TRANSACTIONS of the NORFOLK & NORWICH NATURALISTS' SOCIETY

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Blakeney Point Centenary Volume

TRANSACTIONS OF THE NORFOLK & NORWICH NATURALISTS' SOCIETY

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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.

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Special volume to celebrate 100 years of ownership of Blakeney Point by the National Trust

Cover: **Lifeboat Station on Blakeney Point with a carpet of Common Cats-ear *Hypochaeris radicata*.** *Richard Porter*

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The President 2012-13, Mr. Norman Sills ,was unable to deliver a Presidential Address.

The saga of Foxley Woods

Alec Bull

Moira Worland, Director of Norfolk Naturalists' Trust [as it then was] announced that the Trust had bought Foxley Wood and is quoted as saying "The careful management of Foxley Wood for several hundreds of years has preserved it as an invaluable source of knowledge about the effects of woodland management, as well as a place of great beauty".

Eastern Daily Press
24 November 1988.

This statement could only have applied to the two compartments retained by the owner when the remainder of the wood was leased out. Back to 1965, when the author had recently bought his first car, a day trip was made to the North Norfolk coast returning home across country. Referring to my diary for that day, 5 March, a note states: 'between Themelthorpe and Foxley we passed a large wood with a wide verge stretching for more than 100 yards, packed from end-to-end with huge oak trunks awaiting collection en route to the sawmill'. The wood itself was a scene of devastation as it had been a very wet season and the deep tracks made by tractors pulling the trunks out were filled with vast pools of water, the whole scene similar to the trenches in France during the First World War.

In late 1967 we moved to the village of Foxley and during the spring of 1968 a surreptitious visit was paid to the wood to see if any ground flora had survived such treatment. Amazingly, the scars were healing well and the tracks and rides were already coming into bloom with an obviously rich woodland flora. A letter was sent to the Nature Conservancy Council offices in Bracondale, Norwich, asking if Foxley Wood had any conservation status. A reply was received from Dick Hornby (later Dr. Hornby) stating that the wood had been an SSSI for a number of years on account of the large number of ancient oaks, but as these had all been felled a few years previously the NCC was considering whether to de-schedule the site as they had no information on the ground flora. If information could be provided, however, the NCC would be very happy to maintain the wood's status as an SSSI.

At that time the wood was owned by Dixon Spain Estates from Thorney near Peterborough, whose name and address was sent me by Dick Hornby, and a permit to visit the wood for the purpose of recording the flora and fauna was applied for. This was readily granted and the acquaintance was soon made of Dixon Spain's gamekeeper and woodman, dear old Jimmy Bartrum, who looked after the two retained compartments within the wood, the remainder being leased by the Forestry Commission. Jimmy was a great source of information of all kinds regarding the wood, from the former presence of Purple Emperors, *Apatura iris* ["They had a King oak and they used to fly round that as big as a bat"], to the identity of a fruit tree in the middle of the wood. The author and the late Eric Swann were not certain whether it was an apple or a pear at the season of their visit. When asked, Jimmy replied, "That's a William Gladstone [an old type of apple] planted by old Clarke [Jimmy's predecessor]".

During the remainder of 1968, and much of

1969, as much time as possible was spent in the wood, recording everything that could be found in each of the compartments. Eric Swann accompanied the author on a number of occasions to help with the mosses and liverworts, the overall survey being confined to those compartments which had not already been coniferised. A report was written and sent in January 1970 to Dick Hornby, who in turn passed it on to Dr George Peterken at the Nature Conservancy's Monks Wood Experimental Station. Dr Peterken visited the wood on a number of occasions, on one of which he was accompanied by Dr Oliver Rackham.

A copy of a 12-page report by Dr Peterken, dated 6 July 1970, for Dick Hornby, acknowledges a "Foxley Wood report dated Jan 19th 1970 by Mr A Bull", together with letters from the author dated 15 and 17 June, and a letter on the butterflies of Foxley from Mr D. Ruthven dated 5 June 1970.

A copy of another report sent to Norfolk Naturalists Trust by Dr John Barkham, detailing research being carried out in the wood by the University of East Anglia was also received by the author, via Dick Hornby.

A meeting was arranged in the wood during the autumn of 1970 that was attended by Dr Peterken, Dick Hornby, Peter Stevens (then Conservation Officer of the Norfolk Naturalists' Trust), officers of the Forestry Commission, Mr Dixon Spain and the author. During this meeting, all aspects of the woodland and its future management were discussed. During the course of the meeting, the author as approached by Mr Dixon Spain who thanked him for his work in surveying and recording the plants etc. He explained that he had, in good faith, sold a lease to an unnamed gentleman which allowed him to fell mature trees and replant as was appropriate. In the event he had felled all the mature trees outside the retained compartments and passed on the lease to the Forestry Commission to do the replanting, which at that time, meant coniferisation. On 4 December 1970, a further meeting was held in the wood between Dr. Peterken, Dick Hornby, and for the Forestry Commission, K.P. Thallon, F.M. Kew and Mr Lofthouse, to discuss in detail the management plan suggested by Dr Peterken.

A further report from Dr. Peterken via Dick Hornby dated January 1971 includes the suggestion that he assumes that the Forestry Commission will now be prepared to plant hardwoods and adds that at least part of the wood should become a nature reserve.

Finally a completed management plan was received dated 20 February 1974 and signed by the Forestry Commission's District Officer D. McIntosh.

The nature reserve idea obviously stayed in Mr Dixon Spain's mind, although there were family reasons for retaining the wood for as long as possible – the ashes of a Dixon Spain ancestor had been scattered in the centre of the wood in a small compartment then called the 'Sacred Ground'. When, however, the Forestry Commission's lease expired in 1988, the whole wood was offered to the Norfolk Naturalists Trust as the preferred buyer. Had the deal not gone ahead, the probable purchaser might well have been the Forestry Commission who would still have been subject to the agreed management plan.

The initiative by Dick Hornby in approaching the leading woodland ecologists of the day almost certainly saved Foxely Wood from being totally coniferised. This was, of course, 18 years before Norfolk Naturalists Trust were able to buy the wood.

The culmination of the Saga of Foxley Wood came on 22 May 2002 when it was declared a National Nature Reserve.

Alec Bull, Hillcrest, East Tuddenham, Dereham, NR20 3JJ.

An analysis of the water bodies and water beetles (Coleoptera) of the Stanford Training Area (STANTA), Norfolk

Bryan Sage

Summary

A total of 139 species of water beetle have been recorded on that part of STANTA defined in the Introduction. Ten species were found only in the River Wissey, streams and ditches, and two further species in non-pond habitats. This leaves 127 species recorded from a total of 54 ponds, meres etc. A total of 38 species are classed as Critically Endangered (1), Vulnerable (4), Near Threatened (16) or Nationally Scarce (17). The distribution by site of the 127 species is shown in Appendix 6, and various analyses of this data are presented in Appendices 7-12. The 12 most widely distributed species are *Agabus bipustulatus*, *Colymbetes fuscus*, *Enochrus nigritus*, *Haliplus ruficollis*, *Hydrobius fuscipes*, *Hydroporus planus*, *Hygrotus impressopunctatus*, *Hygrotus inaequalis*, *Hyphydrus ovatus*, *Ochthebius minimus*, *Rhantus exsoletus* and *Rhantus frontalis*. The ten highest scoring sites in terms of the number of species are Sturston Nursery 4 (89 species), Bagmore Pit (81), Sturston Nursery 3 (80), Sturston Nursery 7 (63), West Mere (55), Reed Fen (54), King Edward VIII 1 (51), Mortimer's Mere (50), Smokershole (43) and Sturston Nursery 6 (42). Important pond complexes are found at Tottington (29 species), Sturston Carr/Nursery (20) and Bagmore Pit (18). Attention is drawn to the fact that the 54 ponds etc. covered in this survey represent only 27% of the approximately 200 actual or potential water beetle sites in the area.

Introduction

The Stanford Training Area (STANTA) is part of Norfolk Breckland and, excluding what is known as the Northern (Hilborough) Extension to the north of the B1108 road, covers an area of some 8,561ha (21,154 acres), including leased and licenced land. This is the area covered by the present paper. The central core of Breckland grassland and heath was first notified as a Site of Special Scientific Interest (SSSI) in 1971 and renotified in 1985. A number of areas around the margins of this site were deleted in 1985, and others were added in 1999. The last site review by English Nature was in March 1999. The SSSI currently covers 4,681ha (11,567 acres) and the area is classed as a Grade 1 Nature Conservation Site.

This is an opportune point at which to carry out a review of the water beetles of STANTA since there are hundreds of records accumulated over a period of around 40 years that have not previously been analysed in detail. Furthermore, as discussed below, the aquatic habitats of the area are in a constant state of flux. Sometimes, for example, this is because the quality of the water changes, causing some species intolerant of the change to disappear whilst others adapted to the new conditions move in and colonise. However, even bigger changes may occur in the future, both locally and on the broader geographical scale as a result of climate change, in which case this review could be of use in measuring the effects of these changes. The primary purpose of this review is to identify which are the most important sites for water beetles within STANTA and to examine various aspects of the distribution and ecology of these beetles. Nomenclature follows Foster & Friday (2011) and Foster & Friday (in press). When

planning this analysis two fundamental questions immediately came to mind: first, what is a water beetle; and, secondly, how many water bodies, in the broadest sense, are there on STANTA? Both these questions are addressed below.

As will be shown later, there are a number of sites which have a high score (60, 70 or 80) in respect of the number of species recorded. As will no doubt be readily appreciated this does not mean that visits in any one year will yield similar numbers (for various reasons, some of which are mentioned above). This is very much a historical analysis and some species have not been recorded for many years. This does not necessarily mean that they are not still present as several factors may play a part, particularly recording effort and habitat condition.

A total of 139 species have been recorded in the area defined above and these are listed in Appendix 1, which also shows the habitat preferences for each species at the national level, and which species were recorded in pingo ponds in East Anglia by Foster (1993) – amounting to 104 (75%) of the total. There are two taxonomic points that need explanation. The first concerns the hydroporine genus *Suphrodytes*. Recent DNA studies have established that there are two species, *S. dorsalis* and *S. figuratus*, previously represented by *S. dorsalis sensu lato* (Foster & Friday 2011). Both species occur in lowland pools and fenland ditches in part shade, the two often coexisting. Until such time as all pre-2011 records can be re-assessed it is not known whether or not both species are present at STANTA (both species are listed in Appendix 1, but all the writer's specimens have proved to be *S. figuratus*). The second point concerns the hydrophilid *Enochrus nigritus* which, until 1984, was confused with *E. affinis*. All STANTA records have been referred to the former, and at the time of writing the true *E. affinis* has not been recorded in Norfolk. Finally, specimens from STANTA originally determined as *E. isotae* have been referred to *E. nigritus*, of which *isotae* is now regarded as a synonym.

There appear to be only three published papers or notes concerning water beetles at STANTA. The first is that of Palmer (1981), which deals with a survey of the aquatic fauna and flora in 1976-1977. A total of 38 ponds were sampled, as well as ditches, streams and margins of the larger water bodies, and 77 species of water beetle were recorded. It was found that shaded ponds contained few macrophytes and invertebrate species, but 43 species of beetle, 12 species of Hemiptera and 23 species of macrophyte were found in the richest water body. This site was Bagmore Pit (TL862924). The second paper, by Foster (1986), discusses the result of site visits made in April 1981 and March and August 1986 which together resulted in the number of species recorded from STANTA increasing from 77 to 111. The third paper, by Collier & Sage (2005), deals with the discovery of the rare aquatic weevil *Bagous lutosus* at what the authors named Mortimer's Pond but should more accurately be referred to as Mortimer's Mere. The presence of a number of uncommon water beetles is also mentioned.

Some minor corrections need to be made to Table 1 in Palmer (1981). In column d the total number of species listed is 3, not 4 as shown. In column I it should be 4 not 5 species, and in column j 7 not 6 species. In the column headed R. Wissey & streams the number of species listed is 32 and not 30 as shown. The record of *Ilybius aenescens* from Fowlmere was subsequently referred to *Ilybius guttiger* by Professor Garth Foster. Finally, it should be noted that two of Palmer's species are not regarded as water beetles for the purposes of the present paper. The species in question are *Cercyon marinus*, which is usually found in damp litter in marshes (found by Palmer in Reed Fen) and *Cryptopleurum minutum*, which is found in horse dung and decaying

vegetation, overwintering in grass tussocks, moss etc. (collected at Bagmore Pit and Tottington 3).

Defining a water beetle

Defining what should be included in the term 'water beetle' can present problems, despite the fact that many people think they know what a water beetle is. Many species of beetle are obligately associated with water and there is a continuum from those that are found throughout their life-cycle under water, through those that pupate out of the water but are aquatic as both larvae and adults (the majority), and on to those that live in the water as larvae but are found above and away from the water as adults (Foster 2010). In the first category are the reed beetles in the genus *Macroplea* (Chrysomelidae: Donaciinae) which are not known from STANTA. Also in this category are a few weevils, particularly of the genus *Bagous* (Curculionidae: Bagoinae). Two species, *Bagous limosus* Notable B and *Bagous lutosus* pRDB1, have been recorded. Professor M.G. Morris took *Bagous limosus* at West Mere on 21 September 1966, and Martin Collier (MC) found it at Mortimer's Mere on 14 July 2005. The author found *Bagous lutosus* at Mortimer's Mere on 22 June 2004, and MC recorded it there on 20 and 28 July. Neither of these groups is considered further in this review. Also excluded here are the species in the last category which comprises the family Scirtidae and many plant-feeding species, particularly the reed beetles of the genera *Donacia* and *Plateumaris*, five species of which have been found at STANTA. The adults are often found resting on the foliage of water plants at the margins of lakes and rivers. This review is concerned with those species that fall within the second category, which comprises the Hydradephaga, that is to say the aquatic members of the sub-order Adephaga – Dytiscidae, Gyrinidae, Haliplidae, Noteridae and Paelobiidae. Also included are several families of Polyphaga – Dryopidae, Elmidae, Georissidae, Helophoridae, Heteroceridae, Hydraenidae, Hydrochidae, and the aquatic Hydrophilidae

How many ponds etc. on STANTA ?

This may seem a fairly easy question to answer, but that is far from being the case. The obvious approach is to use the relevant large-scale Ordnance Survey map and count the number of water bodies that are shown thereon. However, any answer obtained by this method will be far from accurate for several reasons. It was found that some sites shown on the map had not contained any water for many years, in some instances not in living memory. Conversely, various sites that did have water in them when visited were not shown on the map. These problems largely concern very small sites such as shell/bomb holes etc., although one recent edition of the OS map does not show Fowlmere, which is fairly large, but was presumably in one of its dry phases when the (aerial ?) survey was carried out. Fortunately, Nick Gibbons (NG), in the course of research on the amphibians and reptiles, used a GPS (and later other precise methods) to record the exact location of every site visited, which resulted in a total of 199 water bodies. However, not all of these contained water when visited. The map references and site names used in the present paper are those established by NG (unpublished MS).

Wetland habitats

The mosaic of habitats at STANTA includes areas of standing water of varying sizes (including meres), wetlands, springs, ditches, minor streams and the River Wissey. The fluctuating meres are fed by groundwater from the chalk aquifer and are internationally important. The majority of these habitats were largely unaffected by drainage, pollution, eutrophication or water abstraction until about the early 1990s, but water abstraction has increased considerably in more recent years and is now a threat. The water bodies undergo considerable change

over time due to the natural processes of silting and succession. In the case of Stanford Water the rate of silting increased rapidly following the construction of a fixed weir in the 1970s. The River Wissey itself suffers to some extent from pollution and silt carried down from upstream, but many of the side streams contain very clear water and have gravelly beds. One of the main tributary streams of the River Wissey flows from Thompson Common (outside the area to the east) via Thompson Water, Tottington, Sturston Carr, Stanford Water and on to Buckenham Tofts, finally joining the River Wissey below the second weir. The long narrow lake at Buckenham Tofts is simply a widening of this stream controlled by two sluices that hold the water back. There are a number of areas of mixed fen in the Wissey Valley. Swamp vegetation has developed around several of the non-fluctuating meres/ponds. The artificial non-fluctuating water bodies also possess well-developed marginal vegetation The most extensive type of wetland in the area is wet carr woodland, largely dominated by Alder *Alnus glutinosa* and birch *Betula* spp., with sallows *Salix* spp. most abundant on the margins. The finest example of this habitat is at Sturston Carr. As mentioned above, many 'ponds' are quite small and are mostly shell or bomb holes. More often than not they are dry, or only contain water for very short periods.

Photographs of some of these water bodies can be found on pp. 34-35.

Ponds are species-rich habitats and have been estimated to support at least 66% of the aquatic taxa that are native to the United Kingdom including, amongst other groups, invertebrates and macrophytes (Williams *et al.* 1997). Also, many species found in ponds have significant rarity value and according to Pond Conservation (2008) ponds support approximately 80 UK Biodiversity Action Plan (BAP) species. However, it has to be remembered that over decades or more ponds are essentially ephemeral habitats that normally undergo succession to fen, swamp and/or wet woodland, unless subjected to remedial management.

The classification of standing water bodies

In the paper by Palmer (1981) the lakes, meres and ponds are divided into five categories:

1. Large artificial water bodies (West Tofts Mere, Stanford Water, Thompson Water, Sturston Carr 1 (Warren Marsh) and Bagmore Pit). Stanford Water was originally a small mere that was converted by the then Lord Walsingham about 1847. At the same time he created Thompson Water (Clark 1925). There have been differing opinions regarding the origin of Bagmore Pit; Palmer (1981) classed it as an artificial water body, Foster (1986) referred to it as a marl pond, and Lambley (1994) stated that it is a natural lake. I believe it to be a true fluctuating Breckland mere fed by groundwater from the underlying chalk aquifer. Particular features of this mere are the very large tussocks of Tufted Sedge *Carex elata*, some of which may be 50-100 years old, and some large stands of Common Club-rush *Schoenoplectus lacustris*.
2. Large fluctuating meres (Fowlmere, West Mere and Home Mere).
3. Possible small fluctuating meres/ponds (SE of Mousehall, Mousehall (2), west side of Bagmore Road, Madhouse South and near Sturston Nursery).
4. Heavily shaded ponds (not 'fluctuating') - a total of nine sites.
5. Other ponds (not heavily shaded, not 'fluctuating') - a total of 15 sites.

Pingo ponds

The various types of periglacial landforms found in Norfolk, including pingos, and their ecological importance, have been discussed in detail by Walmsley (2009). Pingo is a word of Inuit origin meaning small hill or conical hill. The finest example in

Norfolk of an intact system of pingo ponds is on Thompson Common, which is adjacent to the eastern boundary of STANTA. The pond system on the common extends into the military area, a good example being the ponds in and near Waterhouse Plantation. Despite the fact that these ponds must be fed by groundwater, there are no obvious springs or flushes associated with the Thompson Common pingos. The pingo ponds are typically very shallow and are thus unsuitable for the larger species of diving beetle, or for the whirligig beetles (Gyrinidae). Foster (1993) noted that the pingo systems of Norfolk are dominated by nationally rare species of water beetle. They are considered to be the remnants of early post-glacial biota. Reference to Appendix 1 shows that of the 139 species of water beetles recorded at STANTA, 104 are known to be associated with pingo ponds. A total of 30 (29%) of the latter species fall into the following categories – Near Threatened (NT) 13 species; Nationally Scarce (NS) 12; Vulnerable (VUL) 4; Critically Endangered (CE) one species.

Pond complexes

There are three of what are best referred to as 'pond complexes', the most important of which is at Tottington, where there are 29 ponds in total, including two that were cleared and enlarged in the 1990s. There are also a number of ditches and boggy pastures.

Since about 2000 there has been an ongoing programme of pingo/pond restoration, aimed at improving the habitat for Great Crested Newt. This work has been centred around Tottington and the Madhouse/ Waterhouse Plantations (Ian Levett *pers. comm.*). Tottington was formerly a thriving village lying on either side of the stream from Thompson Common to Buckenham Tofts, mostly very low lying but with the farmsteads on somewhat higher ground. Some of the many ponds were intermingled with the cottages. This area is well described by Bull (2011). The second complex is at Sturston Carr/Sturston Nursery, where there are 20 ponds in total. Included in this complex is a series of pools along an old ditch line, a flooded ditch system, and a spring and ditch system. The largest pond is Sturston Carr 1 (Warren Marsh) on the north side of Sturston Carr. The third complex is at Bagmore Pit (TL862924), around which are scattered about 18 ponds of varying size.

