the UK and locally common, mainly on sandy soils. Uniquely for the genus the mated females overwinter and nest March to May, with fresh females and males emerging July to September. Norfolk Status: locally common, especially in the Brecks, with 29 records from 14 sites.

[p.35]

[*Ancistrocerus oviventris*] There are a couple of old records (EAA, JBB) of this species which has a mainly northern and western distribution in the UK.

Ancistrocerus parietinus A widespread species, possibly declining nationally. Nests in hollow stems and active May to August. Norfolk Status: scarce, with 8 records from 8 sites.

Ancistrocerus parietum This widespread species is possibly commonest in the northern half of England, and is most frequent in damp and wooded sites, often in gardens. Active late April to October. Norfolk Status: common, with 40 records from 16 sites.

Ancistrocerus scoticus This species is found throughout the UK, but has experienced a recent decline in southern England and is now mainly coastal. Active June to September. Norfolk Status: scarce and local, with 7 records, all from the coast between Blakeney and Caister.

Ancistrocerus trifasciatus A widespread species of damp, wooded and scrubby areas, hunting the larvae of leaf beetles and small moths, often on willows. It is very similar to the preceding species, but more slender. Active May to September. Norfolk Status: common in suitable habitat, with about 90 records from 16 sites.

Gymnomerus – *very similar in appearance to Odynerus, but nesting in hollow stems (8-11 mm).*

Gymnomerus laevipes A widely distributed but rather elusive species which occurs in a range of habitats and hunts *Hypera* weevil larvae. Norfolk Status: scarce, with 8 records from 6 widely scattered sites.

Odynerus – *these mason wasps are black and yellow/white and nest in soil, producing a characteristic chimney/turret around the nest entrance (8-12 mm).*

Odynerus simillimus RDB1. BAP Priority.

The Fen Mason Wasp is a globally rare and little-known species, currently known from Essex and Norfolk and nowhere else in Western Europe. It is a wetland species, hunting the larvae of a weevil *Hypera pollux* from either Fool's Water-cress *Apium inundatum* or Lesser Water-parsnip *Berula erectum*, and nesting in level or sloping bare ground. Norfolk status: very local, found only in Broadland with good populations in the Thurne and Ant valleys, and an isolated record from the Bure valley. The first UK record was one collected near Brundall in 1873, which is now in the Bridgman collection at Norwich Castle Museum. [p.35]

Odynerus spinipes The Spiny Mason
Wasp hunts weevil *Hypera* spp. larvae in grassland and typically nests in vertical faces in clayey soil, producing a long, down-curved tube around the nest entrance. Norfolk status: very local, only recorded from soft cliffs at Overstrand and Mundesley, and at Sutton Fen.

Microdynerus – small and slender mason wasps, nesting in beetle holes in deadwood (7-9 mm).

Microdynerus exilis A relative newcomer to the UK, first recorded in Hampshire in the 1930s. Active late May to late August. Norfolk status: rare, only recorded at St. James' Hill, Norwich, in 2007.

Symmorphus – similar to *Ancistrocerus*, but distinguished by a short longitudinal groove at the rear of the first abdominal segment; found in moist wooded habitats, collecting phytophagous insect larvae as prey, nesting in deadwood or hollow stems and sealing the nest with soil (6-12 mm).

Symmorphus bifasciatus A common species of damp places that hunts the larvae of leaf beetles (Chrysomelidae) found on willows. Active early June to mid August. Norfolk status: common, with 70 widely scattered records. [p.35]

Symmorphus connexus RDB3. A small species associated with damp wooded rivers valleys where it hunts mainly leaf beetle larvae on Aspen. Norfolk status: rare, only recorded at Redgrave and Lopham Fen 2003 (NBN).

Symmorphus gracilis A widespread species of moist places, mainly hunting the larvae of weevils *Cionus* spp. that feed on figworts *Scrophularia* spp., and best found by watching figwort plants in full sun. Active late May to early August. Norfolk status: local, with 25 records, mostly in the Yare Valley fens, and at Caudlesprings and Flordon Common. [p.35]

Subfamily **VESPINAE** – the social wasps.

Dolichovespula – the 'long-cheeked' social wasps typically only show aggression when disturbed at the nest and are rarely attracted to food and drink; nests are often in a tree or bush, usually producing 100-300 workers and are mainly active April-August; males are hard to identify (12-27 mm).

Dolichovespula media Nationally Scarce.

The Median Wasp is a recent colonist of the UK, first recorded in Sussex in 1980. It is a large and variable species, often showing little yellow on the abdomen, but easily recognised by the thorax markings and the entirely yellow eye notches. Norfolk status: widespread and possibly now the commonest species of the genus; first recorded in 1990 at Reedham (Irwin, 1990). [p.38]

Dolichovespula norwegica The Norwegian Wasp is much commoner in northern England and Scotland than in southern Britain. Norfolk status: apparently rare, with just 2 recent records: Santon Warren 1986 JF; Sutton Fen (July 2011, TS).

Dolichovespula saxonica Nationally Scarce. The Saxon Wasp is another recent colonist, first recorded in Surrey in 1987, now widespread in southern England. It can only be distinguished from the preceding species with care. Norfolk status: fairly widespread though not common; it has steadily increased since the first record, which was also the second UK record, at North Walsham in 1990 (Irwin, 1992).

Dolichovespula sylvestris The Tree Wasp usually nests, as its name suggests, in trees or bushes, but will also occasionally nest in the ground. Norfolk status: widespread and fairly common.

Vespa – hornets are the largest of the social wasps; there is only one native species in NW Europe although exotic species occasionally turn up with imported goods and *Vespa velutina* from SE Asia is now established in

SW and central France (20-40 mm).

Vespa crabro The native Hornet is a gentle giant that rarely comes into conflict with human activities, though it can deliver a painful sting if threatened. It favours areas with plenty of mature trees and builds its nest in the ground, in hollow trees or in buildings. Active April to October. Norfolk status: fairly common in well-wooded areas (Fig. 2) [p.38].

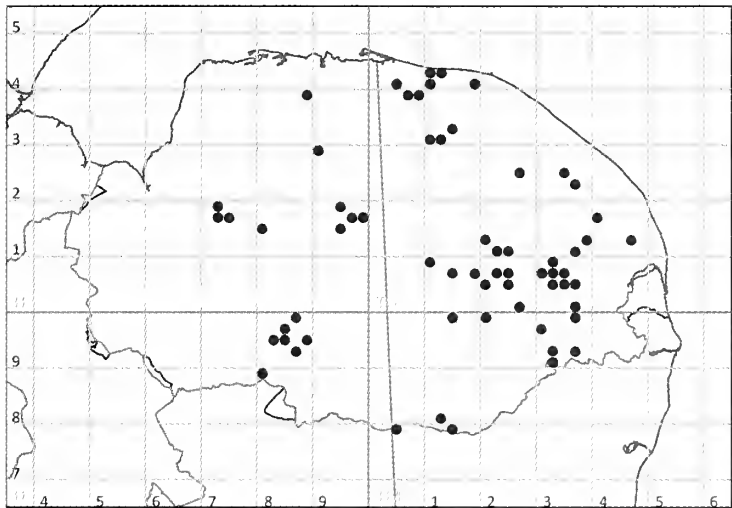


Figure 2. Distribution of the Hornet *Vespa crabro*. This conspicuous species is better recorded than most but is undoubtedly found more widely than the map suggests.

Vespula – the ‘short-cheeked’ social wasps usually nest in the ground but will also nest in cavities in trees or buildings; nests may contain up to 2000 workers and are active March-November (10-25 mm).

Vespula germanica The largest *Vespula* species, the German Wasp, usually builds its nest from dry dead wood. Norfolk status: common, and often more abundant than the Common Wasp away from trees. [p.38]

Vespula rufa In contrast to other *Vespula*, the Red Wasp is not aggressive. It frequents open woodland, heath and moorland throughout the UK, but is scarce in many areas. Norfolk status: scarce, with most records from the Brecks and north coast, but possibly overlooked. [p.38]

Vespula vulgaris The ubiquitous Common Wasp is the smallest of the social wasps.

It is really a woodland insect, building its nest with decaying wood, and is scarce in treeless habitats. Norfolk status: very common everywhere.

SPHECIDAE – the ‘thread-waisted’ digger wasps or sand-wasps; all UK species have an elongate black and red abdomen, and provision their nests with *Lepidoptera* larvae.

Subfamily SPHECINAE

Ammophila – the largest solitary wasps in the UK, nesting in bare sandy ground (15-25 mm).

Ammophila pubescens The Heath Sand-wasp is very similar to the following species, but smaller, lacking the blue sheen to the black abdominal tip and with other subtle differences. Restricted to *Calluna* heathland in southern England and active late May to August. Norfolk status: very local, with about 12 recent records from Roydon Common, Leziate Heath, Kelling Heath and Beeston Common. Oddly missing from the relatively well-recorded Brecks.

Ammophila sabulosa The Common Sand-wasp is large and conspicuous and one of the better-recorded solitary wasps. Found in dunes, heathland, and other places with bare sandy soil, and active late April to September. Norfolk status: common on dunes, heath, quarries and other sandy places. The most frequently recorded solitary wasp with over 120 records (Fig. 3). [p.38]

Podalonia – more robust and hairier than *Ammophila* (13-23 mm).

Podalonia affinis Nationally restricted to coastal sand dunes in SE England and the Brecks. Active June to August. Norfolk status: local, with 32 records from heaths and forestry rides in Breckland, at Roydon Common and at most coastal dune sites.

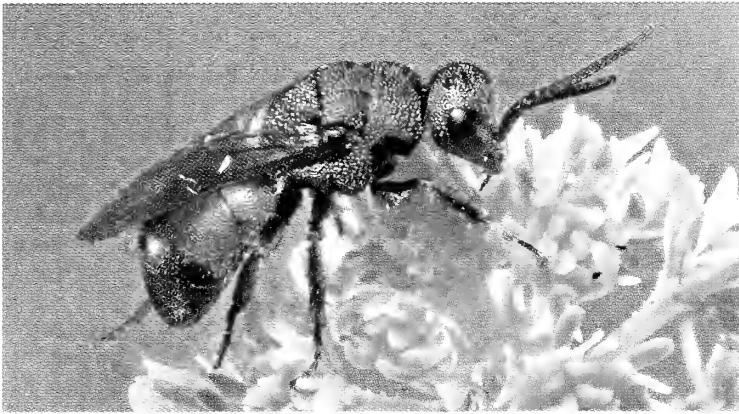
Podalonia hirsuta Larger than the preceding species, more widely distributed



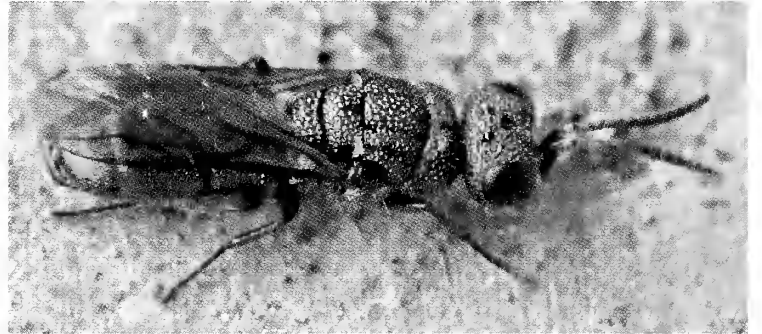
Chrysis ignita, f. p.27. Geoff Nobes



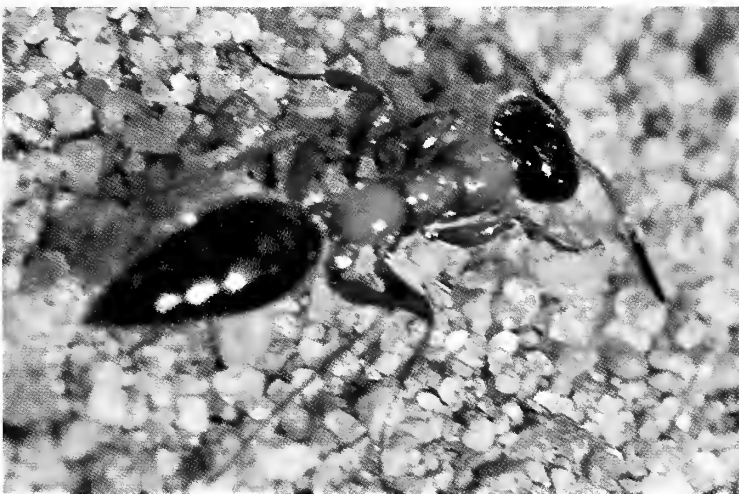
Hedychridium roseum, f. p.26. Nick Owens



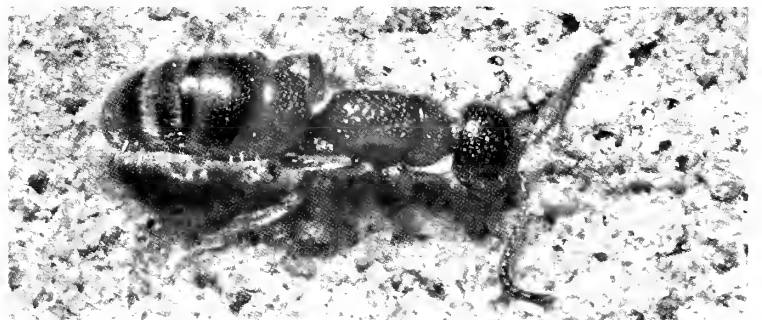
Hedychrum niemelai, f. p.26. Geoff Nobes



Trichrysis cyanea, f. p.27. Tim Strudwick



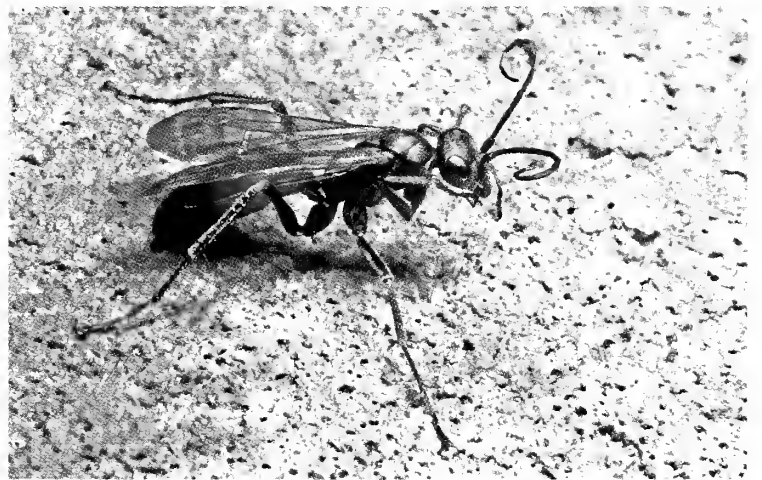
Methocha articulata, f. p.27. Nick Owens



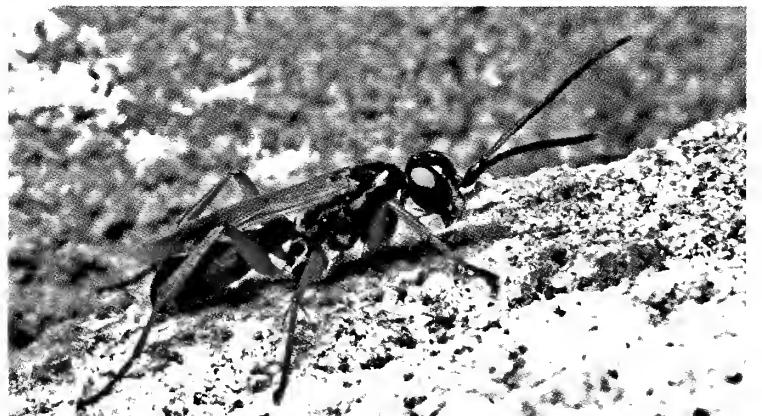
Myrmosa atra, f. p.28. Geoff Nobes



Sapyga quinquepunctata, f. p.28. Tim Strudwick

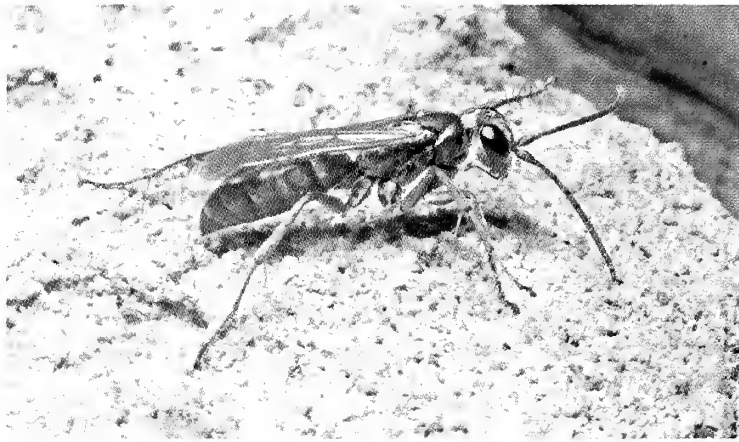


Priocnemis perturbator, f. p.29. Geoff Nobes



Agenioideus cinctellus, f. p.29. Geoff Nobes

Abbreviations: f, female; m, male;
q, queen; w, worker.



Pompilus cinereus, f. p.30. Geoff Nobes



Episyron rufipes, f. p.30. Geoff Nobes



Anoplius viaticus, f. p.29. Nick Owens



Symmorphus gracilis, f. p.32. Tim Strudwick



Arachnospila spissa, f. p.30. Geoff Nobes



Anoplius nigerrimus, f. p.29. Geoff Nobes



Odynerus simillimus, m. p.31. Tim Strudwick



Ancistrocerus nigricornis, f. p.31. Geoff Nobes



Symmorphus bifasciatus, f. p.32. Tim Strudwick

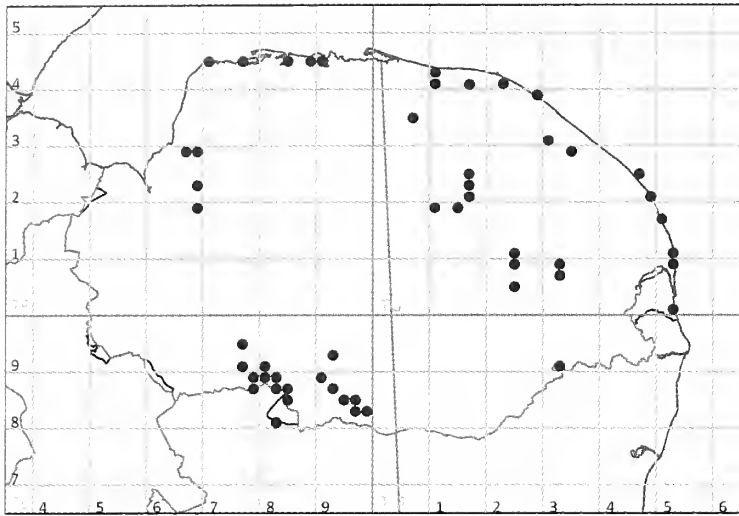


Figure 3. Distribution of Common Sand-wasp *Ammophila sabulosa*. A large, conspicuous species, found in sandy habitats with plenty of bare ground.

nationally, and found in a wider range of coastal habitats. Active from March to September, with mated females overwintering. Norfolk status: local, with 28 records from dunes/cliffs from Holme to Gorleston and at Kelling Heath. [p.38]

CRABRONIDAE – digger wasps.

Subfamily ASTATINAE

Astata – medium–large black and red ground-nesting wasps preying on shieldbug nymphs and occasionally also on adults (9-13 mm).

Astata boops A widely distributed but local species, most frequently found on heathland and acid grassland. The Gorse Shieldbug *Piezodorus lituratus* is a frequent prey item. The male has very large eyes that meet in the middle of the head. Active June to August. Norfolk status: local, recorded from about 14 locations, mostly in East Norfolk. [p.39]

Dryudella – a black and red wasp similar to *Astata* (6-8 mm).

Dryudella pinguis A widely distributed wasp that hunts ground-bug nymphs (Hemiptera Lygaeidae) in sandy habitats and is active June to August. Norfolk status: Scarce, with 10 records from Breckland and Winterton Dunes.

Subfamily LARRINAE

Miscophus – very small black or blackish-red ground-nesting wasps that prey on spiders (4-5 mm).

Miscophus concolor A species of sandy heath in SE England, active mainly in July and August. Norfolk Status: rare, only recorded at Weeting 2003 (NBN).

Tachysphex – small black or red and black ground-nesting wasps that hunt grasshopper nymphs (5-9 mm).

Tachysphex nitidus Nationally Scarce. This all-black species of coastal dunes and heathland was only recently separated from the very similar *T. unicolor*. All Norfolk records supported by specimens have so far proved to be this species. Active May to August. Norfolk status: local on dunes and heaths with 10 records from 7 sites.

Tachysphex pompiliformis This red and black species is found on heath, dunes and other sandy places throughout the UK. Active late April to August. Norfolk status: common, with about 75 records from 30 sites. [p.39]

Trypoxylon – a genus of slender black wasps that hunt small spiders; nests are sealed with soil (5-13 mm).

Trypoxylon attenuatum Found throughout the UK, this very slender species nests in hollow plant stems and is found in open and lightly wooded habitats. Active late April to mid October. Norfolk status: very common and widespread, with 82 records.

Trypoxylon clavicerum This species can be distinguished from others in the genus by orange-brown on the front legs, and nests in holes in deadwood and in hollow stems in wooded habitats. Active May to August. Norfolk status: fairly common, with about 20 records from 12 sites.

Trypoxylon figulus The largest species of the genus, nesting in deadwood and

hollow stems. Possibly prefers moister habitats than *T. medium*. Active May to August. Norfolk status: fairly common, with 35 records from 11 sites.

Trypoxylon medium Only recently separated from *T. figulus*, this seems to be the commoner of the two species in southern England, with a preference for dry, sandy habitats. Active late April to August. Norfolk status: locally common, with 31 records from the Brecks, and 6 sites elsewhere.

Subfamily CRABRONINAE

Crabro – medium–large black and yellow ground-nesting wasps; hunt flies; the male fore tibia are enlarged into discs which are held over the eyes of the females during copulation (7-15 mm).

Crabro cribrarius The largest and commonest species in the genus, found in a range of habitats but always nesting in free-draining soils. Active mid June to early September. Norfolk status: common on suitable soils, with 65 records. [p.39]

Crabro peltarius Slightly smaller and less common than *C. cribrarius*, and more restricted to open sandy habitats like heathland and sand dunes. Active June to August. Norfolk status: widespread in sandy habitats, with 48 records.

Crabro scutellatus Nationally Scarce. A small species that hunts Dolichopodid flies associated with water, mainly found in the damper parts of heathland. Active June to August. Norfolk status: rare, with just 3 records from 2 sites: Dersingham Bog in 1987 (IM) and 2005 (JW), and Strumpshaw Fen in 2000 (ME).

Crossocerus – a large genus of very small to medium-sized black or black/yellow wasps; most hunt small flies or aphids. They nest in soil or beetle holes in deadwood and hollow stems; few can be identified to species level without a microscope (4-11 mm).

Crossocerus annulipes A widespread species that nests in deadwood, hunts Hemipteran bugs and flies June to September. Norfolk status: common in the Norwich area, but otherwise only recorded from Santon Warren and Boughton Fen. Probably overlooked.

Crossocerus binotatus Nationally Scarce. One of the larger *Crossocerus* species, with yellow marking on the abdomen. Associated with mature trees and hunting flies, particularly snipeflies (Rhagionidae); active June to August. Norfolk status: very scarce, with four recent records, all in VC27: Aylmerton 1974 (KD), Sutton Broad 1979 (AGI), Sheringham Hall 1997 (KD) and West Runton 2010 (MEA). Possibly overlooked.

Crossocerus capitosus Usually a stem nester but also nests in beetle holes in wood, and hunts small flies. Active mid-May to August. Norfolk status: apparently rare, only recorded from Strumpshaw Fen 2007 & 2008 (TS) where it nests in dead willows, but probably overlooked.

Crossocerus cetratus A widespread species that nests in deadwood or hollow stems, hunts small flies and is active mid-May to August. Norfolk status: fairly common, with 24 records from about 14 sites.

[*Crossocerus dimidiatus*] One of the black/yellow, larger species of the genus that hunts snipeflies and is more common in the north and west. Recorded by JB Bridgman at Norwich in the 1870s, but not since.

Crossocerus distinguendus A recent arrival in the UK, first recorded in the 1970s, now widespread in southern England. It nests in soil banks, walls or deadwood, hunts small flies and aphids, and flies April to September. Norfolk status: scarce, with 5 records from 5 East Norfolk sites.



Hornet *Vespa crabro*, w. p.33. Richard Chandler

Dolichovespula media, m. p.32. Tim Strudwick



German Wasp *Vespula germanica*, q. p.33. Geoff Nobes



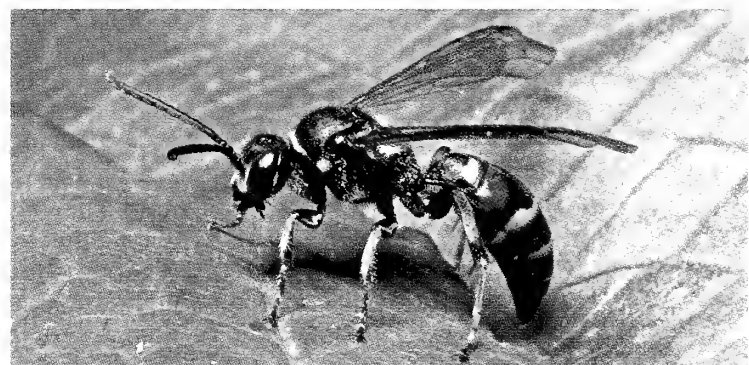
Red Wasp *Vespula rufa*, f. p.33. Tim Strudwick



Ammophila sabulosa, f. p.33. Nick Owens



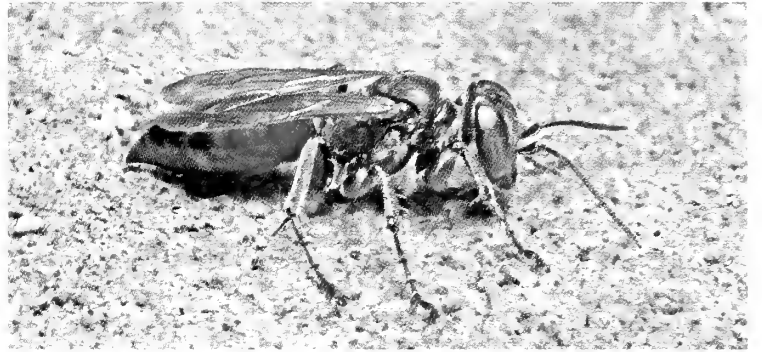
Podalonia hirsuta, f. p.36. Geoff Nobes



Argogorytes mystaceus, f. p.44. Geoff Nobes



Astata boops, f. p.6. Nick Owens



Tachysphex pompiliformis, f. p.36. Geoff Nobes



Crabro cribrarius, m. p.37. Nick Owens



Crossocerus megacephalus, f. p.40. Geoff Nobes



Mimumesa dahlbomi, f. p.42. Geoff Nobes



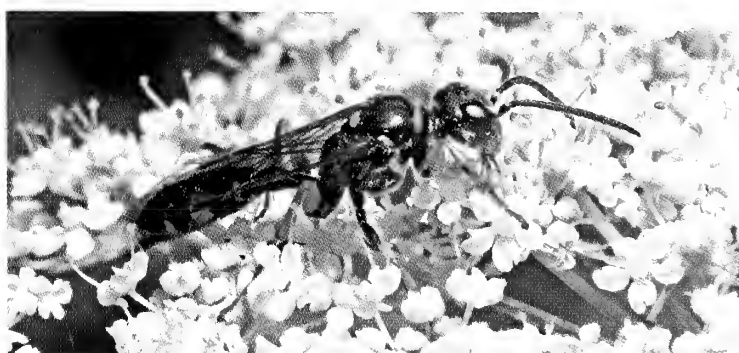
Crossocerus quadrimaculatus, f. p.40. Geoff Nobes



Ectemnius continuus, m. p.41. Geoff Nobes



Ectemnius sexcinctus, f. p.41. Tim Strudwick



Mellinus arvensis, m. p.44. Geoff Nobes



Oxybelus argentatus, f. p.41. Nick Owens

- Crossocerus elongatulus* This widespread species is very similar to *C. distinguendus*, is found in similar places and has similar habits. The females cannot be distinguished. Norfolk status: scarce, with 5 records from 5 sites.
- Crossocerus exiguus* RDB3. A very small species confined to SE England and found in sandy, wooded areas. Norfolk status: rare, with one record at Wells Dunes 1984 (KD).
- Crossocerus megacephalus* A common deadwood nesting species that hunts small flies and is active May to September. Norfolk status: common, with 27 records from 19 sites. [p.39]
- Crossocerus nigritus* A widespread species, nesting in hollow stems and deadwood, and hunting small flies. Active May to September. Norfolk status: local, with 12 records from 5 sites.
- Crossocerus ovalis* A widespread ground-nesting species found in sandy habitats and hunts small flies. Active mid-May to September. Norfolk status: common, with 25 records from 13 sites.
- Crossocerus palmipes* Nationally Scarce. Mainly confined to SE England, this species is found in dry, sandy habitats and hunts small flies. The males have enlarged, flattened front tibiae like *Crabro* males. Active June to September. Norfolk status: rare, with 5 records from the Brecks.
- Crossocerus podagricus* A very small and widespread species of southern Britain, nesting in deadwood and most often seen on flowers of Apiaceae. It hunts small flies and is active June to mid September. Norfolk status: common, with 48 records.
- Crossocerus pusillus* A small and very widespread ground-nesting species, mainly found on sandy soils. It hunts small flies and is active May to October. Norfolk status: common, with 22 records from 12 sites.
- Crossocerus quadrimaculatus* A widespread species of heathland, quarries and other sandy habitats. It hunts small flies, nests in a vertical sand face or rabbit burrow and is active June to September. One of the larger species, with a variable yellow pattern on the abdomen. Norfolk status: common, with 116 records from 36 locations. [p.39]
- Crossocerus tarsatus* A widespread, small, ground-nesting species, very similar to *C. pusillus*. It hunts flies and is active late May to September. Norfolk status: fairly common with 11 records from 8 locations.
- [*Crossocerus vagabundus*] RDB1. A large, black-yellow species that nests in deadwood and mainly hunts crane-flies (Tipulidae). Old records exist from Norwich (JBB) and King's Lynn (EAA).
- Crossocerus walkeri* Nationally Scarce. This species nests in deadwood, hunts mayflies and is found near streams and rivers. Active May to August. Norfolk status: rare, only recently recorded from STANTA 1985 (NBN), Santon Downham 1986 (JCF) and the upper Wensum 1992 (NBN).
- Crossocerus wesmaeli* A very small ground-nesting species, distinguished by white markings on the legs and thorax, and found in bare sandy places. Active June to early September. Norfolk status: local, with 23 records from 11 sites, mainly Breckland and coastal.
- Ectemnius* – black and yellow wasps with a very shiny abdomen but matt thorax, nesting in deadwood, hollow stems and other aerial cavities; prey are hoverflies and other medium-sized Diptera (6-17 mm).
- Ectemnius cavifrons* A common species, and one of the largest of the genus, nesting in deadwood. Active late May to early October. Norfolk status: common, with 37 records from 25 sites.
- Ectemnius cephalotes* Another large, fairly common deadwood-nesting species.

Active June to September. Norfolk status: local, with 16 records from 11 sites.

Ectemnius continuus The commonest *Ectemnius* species over much of the southern half of the UK. There is little or no yellow on the third abdominal segment, a feature only shared with *E. rubicola*. Active May to early October. Norfolk status: very common, with 177 records from 60 sites. [p.39]

Ectemnius dives Nationally Scarce. A fairly recent colonist of the UK, not recorded until early in the 20th century now found as far north as Yorkshire. Active June to September. Norfolk status: scarce, with 11 records from 8 Breckland sites and Buckenham.

Ectemnius lapidarius Found throughout the UK, but often rather local with a preference for moist habitats and nesting in decaying wood. Active mid-May to September. Norfolk status: common, with 120 records from 35 locations.

Ectemnius lituratus A common, mainly southern species. Active June to early September. Norfolk status: common, with 47 records from 17 locations.

Ectemnius rubicola A south-eastern species, reputed to nest in stems and often found in open habitats and drier grasslands. Active June to mid-September. Norfolk status: scarce, with 13 records from 8 locations, but possibly overlooked as the very similar *E. continuus*.

Ectemnius ruficornis Nationally Scarce. An uncommon deadwood-nesting species. Active June to September. Norfolk status: rare, only recorded in VC28 at Caudlesprings 2009 and Langmere 2008 (both GN).

Ectemnius sexcinctus Nationally Scarce. A large species, often found in urban areas, nesting in rotten timber in

buildings. The only *Ectemnius* species with large yellow spots on the underside of the abdomen. Active June to mid-September. Norfolk status: local, with 30 records from 4 locations on the north coast, and 5 around Norwich. [p.39]

Entomognathus – very small, black, ground-nesting wasps distinguished from similar genera by the presence of hairy eyes (3-6 mm).

Entomognathus brevis Found in dry sandy habitats. Hunts small leaf beetles. Active June to August. Norfolk status: widespread, with 26 records from 15 locations.

Lindenius – small, black, ground-nesting wasps with pale markings on the thorax and legs (4-8 mm).

Lindenius albilabris A species of open, sandy habitat which hunts small hemipteran bugs and flies. Active May to early September. Norfolk status: common with 64 records from 27 sites.

Lindenius panzeri A heathland species which hunts small flies. Active June to August. Norfolk status: local, with 28 records from 14 locations.

Oxybelus – small but rather stout, ground-nesting wasps with paired whitish spots on the abdomen; they hunt small flies which are, unusually, carried impaled on their sting (5-9 mm).

Oxybelus argentatus Nationally Scarce. A species of dunes and sandy heaths, active June to August. Norfolk status: local, 23 records from 6 coastal sites and 3 in the Brecks. [p.39]

Oxybelus mandibularis Nationally Scarce. A species of heath and dunes, active June to August. Norfolk status: rare, with 8 records from 4 sites: Weeting, Santon Warren, Thetford Warren and Winterton Dunes.

Oxybelus uniglumis A common species, nesting in bare ground in a variety of habitats, including arable fields. The

female has obviously red legs. Active late May to August. Norfolk status: common, with 77 records from 32 sites.

Rhopalum – small black or black/red wasps that hunt small flies and Hemipteran bugs (4-7 mm).

Rhopalum clavipes A widespread small, black/red stem-nester that hunts mainly Psocidae. Norfolk status: apparently scarce, with 7 records from 6 sites. That this species has fewer records in the county than the rare *R. gracile* is a good example of the recording bias towards 'rare' habitats.

Rhopalum coarctatum A black species, nesting in deadwood and hollow stems and hunting small flies. Norfolk status: scarce, with 12 records from 8 sites.

Rhopalum gracile RDB3. A rare species, nationally confined to Norfolk. A very small fen specialist, nesting in the vacated galls of the Chloropid fly *Lipara lucens* in Common Reed *Phragmites australis*. Norfolk status: very local, with 8 records from 6 Broadland fen sites, mainly as a result of targeted invertebrate surveys.

Subfamily PEMPHREDONINAE

Diodontus – very small, black, ground-nesting wasps that hunt aphids (3-6 mm).

Diodontus luperus A widespread species of open habitats in southern Britain, active June to September. Norfolk status: rare, with just three records: Cranwich 2011 (GN), Mousehold Heath 2007 (TS), TG24 1986 (NBN).

Diodontus minutus A common species of sandy places in southern Britain, active late May to September. Norfolk status: local, with 22 records from 19 locations.

Diodontus tristis A widespread species of sandy places as far north as central Scotland, active June to August. Norfolk status: scarce, with 7 records from 5 widely scattered sites.

Mimesa – small, ground-nesting wasps with a petiolate red and black abdomen, found in open sandy habitats and preying upon small leafhoppers (6-10 mm).

Mimesa bicolor RDB2. A very rarely recorded species of southern Britain, active June to September. Norfolk status: rare, with only 3 records: Weeting 2003 (NBN), Cranwich Camp 2011 (GN) and Bowthorpe 2011 (TS).

Mimesa bruxellensis Nationally Scarce. Mainly found in SE England and active June to September. Norfolk status: rare, the only record at Brundall 2010 (TS).

Mimesa equestris By far the most widespread species of the genus, found as far north as Inverness, and active late June to early September. Norfolk status: common, with 39 records from about 25 sites.

Mimesa lutaria A widespread species of southern Britain. Norfolk status: scarce, with 13 records from 9 locations.

Mimumesa – small, all black ground and deadwood-nesting wasps with a petiolate abdomen, preying upon small leafhoppers.

Mimumesa dahlbomi A widespread species found as far north as Yorkshire, occurring in a variety of habitats where it nests in beetle holes in deadwood, and active late April to early September. Norfolk status: common, with 33 records from 21 sites. [p.39]

[*Mimumesa spooneri*] Recorded around 1900 at King's Lynn. Very similar to *M. dahlbomi* and possibly overlooked. Found in damp, rushy places on heathland.

Passaloecus – small, slender black wasps, nesting in deadwood and hollow stems, and hunting aphids; these small wasps are very tricky to separate and are certainly under-recorded (3-7 mm).

Passaloecus clypealis RDB3. A wetland species, nesting in disused galls of the chloropid fly *Lipara lucens* in Common

Reed *Phragmites australis*, and mainly active June to July. Norfolk status: very local, with 12 records from 7 Broadland fen sites.

Passaloecus corniger Very widely distributed in England and Wales, and associated with deadwood, this species has the habit of raiding nests of other *Passaloecus* species to collect prey. Active May to August. Norfolk status: apparently rare, with just 4 records: (Santon Warren, Swanton Morley, Brundall, Strumpshaw Fen), but probably overlooked.

Passaloecus eremita This wasp was first found in the UK, in Sussex, as recently as 1978, but has now spread throughout SE England. It is associated with pine trees and is active May to August. Norfolk status: rare, with just 2 records, at Santon Warren 1986 (JF) and TL78 1982 (NBN).

Passaloecus gracilis Widely distributed in England and Wales, nesting in deadwood and hollow stems, and active June to August. Norfolk status: widespread, with 15 records from 12 sites.

Passaloecus insignis A similar distribution to *P. gracilis* but less frequently recorded. Active June to August. Norfolk status: scarce, with 5 records from 5 sites.

Passaloecus singularis Another widely distributed species with similar habits to the last two species. Active May to August. Norfolk status: local, with 14 records from 5 sites.

Pemphredon – small black wasps with a short narrow 'stem' at the front of the abdomen; nesting in deadwood and hollow stems and hunting aphids (5-12 mm).

Pemphredon inornata Found throughout the UK in a variety of habitats but usually near trees and often on brambles. Active June to September. Norfolk status: widespread, with 20 records from 13 sites.

Pemphredon lethifer Found throughout the UK in a variety of habitats, including treeless places. It nests in hollow stems and is active late May to September. Norfolk status: widespread, with 21 records from 16 sites.

Pemphredon lugubris Common throughout the UK, this is the largest *Pemphredon* species and excavates its own nest holes in rotten wood. Active May to early October. Norfolk status: common, with 63 records from 21 sites.

Pemphredon morio Nationally Scarce. Restricted to southern Britain, this scarce species is associated with old trees where it nests in beetle holes. Active June to August. Norfolk status: rare, with one record from Caudlesprings 2011 (GN).

Psenulus – small black wasps nesting in deadwood or hollow stems (5-8 mm).

Psenulus concolor Mainly recorded from England north to Yorkshire, and hunting nymphs of Homoptera Psyllidae. Norfolk status: very scarce, with 6 records from 4 sites.

Psenulus pallipes Well-distributed throughout England and Wales, and hunting aphids. Norfolk status: widespread with 24 records from 9 sites.

Spilomena – extremely small black wasps, rarely recorded and probably much more widespread than records suggest (2-3 mm).

Spilomena troglodytes This species is widely distributed in the southern half of the UK, hunts thrips and nests in beetle holes in deadwood. Norfolk status: just 3 records but probably fairly widespread.

Stigmus – very small, black wasps with a large dark stigma in the forewing. They hunt aphids and nest in deadwood (3-6 mm).

Stigmus pendulus A newcomer to the UK, first recorded in Kent in 1986, and steadily spreading north and west. Norfolk status: scarce, with 12 records

from 6 sites, all since 2007. Probably overlooked.

Stigmus solskyi A widespread species in the south half of the UK, but only common in SE England. Norfolk status: apparently scarce, with 6 records from 6 sites, but probably overlooked.

Subfamily MELLINAE

Mellinus – ground-nesting wasps with a particularly slender first abdominal segment (7-14 mm).

Mellinus arvensis This very widespread black and yellow species hunts various large Diptera in a range of habitats on sandy soils including urban areas. It is active from July to late October and is often seen around Ivy *Hedera helix* flowers. Norfolk status: common, with 183 records. [p.39]

[*Mellinus sabulosus*] Once scarce but widespread, but not seen in the UK since 1952. Recorded at Brundall (JBB) and King's Lynn (EAA), the last record around 1910.

Subfamily NYSSONINAE

Argogorytes – black and yellow ground-nesting wasps that hunt froghoppers (10-13 mm).

Argogorytes fargeii Nationally Scarce. This species seems to require a combination of moist habitats with abundant Hogweed *Heracleum sylvestris* for nectar, and dry sandy banks for nesting, and is often found at gravel pits along river valleys. Active June to August. Norfolk status: very local, with 23 records, from the Weybourne-Mundesley soft cliffs, the Yare Valley up and downstream of Norwich and 3 scattered locations in west Norfolk.

Argogorytes mystaceus A widespread species of open woodland and scrub, and one of the earliest solitary wasps, active from late April to July. The male

of this species is the main pollinator of Fly Orchid *Ophrys insectifera*, attracted to the flower by pheromones that mimic the female wasp. Norfolk status: common, with 51 records from 27 locations. [p.38]

Gorytes – black/yellow ground-nesting wasps with a smooth, glassy abdomen, most frequently seen on umbellifer flowers; prey on froghoppers and other Homoptera (9-13 mm).

Gorytes laticinctus RDB3. A sparsely distributed species of SE England with strongholds in Dorset and Norfolk. Active June to August. Norfolk status: local, with 19 records from 11 sites. Seven of the records come from the author's Brundall garden where this wasp nests in plant containers. [p.61]

Gorytes quadrifasciatus Nationally Scarce. Widely distributed in southern UK, but not abundant. Mainly on sandy soils but often foraging in moist habitats, and active June to early September. Norfolk status: common with 43 records from 27 sites.

Harpactus – a black and red ground-nesting wasp with white spots on the thorax and abdomen; prey on froghoppers and leafhoppers (6-8 mm).

Harpactus tumidus Widely distributed throughout the UK, this small species is found in sandy habitats where it is active June to September. Norfolk status: scarce, with 11 widely scattered records. [p.61]

Lestiphorus – black/yellow ground-nesting wasps similar to *Gorytes* but with a constriction at the base of the first abdominal segment (7-10 mm); prey on froghoppers and leafhoppers.

Lestiphorus bicinctus Nationally Scarce. A rather elusive species of southern England found in scrubby places on light soils. Active late June to September. Norfolk status: local, with 19 records from 11 sites.

Nysson – cleptoparasitic wasps with distinctive conical projections at the rear of the thorax; most are black and yellow (4-12 mm).

Nysson dimidiatus Widespread in S. Britain in open sandy habitats. Unlike the other three *Nysson* species, this is black and red with white spots, very like its host *Harpactus tumidus*. Active June to August. Norfolk status: local, with 17 records from 12 locations.

Nysson interruptus RDB2. A very rare species that targets *Argogorytes fargeii*, with the only recent UK records from Hampshire, Isle of White and Norfolk. Active late May to July. Norfolk status: rare, recorded at Buckenham (2008, 2010, TS) and Overstrand (2011, TS).

Nysson spinosus The most widespread *Nysson* species, usually found, like its host *Argogorytes mystaceus*, around scrub or woodland. Norfolk status: common, with 52 records from 21 locations.

Nysson trimaculatus Nationally Scarce. A small species found, like its hosts *Gorytes quadrifasciatus* and *Lestiphorus bicinctus*, in scrubby habitats on sandy soils, but more frequently recorded than either of them. Norfolk status: common, with 62 records from 20 locations. [p.61]

Subfamily PHILANTHININAE

Cerceris – medium–large black and yellow ground-nesting wasps with distinctive constrictions between each abdominal segment (6-13 mm); often nesting in conspicuous aggregations on bare sandy ground with a conspicuous spoil heap around each nest hole.

Cerceris arenaria A large species, nesting on heathland tracks, woodland rides, etc. It hunts weevils and is active June to August. Norfolk status: common, with 120 records from 55 locations. [p.61]

Cerceris quinquefasciata RDB3, BAP Priority. A species of sandy grassland in SE

England that hunts small weevils and is active June to early September. Norfolk status: local, with 50 records, most in the Brecks and around Norwich, but also at Roydon Common and Flordon Common. [p.61]

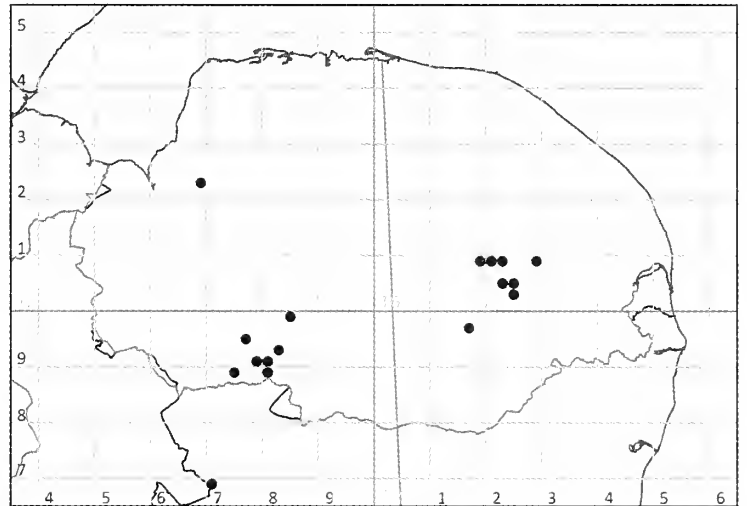


Figure 4. Distribution of the Five-banded Weevil Wasp *Cerceris quinquefasciata*. A RDB3 and BAP priority species associated with dry sandy grasslands. The strong populations around Norwich were only discovered in 2010.

Cerceris ruficornis Nationally Scarce.

Confined to southern and eastern England, and largely a heathland species but occasionally found on sandy or calcareous grassland. It hunts weevils and is active June to mid September. Norfolk status: local, with 15 records from 7 Breckland sites, Marsham Heath and Norwich. [p.61]

Cerceris rybyensis A medium to large species that hunts solitary bees and is active late May to early September, often nesting with *C. arenaria*. Norfolk status: common, with 99 records from 54 sites. [p.61]

Philanthus - large black and yellow ground-nesting wasps with a large pale facial patch in both sexes (8-17 mm).

Philanthus triangulum RDB1. Until the 1970s the Bee-wolf or Bee-killer was very rare, confined to the Isle of Wight and Suffolk coast but has now spread

as far as north as Yorkshire. It hunts Honey Bee *Apis mellifera* workers, makes deep nest burrows in sandy soil, often in large aggregations, and is active June to September. Norfolk status: first recorded in the county in 1980 and now locally common in sandy areas. There is a conspicuous nest aggregation on a bank by the A1151/ A1062 junction in Hoveton, the nest spoil easily visible from a passing car. [p.61]

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The conservation value and population status of birds at Upton Broad and Marshes 2006 - 2011

Nigel Robson

Introduction

The Norfolk Wildlife Trust (NWT) reserve Upton Broad and Marshes, the reserve, which is central to the Bure Valley Living Landscapes Initiative by the NWT, lies within the Broads Authority Biodiversity Action Plan area. This aims to increase the biodiversity and enhance the landscape by restoring the mosaic of semi-natural habitats in the valley. Overall plans include appropriate management of the river and reducing levels of agro-chemicals on the arable land. Partners involved in the management are the Department for Environment, Food and Rural Affairs (DEFRA), Natural England (NE), Environment Agency (EA), Broads Authority (BA), the Broads Internal Drainage Board (IDB) and private landowners.

The reserve (TG395140), when integral sections under private ownership are included, was of some 380ha during the study period (excluding a small area to the west added in 2011). It is best known for its flora and insects, including dragonflies (Odonata), butterflies (Lepidoptera: Rhopalocera) and beetles (Coleoptera). Little has been published on its avifauna. Plans are now being implemented to expand its biodiversity and increase its attraction to wintering waterfowl and breeding waders.

Objective

The objective of this study is to provide baseline data on the birdlife of the reserve from which to monitor the effect of changes in the habitats on the avifauna of the area. Changes include those by planned modifications, and from events such as drought, flooding and saline incursions.

The study area

Upton Broad and Marshes is situated within the Broads Executive Area which enjoys the status equivalent to a National Park. It became a reserve with purchases of land at Upton Fen (including the broads) in 1979 and extended into Upton Marshes in 2003. It is located on flat land on the south side of the River Bure north of the village of Upton (see Figure 1, p.57), grading from about -0.5m below mean sea level in the east to about +1.0m in the southwest. It comprises a mosaic of grazing marsh, rich fen, broad and wet woodland (see Figure 2, p.57). A small area (15 ha) of South Walsham Marshes added to the reserve in 2011 did not form part of the study area. The undrained fen, including the broads and wet woodland, and part of the drained grazing marshes, were designated a Site of Special Scientific Interest (SSSI) in 1959 and 1986 respectively. The reserve also lies within the Broadland RAMSAR site designated in 1976, Broadland Special Protection Area (SPA) designated in 1994, and the Norfolk Valley Fens Special Area of Conservation (SAC) designated in 2005.

The habitats

During the study period, 2006-2011, changes to the reserve habitats had little evident effect on the avifauna, except where work to the river defences provided temporary disturbed ground and additional water bodies. In the following habitat descriptions, the plant communities in dykes, rich fen, broads and wet woodland are based on those in the reserve management plan (Harding & Smith 2005).

River bank and margins

The River Bure, including Thurne Mouth, stretches some 3.4 km along the reserve's north and east boundaries. It is subject to tidal influence as far inland as Coltishall, some 30 km upstream from Upton Dyke, and the effects of surges resulting from frequent minor and occasional major fluctuations in the level of the North Sea. The middle Bure is susceptible to surge-induced saltwater incursions that have a profound effect on its ecology (George 1992). The water level is higher than the surrounding marshes. In response to bank settlement, and to some erosion from river craft, a flood-prevention scheme was in progress during the study period. This involved repositioning, raising and widening the banks to exclude saline and polluted water from the marshes. Alongside these, new soke dykes (ditches dug beside the river to provide material for the river embankments) were formed in a double set. The outer dyke (nearest the bank) is for absorbing river seepage through the bank, and brackish water that accumulates is pumped back into the river. The inner dyke (on the marshes side) assists distributing fresh water around the marshes. At the end of 2011 sediment dredged from the river was laid down between the river and the set-back northern bank, obliterating a riverside channel with developing reed swamp. This was shaped to create shallow 'buffer' lagoons connected to the river with small inlets. The river is thinly fringed with Common Reed *Phragmites australis*, and the lagoons are expected to develop reed swamp communities.

Grazing marshes

The marshes, overall some 270 ha, are undergoing considerable modification. They were drained around 1800, the date attributed to the construction of the drainage pump, Upton Mill. The tythe map dated 1839 shows a mosaic of plots with both pasture and arable usage. The RAF aerial photographic survey of 1948 (in black and white) shows most plots under

pasture. In 1954 much of the southern section between Upton Mill and Upton Dyke, known as Boat Dyke Marshes, was put under cultivation. From the 1970s other sections of the marshes were developed for cropping, with deep dykes and underdrains (perforated plastic piping). Google Earth aerial photographs dated 1999 show approximately 40 percent of the area under cultivation. This all reverted to grassland in 2003 after NWT began purchasing sections of the marshes for incorporation into the reserve. Presently there remain some sections under private ownership, with shooting rights (see Figure 1). The marshes are now traditionally managed by grazing with livestock, with seasonal removal of the hay crop from some privately-owned plots. Areas of permanent grazing marshes (with the early type of clay pipe underdrains) are contained by a network of shallow dykes holding species-rich calcicolous aquatic plant communities.

Characteristic species include Water-soldier *Stratoides aloides*, Grass-wrack Pondweed *Potamogeton compressus*, Fen Pondweed *Potamogeton coloratus* and Greater Water Parsnip *Sium latifolium*. A survey of the dykes during summer 1974 recorded 71 species of plant, including higher plants, bryophytes and charophytes, but excluding most algae. At least 89 species of aquatic invertebrates were recorded, with some groups including many insect larvae not identifiable to species level (R.J. Driscoll unpublished). Efforts to raise water levels, underway in 2009, met with difficulties both with water inflow and retention. Only towards the end of 2011 did they begin to achieve the desired effect, when areas of standing water were introduced with foot drains and shallow flashes. It has been decided to allow a controlled river inflow to augment and stabilise water levels in Boat Dyke Marshes. This water will not connect with the existing ditches with sensitive freshwater plant communities in the SSSI marshes.

Tall hedgerows

Tall hedgerows occur at the western end of the grazing marsh and at Upton Mill. The former, which are left uncut, are located on the double bank that leads from the marsh wall which separates the undrained fen from the drained marshes, to within 330 m of the river. It originally connected with the river bank, the last reach having been removed in the late 1970s. These hedgerows have fine ecological structures, of mixed height, composition and density. They are dominated by Hawthorn *Crataegus monogyna*, Bramble *Rubus fruticosus* agg., contiguous reed-fringed dykes and tall herbage, and provide beneficial diversity to the habitats in the reserve.

Rich fen

The undrained fen is one of the most notable areas of its kind in Broadland, characterised by a botanical richness and composition that distinguishes it from all other known Broadland fens (Wheeler 1985). It is isolated from the river, and separated from the drained marshes by the marsh wall on the Upton and South Walsham sides (see Figure 3, p.60). There is a rich graded mosaic of plant communities within some 34 ha of fen with moderately high and stable spring-fed groundwater. These calcareous mires are of special botanical interest and comprise communities of diverse composition and physiognomy, even within individual stands. There is generally a fairly rich assemblage of vascular plants, among which sedges predominate over a carpet of mosses. One community can be classed as Black Bog-rush *Schoenus nigricans* - Blunt-flowered Rush *Juncus subnodulus* mire since these are the characteristic species. Another type, which occurs in nutrient-poor sites is characterised by the dominance of Bottle Sedge *Carex rostrata*. Other species which have been found in this community in the reserve include the rare Fen Orchid *Liparis loeselii* and Round-leaved Wintergreen *Pyrola rotundifolia*. The reed swamp and reedbed habitat is also somewhat varied

in composition. The calcareous Common Reed *Phragmites australis* - Milk-parsley *Peucedanum palustre* tall-herb fen represents one community type which, in Norfolk, is now confined to Broadland. Other species present include Greater Tussock-sedge *Carex paniculata*, Great Fen-sedge *Cladium mariscus* and Cowbane *Cicuta virosa*. Bog-myrtle *Myrica gale* occurs where conditions become acidic. Blunt-flowered Rush *Juncus subnodulosus* - Marsh Thistle *Cirsium palustre* fen-meadow habitat adds to the mosaic. Whilst readily recognisable this species-rich habitat shows considerable variation in its floristic composition. Other species present here include Tufted Sedge *Carex elata* and Yellow Iris *Iris pseudacorus*. In areas where the peat is mildly acid another type of fen-meadow occurs. This is the Purple Moor-grass *Molinia caerulea* - Meadow Thistle *Cirsium dissectum* community in which, in the reserve, the Grass of Parnassus *Parnassia palustris* is found.

Broads

Great Broad (5.7 ha with water depth 44-147 cm) and Little Broad (1.3 ha with water depth 22-70 cm prior to mud-pumping and 22-120 cm after) are calcareous spring-fed shallow open waters, deepest on their north side and shallowest on the south. There is little water movement. They are in close proximity and up to at least the end of the nineteenth century were connected by a narrow channel (boat dyke). They lie within pure peat in the undrained fen, isolated from riverine influence. The double bank across the drained marshes, referred to above under 'Tall hedgerows', marks the course of a nineteenth century sluice-controlled navigable channel that allowed run-off from Great Broad to reach the River Bure. The broads have contracted in size in recent time. With a reed fringe of variable width, they are bordered by wet woodland and some open fen. Currently supporting a species-poor though botanically valuable flora, they host the nationally rare Holly-leaved Naiad *Najas marina*. As part of

their lake restoration strategy, the Broads Authority mud-pumped Little Broad during 2011. There was no nutrient enrichment problem, and the aim was to increase the water depth by partially removing sediment, and in so doing release some of the dormant and viable seed base from past aquatic communities for re-establishment. The results of this operation, as yet unknown, will influence a future decision on removal of sediment from Great Broad (D. Hoare pers. comm.).

Wet woodland

Within the undrained fen, wet woodland occupies some 70 ha. Much of this is undisturbed because the trees are dense and the ground saturated. Patches of woodland south of the two broads are at least 130 years old (Wheeler 1985). The majority of the wetter parts are characterised by Alder *Alnus glutinosa*, and the more elevated, dryer ground, by Pedunculate Oak *Quercus robur* and Ash *Fraxinus excelsior* with Common Nettle *Urtica dioica* and Bramble. Bird Cherry *Prunus padus* is a feature at the reserve. Closer to the broads and open fen are Grey Willow *Salix cinerea*, Downy Birch *Betula pubescens*, and remnant fen species such as *Sphagnum squarrosum*. Scrub encroachment on the fen margin is controlled. In the area between the north side of the broads and the marsh wall, known as the Doles, removal of selected stands of the more recently colonized woodland is in progress to reclaim tall herb fen.

Bordering land

The reserve is bounded by river, further grazing marshes, cultivated fields, horse paddocks, farmyards and residential gardens. These inter-related habitats compliment the diversity within the reserve. Of particular importance to the avifauna is St Benet's Level to the north, with its mixture of livestock grazing and arable agriculture.

Precipitation

The weather factor most affecting wintering waterfowl in the reserve is rainfall during the five months November to March. Together with natural spring water inflow and any introduced river water, this determines the all-important level of the water table and desirable saturation of the grazing marshes, and impacts on breeding conditions for waders in spring. Rainfall from April to June influences the breeding success of waders. Feeding areas need to remain wet, but an excess of rain and low temperatures will adversely affect chick survival.

No rainfall data are obtainable for the Upton area. From Buxton, some 18 km to the northwest, comprehensive data collected and prepared by Charles Briscoe is available at www.buxton-norfolk.co.uk/weather.htm. Although rainfall at Buxton will differ appreciably from that nearer the coast at Upton, monthly amounts as a percentage of monthly averages are considered to be reasonably comparable (C. Briscoe pers. comm.). Data in this form are presented for the winter and early summer periods to give an indication of conditions at the reserve during 2006-2011 (see Tables 1 & 2). The 30-year (1981-2010) average amount for November to March collectively is 287.3 mm and for April to June is 157.4 mm.

River salinity

Electrical conductivity, the ability of a material to transmit electric current, is

Table 1. November-March rainfall at Buxton as a percentage of the average.

2005/6	2006/7	2007/8	2008/9	2009/10	2010/11
85%	118%	122%	97%	132%	92%

Table 2. April-June rainfall at Buxton as a percentage of the average.

2006	2007	2008	2009	2010	2011
73%	199%	79%	59%	51%	65%

used to track the levels of salt in water. EA considers values above $40,000 \mu\text{S cm}^{-1}$ equivalent to sea water, above $20,000 \mu\text{S cm}^{-1}$ to cause freshwater fish to die, and $700\text{--}1,000 \mu\text{S cm}^{-1}$ an indication of freshwater (L Taylor pers. comm.). Buglife used conductivity of $2,000 \mu\text{S cm}^{-1}$ as the threshold for separating fresh from brackish water in grazing marsh ditch systems (Drake *et al.* 2009). The EA receives conductivity readings in the River Bure every 15 min. from a permanent recording station at Acle, some 2 km downstream from Upton Dyke, and monitors the progression of salt during saline incursions. When values are recorded above $10,000 \mu\text{S cm}^{-1}$ the station transmits an alarm to provide the EA with time to assess the data and decide upon action required. Under normal conditions, daily conductivity readings below $1,500 \mu\text{S cm}^{-1}$ are obtained at Acle when tidal influence is lowest. Occasions when readings reach $20,000 \mu\text{S cm}^{-1}$ may be regarded as major saltwater incursions (when freshwater fish die). During the six-year study period (2191 days), there were 123 days when some or all readings exceeded $20,000 \mu\text{S cm}^{-1}$: 36 days in 2006, 29 in 2007, 9 in 2008, 11 in 2009, 13 in 2010 and 25 in 2011. The major incursion of longest duration, when consecutive 15-minute readings of over $20,000 \mu\text{S cm}^{-1}$ were recorded, was from midnight 1 February 2006 until 14.30 on 10 February 2006. During these 10 days, readings peaked at $51,010 \mu\text{S cm}^{-1}$.

Methods

Weekly visits to the grazing marshes and monthly visits to the rich fen, broads and wet woodland were undertaken as regularly as possible throughout the six-year period, with increased visits in the spring and autumn. Coverage was by transects on foot following footpaths, concrete roads and fixed routes crossing open land. All species seen were noted and counts made. Waterfowl using Great Broad and Little Broad during the period were counted each month for the national Wetland Bird Survey

(WeBS). In spring 2011, the numbers of territories of breeding birds were estimated, mostly based on counts of singing males in early morning. Breeding was not proved for every species and breeding success not assessed. Because much of the wet woodland is isolated from access paths, the counts of most common species breeding in this habitat were unrepresentative of the whole. In these cases estimates were made in proportion to the total area of habitat and having regard to territory size. An example is Treecreeper *Certhia familiaris*, a resident bird found frequently amongst winter bird parties. Only a single breeding pair was detected by transect walking, and therefore a calculation was made that 8-10 pairs were probably present.

For each species recorded, the status, relative abundance and habitat preference in the reserve were ascertained and a conservation value sought. The values applied are according to the priority listings of the UK Biodiversity Action Plan (UKBAP) of August 2007, the Broadland Special Protection Area (SPA) of 2001, and the UK Birds of Conservation Concern 3 (BoCC) of 2009. BoCC places species, and some subspecies, on three separate lists. Red List species are those globally threatened, those whose population or range has declined rapidly in recent years, and those that have declined historically and not shown a substantial recent recovery. Amber List species are those with an unfavourable conservation status in Europe, those whose population or range has declined moderately in recent years, those whose populations have declined historically but made a substantial recent recovery, rare breeders, and those with internationally important or localized populations. Green List species fulfill none of the above criteria. Naturalized resident species are excluded from the BoCC listing (Eaton *et al.* 2009).

Mark Amiss, of the reserve staff, supplied the heron nest counts and carried out the WeBS count on the few occasions when the

author was absent. Where stated, certain sightings made from the reserve of birds across the river at St. Benet's Level are included.

Results and discussion

Of the 138 bird species recorded during the study period, the value and status is given with supporting notes in Appendix 1. 24 are listed by UKBAP and 8 by Broadland SPA, 25 are on the BoCC Red List, 60 on the Amber List, and 46 on the Green list: 6 are not on any of the lists. The monthly WeBS counts of waterfowl using Great Broad and Little Broad are shown in Appendix 2.