The Meres

As mentioned above, Palmer (1981) listed a total of nine fluctuating meres, to which I believe Bagmore Pit should be added, bringing the total to ten. I consider, however, that a further four sites must now be included here (Corkmere Bottom 1, Mortimer's Mere, Sturston Carr 7 and Sturston Nursery 4), raising the total to fourteen. The Breckland meres were the subject of a detailed report by Watson (1974), who listed twelve semi-permanent meres in Norfolk, several of which were in the military area.

The unpredictable fluctuations in water level have been known and commented on for centuries and have been well documented. For example, in 1882 Ringmere was a deep lake, from 1901-1903 it was completely dry, but then full again in 1904. In July 1950 it was so full that it overflowed the Hockham road. Fowlmere was reported as being dry in 1859, and during another dry period in 1906 the bed was ploughed and a good crop of swedes and cabbages were grown there (Cook 1956). About a decade ago the mere at Corkmere Bottom was so full it overflowed the road for two or three months during the summer (see the photograph facing p.18 in Bull 2011).

In spite of the groundwater, the fauna is one of temporary waters and the ponds need to dry out in order to provide the conditions appropriate for so many beetles (Eyre, Carr, McBlane & Foster 1992). It is a question of degree. At the present time it is not unusual for ponds/meres to be without

water for two, three or more consecutive years. But, whilst the fauna and flora of these fluctuating water bodies are well adapted to the periodic drying out, long periods of dryness may well affect the water beetles, particularly those species that are flightless, such as *Agabus labiatus* and *A. undulatus*.

A check on 29 December 2011 covered Corkmere, Fowlmere, Mortimer's Mere, West Mere, the Tottington Hall pond complex, the Bagmore Pit complex, the Sturston Carr/Nursery complex, and the ponds in the Mousehall area – all were bone dry. The only exception was Sturston Carr 1 (Warren Marsh) which had been reduced to a few very shallow pools. It is likely that all the other ponds that were not visited were also dry. in January 2012 Norfolk and other parts of East Anglia were in the grip of the worst drought conditions for 91 years.

By contrast, the summer of 2012 was the wettest in England and Wales for 100 years, and the fourth wettest since 1727; by the end of December 2012 had been the wettest on record for the UK overall. It was reasonable to suppose that this level of rainfall would have a major impact on water levels in the meres and ponds of STANTA. On 16 December 2012 a check was made of 21 sites of which five were found to be completely dry – Corkmere Bottom, Home Mere, Mortimer's Mere, Sturston Carr 7 and Tottington Hall 5. Bagmore Pit 4 had a small area of shallow water in the centre. Similarly, King Edward VIII-2 had just a few centimetres of water in the bottom. The remaining sites varied. Blacklands 4 was 33% full, Sturston Carr 1 was 25% full, and Tottington Hall N was 75% full. The following 12 sites were completely full – King Edward VIII-1, Lake Plantation , Smokershole, Sturston Nursery 3, Sturston Nursery 4, Tottington Hall S, Tottington Hall 13, Tottington Hall 14, Tottington 4, Tottington 7 and West Mere. Fowlmere was checked by Peter Feakes on 23 December and was found to be half full. It is interesting to note that ponds in close proximity, as for example at Sturston and Tottington, varied from dry to full. The River Wissey was topping its banks in the Langford area on 16 December and the adjacent water meadow was also extensively flooded. All streams and ditches throughout the area were at top water level. It may be noted that on 7 April 2013 Bagmore Pit was so full that the water almost reached the nearby road, and many of the large sedge tussocks on the lake bed were almost completely submerged.

The extent of recording

The total number of water bodies on the training area is about 200, many of which are likely to be dry at any one time, and this analysis shows that there are water beetle records for only 54 (27%) of these sites.

Excluding ditches and the River Wissey, Palmer (1981) presented records from 38 sites: in two (Blacklands 4 and Stanford Water) no water beetles were found, and there are still no records for these sites; 16 sites where beetles were found appear to have no later records, while a further 20 sites have subsequent records. In addition to these, there are 16 sites which were not included in the 1976-1977 survey for which records are now available. Palmer (1981) gives neither site names nor map references, but the author subsequently provided some site names and all the relevant map references. In the interests of completeness and to assist future researchers, a revised version of the relevant section of Palmer's Table 1 is included here as Appendix 2, and a complete list of the 54 sites mentioned above is given in Appendix 3. The site names, map references and pond numbers shown in this appendix are those established by Nicholas Gibbons. Records of Dytiscidae larvae not specifically identified have been ignored.

Looking at the figures geographically, the complex of ponds in the Tottington Hall area is the most important in terms of the number of ponds. However, out of the

total of 29 ponds in this complex only 11 (38%) have been checked for water beetles and in the case of two of these the records date back to 1976-1977. In the Sturston Carr/Nursery complex there are 20 sites, of which nine (45%) have been sampled. In the Bagmore Pit complex 8 (47%) of the 17 sites have been checked, and in the case of three of these there have been no records since 1976-1977.

Results of the analysis

Among the 139 species recorded on the military training area are many that are widespread and, at the other extreme, those for which there are only a few records and have a limited distribution. In interpreting the results of this anaylsis it must be borne in mind that the total of 139 species is based on hundreds of records over 40 plus years, although the main research effort has been from the 1980s onwards. The high number of species recorded from various individual sites, some of which were mentioned earlier, must be viewed in this historical context. Because of habitat changes, increased water abstraction, climate change and other factors, a few visits now in the course of a year to a site from which, say, 50 species have been recorded over the years, is unlikely to yield anywhere near that number. A perfect example is Fowlmere, where 32 species were found in 1976-1977. In May 1995 17 species were recorded, but a few checks in more recent years have failed to find any beetles.

Ten species have recorded from the River Wissey and in streams and ditches that have not been found in any of the ponds. Also, the only record of *Helophorus aequalis* is of one in a temporary pool in Sturston Quarry (TL8694) on 29 May 2006. Similarly, *Cercyon bifenestratus* was taken in a flight interceptor trap nowhere near water in TL8892 on 24 March 1991. This means that there are 127 species recorded from the various ponds. The records from the River Wissey etc. are discussed below.

Scarce and threatened species

Until recently the categories used for defining scarce and threatened species were those of Hyman & Parsons (1992), where water beetles are listed in Appendix 1. This classification has now been replaced by that of Foster (2010), with four categories applicable here: Critically Endangered (CE), Vulnerable (VUL), Near Threatened (NT) and Nationally Scarce (NS). Under the earlier system a total of 58 species recorded at STANTA fell into five categories as follows: RDB1 one species, RDB2 two species, RDB3 15 species, Notable A three species and Notable B 36 species. Using Foster (2010) the total number of species is reduced to 38 in four categories: CE one species, VUL four species, NT 16 species and NS 17 species. The difference in the total number of species is due to the fact that 21 species originally classified as Notable B have now been downgraded and are not regarded as Nationally Scarce. All these data are shown in Appendix 4, which also shows the number of sites at which each species has been recorded, the number of records for each species, and the year in which the species was last recorded. The only Critically Endangered species is *Bidessus unistriatus,* which has been recorded from just four sites (Sturston Nursery 3, Sturston Nursery 4, Home Mere and West Mere), all between October 1985 and August 1986; there are no later records.

The River Wissey and streams

The sampling effort for this habitat has been somewhat limited. In Palmer (1981) 32 species are listed for the River Wissey and nine species from three different streams. Palmer listed seven species for a ditch at Tottington (TL8995), but it seems probable that this was not a ditch but a section of the stream that flows from Thompson to Buckenham Tofts. Palmer sampled the River Wissey at three different locations, the first being near Buckenham Tofts at TL831950. This site was also visited by Professor Garth Foster on 13 September 1977 and C.D.

Smith (CDS) in August 1989. As a result the species total for this stretch of the river is now 35. The river was also sampled by CDS near Mundford (TL807944) in August 1989 and a total of nine species was found. This site is actually outside the military boundary, but only two of the species recorded – *Helochares lividus* and *Hydraena gracilis* – have not also been found within STANTA. A further species, *Ochthebius bicolon*, was found by Martin Collier at Langford Bridge on 14 January 2007. All the data discussed above are shown in Appendix 5.

The Sturston Carr pool/ditch site

This comprises a series of small pools along an old ditch line and flooded Purple Moor-grass *Molinia caerulea*/sedge/rush beds at TL871953, close to Sturston Carr 1 at TL871952. It is an interesting section of habitat that has yielded 16 species of water beetle: *Agabus bipustulatus, Copelatus haemorrhoidalis, Cymbiodyta marginellus, Dryops ernesti, Haliplus lineolatus,Hydrobius fuscipes, Hydroporus erythrocedphalus, Hydroporus palustris, Hydroporus pubescens, Hygrotus impressopunctatus, Hygrotus inaequalus, Laccobius colon, Laccobius minutus, Noterus crassicornis, Ochthebius minimus* and *Rhantus exsoletus*.

Ponds and meres

The detailed distribution of species at 54 sites is shown in Appendix 6 (1-6) and the data are summarised in Appendix 7. Examination of the former shows, for example, that 12 sites had fewer than five species recorded, and that only three species occurred in 50% or more of the sites: *Hygrotus inaequalis* (32 sites, 59%), *Hydrobius fuscipes* (29 sites, 54%) and *Ochthebius minimus* (28 sites, 52%). The next most widely distributed species is *Haliplus ruficollis* (25 sites, 46%), followed by three further species, *Hyphydrus ovatus, Agabus bipustulatus* and *Hydroporus planus,* each recorded at 24 sites (44%). Five species were found at 23 sites (42%): *Colymbetes fuscus, Enochrus nigritus, Hygrotus impressopunctatus, Rhantus exsoletus* and *R. frontalis*. Another approach is to ascertain how many species have a very limited distribution: 21 species have been found at only one site and these are listed, together with the dates they were recorded, in Appendix 8. Mention should also be made of a specimen of *Elmis aenea* (Elmidae) which was found in Sturston Nursery 4 by Professor Garth Foster on 8 August 1986. This is regarded as an aberrant record and it is not included in the total number of species recorded for that pond which is given below. There are 12 species known from only two sites and full details of these are given in Appendix 9. Further analysis of Appendix 6 (1-6) reveals seven species known from only three sites, 10 from four sites, five from five sites, eight from six sites and three from seven sites.

The 10 highest scoring individual sites in terms of the number of species that have been recorded are Sturston Nursery 4 (89 species), Bagmore Pit (81 species), Sturston Nursery 3 (80 species), Sturston Nursery 7 (63 species), West Mere (55 species), Reed Fen (54 species), King Edward VIII-l (51 species), Mortimer's Mere (50 species), Smokershole (43 species) and Sturston Nursery 6 (42 species).

It is clear from the data discussed above that the ponds in the Sturston Carr/Nursery area are of considerable importance. Four of these ponds are close to the western edge of Sturston Nursery: from west to east, Sturston Nursery 7, Sturston Nursery 6, Sturston Nursery 4 and Sturston Nursery 3. It is instructive to look at the records from these four sites as an entity and this is done in Appendix 10. This analysis shows that a total of 95 species have been recorded, representing 75% of the 127 species known from the ponds and meres of STANTA. Whilst there are a few species such as *Dryops anglicanus, Dytiscus marginalis, Haliplus ruficollis* and *Hydraena britteni* that are only recorded from one of the ponds, the majority have been found in at least three ponds. It may be noted that Sturston

Carr 1, on the north side of Sturston Carr, has yielded 37 species, of which the following four species have not been recorded in any of the four Sturston Nursery ponds: *Dryops ernesti, Haliplus lineolatus, Ilybius quadriguttatus* and *Noterus crassicornis*.

The 11 ponds in the Tottington Hall complex that have been sampled for water beetles are all in the area to the east of the road at Tottington. A total of 93 species have been recorded in these ponds, which represent 73% of the 127 known from the ponds and meres of STANTA. Five of the 11 ponds have yielded less than 10 species. The highest scoring sites are Tottington Hall 13, a 'new' pond (31 species); Tottington 7 (28 species); Tottington Hall 3 (23 species), and Tottington Hall 1 (22 species). The distribution of the 93 species in the 11 ponds is shown in Appendix 11. Six of the Tottington species have not been recorded in the Sturston Carr/Nursery ponds: *Agabus unguicularis, Haliplus immaculatus, Heterocerus fenestratus, Hydroporus elongatulatus, Hydroporus umbrosus* and *Noterus crassicornis*.

The Bagmore Pit complex comprises a total of 18 sites, of which Bagmore Pit is the largest, with the others scattered at varying distances and directions. There are no records at all for seven of these sites, and for a further four there are no records since 1976-1977, with the highest scoring being Bagmore Pit 7 and Bagmore Farm with eight species each, and Bagmore Pit 6 with seven species. At Bagmore Pit itself 43 species were recorded in 1976-1977 and this had increased to 81 by 2012. A short distance NE of Bagmore Pit is King Edward VIII-l which was not sampled in 1976-1977 but which subsequently yielded 51 species. A little further to the NE is King Edward VIII-2 where 29 species have been recorded. The data for these three sites is summarised in Appendix 12. Next to Bagmore Pit, the most interesting pond in this complex is King Edward VIII-2, which is quite small and steep-sided and has dense clumps of Tufted Sedge *Carex elata* in the bottom; 29 species seems a surprisingly high total for such a uniform habitat.

Further comments on distribution

These are some selective comments on distribution and are mainly additional to those given earlier. Only three species that have not been recorded since 1976-1977: *Haliplus lineolatus* (4 sites), *Hydroporus tristis* (Bagmore Pit) and *Nebrioporus elegans* (Thompson Water). An example of a species recorded from only one site (see Appendix 7) is *Graptodytes pictu,s* which was found at Bagmore Pit on 14 April 1981 but has not been seen since. There are also four species that were last recorded in August 1986: *Agabus unguicularis* (Sturston Nursery 4 and Tottington Hall 3), *Hydrochus ignicollis* (Sturston Nursery 4), *Hydroporus elongatulus* (Tottington Hall 3) and *Hydroporus umbrosus* (Robin's Lodge 2, Tottington Hall 3 and Tottington Warren).

Considerable interest attaches to the family Dryopidae with six species of *Dryops* known from this site. Palmer (1981) recorded only *Dryops luridus*, and that was in the River Wissey (see Appendix 5). Four of the species recorded at STANTA are Notable (see Appendix 4). The only records for *D. ernesti* and *D. similaris* are from Fowlmere in May 1995. *Dryops anglicanus* has been recorded from three locations: Bagmore Pit (1981, 2004, 2007), Sturston Carr 7 (March 2011) and Sturston Nursery 4 (May 2002). According to Foster (2010) this species is confined to wet vegetation at the edge of relict lowland fen and fen carr, often in association with tussocks. *Dryops auriculatus* is a species of shallowly flooded vegetation in low-lying fenland, as well as pingo ponds and heathland pools. It is known from four sites: Corkmere Bottom (2007, 2011), Robin's Lodge 2 (March 1986), Sturston Nursery 4 (1986, 2002, 2004, 2007) and Sturston Nursery 7 (2004, 2007). Slightly more widespread is *Dryops luridus*, known from seven sites: three in

the Bagmore Pit complex, one each in the Sturston and Tottington complexes, and Mortimer's Mere and West Mere. The last records for all seven sites were in 2007. This leaves *Dryops griseus*, according to Foster (2010) the rarest of the genus in Britain and confined to relict, lowland, temporary fen pools, such as pingo fens and the fluctuating meres of Breckland. At STANTA it has been found at 13 sites including four in the Sturston complex, three in the Bagmore Pit complex, two in the Tottington complex, and outliers at Lake Plantation, Mortimer's Mere, Robin's Lodge 2 and West Mere. It is worth noting that three species of *Dryops* have all been taken in pitfall traps set by the author in wet pastures near the River Wissey at Langford. They are *D. griseus* (30 April 2000), *D. luridus* (16 July 2000) and *D. similaris* (30 April 2000).

The family Dytiscidae includes the larger diving beetles, of which three species in the genus *Dytiscus* have been recorded. The first is *D. dimidiatus*, whose typical habitat is given by Foster (2010) as permanent, richly vegetated drains. It is not a common species in Norfolk and as of January 2013 there had been nine records from four 10 kilometre squares. It has been found in the Broads and as recently as 2001 on Thompson Common adjacent to STANTA. The only records for STANTA are from Mortimer's Mere on 28 July 1994 (Sage), and 31 August 1994 (Collier). Next is *D. semisulcatus* with three records: Sturston Carr 1 (August 1986), West Mere (August 1986) and Sturston Nursery 4 (March 2002). Finally, the commonest member of the genus is *D. marginalis* which has been recorded from five sites: Sturston Nursery 4 (August 1986), Bagmore Pit (September 1998), Robin's Lodge 2 (September 2000), Corkmere Bottom (March 2004) and Mortimer's Mere (August 2004). It is of interest to note that the latter site is the only one to have yielded two species of *Dytiscus*

There are 18 species of the genus *Agabus* on the current British list. Eight (44%) have been recorded at STANTA, three of which are classed as Near Threatened (NT): *A. labiatus* (10 sites), *A. uliginosus* (8 sites) and *A. undulatus* (6 sites). As mentioned earlier, *A. bipustulatus*, known from 24 sites, is widely distributed in the area, with *A. nebulosus* (19 sites) being the next commonest. The two least common species, each known from only four sites, are *A. paludosus* and *A. unguicularis*. The former has been found at Bagmore Pit (2004), Smokershole (2000), Sturston Nursery 4 (2002) and Tottington Hall 1 (1986), whilst the latter is recorded from Bagmore Farm (1976-1977), Bagmore Pit (1976-1977, 1981), Smokershole (1976-1977) and Tottington Hall 3 (1986). Reference to Appendix 6 shows that all eight species have been recorded from Bagmore Pit, while Sturston Nursery 4 has yielded seven species with just *A. unguicularis* missing, and Sturston Nursery 3 has six species with *A. paludosus* and *A. unguicularis* absent. At the Tottington Hall complex five species have been recorded from six different ponds, the maximum number from any one pond being four (see Appendix 11).

There are 28 species of *Hydroporus* on the British list and 17 (61%) of these have been recorded at STANTA, of which three are known from single sites only. Out of these 17 species, 14 (82%) have been recorded from just three sites in the Bagmore Pit complex, whilst 12 (70%) are known from the Sturston Carr complex. Amongst the smaller species of Hydroporinae is *Graptodytes granularis* which Foster (2011) says '...is the commonest very small diving beetle in Britain and Ireland....'. At STANTA it is known from just 11 (20%) of the sites checked.

Nationally there are 10 species of *Ilybius* of which 7 (70%) have been recorded at this site. *I. subaeneus* is Nationally Scarce (NS) and is known from four sites at STANTA, while *I. guttiger* and *I. quadriguttatus* have been found in only two ponds (see Appendix 9).

The genus *Rhantus* has six species nationally of which four (67%) are known from the military area. *R. frontalis* is Nationally Scarce but nevertheless is known from 23 sites in this area, as is *R. exsoletus* (see Appendix 6).

The Gyrinidae are not a feature of the ponds in STANTA and even the common *Gyrinus substriatus* has only been found at 10 sites. The remaining two species are known from single sites only: *G. marinus* from Madhouse S on 5 May 1995 and *G. paykulli* from Mortimer's Mere on 11 April 2007 (see Appendix 8).

The family Helophoridae has 20 species in the genus *Helophorus* of which nine (45%) have been found at STANTA, eight in ponds and one in a temporary pool. Two species have been found in single sites only (see Appendix 8), whilst the most widely distributed are *H. minutus* (17 sites) and *H. brevipalpis* (15 sites).

The Hydraenidae are generally referred to as moss beetles since both adults and larvae are usually found in moss and among submerged vegetation in running water, or sometimes in stagnant water. Of the nine species recorded at STANTA six have been found in the River Wissey (see Appendix 5), but only *Ochthebius bicolon* has not also been found in ponds.