The rich fen is managed to optimise the mosaics of habitat, maintaining its nationally important floral diversity, and to maximise conditions for key species including Norfolk Hawker *Aeshna isosceles* and Swallowtail *Papilio machaon*. Important assemblages of invertebrates are supported as there are numerous transitions and hence niches available. This part of the reserve appears to be in a stable condition. In some years, Bittern is a regular visitor and breeding has taken place. The only *Phragmites* reedbed, however, is small and rarely attracts Bearded Tit, although Reed Warbler breeds and Marsh Harrier bred in 2011 (S. Milburn pers. comm.). Grasshopper Warbler is distributed throughout the tall herbaceous fen.

The wet woodland has a rich hole-nesting avifauna including Marsh Tit, Great Tit, Blue Tit, Green Woodpecker, Great Spotted Woodpecker, Stock Dove and Tawny Owl. Treecreeper also nests and Song Thrush strongly favours this habitat. The abundance of dragonflies from the fen has attracted Hobby to nest. There is a low density of breeding Woodcock but a higher, variable number of wintering individuals. A large *corvid* roost, observed in this woodland during November/December 2011, numbered some 5,000-10,000 birds, with Jackdaw more numerous than Rook, and including some Carrion Crow.

The broads attract low numbers of waterfowl in summer and unpredictable numbers in winter (see Appendix 2). Following the sediment reduction in Little Broad in 2011 to increase its depth and re-establish aquatic plant and fish communities, it will be interesting to see if there are any resulting changes in the species and number of birds occurring there.

Improvement of the grazing marshes to benefit wintering waterfowl and breeding waders is a priority of NWT. Because wetland birds respond readily to suitable conditions, results are achievable after as little as one year under favourable circumstances. But with sections of contiguous land in private ownership in the reserve, water management, including saturation of the grassland, has to balance the needs of agriculture, flood defence and conservation.

Farmers prefer dryer grazing conditions which benefit high productivity grasses such as Rye-grass *Lolium perenne*. When grassland conditions become wetter, the Rye-grass is suppressed and species which are capable of dealing with wetter conditions, such as Creeping Bent *Agrostis stolonifera*, re-establish. These inundation species are less productive, and during the transition period the grazing becomes poorer before recovering. Farmers are faced with an adjustment which may include changing their breed of cattle to a type more able to deal with the wetter conditions and poorer grass quality, or lowering the intensity of their stocking levels. In due course they may have to contend with the ill-effects of Common Liver Fluke *Fasciola hepatica* on grazing animals. This parasitic flat-worm occurs in wet grass and may be inadvertently eaten, requiring periodic veterinary treatment of infected cattle.

For waterfowl an appropriate non-intensive grazing regime is needed to produce a short sward of 5-15 cm at the beginning of winter and at the start of the breeding season in

spring. Saturation needs to be controlled to maintain flashes of water in low points on the marsh as well as in foot drains. The existence of clay pipe underdrains is not seen as a hindrance to this because without constant flow and maintenance they silt-up and become ineffective. Lengths of the deeper and more efficient perforated plastic piping have been spot-plugged to stop leakage, although they also silt-up when water levels in the ditches into which they discharge are maintained above their invert levels. Breeding waders need wet soil conditions (but not flooded) to ensure an abundance of surface-dwelling invertebrates. The installation of shallow wet features, especially foot drains that move water to the centre of grazing compartments and retain it, provide valuable foraging locations for chicks, particularly later in the season when these are likely to be the main source of water available. Predicted changes to the seasonality of precipitation at temperate latitudes means that provision of wet features is likely to be increasingly important for maintaining breeding wader populations (Eglington *et al.* 2010). These conditions will also benefit livestock. In the breeding areas it is recommended that a maximum density of 0.75-1 livestock unit per hectare is suitable up to the end of May. To reduce the likelihood of trampling nests and chicks, the more boisterous breeds of cattle and bullocks should be excluded.

Areas of Hard Rush *Juncus inflexus* and Soft Rush *Juncus effusus* are spreading in the more saturated sections of the grazing marshes. These are known to have a detrimental effect on the maintenance of a short grass sward and have little or no benefit in providing cover for breeding waders (M.A.Smart pers. comm.). They are not palatable to livestock, and may be controlled by chemical methods using the weed wiping technique.

Under the present circumstances, a small number of Lapwing, Redshank, Oystercatcher and Yellow Wagtail

continue to nest, and in winter Lapwing, Golden Plover, Starling, Bewick's Swan, and occasionally Crane, use the marshes, whereas wintering geese and ducks, apart from resident species, rarely settle to graze. Barn Owl and Marsh Harrier hunt throughout the year. In spring and autumn a variety of migrating waders pass through, including parties of Whimbrel. The tall hedgerows and associated dyke herbage are inhabited by breeding finches and warblers, including Cetti's Warbler, and in winter by large numbers of continental thrushes and parties of Bullfinch.

A strip of bare ground beside the river at the northern boundary of the reserve, between the original river bank and the new bank, was formed during bank profiling operations. It contained a narrow channel of water parallel to the river, fringed with reed swamp, referred to as 'the riverside channel' in the species accounts in Appendix 1. This temporary bare ground attracted Avocet, Little Ringed Plover and Common Tern to breed. In 2011 this area was altered to form riverside lagoons, subject to tidal changes from wet mud to open water, and planned to convert to reed swamp. Ducks and other aquatic species, Reed Warbler and Reed Bunting breed generally in the fringing reed swamp beside the river, and Bearded Tit occurs in winter.

Fox *Vulpes vulpes* and Carrion Crow are major nocturnal and diurnal predators, respectively, of ground-nesting birds. The former is common in the reserve judging from the quantities of scat and frequency of diurnal sightings. Carrion Crow is also common, with several nesting pairs and non-breeding visitors. A breeding pair defends its territory from non-breeding groups and may reduce overall predation by excluding them. On the other hand, individual pairs become more specialised at predating. Their impact may be mitigated by reducing the number of look-out perches used by crows, for example by lowering the height of hedgerows. However, the

tall hedgerows in the reserve are small in extent and away from the main area of grassland used by breeding waders, and cutting back could seriously damage this bird-rich component. Bolton *et al.* (2007) studied what effects controlling foxes and crows had on breeding Lapwing at, *inter alia*, RSPB Berney Marshes nearby in the Yare valley. At this site it was found that the proportion of nests surviving to hatching increased during years of predator control, and that this was predominantly the result of reducing the number of foxes, responsible for nocturnal predation.

A survey of the aquatic vegetation and invertebrate fauna of ditches in the grazing marshes, carried out in 2009 to observe changes in the biota compared with previous surveys, indicated that the new river defences (higher bank and paired soke dykes) have had a marked effect in reducing saline penetration from the river (Drake *et al.* 2009).

Mention should be made of the importance to the reserve of St Benet's Level immediately across the river to the north, which currently attracts more stable numbers of certain wintering birds, notably Bewick's Swan, Wigeon, Crane, Lapwing, Golden Plover and Skylark. The mixture of arable land and ponds with grazing marsh provides a range of feeding opportunities that is of extra benefit to these species.

Infrequent disturbance from wildfowling on some privately-owned sections of the marshes continues. Dog-walking activities are rarely of consequence, except when ground-nesting birds at the river bank are disturbed by free-ranging dogs. An increase in visitor numbers, consistent with the Living Landscapes concept of connection with people, may have to be accommodated with well-defined footpaths and viewing opportunities planned to avoid any disturbance to sensitive organisms.

Attention is drawn to a few errors and omissions in recently published work

covering birds at the reserve. In *Best Birdwatching Sites in Norfolk* (Glenn 2006), Nightingale *Luscinia megarhynchos* and Lesser Spotted Woodpecker *Dendrocopos minor* are listed as 'target birds' to be seen all year. The former is a summer migrant that does not feature in the reserve, and the latter is now a rarity if it occurs at all. The reserve's avifauna is under-represented in the most recent Norfolk bird atlas (Taylor & Marchant 2011). The mapping does not include a substantial number of summering and wintering species that have been found subsequently in the reserve within the tetrads TG31W and TG31X. The additional species are listed in Appendix 3.

Natural England has compiled an assessment of the condition of the SSSI units within the reserve, dated 01 February 2012. This determines what percentage area meets the Government's Public Service Agreement (PSA) target of all units being in favourable or unfavourable-but-recovering condition. The latter is often simply known as 'recovering'- not yet fully conserved but all the necessary management measures are in place. The assessment concludes that the percentage area meeting the PSA target is 100%, that in favourable condition is 6.17% (Great Broad and units of wet woodland), and that in unfavourable condition but recovering is 93.83%.

Conclusion

This paper forms the basis of the study that will continue into the next stage of monitoring the avifauna with habitat changes. It is hoped that it will also be of assistance to future studies should the desired objective of creating a continuous tract of biologically-rich land connecting Upton to the Bure Valley National Nature Reserve be realised as part of the Living Landscapes vision.

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APPENDIX 1: Conservation value and population status of birds at Upton Broad and Marshes 2006-2011

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Mute Swan <i>Cygnus olor</i>	Green			Breeding resident	Widespread. Non-breeding herd max. 118 on 02.06.06. Winter max. 86 on 08.02.09. C.12 pairs breed (2011 breeding pairs count: 12). R B G F
Bewick's Swan <i>Cygnus columbianus</i>	Amber	SPEC WL WI	UKBAP. Broadland SPA Eur. conservation concern Non-breeding localised Non-breeding internat. imp.	Winter visitor	Variable occurrence. During Jan-Feb 2006-2009 (to mid-March in 2006), 100-150 with half as many Mute Swans. Max. 180 on 17.02.07. In 2009/10 noted overflying only. In 2010/11 max. 30 on 24.02.11. G
Whooper Swan <i>Cygnus cygnus</i>	Amber	BR WL	Breeding rarity Non-breeding localised	Winter visitor	2 with 8 Bewick's Swans overflying on 16.11.11.
Pink-footed Goose <i>Anser brachyrhynchus</i>	Amber	WL WI	Non-breeding localised Non-breeding internat. imp.	Winter visitor	Abundant overflying. Exceptional max. c.12,000 flying east on 13.01.06. 119 at the marshes on 16.11.11 with White-fronted Geese. G
European White-fronted Goose <i>Anser albifrons albifrons</i>	Red	WDp ¹ WDp ² WL	UKBAP Non-breeding decline 25yr Non-breeding decl. longer term Non-breeding localised	Winter visitor	14 overflew the marshes on 14.01.06. 36 amongst Pink-footed Geese at the marshes on 16.11.11 & a similar grouping overflew on 18.12.11. G
Greylag Goose <i>Anser anser</i>	N/A			Naturalised breeding resident	Common. Max. 227 on 03.08.10. A few pairs breed (2011 breeding pairs count: 3). R B G
Canada Goose <i>Branta canadensis</i>	N/A			Naturalised resident	Irregularly common but more usually absent. Max. 142 on 20.09.06. No breeding noted. R G
Egyptian Goose <i>Alopochen aegyptiaca</i>	N/A			Naturalised breeding resident	Regular throughout year, with max. 36 on 04.10.05 & 24 on 15.04.11. A few pairs breed (2011 breeding prs. count: 5). R B G
Shelduck <i>Tadorna tadorna</i>	Amber	WL WI	Non-breeding localised Non-breeding internat. imp.	Winter & summer visitor. May breed	Regular. 1-3 pairs usually present from late winter through to early summer. R B G
Wigeon <i>Anas penelope</i>	Amber	WL WI	Broadland SPA Non-breeding localised Non-breeding internat. imp.	Winter visitor & passage migrant	Common. Max. 457 at Great Broad on 21.01.07. R B
Gadwall <i>Anas strepera</i>	Amber	SPEC WI	Broadland SPA Eur. conservation concern Non-breeding internat. imp.	Resident & winter visitor May breed	Frequent. Max. 31 at the grazing marshes on 11.03.08. Up to 3 pairs present during summer. R B G
Teal <i>Anas crecca</i>	Amber	WI	Non-breeding internat. imp.	Winter visitor & passage migrant	Common. Max. 457 at Great Broad on 21.01.07. R B
Mallard <i>Anas platyrhynchos</i>	Amber	WDMp ¹ WDMp ²	Non-breeding decline 25yr Non-breed. decl. longer term	Breeding resident (incl. feral birds)	Common. Max. 88 at Great Broad on 16.09.07. c.20 pairs breed (2011 breeding pairs count: 17). R B G
Garganey <i>Anas querquedula</i>	Amber	SPEC BR	Eur. conservation concern Breeding rarity	Passage migrant May breed	Drake at the riverside channel from 29-30.05.10. Pair present from 26-30.04.11, favouring the riverside channel and marsh dykes. R

Appendix 1 continued on p. 58

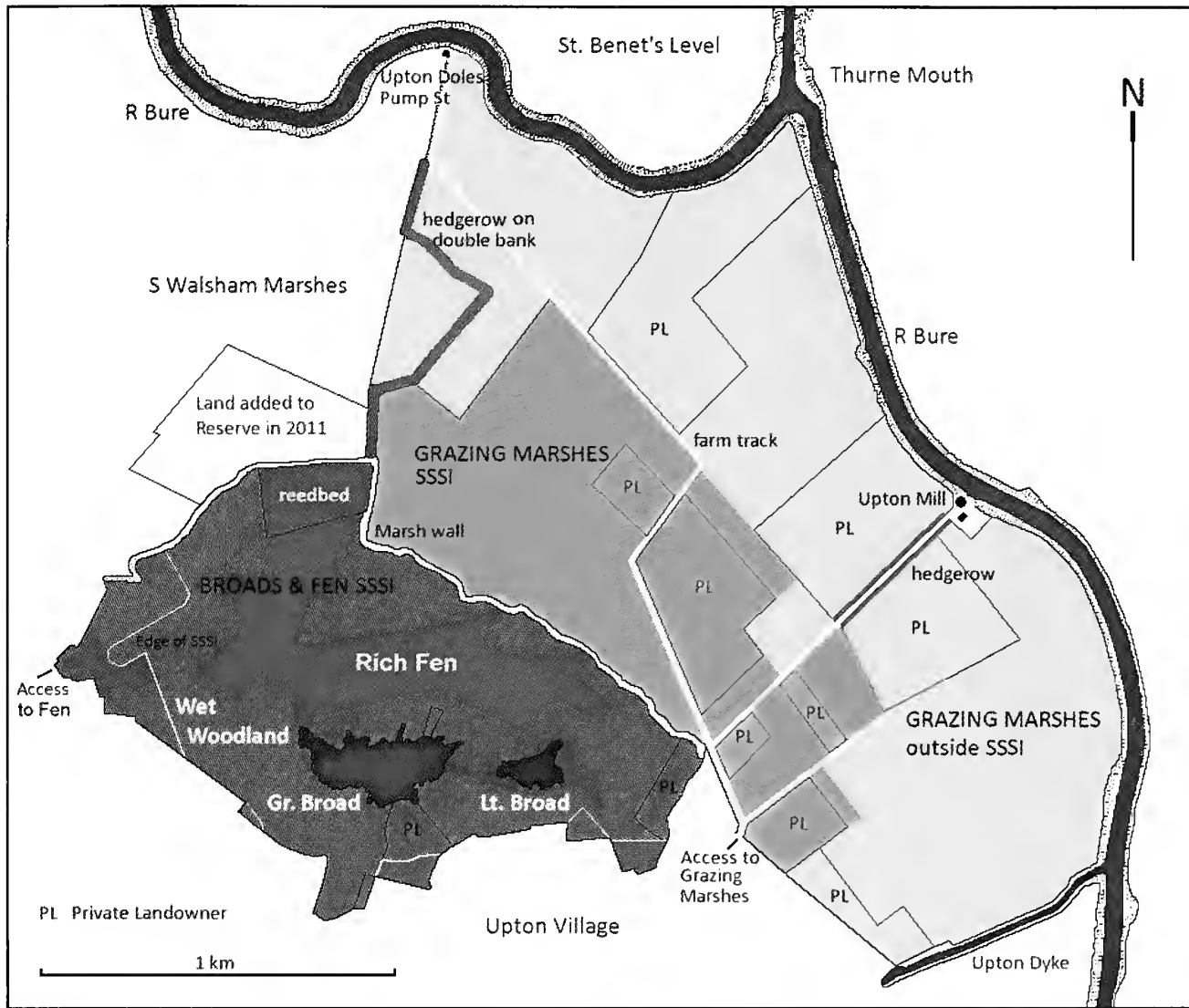


Figure 1. Map of Upton Broad and Marshes study area.



Figure 2. NWT Upton Broad and Marshes, November 2009. Photo courtesy of Mike Page.

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Shoveler <i>Anas chlypeata</i>	Amber	SPEC WI	Broadland SPA Eur. conservation concern Non-breeding internat. imp.	Breeding resident & winter visitor.	Frequent. Max. 12 at Great Broad on 09.03.08 & 15 at the riverside channel on 08.01.11. Up to 3 pairs present during summer. (2011 breeding pairs count: 1). R B G
Pochard <i>Aythya ferina</i>	Amber	SPEC WDMp ¹ WDMp ² WI	Eur. conservation concern Non-breeding decline 25yr Non-breed. decl. longer term Non-breeding internat. imp.	Resident & winter visitor. May breed.	Frequent. Max. 61 at the river channel on 02.03.07 & 18 at Great Broad on 06.04.08. A few present in summer, including parties of drakes. R B
Tufted Duck <i>Aythya fuligula</i>	Amber	SPEC	Eur. conservation concern	Breeding resident & winter visitor	Common. Max. 112 at Great Broad on 14.01.07. Up to 4 pairs present throughout summer. 3 pairs bred in 2010 at the riverside channel (2011 breeding pairs count: 0). R B
Goldeneye <i>Bucephala clangula</i>	Amber	BR	Breeding rarity	Winter visitor	Singles at the river on 30.01.10 & at Great Broad on 21.02.10 & 30.12.11. R B
Smew <i>Mergellus albellus</i>	Amber	SPEC WR	Eur. conservation concern Non-breeding rarity	Winter visitor	1 at Great Broad on 21.02.09. B
Goosander <i>Mergus merganser</i>	Green			Winter visitor	Pair flying up the river on 17.12.11. R
Red-legged Partridge <i>Alectoris rufa</i>	N/A			Naturalised breeding resident	Regular. 1-3 pairs breed (2011 breeding pairs count: 2). G
Pheasant <i>Phasianus colchicus</i>	N/A			Naturalised breeding resident	Common. Breeding not assessed as captive birds are bred locally. G
Cormorant <i>Phalacrocorax carbo</i>	Green			Non-breeding res. & winter visitor	Regular, & abundant overflying to winter roost (at Ranworth Broad). R B
Bittern <i>Botaurus stellaris</i>	Red	HD SPEC BR WR	UKBAP Broadland SPA Historical decline Eur. conservation concern Breeding rarity Non-breeding rarity	Resident & winter visitor (has bred)	Pair bred 2006 (seen feeding young) and present throughout summer 2007. Booming heard from fen reedbed May 2008 & April 2011 but no subsequent indication of breeding. Occurs at both broads during winter. B G F
Little Egret <i>Egretta garzetta</i>	Amber	BL	Breeding localised	Non-breeding resident	Regular. Max. 6 on 23.08.08, 8 on 30.08.09 & 6 on 07.03.11. No status change during 2006-2011. R G F
Grey Heron <i>Ardea cinerea</i>	Green			Breeding resident	Common. Breeds singly & in association (max. 4 grouped) in wet woodland. Up to 8 pairs breed (2011 breeding pairs count: 6). R B G W
Little Grebe <i>Tachybaptus ruficollis</i>	Amber	BDMp ¹ BDMp ²	Breeding decline 25yr Breeding. decline longer term	Breeding resident & winter visitor	Regular. 2 pairs bred 2010 at the riverside channel & bred at Little Broad (2011 breeding pairs count: 1). R B
Great Crested Grebe <i>Podiceps cristatus</i>	Green			Breeding resident & winter visitor	Common. 2 pairs breed at the river. A pair bred at Great Broad 2007 (2011 breeding pairs count: 2). R B
Marsh Harrier <i>Circus aeruginosus</i>	Amber	WR BL	Broadland SPA Non-breeding rarity Breeding localised	Non-breeding resident	Regular. A breeding pair at S. Walsham Broad hunts the fen & marshes. Max. 3 winter & summer. G

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference		
					R= River & Dyke G= Grazing Marsh	F= Fen H= Hedgerow	B= Broad W= Wet Woodland
Hen Harrier <i>Circus cyaneus</i>	Red	HD SPEC	Broadland SPA Historical decline Eur. conservation concern	Winter visitor	1 in the area throughout winters 2008/9 and 2009/10. An adult male over the fen on 12.04.08. G F		
Montagu's Harrier <i>Circus pygargus</i>	Amber	BR	Breeding rarity	Passage migrant	An adult male at the grazing marshes on 25.04.10. G F		
Sparrowhawk <i>Accipiter nisus</i>	Green			Breeding resident	Regular. 1-2 pairs breed (2011 breeding pairs count: 1). G F W H		
Buzzard <i>Buteo buteo</i>	Green			Non-breeding visitor	1 on 07.01.06, 1 on 26.06.10, 3 on 11.12.10 & 1 on 24.12.10. G W		
Osprey <i>Pandion haliaetus</i>	Amber	SPEC BR	Eur. conservation concern Breeding rarity	Passage migrant	1 at Great Broad on 25.08.09. B		
Kestrel <i>Falco tinnunculus</i>	Amber	SPEC	Eur. conservation concern	Breeding resident	Regular. A pair present throughout the year (2011 breeding pairs count: 1). G F H		
Red-footed Falcon <i>Falco vespertinus</i>	Green			Passage migrant	An adult male present at the grazing marshes 23-24.05.08. G		
Hobby <i>Falco subbuteo</i>	Green			Breeding summer visitor	Regular. Max. 5 over Great Broad on 02.10.06. A pair breeds in the wet woodland (2011 breeding pairs count: 1). B G F W		
Peregrine <i>Falco peregrinus</i>	Green			Winter visitor & passage migrant	1 on late passage 03.06.06. Singles on 16.03.07, 23.11.08, 07.01.10, 25-28.11.10 & 31.03.11. G F		
Water Rail <i>Rallus aquaticus</i>	Green			Breeding resident & winter visitor	Common. Several foraging in woodland during hard winter 2009/10. Breeds in reed and herb fen throughout the reserve (2011 breeding pairs count: not assessed). R B F W		
Moorhen <i>Gallinula chloropus</i>	Green			Breeding resident & winter visitor	Common. At least 35 pairs breed (2011 breeding pairs count: 18). R B G F		
Coot <i>Fulica atra</i>	Green			Breeding resident	Common. Max. 38 on Great Broad 17.11.06. C.15 pairs breed at the dykes & broads (2011 breeding pairs count: 7). R B G		
Crane <i>Grus grus</i>	Amber	SPEC BR	Eur. conservation concern Breeding rarity	Non-breeding resident	Increasingly regular. 3 on 24.03.08, 2 on 13.04.08, 3 on 21.01.09, 22.08.10, & from 10-28.11.10, 6 on 11.12.10. A pair from 18.03.11- 24.04.11. Present on adjacent St Benet's Level winter 2011 with max. 11 on 20.01.11. Breeds locally. G		
Oystercatcher <i>Haematopus ostralegus</i>	Amber	WL BI WI	Non-breeding localised Breeding internat. importance Non-breeding internat. imp.	Breeding summer visitor & passage migrant	Regular. 1-3 pairs breed (2011 breeding pairs count: 3). G		
Avocet <i>Recurvirostra avosetta</i>	Amber	BL WL	Breeding localised Non-breeding localised	Summer visitor (has bred)	A pair bred 2010 at the riverside channel, 1 chick raised from 4 eggs laid in May. 1 present 27.06.11- 02.07.11. R		
Stone-curlew <i>Burhinus oediacenus</i>	Red	SPEC BDMi ² BL	UKBAP. Eur. conservation concern Range decline longer term Breeding localised	Passage migrant	1 loafing on the grazing marshes all day on 28.04.10. G		



Figure 3. The marsh wall separating undrained fen and wet woodland from drained grazing marsh. In the distance is tall hedgerow. Photo: Nigel Robson



Ichneumon flies recorded from Marriott's Way (see p. 100). Left: *Dolichomitris mesocentrus* (Gravenhorst). Right: *Fredegunda diluta* (Ratzeburg). Scale bar 10 mm.



Cerceris rybyensis, f. p.45. Nick Owens



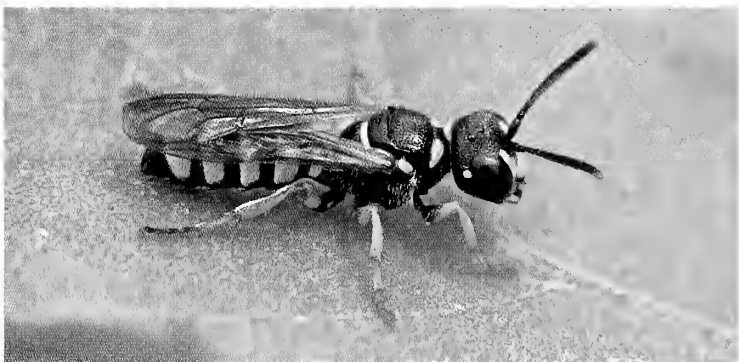
Nysson trimaculatus, f. p.45. Geoff Nobes



Passaloecus gracilis, f. p.43. Tim Strudwick



Gorytes laticinctus, f. p.44. Geoff Nobes



Cerceris quinquefasciata, f. p.45. Tim Strudwick



Harpactus tumidus, m. p.44. Geoff Nobes



Bee-wolf *Philanthus triangulum*, f. p.46. Nick Owens



Cerceris arenaria, f. p.45. Geoff Nobes



Cerceris ruficornis, f. p.45. Geoff Nobes

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Little Ringed Plover <i>Charadrius dubius</i>	Green			Passage migrant & summer visitor (has bred)	Infrequent. 2 pairs at the river bank & channel on 25.04.10 remained to breed, 1 raising 3 chicks. Pair in Jun/Jul 2011 but no evidence of breeding. R
Ringed Plover <i>Charadrius hiaticula</i>	Amber	BDMp ¹ WI	Breeding decline 25yr Non-breeding internat. imp.	Passage migrant	1 on 07.05.08, 3 on 25.04.10 & 1 on 08.09.11. R G
Golden Plover <i>Pluvialis apricaria</i>	Amber	WI	Non-breeding internat. imp	Passage migrant & winter visitor	Frequent but variable numbers. Max. 150 on 03.02.08, 114 on 25.04.10, 250 on 1.12.10 & 125 on 24.04.11. G
Lapwing <i>Vanellus vanellus</i>	Red	BDp ¹ SPEC BDMp ² WI	UKBAP Breeding decline 25yr Eur. conservation concern Breeding decline longer term Non-breeding internat. imp.	Breeding summer & winter visitor, & passage migrant	Common. Winter feeding numbers vary. Max. 250 on 19.02.09 & 700 on 1.12.10. Up to 6 pairs breed (2011 breeding pairs count: 5). G
Dunlin <i>Calidris alpina</i>	Red	WDp ² SPEC WDMp ¹ BL WL WI	Non-breed. decl. longer term Eur. conservation concern Non-breeding. decline 25yr Breeding localised Non-breeding localised Non-breeding internat. imp.	Passage migrant & winter visitor	2 on 25.04.10, singles on 01.12.10, 19.04.11 & 24.07.11. R G
Ruff <i>Philomachus pugnax</i>	Red	BDp ¹ BDp ² SPEC WDMp ² BR	Broadland SPA Breeding decline 25yr Breeding decline longer term Eur. conservation concern Non-breeding decl. longer term Breeding rarity	Passage migrant & winter visitor	2 on 03.05.08, 1 on 14.04.10 & 2 on 01.12.10. R G
Snipe <i>Gallinago gallinago</i>	Amber	SPEC	Eur. conservation concern	Passage migrant & winter visitor	Common, usually small numbers. Max. 36 on 23.11.08 & 45 on 1.12.10. No breeding evidence. G
Woodcock <i>Scolopax rusticola</i>	Amber	SPEC	Eur. conservation concern	Breeding resident & winter visitor	Fairly common, especially winter 2009/10. 1-2 pairs breed (2011 breeding pairs count: 1). FW
Black-tailed Godwit <i>Limosa limosa</i>	Red	HD SPEC BR WL WI	UKBAP Historical decline Eur. conservation. concern Breeding rarity Non-breeding localised Non-breeding internat. imp.	Winter visitor	19 overflying the marshes on 08.02.09. G
Whimbrel <i>Numenius phaeopus</i>	Red	BDp ¹ BR	Breeding decline 25yr Breeding rarity	Passage migrant	Regular in spring. Max. 30 on 03.05.08 & 18 on 02.05.11. In autumn, max. 3 on 30.07.11. G

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Curllew <i>Numenius arquata</i>	Amber	SPEC BDMp ¹ BDMp ² BI WI	UKBAP Eur. conservation concern Breeding decline 25yr Breeding decline longer term Breeding internat. import. Non-breeding internat. imp.	Passage migrant & winter visitor	Regular. Max. 20 on 02.09.06, 7 on 08.01.11 & 10 on 14.10.11. Fewer on spring passage. G
Common Sandpiper <i>Actitis hypoleucos</i>	Amber	SPEC BDMp ¹	Eur. conservation concern Breeding decline 25yr	Passage migrant	Regular at the river bank & channel. Max. 3 on 02.09.06 & 3 on 07.05.08. R
Green Sandpiper <i>Tringa ochropus</i>	Amber	BR	Breeding rarity	Passage migrant & winter visitor	Regular at dykes and the riverside channel. Max. 6 on 25.07.10 & 06.08.10. 3 on 08.12.09. R
Spotted Redshank <i>Tringa erythropus</i>	Amber	SPEC WR	Eur. conservation concern Non-breeding rarity	Winter visitor (& passage migrant)	A wintering bird 24.10.10-11.12.10. at the riverside channel. R
Greenshank <i>Tringa nebularia</i>	Green			Passage migrant	Regular, usually singly. Max. 5 from 23.08.09-03.09.09. R G
Wood Sandpiper <i>Tringa glareola</i>	Amber	SPEC BR WR	Eur. conservation concern Breeding rarity Non-breeding rarity	Passage migrant	2 on 06.05.08 & 1 on 09.07.10. R G
Redshank <i>Tringa totanus</i>	Amber	SPEC BDMp ¹ BDMp ² WI	Eur. conservation concern Breeding decline 25yr Breeding decline longer term Non-breeding internat. imp.	Breeding summer visitor, passage migrant & winter visitor	Regular. Winter max. 5 on 11.12.10. A bird present in May 2011 was tagged when a chick at Snettisham (saltmarsh) in May 2005. 2-3 pairs breed (2011 breeding pairs count: 3). R G
Black-headed Gull <i>Chroicocephalus ridibundus</i>	Amber	WDMp ¹ WI	Non-breeding decline 25yr Non-breeding internat. imp.	Non-breeding resident & winter visitor	Very common throughout the year, breeding locally. R B G
Common Gull <i>Larus cantus</i>	Amber	SPEC WI	Eur. conservation concern Non-breeding internat. imp.	Winter visitor	Very common. Occasionally noted in summer. R B G
Lesser Black-backed Gull <i>Larus fuscus</i>	Amber	BL BI	Breeding localized Breeding internat. import.	Non-breed. visitor mainly in summer	Common in small numbers. G
Herring Gull <i>Larus argentatus</i>	Red	BDp ² WDp ¹ BDMp ¹ WI	UKBAP Breeding decline longer term Non-breeding decline 25yr Breeding decline 25yr Non-breeding internat. imp.	Winter visitor	Infrequent in small numbers. G
Great Black-backed Gull <i>Larus marinus</i>	Amber	WDMp ¹	Non-breeding decline 25yr	Winter visitor	Infrequent in small numbers. G
Common Tern <i>Sterna hirundo</i>	Amber	BL	Breeding localized	Summer visitor (has bred)	Common at the river; also noted aerial feeding over the marshes. A pair bred in 2010 at the riverside channel, raising 1 chick. R



Caenopsis fissirostris. See p.110.
Photo: Frank Köhler.