Within the family Hydraenidae the most widespread species in the genus *Hydraena* at STANTA is *H. riparia* (16 sites), but the most widespread species in the family is *Ochthebius minimus* (28 sites) as mentioned above.

There are seven species of Hydrochidae on the British list and four (57%) occur at STANTA: all seven species are classed as Near Threatened. They are small, rather narrow beetles found in shallow water, especially fens. There is only one record for *Hydrochus ignicollis* (see Appendix 8). The most widespread are *H. crenatus* (12 sites) and *H. brevis* (10 sites).

The Hydrophilidae are a diverse assemblage of beetles ranging in size from minute to very large, notably *Hydrophilus piceus* (34-48mm). This is a local species in eastern England and there are currently 47 Norfolk records from nine 10 kilometre squares, but it has not so far been found in STANTA. The family has some 70 species in Britain and all are either aquatic, or terrestrial in dung and damp decaying vegetation e.g. some *Cercyon* species. At STANTA 29 species have been recorded and the four most widely distributed in terms of the number of sites are *Hydrobius fuscipes* (29), *Enochrus nigritus* (23), *E.quadripunctatus* (21) and *Cymbiodyta marginellus* (19). The least common are *Laccobius striatulus* (one site) and *Berosus affinis* (three sites).

Discussion

A number of questions arise from the data presented above and in the appendices. An obvious one is how does STANTA compare with other sites in Norfolk and further afield ? I have not attempted to answer this question since to do so would require assembling a huge amount of data and subjecting it to sophisticated statistical analysis, which is really outside the scope of this paper. STANTA is clearly an important site in Norfolk for water beetles and if anyone wishes to make detailed comparisons all the data needed are in the appendices. However, it is worth noting that at Thompson Common, immediately east of STANTA, 120 species of water beetle have been recorded.

In the 1976-1977 survey a total of 77 species were recorded, of which 64 were found in ponds and meres etc. Subsequently Professor Garth Foster and others visited the site in April 1981 and March and August 1986., and the species collected increased the total from 77 to 111. By December 2012 the total was 127 (excluding rivers and ditches) an increase of 63 since 1976/1977. It is tempting to suggest that this increase reflects an improvement in habitat and

water quality over time, but this would be very difficult to prove. What is far more likely is that the increase is due to the much higher level of recording activity, particularly since 1980. As mentioned earlier there are a number of species that have not been found for many years, including three not seen since 1976-1977. Whilst some of these species may indeed no longer be present this cannot be said with complete certainty. There are many factors that could be responsible for their apparent and, possibly, only temporary absence. Reference to Appendix 3 shows that, with just a few exceptions, every site checked in 1976-1977 had shown an increase in the number of species by 2012. The most striking example is Sturston Nursery 3, which increased from 2 to 79.

Some thought needs to be given to the future prospects of the water beetle fauna of STANTA, particularly in the context of adverse habitat changes. The most important sites in terms of the number of species recorded have been clearly identified and the top four are Sturston Nursery 4 (89), Bagmore Pit (81), Sturston Nursery 3 (79) and Sturston Nursery 7 (63). There is a real need for a comprehensive management plan related specifically to the ponds and meres with particular reference to the four sites just mentioned, with other sites being dealt with in order of importance as and when resources permit. What little pond restoration and improvement has been carried out so far has been confined to the Tottington and Waterhouse Plantation area. As pointed out by Lambley (1994), many of the fluctuating meres of Breckland are of national importance.

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APPENDIX 1. Checklist of the water beetles of Stanta, Norfolk, December 2012.

Abbreviations: Hyman & Parsons 1992: Not., Notable; RDB, Red Data Book; pRDB, provisional Red Data Book. Foster 2010: CE, Critically Endangered; NS, Nationally Scarce; NT, Nationally Threatened; VUL, Vulnerable. P, species also found in pingo ponds (Foster 1993).

Species	Status		Habitat	
	H&P 1992	GNF 2010		
Dryopidae				
Dryops anglicanus Edwards	RDB3	NT	Wet vegetation at the edge of relict, lowland "pingo" fens & carr	P
Dryops auriculatus (Fourcroy)	Not.B	NT	Shallowly flooded vegetation in low-lying fenland;also heathland pools	P
Dryops ernesti des Gozis			In vegetation at edge of ponds etc	
Dryops griseus (Erichson)	RDB3	VUL	Relict lowland, temporary fen pools & fluctuating meres	P
Dryops luridus (Erichson)			Associated with the water's edge, often by running water and usually over clean mud	P
Dryops similaris Bollow	pRDB3	NS	In fluctuating water over exposed substratum with grass and moss	P
Dytiscidae				
Acilius sulcatus (L.)			Large areas of water, ponds	P
Agabus bipustulatus (L.)			A wide range of habitats	P
Agabus labiatus (Brahm)	Not.B	NT	Stagnant & temporary waters; some permananent acid pools	P
Agabus nebulosus (Forst.)			Ponds, especially new ones	P
Agabus paludosus (Fab.)			Running water with vegetation	P
Agabus sturmii (Gyll.)			Stagnant water	P
Agabus uliginosus (L.)	Not.B	NT	Highly temporary & marshy still waters on low ground	P
Agabus undulatus (Schrank)	pRDB3	NT	Lowland fens, ponds & ditches with rich vegetation	P
Agabus unguicularis (Thoms.)	Not.B		Marshy pools	P
Bidessus unistriatus (Goeze)	RDB1	CE	Lowland stagnant water bodies, mainly marl pits & slow drains; fluctuating meres on the Brecks, but not "pingo" pools	P
Colymbetes fuscus (L.)			Ponds and ditches	P
Dytiscus dimidiatus Bergstrasser	pRDB3	NT	Rich fen vegetation in lowland drains & ponds	
Dytiscus marginalis L.			Ponds and drains	P
Dytiscus semisulcatus Muller			Stagnant shallow water	P
Graptodytes granularis (L.)	Not.B		Swampy areas of ponds, fens, bogs	P
Graptodytes pictus (Fab.)			Slow-flowing drains and ponds	P
Hydaticus seminiger (De Geer)	Not.B	NS	Pools, often shaded	P
Hydroglyphus geminus (Fab.)	Not.B		New ponds, mossy ditches, heath pools	
Hydroporus angustatus Sturm			Fens and ponds	P
Hydroporus elongatulus Sturm	RDB3	VUL	Temporary areas of stagnant, base-rich fen	P
Hydroporus erythrocephalus (L.)			Marsh, peat-mosses in pools	P
Hydroporus glabrinsculus Aube	RDB3	VUL	Undisturbed, relict fen & bog systems	P
Hydroporus gyllenhalii Schiodte			Acid waters	P
Hydroporus incognitus Sharp			Peaty water, in woods	P
Hydroporus memnonius Nicolai			Stagnant water with dead leaves	P
Hydroporus neglectus Schaum	Not.B	NS	Shaded, acid water	P
Hydroporus nigrita (Fab.)			Ditches, ponds, Sphagnum	P
Hydroporus palustris (L.)			Ponds and slow water	P
Hydroporus planus (Fab.)			Lowland pools, often temporary	P
Hydroporus pubescens (Gyll.)			Peaty, fresh or brackish water	P
Hydroporus scalesianus Steph.	RDB2	VUL	Boggy ponds	P
Hydroporus striola (Gyll.)			Ditches, pools and marshes	P
Hydroporus tristis (Payk.)			Fen marshes	P
Hydroporus umbrosus (Gyll.)			Fen marshes	P
Hygrotus confluens (Fab.)			Ponds, temporary waters	
Hygrotus decoratus (Gyll.)	Not.B	NS	Ponds and drains	P

Species	Status		Habitat	
	H&P 1992	GNF 2010		
Hygrotus inaequalis (Fab.)			Ponds, bays of lakes, slow water	P
Hygrotus impressopunctatus (Schaller)			Ponds and drain vegetation	P
Hygrotus versicolor (Schaller)			Ponds, drains, slow rivers	
Hyphydrus ovatus (L.)			Still or slow-running water with vegetation	P
Ilybius ater (De Geer)			Stagnant water	P
Ilybius fenestratus (Fab.)	Not.B		Ponds, pits, rivers, marshes	
Ilybius fuliginosus (Fab.)			A wide range of habitats	P
Ilybius guttiger (Gyll.)	Not.B		Stagnant water, fens & bogs	P
Ilybius montanus (Steph.)			Acid waters	
Ilybius quadriguttatus (Lacordaire)			Stagnant water	P
Ilybius subaeneus Erichson	Not.B	NS	Detritus ponds	
Laccophilus hyalinus (De Geer)			Slow-running water	
Laccophilus minutus (L.)			Ponds & ditches	P
Laccornis oblongus (Steph.)	pRDB3	NT	Shallow, mossy areas of temporary base-rich fens	P
Liopterus haemorrhoidalis (Fab.)			Ponds & drains	P
Nebrioporus elegans (Panzer)			Rivers & lochs	
Platambus maculatus (L.)			Running water & wave-washed lakes	
Porhydrus lineatus (Fab.)			Muddy ponds & ditches	P
Rhantus exsoletus (Forster)			Ponds & drains, edges of lakes	P
Rhantus frontalis (Marsh.)	Not.B	NS	Sandy pools	P
Rhantus grapi (Gyll.)	Not.B		Ponds & fen drains	P
Rhantus suturalis (MacLeay)	Not.B		Silt & detritus pools	P
Scarodytes halensis (Fab.)	Not.B	NS	Base-rich pools & slow-running ditches with sparse vegetation.	
Suphrodytes dorsalis (Fab.)			Ponds & ditches, often shaded	P
Suphrodytes figuratus (Gyll.)			As above	P
Elmidae				
Elmis aenea (Muller)			Running water in riffles	
Limnius volkmari (Panz.)			Running water in riffles	
Oulimnius tuberculatus (Muller)			Running water & lakes	
Georissidae				
Georissus crenulatus (Rossi)	Not.A	NS	Crumbling damp silt by running water, sand pits	
Gyrinidae				
Gyrinus marinus Gyll.			Fresh, peaty & brackish water	P
Gyrinus paykulli (Ochs)	Not.A	NS	Reeds at edge of open water	
Gyrinus substriatus Steph.			Fresh, peaty & brackish water	P
Haliplidae				
Brychius elevatus (Panzer)			Running water & wave-washed lakes	
Haliplus confinis Steph.			Fen ditches & dykes, pools & streams	
Haliplus flavicollis Sturm			Running water & lakes	P
Haliplus fluviatilis Aube			Rivers, sometimes lakes & pools	
Haliplus fulvus (Fab.)			Large areas of water, or bog pools	
Haliplus immaculatus Gerhardt			Canals, lakes, clean ponds	
Haliplus lineatocollis (Marsh.)			Mainly slow--running water	P
Haliplus lineolatus Mann.			Rivers & lakes	
Haliplus obliquus (Fab.)			Pools, especially with Chara	P
Haliplus ruficollis (De Geer)			Ponds & ditches	P
Helophoridae				
Helophorus aequalis Thoms.			Grassy pools & ditches	P
Helophorus brevipalpis Bedel			Ditches, ponds & pools, usually temporary waters	P
Helophorus grandis Ill.			Shallow streams, grassy pools & ditches	P
Helophorus granularis (L.)		NS	Grassy ponds, often stagnant	P

Species	Status		Habitat	
	H&P 1992	GNF 2010		
Helophorus griseus Herbst	Not.B		Grassy ponds & fens, marl pools	P
Helophorus minutus Fab.			Grassy ponds & fens	P
Helophorus nanus Sturm	Not.B	NS	Stagnant shallow grassy pools, usually acid, & fens	P
Helophorus obscurus Mulsant			Stagnant or base-rich ponds & pools	P
Helophorus strigifrons Thomson	Not.B	NS	Temporary waters with rushes & sedges, & stagnant grassy pools	P
Heteroceridae				
Heterocerus fenestratus (Thunb.)			Beside fresh or brackish water ponds & ditches	P
Hydraenidae				
Hydraena britteni Joy			Fens & grassy streams	P
Hydraena palustris Erich.	RDB2	NT	Temporary & semi-permanent, stagnant water, with well-developed marginal vegetation. Can occur in partial shade in fen carr	P
Hydraena riparia Kugelaan			Ditches & pools	P
Hydraena testacea Curtis	Not.B		Stagnant water or muddy streams	P
Limnebius aluta Bedel	pRDB3	NT	Relict lowland fen areas, living in the edges of pools & slow-running ditches in association with mud, wet moss & litter beneath rich,	P
Limnebius papposus Mulsant	Not.B	NT	Drains & ponds in lowland fen areas, usually with rich vegetation & detritus	P
Limnebius truncatellus (Thunb.)			Running water	P
Ochthebius bicolon Germar	Not.B		Mud by running water	
Ochthebius minimus (Fab.)			Stagnant water & ponds, usually in mud	P
Hydrochidae				
Hydrochus brevis (Herbst)	RDB3	NT	In well established weeds pools & fens with dense emergent vegetation, often in partial shade, usually with a soft bottom of mud or peat	P
Hydrochus crenatus (Fab.)	RDB3	NT	Mainly in mossy edges of usually fluctuating ponds & in rich fens	P
Hydrochus elongatus (Schall.)	RDB3	NT	In shallow, well vegetated, still water, often in reed beds & other areas with rich emergent vegetation over clay	
Hydrochus ignicollis Motsch.	RDB3	NT	In mossy edges & Phragmites litter beside stagnant well-vegetated, often temporary fen & pingo pools. Exclusively	P
Hydrophilidae				
Anacaena bipustulata (Marsh.)	Not.B		Streams, rivers, ditches & ponds	
Anacaena globulus (Payk.)			In streams, ditches & stagnant ponds, or in moss or litter on damp ground near water	P
Anacaena limbata (Fab.)			In rivers, streams, canals, ditches, marshes & peaty pools	P
Anacaena lutescens (Steph.)			Acid waters, ditches & peaty pools	P
Berosus affinis Brulle	Not.B		Ditches, ponds, drains, in brackish or fresh water overlying clay	
Berosus luridus (L.)	Not.B	NT	Lowland ponds & slow drains with a peaty substratum. Not confined to acid water	P
Berosus signaticollis (Charp.)	Not.B		In clear, shallow acid pools & flooded wheel ruts on sandy or stony soils	
Cercyon bifenestratus Kuster	Not.A	NS	In damp litter on bare sand, or mud by water	
Cercyon convexiusculus Steph.	Not.B		Grass tussocks, fen litter & moss near fresh water	P
Cercyon granarius Erich.	RDB3	NS	On floating vegetation in marsh drains & ditches	
Cercyon sternalis (Sharp)	Not.B		Fen litter	P
Cercyon tristis (Illiger)	Not.B		In grass tussocks near water in bogs & fens	P
Cercyon ustulatus (Preyssler)	Not.B		Hygrophilous, in wet mud & litter at the edge of ponds	P
Coelostoma orbiculare (Fab.)			In marshes, well-vegetated peaty pools, ditches, ponds & fen pools	P
Cymbiodyta marginellus (Fab.)			Stagnant water with vegetation-ditches, ponds & pools in grassland	P
Enochrus coarctatus (Gredler)			Well vegetated ditches & ponds	P
Enochrus melanocephalus (Ol.)	Not.B		Brackish water, ponds, lakes, fens, gravel pits, canals and fluctuating meres	
Enochrus nigritus (Sharp)	RDB3	NT	Mesotrophic & base-rich fens & ponds in lowlands	P

Species	Status		Habitat	
	H&P 1992	GNF 2010		
Enochropterus ochropterus (Marsh.)	Not.B		Detritus pools, drains, ditches & ponds	
Enochrus quadripunctatus (Herbst)	Not.B	NS	Open, shallow freshwater pools, often clay-bottomed	P
Enochrus testaceus (Fab.)			Dykes, ponds, ditches & reservoirs	P
Helochares lividus (Forst.)	Not.B		Streams, lakes, ponds & ditches	
Helochares punctatus Sharp	Not.B	NS	Acid peat & Sphagnum pools & ditches	P
Hydrobius fuscipes (L.)			Detritus pools & stagnant well-vegetated fresh water pools	P
Laccobius bipunctatus (Fab.)			In wet mud beside fresh water	P
Laccobius colon (Stephens)			Silt ponds, coastal drains & wet mud beside stagnant fresh water	P
Laccobius minutus (L.)			In wet mud or sand beside stagnant fresh or brackish water	P
Laccobius sinuatus Motsch.	Not.B		Slow-flowing drains & new ponds	P
Laccobius striatulus (Fab.)			Slow trickles, streams, riverbank mud	P
Noteridae				
Noterus clavicornis (De Geer)			Still water, often in reed rafts;canals, ditches, lakes & ponds	P
Noterus crassicornis (Muller)	Not.B	NS	Still water, in canals, ditches, lakes & fen pools	P
Paelobiidae				
Hygrobia hermanni (Fab.)			Slow-moving rivers, streams, ditches, lakes, silt & detritus ponds	P
Total 139	**58**	**28**		**105**
Red Data Boook 1	**1**	**1**	Critcally Endangered	
Red Data Boook 2	**2**	**4**	Vulnerable	
Red Data Boook 3	**10**	**16**	Nationally Threatened	
Provisional Red Data Boook 3	**5**	**17**	Nationally Scarce	
Notable A	**3**			
Notable B	**37**			

APPENDIX 2 Palmer's 1976/1977 localities.

No water beetles were recorded in 1976/1977 at two sites.

Site	Name	Map Ref. TL	Gibbon's pond No.	Species 1976/77
Large artificial water bodies				
A	West Tofts Mere	844919	245	3
B	Stanford Water	858949	289	0
C	Thompson Water	915946	-	8
D	Sturston Carr 1 (Warren Marsh)	871952	291	14
E	Bagmore Pit	862924	261	43
Large fluctuating meres				
F	Fowlmere	879895	26	31
G	West Mere	887960	297	5
H	Home Mere	893897	242	1
Possible small fluctuating meres (ponds)				
I	Blacklands 4 (SE of Mousehall)	855908	253	13
J	Blacklands 2 (Mousehall)	852910	251	1
K	Blacklands 3 (Mousehall)	853910	252	6
L	Bagmore Farm (spring)	859925	-	8
M	Madhouse S (NW of Six Acre Pltn.)	905945	354	2
N	Sturston Nursery 3	885953	304	2
Heavily shaded ponds (not 'fluctuating')				
O	Blacklands 4 (Mousehall)	855909	253a	0
P	Bagmore 1	861921	258	1
Q	Tottington 1 (E of Mortimer's Farm)	899948	271	2
R	Tottington 8 (W of Waterhouse Pltn.)	901949	284	2
S	Tottington 3	901947	273	3
T	Warbeck (Buckenham Tofts)	840945	373	1
U	Lynford Arboretum 1 (The Screens)	826934	-	2
V	Mortimer's Farm 4	896948	321	2
W	Blacklands 9 (S of Sandy Hill)	853949	370	1
Other ponds (not heavily shaded, not 'fluctuating')				
X	Smokershole	879916	285	14
Y	Reed Fen	891956	300	18
Z	Bagmore Pit 4 (S of Bagmore Pit)	866917	328	4
a	Bagmore Pit 6 (S of Bagmore Pit)	866919	330	7
b	Robin's Lodge 2	862962	287	4
c	Bagmore Pit 7 (S of Bagmore Pit)	869919	331	7
d	Bagmore Pit 3 (S of Bagmore Pit)	863921	260	3
e	Tottington 7 (W of Waterhouse Pltn.)	903948	283	5
f	Waterhouse Pltn. 2 (NW of Six Acre Pltn.)	905948	276	4
g	Fowlmere Wood	880889	-	3
h	STANTA sheep dip	859904	315	7
i	Tottington Hall N	899955	342	4
j	Great Carr 1 (W of Great Carr)	848930	368	7
k	Great Carr 2	851929	369	2
l	Tottington Hall 5 (S edge Kingfisher Pltn.)	903955	348	1
Total 38 sites				

APPENDIX 3. Sites at which water beetles have been recorded.

At Stanford Water and Mousehall no water beetles were found.

* Sites (16) at which no records have been made since 1976/77.