Colydium elongatum. See p.110.
Photo: Frank Köhler.



Rhizophagus perforatus. See p.112.
Photo: Frank Köhler.



Derocrepis rufipes See p.109.
Photo: Ingrid Altman.



Left: Yellow Nonea
Nonea lutea.
Photo: A.E.H.



Right. Hairy Bird's-
foot-trefoil *Lotus*
subbiflorus.
Photo: Bob Ellis.

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Stock Dove <i>Columba oenas</i>	Amber	BI	Breeding internat. import.	Breeding resident	Regular. 2-3 pairs breed (2011 breeding pair count: 3). G W
Woodpigeon <i>Columba palumbus</i>	Green			Breeding resident & winter visitor	Very common, with many breeding (2011 breeding pairs count: 40).
Collared Dove <i>Streptopelia decaocto</i>				Breeding resident	Common in perimeter farms where most breed (2011 breeding pairs count: 0).
Turtle Dove <i>Streptopelia turtur</i>	Red	BDp ¹ BDp ² SPEC	UKBAP Breeding decline 25yr Breeding decline longer term Eur. conservation concern	Non-breeding summer visitor	Scarce, breeding locally. Pair on 04.06.06 and 2 (separately) on 06.05.08. H
Cuckoo <i>Cuculus canorus</i>	Red	BDp ¹ BDp ²	UKBAP Breeding decline 25yr Breeding decline longer term	Breeding summer visitor	Regular but uncommon. 1 pair around the marshes annually (2011 breeding pairs count: 1). G F
Barn Owl <i>Tyto alba</i>	Amber	SPEC	Eur. conservation concern	Breeding resident	Regular. Max. 5 on 23.01.10. 2-3 pairs hunt in the reserve (2011 breeding pairs count: 2). R G F W
Little Owl <i>Athene noctua</i>	N/A			Naturalised non-breeding resident	Uncommon, breeding locally. A pair in perimeter farmland (Holly Farm).
Tawny Owl <i>Strix aluco</i>	Green			Breeding resident	Regular. 1-2 pairs breed (2011 breeding pairs count: 1). W
Short-eared Owl <i>Asio flammeus</i>	Amber	SPEC	Eur. conservation concern	Winter visitor	1 adjacent on St Benet's Level on 17.12.06. G
Swift <i>Apus apus</i>	Amber	BDMp ¹	Breeding decline 25yr	Non-breeding summer visitor & passage migrant	Common overflying in small numbers in mid-summer & greater numbers on passage.
Kingfisher <i>Alcedo atthis</i>	Green	SPEC	Eur. conservation concern	Resident. May breed	Regular some years but uncommon (not more than 2). R B
Green Woodpecker <i>Picus viridis</i>	Green	SPEC	Eur. conservation concern	Breeding resident	Frequent but variable. 1-2 pairs breed. (2011 breeding pairs count: 0, after hard winter). W
Great Spotted Woodpecker <i>Dendrocopos major</i>	Green			Breeding resident	Common but variable. 3-4 pairs breed (2011 breeding pairs count: 3). W
Magpie <i>Pica pica</i>	Green			Breeding resident	Regular in pairs or a small group. C.5 pairs breed (2011 breeding pairs count: 5). G H

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Jay <i>Garrulus glandarius</i>	Green			Breeding resident	Frequent, in pairs or small groups. 4-5 pairs breed (2011 breeding pairs count: 5). W
Jackdaw <i>Corvus monedula</i>	Green			Non-breeding resident	Very common. In winter frequently over 100. See Rook for roost numbers. G W
Rook <i>Corvus frugilegus</i>	Green			Non-breeding resident	Very common, breeding locally. In winter frequently over 200. Usually outnumbered by Jackdaw 2:1, but not at roost. A mixed corvid roost (majority Jackdaw) in the wet woodland beside the marshes of 5000-10000 birds during Nov-Dec 2011. G W
Carrion Crow <i>Corvus corone</i>	Green			Breeding resident	Common. A winter roost of c.140 noted in late Oct 2010. A non-breeding group of 10-15 occupy the marshes in summer. C.15 pairs breed (2011 breeding pairs count: 15). G H W
Goldcrest <i>Regulus regulus</i>	Green			Breeding resident & winter visitor	Scarce in summer, common at times in winter. Few breed (2011 breeding pairs count: 1). W
Blue Tit <i>Cyanistes caeruleus</i>	Green			Breeding resident	Very common. 30-40 pairs breed (2011 breeding pairs count: 26). W H
Great Tit <i>Parus major</i>	Green			Breeding resident	Very common. 35-45 pairs breed (2011 breeding pairs count: 28). W.H
Coal Tit <i>Parus ater</i>	Green			Breeding resident	Uncommon. 2-3 pairs breed (2011 breeding pairs count: 3). W
Marsh Tit <i>Poecile palustris</i>	Red	BDp ² SPEC BDMp ¹	UKBAP Breeding decline longer term Eur. conservation concern Breeding decline 25yr	Breeding resident	Common. Max. 15 in Sep 2006. 5-10 pairs breed (2011 breeding pairs count: 7). W
Bearded Tit <i>Panurus biarmicus</i>	Amber	BDMr ¹ BL	Range decline 25yr Breeding localized	Non-breeding visitor	Irregular, usually beside river. Max. 4 on 17.10.06. & 3 on 18.11.10. R
Skylark <i>Alauda arvensis</i>	Red	BDp ² SPEC BDMp ¹	UKBAP Breeding decline longer term Eur. conservation concern Breeding decline 25yr	Breeding summer & winter visitor	Common, but numbers fluctuate in winter. Max. 80 on 17.10.06. 15-20 pairs breed (2011 breeding pairs count: 19). G
Sand Martin <i>Riparia riparia</i>	Amber	SPEC	Eur. conservation concern	Non-breeding summer visitor & passage migrant	Fairly common on passage, mainly autumn. G
Swallow <i>Hirundo rustica</i>	Amber	SPEC	Eur. conservation concern	Breeding summer visitor & passage migrant	Common, with large numbers on autumn passage. 1-2 pairs breed (2011 breeding pairs count: 2). G

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
House Martin <i>Delichon urbicum</i>	Amber	SPEC BDMp ¹ BDMp ²	Eur. conservation concern Breeding decline 25yr Breeding decline longer term	Non-breeding summer visitor & passage migrant	Common overflying, breeding locally.
Cetti's Warbler <i>Cettia cetti</i>	Green			Breeding resident	Common. 25-30 pairs breed (2011 breeding pairs count: 28). R B W H
Long-tailed Tit <i>Aegithalos caudatus</i>	Green			Breeding resident	Common. Max. c. 70 on 26.11.08. 10-15 pairs breed (2011 breeding pairs count: 9). W H
Chiffchaff <i>Phylloscopus collybita</i>	Green			Resident & breed. summer visitor	Very common in summer, scarce in winter. 50-60 pairs breed in the wet woodland (2011 breeding pairs count: 54). W H
Willow Warbler <i>Phylloscopus trochilus</i>	Amber	BDMp ¹ BDMp ²	Breeding decline 25yr Breeding decline longer term	Breeding summer visitor	Common in the willow scrub between fen & woodland where c.30 pairs breed (2011 breeding pairs count: 30). F W H
Blackcap <i>Sylvia atricapilla</i>	Green			Breeding summer & winter visitor	Very common in summer, scarce in winter. 40-50 pairs breed (2011 breeding pairs count: 37). W H
Garden Warbler <i>Sylvia borin</i>	Green			Breeding summer visitor	Fairly uncommon. 5-7 pairs breed at the woodland edge (2011 breeding pairs count: 6). W H
Lesser Whitethroat <i>Sylvia curruca</i>	Green			Passage migrant	Regular in autumn and infrequent in spring. 1 on 25.04.10. Max. 3 on 07.09.06 & 25.08.10. H
Whitethroat <i>Sylvia communis</i>	Amber	BDMp ²	Breeding decline longer term	Breeding summer visitor	Common in hedgerows and bramble. 15-22 pairs breed (2011 breeding pairs count: 18). G H
Grasshopper Warbler <i>Locustella naevia</i>	Red	BDp ¹ BDp ²	UKBAP Breeding decline 25yr Breeding decline longer term	Breeding summer visitor	Fairly common in herb fen. 5-10 pairs breed (2011 breeding pairs count: 7).
Sedge Warbler <i>Acrocephalus schoenobaenus</i>	Green			Breeding summer visitor	Abundant. 70-90 pairs breed (2011 breeding pairs count: 73). R B F H
Reed Warbler <i>Acrocephalus scirpaceus</i>	Green			Breeding summer visitor	Common. 40-50 pairs breed (2011 breeding pairs count: 46). R F
Treecreeper <i>Certhia familiaris</i>	Green			Breeding resident	Fairly common. 8-10 pairs breed (2011 breeding pairs count: 1). W
Wren <i>Troglodytes troglodytes</i>	Green			Breeding resident	Abundant. 70-100 pairs breed (2011 breeding pairs count: 58). R F W
Starling <i>Sturnus vulgaris</i>	Red	BDp ¹ BDp ² SPEC	UKBAP Breeding decline 25yr Breeding decline longer term Eur. conservation concern	Non-breeding resident & winter visitor	Regular, breeding locally, and abundant at times in winter. Max. 2000-2500 on 29.03.08. G

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Ring Ousel <i>Turdus torquatus</i>	Red	BDp ¹	UKBAP Breeding decline 25yr	Passage migrant	1 pair in the marshes tall hedgerow on 09.04.10. H
Blackbird <i>Turdus merula</i>	Green			Breeding resident & winter visitor	Common in summer & very common in winter following influxes of continental birds. 10-20 pairs breed (2011 breeding pairs count: 10). W H
Fieldfare <i>Turdus pilaris</i>	Red	BDp ² BDMp ¹ BR	Breeding decline longer term Breeding decline 25yr Breeding rarity	Winter visitor & passage migrant	Very common at times, especially favouring hedgerows, & later in winter the grazing marshes. G W H
Song Thrush <i>Turdus philomelos</i>	Red	BDp ²	UKBAP Breeding decline longer term	Breeding resident & winter visitor	Common. Max. in tall hedgerows during influxes of continental birds 40 on 17.10.06 & 45 on 04.10.10. 10-12 pairs breed in the wet woodland (2011 breeding pairs count: 12). W H
Redwing <i>Turdus iliacus</i>	Red	BDp ² BR	Breeding decline longer term Breeding rarity	Winter visitor & passage migrant	Very common at times, especially favouring the tall hedgerows. G W H
Mistle Thrush <i>Turdus viscivorus</i>	Amber	BDMp ¹ BDMp ²	Breeding decline 25yr Breeding decline longer term	Breeding resident	Frequent. Max. 10 on 27.02.06. 1-2 pairs breed on periphery (2011 breeding pairs count: 0). G H
Spotted Flycatcher <i>Muscicapa striata</i>	Red	BDp ¹ BDp ² SPEC	UKBAP Breeding decline 25yr Breeding decline longer term Eur. conservation concern	Summer visitor (has bred)	Pair with fledged young on perimeter at Holy Farm 15.06.06. Another with young at Upton Dyke 01.07.06. 1 in the fen on 28.07.06. H
Robin <i>Erithacus rubecula</i>	Green			Breeding resident & winter visitor	Very common. 30-40 pairs breed (2011 breeding pairs count: 28). H
Whinchat <i>Saxicola rubetra</i>	Amber	BDMp ¹	Breeding decline 25yr	Passage migrant	1 on 22.08.10 near Upton Mill. H
Stonechat <i>Saxicola torquatus</i>	Green			Winter visitor	Regular but uncommon. 1 most years, max 3. G
Wheatear <i>Oenanthe oenanthe</i>	Amber	SPEC	Eur. conservation concern	Passage migrant	Regular but uncommon. Most in spring, usually 1-2. Max. 4 on 25.04.10 & 3 on 19.04.11. G
Duncock <i>Prunella modularis</i>	Amber	BDMp ²	UKBAP Breeding decline longer term	Breeding resident & winter visitor	Common. 8-15 pairs breed (2011 breeding pairs count: 6). H
House Sparrow <i>Passer domesticus</i>	Red	BDp ¹ BDp ² SPEC	UKBAP Breeding decline 25yr Breeding decline longer term Eur. conservation concern	Non-breeding resident	Common around the perimeter farmsteads, where breeds in loose associations. H
Yellow Wagtail <i>Motacilla flavissima</i>	Red	BDp ¹ BDp ²	UKBAP Breeding decline 25yr Breeding decline longer term	Breeding summer visitor & passage migrant	Common on passage, scarce breeder. Spring max. 10 (males) on 10.04.09. Autumn max. 12 on 06.08.07. 1 pair breeds most years, 2 in 2010 (2011 breeding pairs count: 1). R G

Species	BoCC rating	BoCC criteria	Conservation value	Status	Relative abundance and habitat preference R= River & Dyke F= Fen B= Broad W= Wet Woodland G= Grazing Marsh H= Hedgerow
Grey Wagtail <i>Motacilla cinerea</i>	Amber	BDMp ²	Breeding decline longer term	Non-breeding visitor	1 at the riverside channel on 19.02.09 & 2 on 09.08.10. R
Pied Wagtail <i>Motacilla alba</i>	Green	BDMp ¹ BDMp ²		Breeding resident & winter visitor	Common. Mainly at the riverside. Usually 1 pair breeds (2011 breeding pairs count: 1). R G
Meadow Pipit <i>Anthus pratensis</i>	Amber	BDMp ¹ BDMp ²	Breeding decline 25yr Breeding decline longer term	Breeding summer & winter visitor, & passage migrant	Singles at the riverside channel on 17.03.10, 18.11.10-11.12.10 & 02.12.11. R
Water Pipit <i>Anthus spinoletta</i>	Green			Winter visitor	Common. Usually well scattered. Max. group 36 on 06.08.10. 25-30 pairs breed (2011 breeding pairs count: 28). R
Chaffinch <i>Fringilla coelebs</i>	Green			Breeding resident	Very common (fewer in summer 2010). 25-35 pairs breed (2011 breeding pairs count: 26). W H
Greenfinch <i>Carduelis chloris</i>	Green			Breeding resident	Common, usually in groups of less than 10. Breeds in loose association on the periphery around gardens (2011 breeding pairs count: 0). H
Goldfinch <i>Carduelis carduelis</i>	Green			Breeding resident	Very common and widespread. Breeds on the periphery (2011 breeding pairs count: 3). G W H
Siskin <i>Carduelis spinus</i>	Green			Winter visitor	Regular, usually in small groups. W
Linnet <i>Carduelis cannabina</i>	Red	BDp ² SPEC BDMp ¹	UKBAP Breeding decline longer term Eur. conservation concern Breeding decline 25yr	Breeding resident	Common. Max. 45 at winter roost in brambles on the marshes on 15.12.06. Max. group in spring c.60 in April 2011. 15-20 pairs breed (2011 breeding pairs count: 18). G H
Lesser Redpoll <i>Carduelis cabaret</i>	Amber		UKBAP. Breeding decline 25yr Breeding decline longer term	Winter visitor	Irregular. Max. 19 on 13.01.08 W
Bullfinch <i>Pyrrhula pyrrhula</i>	Amber	BDMp ¹ BDMp ²	UKBAP Breeding decline 25yr Breeding decline longer term	Breeding resident	Uncommon. In woodland, max. 4 on 20.01.10. Every winter in the marsh tall hedgerow, with max. 9 on 08.01.11 & 11 on 16.11.11. A few pairs breed (2011 breeding pairs count: 3). W H
Snow Bunting <i>Plectrophenax nivalis</i>	Amber	BR	Breeding rarity	Passage migrant	At the riverside channel, 1 on 24.10.10 and another 18.11.10. G
Yellowhammer <i>Emberiza citrinella</i>	Red	BDp ¹ BDp ²	UKBAP Breeding decline 25yr Breeding decline longer term	Non-breeding resident	Regular in perimeter farmland where several breed. In the fen, max. 5 on 05.12.11. F H
Reed Bunting <i>Emberiza schoeniclus</i>	Amber	BDMp ²	UKBAP Breeding decline longer term	Breeding resident	Common, less so in winter. C.40 pairs breed (2011 breeding pairs count: 38). R G F H

Appendix 2: Wetland Birds Survey (WeBS) monthly counts at Upton Broads 2007-2011

Great Broad 2007	21.01.07	18.02.07	15.03.07	15.04.07	14.05.07	17.06.07	15.07.07	12.08.07	16.09.07	07.10.07	11.11.07	09.12.07
Mute Swan			2	2	2	2		2	3	3	2	3
Greylag Goose			4	7	2							
Egyptian Goose			1									
Shelduck					4							
Wigeon		97										
Gadwall									1			
Teal	457	9	29	4					4	3		
Mallard	1	6	3		2				88	44		
Pochard	5			4	6							
Tufted Duck	80	39	33	4	11	5		2	27	18		
Great Crested Grebe			1	1	1	1	1	3	4	2		
Cormorant		3						1	1			
Moorhen			1		1							
Coot	31	11	8	7	2	4	4	2	17	29		24
Water Rail	1											
Little Broad												
Shelduck					1							
Teal										1		
Mallard		2	2					2		2		
Little Grebe			2									
Cormorant		1										
Moorhen					1							
Coot		2	1				2					

Great Broad 2008	13.01.08	10.02.08	09.03.08	06.04.08	18.05.08	22.06.08	20.07.08	17.08.08	14.09.08	19.10.08	16.11.08	14.12.08
Mute Swan	3	3			2	2	2	2	2	2	5	2
Shelduck		1					3					
Wigeon									6			
Gadwall		4		4	4				4			
Teal		91	41						7			
Mallard	2	2	3	1	4	2	5	9	30	1		
Shoveler			12									
Pochard				18	16	2			2			
Tufted Duck		42	11	16	23	12	3	5	5			
Gr Crested Grebe			2	2	2	2	3	3	1			
Cormorant	1	1										
Moorhen		1			2		3					
Coot	17	15	11	5	3	3	12	24	32	12		
Common Tern							1					
Kingfisher			1									
Little Broad												
Shelduck		1										
Mallard		2	2		2							1
Tufted Duck			2									
Little Grebe								1	3			
Grey Heron								1				
Coot		1		2		2	2					
Common Tern							1					

Great Broad 2009	18.01.09	21.02.09	15.03.09	18.04.09	10.05.09	14.06.09	12.07.09	23.08.09	20.09.09	11.10.09	22.11.09	20.12.09
Mute Swan	2	2	1	2	4		2	2	2	2	2	2
Greylag Goose				4	8							
Wigeon									4			
Gadwall	1		5									
Teal	2	114	10						3			
Mallard	4	18	2				2	6	62	20		
Pochard		4	3			1						
Tufted Duck	2	46	42	11	8	3			1			
Smew		1										
Little Grebe			1									
Cormorant							1	1			1	
Grey Heron			1									
Moorhen		1	1	1					2			
Coot	22	22	13	7	6	7	12	13	15	10	6	6
Water Rail								1				
Black-headed Gull										2		
Common Gull											1	
Common Tern					12		1					
Little Broad												
Mute Swan									2	2	2	2
Greylag Goose				8								9
Shelduck		1	1									
Teal				2								
Mallard		4	1	1		1	5	37	2		12	
Tufted Duck				2								
Little Grebe								1	1			
Grey Heron						1						
Moorhen		1										
Coot		6	4	1		2	1	2	2			
Great Broad 2010	17.01.10	21.02.10	14.03.10	17.04.10	16.05.10	20.06.10	17.07.10	15.08.10	19.09.10	10.10.10	14.11.10	19.12.10
Mute Swan	2	2		1	1	1		3	1	3		3
Greylag Goose				2								
Shelduck		3										
Teal		51	42									32
Mallard	11	12	2		3	4	2		3			33
Pochard	12	3	1									4
Tufted Duck		17	20	2						1		1
Goldeneye		1										
Little Grebe			1							3		1
Gr Crested Grebe			1									
Cormorant			1	1						2	1	
Grey Heron												1
Coot	7	12	9	2	1	2	7	16	8	25	22	3
Black-headed Gull												2
Common Gull			1									
Kingfisher							1					
Little Broad												
Mute Swan				2						2	2	
Shelduck			1									
Mallard				2	2	2	21		5			
Moorhen				1	1		1		1			
Coot			2	1	1	1	1		2			

Great Broad 2011	23.01.11	13.02.11	13.03.11	17.04.11	No count	12.06.11	17.07.11	14.08.11	18.09.11	16.10.11	20.11.11	18.12.11
Mute Swan	3	2	1	2	-				6	6	4	3
Shelduck	2	2	2		-							
Wigeon					-				1			
Gadwall					-						2	4
Teal	9		18		-				1		34	169
Mallard	10	2	4	2	-				11		13	10
Shoveler					-						3	
Pochard	35				-						17	5
Tufted Duck	48		7	11	-	6			14		12	29
Little Grebe					-							1
Gr Crested Grebe					-			1		1		
Cormorant	1	1			-					1	1	1
Grey Heron					-		1			1		
Moorhen					-					1		
Coot	12	10	5	2	-	3	13	23	24	31	25	37
Water Rail					-						1	
Black-headed Gull					-					89	15	2
Common Tern					-	1	2					
Little Broad												
Mute Swan		2			-							
Mallard					-	2		6				
Tufted Duck					-					4		
Little Grebe					-		1		3		1	
Cormorant					-					1		
Coot	2	2	2	2	-	2	2	2				
Water Rail					-						1	

Appendix 3: Species recorded at NWT Upton Fen in 2006-2011 additional to those included in The Norfolk Bird Atlas: Summer and Winter Distributions 1999-2007 (Taylor and Marchant 2011). Following the criteria applied to the atlas, 'summer' is defined as the period April, May and June. The main focus is on breeding birds but passage migrants recorded during this period are also included. 'Winter' is defined as the period December, January and February.

Tetrad TG31W which includes grazing marsh, fen, broad and wet woodland.

SUMMER

Egyptian Goose	Black-headed Gull	Jackdaw	Spotted Flycatcher
Gadwall	Lesser Black-backed Gull	Goldcrest	Duncock
Pochard	Common Tern	Sand Martin	Meadow Pipit
Cormorant	Stock Dove	Chiffchaff	Goldfinch
Little Grebe	Collared Dove	Garden Warbler	Linnet
Water Rail	Little Owl	Whitethroat	Reed Bunting
Lapwing	Green Woodpecker	Treecreeper	

WINTER

Pochard	Little Egret	Stock Dove	Meadow Pipit
Goldeneye	Hen Harrier	Kingfisher	Linnet
Smew	Peregrine	Jay	Yellowhammer
Cormorant	Lapwing	Coal Tit	Reed Bunting
Bittern	Common Gull	Cetti's Warbler	

Tetrad TG31X which includes grazing marsh and fen.

SUMMER

Shelduck	Stone-curlew	Whimbrel	Cuckoo
Bittern	Little Ringed Plover	Curlew	Kingfisher
Little Grebe	Ringed Plover	Green Sandpiper	Lesser Whitethroat
Montagu's Harrier	Golden Plover	Wood Sandpiper	Ring Ousel
Sparrowhawk	Dunlin	Common Gull	Wheatear
Avocet	Ruff	Turtle Dove	Bullfinch

WINTER

Pink-footed Goose	Little Grebe	Woodcock	Kingfisher
White-fronted Goose	Hen Harrier	Black-tailed Godwit	Bearded Tit
Wigeon	Buzzard	Curlew	Chiffchaff
Pochard	Peregrine	Green Sandpiper	Redwing
Goldeneye	Crane	Spotted Redshank	Mistle Thrush
Goosander	Golden Plover	Redshank	Grey Wagtail
Red-legged Partridge	Dunlin	Lesser Black-backed Gull	Water Pipit
Little Egret	Ruff	Short-eared Owl	Snow Bunting

The Great Crested Newts *Triturus cristatus* of Stanford Training Area, Thetford, Norfolk

Nick Gibbons

Introduction

The Stanford Training Area (Stanta) has an area of some 87 sq km. It comprises around 9% of what is recognised as Breckland and lies mainly in the 10 km square TL89. The central core of land has very restricted public access due to MoD (Ministry of Defence) live firing training activities but some peripheral areas of farmland and forest, used by the MoD for other training, are not subject to the same access restrictions. The whole area contains nearly 200 water bodies. Most of the site is an SSSI and Great Crested Newt is included as a feature of the notification.

Three surveys have been undertaken in and around this area of Norfolk:

Survey 1

During the National Amphibian Survey of 1989-92 a survey of the amphibians of the Thetford area was carried out (Swan and Oldham 1993, Gibbons 1992) (Figure 4). This included a small peripheral area of the Stanford Training Area that is used for general training but is also open to public access.

Survey 2

As a result of this work the author was invited to survey the whole of Stanta and this was undertaken in 1997-8 (Gibbons 1998).

Survey 3

A repeat survey of Stanta for Great Crested Newts was carried out in the period 2010-12.

Methods

Survey 1 was a blanket survey and included all species of amphibians. This required

multiple visits to the water bodies and the use of a wide range of survey techniques, including torching at night, netting, bottle trapping, visual searches for eggs and searches of surrounding terrestrial habitat. As with later surveys the majority of the work was carried out in the period February to June inclusive.

In contrast, Survey 2 was largely for Great Crested Newt. Similar techniques were used but once Great Crested Newt had been identified no further survey work was carried out at a water body.

The results from Surveys 1 and 2 for all amphibian species were mapped and, for Great Crested Newt, metapopulations were determined using 250 and 500 m water body boundaries.

Survey 3 also concentrated on Great Crested Newt only and was largely carried out by egg searches, terrestrial habitat searches and, where necessary, torching. Once Great Crested Newts had been identified no further survey work was carried out at a water body. An estimate was made of the number of eggs recorded, although the correlation of this figure with the size of the newt population is open to discussion.

All water bodies have been identified with a unique number and name and these have been passed to the MoD who have plotted them on their GIS system. A number of new water bodies were identified during 2010 and 2011 and these have been added to the list. Photographs of each water body have been taken for reference purposes and will be held by the Norfolk Biological Information Service.

Results

During the first full Stanta survey (Survey 2) a total of 167 water bodies was identified. A breakdown of the amphibians found is given in Table 1.

Table 1. Number of water bodies found with amphibian species in Survey 2.

Species	No of water bodies n=159*	% of water bodies*
Common Toad <i>Bufo bufo</i>	28	18
Common Frog <i>Rana temporaria</i>	12	8
Great Crested Newt <i>Triturus cristatus</i>	45	28
Smooth Newt <i>Triturus vulgaris</i>	33	21
Nil found	97	61

* Excluding the eight sites that have been deleted as never holding water (Appendix 1).

During the 2010-12 survey (Survey 3) a total of 192 water bodies were identified. The increase is partly due to the author's increased familiarity with Stanta. Many water bodies are not marked on the OS maps due to their ephemeral nature and these also change with the different editions of the OS maps, depending on the timing of the OS aerial survey. A good example is that Fowlmere is no longer shown as a lake on the more recent OS maps while some water bodies which have been dry for many years such as that at Pinnacle Lodge are still shown. In addition, several new ponds were constructed by the MoD during the intervening years as part of their conservation programme.

The latest survey results appear in Table 2. Note that

Table 2. Number of water bodies found with amphibian species in Survey 3.

Species	No. of water bodies n=184*	% of sites*
Common Toad	12	7
Common Frog	9	5
Great Crested Newt	64	35
Smooth Newt	21	11
Nil found	108	59

* Excluding the 8 sites that have been deleted as never holding water (Appendix 1).

other amphibian species numbers are reduced in comparison with Survey 2 and this is most likely due to the survey methodology, which focused on Great Crested Newt.

A full list of water bodies and species is given in Appendix 2.

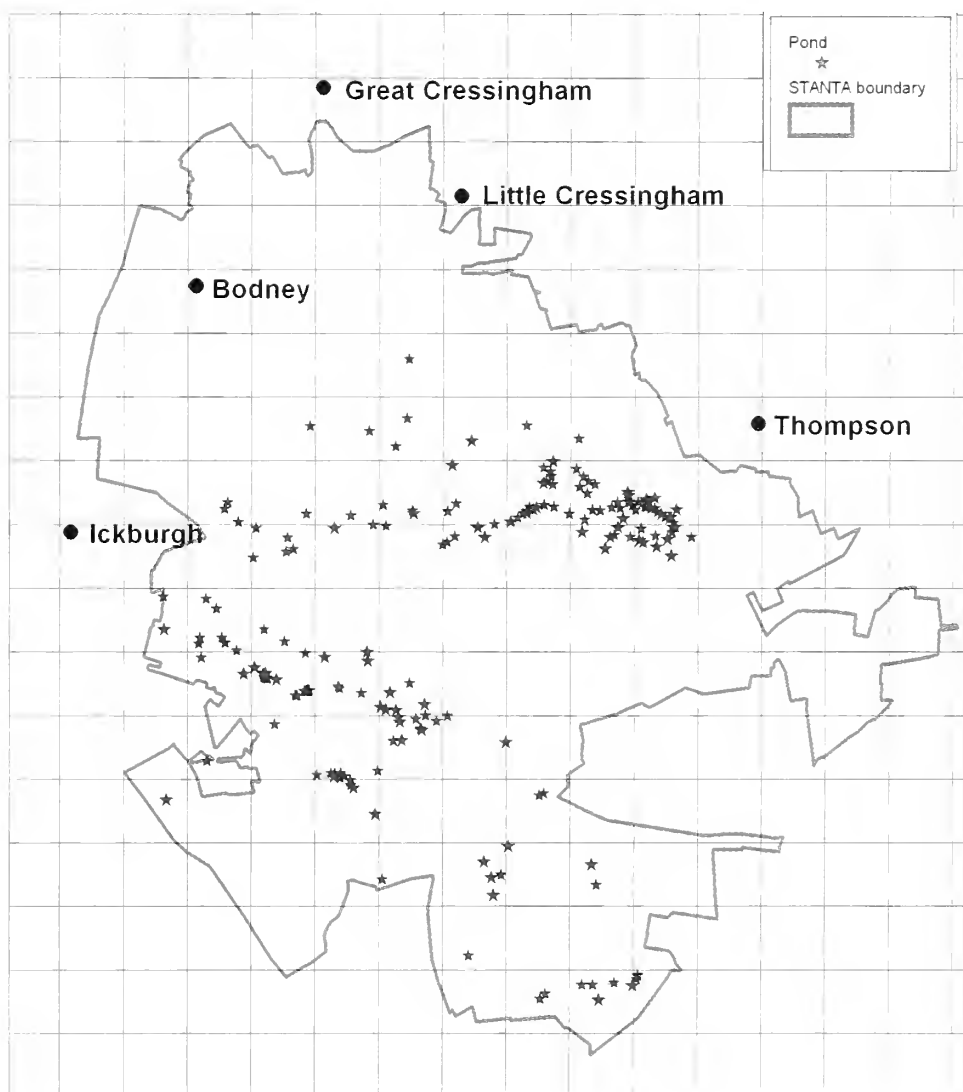


Figure 1. Water bodies of Stanford Training Area, all years.

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Distribution and origin of water body habitats of Stanta

The water bodies of Stanta are located in a variety of habitats and are at various stages of succession. Some are semi-natural, such as meres, pingos/periglacial features, spring lines and low-lying meadows with natural depressions, whilst others are clearly man-made e.g. mineral extraction pits, semi-domestic features from pre-MoD inhabitants, and more recent creations by the MoD in response to the 1990s survey and the Integrated Land Management Plan for the SSSI.

The distribution of water bodies is given in given in Fig 1, and this clearly shows the enormous variation in water body density across the area. The types of water body are summarised in Table 3.

Pits and hollows resulting from mineral extraction, either for sand and gravel or for marl for agricultural improvement, are widespread and found across the whole of the Stanta area (c. 61 sites). Many are shown on Ordnance Survey maps but only a few have been added to the water body list since most do not appear to have held water in recent years. The majority were visited in the 1990s and only those deemed to be potential water bodies were visited during Survey 3. Of these, eight were dry and lacked any indication of aquatic flora in Survey 3 and will be removed from the list for any further surveys.