Water body	Map ref. TL	Gibbons pond number	Species 1976/77 (Palmer)	Species to 2012
Large artificial water bodies				
Stanford Water	858949	289	0	0
Sturston Carr 1	871952	291	14	37
Thompson Water	915946*	-	8	8
West Tofts Mere	844919	245	3	19
Large fluctuating meres				
Bagmore Pit	862924	261	43	81
Fowlmere	879895	26	31	36
Home Mere	893897	242	1	34
West Mere	887960	297	5	55
Possible small fluctuating meres (ponds)				
Bagmore Farm	859925*	428	8	8
Blacklands 2 (Mousehall)	852910*	251	1	1
Blacklands 3 (Mousehall)	853910*	252	6	6
Blacklands 4 (SE of Mousehall)	855908	253	13	34
Corkmere Bottom 1	886908	339	-	21
Madhouse S (NW of Six Acre Pltn.)	905945	354	2	6
Mortimer's Mere (Mortimer's Farm 1)	896947	318	-	50
Sturston Carr 7	869947	425	0	9
Sturston Nursery 3	885953	304	2	80
Sturston Nursery 4	884952	305	-	89
Heavily shaded ponds				
Blacklands 4 (Mousehall)	855909	253 a	0	0
Tottington 1 (E of Mortimer's Farm)	899948*	271	2	2
Tottington 8 (W of Waterhouse Plantation)	901949*	284	2	2
Tottington 3 (W of Waterhouse Plantation)	901947*	273	3	3
Bagmore 1	861921*	258	1	1
Buckenham Tofts (Warbeck)	840945*	373	1	1
Lynford Arboretum 1 (The Screens)	826934*	-	2	2
Mortimer's Farm 4	896948*	321	2	2
Blacklands 9 (S of Sandy Hill)	853949*	370	1	1
Other ponds				
Bagmore Pit 4 (S of Bagmore Pit)	866917	328	4	6
Bagmore Pit 6 (S of Bagmore Pit)	866919*	330	7	7
Bagmore Pit 7 (S of Bagmore Pit)	869919	331	7	8
Bagmore Pit 3 (S of Bagmore Pit)	863921*	260	3	3
Pond near Fowlmere	882894	-	-	14
Fowlmere Wood	880889*	-	3	3
Great Carr 1 (W of Great Carr)	848930	368	7	8
Great Carr 2	851929	369	2	14
King Edward VIII 2 (tussock pond)	858930	263	-	29

continued

Water body	Map ref. TL	Gibbons pond number	Species 1976/77 (Palmer)	Species to 2012
King Edward VIII 1 (W side Bagmore Road)	858929	262	-	51
Lake Plantation	865952	420 a	-	18
Reed Fen	891956	300	18	54
Robin's Lodge 2	862962	287	4	33
Smokershole	879916	285	14	43
STANTA sheep dip	859904*	315	7	7
Sturston Nursery 2	886953	303	-	12
Sturston Nursery 5	883953	306	-	11
Sturston Nursery 6	883952	307	-	42
Sturston Nursery 7	883951	308	-	63
Tottington 7 (W of Waterhouse Pltn.)	903948	283	5	28
Tottington Hall N	899955	342	4	7
Tottington Hall S	899954	343	-	23
Tottington Hall 1	899953	344	-	22
Tottington Hall 3	900954	346	-	17
Tottington Hall 5 (S of Kingfisher Pltn.)	903955	348	1	3
Tottington Hall 17	901953	413	-	14
Tottington Hall 13	898951	406	-	31
Tottington Warren	871959	293	-	35
Waterhouse Plantation 2 (NW of Six Acre Pltn.)	905948	276	4	5
Total sites 56				

APPENDIX 4. Scarce and threatened species of water beetle.

Species and status	No. sites	No. records	Last recorded
Critically Endangered (CE) 1 species			
Bidessus unistriatus	4	7	1990
Vulnerable (VUL) 4 species			
Dryops griseus	12	26	2011
Hydroporus elongatulus	1	1	1986
Hydroporus glabriusculus	2	2	2002
Hydroporus scalesianus	1	2	1981
Near Threatened (NT) 16 species			
Agabus labiatus	10	20	2007
Agabus uliginosus	7	8	2005
Agabus undulatus	7?	14	2007
Berosus luridus	1	1	1995
Dryops anglicanus	3	5	2011
Dryops auriculatus	4	9	2011
Dytiscus dimidiatus	1	2	2004
Enochrus nigritus	19	37	2011
Hydraena palustris	4	6	2007
Hydrochus brevis	10	17	2010
Hydrochus crenatus	12	28	2008
Hydrochus elongatus	7	12	2007
Hydrochus ignicollis	1	1	1986
Laccornis oblongus	3	3	2002
Limnebius aluta	2	2	2002
Limnebius papposus	10	11	2007
Nationally Scarce (NS) 17 species			
Cercyon bifenestratus	1	1	1991
Cercyon granarius	1	1	2007
Dryops similaris	1	1	1995
Enochrus quadripunctatus	14	21	2011
Georissus crenulatus	1	1	1995
Gyrinus paykulli	1	1	2007
Helochares punctatus	9	12	2007
Helophorus granularius	2	2	1981
Helophorus nanus	7	10	2007
Helophorus strigifrons	1	2	2011
Hydaticus seminiger	10	10	2007
Hydroporus neglectus	6	6	2007
Hygrotus decoratus	18	31	2007
Ilybius subaeneus	3	3	2004
Noterus crassicornis	4	5	2011
Rhantus frontalis	23	33	2007
Scarodytes halensis	1	1	2011
Formerly National Notable 21 species			
Agabus unguicularis	4	6	1981
Anacaena bipustulata	1	1	1976
Berosus affinis	3	3	2007
Berosus signaticollis	7	11	2007
Cercyon convexiusculus	6	8	2008
Cercyon sternalis	14	20	2010
Cercyon tristis	2	2	2004
Cercyon ustulatus	1	1	2007
Enochrus melanocephalus	4	4	2007
Enochrus ochropterus	4	4	2007
Graptodytes granularis	13	23	2007
Helochares lividus	12	19	2007
Helophorus griseus	1	2	1989
Hydraena testacea	3	3	2007
Hydroglyphus geminus	12	19	2007
Ilybius fenestratus	3	3	1986
Ilybius guttiger	2	2	1981
Laccobius sinuatus	1	1	2002
Ochthebius bicolon	1	1	2010
Rhantus grapii	6	7	2004
Rhantus suturalis	7	8	2010

APPENDIX 5. Checklist of water beetles from the River Wissey, streams and ditches.

River Wissey TL831950

Dryopidae

Dryops luridus

Dytiscidae

Agabus paludosus
Agabus sturmii
Hydroporus angustatus
Hydroporus palustris
Hydroporus striola
Hygrotus versicolor
Hyphydrus ovatus
Ilybius fuliginosus
Laccophilus minutus
Nebrioporus elegans

Elmidae

Elmis aenea
Limnius volckmari
Oulimnius tuberculatus

Gyrinidae

Gyrinus substriatus

Haliplidae

Brychius elevatus
Haliplus fluviatilis
Haliplus immaculatus
Haliplus lineatocollis
Haliplus lineolatus
Haliplus ruficollis

Helophoridae

Helophorus brevipalpis

Hydraenidae

Hydraena riparia
Limnebius papposus
Limnebius truncatellus
Ochthebius minimus

Hydrophilidae

Anacaena bipustulata
Anacaena globulus
Hydrobius fuscipes
Laccobius bipunctatus
Laccobius minutus
Laccobius striatulus
Noterus clavicornis
Noterus crassicornis

Total 35

Langford Bridge, River Wissey TL839963

Hydraenidae

Ochthebius bicolon

Hydrophilidae

Cercyon tristis

Haliplidae

Haliplus immaculatus

Total 3

Stream at Bridge Carr TL838950

Haliplidae

Haliplus immaculatus
Haliplus lineolatus

Noteridae

Noterus crassicornis

Total 3

Stream nr. West Tofts Mere TL845920

Dytiscidae

Agabus paludosus
Ilybius fuliginosus

Hydrophilidae

Enochrus testaceus

Total 3

River Wissey at Mill Carr TL833955

Hydrophilidae

Anacaena bipustulata

Total 1

River Wissey at Mundford TL807944

Dytiscidae

Nebrioporus elegans

Elmidae

Elmis aenea
Limnius volckmari
Oulimnius tuberculatus

Haliplidae

Brychius elevatus
Haliplus fluviatilis

Hydraenidae

Hydraena gracilis
Ochthebius minimus

Hydrophilidae

Helochares lividus

Total 9

(Outside STANTA boundary)

APPENDIX 6. Distribution of the water beetles of Stanta, Norfolk. See end of Appendix for list of sites.

SITE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Dryopidae																																										
Dryops anglicanus	x	x																													x										
Dryops auriculatus	x		x	x						x						x						x																		
Dryops ernesti											x	x																													
Dryops griseus	x	x	x	x	x		x	x		x						x	x	x						x						x							x			
Dryops luridus	x	x	x		x		x	x									x	x																						
Dryops similaris												x																													
Dytiscidae																																									
Acilius sulcatus	x		x	x			x			x																								x						x
Agabus bipustulatus	x	x	x	x	x	x	x		x	x	x	x	x		x	x	x		x	x	x		x	x	x	x	x		x									x		
Agabus labiatus	x	x	x	x	x		x	x									x	x																						
Agabus nebulosus	x	x	x		x	x	x	x				x	x		x	x		x																			x		x	x	
Agabus paludosus	x	x				x			x												x																			
Agabus sturmii	x	x	x	x				x	x	x	x		x								x	x			x		x	x		x										
Agabus uliginosus	x	x	x			x		x				x		x										x																
Agabus undulatus	x	x	x		x	x					x														x															
Agabus unguicularis		x							x												x												x							
Bidessus unistriatus	x		x		x									x																										
Colymbetes fuscus	x	x	x	x	x	x	x	x	x	x		x	x	x	x				x				x	x			x					x						x		
Dytiscus dimidiatus								x																																
Dytiscus marginalis	x	x						x								x						x																		
Dytiscus semisulcatus	x		x								x																													
Graptodytes granularis	x	x	x	x	x	x	x	x		x	x		x		x								x																	
Graptodytes pictus		x																																						
Hydaticus seminiger	x	x	x	x	x		x		x	x		x								x																				
Hydroglyphus geminus	x	x	x		x	x	x		x								x					x	x			x		x												
Hydroporus angustatus	x	x	x	x	x	x			x	x	x	x	x		x		x	x		x				x					x	x										
Hydroporus elongatulus																					x				x															
Hydroporus erythrocephalus	x	x	x	x		x	x	x	x	x	x	x			x				x	x		x	x						x	x		x				x	x			
Hydroporus glabriusculus			x		x																																			

See end of Appendix for list of sites.

SITE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Hydroporus gyllenhalii	x	x	x	x					x										x																							
Hydroporus incognitus	x	x							x		x			x																												
Hydroporus memnonius	x	x	x	x		x				x											x								x												
Hydroporus neglectus	x	x	x		x				x		x																														
Hydroporus nigrita	x		x	x	x	x				x					x			x																							
Hydroporus palustris	x	x	x	x	x	x	x		x	x	x		x		x	x		x	x			x	x	x						x						x					
Hydroporus planus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x			x		x		x			x					x		x					
Hydroporus pubescens	x	x	x		x	x	x				x								x				x					x	x												
Hydroporus scalesianus		x																																							
Hydroporus striola	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x											x							x					
Hydroporus tristis		x																																							
Hydroporus umbrosus		x							x			x	x			x					x				x																
Hygrotus confluens							x	x																																		
Hygrotus decoratus	x	x	x	x	x	x		x	x	x	x		x			x					x				x		x	x	x												
Hygrotus impressopunctatus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x					x		x									
Hygrotus inaequalis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x		x	x	x	x	x		x		x	x	x			x		x
Hyphydrus ovatus	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x		x	x	x								x			x	x			x		
Ilybius ater	x	x	x				x						x			x																									
Ilybius fenestratus	x												x			x																									
Ilybius fuliginosus	x	x	x	x	x	x	x			x			x			x		x						x																	
Ilybius guttiger		x										x																													
Ilybius montanus	x		x	x					x	x			x																												
Ilybius quadriguttatus						x					x																														
Ilybius subaeneus		x		x				x		x																															
Laccophilus hyalinus																												x											x		
Laccophilus minutus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			x							x				x		x					
Laccornis oblongus			x																		x				x																
Liopterus haemorrhoidalis	x	x	x	x	x	x		x	x	x	x			x	x			x						x						x											
Nebriopous elegans																																	x								
Porhydrus lineatus	x	x	x	x	x	x	x			x			x			x		x		x				x														x			
Rhantus exsoletus	x	x	x	x	x	x	x	x	x		x	x		x	x		x	x	x	x	x	x		x	x	x	x					x								
Rhantus frontalis	x	x	x	x	x	x	x	x		x		x	x	x			x		x	x	x	x		x	x	x	x					x							x	x
Rhantus grapii	x	x		x			x			x						x																									

SITE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Rhantus suturalis	x		x		x			x	x					x			x																									
Scarodytes halensis														x																												
Suphrodytes dorsalis	x	x	x	x		x	x		x	x			x		x		x	x			x	x	x		x		x		x		x		x						x		
Georissidae																																										
Georissus crenulatus																												x														
Gyrinidae																																										
Gyrinus marinus																																								x	
Gyrinus paykulli								x																																		
Gyrinus substriatus		x		x			x			x								x	x	x		x	x										x					x				
Haliplidae																																										
Haliplus confinis		x	x		x		x					x							x								x								x		x				
Haliplus flavicollis																	x										x														
Haliplus fulvus					x																																					
Haliplus immaculatus		x													x		x			x																						
Haliplus lineatocollis	x			x			x	x				x			x		x									x				x				x						x		
Haliplus lineolatus	x					x					x																														x	x
Haliplus obliquus		x																																								
Haliplus ruficollis	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x			x	x			x				x	x	x	x					x		x	x			x	x
Helophoridae																																										
Helophorus brevipalpis	x	x	x	x				x		x	x		x							x			x									x	x		x				x			
Helophorus grandis	x	x		x		x								x								x																				
Helophorus granularis		x				x																																				
Helophorus griseus							x																																			
Helophorus minutus	x	x	x	x	x		x	x		x		x	x	x	x	x						x				x					x							x				
Helophorus nanus	x	x	x	x		x	x	x					x																													
Helophorus obscurus	x	x	x	x		x	x		x					x			x	x																								
Helophorus strigifrons																															x											
Heteroceridae																																										
Heterocerus fenestratus																			x																						x	
Hydraenidae																																										
Hydraena britteni			x			x																																				
Hydraena palustris	x	x	x		x											x																										
Hydraena riparia	x	x	x	x	x	x	x	x		x	x				x	x	x	x			x				x					x											
Hydraena testacea	x			x																																						

SITE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Limnebius aluta	x	x	x																																							
Limnebius papposus	x		x								x				x	x		x		x	x				x															x	
Limnebius truncatellus	x	x								x				x									x																		
Ochtebius minimus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x			x			x	x	x				x			
Hydrochidae																																										
Hydrochus brevis	x	x	x	x	x	x	x	x							x		x		x																						
Hydrochus crenatus	x	x	x		x	x		x					x	x		x	x		x									x													
Hydrochus elongatus	x		x	x			x	x						x			x																							
Hydrochus ignicollis	x																																								
Hydrophilidae																																									
Anacaena globulus	x	x	x			x		x			x					x			x		x	x			x			x						x							
Auacaena limbata	x	x	x	x	x	x		x		x		x				x										x															
Anacaena lutescens	x		x	x	x	x	x	x	x			x		x				x	x								x													
Berosus affinis	x		x		x												x																							
Berosus luridus																												x												
Berosus signaticollis	x		x				x	x						x			x					x						x												
Cercyon convexiusculus	x	x	x	x		x													x																						
Cercyon granarius		x																																							
Cercyon sternalis	x	x	x	x	x	x					x	x			x				x	x	x	x																			
Cercyon tristis		x						x																																	
Cercyon ustulatus									x																																
Coelostoma orbiculare	x	x	x	x		x		x	x															x								x									
Cryptopleurum minutum		x																																							
Cymbiodyta marginellus	x	x	x	x	x	x	x	x	x		x	x		x	x	x		x			x				x	x	x														
Enochrus affinis		x				x																																			
Enochrus coarctatus	x	x	x	x		x	x		x						x	x		x					x																		
Enochrus melanocephalus	x			x	x			x																																		
Enochrus nigritus	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x		x	x	x					x	x				x										
Enochrus ochropterus	x		x											x	x																										
Enochrus quadripunctatus	x	x	x	x	x	x	x	x	x	x		x	x	x			x		x	x						x					x				x	x					
Enochrus testaceus	x	x		x	x	x		x	x	x	x	x	x			x				x																					
Helochares lividus	x		x	x	x	x		x	x			x		x			x	x				x																			
Helochares punctatus	x		x	x	x		x		x					x	x	x																									

SITE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Hydrobius fuscipes	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×		×		×		×		×									
Laccobius bipunctatus	×		×	×	×		×									×	×	×			×				×									×								
Laccobius colon	×	×	×	×	×	×			×	×	×	×	×	×	×				×	×						×																
Laccobius minutus	×	×	×	×		×	×				×						×	×	×															×								
Laccobius sinuatus	×	×	×				×							×																												
Laccobius striatulus														×																												
Noteridae																																										
Noterus clavicornis	×	×	×	×	×		×	×	×	×		×	×	×	×	×																×										
Noterus crassicornis											×									×				×														×				
Paelobiidae																																										
Hygrobia hermanni	×		×	×	×			×	×			×	×		×		×			×				×													×	×				
TOTAL	89	81	79	63	55	54	51	50	43	42	37	36	35	34	34	33	31	29	28	23	22	21	19	18	17	14	14	14	12	11	9	8	8*	8*	8	7*	7*	7	6*	6	6	5

* No records since 1976/77

Site details for Appendix 6

No. in table	Site	Grid Ref. TL	Gibbon's Pond No.
1	Sturston Nursery 4	884952	305
2	Bagmore Pit	862924	261
3	Sturston Nursery 3	885953	304
4	Sturston Nursery 7	883951	308
5	West Mere	887960	297
6	Reed Fen	891956	300
7	King Edward VIII 1	858929	262
8	Mortimers Mere	896947	318
9	Smokershole	879916	285
10	Sturston Nursery 6	883952	307
11	Sturston Carr 1	871952	291
12	Fowlmere	879895	26
13	Tottington Warren 1	871959	293
14	Home Mere	893897	242
15	Blacklands 4	855908	253
16	Robin's Lodge 2	862962	287
17	Tottington Hall 13	898951	406
18	King Edward V111 2	858930	263
19	Tottington 7	903948	283
20	Tottington Hall S	899954	343
21	Tottington Hall 1	899953	344
22	Corkmere Bottom 1	886908	339
23	West Tofts Mere	844919	245
24	Lake Plantation	865952	420a
25	Tottington Hall 3	900954	346
26	pond near Fowlmere	882894	-
27	Tottington Hall 17	901953	26
28	Great Carr 2	851929	369
29	Sturston Nursery 2	886953	303
30	Sturston Nursery 5	883953	306
31	Sturston Carr 7	869947	425
32	Great Carr 1	848930	368
33	Bagmore Farm	859925	428
34	Thompson Water	915946	-
35	Bagmore Pit 7	869919	331
36	Bagmore Pit 6	866919	330
37	STANTA sheep dip	859904	315
38	Tottington Hall N	899955	342
39	Blacklands 3 (Mousehall)	853910	252
40	Bagmore Pit 4	866917	328
41	Madhouse S	905945	354
42	Waterhouse Plantation 2	905948	276

APPENDIX 7. Number of sites per species.

Species	No. of sites
Dryopidae	
Dryops anglicanus	3
Dryops auriculatus	4
Dryops ernesti	1
Dryops griseus	13
Dryops luridus	7
Dryops similaris	1
Dytiscidae	
Acilius sulcatus	7
Agabus bipustulatus	24
Agabus labiatus	10
Agabus nebulosus	19
Agabus paludosus	4
Agabus sturmii	12
Agabus uliginosus	8
Agabus undulatus	6
Agabus unguicularis	4
Bidessus unistriatus	4
Colymbetes fuscus	23
Dytiscus dimidiatus	1
Dytiscus marginalis	5
Dytiscus semisulcatus	3
Graptodytes granularis	11
Graptodytes pictus	1
Hydaticus seminiger	10
Hydroglyphus geminus	10
Hydroporus angustatus	17
Hydroporus elongatulus	1
Hydroporus erythrocephalus	22
Hydroporus glabriusculus	2
Helophoridae	
Helophorus brevipalpis	15
Helophorus grandis	6
Helophorus granularis	2
Helophorus griseus	1
Helophorus minutus	17
Helophorus nanus	8
Helophorus obscurus	9
Helophorus strigifrons	1
Heteroceridae	
Heterocerus fenestratus	2
Hydraenidae	
Hydraena britteni	2
Hydraena palustris	4
Hydraena riparia	16
Hydraena testacea	3
Limnebius aluta	2
Limnebius papposus	10
Limnebius truncatellus	5
Ochthebius minimus	28
Hydrochidae	
Hydrochus brevis	10
Hydrochus crenatus	12
Hydrochus elongatus	7
Hydrochus ignicollis	1
Hydroporus gyllenhalii	6
Hydroporus incognitus	4
Hydroporus memnonius	6
Hydroporus neglectus	6
Hydroporus nigrita	7
Hydroporus palustris	19
Hydroporus planus	24
Hydroporus pubescens	11
Hydroporus scalesianus	1
Hydroporus striola	16
Hydroporus tristis	1
Hydroporus umbrosus	6
Hygrotus confluens	2
Hygrotus decoratus	17
Hygrotus inaequalis	32
Hygrotus impressopunctatus	23
Hyphydrus ovatus	24
Ilybius ater	6
Ilybius fenestratus	3
Ilybius fuliginosus	11
Ilybius guttiger	2
Ilybius montanus	5
Ilybius quadriguttatus	2
Ilybius subaeneus	4
Laccophilus hyalinus	2
Laccophilus minutus	22
Laccornis oblongus	2
Liopterus haemorrhoidalis	14
Nebrioporus elegans	1
Hydrophilidae	
Anacaena globulus	13
Anacaena limbata	11
Anacaena lutescens	13
Berosus affinis	3
Berosus luridus	1
Berosus signaticollis	8
Cercyon convexiusculus	6
Cercyon granarius	1
Cercyon sternalis	12
Cercyon tristis	2
Cercyon ustulatus	1
Coelostoma orbiculare	9
Cymbiodyta marginellus	19
Enochrus coarctatus	11
Enochrus melanocephalus	4
Enochrus nigritus	23
Enochrus ochropterus	4
Enochrus quadripunctatus	21
Enochrus testaceus	12
Helochares lividus	11
Helochares punctatus	8
Hydrobius fuscipes	29
Laccobius bipunctatus	10
Laccobius colon	16
Laccobius minutus	10
Laccobius sinuatus	5
Laccobius striatulus	1
Porhydrus lineatus	14
Rhantus exsoletus	23
Rhantus frontalis	23
Rhantus grapii	6
Rhantus suturalis	7
Scarodytes halensis	1
Suphrodytes dorsalis	21
Georissidae	
Georissus crenulatus	1
Gyrinidae	
Gyrinus marinus	1
Gyrinus paykulli	1
Gyrinus substriatus	10
Haliplidae	
Haliplus confinis	9
Haliplus flavicollis	4
Haliplus fulvus	1
Haliplus immaculatus	3
Haliplus lineatocollis	10
Haliplus lineolatus	4
Haliplus obliquus	1
Haliplus ruficollis	25
Noteridae	
Noterus clavicornis	14
Noterus crassicornis	5
Paelobiidae	
Hygrobia hermanni	13

APPENDIX 8. Species recorded from only one site.

Collectors: BS = Bryan Sage MC = Martin Collier GF = Garth Foster
MP = Margaret Palme GN = Geoff Nobes MS = Magnus Sinclair

Species	Grid ref. TL	Pond No.	Site	Dates		Collector
Dryopidae						
Dryops ernesti	879895	26	Fowlmere	13/05/1995		J.H.Bratton
Dryops similaris	879895	26	Fowlmere	13/05/1995		J.H.Bratton
Dytiscidae						
Dytiscus dimidiatus	896947	318	Mortimers Mere	28/07/1994	31/08/1994	MC & BS
Graptodytes pictus	862924	261	Bagmore Pit	14/04/1981		GF
Hydroporus elongatulus	900954	346	Tottington Hall 3	08/08/1986		GF
Hydroporus scalesianus	862924	261	Bagmore Pit	13/09/1977	14/04/1981	GF & MS
Hydroporus tristis	862924	261	Bagmore Pit	13/09/1977		GF
Nebrioporus elegans	915946	0	Thompson Water	1976/1977		MP
Scarodytes halensis	893897	242	Home Mere	10/04/2011		GN
Georissidae						
Georissus crenulatus	851929	369	Great Carr 2	05/05/1995		MC
Gyrinidae						
Gyrinus marinus	905945	354	Madhouse S	05/05/1995		MC
Gyrinus paykulli	896947	318	Mortimers Mere	11/04/2007		GN
Haliplidae						
Haliplus fulvus	887960	297	West Mere	16/03/2004		GN
Haliplus obliquus	862924	261	Bagmore Pit	18/04/2002	10/04/2011	BS
Helophoridae						
Helophorus griseus	858929	262	King Edward V111 l	26/03/1986	19/03/1989	MC
Helophorus strigifrons	8669947	425	Sturston Carr 7	19/03/2011	10/04/2011	BS
Hydrochidae						
Hydrochus ignicollis	884952	305	Sturston Nursery 4	08/08/1986		GF
Hydrophilidae						
Berosus luridus	851929	369	Great Carr 2	05/08/1995		MC
Cercyon granarius	862924	261	Bagmore Pit	14/01/2007		MC
Cercyon ustulatus	879916	285	Smokershole	11/04/2007		GN
Laccobius striatulus	893897	242	Home Mere	1976/1977		MP
TOTAL 21						

Water bodies in the Stanford Training Area (STANTA)

Photographs: Bryan Sage

Pond at Corkmere Bottom. April 2008.

River Wissey at Langford. May 2002.

Stanford Pond nr. Bridge House. Sept. 2006.

Mortimers Pond. July 2003.

Dry bed of Mortimers Pond. Oct. 2005.

Bagmore Pit from west. April 2007.

High water level at Fowlmere. June 2003.

Smokershole Pond. May 2007.

Pond on north side of Sturston Carr. July 2007.

Pond by Sturston Nursery. April 2002.

West Mere April 2008.

APPENDIX 9. Species recorded from only two sites [11 spp.].

Collectors: AI=Tony Irwin MC=Martin Collier BS=Bryan Sage MP=Margaret Palmer
GF=Garth Foster MS=Magnus Sinclai GN=Geoff Nobes

Species	Grid ref. TL	Pond No.	Site	Date	Collector
Dytiscidae					
Hydroporus glabriusculus	885953	304	Sturston Nursery 3	17/03/2004	MC
	887960	297	West Mere	10/04/2002	BS
Hygrotus confluens	858929	262	King Edward V111 1	10/04/2007	GN
	896947	318	Mortimers Mere	11/04/2007	GN
Ilybius guttiger	862924	261	Bagmore Pit	14/04/1981	GF
	879895	26	Fowlmere	1976/1977	MP
Ilybius quadriguttatus	871952	291	Sturston Carr 1	08/08/1986	GF
	891956	300	Reed Fen	16/03/2005	BS
Laccophilus hyalinus	866917	328	Bagmore Pit 4	1976/1977	MP
	851929	369	Great Carr 2	07/09/2000	BS
Laccornis oblongus	900954	346	Tottington Hall 3	08/08/1986	AI
	885953	304	Sturston Nursery 3	17/03/2002	MC
Helophoridae					
Helophorus granularis	862924	261	Bagmore Pit	14/04/1981	GF
	891956	300	Reed Fen	14/04/1981	GF
Heteroceridae					
Heterocerus fenestratus	905945	354	Madhouse S	22/09/1993	MC
	858929	262	King Edward V111 1	21/04/1993	MC
Hydraenidae					
Hydraena britteni	891956	300	Reed Fen	14/04/1981	GF
	885953	304	Sturston Nursery 3	17/03/2002	MC
Limnebius aluta	862924	261	Bagmore Pit	14/04/1981	GF
	884952	305	Sturston Nursery 4	17/03/2002	GN
Hydrophilidae					
Cercyon tristis	862924	261	Bagmore Pit	14/04/1981	MS
	896947	318	Mortimers Mere	20/07/2004	MC

APPENDIX 10. Water beetle records from four ponds in the Sturston Carr complex (from W to E).

Species	Pond			
	TL883951	TL883952	TL884952	TL885953
	308	307	305	304
Dryopidae				
Dryops anglicanus			x	
Dryops auriculatus	x	x	x	x
Dryops griseus	x	x	x	x
Dryops luridus			x	x
Dytiscidae				
Acilius sulcatus	x	x	x	x
Agabus bipustulatus	x	x	x	x
Agabus labiatus	x		x	x
Agabus nebulosus			x	x
Agabus paludosus			x	
Agabus sturmii	x	x	x	x
Agabus uliginosus			x	x
Agabus undulatus			x	x
Bidessus unistriatus			x	x
Colymbetes fuscus	x	x	x	x
Dytiscus marginalis			x	
Dytiscus semisulcatus			x	x
Graptodytes granularis	x	x	x	x
Hydaticus seminiger	x	x	x	x
Hydroglyphus geminus			x	x
Hydroporus angustatus	x	x	x	x
Hydroporus erythrocephalus	x	x	x	x
Hydroporus glabriusculus				x
Hydroporus gyllenhalii	x		x	x
Hydroporus incognitus			x	
Hydroporus memnonius	x	x	x	x
Hydroporus neglectus			x	x
Hydroporus nigrita	x	x	x	x
Hydroporus palustris	x	x	x	x
Hydroporus planus	x	x	x	x
Hydroporus pubescens			x	x
Hydroporus striola	x	x	x	x
Hygrotus decoratus	x	x	x	x
Hygrotus impressopunctatus	x	x	x	x
Hygrotus inaequalis	x	x	x	x
Hyphydrus ovatus	x	x	x	x
Ilybius ater			x	x
Ilybius fenestratus			x	
Ilybius fuliginosus	x	x	x	x
Ilybius montanus	x	x	x	x
Ilybius subaeneus	x	x		
Laccophilus minutus	x	x	x	x
Laccornis oblongus				x
Liopterus haemorrhoidalis	x	x	x	x
Porhydrus lineatus	x	x	x	x
Rhantus exsoletus	x		x	x
Rhantus frontalis	x	x	x	x
Rhantus grapii	x	x	x	
Rhantus suturalis			x	x
Suphrodytes dorsalis	x	x	x	x
Gyrinidae				
Gyrinus substriatus	x	x		
Haliplidae				
Haliplus confinis				x
Haliplus flavicollis			x	
Haliplus lineatocollis	x		x	
Haliplus ruficollis	x	x	x	x
Helophoridae				
Helophorus brevipalpis	x	x	x	x
Helophorus grandis	x		x	
Helophorus minutus	x	x	x	x
Helophorus nanus	x		x	x
Helophorus obscurus	x		x	x
Hydraenidae				
Hydraena britteni				x
Hydraena palustris			x	x
Hydraena riparia	x	x	x	x
Hydraena testacea	x		x	
Limnebius aluta			x	x
Limnebius papposus			x	x
Limnebius truncatellus		x	x	

Species	Pond			
	TL883951	TL883952	TL884952	TL885953
	308	307	305	304
Ochthebius minimus	x	x	x	x
Hydrochidae				
Hydrochus brevis	x		x	x
Hydrochus crenatus			x	x
Hydrochus elongatus	x		x	x
Hydrochus ignicollis			x	
Hydrophilidae				
Anacaena globulus			x	x
Anacaena limbata	x	x	x	x
Anacaena lutescens	x		x	x
Berosus affinis			x	x
Berosus signaticollis			x	x
Cercyon convexiusculus	x		x	x
Cercyon sternalis	x		x	x
Coelostoma orbiculare	x		x	x
Cymbiodyta marginellus	x		x	x
Enochrus coarctatus	x		x	x
Enochrus melanocephalus	x		x	
Enochrus nigritus	x	x	x	x
Enochrus ochropterus			x	x
Enochrus quadripunctatus	x	x	x	x
Enochrus testaceus	x	x	x	
Helochares lividus	x		x	x
Helochares punctatus	x		x	x
Hydrobius fuscipes	x	x	x	x
Laccobius bipunctatus	x		x	x
Laccobius colon	x	x	x	x
Laccobius minutus	x		x	x
Laccobius sinuatus			x	x
Noteridae				
Noterus clavicornis	x	x	x	x
Paelobiidae				
Hygrobia hermanni	x		x	x
TOTALS	63	42	89	79

APPENDIX 11. Water beetle records from the Tottington Hall pond complex.

406 Tottington Hall 13 | 283 Tottington 7 | 343 Tottington Hall S | 344 Tottington Hall 1
346 Tottington Hall 3 | 413 Tottington Hall 17 | 342 Tottington Hall N | 273 Tottington 3
284 Tottington 8 | 348 Tottington Hall 5 | 271 Tottington 1

Species	Pond										
	TL 898951	TL 903948	TL 899954	TL 899953	TL 900954	TL 901953	TL 899955	TL 901947	TL 901949	TL 903955	TL 899948
	406	283	343	344	346	413	342	273	284	348	271
Dryopidae											
Dryops griseus	x						x				
Dryops luridus	x										
Dytiscidae											
Agabus bipustulatus	x	x	x	x	x	x					
Agabus labiatus	x										
Agabus paludosus				x							
Agabus sturmii				x	x	x					
Agabus unguicularis				x	x						
Colymbetes fuscus		x				x		x		x	
Hydaticus seminiger			x								
Hydroglyphus geminus	x										
Hydroporus angustatus	x		x								
Hydroporus elongatulus				x	x					x	
Hydroporus erythrocephalus		x	x						x		
Hydroporus gyllenhalii		x									
Hydroporus memnonius				x							
Hydroporus palustris		x							x		
Hydroporus planus		x							x		
Hydroporus pubescens		x									
Hydroporus umbrosus				x	x						
Hygrotus decoratus				x	x	x					
Hygrotus impressopunctatus	x			x	x						
Hygrotus inaequalis		x	x			x					
Hyphydrus ovatus	x	x	x					x			
Laccophilus minutus	x	x	x								
Laccornis oblongus				x	x					x	
Porhydrus lineatus			x								
Rhantus exsoletus	x	x	x	x	x	x					
Rhantus frontalis	x	x	x	x	x	x					
Rhantus suturalis	x										
Suphrodytes dorsalis	x			x	x	x					
Gyrinidae											
Gyrinus substriatus		x	x				x				
Haliplidae											
Haliplus confinis		x					x				

Species	Pond										
	TL 898951	TL 903948	TL 899954	TL 899953	TL 900954	TL 901953	TL 899955	TL 901947	TL 901949	TL 903955	TL 899948
	406	283	343	344	346	413	342	273	284	348	271
Haliplus flavicollis	x										
Haliplus immaculatus	x		x								
Haliplus lineatocollis	x										x
Haliplus ruficollis		x	x			x	x				x
Helophoridae											
Helophorus brevipalpis			x								
Helophorus minutus							x				
Helophorus obscurus	x										
Heteroceridae											
Heterocerus fenestratus		x									
Hydraenidae											
Hydraena riparia	x			x	x						
Limnebius papposus			x	x	x						
Ochthebius minimus	x	x		x		x					
Hydrochidae											
Hydrochus brevis	x	x									
Hydrochus crenatus	x	x									
Hydrochus elongatus	x										
Hydrophilidae											
Anacaena globulus		x		x	x						
Anacaena lutescens		x				x					
Berosus affinis	x										
Berosus signaticollis	x										
Cercyon convexiusculus		x									
Cercyon sternalis		x	x	x							
Cymbiodyta marginellus				x	x	x					
Enochrus nigritus	x	x	x	x		x					
Enochrus quadripunctatus	x	x	x								
Enochrus testaceus			x								
Helochares lividus	x										
Hydrobius fuscipes	x	x	x	x	x	x		x			
Laccobius bipunctatus	x			x	x						
Laccobius colon		x	x								
Laccobius minutus	x	x									
Noteridae											
Noterus crassicornis			x				x				
Paelobiidae											
Hygrobia hermanni	x		x				x				
Total species 93	**31**	**28**	**23**	**22**	**17**	**14**	**7**	**3**	**3**	**3**	**2**

APPENDIX 12. Water beetle records from three ponds in the Bagmore Pit complex.

TL862924 Bagmore Pit TL858929 King Edward VIII I TL858930 King Edward VIII 2

Species	Pond		
	TL862924	TL858929	TL858930
	261	262	263
Dryopidae			
Dryops anglicanus	x		
Dryops griseus	x	x	x
Dryops luridus	x	x	x
Dytiscidae			
Acilius sulcatus		x	
Agabus bipustulatus	x	x	
Agabus labiatus	x	x	x
Agabus nebulosus	x	x	x
Agabus paludosus	x		
Agabus sturmii	x		
Agabus uliginosus	x		
Agabus undulatus	x		
Agabus unguicularis	x		
Colymbetes fuscus	x	x	
Dytiscus marginalis	x		
Graptodytes granularis	x	x	
Graptodytes pictus	x		
Hydaticus seminiger	x	x	
Hydroglyphus geminus	x	x	
Hydroporus angustatus	x		x
Hydroporus erythrocephalus	x	x	
Hydroporus gyllenhalii	x		
Hydroporus incognitus	x		
Hydroporus memnonius	x		
Hydroporus neglectus	x		
Hydroporus nigrita			x
Hydroporus palustris	x	x	x
Hydroporus planus	x	x	x
Hydroporus pubescens	x	x	
Hydroporus scalesianus	x		
Hydroporus striola	x	x	x
Hydroporus tristis	x		
Hydroporus umbrosus	x		
Hygrotus confluens		x	
Hygrotus decoratus	x		
Hygrotus impressopunctatus	x	x	x
Hygrotus inaequalis	x	x	x
Hyphydrus ovatus	x	x	
Ilybius ater	x	x	
Ilybius fuliginosus	x	x	x

Species	Pond		
	TL862924	TL858929	TL858930
	261	262	263
Ilybius guttiger	x		
Ilybius subaeneus	x		
Laccophilus minutus	x	x	x
Liopterus haemorrhoidalis	x		x
Porhydrus lineatus	x	x	x
Rhantus exsoletus	x	x	x
Rhantus frontalis	x	x	
Rhantus grapii	x	x	
Suphrodytes dorsalis	x	x	x
Gyrinidae			
Gyrinus substriatus	x	x	x
Haliplidae			
Haliplus confinis	x	x	
Haliplus immaculatus	x		
Haliplus lineatocollis		x	
Haliplus obliquus	x		
Haliplus ruficollis	x	x	
Helophoridae			
Helophorus brevipalpis	x		
Helophorus grandis	x		
Helophorus griseus		x	
Helophorus granularis	x		
Helophorus minutus	x	x	
Helophorus nanus	x	x	
Helophorus obscurus		x	x
Hydraenidae			
Hydraena palustris	x		
Hydraena riparia	x	x	x
Limnebius aluta	x		
Limnebius papposus			x
Limnebius truncatellus	x		
Ochthebius minimus	x	x	x
Hydrochidae			
Hydrochus brevis	x	x	
Hydrochus crenatus	x		
Hydrochus elongatus		x	
Hydrophilidae			
Anacaena globulus	x		
Anacaena limbata	x		
Anacaena lutescens		x	x
Berosus signaticollis		x	

continued on p.44

Beetles: Wildlife Reports p.68.