Stanta includes three true meres, Fowlmere, Punchbowl and Home Mere.

Pingos and periglacial features are quite widespread but are largely confined to the

Table 3. Water body sites in Stanta.

Types of water body	Approx no.
True meres	3
Pingos/periglacial features	80
Spring lines/ditches/wet depressions	29
Man made landscape features	13
New/modified features created by MoD	5
Other man made sites e.g. by mineral extraction	62
TOTAL	192

valley of the River Wissey, spreading from Waterhouse Plantation and Tottington in the east to Sturston and Stanford in the west. Other groups are found in the Blacklands and Corkmere areas and together they account for 80 water body sites.

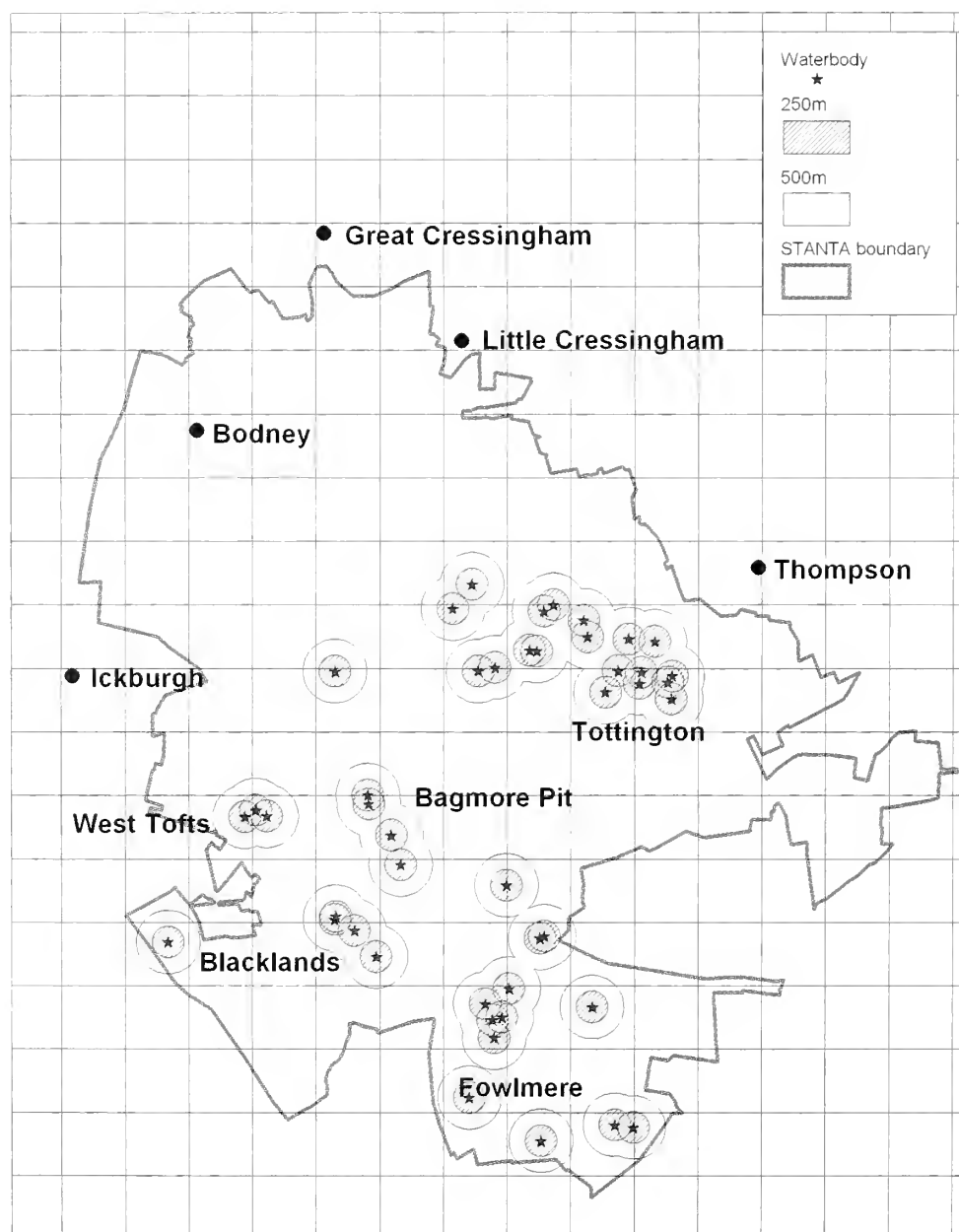


Figure 2. Distribution of the Great Crested Newt on Stanta from Survey 2.

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Figure 3. Distribution of the Great Crested Newt on Stanta from 2010-12 survey

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Spring lines, ditches from attempts to control water levels for agricultural purposes, and natural wet depressions appear mainly along the valley of the River Wissey and account for *c.* 29 sites. In general, flowing water is not always suitable for many amphibians but usually there are suitable wet areas around the springs themselves.

Man made 'landscape' features account for a further 13 sites and include water bodies such as Stanford Water, West Mere and domestic features such as the square fish pond at Buckenham Tofts, and Tottington and Sturston moats.

More recently work has been undertaken by the MoD to create additional water features and these have been mainly in the

Tottington area where the density of water bodies is far higher than anywhere else on the Stanta complex. Apart from some new ponds others have been greatly modified by the MoD in an attempt to improve them as suitable sites for amphibians and other aquatic organisms.

Water body habitat status

Before the 1990s there was little visible water body management in the Stanta area and as a result of natural succession around 45% of water bodies are unsuitable for amphibians due to shading, large quantities of accumulated leaf litter and eutrophication of the water. This is particularly so in the impact area in the heart of the training area where there is still too much unexploded ordnance for dredging work to be readily undertaken in a safe manner. Nevertheless, a few such water bodies have small populations of Great Crested Newt.

More recently, work has been undertaken to open up some of the sites where Great Crested Newts have been recorded in recent years by the removal of shading scrub and trees. Treatment of stumps with herbicide has not been undertaken and the likelihood is that these sites will need further scrub management in the near future to maintain the habitat.

Water bodies that are in the areas most heavily grazed have remained more open in many instances, although puddling by sheep and wallowing by deer can have a deleterious impact on the water quality and the marginal vegetation. Surprisingly some

Table 4. Comparison of Great Crested Newt occupancy between Survey 1 and Survey 3.

	Survey 1 (1988-92)	Survey 3 (2010-12)
Number of water bodies	214	197
Great Crested Newt sites (%)	18	35
No amphibians present (%)	45	59

of these sites, such as those on Tottington Warren, appear to have reasonable populations of amphibians despite the surrounding habitats being visually unsuitable for their terrestrial phase of life due to the grazing.

Great Crested Newt populations

Sites

The sites where Great Crested Newts have been identified in Surveys 2 and 3 are shown in Figs 2 and 3. In general, sites where Great Crested Newts were found in Surveys 1 and 2 were also found to have them in 2010-12. There were only 11 water bodies where this was not the case. These 11 were mainly in the Waterhouse Plantation, Tottington Church, Corkmere and the Croxton Forest block areas.

At Waterhouse a number of ponds have deteriorated due to scrub and tree growth to the extent where the pond is barely suitable for this species. At Tottington Church area, the associated reed beds and ponds were dry in the spring of 2012 when surveyed and no newts were recorded in or around any of them. Some water recharge of one of the ponds was found by the end of May 2012 and Great Crested Newt eggs were recorded from this site. In general the habitat appears not to have changed significantly and hopefully animals will be found when water levels return to normal in this area. In the Croxton Forest block water levels were low and some ponds badly shaded or heavily poached by deer wallowing. At Corkmere there has been hardly any water present in the ponds during the period 2010 to 2012.

The loss of sites is more than made up for by the 30 additional water bodies where Great Crested Newts were found in 2010-12. This has been due to conservation work to improve water body habitats and also the finding of additional water bodies not recorded in the previous survey. These were mainly in the Waterhouse Plantation, Tottington.

Table 4 compares the above results with those from the blanket water body survey of the adjacent land to the south of Stanta undertaken by the author in 1988-92 (Survey 1) as part of the National Amphibian Survey (Gibbons 1992).

The percentage of water bodies with Great Crested Newts present was considerably higher within Stanta than in the adjacent area to the south and this shows the importance of Stanta for this species. Whilst the proportion of water bodies with no amphibians in the area bordering Stanta surveyed in Survey 1 was lower, this was probably because of the different methods used in the survey, surveying ceasing when Great Crested Newt were identified in Survey 3.

Populations

In the 1990s an attempt was made to identify the metapopulations of Great Crested Newt on Stanta. These are areas where there is the potential for sufficient interchange between adjacent breeding sites to allow genetic interchange between them.

The importance of 'pond clusters' has long been recognised for various species, including Great Crested Newt. A cluster improves the chance of having at least one pond in suitable condition for newts to breed as natural pond succession takes place. In addition, it also allows movement of newts between ponds and allows an interchange of genes between populations at adjacent sites to give more robust, less inbred populations.

In their terrestrial phase of life the highest

density of newts is normally within 250 m of the breeding site. Densities get significantly lower as the distance from the pond increases and after 1 km any interchange of population is likely to be very low (Baker *et al.* 2011). Water bodies where Great Crested Newt were found in for Survey 2 are shown with 250 m and 500 m radii circles (Figure 2). Where there was overlap of these circles it was considered that there would be sufficient interchange to class them as a single population (known as a metapopulation).

A similar exercise was undertaken for Survey 3 and the results shown in Figure 3.

In Survey 2 there are clearly major metapopulations in the Tottington, Blacklands, West Tofts, Bagmore Pit and Fowlmere areas, with several more isolated populations centred on only one or two water bodies.

The overall distribution has not changed much in two decades, although some of the more isolated populations have been found to have almost reached the point of extinction. Home Mere required several visits to confirm the presence of Great Crested Newts in 2011 and even then only a handful of eggs were found during two

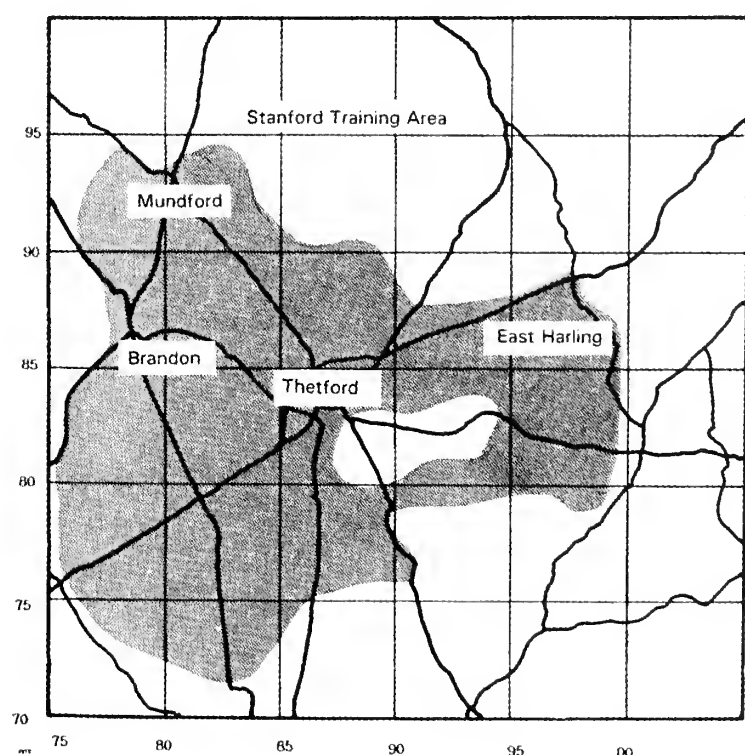


Figure 4. 1988-92 blanket survey area.

Table 4. The quantitative indices used by Natural England to assess populations (NCC 1989).

Survey method	Population score		
	Low	Good	High
Seen or netted (day)	<5	5-50	>50
Counted (night)	<10	10-100	>100

evenings torching and no adults were observed. The Croxton Forest block has fewer records as the water bodies had low water levels or are now unsuitable. An additional isolated population was found on Bodney Warren. Smokers Hole remains an isolated population but the permanent water and the good adjacent habitat means that this should at least be a sustainable population.

There is more hope for the populations along the Wissey valley with the finding of ponds adjacent to Lake Plantation which almost connects the Tottington and Waterhouse metapopulations and, as the habitat between them is regularly wet and is really good terrestrial habitat for newts, they are quite likely to move up to the 1km and maybe beyond.

The complex of ponds and other water bodies in Stanta make it far more suitable for the long term survival of this species compared with the current situation in the area surveyed in 1988-92 to the south of the training area (Figure 4).

Outside of Stanta changes in agriculture from stock to arable in the last 60 years have meant that ponds are no longer an integral part of the landscape. They continue to be lost, either to infilling or to natural succession and their adjacent habitat is often no longer suitable for the terrestrial phase of the Great Crested Newt life cycle.

The quality of a Great Crested Newt population can be assessed by the number found during survey work by visual observation during the day or at night with a torch or netting. This can be from

an individual pond or, where there are a number of ponds in close proximity, from a group of ponds.

Natural England uses quantitative indices to assess populations (Table 4; Nature Conservancy Council 1989). In the first survey a number of sites were found to be in the 'Good' category but none in the 'High' category. As the latest survey was carried out mainly by egg searching it is not possible to compare or quantify the current state. The increase in water bodies used by the newts would, however, indicate that the population is still healthy.

As this species is one for which the Stanta SSSI was notified, Natural England require good baseline data for future SSSI quality assessments and it was proposed to commence this in 2012. A statistical sample of 20 ponds spread across the various habitats of the Stanta SSSI were selected and survey work began in the spring and early summer of 2012. All 20 ponds have been visited but due to the drought conditions many were dry and it has not been practical to produce a realistic baseline. These visits were of interest, however, in that they did show which of the selected sites were the more permanent and these results will be used to re-assess the list of 20 ponds for a future baseline survey.

Acknowledgements

Thanks go to the staff of the Stanford Training Area for giving me permission to access the site and to carry out the surveys between the periods of intense MoD training. Also to the Forestry Commission for access permission to carry out the survey.

Thanks also to Nick Owens and John Buckley for help and advice in the compilation of this data and Martin Horlock of NBIS for the mapping work.

Natural England assisted with travelling expenses for the survey work in 2012 to try and provide a base-line set of data for Great

Crested Newts on the Training Area.

Thanks to my wife Mollie who has again put up with me disappearing at all sorts of odd hours and often at short notice and returning at unsociable hours.

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APPENDIX 1. Sites to be deleted from further surveys.

Site No.	Name	Site No.	Name
243	Pinnacle Lodge	290	Waterend Farm
264	West Tofts 1	295	Westmere Strip
286	Robin's Lodge 1	333	Bagmore 9
288	Robin's Lodge 3	336	Bagmore 11

APPENDIX 2. Amphibia recorded in the 1988-98 and 2010-2012 surveys.

G = Great Crested Newt; S = Smooth Newt; F = Common Frog; T = Common Toad.

No.	Grid Ref.	Name	1988-1998	2010-2012	No.	Grid Ref.	Name	1988-1998	2010-2012
0026	TL8791589510	Fowlmere	GSFT		266	TL8318993232	West Tofts 3		
0034	TL8779789180	Punchbowl	GSFT	GS	267	TL8264093364	West Tofts 4	S	G
009	TL8330491303	Lynford Cross	FT		268	TL8376493035	West Tofts 5		
010	TL8946187541	Dickey Pit	SFT	GS	269	TL8358493157	West Tofts 6		
011	TL8969687808	Pit block c53	GST	S	270	TL8353293237	West Tofts 7		
012	TL8998787767	Pit block c54	GSF	G	271	TL8993494811	Tottington 1		
013a	TL9006487928	Pit block c54	FT		272	TL9007294770	Tottington 2	G	G
013b	TL9006187913	Pit block c54		S	273	TL9013894735	Tottington 3	T	G
013c	TL9004087868	Pit block c54			274	TL9034294665	Tottington 4		GT
027	TL8740988238	Pit block c56	GST	S	275	TL9052294789	Waterhouse Plantation 1	G T	GFT
028	TL8853587556	Pit block c69	GSFT	S	276	TL9059294883	Waterhouse Plantation 2	G	
029	TL8860987635	Stronghold	F		277	TL9064394975	Waterhouse Plantation 2		GS
031	TL8605889439	Pit TA112			278	TL9058794980	Waterhouse Plantation 3		
039	TL8267490692	Lynford Cross Sand Pit	G	GS	279	TL9060395038	Waterhouse Plantation 4		
162	TL8262093881	Lynford Arboretum 1			280	TL9055295122	Waterhouse Plantation 5		G
240	TL8765689722	Fowlmere 1	GFT	G	281	TL9066395249	Tottington 5	T	G
241	TL8802789960	Fowlmere 2	GSFT	GSFT	282	TL9047495124	Tottington 6		SF
242	TL8933489670	Home Mere	GSFT	GS	283	TL9032494831	Tottington 7	SFT	
243	TL8941089347	Pinnacle Lodge			284	TL9010294945	Tottington 8	GT	
245	TL8435991874	West Tofts Mere	T		285	TL8798991588	Smokers Hole	GS	G
250	TL8503091077	Blacklands 1		S	286	TL8643496675	Robins Lodge 1		
251	TL8529391052	Blacklands 2	GT	G	287	TL8626096241	Robins Lodge 2		
252	TL8531091095	Blacklands 3	GS		288	TL8584696473	Robins Lodge 3		
253	TL8559990875	Blacklands 4	GS	G	289	TL8610394990	Stanford Water		
253a	TL8555790914	Blacklands 4			290	TL8606295311	Waterend Farm		
254	TL8555190997	Blacklands 5			291	TL8706795215	Sturston Carr 1		T
255	TL8597291146	Frog Hill Covert 1			292	TL8719895344	Sturston Carr 2		
256	TL8623091614	Frog Hill Covert 2			293	TL8714795944	Tottington Warren 1	GS	G
257	TL8635691622	Frog Hill Covert 3		GS	294	TL8744796328	Tottington Warren 2	GS	G
258	TL8610292106	Bagmore 1		G	295	TL8831196567	Westmere Strip		
259	TL8602592149	Bagmore 2		G	296	TL8857595906	West Mere 1	G	S
260	TL8626292094	Bagmore 3		GSFT	297	TL8872596006	West Mere	GS	G
261	TL8618092379	Bagmore Pit	GS	G	298	TL8908595886	West Mere 2		
262	TL8582792868	King Edward VIII 1	GS	G					
263	TL8581393011	King Edward VIII 2	G	G					
264	TL8321392926	West Tofts 1							
265	TL8317293144	West Tofts 2	S						

No.	Grid Ref.	Name	1988-1998	2010-2012
299	TL8926395498	St Andrews Church	GS	G
300	TL8914195597	Reed Fen		
301	TL8912996372	Clayacre Covert		
302	TL8873995285	Sturston Nursery 1	S	
303	TL8858595320	Sturston Nursery 2		
304	TL8846395276	Sturston Nursery 3	GST	G
305	TL8841495248	Sturston Nursery 4	S	G
306	TL8834795292	Sturston Nursery 5	GS	
307	TL8830595214	Sturston Nursery 6		
308	TL8830795188	Sturston Nursery 7		G
309	TL8824995185	Sturston Nursery 8		
312	TL8777189464	Fowlmere West	GT	G
315	TL8594090463	Stanta Sheep Dip	GST	G
318	TL8954594630	Mortimer's Farm 1	GST	G
319	TL8917494895	Mortimer's Farm 2		G
320	TL8921795083	Mortimer's Farm 3		S
321	TL8961794816	Mortimer's Farm 4		G
322	TL8968194849	Mortimer's Farm 5		
323	TL8973894969	Mortimer's Farm 6	G	G
328	TL8667191784	Bagmore Pit 4		G
329	TL8664591803	Bagmore Pit 5		
330	TL8657891959	Bagmore Pit 6		
331	TL8689891921	Bagmore Pit 7		
332	TL8673392012	Bagmore Pit 8		
333	TL8707092001	Bagmore Pit 9		
334	TL8647892524	Bull Run S		S
335	TL8671092190	Bagmore Pit 10		G
336	TL8631191982	Bagmore Pit 11		G

No.	Grid Ref.	Name	1988-1998	2010-2012
337	TL8632791913	Bagmore Pit 10	GS	G
338	TL9089394813	Waterhouse Plantation 6		
339	TL8858490788	Corkmere 1	G	
340	TL8851790755	Corkmere 2	G	
342	TL8989295524	Tottington Hall N		G
343	TL8990795466	Tottington Hall S	GST	GSF
344	TL8996395311	Tottington Hall 1		
345	TL9001795235	Tottington Hall 2		
346	TL9005395362	Tottington Hall 3		
347	TL9018795371	Tottington Hall 4		
348	TL9031595431	Tottington Hall 5	GT	G
349	TL9031695269	Tottington Hall 6		
350	TL8977095273	Tottington Hall 7		G
351	TL8963795276	Tottington Hall 8		
352	TL8946395225	Tottington Hall 9		
353	TL8933795239	Tottington Moat		
354	TL9057394525	Madhouse S	GT	G
355	TL8439192575	Fen Clump		G
356	TL8425392586	Brick Kiln 1	T	
357	TL8421492598	Brick Kiln 2		
358	TL8418692618	Brick Kiln 3		
359	TL8417892669	Brick Kiln 4		
360	TL8421392647	Brick Kiln 5		
361	TL8422192680	Brick Kiln 6	G S	G
362	TL8424492609	Brick Kiln 7		
363	TL8468492324	Young Salamanca 1		
364	TL8471292326	Young Salamanca 2		
365a/b	TL8490592405	Young Salamanca 3		
365c	TL8488192395	Young Salamanca 3		
365d	TL8487492409	Young Salamanca 3		
365e	TL8485892401	Young Salamanca 3		
365f	TL8483092400	Young Salamanca 3		

No.	Grid Ref.	Name	1988-1998	2010-2012
366	TL8537992434	Woodcock Corner 1		
367	TL8536292473	Woodcock Corner 2		S
368	TL8484592989	Great Carr 1	T	
369	TL8514592928	Great Carr 2	T	G
370	TL8529494961	Sandy Hill	G	G
371	TL8454794583	Parkpond Covert		
372	TL8456694805	Parkpond 2		
373	TL8403294502	Warbeck		S
374	TL8486095191	Mill Hill		
375	TL8406894955	River Crossing		
376	TL8491696560	Bodney Warren		S
377	TL8646497602	Maggotbox		
378	TL8357495259	Bridge Carr 1		
379a/b	TL8362495362	Bridge Carr 2		
380	TL8379495062	Bridge Carr 3		
381	TL8387792667	Lavender Walk	GS	G
382	TL8405192774	Brick Kiln 8	GS	G
383	TL8345593696	West Tofts Coverts		
384	TL8329993846	Lynford Forest		
385	TL8419993369	West Tofts 1		
386	TL8452393170	West Tofts 2		
387	TL9041295183	Tottington Hall 10	S	GT
388	TL8524691113	Blacklands 6		S
389	TL9010995335	Tottington Hall 110		
390	TL8556295161	Stanford Carr		
391	TL8754294962	Sturston Hall 1	G	G
392	TL8780595020	Sturston Hall 2	G	
393	TL8805695053	Sturston Carr 3		G
395	TL8871795642	West Mere 3		
396a	TL8857295657	West Mere 4		G
396b	TL8861095691	West Mere 4		
397	TL8869595770	West Mere 5		
398	TL8937595638	St Andrews Church 2		
399	TL8928295688	St Andrews Church 3		
400	TL8920295760	St Andrews Moat	G	

No.	Grid Ref.	Name	1988-1998	2010-2012
401	TL8897595182	Sturston Nursery 9	S	
402	TL8718794821	Sturston Carr 4		
403	TL8765894811	Sturston Hall 3		GT
404	TL8990595373	Tottington Hall 11		FT
405	TL8992695359	Tottington Hall 12		FT
406	TL8982095108	Tottington Hall 13		GSFT
407	TL8972795363	Tottington Hall 14		
408	TL8919187777	Croxton C51		
409	TL8935587777	Croxton C52		
411	TL9025295272	Tottington Hall 15		GT
412	TL9018495293	Tottington Hall 16		
413	TL9015295290	Tottington Hall 17		
414	TL9057795133	Waterhouse Plantation 6		
416	TL8539591106	Blacklands 8		
417	TL8538691026	Blacklands 9		
418	TL8546591059	Blacklands 10		
419	TL8590495008	Waterend Farm 2		
420a	TL8652095224	Lake Plantation		
420b	TL8653595193	Lake Plantation		GS
421	TL8465594622	Parkpond Covert 2		
422	TL8868095840	West Mere 6		
423	TL8817295118	Sturston Carr 5		
424	TL8706694739	Sturston Carr 6		
425	TL8699294690	Sturston Carr 7		
426	TL9035495210	Tottington 18		
427	TL9018795413	Tottington 19		GT
428	TL8571892363	Bagmore Pit 10		

G = Great Crested Newt; S = Smooth Newt; F = Common Frog; T = Common Toad.

Grasshoppers (Orthoptera) of Great Yarmouth

Tim Gardiner

Introduction

Consulting David Richmond's atlas of Norfolk's Orthoptera (Richmond 2001), it appeared that the group was significantly under-recorded in the extreme east of the county, particularly in Great Yarmouth Borough. This is probably due to the large size of Norfolk, making it extremely difficult to cover adequately the county with the limited number of recorders which groups such as Orthoptera seem to attract. Therefore, despite the sterling efforts of active recorders, some areas are inevitably under-recorded during county surveys.

Great Yarmouth has a history of Orthoptera recording, with the Pagets observing several species in the area in the 1800s such as the Dark Bush-cricket *Pholidoptera griseoptera* and Great Green Bush-cricket *Tettigonia viridissima*. Ted Ellis, writing in 1934, stated that only five species (including the two previously mentioned) had been recorded in the Great Yarmouth area. In a recent assessment of Norfolk Orthoptera (including records submitted for Richmond's 2001 atlas) 13 species were believed to be present in Great Yarmouth Borough (Richmond 2011). However, without a rigorous systematic survey of the Orthoptera of the Borough it is difficult to make any accurate description of the status of species in east Norfolk. It is the aim of the current paper to provide an assessment of the value of Great Yarmouth Borough for Orthoptera and to describe their habitats and conservation.

Distribution survey

The survey area was defined as Great Yarmouth Borough (with the political boundary used as the limit of survey).

Great Yarmouth Borough is approximately 182 km² in area, and for the purposes of recording Orthoptera, is covered by 59 tetrads (2 x 2 km grid squares). To ensure a systematic survey of the area, every single tetrad was visited at least once from 2008-2011 during the active Orthoptera season from May to October. Visiting every tetrad ensured that the survey was relatively unbiased and all areas were covered during recording. A range of methods were used to record Orthoptera, but quite commonly hearing the stridulation (or song) was enough to confirm the presence of most of the commoner species. However, for determination of certain species, it was necessary to capture individuals for inspection of their distinctive characteristics (e.g. for *Conocephalus* species, separation was possible between *C. discolor* and *C. dorsalis* by inspection of the ovipositor). Beating of trees was undertaken using a tray and pole to dislodge Oak Bush-crickets *Meconema thalassinum* and Speckled Bush-crickets *Leptophyes punctatissima*, and was mainly concentrated in the largest wooded area of the Borough, Waveney Forest.

Habitat survey

One obvious weakness of the distribution survey was that favourable habitats were selected in each tetrad to maximise the chances of finding Orthoptera. The length of time spent in each tetrad and habitat varied, with much more effort being spent recording in Waveney Forest due to the need to document its insect fauna because of the potential threat from gravel extraction (Gardiner 2010b). Therefore, a fixed-time survey was undertaken in several different habitats during the weekend of 6-7th August 2011. The area to the north-west of Great

Table 1. Number of recorded sites and tetrads for species of Orthoptera in the Great Yarmouth area in the 2008-11 survey and their likely status.

Family/species	Recorded sites	Tetrad records	Likely status
Acrididae (grasshoppers)			
<i>Chorthippus albomarginatus</i>	80	50	Widespread
<i>Chorthippus brunneus</i>	107	56	Widespread
<i>Chorthippus parallelus</i>	26	21	Widespread
<i>Myrmeleotettix maculatus</i>	17	11	Localised
<i>Omocestus viridulus</i>	12	6	Localised
<i>Stenobothrus lineatus</i>	2	2	Rare
Tetrigidae (groundhoppers)			
<i>Tetrix subulata</i>	0	0	Rare, under-recorded?
<i>Tetrix undulata</i>	1	1	Rare, under-recorded?
Tettigoniidae (bush-cricket)			
<i>Conocephalus discolor</i>	18	15	Localised
<i>Conocephalus dorsalis</i>	5	4	Scarce
<i>Leptophyes punctatissima</i>	3	3	Rare, under-recorded?
<i>Meconema thalassinum</i>	2	2	Rare, under-recorded?
<i>Metrioptera roeselii</i>	13	10	Localised
<i>Pholidoptera griseoaptera</i>	31	23	Widespread
<i>Tettigonia viridissima</i>	1	1	Rare
TOTAL	318	205	

Total number of tetrads in Great Yarmouth Borough = 59

Yarmouth was selected for the survey as four habitats were present in close proximity: arable field margins, churchyards, fen and marshes, and roadside verges. Ten minutes was spent searching vegetation in a 10 x 10 m plot at each of the 25 survey sites to determine the number of species present. Acoustic monitoring and visual observations were used to ascertain the species richness of each plot, which would be comparable between different sites and habitats. The mean species richness per plot for the four different habitat types was then compared to ascertain the most important Orthoptera sites.

Species accounts

The following are brief descriptions of the

occurrence of the 14 species which have been recorded in the Great Yarmouth area by the author (Table 1). An additional species, Slender Groundhopper *Tetrix subulata*, has been recorded, but was not detected during the 2008-2011 survey, suggesting it is rare in the Borough. What is notable is that of the 14 species, only four could be considered widespread (Table 1). The widespread distribution of the commonest species, Field Grasshopper *Chorthippus brunneus*, probably indicates its preference for the well-drained, sandy soils which predominate throughout the area. Several species are localised, including the Common Green Grasshopper *Omocestus viridulus* and Mottled Grasshopper *Myrmeleotettix maculatus* or rare (Stripe-

winged Grasshopper *Stenobothrus lineatus*, and both groundhoppers). The rarity of many species is due to their specialised habitats which are scarce in the Great Yarmouth area. For example, the Mottled Grasshopper is an insect of habitats with plenty of bare ground, such as dry heathland or sand dunes. Heathland is scarce in the Borough; the only sizeable examples are present in the Belton Common and Waveney Forest area. Even here the heathland is much degraded due to unmanaged scrub encroachment or planting with conifers as in Waveney Forest. The extensive sand dunes north of Great Yarmouth which run towards Winterton are the main stronghold of this grasshopper.

How does Great Yarmouth Borough compare with the rest of Norfolk? Of the 16 native species that Richmond (2001) gives as recorded in the county since 1981, only the Bog Bush-cricket *Metrioptera brachyptera* has yet to be recorded in Great Yarmouth Borough. The nearest known populations are in the Broads and at Cawston Heath. Some suitable bog habitat is present in Waveney Forest where Purple Moor-grass *Molinia caerulea* abounds, but as yet the Bog Bush-cricket has not been observed.

In other areas of Norfolk, the number of species of Orthoptera recorded is much lower. For example, Richmond (2001) notes the high number of species recorded at Buxton Heath (13 species), Roydon Common (12 species) and Santon Warren (12 species), which trail behind the total of 15 species observed in the Belton and Waveney Forest area of Great Yarmouth. This area of east Norfolk, therefore, deserves special mention with regard to Orthoptera.