***Otiorhynchus armadillo*.** Photo: Frank Köhler.

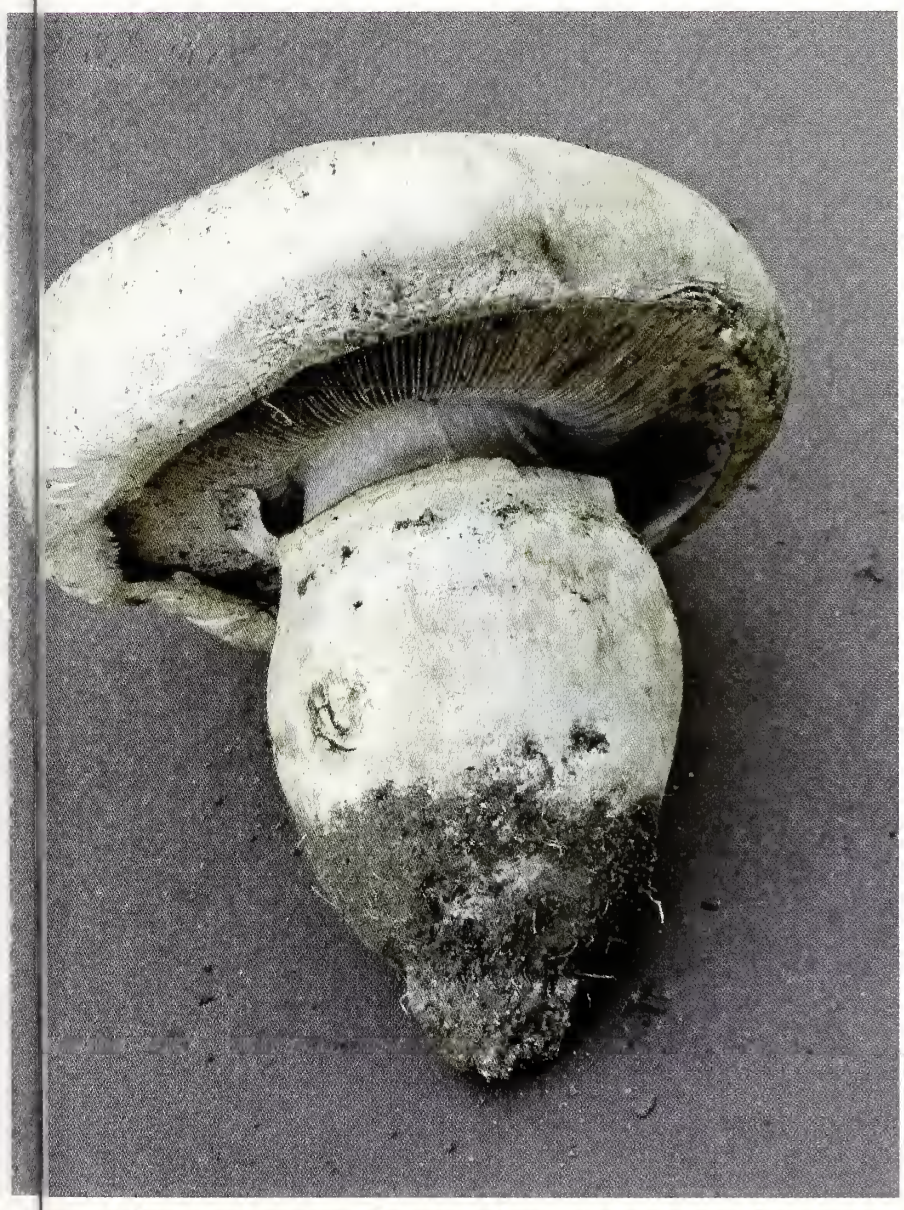
***Pediacus depressus*.** Photo: Frank Köhler.

***Rhizophagus cribratus*.** Photo: Frank Köhler.

Mosses: Wildlife Reports.

***Lophocolea semiteres* in Norfolk** (see p.77). Photos: Robin Stevenson.

The hoverfly *Volucella inflata* was recorded four times in Norfolk during 2011. See p.66.



The scarce mushroom *Agaricus gennadii* appears reguarly in a polytunnel at Hindolveston. See p.80.

Only young specimens of *Bolbitius coprophilus* show the distinctive pale pink flush of this fungus which occasionally appears on dungy straw. See p.80.

Species	Pond		
	TL862924	TL858929	TL858930
	261	262	263
Cercyon convexiusculus	x		
Cercyon granarius	x		
Cercyon sternalis	x		
Cercyon tristis	x		
Coelostoma orbiculare	x		
Cryptopleurum minutum	x		
Cymbiodyta marginellus	x	x	x
Enochrus coarctatus	x	x	x
Enochrus nigritus	x	x	
Enochrus quadripunctatus	x	x	
Enochrus testaceus	x		
Helochares lividus			x
Helochares punctatus		x	
Hydrobius fuscipes	x	x	x
Laccobius bipunctatus		x	x
Laccobius colon	x		
Laccobius minutus	x	x	x
Laccobius sinuatus	x		
Noteridae			
Noterus clavicornis	x		
Noterus crassicornis		x	
TOTALS	**80**	**51**	**29**

The Hornet Moth *Sesia apiformis* at Holkham NNR

Andrew Bloomfield

The Hornet Moth *Sesia apiformis* is arguably one of Britain's most impressive looking moths. It closely resembles a Hornet *Vespa crabro* not only in colour, size and general appearance but also because it often buzzes in flight (Waring 2005). It is, however, a member of the clearwing family of moths (Sesiidae). See pp.46-47 for photographs.

In Britain it is nationally scarce with a distribution that is biased towards south-east England and the Midlands. Scattered records come from as far north as Co. Durham and southern Scotland, and also to the west in Wales. In Norfolk it is widely scattered in localised areas of open woods, parkland and shelter belts of poplars (*Populus* spp.) and has been recorded in 40 10 km squares; 58% of the total (Norfolk Moths website). It could well be that it is still under-recorded and my observations are that most stands of poplars, and indeed sometimes even isolated poplar trees, in mid and north Norfolk show evidence of Hornet Moths.

Life cycle

Hornet Moths live almost exclusively in and around poplars. The best time and place to find adult Hornet Moths is around the trunks of mature trees in June and July when the adults emerge. Although day-flying, all members of the clearwing family are notoriously difficult to see in their adult state and the best opportunity arises during their brief emergence period. Adults emerge early to mid-morning and remain static on the lower part of the trunk for a short time whilst their wings harden off. This takes, on average, an hour during which the female emits a chemical scent to attract a male. When a pair couple, they often remain in tandem on a trunk for up to four hours, enabling them to be seen easily up to midday. Males (identified by their smaller size) that fail to find a female simply drift off into the canopy. Recently it has been possible to obtain artificial chemical pheromones that replicate the female's scent to attract wandering males.

The eggs of the Hornet Moth are laid on the trunk and when they hatch the caterpillars bore their way under the surface of the bark. Here they spend one or two years as a larva before making a cocoon in either their second or third winter period. When emergence begins, the chrysalis is forced out through an exit hole in the tree and sometimes after only a few minutes the adult moth bursts head-first into the world.

Hornet Moths at Holkham

The Hornet Moth was first discovered at Holkham in the early 2000s when a visiting naturalist noticed exit holes in the trunks of the poplars at Lady Anne's Drive. It is likely that the species has been present for much longer as the poplars were planted in the late 1950s after sea water from the great flood of 1953 killed the Holm Oaks *Quercus ilicifolia* that had previously grown there. Lady Anne's Drive, the main entrance to Holkham NNR, is 0.8 km long and runs from the A149 coast road northwards towards to Holkham beach. It is lined by a total of 111 Hybrid Black Poplars *Populus x canadensis*; 53 on the west side and 58 on the east side.

Survey method

In 2009 to 2011, first sightings of adult Hornet Moths were made on July 4, June 23 and June 8 respectively. In 2012 a survey was undertaken to estimate the size of the population of Hornet Moths at Holkham

Hornet Moths at Holkham. All except the lower moth of the mating pair are females.

Hybrid Black Poplars along Lady Ann's Drive, Holkham.

Photographs by Andrew Bloomfield.

Top right: **Larva.** Above right: **Adult emerging from pupa protruding from trunk.** Below: **Emergence holes at base of poplar.** Inset: **Tree felled to leave moths to emerge.** Photos: Andrew Bloomfield.

and to begin annual monitoring. From the beginning of June, each poplar tree along Lady Anne's Drive was thoroughly searched at 7.30 am. The number of moths resting on the trunks was counted together with the number of empty pupal cases projecting from exit holes (see photograph, p.45). The latter number was recorded, where no moths were seen, indicating they had already dispersed before the counting commenced. Pupal cases were removed after counting. Although observations continued, no fresh emergences were detected after July 23. At no time were artificial lures used to attract the moths.

Results

The highest number of emergences was recorded from 28 June to 10 July, with double figures noted daily. A peak of 30 was reached on 30 June, with 29 on 3 July and 28 on 5 July. Numbers started to drop from 8 July when 8 were seen, but then picked up again on 13 and 14 July when 16 and 11 were seen. The last high figure was on 17 July when 9 were recorded, with only small numbers seen thereafter, dropping to none by 24 July.

A total of 219 moths and a further 66 pupal cases were recorded, indicating a minimum of 285 moths emerging (Table 1 and Figure 1). Every one of the 111 trees in Lady Anne's Drive had exit holes present indicating that all had been used at some time in the past, but not all of the trees produced newly emerged moths in 2012. This does not mean that they were 'vacant'; it could have been due to the moth's life-cycle timing *i.e.* some of the current generation of larva might still have been in their first year, thus not ready for pupation.

The most moths seen on a single tree was seven (three mating pairs and a single male on June 29). However, eight fresh empty pupal cases were seen on a single tree on June 30. On only two occasions were two pairs mating seen on a single tree.

Table 1. Total number of Hornet Moths emerging each day, 2012.

Date	No. of moths	Additional pupal cases	Total
28 June	10	2	12
29 June	19	NC	19
30 June	13	17	30
1 July	12	5	17
2 July	9	6	15
3 July	25	4	29
4 July	16	3	19
5 July	24	4	28
6 July	10	2	12
7 July	9	8	17
8 July	6	2	8
9 July	6	4	10
10 July	9	2	11
11 July	3	0	3
12 July	7	0	7
13 July	16	0	16
14 July	10	1	11
15 July	1	2	3
16 July	2	0	2
17 July	7	2	9
18 July	3	0	3
19 July	1	1	2
20 July	0	0	0
21 July	0	1	1
22 July	0	0	0
23 July	1	0	1
Totals	**219**	**66**	**285**

Although most emergences were from ground level to c. 10 cm up the trunk, some were higher; the highest recorded was at 1.8 metres.

Discussion

Morning temperatures during the survey period varied between 12°C and 16°C but there was no obvious correlation between

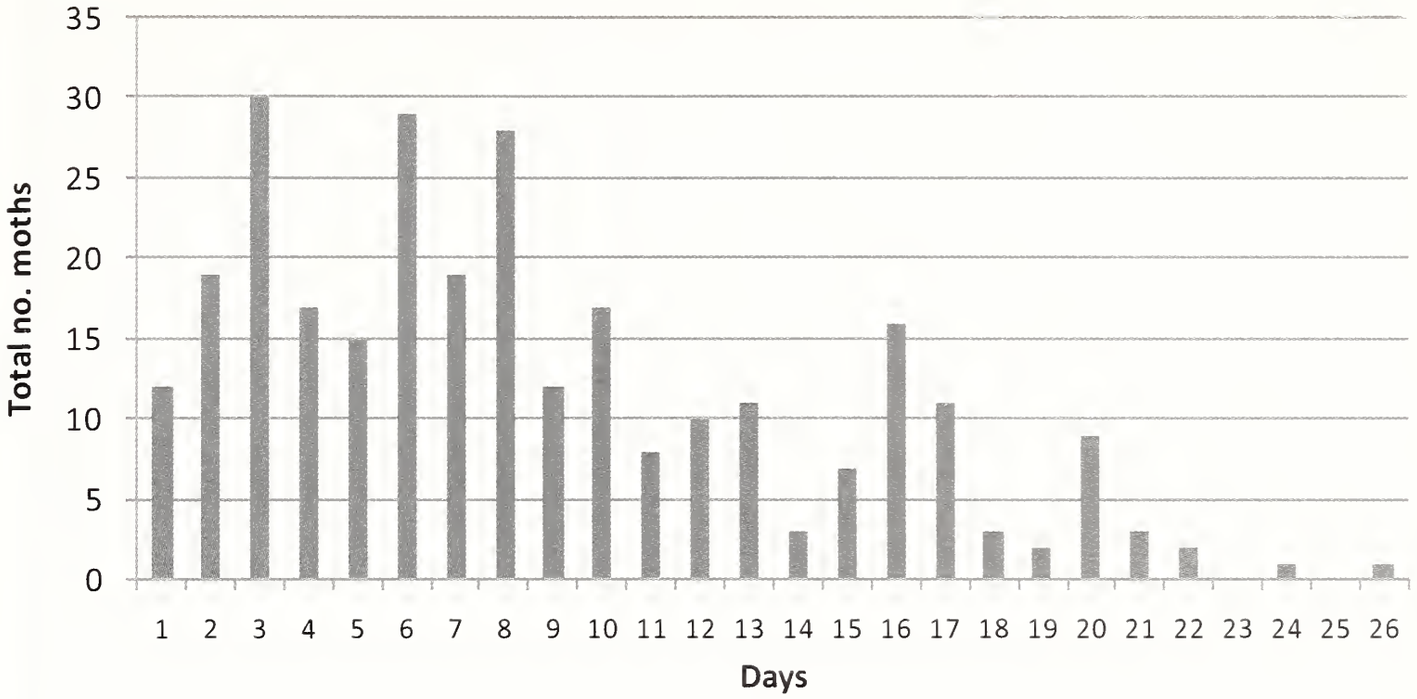


Figure 1. Total number of Hornet Moths emerging each day, June 28-July 23 2012.

the temperature and the number of moths emerging.

It might be assumed that the south-facing side of the tree would be best for the moths to harden their wings off in the sun, but no pattern was observed and exit holes could be found all around the base of the trees. What did seem essential was just the right micro-environment. If there was too much vegetation (bramble and ivy), conditions seemed less suitable. The favoured trees seemed relatively clear by comparison, with grass on average about 40 cm high growing around the base.

Some notes on behaviour of the Hornet Moth

Most sightings of the moths involved individuals sitting still on a tree trunk. Usually one or two would be encountered, unless a female was present and then there would often be a male in attendance and it was usually not long before the two coupled up to mate. This involved a rapid movement by the male in which he generally flew above the static female, getting up close to her abdomen whilst facing in the same direction, before coupling up and swivelling around to adopt the characteristic pose in which the female would be facing up the trunk and the male would facing downwards (see photograph). It was not unusual to see a couple of males jostling for position over a female. On one occasion, three were noted trying to move in on a single female. Once a pair had coupled up, the rival male invariably loses interest. He would usually fly off but it was not unusual to find a mating pair with a single male sitting nearby.

The moths have a defence mechanism whereby if approached suddenly on the trunk they will drop off. If at this stage they are still unable to fly they soon find the nearest grass which they use as an aid to cling to and crawl back up onto the trunk.

The time of the moths emergence has often been quoted as being *c.* 0700hrs. My counts were usually between 0730hrs and 09.00hrs. On a couple of occasions the actual act of the moth breaking free from its chrysalis was noted: on 29 June a male was seen emerging at *c.* 1100hrs; the procedure being completed in a few seconds. Another emergence was seen on 16 July at 0900hrs.

Apart from those seen resting after emergence, there are surprisingly very few reports of Hornet Moths from the area. In

2009 one was seen flying around a poplar at about 1400hrs while on 29 June 2012 one entered the food retail caravan at Lady Anne's Drive during the late morning; it was promptly killed by a person thinking it was a genuine Hornet.

Effects on timber

There are conflicting reports on the internet as to the damage caused by Hornet Moth 'infestation' of poplar trees. It has been suggested that severe die back in the crown of a poplar might well be as a result of the presence of Hornet Moths. Following a survey carried out in the Midlands in 1999 and 2001 (Straw *et al*. 2007) in it was concluded that the main cause of poplar dieback was actually drought and the presence of the moths was secondary. This is supported by our observations in 2012 when four dead and dying trees at Lady Anne's Drive had to be felled. There was little evidence within the core of the trunk of damage by the moth's larvae. Indeed, when some cross-sections were obtained it seemed that the larvae live under the bark rather than boring into the heart of the trunk. As the felling took place at the start of the main emergence period of the moths, efforts were made to minimize the impact of the operation on the moth population. The trees were felled at a height of approximately three metres and any moths that subsequently emerged were moved to a neighbouring tree.

The Hornet Moth's future at Holkham

The Hornet Moth would appear to be a reasonably common species in localised parts of the area. In Osier Carr and the wood to the west of Lady Anne's Drive, where there is little or no recent evidence of moths being present, scrub clearance to let more light penetrate to the base of the tree trunks could benefit the moth. If more trees have to be removed from Lady Anne's Drive car park, they should be cut as described above.

Acknowledgements

Thanks are due to the Holkham Estate and to the following people for help and support during this project: David Foster, Sarah Henderson, James McCallum and Gary Smith.

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Nightjar rediscovered in Waveney Forest

Tim Gardiner & Adrian Gardiner

William Dutt described 'the strange churring of the nightjar' from 'the gloom of the grove which hides the church' at Burgh Castle in his classic work on the Norfolk Broads (Dutt 1906). The Nightjar *Caprimulgus europaeus* would no doubt have graced the heathland of Fritton Warren between Belton and St. Olaves. Its available habitat in the area has, however, been greatly reduced by extensive conifer planting since World War II. The remaining unplanted patches of heathland are extremely fragmented, with succession to woodland due to a lack of conservation management a serious threat to potential Nightjar habitat in Waveney Forest; Nightjars also require extensive areas of feeding habitat, especially uncultivated land.

In Norfolk, 313 churring male Nightjars were recorded in 2004, in 14 10-km squares, an increase from 223 males in 1992. Much of the recent recovery in Nightjar numbers has been due to their nesting in young conifer plantations where there is still bare ground between the trees (Langston *et al.* 2007). As the plantations mature, it is likely that their favourability for nesting declines. Clear-felling of mature conifers is also thought to be behind the recent increase in Nightjar numbers as the felled areas become suitable for nesting (Langston *et al.* 2007). Therefore, the recent felling of a large swathe of conifers in Waveney Forest (13 ha clear felled out of *c.* 130 ha) should provide suitable nesting habitat for the Nightjar for a few years before the replanted trees shade the ground.

Nightjars were last recorded in Waveney Forest in 1998 when Colin Jacobs saw them wing-clapping along one of the rides. To investigate whether the recent felling had enticed Nightjars to nest in the Forest, a survey was undertaken on 13 July 2013 by the authors. Both of the recently clear-felled areas were checked after 2100 hrs as suggested in the literature. No churring Nightjars were heard from the 5 ha area near the river that was felled in winter 2012-2013. In the 8 ha area clear-felled in the winter 2010-2011 near the car park (TG461005) our attention was diverted by several Noctule bats *Nyctalus noctula*, but was soon captured by the wonderful churring of a male Nightjar in the felled area. We listened for several minutes to the changing tones of the Nightjar before making our way back to the car. Apparently, Nightjars require 2 ha to nest, an area adequately provided by both clear fell plots. They can nest on such sites until the replanted trees are about 15 years old, so Waveney Forest may be suitable habitat for the next two decades or more as additional plots are clear-felled.

To rediscover the Nightjar in Waveney Forest after an absence of 15 years was an exciting event, particularly as neither author had heard the evocative call of this heathland migrant before. The already high wildlife value of the Forest is further enhanced by this discovery. There are few areas of heathland suitable for Nightjars in the Great Yarmouth area, although they have been found nesting close to Winterton Dunes (Allard *et al.* 2000).

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Observations of swimming grasshoppers in acid pools in Waveney Forest

Tim Gardiner

Introduction

A recent short communication in the *Journal of Orthoptera Research* detailed the swimming behaviour of the Common Green Grasshopper *Omocestus viridulus* and Meadow Grasshopper *Chorthippus parallelus* in an acid pool in Epping Forest (Gardiner 2009). These observations provided evidence of the swimming ability of two grasshoppers commonly found on bogs and wet heathland in the UK. It seemed both species could swim under water and on the surface film, although the ability to swim was much stronger in early instar nymphs due to their smaller body size and mass than in later instars. This short article describes observations of swimming behaviour for two additional species of grasshopper (Orthoptera: Acrididae) in which this behaviour has not previously been documented in the UK.

Observations and discussion

The observations of swimming behaviour were made in Waveney Forest in East Norfolk, at an acid pool in a recently clear-felled area of coniferous woodland (TG 46141 00600). The felling of 8ha of mature *Pinus* plantation in winter 2010/2011 has led to the re-establishment of small areas of heathland vegetation composed of Bell Heather *Erica cinerea* and Heather *Calluna vulgaris*, with sparse vegetation dominated by Sheep's Sorrel *Rumex acetosella*. The pool, *c.* 10cm deep, 200cm wide and 400cm long, had formed in a depression caused by wheel rutting on a bare earth track used for access by heavy machinery during the felling operation. Situated on sandy soil that drains quickly, it is likely to be ephemeral.

While surveying for Orthoptera on 15 July 2012, as I walked past the pool at 1330hrs I observed two male Field Grasshoppers *Chorthippus brunneus*, body length *c.* 1.5cm, jump into the water, swim to the marginal vegetation and climb out. Both were swimming on the surface film of the water using their hind legs in a kicking motion for approximately 2 minutes before they exited the pool. Neither grasshopper was observed to sink and swim underwater. On reaching the edge of the pool, both grasshoppers walked away, apparently unscathed.

A female Mottled Grasshopper *Myrmeleotettix maculatus*, a localised insect in Norfolk (Richmond 2001), body length *c.* 1.5cm, was observed to jump into the pool and immediately sink beneath the surface

film. It managed to swim underwater, albeit quite weakly, in a constant direction. An underwater hop, as has been observed for *C. parallelus* (Gardiner 2009), was exhibited by the female, but eventually it became tangled in vegetation, stopped moving after *c.* 3 minutes and apparently 'drowned'. To see if the grasshopper could be revived it was collected after 4 minutes submergence and left on the bank to recover. After *c.* 1 minute it started to move its hind legs and wings before walking slowly off. This observation of adult *M. maculatus* submergence at Waveney Forest is consistent with experiments conducted by Brust *et al.* (2007), who observed a degree of tolerance to immersion in hypoxic water in several species of rangeland grasshopper in the USA. They speculated that drowning due to intense periods of precipitation is rare in the field as grasshoppers can tolerate immersion in hypoxic water for periods of 3-21 hours depending on their life stage; nymphs were killed more quickly than adults.

Large Marsh Grasshopper *Stethophyma grossum*, a Red Data Book insect and the UK's largest native grasshopper, has probably become extinct in the Waveney Forest area due to shading of the bogs by planted conifers. On a recent visit to the New Forest, however, in search of *S. grossum* in valley mires, a male was observed swimming quite strongly in an ephemeral acid pool. It floated on the surface film and used its hind legs in a kicking motion in much the same way as *C. brunneus* before exiting the pool. Swimming has now been observed for five grasshopper species in the UK (*Chorthippus brunneus*, *C. parallelus*, *Myrmeleotettix maculatus*, *Omocestus viridulus* and *Stethophyma grossum*) and may be more common than was previously thought. In total, swimming has been observed for nine species of Orthoptera in the UK, including all three groundhoppers (Tetrigidae) and the endangered Mole Cricket *Gryllotalpa gryllotalpa*.

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Bauhinus parlatorei: a newly revealed gall-causing fungus for Norfolk

Robert Maidstone

Following the publication of the new edition of British Plant Galls (Redfern *et al.* 2011) I checked my files of galls I had found against the names in the book for any revised names; one caused me to stop and check that I had the identification right.

The specimen concerned was a black and withered bit of stem, no more than an inch long, in a small re-sealable bag, beside which a purple-black smudge clung to the plastic. These were the dried remains of the top section of the slightly swollen stem of Wood Dock *Rumex sanguineus* which I had collected in July 2003 from the rough, unmown strip under the overhanging trees around Wacton Green (Fig. 1).

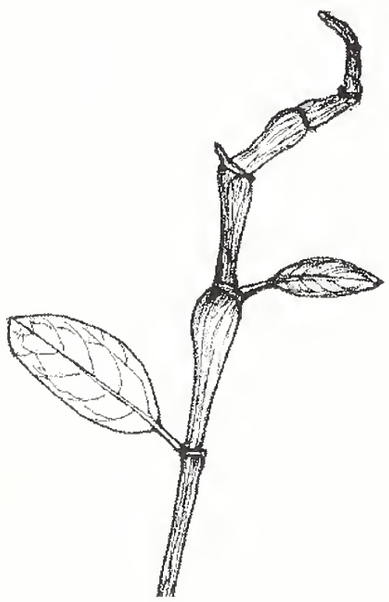

Figure 1. Gall on stem of Wood Dock *Rumex sanguineus.*

The first edition of Redfern *et al.* (2002) gave two fungus causers of galls on docks: the rust *Puccinia phragmitis* on the leaves and the smut *Ustilago kuehneana* on stems and flowers. The description in Ellis & Ellis (1985) of *Ustilago kuehneana* fitted what I had found: 'blisters on upper part of stems....spore mass pinkish purple .... not uncommon.' I took 'not uncommon' to mean it was more common than rare so I made a drawing of the freshly collected plant and sections of the stem and just logged it as something anyone might collect, if they looked.

The new key (Redfern *et al.* 2011) described two fungal galls on *Rumex* stems which had formerly been included under *Ustilago kuehneana* but now split and transferred to the genus *Microbotryum*. That which kept the original specific name, *Microbotryum kuehneanum*, was restricted to Sheep's Sorrel *R. acetosella*; the other, *M. parlatorei* was found on various docks and considered 'very rare'.

I posted a note on the British Galls e-group asking if there was anything else I could have confused my specimen with. Malcolm Storey replied to say that the only thing he could think of was *Uromyces rumicis* and that I should check the spores. Tony Leech kindly did this for me and reported that the spores were 'one of these (*Microbotryum*) species, i.e. 13-15µm, more or less spherical (slightly irregular) with reticulum on surface - definitely not *Ustilago rumicis*.' He also informed me that the fungus was now called *Bauhinus parlatorei*.

Although it has not proved possible to discover the criteria which separate the two smuts on *Rumex* spp., it seems likely from the definitive statement that *M. (B.) kuehneana* is restricted to *Rumex* subgenus *Acetosella* (Spooner & Legon 2006) that the gall collected at Wacton was caused by the fungus *M. parlatorei* and that this is the first British record of the fungus since 1957, the first record for Norfolk and the first ever on Wood Dock.

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Limax cinereoniger: retraction of a record

Garth Coupland

In Transactions 2001 (34: 23-25) I reported the discovery of a second site in the County, Hercules Wood near Blickling Hall, for Europe's largest Slug, *Limax cinereoniger*. Because of the requirement for absolute integrity of scientific recording I have to state, sadly, that this record must be withdrawn.

After recording it I visited Hercules Wood again on a damp and perfect slug-hunting night and found many specimens of the slugs that I had identified as *Limax cinereoniger*. On examining these I found something that gave me a small but niggling doubt as to my identification. I sent a live specimen to the Mollusc Department of the Natural History Museum where it was identified as *Limax maximus*, the common Leopard or Great Grey Slug. In my defence it took several experts considerable time to reach this conclusion!

These woodland slugs are so different from all other specimens of *Limax maximus* that I have observed that it makes me wonder about the reasons for this difference. Assuming that my original identification was wrong there are three questions which may provide an answer. Do we have a hybrid between two closely related species that has survived where its *cinereoniger* parent has disappeared? Does the woodland habitat itself have a profound effect on the appearance and habits of the species? Have these slugs been isolated and inbred for so long that they have a unique and uniform appearance? I feel that the last two questions may hold the key. This is a very variable species in colouration and in fact I found one specimen on a subsequent visit that did show a *maximus* characteristic which satisfied me that the experts were right. Also, in the same wood, I have found many specimens of *Limax marginatus*, the 'Tree Slug', which display a consistent appearance within the wood. They are quite different from specimens found elsewhere, e.g. garden habitats in East Norfolk, where the species displays a consistent appearance within *that* habitat. This tends to support my theories.

It is always disappointing when an exciting discovery turns out not to be so and it is always a blow to one's confidence when an identification one has made proves to be wrong. I can only apologise for my mistake and try to learn from it. The illustrations accompanying my original report in Transactions *are* of a typical specimen of *Limax cinereoniger*, drawn from one I found in Wolves Wood, Suffolk. It shows the characteristics of the species that would enable an identification in the field. I promise!

Garth. M. Coupland

Freshwater and terrestrial molluscs from a substrate sample of a pingo pond at Thompson Common, Norfolk

Chris Gleed-Owen

Introduction

This paper presents a list of molluscs recorded from Norfolk in 1996. During preliminary work for the reintroduction programme of the Pool Frog *Pelophylax lessonae*, molluscs were examined from pond substrates at Thompson Common in Norfolk. Several ponds were visited to search the substrate for ancient frog bones. The gastropods and bivalves contained in a sediment sample are described here as a contribution to the county's biological record. Thompson Common is a Norfolk Wildlife Trust (NWT) nature reserve and Site of Special Scientific Interest. The local landscape is characterised by numerous pingo ponds; bowl-shaped depressions formed by periglacial conditions during the Lateglacial period. English Nature (Natural England) commissioned the work.

Methodology

Several locations around the margins of pingo 65a and a neighbouring pond (TL936960) were visited in summer 1996. Pingo 65a was nearly dry, with a grey silt/clay substrate exposed. A neighbouring pingo held water, with Tench *Tinca tinca* visible. Coring near the margins with a 'Dutch Gouge' enabled sampling of the soft organic mud and peat substrate. A sample of about 500 g was taken, and processed later at Coventry University's Department of Geography. It was soaked, wet-sieved through a 0.25 mm sieve, dried at 40°C, and examined under a binocular microscope at x7-40 magnification. All molluscs were removed and identified in September 1996 using standard field guides (Ellis, 1978; Kerney & Cameron, 1979) and comparative material. Assistance was also received from Dr Roy Baker.

Results

The sample residue contained at least 16 mollusc species, all of them in low numbers of one to six shells, opercula or valves per species. Although the sample yielded no frog bones (the primary purpose of the sampling), small fish scales and bone, ostracod valves, caddis cases, and beetle remains were also noted.

Table 1 shows the mollusc list, comprising 13 snail and three bivalve species. The minimum number of individuals (MNI) is given for each species, based on number of shells and/or opercula, and number of sided valves. In the final column, those which have previously been recorded at Thompson Common are ticked, based upon data accessible from the National Biodiversity Network (NBN) Gateway.

Discussion

Although Mollusca are generally an under-recorded group, and regarded as 'difficult', Norfolk is a relatively well-recorded county. Previous mollusc recording has taken place at Thompson Common, including a survey of pingo 1 by the National Pond Monitoring Network in 1992 (according to data on the NBN Gateway). The Thompson and Stow Bedon area is an ancient landscape with rich habitat diversity, and with further research might prove to be a regional hotspot of molluscan diversity.

All of the species recorded here are widespread in Norfolk, and none are unexpected in the habitats present at Thompson Common. Around ten species are freshwater obligates; four species are terrestrial; two or three are marsh inhabitants that may be classed as terrestrial.

Table 1. Mollusc species identified from a substrate sample at Thompson Common in 2006. *May be *Segmentina nitida*; **partial left valve; ***tumid valves; ****juvenile.

English name	Scientific name	Realm	MNI	TC
Twisted Ramshorn	*Bathyomphalus contortus*	Freshwater	1	√
Common Bithynia	*Bithynia tentaculata*	Freshwater	5	√
Glossy Pillar Snail	*Cochlicopa lubrica*	Land	1	
Dwarf pond snail	*Galba truncatula*	Freshwater	1	√
cf. Flat Ramshorn	cf. *Hippeutis complanatus**	Freshwater	1	√
Rayed Glass Snail	*Nesovitrea hammonis*	Land	1	
Rosy Pea Shell	*Pisidium milium*	Freshwater	3	
Shining Pea Mussel	*Pisidium nitidum*	Freshwater	1	
cf. Short-ended Pea Mussel	*Pisidium* cf. *subtruncatum***	Freshwater	1	
Margined Ramshorn	*Planorbis planorbis*	Freshwater	1	√
Dwarf Snail	*Punctum pygmaeum*	Land	1	
cf. Horny Orb Mussel	*Sphaerium* cf. *nucleus****	Freshwater	4	√
an amber snail	*Succinea* sp ****	Marsh	1	
Ribbed Grass Snail	*Vallonia costata*	Land	2	
Flat Valve Snail	*Valvata cristata*	Freshwater	2	√
Marsh Whorl Snail	*Vertigo antivertigo*	Marsh	1	

The sampled pingo exhibited a good-quality freshwater environment; well-vegetated, with moderately-clear water, and relatively little runoff from the surrounding land. The species identified are consistent with this environment.

The habitats immediately surrounding the sampled pingo include grassland, marsh and deciduous woodland. The terrestrial species are all compatible with these local habitats, and dead shells could easily be washed in from the pond margins to become incorporated into substrate sediments.

Acknowledgements

I am indebted to the late Professor David Keen for the knowledge he imparted to me on molluscan identification in the 1990s. Thanks also to Paul Joslin with whom the fieldwork was carried out, Bev Nichols the former NWT warden, and to Dr Tony Gent, formerly of English Nature, who commissioned the work. Dr Roy Baker of Norfolk & Norwich Naturalists' Society kindly reviewed the manuscript and commented on some of the identifications.

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Weather Report 2012

Norman Brooks

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

Monthly accounts

January 2012 A rather mild month **with** wintry conditions delayed until the 29th when a cold easterly airstream spread over East Anglia, with snow flurries on the 30th and 31st.

Jan. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	1	0	0	0	5	13	4	7

February 2012 A month of two halves, with the period 1st - 15th having a mean temperature of only 0.1°C, and in great contrast the period 16th-29th registering a mean of 8.3°C. The air temperature fell to -10.1°C on the 11th, and snow lay from 5th to 12th inclusive with a maximum depth of 9cm. There was a marked rainfall deficit which made it the driest February in Norfolk for ten years. The maximum of 18.6°C on the 23rd is very close to the national record for the date.

Feb. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	2	3	3	2	1	5	7	5	1

March 2012 With a marked excess of sunshine this was the warmest March since 1997. The temperature attained levels appropriate to early summer from the 20th - 29th, with the maximum of exactly 22°C on the 28th, only just below the March record of 22.3°C. The rainfall average over Norfolk was 52.4mm with much of this figure measured during a sustained downpour on the 4th and 5th. The total on these dates exceeded any two-day amount recorded in the Norwich area in March since at least the

Table 1 Monthly summaries for 2012

Month	Total rainfall (mm)	Percentage of mean rainfall	Days air frost	Days ground frost	Monthly mean temperature (°C)	Deviation from mean (°C)
January	41.0	79%	9	13	5.5	+1.5
February	14.5	34%	14	17	4.3	+0.5
March	62.5	134%	6	14	8.2	+2.3
April	119.8	244%	4	13	7.9	+0.3
May	39.8	88%	0	1	12.5	+1.2
June	97.4	182%	0	0	14.3	0.0
July	124.2	220%	0	0	16.5	0.0
August	57.3	112%	0	0	18.1	+1.9
September	50.1	92%	0	1	13.9	- 0.4
October	83.7	144%	2	8	9.9	+1.1
November	87.2	137%	5	12	6.7	0.0
December	94.9	156%	9	15	4.7	- 0.1

end of the 19th century.

Mar. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	4	0	5	4	2	2	6	3	5

April 2012 With rain recorded on 26 days, April was an extremely wet month, the total rainfall of which (119.8mm) exceeded that of the three previous months combined. Unusually, the mean temperature was lower than that of March. A funnel cloud was observed over Norwich on the 12th.

April wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	4	4	0	3	1	4	6	7	1

May 2011 After three weeks of dull and cheerless weather, redemption arrived on the 23rd with a sudden heatwave that peaked on the 28th with a maximum of 27.3°C.

It was the driest May in Norfolk for ten years.

May wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	2	3	3	5	1	4	3	9	1

June 2011 An unseasonably wet month with a rainfall total approaching double the average - but not as wet as June 2007. The maximum on the 3rd was only 10.1°C and it was not until the 26th that a single day achieved a maximum that exceeded the warmest day in March.

June wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	0	1	6	2	8	8	4	0

July 2011 A sodden month with over double the average rainfall making it the wettest July since 1988.

Much of the month was dull and dismal but relief arrived in the last few days when a brief heatwave lifted the monthly mean temperature to exactly normal.

Thunder was heard on four days, with funnel clouds observed between Hindringham and Langham on the 10th and at West Runton on the 18th.

July wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	0	3	2	4	9	6	3	3

August 2011 Unlike many other areas of the United Kingdom, Norfolk enjoyed a good summer month with maxima exceeding 21°C on 27 days and 25°C on seven. On the 18th the temperature soared to 32.8°C, the hottest day locally since 21 July 2006.

Thunder was heard on five days with a downpour measuring 23.6mm during a storm on the 25th. During a brief shower on the 19th a deposit of grey dust was revealed, the origin of which was certainly North Africa.

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

September 2011 Drier than average with near-normal temperatures.

The summer of 2012 ended in dramatic style on the 9th with the very high maximum of 28.5°C, and the first hint of autumn was the ground frost that whitened lawns and fields on the 23rd.

Periods of thin high cloud caused 'mock suns' or 'sun dogs' to be visible on four days.

Sept. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	2	0	2	0	5	7	10	2	2

October 2011 With rain recorded on 22 days it was the wettest October in Norfolk since 2004, and in the Norwich area the wettest since 1993. The month was notably autumnal with a deficiency of sunshine and a short-lived snow cover on the early morning of the 27th. It was the coldest October in Norfolk since 2008.

Oct. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	2	1	2	1	8	7	1	8

November 2011 A nondescript month, the wettest overall in Norfolk since 2009. However, the distribution of the rainfall was uneven, with the north of the county averaging around 100mm and the south 55-65mm. Sleet fell on the 3rd. The first dense fog of the autumn shrouded the countryside on the 15th.

Nov. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	3	0	1	0	7	10	2	1	6

December 2011 The month was generally cold until the 13th, mild thereafter. Snow fell on five days but was insufficient to provide a cover. During the period 18th - 31st only a single, slight, ground frost was recorded, with a consequence that soil temperatures recovered to early summer levels. Excessive rain during this period caused minor flooding of the River Wensum.

Dec. wind	N	NE	E	SE	S	SW	W	NW	Calm
Days	1	0	0	5	4	8	5	2	6

Annual summary 2012

Total rainfall	872.4mm
134% of mean; wettest since 2007	
Wettest day	5 Jul, 27.8mm
Days with rain recorded	206
Days with sleet or snow	18
Days with snow lying	8
Highest maximum temperature	31.6°C 18 Aug
Lowest maximum temperature	0.5°C 12 Dec
Highest minimum temperature	19.3°C 18 Aug
Lowest minimum temperature	-10.1°C 11 Feb
Lowest grass min. temperature	-12.1°C 11 Feb
Air frosts	49
Ground frosts	94
Days with hail	8
Days with thunder	19
Days with gales	4
Longest period with no measurable rain	
15 days (12 March - 2 April inclusive)	
Mean cloud cover at 09.00 hrs	67%
Wind direction at 09.00 hrs (days):	
North	22
North-east	14
East	22
South-east	38
South	31
South-west	78
West	78
North-west	42
Calm	41
Annual mean maximum temp.	14.3°C
Annual mean minimum temp.	6.1°C
Annual mean temperature	10.2°C

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Dragonflies

Pam Taylor

Norfolk suffered less severely from adverse weather conditions in the summer of 2012 than counties further to the west and our commoner dragonfly species had a reasonable year, despite the frequent periods of rain. **Brown Hawker** ***Aeshna grandis*** in particular thrived and good numbers were reported from many sites. Conversely, **Southern Hawker** ***Aeshna cyanea*** had another sparse year, with two-thirds of all sightings involving single individuals.

Southern Migrant Hawker ***Aeshna affinis*** A vagrant to Britain that has now established a small breeding colony in Essex. A male was reported from Strumpshaw Fen in September and the record has been accepted by the Odonata Rarities Committee.

Norfolk Hawker ***Aeshna isosceles*** Reported as usual from its main Broadland strongholds including Upton Fen, Sutton Fen and Hickling. It was also recorded at the UEA Broad and on the River Yare in the same area. Away from its main breeding sites, a single male was photographed at a private lake near Westwick and another individual was seen to the west of Bawburgh.