Acrididae (grasshoppers)

Lesser Marsh Grasshopper *Chorthippus albomarginatus*

This grasshopper is one of the few widespread orthopterans in the Great Yarmouth area. It is common in a range of

habitats, from coastal sand dunes, marshy grassland and roadside verges, to the disused railway line which runs through Gorleston. It can also be found in pastures and meadows on farmland, an attribute which means that it is capable of sustaining populations in the wider countryside where other species are noticeably absent (e.g. the Common Green Grasshopper and Mottled Grasshopper). The Lesser Marsh Grasshopper is also commonly found on the grassy verges of the A12, A143 and A149; these green corridors may allow it to disperse throughout the area ensuring that there are no obvious conservation threats to this range-expanding grasshopper in the immediate future.

Field Grasshopper *Chorthippus brunneus*

The Field Grasshopper is by far the most commonly encountered species in the survey area. It is a species of dry habitats with plenty of bare earth, conditions frequently encountered on the sandy soils which predominate in the Borough. The grasshopper is found in gardens (including flowerbeds in the garden of the author's parents), dry heathland in Waveney Forest, coastal sand dunes, roadside verges (with Lesser Marsh Grasshopper) and in farmland habitats. An interesting feature of the distribution of this grasshopper on the coast is the range of habitats it will tolerate, from sand dunes at Hopton, Great Yarmouth's North and South Denes and Winterton, to more intensively managed grasslands such as the mown amenity swards on the cliffs of Gorleston seafront. Its tolerance of such a range of grassland conditions, including short swards (grass height less than 10 cm), means it is not in any need of specific conservation action.

Meadow Grasshopper *Chorthippus parallelus*

A widespread grasshopper nationally that was suspected to be rare in east Norfolk, where the Lesser Marsh Grasshopper was apparently the more abundant of the two

species (Richmond 2001). It was believed that this flightless grasshopper had not been able to colonise areas of former marine transgression in the extreme east of Norfolk. However, in the current survey, Meadow Grasshopper was found to be relatively widespread, although not as abundant as the Field and Lesser Marsh Grasshoppers (Table 1). It occupied a range of habitats including marshy grassland, dry heathland, roadside verges and sand dunes. It is another grasshopper which benefits from grassland habitats on roadside verges, being found beside the A12, A149 and A1064.

Mottled Grasshopper *Myrmeleotettix maculatus*

A more localised grasshopper than the three *Chorthippus* species, confined to dry habitats with plenty of bare earth. Apparently a sedentary grasshopper, it only occurred in this survey in sand dunes and dry heathland. The dry heathland sites were restricted to Belton Common and Waveney Forest, where the grasshopper was relatively localised and its open ground habitat appeared to be threatened by unchecked scrub encroachment in several localities. An interesting feature of the grasshopper's occurrence in Waveney Forest was its response to felling of conifers over an eight hectare area; it appeared to colonise the clear-felled open habitat almost immediately due to the warm microclimate and abundance of exposed soil. It also survived a fire in the Forest and at Belton Common in spring 2011, a high proportion of black (melanic) and dark brown individuals being found on the recently burnt ground (89% of grasshoppers counted were without any green colouration in Waveney Forest in summer 2011). The author believes that the dark brown and black forms in a population may be at a substantial advantage on the burnt earth of the fire sites, than lighter coloured forms (with green on them) which may get picked off by avian predators.

Another interesting factor in the distribution of this grasshopper in the Great Yarmouth area is its occurrence in coastal habitats. It occurred in well-established sand dunes with abundant Marram Grass *Ammophila arenaria* behind wooden revetment sea defences at Hopton-Gorleston, although its presence was not noted at Corton to the south or on the amenity grassland swards of the cliffs on Gorleston seafront to the north. The Mottled Grasshopper was absent from the South Denes in Great Yarmouth, where there was little sand dune habitat dominated by Marram Grass, only to reappear on the dunes of the North Denes and be present all the way north to Caister Beach. The grasshopper was also found on the superb Winterton sand dunes.

Its sheer abundance in suitable sand dune habitats on the North Denes and at Winterton mean no conservation efforts are needed for this grasshopper on the coast. However, its inland populations at Belton Common and Waveney Forest are threatened by scrub encroachment, and in the case of the latter site, destruction of its habitats by a proposed gravel pit. Fortunately, the battle to save Waveney Forest has so far been successful and it is unlikely that the proposals will get the go-ahead, due in part to the high conservation value of the Forest.

Common Green Grasshopper *Omocestus viridulus*

Another localised grasshopper, probably due to its preferred damper habitats being rare on the well-drained, sandy soils of the Great Yarmouth area. However, where the soil is sufficiently damp, such as at Lound Lakes and on wet heathland and bogs in Waveney Forest, the Common Green Grasshopper can build up fairly large populations. Rough grassland on the Caldecott Hall Golf Course also had a population of Common Green Grasshoppers where it adjoins Sandy Lane and Belton Common. The only other known site is in the wet dune slacks at Winterton. It is likely that the dry

climate of east Norfolk, combined with the well-drained sandy soils, restrict the occurrence of this grasshopper as has been found in Essex (Gardiner 2010c). There is very little wet grassland left on farmland in the Great Yarmouth area, restricting this grasshopper to unimproved meadows at Lound Lakes where it has been recorded among Common-spotted Orchids *Dactylorhiza fuchsii*. A threat to the remaining sites of the Common Green Grasshopper is from scrub encroachment in Belton Common and Waveney Forest. The future of this grasshopper in the area is by no means assured given the gravel extraction proposals for Waveney Forest.

Stripe-winged Grasshopper *Stenobothrus lineatus*

A recently discovered grasshopper in Waveney Forest (Gardiner 2012a), predominantly observed on localised patches of acid grassland and dry heathland with ant hills. It is not known whether the species has been overlooked in the Forest or it has colonised the area during a recent range expansion. It has not been found at any other sites in the survey and must be considered a rare species until evidence of occupancy outside of Waveney Forest is obtained. Like other species (e.g. Mottled Grasshopper) it is threatened by the proposals for gravel extraction in the Forest and may be susceptible to scrub encroachment of its open habitats as it is distinctly localised due to the extensive planting of conifers. However, recent felling of conifers may aid expansion of its range in the Forest.

Tetrigidae (groundhoppers)

Slender Groundhopper *Tetrix subulata*

The author did not record this groundhopper in the survey, although David Richmond has provided records from five sites in the Borough surveyed between 1984-2000. Richmond (2001) notes that it is often found on marshy ground which has been grazed by cattle, the poached areas

providing ideal habitat. There are marshes in the Burgh Castle area adjoining Breydon Water, but these are largely inaccessible (no public footpaths are present). Therefore, it is possible that populations of Slender Groundhopper are undetected in the area.

Common Groundhopper *Tetrix undulata*

Only one site was recorded for this groundhopper, at Belton Common. Despite extensive searches in nearby Waveney Forest no populations were observed there. Therefore, the Common Groundhopper, along with the Slender Groundhopper, should be considered rather rare in the Great Yarmouth area. However, David Richmond has provided records from three sites in the Borough surveyed between 1984-1989, which suggests that the groundhopper, although seemingly very rare in the present survey, may be more widespread.

At Belton Common its lichen heath habitat is threatened by unchecked scrub encroachment, the main culprit being Gorse *Ulex europaeus*. A fire at Belton Common in April 2011 devastated a fairly large area of gorse scrub. Far from being a threat to the Common Groundhopper, the ground underneath the burnt canopy is regenerating with Ling *Calluna vulgaris* and Sheep's Sorrel *Rumex acetosella*. Therefore, this fire may have helped to keep scrub encroachment in check for a while longer at Belton Common. The Common Groundhopper appears to respond in a similar way to fire as the Mottled Grasshopper. Melanic individuals are commonly found on blackened, burnt ground where they are at an advantage over lighter colour forms being camouflaged against predation. This form of natural selection, which ensures effective survival in fire-ravaged habitats for the Common Groundhopper, has been described in Gardiner (2012b).

Tettigoniidae (bush-crickets)

Long-winged Conehead *Conocephalus discolor*

This range-expanding bush-cricket was

first recorded in Norfolk in 2000 (Richmond 2001). It has been recorded at 18 sites during the current survey and should be considered localised in the Borough. It occupies a range of habitats from roadside verges and sand dunes to dry heathland at Belton Common. It is also found in tall grassland beside the river at Waveney Forest. To the north-west of Great Yarmouth it has been recorded on the grassy verges of several rural roads and also along the A149, suggesting it has been using tall, unmown grassland to disperse throughout the area during its range expansion. It is likely that the Long-winged Conehead will become more frequent in Great Yarmouth Borough in the coming years, particularly if the pattern of warmer springs and summers since 2000 continues.

Short-winged Conehead *Conocephalus dorsalis*

The Short-winged Conehead appears much scarcer than the range-expanding Long-winged Conehead. The author only found it at five sites in four tetrads. Its main habitats were the cliffs and sand dunes at Hopton-Gorleston, riverside grassland at Waveney Forest, and dry heathland at Belton Common. Interestingly, it was not found on the dunes at Winterton or on the North and South Denes in Great Yarmouth, although this may be due to it being overlooked because of its cryptic behaviour. Short-winged Coneheads often flatten their bodies against grass stems and extend their hind limbs when approached by an observer. This cryptic behaviour is often accompanied by movements of the individual around a grass stem so as to keep the perch between themselves and the observer (Gardiner & Hill 2006a). David Richmond noted its presence at nine sites during the period 1989-2007, which suggests that the species, although seemingly scarce, may have been under-recorded slightly in the present survey. Due to its apparent scarcity in the area it may be vulnerable to scrub encroachment at Belton Common,

and to gravel extraction plans for Waveney Forest.

Speckled Bush-cricket *Leptophyes punctatissima*

This bush-cricket of scrubby and woodland habitats appears to be rather rare in the Great Yarmouth area and was only recorded from scrub in Belton and Waveney Forest. This may be because there are few extensive areas of woodland, and hedgerows on farmland tend to be sparse due to the large fields. A beating tray was used to collect bush-crickets dislodged from branches with a pole. This technique is quite effective for recording nymphs of this insect, which reside nearer the ground in hedgerows in May and June, than the adults, which are often found higher in the canopy later in the summer. In a study by Patricia Ash and David Robinson at Wittenham Clumps in Oxfordshire, adult Speckled Bush-cricket males have been recorded singing from 3.4–9.6 m above ground level, which makes them totally unsuitable for beating surveys (Patricia Ash, pers. comm.). Therefore, the limited time window for recording nymphs of the Speckled Bush-cricket, combined with the restricted amount of beating undertaken by the author, suggests that the insect may be more frequent in Great Yarmouth than the survey indicates. David Richmond provided records from seven sites obtained from 2000-2011 using a bat detector, suggesting that the bush-cricket is not as rare in the Borough as the author's study has indicated. The use of a bat detector is recommended in future studies (call frequency 40 kHz) to obtain a more complete picture of the distribution of the Speckled Bush-cricket in the Borough.

Oak Bush-cricket *Meconema thalassinum*

An apparently rare insect of scrub and woodlands, inhabiting the same habitats as the Speckled Bush-cricket. The lack of woodland cover in Great Yarmouth may be a limiting factor, particularly as it is believed that the Oak Bush-cricket prefers ancient

woodlands and hedgerows (Gardiner 2010a), which are rare in the Borough. The scarcity of woodland is reflected by the fact that only 53 hectares (0.5 km²) of woodland habitat is found within the 189 ha of Local Wildlife Sites (LoWS) in the Borough. The only sites from which the Oak Bush-cricket was recorded in this survey were Waveney Forest (although it was only beaten from native trees and not planted conifers) and the wooded slopes of Burgh Castle. Similar to the Speckled Bush-cricket, the limited time spent beating trees in this survey may have meant the Oak Bush-cricket was under-recorded in the area. No beating was undertaken in the wet woodlands of the Trinity Broads to the north-west of Great Yarmouth and further beating should be targeted here.

Roesel's Bush-cricket *Metrioptera roeselii*

This bush-cricket was first recorded in Norfolk in 1997 (Richmond 2001) after a national range expansion since the 1970s. Its expansion in range has in part been due to warmer summers and increased availability of tall grassland on farmland since the introduction of environmental schemes promoting the creation of grass field margins around cropped fields (Gardiner 2009b). Land set-aside from cropping has also aided its expansion in range from the south-east coast of Essex and Kent (Gardiner 2009a). Similar to the Long-winged Conehead this bush-cricket is currently localised in the Borough, occurring in tall grassland habitats on roadside verges and around the edges of arable fields. It also occurs by the river at Waveney Forest and in dry heathland at Belton Common. It is likely that Roesel's Bush-cricket will become more frequent in Great Yarmouth Borough in the coming years, particularly if the pattern of warmer springs and summers since the millennium continues. The occurrence of the macropterous form (f. *diluta*) may be crucial in the future range expansion of this bush-cricket (Gardiner 2009b).

Dark Bush-cricket *Pholidoptera griseoptera*

Despite the apparent scarcity of other species of woody habitats (e.g. Oak and Speckled Bush-crickets), the Dark Bush-cricket is one of the few widespread orthopterans in the Borough. It was easy to detect due to its stridulation which was most commonly heard during the early evening in hedgerows, churchyard scrub (in Billockby ruins, Great Yarmouth Cemetery and Thurne churchyard) and tall grassland on roadside verges and around the edges of arable fields. It was also one of the only orthopterans (the other being the Field Grasshopper) to be found in urban habitats, such as scrub in the James Paget Hospital grounds.

Great Green Bush-cricket *Tettigonia viridissima*

A rare bush-cricket in Norfolk (Richmond 2001), mainly recorded from the Reedham area just to the west of the River Waveney. Within Great Yarmouth Borough, Richmond noted that there were occasional records from Belton and Burgh Castle in 2005. Surveys in 2011 on the flood defence which runs to the north of the Roman ruins of Burgh Castle revealed a small population of the Great Green Bush-cricket on the slopes of the earth embankment and along the borrowdyke (or soke dyke) edge where uncut Common Reed *Phragmites australis* predominated. Sixteen stridulating males were heard in a 1 km long walk along the footpath on the crest of the flood wall in early September 2011. The Great Green Bush-cricket is more frequent on sea walls on the Suffolk and Essex coasts and is decidedly rare to the north of Norfolk in the UK. Therefore, the seemingly established Burgh Castle population is extremely important in the conservation of this large bush-cricket in Norfolk.

Extinct species

Two species which once graced the countryside surrounding Great Yarmouth have sadly not been seen for over a century.

It is almost certain that these insects have become extinct in the Borough, although it is remotely possible that populations may remain undetected.

Mole Cricket *Gryllotalpa gryllotalpa*

This is a large and impressive insect, which is rarely seen in the wild in the UK. Richmond (2001) noted that it was recorded in Caister in the 1800s, but there have been no further observations of Mole Crickets in the Great Yarmouth area. Mole Crickets have the ability to swim and burrow underground with their powerful front, mole-like, legs. I have only ever come across one dead specimen (*Gryllotalpa* sp.), brought to me by a colleague from the Environment Agency (EA), who found one in a smashed Christmas tree bauble that was made in China. It seems these imported specimens, as Richmond (2001) suggests, are the main source of casual reports of Mole Crickets, with the discovery of genuine wild populations a rarity in the modern countryside.

Large Marsh Grasshopper *Stethophyma grossum*

There is a tantalising record of the nationally rare Large Marsh Grasshopper *Stethophyma grossum* from Belton Bog in 1911 (Richmond 2001). Unfortunately, this grasshopper appears to have become extinct in Norfolk, although it is just possible that it may remain in boggy areas at Belton Common or Waveney Forest. This large grasshopper is included in the Red Data Book due to its rarity.

Habitat survey results

The predominant land use in the Great Yarmouth area is arable farming, with large fields, few hedgerows and little woodland. Most of these fields are cropped right up to the edges and intensively managed using chemical fertilisers to increase yields and pesticides to eradicate insects and weeds. Therefore, the potential value of arable land for Orthoptera is low (Cherrill 2010),

with grasshoppers being unable to sustain populations due to annual ploughing destroying egg-pods of species such as the Meadow Grasshopper which are laid in the soil (Gardiner 2007). However, grass margins at the edge of arable fields established under the government's Environmental Stewardship Scheme (ESS), whereby farmers are paid to create buffer habitats, are important for Orthoptera which would otherwise not survive on agricultural land. In arable farmland to the north-west of Great Yarmouth, these grass margins can support up to six species of Orthoptera and have comparable numbers of species to roadside verges (Table 2). Grass field margins (two and six metre wide) have been found to be important in the range expansion of species such as the Lesser Marsh Grasshopper, Long-winged Conehead and Roesel's Bush-cricket in Essex (Gardiner *et al.* 2008; Gardiner 2009a). The increased availability of grassland on farmland since the introduction of the Countryside Stewardship Scheme (CSS was fore-runner to the ESS) in 1991 is thought to be partly responsible for the spread of these species, which was initiated by increasing air temperatures during spring and summer as a result of climate change. The occurrence of the macropterous (long-winged) form of Roesel's Bush-cricket is believed to be important in the range expansion of this bush-cricket (Gardiner 2009b).

Roadside verges are also useful linear habitats for the dispersal of Orthoptera in Great Yarmouth, particularly in areas of intensive farming. The aforementioned range-expanding species were also recorded on roadside verges, which had comparable numbers of species to arable grass margins (Table 2).

One interesting comparison from the survey of habitats to the north-west of Great Yarmouth was how species-poor churchyards generally were (Table 2). Only four species were observed, including

Table 2. Mean number of Orthoptera species recorded from four habitat types to the north-west of Great Yarmouth.

Habitat	No. plots sampled	Mean no. species/plot	Species recorded*
Roadside verges	13	3.9	Ca, Cb, Cd, Cp, Mr, Pg
Arable grass margins	3	3.7	Ca, Cb, Cd, Cp, Mr, Pg
Fen and marsh	3	3.0	Ca, Cb, Cd, Cp, Pg
Churchyards	6	1.3	Ca, Cb, Cp, Pg

*Ca = *Chorthippus albomarginatus*, Cb = *Chorthippus brunneus*, Cd = *Conocephalus discolor*, Cp = *Chorthippus parallelus*, Mr = *Metrioptera roeselii*, Pg = *Pholidoptera griseoaptera*.

the range-expanding Lesser Marsh Grasshopper. The other range-expanding species, Long-winged Conehead and Roesel's Bush-cricket, were noticeably absent from churchyards, probably because most of them had very little tall grassland due to regular summer mowing regimes eradicating suitable Orthoptera habitats. Uniformly short swards (less than 10 cm in height) are well known for their unsuitability for *Chorthippus* grasshoppers (Gardiner *et al.* 2002), perhaps due to their absence of cover from avian predators and excessively high microclimatic temperatures with no shade habitat (Gardiner & Hassall 2009). In only two churchyards, Thurne and Runham, were there conservation areas with tall unmown grassland and scrub suitable for Orthoptera. The author suggests that conservation areas should be introduced into as many rural churchyards as possible; the resulting tall unimproved grassland would be highly beneficial for the more common Orthoptera.

The final habitats surveyed were fen and marsh vegetation, typically composed of Common Reed or Sedges *Carex* spp. with scattered species such as Water Mint *Mentha aquatica* and Wild Angelica *Angelica sylvestris*. This habitat was comparatively rare in the area except around Filby and Ormesby Broads. In a Common Reed dominated stand at Repps, four species were observed including the Long-winged Conehead. Therefore, tall-herb fen and

marshes can support important Orthoptera populations. The visit to Filby Broad on 7 August 2011 provided the most exciting moment of the survey, when the bird hide was discovered on fire. The fire brigade turned up promptly and extinguished the fire in what remained of the hide. Who said studying insects was boring!

Threats and conservation

The survey has highlighted the importance of the Waveney Forest heathlands and adjoining riverside habitats. Indeed, the author first started recording Orthoptera in the Forest in 2008 due to the threat posed by gravel extraction proposals, only to expand the survey in future years to cover other areas of the Borough. The total of 13 species recorded (15 if you include the Slender Groundhopper and the Great Green Bush-cricket recorded before the survey commenced) in Belton and Waveney Forest combined outlines the importance of the Forest area both in a Great Yarmouth and a Norfolk context, where such a high number of species is unusual. The destruction of the Forest's heathland by gravel extraction would probably lead to increasing scarcity of species such as the Common Green Grasshopper and may eradicate the newly discovered Stripe-winged Grasshopper (Gardiner 2012a). If the Forest survives the threat of gravel extraction, and it may well as Norfolk County Council (NCC) have twice listed the site as unsuitable for mineral working, then the recent felling

of eight hectares of conifers may allow more Orthoptera-friendly open habitat to become established until the shade of replanted trees becomes an issue once more in decades to come. The warm microclimate and regenerating patches of dry heathland in felled areas should be ideal for species such as the Mottled Grasshopper.

Scrub encroachment through lack of habitat management is a threat to Orthoptera of heathlands at Belton Common and Waveney Forest, particularly to species such as the Common Groundhopper, Mottled Grasshopper, and Stripe-winged Grasshopper, which have localised populations. It seems that only accidental fires are holding back gorse encroachment at Belton Common. If unchecked the expansion of scrub cover will lead to the loss of acid grassland and heathland, spelling disaster for Orthoptera.

Outside of the Waveney Forest area, threats exist to Orthoptera from general management of the countryside, for example, agricultural 'improvement' of pastures and meadows by application of chemical fertilisers to increase grass yields, which creates swards too tall and dense for grasshoppers in particular (Gardiner 2009a). Very heavy grazing of pastures and midsummer mowing in hay meadows can also be extremely damaging to Orthoptera by the creation of uniformly short swards (< 10 cm in height) unsuitable for grasshoppers in particular, effectively eradicating some species such as the Meadow Grasshopper, from farmland (Gardiner *et al.* 2002). Mowing during July and August in hay meadows can lead to mortality of adult grasshoppers (Gardiner & Hill 2006b) and ploughing of arable fields right up to the edges effectively destroys any egg-pods laid by grasshoppers in the soil (Gardiner 2007). Therefore, conservation measures on arable farmland in the Borough should revolve around the promotion of more environmentally sustainable farming practices such as providing grass strips

(commonly two or six metres wide) around the edges of cropped fields as part of government funded agri-environment schemes (such as the ESS; Gardiner *et al.* 2008). These grass strips can provide the tall grassland needed by range-expanding bush-crickets such as the Long-winged Conehead, which is otherwise absent from arable farmland.

General tidying up of churchyards by regular mowing throughout the summer, eradicating the tall grassland needed by many orthopterans (such as Roesel's Bush-cricket), should be resisted where possible. The benefits of a conservation area of tall unmown grassland and scrub for Orthoptera and other insects (e.g. butterflies) cannot be overstated and it does not necessarily have to be very large (e.g. grassland around older graves could be left unmown throughout the spring and summer). Research from Essex indicates that novel techniques such as grasshopper strips can be introduced where areas of tall grassland could be regarded as 'unsightly' (Gardiner *et al.* 2011).

A large area of grassland is present around the Roman ruins of Burgh Castle; because of this the numbers of grasshoppers and bush-crickets can be impressive before the annual hay cut. A total of nine species were recorded from the Burgh Castle area due to the diverse range of habitats present, from long, uncut grassland on flood embankments, woodland and scrub cover on the southern slopes of the Castle ruins, and reedbeds along dykes. Outside of Waveney Forest, Burgh Castle is the most species-rich area for Orthoptera in Great Yarmouth.

Despite facing threats, the outlook for Great Yarmouth's Orthoptera does seem favourable as green corridors such as roadside verges and grass field margins should allow the more common Orthoptera to maintain populations in the Borough, while assisting the range-expanding

species (e.g. Long-winged Conehead) in their continued spread. Opposition to plans for gravel extraction in Waveney Forest is widespread (over 27,000 people have signed a recent petition against the plans) and it seems that NCC will finally rule out mineral working of this important site for conservation. The Forest is not only valuable for its Orthoptera but also for dragonflies and butterflies (Gardiner 2008; 2010b).

Future surveys

Due to the absence of any thorough beating surveys in the Borough, the author suggests that more time could be spent looking for the Oak and Speckled Bush-crickets using this method. A bat detector could also be used to record the latter species as demonstrated by David Richmond with some success. No beating was undertaken in the wet woodland of the Trinity Broads to the north-west of Great Yarmouth and further surveys could focus on this area to determine if arboreal species are present.

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Marriott's Way County Wildlife Sites

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Introduction

Although it is only a small part of this popular 26 mile cycling and walking route, the roughly three-mile long section of the Marriott's Way within Norwich is, from a wildlife viewpoint, one of the most interesting and varied. This section of the Marriott's Way, between the Barn Road roundabout and Hellesdon, closely follows the valley of the River Wensum. This part of the valley is a green corridor that stretches right into the heart of Norwich. It is a real biodiversity hotspot, containing several County Wildlife Sites (CWS): Mile Cross Marsh (part of Norwich City Council's Wensum Valley Local Nature Reserve) and the Sweet Briar Meadows SSSI, as well as the river itself, part of which is a Special Area of Conservation.

Much of the Marriott's Way itself is also designated as County Wildlife Sites - CWS 1467 includes Train Wood and part of the route immediately to the west, while CWS 1453 takes in a large mosaic of young woodland, scrub and species-rich grassland with bare ground on the northern side of the old railway route stretching from Sloughbottom Park to Sweet Briar Road and beyond to Hellesdon.

Much of CWS 1467 consists of wet woodland, most of which has grown up on the site of an old railway station and depot. There is a pond within the woodland, as well as some 'mini glades' adjacent to the Marriott's Way that are cut annually to encourage butterflies and other insects. The woodland itself has been managed on a 'low maintenance' basis, with both fallen and standing dead wood being left for wildlife so far as safety considerations permit. Unsurprisingly, the abundant insect food attracts a wide range of small

birds, especially tits and warblers, as well as larger species such as Song Thrush, Jay, Great Spotted Woodpecker and Sparrowhawk.

CWS 1453 is very different in character. From a biodiversity viewpoint, the key interest here is the slightly acid, dry grassland that contains a diverse range of wildflowers including Wild Carrot *Daucus carota*, Red Bartsia *Odontites vernus*, Agrimony *Agrimonia eupatoria*, Field Scabious *Knautia arvensis* and Bee Orchid *Ophrys apifera*, together with taller species such as Broom *Cytisus scoparius* and Great Mullein *Verbascum thapsus*. The wildflowers, together with the adjacent patches of dry, bare ground, attract many insects, especially butterflies, hoverflies and solitary bees and wasps. Again, management of the area has been mostly low key, with the main aim being to prevent the existing grassland areas being overgrown with scrub; the existing woodland areas will be retained. There is some rabbit grazing on the grassland areas, and sporadic 'unofficial' grazing by horses, but every year the grassland areas are also cut and raked off by volunteers.

In the long term, it is hoped to enter CWS 1453 into the Higher Level Stewardship agri-environment scheme, which should provide greater recognition and more resources for managing this area.

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Vascular plants

County Wildlife Sites 1467 and 1453 were surveyed for vascular plants in May, August and September 2011. Some 185 species were noted in CWS 1467 and 235 in CSW 1453.

Obviously just a few of these species can be mentioned in this brief report.

CWS 1467 provides a range of habitats between the bank of the River Wensum and the course of the old railway line, now Marriott's Way, which follows the edge of the City Trading Estate for much of its length. Train Wood occupies most of the area between. At the western end of the site a large colony of Butterbur *Petasites hybridus* was noted and further along the river bank to the east, several plants of Green Figwort *Scrophularia umbrosa* were seen. In wetter parts of Train Wood itself several fen species were present, including Tufted-sedge *Carex elata*. The wood is quite dense and shady but this suits the ferns and three species of *Dryopteris* were recorded, including Borrer's Male-fern *D. borrieri*.

On the edges of Marriott's Way there are small areas of grassland on gravelly soils. Hare's-foot Clover *Trifolium arvense* and Autumn Hawkweed *Hieracium sabaudum* were found here as well as a colony of Vervain *Verbena officinalis*. In disturbed ground there are ample opportunities for 'weeds' to flourish – finding Guernsey Fleabane *Conyza sumatrensis*, Hoary Mustard *Hirschfeldia incana* and Perennial Wall-rocket *Diplotaxis tenuifolia* was no surprise as they are now quite frequent in this part of the city.

Towards the west between Train Wood and the cycle track there are a number of willow species. Presumably most of these were planted here at some time. They include Olive Willow *Salix elaeagnos* as well as the native species: Purple Willow *Salix purpurea*, Almond Willow *Salix triandra*, Crack Willow *Salix* × *fragilis* and Grey Willow *Salix cinerea* subsp. *oleifolia*, which in Norfolk is the scarcer of our two subspecies.

CWS1453 extends for approximately 1.7 km but botanically the most interesting area is the eastern section and very little was added west of Sweet Briar Road. Species recorded

in the area of grassland immediately to the south of the industrial estate and on the banks of the ditch here include Oval Sedge *Carex ovalis*, Prickly Sedge *Carex muricata* subsp. *pairae*, Meadow Saxifrage *Saxifraga granulata*, Yellow-rattle *Rhinanthus minor* and Wild Clary *Salvia verbenaca*. Although this grassland is mostly on the slightly acid side of neutral, the presence of Wild Parsnip *Pastinaca sativa* and Greater Knapweed *Centaurea scabiosa* suggest some areas are more calcareous. The steep slopes on light soil by the ditch and track provide an opportunity for more ruderal species and there is a fine colony of Hoary Mullein, *Verbascum pulverulentum*.

The ground flora in the wooded areas is sparse, but Wood Anemone *Anemone nemorosa*, Bluebell *Hyacinthoides non-scripta*, Three-veined Sandwort *Moehringia trinervia* and Pignut *Conopodium majus* were recorded in places.

The banks of the old railway line, particularly to the south, are interesting. Harebell *Campanula rotundifolia* and Wood Meadow-grass *Poa nemoralis* are quite frequent and there is a large colony of a hawkweed belonging to the *Hieracium exotericum* group. Unfortunately, as happens from time to time with micro-species, it cannot actually be given a name. One of the most special plants in this area, Basil Thyme *Clinopodium acinos* was reported later on by Stuart Paston. It has been known in the area for some time and Craig Robson recorded it here in 2000.

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Bryophytes

Introduction

The bryophytes along the whole lengths of Marriots Way County Wildlife Sites numbers 1453 and 1467 were recorded in 2011 by Mary Ghullam and Bob Ellis. CWS 1467 to the west of Mile Cross Road was recorded in May and September, while CWS 1453 to the east of the road, along the River Wensum, was only recorded in September. The weather was exceptionally dry in May, making it difficult to record the very small acrocarps, which are probably under recorded. In all 39 different species were recorded over both sites - 6 liverworts and 33 mosses. (see Table 1)

Habitats

Habitats present ranged from dry acid grassland, including some steep banks with bare soil, wetter grassland, man-made substrates, such as paths and bridges, river banks and broad-leaved trees and scrub. There were very few areas with a moist microclimate and this is reflected in the type and number of bryophytes found.

Most of the bryophytes recorded were those common in urban habitats and fairly ubiquitous in the county. Species such as Neat Feather-moss *Pseudoscleropodium purum* and Springy Turf-moss *Rhytidiadelphus squarrosus* occurred in the dry grassland, while Pointed Spear-moss *Calliergonella cuspidata* and Bifid Crestwort *Lophocolea bidentata* were to be found in wetter grassland. Such species as Great Hairy Screw-moss *Syntrichia ruralis* var. *ruralis* and Redshank *Ceratodon purpureus* grew on the bare soil of steep dry banks. The bare soil on the wetter banks by the side of the Wensum allowed such small mosses as Pink-fruited Thread-moss *Pohlia melanodon* and the thalloid liverworts Crescent-cup Liverwort *Lunularia cruciata* and Common Liverwort *Marchantia polymorpha* to colonise.

Small acrocarpous mosses, such as Lesser Bird's-claw *Barbula convoluta*, Bird's-claw

Beard-moss *B. unguiculata*, and Silver-moss *Bryum argenteum* grew on the hard substrates and trampled areas of the paths. Hoary species of moss, well adapted with their hair-pointed leaves both to survive the driest conditions and to reproduce freely, grew on concrete parapets. The species included Thickpoint *Grimmia Schistidium crassipilium*, with its short red capsules hidden among its cushioned tufts, and Grey-cushioned *Grimmia Grimmia pulvinata*, which tucks its long seta capsules down amongst its leaves in drought. Greater Water-moss *Fontinalis antipyretica* was also found growing on concrete, but as the name suggests, on the river edge, in CWS 1467. This large moss, reputedly the longest moss in the world, was used in the past to line chimneys in Sweden, to prevent them catching fire, as its Latin name implies (Porley & Hodgetts 2005).

Marriots Way is interspersed with trees and scrub, some in very exposed areas, while in other places there are thicker belts. The usual woodland floor mosses do occur, such as Swan's-neck Thyme-moss *Mnium hornum*, Hart's-tongue Thyme-moss *Plagiomnium undulatum* and the commoner epiphytes. It is, however, among the epiphytes that the less commonly recorded mosses occur. These are ones which, as less pollution tolerant, have benefitted from cleaner air and have spread across the county in recent years. Lateral Cryphaea *Cryphaea heteromalla*, so named from where its capsules appear, and Straw Bristle-moss *Orthotrichum stramineum*, both were found growing on willows.

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Table 1. Bryophytes recorded in 2011 along Marriots Way County Wildlife Sites 1453 and 1467. Species names follow Hill et al 2008.

Species	English Name	CWS 1453	CWS 1467
LIVERWORTS			
<i>Lophocolea bidentata</i>	Bifid Crestwort	Y	
<i>Lophocolea heterophylla</i>	Variable-leaved Crestwort	Y	
<i>Lunularia cruciata</i>	Crescent-cup Liverwort	Y	Y
<i>Marchantia polymorpha</i>	Common Liverwort		Y
<i>Metzgeria furcata</i>	Forked Veilwort	Y	Y
<i>Metzgeria violacea</i>	Blueish Veilwort	Y	
MOSSES			
<i>Amblystegium serpens</i>	Creeping Feather-moss	Y	Y
<i>Atrichum undulatum</i>	Common Smoothcap	Y	
<i>Barbula convoluta</i> var. <i>convoluta</i>	Lesser Bird's-claw Beard-moss	Y	Y
<i>Barbula convoluta</i> var. <i>sardoa</i>	Sardinian Bird's-claw Beard-moss		Y
<i>Barbula unguiculata</i>	Bird's-claw Beard-moss	Y	Y
<i>Brachythecium albicans</i>	Whitish Feather-moss	Y	
<i>Brachythecium rutabulum</i>	Rough-stalked Feather-moss	Y	Y
<i>Bryum capillare</i>	Capillary Thread-moss	Y	Y
<i>Bryum argenteum</i>	Silver-moss		Y
<i>Bryum rubens</i>	Crimson-tuber Thread-moss	Y	
<i>Calliergonella cuspidata</i>	Pointed Spear-moss	Y	Y
<i>Ceratodon purpureus</i>	Redshank	Y	
<i>Cryphaea heteromalla</i>	Lateral Cryphaea	Y	
<i>Fontinalis antipyretica</i>	Greater Water-moss		Y
<i>Funaria hygrometrica</i>	Common Cord-moss	Y	Y
<i>Grimmia pulvinata</i>	Grey-cushioned Grimmia	Y	Y
<i>Hypnum cupressiforme</i>	Cypress-leaved Plait-moss	Y	Y
<i>Kindbergia praelonga</i>	Common Feather-moss	Y	Y
<i>Mnium hornum</i>	Swan's-neck Thyme-moss	Y	
<i>Orthotrichum affine</i>	Wood Bristle-moss	Y	Y
<i>Orthotrichum anomalum</i>	Anomalous Bristle-moss	Y	
<i>Orthotrichum diaphanum</i>	White-tipped Bristle-moss	Y	Y
<i>Orthotrichum stramineum</i>	Straw Bristle-moss	Y	
<i>Plagiomnium undulatum</i>	Hart's-tongue Thyme-moss	Y	
<i>Pohlia melanodon</i>	Pink-fruited Thread-moss		Y
<i>Pseudoscleropodium purum</i>	Neat Feather-moss	Y	
<i>Rhynchostegium confertum</i>	Clustered Feather-moss		Y
<i>Rhytidiadelphus squarrosus</i>	Springy Turf-moss	Y	Y
<i>Schistidium crassipilum</i>	Thickpoint Grimmia	Y	
<i>Syntrichia ruralis</i> var. <i>ruralis</i>	Great Hairy Screw-moss	Y	
<i>Tortula muralis</i>	Wall Screw-moss	Y	Y
<i>Zygodon conoideus</i> var. <i>conoideus</i>	Lesser Yoke-moss	Y	

Insects: Diptera and Hymenoptera (excluding ants)

Fieldwork undertaken by the author in 2011 on a section of the northern side of Marriott's Way in Norwich produced a number of uncommon, or overlooked, flies (see below), as well as two hymenopteran parasites of note.

The area studied lies between Sloughbottom Park and Sweet Briar Road (TG206099, TG207099) and provides a diversity of habitats comprising ruderal ground, grassland, scrub (predominantly hawthorn) and oak-birch woodland. All of the open areas were grazed by horses from late summer to early winter in 2011.

Diptera

Hybomitra bimaculata A male of this horsefly was discovered on a pathway amid woodland and scrub on 2 June. In lowland areas this species prefers a combination of wet ground and woodland so given the dry nature of the immediate surroundings it is likely to have wandered from wetland to the south. Although widespread in Norfolk this species is uncommon over much of its range in Britain.

Machimus cingulatus A female of this robberfly was taken on 12 August on the piece of ruderal ground adjoining the Burnett Road industrial estate. Although given the name Brown Heath Robberfly the species also occurs on dunes in parts of its range. Its presence on such a small area of suitable habitat hints at a much wider Norfolk distribution than currently indicated and sampling the robberfly fauna on heathland and fragments of sandy habitat well away from its Breck sites could well be productive. The study area is good for robberflies with *Dioctria atricapilla*, *Dioctria rufipes*, *Leptogaster cylindrica* and *Machimus atricapillus* also recorded during 2011.

Cheilosia lasiopa This hoverfly, locally common in southern England, has been widely recorded in Norfolk in the not too distant past but the most recent records are concentrated in Breckland. Its presence on the outskirts of Norwich is therefore of note. A male was taken on 20 April on sparsely vegetated sandy ground near woodland TG206099 and further males were present hovering low above the ground on a later visit. It is associated with wooded localities where it occurs in sheltered areas such as clearings or track sides.

Pipiza luteitarsus A male of this uncommon but widespread hoverfly was discovered on 6 May, hovering beside a pathway amid scrub. It is associated with elm in wooded areas where the larvae feed on *Schizoneura* aphids which curl the leaves of the host tree. Very little elm was noticed in the immediate vicinity of the sighting.

Paragus haemorrhous A female of this very small, easily overlooked hoverfly was taken on the area of ruderal ground adjoining the Burnett Road industrial estate on 24 April. It occurs widely on a variety of soils where there are areas of bare or sparsely vegetated ground.

Polietes meridionalis A male of this large muscid was obtained on 1 November from a white water trap operated in woodland TG206099. This species was not recognized as occurring in Britain until recently owing to a close resemblance to the very common *P.lardarius*.

Actia lamia A female of this small tachinid fly was taken on 2 July from a strip of grassland alongside woodland TG206099. As well as woodland and dry scrubby grassland, the habitat of this species also encompasses marshes and wet grasslands so it is likely to be present on Sweet Briar meadows to the south.

It is a parasitoid of Tortricid moth larvae that live in plant stems and roots, with

Marsh Thistle being significant as a principal food plant of host species.

Hymenoptera

Dolichomitis mesocentrus A female of this large ichneumon-fly (photo p.60) was collected on 15 September from an area of scrub adjoining oak-birch woodland close to Sweet Briar Road. This seems to be an uncommon species, stated to be associated with beetles in dead oak and beech (Fitton *et al.* 1988).

Fredegunda diluta A female of this distinctive ichneumon-fly was taken on 19 September from the area of scrub adjoining woodland as above (photo p.60). It is associated with reed beds where it is parasitic upon Noctuid moth larvae within reed stems, Brown-veined Wainscot and Fen Wainscot being recorded hosts. It is stated to be 'rare, perhaps only in eastern England from Sussex to Humberside' in Fitton *et al.* (1988). No reeds were present in the immediate vicinity of capture but the plant is plentiful in the general area, especially to the south alongside the Wensum. The generic name *Fredegunda* refers to a 'wicked medieval queen who sent assassins in the guise of messengers' - never let it be said that the world of zoological nomenclature is lacking in imagination.

I thank Tony Irwin for help in identifying this species and supplying the photographs of both ichneumon-flies.

Reference

FITTON, M.G., SHAW, M.R. & GAULD, I.D. 1988.
Royal Entomological Society Handbook for the Identification of British Insects. Pimpline Ichneumon-flies. 7(1).

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Ants

Three species of ant were recorded on 24 June 2011 nesting in the south-facing borders along the Marriott's Way. The species recorded are commonly found in sunny grassland sites.

The preferred nesting sites for these ants would be in warm microclimates at ground level where the sun is able to warm the nest. Where these conditions existed nests were plentiful. However, the habitats along the Marriott's Way CWS are not uniformly ideal for ants. Where the plants grew tall and shaded the ground, or there was dense scrub, ants were not present.

Lasius flavus was recorded nesting in short grassland, sparsely vegetated borders and south-facing earth banks beside the footpath. Many ant-hills were forming, particularly in the earth banks. The locations for these nests were TG210100 and TG210099.

Lasius niger was recorded nesting in short grassland and earth banks beside the footpath at TG221098, TG210099, TG207099 and TG200099.

Myrmica rubra was recorded nesting in south-facing vegetated borders along the footpath at TG214100 and TG212100, but just outside the actual CWS.

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Weather Report 2011

Norman Brooks

Observations made with approved Meteorological Office instrumentation, and in accordance with standard Meteorological Office practice, at Old Costessey, Norfolk. Monthly figures are presented in Table 1.

Monthly accounts

January 2011 After a very cold end to November 2010 and an exceptionally frigid December, it came as a surprise to many that January, by comparison, seemed to be the beginning of spring. Although the monthly mean temperature of 4.3°C was only marginally above normal, it was in great contrast to the preceding December whose mean was exactly 0.0°C.

A feature of January was the paucity of sunshine, with many days dominated by low cloud trapped within stubborn areas of high pressure, resulting in the aptly named 'anticyclonic gloom'.

The rainfall total of 70.7 mm was 122%

of average, and the only snow observed during the month were a few random flakes on 2 and 27 January.

Jan. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	5	4	1	0	3	7	1	3	7

February 2011 With a temperature of 6.4°C it was the mildest February since 2002 - and was warmer than the average March!

Sunshine was at a premium, and there was a seemingly endless series of dull, dreary and misty days causing the countryside to assume a 'washed-out' appearance. The month was one of the dullest since 1947.

Feb. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	1	3	6	4	6	3	2	3

The maximum of 15.0°C on 25 February was noteworthy as was the very modest lowest screen minimum of -2.3°C on 1 February. The wind reached gale-force on 4 February, and the monthly rainfall total of 41.9 mm was very close to the average. Slight snow

Table 1 Monthly summaries for 2011

Month	Total rainfall (mm)	Percentage of mean rainfall	Days air frost	Days ground frost	Monthly mean temperature (°C)	Deviation from mean (°C)
January	70.7	122%	10	17	4.3	+0.3
February	41.9	97%	3	7	6.4	+2.6
March	13.7	28%	7	15	6.7	+0.8
April	3.3	7%	0	3	12.2	+4.6
May	16.8	37%	1	3	13.5	+2.2
June	80.0	150%	0	0	15.5	+1.1
July	56.8	100%	0	0	15.6	-0.9
August	80.8	158%	0	0	16.1	-0.3
September	26.8	49%	0	0	15.9	+1.6
October	34.1	59%	0	4	12.9	+1.9
November	24.6	35%	10	5	9.3	+2.6
December	54.5	89%	24	12	5.5	+0.7

was observed on a single day, 22 February.

March 2011 With high pressure dominating for most of the month it was exceptionally dry, the rainfall total of 13.7 mm being only 25% of the average.

Although rain fell on only five days, the countryside never presented the arid 'winter-blasted' appearance, so common in March, due to a total absence of desiccating winds. Surprisingly this was not due to an absence of days with the wind blowing from between north-east and east (there were ten). Due to the general mildness of the winter they were never cold or dry, with only two days during the month recording a maximum below 4°C, The month was without snow - unusual for March.

Mar. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	2	9	1	2	2	3	6	1	5

April 2011 It was the warmest April in the 350-year Central England Temperature Record. (Amazingly, the previous warmest was as recently as 2007.)

Locally, the mean monthly temperature was 4.6°C above normal, with the average day maximum an extraordinary 6.4°C above average and six days recording maxima in excess of 21°C. The maximum of 24.0°C on 6 April was the highest ever recorded on this date in the United Kingdom, and the maximum of 27.0°C on 23 April was notable.

Although not as dry as April 2007, the rainfall total of 3.3 mm was only 7% of normal. Excessive sunshine, combined with dry, warm easterly winds, exacerbated the effects of lack of rainfall.

April wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	3	6	1	3	3	4	6	2	2

May 2011 The moisture deficit increased with another very dry month; the rainfall total of 16.8 mm being only 37% of the average. The Meteorological Office judged that this spring had been the driest in the United Kingdom since at least 1893, with East Anglia the driest region.

The only day during the month that could be defined as 'wet' was 30 May when 6.2 mm of rain was deposited by a front that moved from west to east across our region with an associated dramatic drop in temperature. In the late morning Norfolk was baking under sunny skies, with a temperature of 24°C, but by the afternoon, just prior to the onset of moderate rain under leaden skies and a northerly wind, the temperature had plummeted to a mere 13°C.

Yet again it was a warm month, with the mean temperature of 13.5°C more than 2°C above normal.

May wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	4	0	3	5	8	7	4	0

June 2011 July brought welcome relief from the prolonged dry spell. The monthly rainfall total of 80.0 mm was a satisfactory 150% of average. This change to a wetter regime, with mainly south-westerly winds, is a common feature of mid-June. And, right on cue, the change was heralded on 12 June with a rainfall of 7.3 mm, more than double the total for April.

There was a mini-heatwave on 26 and 27 June, with the maximum climbing to 31.6°C on the latter date. The following night was exceedingly unpleasant with high humidity and a minimum temperature of 17.9°C. Thunder was heard on four days, with a storm on 28 June accompanied by torrential rain that yielded a total of 16.6 mm.

June wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	3	0	2	5	9	8	2	0

July 2011 July ended the succession of warm months with a mean temperature nearly 1°C below normal, making it the coolest July locally since 2000. The monthly rainfall total of 56.8 mm was exactly average, and thunder was heard on only a single day.

Unusually, the month's highest and lowest temperatures were recorded on the same day, 31 July. A screen minimum of 5.0°C around 0400 hrs as followed by a maximum

of 25.7°C in the early afternoon.

On 24 July, our area, in common with much of south-east England, was treated to a display of a rare cloud formation, identified as cirrocumulus undulatus. This cloud formed an arc across the sky with parallel rows of cloud to produce a curious rippled effect.

July wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	5	1	0	0	3	9	3	7	3

August 2011 With a mean temperature of 16.1°C it was the coolest August locally since 1993. (It was also the coolest summer season since 1993.) Unsurprisingly, sunshine was deficient, with a single hot day, 3 August, when exactly 30.0°C was recorded.

It was a wet month, the rainfall total of 80.8 mm being 158% of the average. Slight thunder was heard on only two days.

Aug. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	2	0	2	3	10	8	4	2

September 2011 An unexpected late heatwave redeemed the mediocre summer. Maxima attained high summer values on the final four days of the month: 24.0°C on the 27th; 24.8°C on the 28th; 27.5°C on the 29th and 28.1°C on the 30th. This late season heat occurred three and a half weeks later than the record September heatwave in Norfolk when 32.6°C was registered on 5 September 1949.

Although south-westerly winds predominated, it was another dry month with just under half the monthly rainfall. The wind briefly reached gale-force on 12 September.

Sept. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	0	1	6	4	12	5	0	2

October 2011 The heat of September intensified in the month with exceptional maxima on the first three days: 28.0°C on the 1st; 29.1°C on the 2nd and 27.5°C on the

3rd. The reading of 29.1°C on 2 October is the highest October temperature since records began in 1870. Santon Downham just eclipsed our record with 29.3°C which is currently the national record for that date. With only three very slight air frosts, there was little damage to tender plants.

Autumn rains were nearly absent, the monthly total of 34.1 mm being only 59% of the average.

Oct. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	0	1	3	3	7	8	3	6

November 2011 An exceptionally mild month with grass growth continuing throughout, tender bedding plants remaining in flower and insects abounding. Temperatures in excess of the average were recorded on 29 days. This warmth was not quite record-breaking, however; November 1994 with a mean temperature of 9.9°C (0.6°C higher than this November) was the warmest since records began in 1659. The only truly autumnal influence occurred from 20 to 22 November when most of Norfolk was enveloped in a dripping shroud of fog.

The month was notably dry with the rainfall total of 24.6 mm being only 35% of the average.

Nov. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	2	4	2	3	9	1	0	8

December 2011 A 'westerly' month with rainfall close to normal and daytime maxima rather above.

Slight snow was observed on three days but with not even a single day with a north, north-east or east wind there was a total absence of 'hard' weather. The wind reached gale-force on 12 December.

The contrast with the very cold December of 2010, the mean air temperature of which was 5.5°C colder, illustrate the variability of the British climate.

Dec. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	0	0	0	0	0	6	20	3	2

Annual summary 2011

Total rainfall	504.0 mm
	78% of mean
Wettest day	3 Aug, 21.3 mm
Days with rain recorded	146
Days with sleet or snow	6
Days with snow lying	0
Highest maximum temperature	31.6°C
	27 June
Lowest maximum temperature	1.9°C
	3 January
Highest minimum temperature	17.9°C
	28 June
Lowest minimum temperature	-4.9°C
	8 March
Lowest grass min. temperature	-7.0°C
	8 March
Air frosts	32
Ground frosts	66
Days with hail	5
Days with thunder	8
Days with gales	3
Days with fog (09.00 hrs)	17
Longest period with no measurable rain	
	16 days (12-27 April inclusive)
Mean cloud cover at 09.00 hrs	63%
Wind direction at 09.00 hrs (days):	
North	17
North-east	32
East	12
South-east	29
South	38
South-west	90
West	76
North-west	31
Calm	40
Annual mean maximum temp.	15.4°C
Annual mean minimum temp.	6.9°C
Annual mean temperature	11.1°C

Dragonflies

Pam Taylor

The Norfolk season started earlier than ever with the first Large Red Damselfly exuvia recorded on 6 April. From then through to early June most common species were appearing in good numbers, ten days to a fortnight earlier than usual. After the superb spring, the summer was very quiet and the autumn disappointing. Throughout the county, numbers of our familiar species such as Migrant Hawker *Aeshna mixta* and Common Darter *Sympetrum striolatum* were much reduced.

Norfolk Hawker *Aeshna isosceles* is an early summer species, so had an excellent season throughout the Broads. Once again there were records extending to the west and south-west of Norwich in the River Yare corridor and to the north-west of Norwich, not far from the River Wensum. Interestingly, a female Norfolk Hawker was also seen ovipositing slightly out of its usual range at Captain's Pond, Westwick, a private site, whilst another adult was seen in the coastal sand dunes at Winterton.

Common Hawker *Aeshna juncea* was not well reported and there were only six records for this species. It is certainly not a common species in Norfolk. Apparently confined to the east of the county, one record came from Upton Fen again this year, but sadly only of a failed emergence.

Downy Emerald *Cordulia aenea* was another species with few records in 2011. It only has one established location in the county, so hopefully this just means the area was not visited, rather than any demise of the species itself.

Keeled Skimmer *Orthetrum coerulescens* continues to thrive and once again there were records from four distinct areas. The main colony remains at Holt Lowes; there is

a smaller and more recent colony at Buxton Heath and the species was also reported once again from the Beeston/Sheringham Common area and from Roydon Common. The challenge now is to prove breeding at these last two sites.

Small Red Damselfly *Ceriagrion tenellum* was not recorded at all in Norfolk during 2011, according to the results that reached the county database. This species has just one known site in Norfolk and it is likely the lack of records was due to a lack of recorders, rather than no damselflies being on the wing.

Scarce Emerald Damselfly *Lestes dryas* was recorded on several occasions in June and July, but the only reports this year came from Thompson Common.

Willow Emerald Damselfly *Lestes viridis* has yet to make a real impact in the county. A small group was again seen at Strumpshaw Fen during September and singles were found across the river at Wheatfen and near the coast at Overstrand in October.

Recording continues for both a new national atlas, due for publication in 2013, and for a revised Norfolk atlas, so if you have any dragonfly records please send them to me as County Recorder.

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Orthoptera

David Richmond

The lying snow of December 2010 gave way to milder weather in January-March 2011 which prompted the early emergence of several species. The first nymphs of Dark Bush-cricket were seen on 20 April, with Speckled Bush-cricket nymphs seen on 12 May, both the author's earliest dates since 2003. Common Green Grasshopper was heard stridulating on 21 May, the author's earliest ever date, as were 3 June for Mottled and Field Grasshoppers and 4 June for Lesser Marsh Grasshopper.

Alas, the early promise did not last and July and August turned into colder months. Nonetheless there were a few interesting observations during the year, as range expansions continued and some under-recorded species turned up in new 10km squares.

Oak Bush-cricket was recorded from a new 10km square at Feltwell (TL69) by Martin Greenland.

Roesel's Bush-cricket was recorded from four new 10km squares in the east of the county (TG33, 41, 42, TM49).

Long-winged Conehead was found at Welney (TL59) and Witton (TG33).

Stripe-winged Grasshopper was recorded by the author at Alderford Common (TG11) when the unmistakable metallic stridulation was heard from Water Mint *Mentha aquatica* at the edge of a pond with chalky margins. More surprisingly, Tim Gardiner found two males and four females in an area of acid grassland beneath pylons in Waveney Forest (TG40), more than 20km distant from the nearest known colonies in Norfolk or Suffolk. These are two further examples of the 21st century range expansion by this species,

which has also been witnessed nationally.

Meadow Grasshopper was found in a new 10km square at Witton (TG33) where a male was seen and heard on a grassy headland bordering the SW edge of Bacton Wood.

Locust species. Perhaps the most tantalising record of the year comes from Phil Davison of the Buxton Heath Wildlife Group, whose members saw a locust in the north-east corner of the Heath on 15 October. Despite a dozen close views of the insect in flight they were unable to get close enough to see it well on the ground. It was described as a very large insect with 2-3 inch wingspan, with pale yellowish brown wings, typically flying in 30 yard bursts before eventually disappearing in a bank of gorse. Desert Locust or Migratory Locust would seem to be the most likely options, either as a vagrant from the continent or an escape from captivity.

Late dates

The early emergence dates and drab summer took their toll on longevity with a Field Grasshopper at Beeston Regis on 4 November (F.Farrow) the only report of a grasshopper in that month. The latest dates for Bush-crickets were 28 October for Bog Bush-cricket and Short-winged Conehead at Buxton Heath, 14 November for Dark Bush-cricket in Reepham, 15 November for Long-winged Conehead at Welney (T. Inskipp) and 26 November for Speckled Bush-cricket at Reepham.

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Bumblebees

David Richmond

A full account of the Bumblebees of Norfolk has been given in the Society's most recent Occasional Publication. This article focusses on the 2011 records of the least common species (observers' names in brackets).

Heath Bumblebee *Bombus jonellus* was reported from Weybourne, Sheringham and the Stanford Training Area (Owens).

Tree Bumblebee *B. hypnorum*. There were 42 records for this species which was first recorded in Norfolk in 2008. It is now widespread across the county being recorded from March to October.

Large Garden Bumblebee *B. ruderatus* was recorded on Black Horehound along the Cut-off Channel at Methwold (Benton).

Red-shanked Carder Bumblebee *B. ruderarius* was reported from Weeting Heath (Benton) and West Harling Gallops (Strudwick), a welcome extension to its currently known range.

Moss Carder Bumblebee *B. muscorum* was reported from five sites along the north Norfolk coast. John Dobson saw two queens on Red Dead-nettle at Salthouse in April and Nick Owens found it along the clifftops at Weybourne in May. The Richmonds saw a queen along the salt-marsh edge at Titchwell in early June and also had three males on thistles on the sea bank there a month later. They also saw males on Marsh Woundwort at Morston in July and on Sea Pea on the Blakeney shingle ridge in August.

Hill Cuckoo Bumblebee *B. rupestris* (cuckoo of *B. lapidarius*). There were eight records for this species which continues to make a recovery in the county. It can be recognised by its large size, red tail and dusky wings. In the west, Owens

reported it from Methwold, Weeting and Cranwich. In the north it was seen at Beeston Regis Common (Farrow) and Aylmerton (Owens). In the east it was reported from the Marriott's Way in Norwich (Strudwick) and from Claxton (Owens) and Filby (Saul).

Barbut's Cuckoo Bumblebee *B. barbutellus* (cuckoo of *B. hortorum*). Recorded from the Cut-off Channel at Methwold (Owens) and from Langham (Dobson) and Kelling Heath (Owens).

Field Cuckoo Bumblebee *B. campestris* (cuckoo of *B. pascuorum*). Considering the ubiquity of its host, there are still very few records for this species. In 2011 it was seen at Kelling (Owens), Bowthorpe (Strudwick), Claxton (Owens) and Strumpshaw Fen (Strudwick).

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Beetles

Martin Collier

The aim of this and future beetle reviews is to provide details of records for species either believed to be new to the Norfolk list, or which are otherwise of interest because of their local or national status or distribution. It is almost 100 years since the last review and update of the Norfolk beetle list appeared in these *Transactions* (Edwards, 1914), although details of multiple first county records have occasionally been reported in recent years in general entomological journals (e.g. Collier, 1985; 2003) and numerous accounts of individual 'new to Norfolk' species have also been published. It is way beyond the scope of this review to discuss all the changes to the county's beetle fauna that have taken place over such a long period of time. Only the most significant finds during 2010 and 2011 are therefore reported on this occasion and future reviews will provide annual updates thereafter.

Norfolk has long been a popular county for visiting coleopterists because many rare species can be found in the nationally important habitats of the Brecks, Broads and coast. In some cases these beetles occur nowhere else in Great Britain. Norfolk beetle records exist in a wide and ever-increasing range of published and unpublished sources and data from many of these sources have yet to be extracted and computerised. Although every effort has been made to check the main data sources for previous records, claims of first county records must therefore be regarded as being somewhat provisional. Any detected mistakes will, however, be corrected in future reviews.

All records are my own except where indicated otherwise. Vice-county (VC) designations are based upon the Watsonian

system (Dandy, 1969). The national statuses for scarce species, shown after the names, are as given in the 'National Reviews' (Hyman, 1992; 1994). Species are listed in alphabetical order of family, genus and species, using nomenclature in Duff (2008); those marked with an asterisk are new to Norfolk (16 in total). Several new county records resulted from having a large flight interception trap in wet woodland at the northern end of Stanford Training Area, near Hilborough, VC 28 (TF836010). The trap was in place from May 2010 to June 2011 and was emptied at approximately 4-6 week intervals. In the following species accounts these records are reported as being from "the Stanford flight interception trap", with the relevant dates, to save repeating the locality details.

I thank: Andrew Duff, Scott Pedley, Bryan Sage, Mark Telfer, Stuart Warrington, Jon Webb, Colin Welch and Doreen Wells for permission to report details of their records; Mark Telfer and David Hutchins for identifying specimens of *Ophonus melletii* and all my specimens of *Colony* respectively; and finally, Ingrid Altman and Frank Köhler for permission to use their photographs of *Derocrepis rufipes* and *Colydium elongatum*, *Rhizophagus perforatus* and *Caenopsis fissirostris* respectively.

ANOBIIDAE

**Dorcatoma dresdensis* Herbst.

Notable A

The family Anobiidae includes the well-known woodworm beetle, *Anobium punctatum*, whose larvae can do so much damage to furniture and other untreated softwood structures. The British species of *Dorcatoma*, however, are very much outdoor beetles, breeding in hard bracket fungi or

inside tree trunks, especially oak, containing dry, fungus-infected rotten wood. Adults may be found by beating foliage of the host trees in summer or, more easily, by rearing them through from larvae in samples of rotten wood or fungi. Joy (1932) quotes Berkshire and Norfolk as counties for this species but, due to synonymy problems, this is probably based upon the record given in Fowler (1890) for *chrysomelina* (*dresdensisi* F., *nec* Herbst) from Denton, Norfolk, rather than *dresdensis* Herbst. A single specimen of *D. dresdensis* was collected in the Stanford flight interception trap, 27 May - 17 Jun 2011. *D. chrysomelina* and *flavicornis* were also taken in this trap on different occasions and *D. substriata* has also been found at Stanford and in a few other Norfolk localities. This leaves just one more *Dorcatoma* to be found in Norfolk, *D. ambjoerni*, a species which breeds in fungi in tree rot holes. It was added to the Suffolk list by Howard Mendel in 1980 (Nash, 2009) and so almost certainly occurs here, no doubt also at Stanford, a site that has by far the best recorded saproxylic beetle fauna in Norfolk.

CARABIDAE

**Amara fusca* Dejean

Red Data Book Category 1 (Endangered)

The ground beetles (carabids) are among the best recorded families of beetles in Britain so it is always a red-letter day when a new species is added to the county list, particularly when the species is one as rare as *A. fusca*. This species inhabits sandy heaths and slopes, including dunes, and has only ever been recorded from a handful of sites in Britain. The only known surviving populations occur in the Suffolk Breck (Luff, 1998). It is therefore particularly pleasing to report that this beetle has at long last also been found in the Norfolk Breck. Scott Pedley, at the University of East Anglia, has been managing a major pitfall trap sampling project, studying mainly ground beetles and spiders, investigating

the effects of various types of physical habitat disturbance on specialist Breckland heath species. I have been identifying some of the beetles, which included a single specimen of *A. fusca* from near Weeting, VC 28 (TL760914), 17-24 May 2010. It is hoped that this individual represents a resident population in the area, rather than being an isolated, exploring immigrant from Suffolk.

**Ophonus melletii* (Heer)

Notable A

This very scarce carabid is found in open ground or grassland with calcareous soils. There are few recent British records (Luff, 1998). A single specimen was taken in one of Scott Pedley's pitfall traps (see *Amara fusca* above) near Mundford, VC 28 (TL786935), 19-26 Jul 2010. Although several species in this genus are notoriously difficult to identify and are best confirmed by examination of the male genitalia, my provisional identification of this specimen (unfortunately a female) was confirmed by Mark Telfer, the national carabid recorder. It is thought possible that other examples may have been taken in these pitfall traps but this requires confirmation by re-examination of the relevant specimens (S. Pedley, pers. comm.) and this was not possible in time for this review.

CHRYSOMELIDAE

Derocrepis rufipes (Linnaeus) **Photo. p.64**

This attractive little red and metallic blue/black leaf beetle has a widespread distribution in England and Wales but there are very few records from East Anglia (Cox, 2007). It can be found in a wide range of habitats and the adults and larvae feed on various species of the pea family, Fabaceae. Towards the end of the 19th century, Edwards (1893) considered it to be '*Not very common*' in Norfolk and there appear to be have been no further records until Bryan Sage found it at Swanton Novers Wood, VC 28 (TG0130) on 10 Jul 2010.

COLYDIIDAE

Colydium elongatum* (Fabricius) **Photo.
p.64.

Red Data Book Category 3 (Rare)

Several species of British beetles, especially those associated with deadwood habitat (saproxylics), have been expanding their range northwards in recent decades - some quite slowly and others more dramatically. Up until about 1970, *C. elongatum* had only been recorded from Wiltshire, Dorset and Hampshire but between about 1970 and 1990 it was also discovered in Surrey and Berkshire, from well-worked sites where it was unlikely to have been overlooked, suggesting an expansion of range (Hyman, 1992). There have been subsequent records from South Wales, Buckinghamshire, Middlesex and Hertfordshire (Sage, 2012a) but it was not really a species I expected to reach Norfolk just yet, based on the current known distribution. It was therefore quite a surprise to hear that Bryan Sage had found one example of this strangely elongate predator of bark beetles (Curculionidae: Scolytinae) under bark of a felled oak at Stanford, VC 28 (TL8392) on 29 Dec 2011. A search of the same trunk and other oak and beech timber nearby by Bryan and myself on 24 February 2012 was unsuccessful, so it will be interesting to see where and when this beetle next turns up.

CORYLOPHIDAE

**Sericoderus brevicornis* Matthews

This tiny (c. 1 mm) beetle is an Australian species first found in Britain in 2006 (Galsworthy & Booth, 2007). It is expected to spread rapidly, although it will no doubt be overlooked for some time in many areas because of its diminutive size. The only other species of this genus in Britain, *S. lateralis*, is parthenogenetic, whereas both males and females of *brevicornis* are known to occur. Assuming a dissection of the genitalia is attempted, this provides a useful identification confirmation when a male is found. Andrew Duff found several

examples of *S. brevicornis*, including two males (one kindly given to me), by sieving fungi and leaf litter at Fairhaven Water Gardens, South Walsham, VC 27 (TG3613) on 4 Sep 2011. In addition, one female of this species (identified by M.G. Telfer) was caught in a vane trap set by Stuart Warrington of the National Trust in Sheringham Park, VC 27 (TG1341) during the period 12 Jul to 5 Sep 2011.

CURCULIONIDAE

Caenopsis fissirostris (Walton)

Notable B **Photo. p.64**

Caenopsis waltoni (Boheman)

These ground-living, rather drab and easily overlooked little weevils are usually, but not exclusively, found in heathland habitats, often in association with *Calluna* and *Erica* species (Morris, 1997). They were both recorded from Mousehold Heath in the late 19th Century, with *waltoni* considered to be much scarcer than *fissirostris* (Edwards, 1893), although the opposite is considered to be the case in terms of national occurrence nowadays. After many years without either species being found, Peter Kirby discovered *C. fissirostris* at East Ruston Common on 5 July 1998. Then, in 2011, Doreen Wells sent me the beetles from pitfall traps set for recording ants at Horsford rifle range and Mousehold Heath (both VC 27) and I was delighted to discover that these contained single examples of both *waltoni* and *fissirostris*, the former from Horsford (TG193180), 26 Apr – 10 May 2010 and the latter from Mousehold Heath (TG246101), 28 Apr – 9 May 2011. It is particularly pleasing to discover that *fissirostris* still occurs at Mousehold Heath, despite the greatly reduced area of suitable heathland habitat at this site since Edwards originally found it there in the late 1800s.

Polydrusus flavipes (De Geer)

Notable B

This local and uncommon weevil is polyphagous on broadleaved trees, although in some areas it appears to be particularly

associated with Aspen, *Populus tremula* (Morris, 1997). Edwards (1893) considered it to be rare and gives Brooke Wood and Ketteringham Common as localities where he had found it. There appear to have been no further county records until Bryan Sage found it at Great Cressingham Fen, VC 28 (TF8402) on 17 Jun 2010.

HELOPHORIDAE

Helophorus dorsalis (Marsham)

Notable B

The water beetles are probably the most recorded group of beetles in Norfolk, so the absence of modern records for a species is likely to indicate that the beetle is genuinely scarce. Older records of *H. dorsalis* should be treated with caution due to identification difficulties and taxonomic changes but it seems likely that the species has not been recorded in Norfolk for around 100 years, if ever. However, its rightful place on the Norfolk list was confirmed when Mark Telfer found a single example in a pitfall trap set in exposed mud beside a woodland pond (a typical habitat for this species) at Sheringham Park (National Trust), VC 27 (TG1241), 10 – 14 May 2010.

HYDROPHILIDAE

**Dactylosternum abdominale* (Fabricius)

The first British examples of this hydrophilid beetle were found on the edge of a silage clamp and in a pile of horse dung in Dorset in 2003 (Allen, 2004) and these were followed by several examples in garden compost bins in East Northamptonshire in 2005 (Welch, 2006). The species is no doubt well established in England now but terrestrial hydrophilids living in rotting vegetation and dung are not overly popular with British coleopterists so it is likely to go undetected in many areas. Three examples of *D. abdominale* were sieved from slimy, wet, organic material, including soil and dead grass, inside a felled hollow poplar trunk at Spring Covert, Didlington, VC 28

(TL7996) on 25 Sep 2011. This represents the first British occurrence in a natural rather than man-made habitat. Although superficially similar in general appearance to *Coelostoma orbiculare*, a common water beetle, *Dactylosternum* behaves very differently in the field, running actively to hide in the substrate. In fact, of the three beetles seen, one managed to evade capture and could not be found again.

LEIODIDAE

Colon dentipes (Sahlberg)

Red Data Book Category K (Insufficiently Known),

**C. serripes* (Sahlberg)

**C. zebei* Kraatz

Red Data Book Category K (Insufficiently Known)

Next to nothing is known about the life cycle and habits of *Colon* species and they are rarely found during active fieldwork. Most specimens have been collected in flight interception traps, especially in woodland. Identifying the British species of *Colon* has always been difficult using the available literature and errors in some of these sources, along with taxonomic changes, have all contributed to the general confusion. However, David Hutchins and Richard Lyszkowski at Edinburgh Museum are working on a major revision of this genus, which will surely help clarify the situation when it becomes available. In the meantime, David has identified specimens of the following species, all collected in the Stanford flight interception trap, from which more material has still to be sorted and identified.

C. dentipes: 22 Sep – 7 Oct 2010; 22 Sep – 7 Oct 2010. I know of just one previous Norfolk record, from Lopham Fen (Pope, 1969).

C. serripes: 29 Jul – 11 Aug 2010.

C. zebei (named incorrectly as *barnevillei* in the British checklist (Hutchins, *in lit.*): 21 May – 4 Jun 2010; 29 Jul – 11 Aug 2010.

This brings the total number of *Colon* on the Norfolk list to five, the other two being *brunneum* (the most commonly recorded species in England) and *appendiculatum* (Collier, 1990).

Leiodes oblonga (Erichson)

Notable

All species of *Leiodes* are thought to be associated with subterranean fungi, including truffles, and occur in two main habitats – sandy areas, such as the Breck and coastal sand dunes, and woodlands. The beetles are most commonly found by evening sweeping, although large numbers may also occur in flight interception traps. Some coleopterists have tried using underground traps baited with fungus but these seem to have been largely unsuccessful. Norfolk is well represented, with 18 of the 23 British species being recorded, albeit most species have less than five modern records each, reflecting how infrequently they are encountered.

L. oblonga is one of the woodland species and a single specimen was taken in the Stanford flight interception trap, 7 – 29 Oct 2010. The species has previously been recorded from Santon Downham (VC 28) in the 1980s, also in a flight interception trap, and there is a record from Wayland Wood (VC 28) in 1997 on the NBN Gateway (2012) for which I have no further details at present.

MONOTOMIDAE

Rhizophagus perforatus* Erichson **Photo. p.64

Most species of *Rhizophagus* are found under bark, where they are thought to feed on fungi or other insects, but *R. perforatus* is mainly subterranean, occurring in decaying, mouldy organic material (Peacock, 1977). Single specimens were found in the Stanford flight interception trap during the periods 21 May – 4 Jun and 30 Jun – 21 Jul 2010, providing the first county records.

PTILIIDAE

**Acrotrichis rugulosa* Rosskothen

Featherwing beetles are very small, with most species being around 1 mm or less in length. The adult beetles and their larvae feed on fungal hyphae and spores and can therefore be found in a wide range of habitats including compost heaps, dung, rotten wood and fungi. They are not easy to identify, with the genus *Acrotrichis* in particular being notoriously difficult, and some coleopterists avoid collecting or trying to identify them completely.

Many of the old records are unreliable due to identification difficulties and taxonomic confusion. Colin Welch found many examples, both males and females, of *A. rugulosa* in a large vegetation litter pile at Swanton Novers Wood, VC 28 (TG0131) on 19 Jun 2010.

SCRAPTIIDAE

Anaspis thoracica (Linnaeus)

Notable A

Many species of *Anaspis* can be found in large numbers on hawthorn blossom and the flowers of Umbelliferae but *A. thoracica* is rarely found in numbers and it can be taken from foliage as well as blossom. The larvae have been found in rotten oak wood but almost certainly occur in the dead wood of other tree. Pope (1969) was the first to record this species in Norfolk. One male occurred in the Stanford flight interception trap, 27 May – 17 Jun 2011, and I also found two examples by beating dead ash twigs at Stanford, VC 28 (TL8494) on 12 Jul 2011.

Several species in this genus are superficially similar and the secondary sexual characteristics of the males, in the form of appendages on the sternites, need to be examined in many cases. The recent publication of a handbook on the British Scaptiidae (Levey, 2009) is a welcome aid to identifying beetles in this rather under-recorded little family.

STAPHYLINIDAE

**Batrisodes venustus* (Reichenbach)

Notable A

This nationally scarce species is nearly always found in ancient trees, especially oak and beech, often in association with the ants *Lasius brunneus* and *L. fuliginosus*, although *L. brunneus* has not yet been found in Norfolk (D. Wells, pers. comm.). A single example was found in the Stanford flight interception trap, 30 Jun – 21 Jul 2010.

**Coproporus immigrans* (Schulke)

This species was first found in Britain in 2009, in sievings from a woodchip pile, but the full details have not yet been published. This is the same habitat in which Bryan Sage found it at Swanton Novers Wood, VC 28 (TG0130), on 1 Sep 2011. More examples were found on 9 and 23 Sep and I took one specimen on 16 Oct (Sage, 2012b), all from the same woodchip pile. The species will no doubt soon become widespread.

**Euplectus infirmus* Raffray

Stuart Warrington of the National Trust set a small number of vane interception traps in trees in Sheringham Park, VC 27 in 2011 and Mark Telfer identified the beetles. Several species of interest were found, including one male specimen of *E. infirmus* in a trap in a fallen beech (TG1341), 12 Jul – 5 Sep 2011. Although not a scarce species nationally, this would appear to be the first Norfolk record.

**Microdota boreella* (Brundin)

This species has a mainly boreo-alpine distribution, with most records being from Scotland, including on snowfields, but it has also been found in southern English counties (Owen, 1992). Even allowing for the relative unpopularity of the aleocharine staphylinids due to identification difficulties, this species should probably have some form of Notable status, considering the small number of British records. Colin Welch found one female example in badger dung at Swanton Novers Wood, VC 28 (TG0130) on 19 Jun 2010.

Ocypus nitens (Schrank)

Notable A

A widespread but very local beetle, *O. nitens* has been found in a variety of situations so its habitat requirements are not certain. Edwards (1914) reported the first Norfolk occurrence of this species, from Costessey, by Thouless in 1905. Mark Telfer found one example under a log in Sheringham Park, VC 27 (TG 1241), on 13 May 2010, and another specimen was caught in a pitfall trap at the same locality, 10 – 14 May 2010.

**Planeustomus palpalis* (Erichson)

Red Data Book Category K (Insufficiently Known)

This odd-looking, very elongate little staphylinid is believed to live mostly underground in soft sediments near water, which no doubt accounts, at least partly, for its apparent scarcity. All records are from southern English counties. One specimen occurred in the Stanford flight interception traps, 4 – 18 Jun 2010, the most northerly British record to date.

**Pseudomedon obscurellus* (Erichson)

Notable

Formerly known as *Lithocharis obscurella*, this scarce species was found in Norfolk by Bryan Sage on 1 Sep 2011, in the same woodchip pile at Swanton Novers Wood that produced *Coproporus immigrans*. This species has been found in a wide range of habitats, including manure and compost heaps and also on bare mud and sand. A 2005 record on the northwest Norfolk coast attributed to Jon Webb, shown on the NBN Gateway (2012), appears to be an error (Webb, *in lit.*).

Zyras haworthi Stephens

Notable A

This striking, black and yellow staphylinid is associated with the ant *Lasius fuliginosus*, although it has also been found in other situations. It is a rare beetle, with most records being from southern England. Edwards (1893) reports this species'

presence in Norfolk, citing Stephens as the source, but no locality details are given. This was the only county record until a single example was caught in the Stanford flight interception trap, 21 May – 4 Jun 2010.

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Vascular plants

Bob Ellis & Richard Carter

In July 2011, Tim Inskipp spotted about 75 plants of **Marsh Sowthistle** *Sonchus palustris* standing up above the bank on the north side of Well Creek between Nordelph and Salters Lode. This is the first confirmed record for West Norfolk (vice-county 28) since the 19th century.

In March 2011 two independent reports were received of an attractive adventive member of the Boraginaceae, **Yellow Nonea** *Nonea lutea*. Both Alec Bull and Bill & Carol Hawkins saw it in the same gutter by a garage wall in a lane in Wymondham. Whether this is just a one-off casual occurrence or whether it becomes established remains to be seen. Apparently it has become an abundant weed in parts of Cambridge Botanic Gardens (pers. comm. A.E. & C.D. Hawkins).

Perhaps the most astounding and welcome record of 2011 was Emily Swan's discovery of **Broad-fruited Cornsalad** *Valerianella ramosa* in the same arable margin at Briston where she had found Narrow-fruited Cornsalad *V. dentata* the previous year. Prior to this, the most recent report for Norfolk was from High Kelling in 1941 (Beckett *et al.* 1999).

Another surprise was Robin Stevenson's find of a single plant of **Oak-leaved Goosefoot** *Chenopodium glaucum* at Burnham Overy. There are a number of 19th century records for it in this area (Burnham Westgate, Burnham Sutton and Brancaster, Nicholson 1914), but the most recent record for the county prior to this discovery was from Winterton Ness in 1962 (Petch & Swann 1968). There may have been more plants – it was growing with a great abundance of Red Goosefoot *C. rubrum* and other annuals on large area of

bare soil forming part of the renovation of the sea bank.

Hairy Bird's-foot-trefoil *Lotus subbiflorus* is a new species for the county, found on the edge of a grazing marsh, on and beside a rough track near a fence at Blakeney Freshes by Jo Lester and other members of the *Flora Group*. This was at about the furthest point from either Blakeney village or Cley, near where the Cley Channel and consequently the coastal path have been re-routed. This is a species that occurs as a native in the south and west of the British Isles, mainly on the coasts of Pembrokeshire, Cornwall, Devon, Dorset and Hampshire, as well as on the south coast of Ireland, the Isles of Scilly and the Channel Islands. So how has it arrived on the North Norfolk coast, has it been here long and will it persist? There were plenty of plants, most of which flowering and fruiting.

There were several records during 2011 of **Buttonweed** *Cotula coronopifolia*, mostly in localities from which it has not been previously reported. It has been known at Hickling NWT reserve since 2008 and from Heigham Holmes since 2009. Alex Prendergast added a new location for it at Hickling and Jeremy Halls reported a single plant from West Somerton. The *Flora Group* found it in a small scrape at Blakeney Freshes and in several places on private marshes at Salthouse. Finally, Simon Harrap reported it as frequent in the scrapes at Cley NWT reserve. It would be premature to demonise it as an 'invasive non-native species' at this stage and certainly at Salthouse there was no evidence of it competing with anything other than bare, somewhat brackish mud. It does, however, seem to favour nature reserves and is perhaps worth keeping an eye on.

In May, Bob Leaney reported the diminutive **Bird's-foot Clover** *Trifolium ornithopodioides* at Cromer, in mown grass by the boating lake, a 'new' 10km square for it. Bob also reported some new locations for **Norfolk Comfrey** *Symphytum* × *norvicense*, bringing the total to eleven locations 'in the wild'. Perhaps the most interesting of these was in Swardeston, where it has apparently been known since 1985 and has been regularly cut for compost.

Of the above mentioned plants, Broad-fruited Cornsalad is listed as Endangered on the Red Data List and Oak-leaved Goosefoot as Vulnerable. Other 2011 records in 'new' tetrads since *A Flora of Norfolk* for species classified as Endangered or Vulnerable on the Red Data List are as follows:

Critically Endangered

Shepherd's-needle *Scandix pecten-veneris*
Bintree, TG02B and C, in Triticale (Bob Ellis and Hatty Aldridge). This is the first record since 2000 in this northerly part of its range in the county. It was recorded in three nearby tetrads in *A Flora of Norfolk* (Beckett *et al.* 1999).

Endangered

Corn Chamomile *Anthemis arvensis*
Swannington, TG11P, on the edge of a sandy track.

Also at Lessingham, TG32Z, deliberately introduced in 'wild flower' seed mix (with Corn Marigold *Glebionis segetum*) in the churchyard and perhaps unlikely to persist for long.

Small-flowered Catchfly *Silene gallica*
Knapton, TG23W, more than 100 plants on steep rabbit-disturbed, southeast-facing slope of an old railway cutting. All were variety *quinquevulneraria*. It is surprising that there has been no report from here before as it is a reasonably large population in a well-visited site.

Vulnerable

Stinking Chamomile *Anthemis cotula*
Sea Palling, TG42I, in sugar beet. Well away from its usual range, but there was no indication that it was deliberately introduced.

Rye Brome *Bromus secalinus*
6 tetrads. Ashill TF80X, Holme Hale TF80Y, Hedenham TM39B, Seething & Thwaite TM39C, Ditchingham TM39G and H.

Good-King-Henry *Chenopodium bonus-henricus*
Blakeney TG04H, a few plants.

Frogbit *Hydrocharis morsus-ranae*
Norwich, TG20J, in the river Wensum where it is probably introduced.

Henbane *Hyoscyamus niger*
Old Buckenham, TN08U, in a field corner (*Flora Group*).

Smooth Cat's-ear *Hypochaeris glabra*
Hempstead TG03Y, in well-drained grassland on a hill.

Weasel's-snout *Misopates orontium*
Sparham, TG01U, on an allotment (Peter Lambley).
Wroxham, TG31D, in sugar beet (Bob Leaney).

Holly-leaved Naiad *Najas marina*
Filby Broad, TG41L (*Flora Group*).

Prickly Poppy *Papaver argemone*
Northwold, TL79I (*Flora Group*).
Swannington, TG11P, on the edge of a sandy track.

Small Water-pepper *Persicaria minor*
Grimston, TF62V (*Flora Group*)

Milk Parsley *Peucedanum palustre*
Ormesby Broad, TG41T (Bob Ellis & Abi Hemmant). Perhaps the area was not surveyed for *A Flora of Norfolk* as it is only accessible by boat, but maybe it has colonised here or appeared from the seed bank as a result of improvements to the

fen margin management by the Broads Authority.

Prickly Saltwort *Salsola kali* subsp. *kali*

Sea Palling, TG33R. It is possible that the protective reefs here have improved the chances of a strandline flora developing, but there was only one plant seen on this occasion.

Night-flowering Catchfly *Silene noctiflora*

Great Massingham, TL71Z, beside barley (Bob Ellis & Robin Stevenson).

Castle Acre, TL81C, in sugar beet (Bob Ellis & Robin Stevenson).

Elsing, TG01N (Peter Lambley).

Banham, TM08U and Z, in oilseed rape (*Flora Group*).

Witton, TG33K, in sugar beet, also a 'new' 10Km square.

Corn Spurrey *Spergula arvensis*

Bintree, TG02C, in triticale (*Flora Group*).

Old Buckenham, TM09K and TM08U, in sugar beet (*Flora Group*).

Hempstead, TG13D, in sugar beet.

Morton on the Hill and Ringland, TG11H, at the edge of parsnips (*Norfolk & Suffolk Bryology Group*).

Hoveton, TG31J, in barley (Bob Leaney).

Honing (Crostwight) TG33F (Bob Leaney).

Witton and Walcott, TG33K, in sugar beet.

Lessingham, TG32Z, in barley stubble.

Sea Palling, TG42I, in sugar beet and in wheat.

Fleggburgh, TG41L, in barley (*Flora Group*).

Marsh Stitchwort *Stellaria palustris*

Geldeston, TM49A (Chris Romer)

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Fungi

Tony Leech

Mycologists are probably the only naturalists who enjoy wet weather, or at least hope for good rainfalls through the summer and autumn. In 2011 this was not to be and on some public forays in October we were struggling to make double figures with agaric species. Notwithstanding, there were additions to the county list and a variety of interesting records are described below or listed in Table 1.

Fungi with teeth

Mushroom-shaped fungi have evolved to produce vast numbers of spores and drop them into the air currents that will carry them to new sites. Most use gills to increase their spore-bearing surface area but a smaller number (the boletes) use tubes, packed tightly under the cap, a device also employed by most bracket fungi. But there is a third way of creating a large surface area – by employing downward-pointing fleshy spines on which the spores develop. Relatively few fungi have developed such ‘teeth’. One, the Earpick Fungus *Auriscalpium vulgare*, is common, stunningly beautiful, but so small (it grows on pine cones) that it is easily overlooked. The mushroom-sized Wood Hedgehog *Hydnum repandum* is quite scarce in Norfolk and the rest scarcer still. Several of the white bracket-like tooth fungi have recently made an appearance in the county (Table 1 and Leech 2011) but one that we did not expect to see was Bitter Tooth *Sarcodon scabrosus*, found by Anne Crotty in the woods at St Faith’s Common (TG1817) last autumn. This stocky fungus, pale brown and with a somewhat scaly cap (photograph on inside back cover), has been recorded in Caledonian pine forests and in southern England (Berkshire, Surrey, Kent and Hampshire) where it occurs not with pine

but with Sweet Chestnut (and occasionally oaks). This disjunct distribution with two very different mycorrhizal hosts suggests that more than one species is involved which is why Dr Martyn Ainsworth is undertaking DNA sequence analysis on these fungi at the Royal Botanic Gardens, Kew. It is good to know that Norfolk is contributing – and that the county has another Biodiversity Action Plan species to look after.

Coprinopsis update

In the 2010 Fungus Report the finding of a dung fungus on a henhouse in Briston (TG0632) was described (Leech 2011). Laslo Nagy, to whom the fungus was sent, is of the opinion that the fungus is indeed *Coprinopsis rugulobisporus* despite the unusually large spores. As such it is now recognised as the first British record, but the last word may not have been uttered – there is a report of a large-spored ‘*C. rugulobisporus*’ in Canada that may yet be described as a new species. See back inside cover for photograph.

New sites for Sandy Stiltballs

Imagine a puffball developing underground. As the spores ripen, a rod-like stalk grows rapidly upwards to push the orange-brown spore-mass through the ‘skin’ of the puffball and several inches into the air and you have a Sandy Stiltball *Battarrea phalloides* (see photograph on inside back cover). This distinctive fungus was first described (in 1784) from specimens collected near Bungay and has remained an East Anglian speciality ever since (but with a slowly increasing number of records from elsewhere in southern England).

For a century until the 1990s the Sandy Stiltball had hardly been recorded in

Table 1. New records for some scarce Norfolk fungi (in addition to those described in the text). ARL = Tony Leech.

Species	Place	Collector [Identifier if different**]	Previous Norfolk sites	Habitat
<i>Agaricus phaeolepidotus</i>	Hempstead TG1036 Roughton TG2138	David Longden [ARL]	0	Hedgerow Grass verge.
<i>Agaricus phaeolepidotus</i>	Dinosaur Park, Lenwade TG1017	Tony Leech	2 (above)	Grass verge.
<i>Boletus moravicus</i>	Ken Hill Woods TF6634	Foray [ARL]	0	Leaf litter
<i>Boletus satanas</i> Devil's Bolete	Bunwell TM1094	Anthony Anson	2	Verge
<i>Clitopilus pinsitus</i>	Netherwood Green TG2306	Anne Crotty	1	Base of Beech stump
<i>Entoloma atrocoeruleum</i>	BTO Reserve, Thetford TL8680	Tony Leech	0	Rabbit-grazed grassland
<i>Geopora tenuis</i>	King's Lynn TF6219	Anne Crotty	2	Urban tree pit, with birch
<i>Gymnopus quercophilus</i>	Dinosaur Park, Lenwade TG1017	Tony Leech	0	Dead oak leaf
<i>Hemipholiota populnea</i>	Trowse Woods TG2506	Anne Crotty	1	?Poplar log.
<i>Hericium cirrhatum</i> Tiered Tooth	Newton St. Faith TG2116	[Jonathan Revett]	2	Old sycamore trunk
<i>Hypoxylon macrocarpum</i>	Holt Hall TG0739	Tony Leech	0	End of sycamore trunk
<i>Leucocoprinus birnbaumii</i> Greenhouse Dapperling	Whitlingham TG2707	Anne Crotty	2	Indoor plant pot
<i>Mycena diosma</i>	Holt Country Park TG0837	Foray [ARL]	0	Woodland
<i>Peziza granularis</i>	Wigston Villa TL5294	Jonathan Revett	0	Bare soil

Britain at all but then, within the space of about ten years, it was found in five places in Norfolk, all of them on roadside banks or verges. Now, in 2011, two further sites have been added. The first was discovered by Peter Lambley in July not far from his home in Lyng, also on a roadside bank (TG0617). The second site, or sites as there were six 'colonies' along a 2 km stretch of road (TM3892), was only 5 km from Bungay and could conceivably have been the site of the first discovery of the fungus. These were found by Neil Mahler, Suffolk county fungus recorder, who counted a total of 26 specimens. See inside back cover for photograph.

Amazing amanitas

2011 could go down as the year of the Fly Agaric *Amanita muscaria* as they fruited in

abundance. Nowhere more so than Felbrigg where Jonathan Revett found more than thirty under a beech tree, with the nearest birch, their normal mycorrhizal host, some 300 metres away. Amanitas are a varied group; some are very common, others very rare; some are deadly, others good and edible. They are all large (as agarics go) but the recent publication of an identification guide to the genus (Kibby 2012) has revealed that at least 42 species occur in Britain and given us a sporting chance of correct identifications. With its aid, and guidance from author Geoffrey Kibby himself, it has been established that the mystery amanita found by Janet Metcalfe (Leech 2011) is in fact *Amanita lividopallescens* and a new county record.

A second amanita puzzle has also been solved by this publication. On a foray at Ken

Hill Woods (TF6634), near Dersingham, in October, Doreen Errington and Billy Read collected a ringless amanita with an orange-brown cap, not unlike Snakeskin Grisette *A. ceciliae* but with a much darker pattern on its stem. It turned out to be *A. betulae*, as yet little recorded in Britain but probably quite widespread.

Spots and dots

Numerous fungi are too small to catch the eye of the casual observer but many of these have been well-recorded in Norfolk thanks to the efforts of the late Ted Ellis. His interests, however, apparently did not extend to the many fungi that occur on herbivore dung. These are rarely apparent in the field but appear on samples kept moist in sealed containers, which was how *Schizothecium tetrasporum*, collected on Rabbit dung at the BTO Nunnery Reserve (TL8680) at Thetford in July, was added to the county list (photo opposite). It was initially suspected that *Cephalotrichum purpureofuscum* (on Reeve's Muntjac dung collected at Dersingham Bog NNR (TF6628)) would also be a new county record but Ted Ellis had got there first, recording it at Hellesdon in 1945 on rotting cabbage stems; it is less specific than most fungi.

A significant number of fungi grow on other fungi; some are truly parasitic while others, found on more persistent fruitbodies, only develop on the dead 'host'. At a foray at Bergh Apton (TM3199), several dried fruitbodies of Bearded Milkcap *Lactarius pubescens* were found, their gills covered with small ochre spheres, not unlike closely-packed moth eggs. These were the perithecia of *Hypomyces spadiceus*, not previously recorded in Norfolk and with as few as eight records on the national database (photo opposite). As so often happens with such finds, the same fungus, on the same host, was collected a few weeks later at Pensthorpe (TF9428). Later in the season, close examination of an old Smoky Bracket *Bjerkandera adusta* at Holt Hall (TG0739) revealed clusters of tiny black

perithecia, each bearing a few wispy hairs, later identified as *Melanospora lagenaria*, also new to Norfolk.

New brackets

In contrast to the above, bracket fungi are never small and can produce some of the largest fruiting bodies of all fungi. This does not always make them easy to identify but Anne Crotty's perseverance paid off as she added three more to the Norfolk list this year. Beeswax Bracket *Ganoderma pfeifferi*, found on living Beech at Trowse Woods (TG2506), is mostly recorded from southern and south-eastern England with very few records further north than Norfolk. It is one of the shiny-crusting ganodermas, all scarce. Another large (and shiny) bracket, the Red-belted Bracket *Fomitopsis pinicola* is a more northerly distributed species, rarely recorded in Britain and then mostly, as here, on structural timber, in this case on two gate-posts at Whitlingham Woods (TG 2607, 2707). The identification of both of these was kindly confirmed by Dr Martyn Ainsworth.

The final new species, *Antrodia serialis*, is smaller, whitish and much less bracket-like, and was found on a pine stump at Reffley Wood (TF6522). Anne also found the Brownflesh Bracket *Coroleopsis gallica*, a rarely reported medium-sized hairy bracket, on dead Sycamore wood at Whitlingham (TG2607). There is one previous Norfolk record for this species, from near Grimston in 1985 on unspecified dead wood.

References

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- LEECH, A.R. 2011 Fungus Report 2010. *Trans. Norfolk Norwich Nat. Soc.* **44**: 100-104

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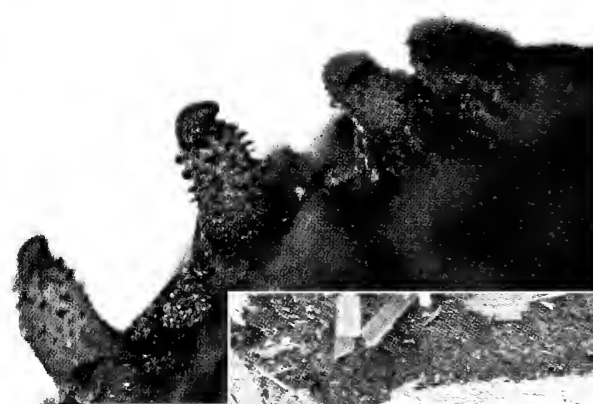


Above: **Bitter Tooth** *Sarcodon scabrosus*. Found by Anne Crotty at St Faith's Common, 100 km from the next nearest record (see p.118). *Tony Leech*.

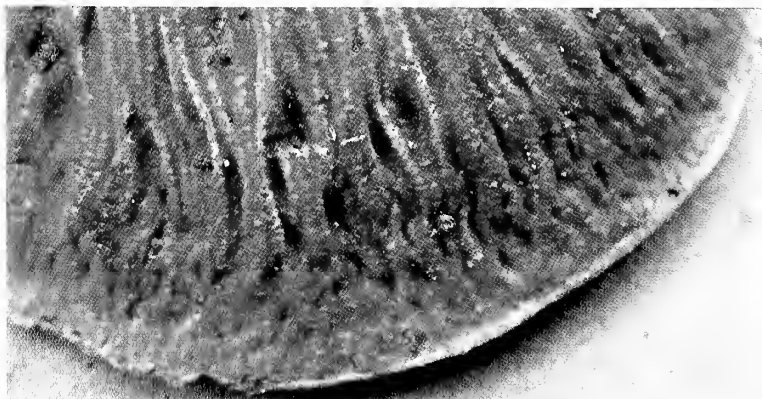
Left: **Sandy Stiltball** *Battarrea phalloides*. New site near Bungay (see p.119). *Neil Mahler*.



Left: *Amanita lividopallescens*. Found by Janet Metcalfe at Barnham Broom. New for Norfolk (p. 119). *Tony Leech*.



Left: *Schizothecium tetrasporum*. On Rabbit dung collected at The BTO Nunnery Reserve, Thetford. Less than 1mm high. (see p.120). *Tony Leech*.



Perithecia of *Hypomyces spadicea*. Covering the gills of a Bearded Milkcap *Lactarius pubescens* at Bergh Apton (see p. 120). *Tony Leech*.



Coprinopsis rugulobisporus. An inkcap new to Britain found on a hen-house at Briston (see p.118). *Tony Leech*.

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