Common Hawker ***Aeshna juncea*** A species that is certainly *not* common in Norfolk. Reported from only two locations: the known breeding site at Winterton Dunes and a single sighting from Burgh Common in the Broads.

Hairy Dragonfly ***Brachytron pratense*** Well reported in East Norfolk, whilst in West Norfolk reports came in once again from coastal regions in the north-west and from fen areas close to the Norfolk/ Suffolk border.

Downy Emerald ***Cordulia aenea*** Numbers were apparently low at its main site near North Walsham during 2012, but this could be due to a lack of recording rather than a lack of actual dragonflies. The highest number reported together during 2012 was just five in early July.

Keeled Skimmer ***Orthetrum coerulescens*** Present in good numbers at Holt Lowes, with smaller colonies continuing at Buxton Heath and Beeston Regis Common. As in previous years, one or two Keeled Skimmers were also found at Dersingham Bog and Roydon Common, indicating that small colonies may also be present on those reserves.

Red-veined Darter ***Sympetrum fonscolombii*** A migrant species that thrived during June and July at a site near Kelling with over twenty seen on several occasions. Ovipositing pairs were observed, but successful breeding could not be proven due to access restrictions at the site. Further pairs were reported from Winterton Dunes and Weybourne in late June, with a single individual at Cley.

Willow Emerald Damselfly ***Lestes viridis*** A recent colonist of Norfolk, once again present at Strumpshaw Fen .There were no records from Wheatfen on the opposite side of the river this year, but further individuals were seen for the first time near Ranworth and on the River Waveney not far from Beccles.

Small Red Damselfly ***Ceriagrion tenellum*** Present in good numbers at Scarning Fen from mid-June to mid-August, with a peak towards the end of July when at least fifteen pairs were present. This is the only site in Norfolk for this species.

The east Norfolk coast was productive for migrants during September. Up to five **Southern Emerald Damselfly** ***Lestes barbarus*** were present with at least two **Scarce Blue-tailed Damselflies** ***Ischnura pumilio***. The latter included an andromorph female; only the second time this form has been reported in Britain.

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Wildlife Report 2012

Orthoptera

David Richmond

The early months of 2012 were warm, but it then turned cold and wet from April to July, delaying the emergence of nymphs and subsequently of adults. The author did not see a Dark Bush-cricket nymph until 29 May, 39 days later than in 2011, and a Speckled Bush-cricket nymph was not seen until 9 June, compared with an average date of 17 May for the previous 11 years. First adults of all species were typically a month later than in 2011, with many species suffering their latest ever 21st century dates for reaching maturity.

The most interesting observations from a generally poor year are reported below, together with some previously unreported records from 2011.

Oak Bush-cricket: Two found indoors at Barnham Broom was a new 10k square record for TG00 (I. White).

Great Green Bush-cricket: Tim Gardiner confirmed this species was still present at Burgh Castle in 2011 (first recorded from this site in 2005).

Dark Bush-cricket: In an intensive survey of the area, Tim Gardiner reported this species from 10 new tetrads in TG41 to the west of Great Yarmouth. At the opposite end of the county Jeremy Halls reported it from unmanaged grassland and scrub off the A47, 1km south-east of King's Lynn Hardwick roundabout. This is the first King's Lynn record away from the banks of the Great Ouse and suggests that further exploration of this area could be rewarding.

Roesel's Bush-cricket: First recorded in Norfolk in 1997, it has since spread across the county and has been reported from all 10k squares with the exception of a

few under-recorded part-squares around the periphery.

Long-winged Conehead: First recorded in Norfolk in 2000, it has now been recorded from all 10k squares except for the less frequently visited parts of the Fens.

Common Groundhopper: Stuart Wright had an unusual record of one in a moth trap at Ingham.

Stripe-winged Grasshopper: A record from the Palm Paper works at King's Lynn is the westernmost record for the county (J. Lines). In mid-Norfolk, Martin Greenland has confirmed that the species is still present at Alderford Common where the author found it in 2011. It would be useful to have a hot summer to check how it is faring in other recently colonised areas.

Meadow Grasshopper: Tim Gardiner reported this insect to be widespread across Great Yarmouth County Borough in his intensive study in 2011-2012, but it has not been reported by other observers. The author visited 7 tetrads in TG41 in ideal weather in August 2012, including several locations cited by Tim Gardiner, but did not encounter this species. Different study techniques were used, the author relying on a bat detector to listen for the insect's distinctive stridulation, whereas Gardiner undertook detailed visual searches of small sample areas. More research is needed to confirm the status of this species in this part of the county.

Egyptian Grasshopper *Anacridium aegyptium*: The most unusual record of the year. A live individual was found in Taverham on 23 July and taken to Rex Hancy, who in turn passed it to experts at the John Innes Centre for formal identification. British examples are usually considered to be accidental imports with consignments of horticultural products from the Mediterranean region.

Late dates

There were no reports of any grasshopper species surviving into November. Using a bat detector, the author monitored his local populations of Dark and Speckled Bush-crickets along the Marriott's Way in Reepham. Dark Bush-cricket survived until 8 November (a relatively poor date) but Speckled Bush-cricket surviving in sheltered cypresses until 28 November, the fourth latest date on record, despite wet and windy weather in the latter part of the month.

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Bumblebees

David Richmond

The publication of Bumblebees of Norfolk (N&NNS Occasional Publication No 14) in June 2012 brought a welcome surge in records for this group. Updated maps can be viewed in the species guide section of the Society's website.

The six most common species are shown to be widely distributed across the county with lots of tetrad infilling from recorders in 2012. *Bombus lucorum* and *B. pratorum* remain the most sparsely distributed of the common species, with the latter having few if any records from the Fens.

Among the new records received was an archive data set from Henry Berman FRES which included records of *B. humilis* at South Wootton in 2005 and King's Lynn in 2006. *B. humilis* is similar to *B.muscorum*, but has a strong brown band across the yellow of the abdomen. If correct, these would be the first records since the mid-1960s. It is a species which is dependent on permanent rank grassland that is rich in flowers.

Records of note for 2012 are given below (alphabetical by scientific name).

Bombus barbutellus (cuckoo of *B. hortorum*): New 10k square records from Castle Acre, Swanton Novers, Weston Longville and Strumpshaw.

Bombus bohemicus (cuckoo of *B. lucorum*): The only record of the year was an individual caught in a water trap at Felmingham railway cutting (new 10km square).

Bombus campestris (cuckoo of *B. pascuorum*): A male on knapweed at Swanton Novers Great Wood was a new 10k square record.

Bombus hypnorum: First recorded in Norfolk in 2008, this bumblebee is now widespread across the county with records from thirty-two 10km squares.

Bombus jonellus: There were new 10km square records from Swanton Novers Great Wood, Strumpshaw and Hickling. Within its established range along the north Norfolk coast it was reported from Holkham Dunes, Blakeney Point, Salthouse Heath and Weybourne Beach.

Bombus muscorum: A poor year, with the only records being from Blakeney Point in June and Weybourne Camp in July and August.

Bombus ruderarius: New 10km square records from Morston and Swanton Novers Great Wood.

Bombus rupestris (cuckoo of *B. lapidarius*): This species continues its recovery with new 10km square records from Thetford Heath, Middle Harling Heath and Barnham Broom and new tetrad records from existing 10km squares at Swanton Novers Great Wood and Cley Eye.

Bombus sylvestris (cuckoo of *B. pratorum*): Widely distributed across the county, with records from five new 10km squares in 2012. It is probably under-recorded.

Bombus vestalis (cuckoo of *B. terrestris):* The most frequently reported cuckoo bumblebee, and widely distributed across the county. Two new 10km squares reported in 2012.

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Moths

Jim Wheeler

Considering the dreadful weather in 2012, a remarkable seven county firsts, nine vice-county firsts and three post-Victorian firsts (species not seen for 100 plus years) were recorded in 2012 (Table 1). Other macro moths of note: Ruddy Carpet at Great Ellingham (C. Knott); Small Ranunculus at Costessey (M. Casey); Dewick's Plusia at Costessey (M. Casey); the second Norfolk record of Oak Processionary at Filby (D. Hipperson); the first record in 10 years of Figure of Eight at Thwaite St Mary (Z. Madgett), amongst many others.

Table 1. New Norfolk county and vice-county records

Species	Date	Place	Recorder	Form	Record
Ectoedemia heringella New Holm-Oak Pigmy	24/03/2012	TG0243 Blakeney	Lee Gregory	Mine vacated	New VC27
Hysterophora maculosana Bluebell Conch	23/05/2012	TG0433 Melton Constable	David.Longden	Adult	Post-Victorian first
Elachista bedellella Grey Dwarf	24/05/2012	TL7699 Foulden Common	Jim Wheeler	Adult	Post -Vic VC28
Dahlica triquetrella Narrow Lichen Case-bearer	06/06/2012	TG5108 Breydon Saltmarsh	John Langmaid	Case	New VC27
Coleophora conyzae Spikenard Case-bearer	07/06/2012	TG0522 Foxley Wood	John Langmaid	Case	New VC27
Infurcitinea argentimaculella Silver-barred Clothes Moth	08/06/2012	TG4221 Hickling Broad	John Langmaid	Larval tube	New VC27. Possibly New for Norfolk
Aethes williana Silver Carrot Conch	10/06/2012	TL7793 Cranwich Heath	Ian Barton/ Kathleen Rosewarne	Adult	New for Norfolk
Cydia illutana Larch Piercer	30/06/2012	TF7628 Amner	Dave Appleton	Adult	New for Norfolk
Sclerocona acutellus Thatch Pearl	04/07/2012	TG3530 Walcott	Mick A'Court	Adult	New for Norfolk
Epiblema grandaevana Great Bell	15/07/2012	TG2440 Overstrand	James McGill	Adult	New for Norfolk
Assara terebrella Dark Spruce Knot-horn	15/07/2012	TG0707 Barnham Broom	J & J Geeson	Adult	New VC27
Nemophora minimella Small Long-horn	21/07/2012	TL7588 Weeting	Ian Barton/ Kathleen Rosewarne	Adult	Post-Vic VC28
Gelechia senticetella Cypress Groundling	27/07/2012	TL8684 Thetford	Lee Gregory	Adult	New for Norfolk
Archanara neurica White-mantled Wainscot	31/07/2012	SE Norfolk	Brian Jones	Adult	New for Norfolk
Sciota adelphella Willow Knot-horn	10/08/2012	TM09 Great Ellingham	Chris Knott	Adult	New VC28
Cydia amplana Vagrant Piercer	18/08/2012	TG5002 Upwell	Jim Wheeler	Adult	New VC28

[Table continued

Species	Date	Place	Recorder	Form	Record
Cochylis molliculana Ox-tongue Conch	27/08/2012	TF6830 Dersingham	Dick Jones	Adult	New for Norfolk
Cochylis molliculana Ox-tongue Conch	01/09/2012	TG4300 Haddiscoe New Cut	Brian Jones	Adult	New VC27
Crocidosema plebejana Southern Bell	24/10/2012	TM0196 Great Ellingham	Chris Knott	Adult	New VC28

The latest records can be viewed on the Norfolk Moths website (www.norfolkmoths.co.uk) where you can easily add records via the on-line recorder. Please keep sending in your records and photos.

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Wildlife Report 2012

Hoverflies

Stuart Paston

Almost 400 records relating to 79 species were received for 2012, with most data from East Norfolk (VC 27), and I would like to thank all those who contributed records. Large, easy-to-spot species were predominant but a notable absentee was *Leucozona lucorum*, a sizeable, conspicuous hoverfly that is mainly on the wing in late spring and early summer. Significantly its larvae feed on aphids and it would appear to have had a poor year in keeping with most species in this category. Indeed, 2012 will be remembered for the record-breaking rainfall of spring and early summer and this undoubtedly impacted on the emergence and activity of hoverflies during that period. An improvement in the weather followed but it was too late for many of the aphidophagous species, the group most affected by the earlier weather, and numbers of these remained low.

It was not all bad news, however; members of the Eristalini, a group whose larvae (rat-tailed maggots) develop in drains and ponds, or in water-filled rot holes in the case of *Myathropa florea*, all enjoyed a good year. The bumblebee- and wasp-mimicking hoverflies always attract attention and *Volucella* spp. in particular were also largely unaffected by the adverse weather, with *V. pellucens* and *V. zonaria* prominent in the data received. Pride of place has, however, to go to *V. inflata* (photo, p.43). This species has been infrequently recorded in Norfolk in recent years but I received four records for 2012, spanning the period from late June to August: Nick Elsey photographed a female on his kitchen window at Stoke Holy Cross and Tim Strudwick confirmed a report of a female at bramble blossom at Strumpshaw Fen. The other records were supplied by Nick Owens who had one enter his house at Weybourne and later discovered a male at knapweed in Swanton Novers Great Wood. *V. inflata* has an association with sap runs so it appears unlikely it will ever become as established and widespread in Norfolk as have the other *Volucella*, which are associated with bee and wasp nests. All the sightings of the past 20 years or so seem to relate to singletons and some of these may have been migrants.

There were no real surprises amid other reports but a number of records confirmed the continued presence of less common or under-recorded species. *Arctophila superbiens*, which favours wet, acidic woodland, was found at Swanton Novers Wood (Nick Owens). The colonies in Norfolk are the sole East Anglian outpost for a species that otherwise has a strictly northern and western distribution in Britain. Breckland supports some hoverfly species that are scarce elsewhere in Norfolk such as *Cheilosia urbana*, recorded from The Nunnery, Thetford (Andy Musgrove) and *Chrysotoxum elegans*, found at West Tofts (Nick Owens).

The use of traps is guaranteed to produce records of interest. The grounds of the UEA in Norwich have yielded a good deal of hoverfly data in the past but in order to remedy a lack of recent records Iain Barr has set up a Malaise trap. This year's catch included the dry grassland species *Cheilosia latifrons* which is infrequently recorded in the county. *C. grossa*, which appears in early spring and is often overlooked as a consequence, was also recorded on the campus by Chris Jones. A Malaise trap run at Strumpshaw Fen in July by Tony Irwin produced *Pipiza lugubris* and *P. luteitarsis* from woodland bordering fen. I otherwise received no records of this genus. Hoverflies are also attracted to moth traps and this source produced an interesting record of *Didea fasciata* from an Acle garden (Martin Greenland). This woodland species is, I suspect, more widespread than the few Norfolk records suggest. The only *Criorhina* records I received were of *C. berberina*, with reports from Beeston (Francis Farrow) and Swanton Novers (Nick Owens).

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Beetles

Martin Collier

Just five beetles were added to the Norfolk list in 2012, which was a little disappointing after the nine additions in 2010 and seven in 2011. Details of these five additions and other 2012 records of interest are provided. Several of these records are of beetles caught in a small flight interception trap placed next to a large log pile in mainly deciduous woodland at Weston Park, VC 27, TG107170. To avoid repetition of these details, just the locality and trapping dates are given in the relevant individual species accounts. Species are listed alphabetically by family, then by genus and species. Nomenclature follows Duff (2102) and the national status, shown after the species name, is as given in the 'National Reviews' (Hyman, 1992 & 1994). All records are my own except where indicated otherwise. Those marked with an asterisk are new to Norfolk.

ANTHRIBIDAE

Choragus sheppardi Notable A

A single specimen of this scarce saproxylic species was found by beating fallen oak *Quercus* branches at Stanford Training Area, VC 28, TL9093 on 7 August 2012. The larvae feed in rotten, fungus-infested wood, especially ivy *Hedera* (Alexander 2002). There are only two other modern Norfolk records, both in 2002, and two 19th Century records.

APIONIDAE

Cyanapion spenceii

This weevil feeds on vetches *Vicia* spp., especially Tufted Vetch *V. cracca*, in damp habitats e.g. fens. It has a somewhat local but widespread distribution in Britain and can be common (Morris 1990). Two examples were found by sweeping grazed fen vegetation at Strumpshaw Fen, VC 27, TG3406, during the RSPB BioBlitz on 23 July 2012. Edwards (1893) considered this species to be common in Norfolk so it is surprising that this appears to be the only modern county record.

CHRYSOMELIDAE

Cassida hemisphaerica Notable A

Ted Ellis (1935) added this tortoise beetle to the Norfolk list, recording it from Wroxham in 1933, although he did not annotate it as being an addition. Presumably this was an oversight because I have not found any earlier records. It has a widely scattered distribution in Britain but is generally very scarce. Adult beetles have been found on campions *Silene* spp., including Ragged Robin *Silene flos-cuculi*, and other species in a wide range of habitats (Cox 2007). A single specimen was beaten from a small, sickly looking elm *Ulmus* bush beside the track to Watermill Broad, Cranwich, VC 28, TL7795 on 10 September 2012. My only other encounter with this species was at Sturston quarry, Stanford Training Area, VC 28, TL8694, on 15 July 2006 (Collier 2007). The first Norfolk record appears to be by E. Brown, at Narborough (probably Narborough railway embankment), VC 28, TF7511 on 7 June 2000 (NBN Gateway, 2013).

CUCUJIDAE

Pediacus depressus Notable A. Photo. p.46

This very scarce saproxylic beetle is attracted to freshly cut wood and Goat Moth *Cossus cossus* burrows (Alexander 2002). It is much rarer than *P. dermestoides*,

the other British species in this genus. *P. depressus* was first recorded in Norfolk in unusual circumstances, when larvae and adults were discovered in wood and grain in a building near Norwich in 1934 (Ellis 1936). Ted Ellis also included this species, along with *dermestoides*, in a manuscript list of beetles recorded from Wheatfen Broad, Surlingham. I understood that Ted transcribed this list from his card index in 1983, but unfortunately I have been unable to discover any supporting details and the Wheatfen record therefore really requires confirmation. On 14 August 2012 a single specimen was found under bark in wet woodland at Sandy Lane, Lower Stow Bedon, VC 28, TL9895. This is the second modern county record, the first being when two specimens were caught in an aerial vane trap in an old oak tree at Buckenham Tofts Park, Stanford Training Area, 10 June–14 July 2005 (Collier 2007).

CURCULIONIDAE

Otiorhynchus armadillo Photo. p.46

This weevil is closely related to the Vine Weevil *Otiorhynhus sulcatus*, a notorious garden pest. The first British specimen was found in south-west London in 1998 (Barclay 2003). As a single example it was initially considered to be a vagrant but three years later it was found in numbers in the same area. The first beetles found were almost certainly introduced from southern Europe with ornamental plants but the beetle obviously finds our climate suitable and it reproduces rapidly. *Otiorhynchus armadillo* now seems to be widespread in Britain, with records from Scotland and Wales (Barclay 2003), and has been found in recent years in the adjoining counties of Suffolk (Nash 2007) and Cambridgeshire (Miquel 2010). The beetle's arrival in Norfolk was therefore anticipated and Andrew Duff was the first to discover it, on 12 May 2012, on ornamental shrubs in the car park of Morrisons supermarket in Cromer, VC 27, TG214420. Searching similar plantings at other supermarkets etc. will no doubt reveal other colonies. Characteristic notching on the edges of leaves is a good indication of adult feeding by species of *Otiorhynchus* (Barclay 2003).

Taphrorychus villifrons

The first reliably identified British specimens of the bark beetle *Taphrorychus villifrons* were taken in Kent in 2003 (Heal 2006). The species was actually added to the British list many years previously (Donisthorpe 1924) but based on a single specimen that was later considered to be a slightly atypical example of *T. bicolor* (Heal 2006). *T. villifrons* has therefore not generally been mentioned in British checklists, although it was included, without comment, by Duffy (1953) in his key to British Scolytidae. Neither species of *Taphrorhychus* had been recorded from Norfolk until several specimens were found in the bark of a felled oak trunk at West Tofts, Stanford Training Area, VC 28, TL837927 on 24 February 2012. These were initially identified as *bicolor* but further examination revealed the presence of small sharp tubercles on the elytral declivity, the distinguishing character of *villifrons*. This determination was confirmed by Norman Heal. A further specimen was caught in an aerial vane trap in an old oak tree in Blickling Park, VC 27, TG179289, 21 August–18 September 2012.

HISTERIDAE

Aeletes atomarius RDB3 - Rare

This beetle can be found in the burrows of Lesser Stag Beetles *Dorcus parallelopipedus*, mainly in rotting Beech *Fagus sylvatica* and Ash *Fraxinus excelsior*. It is probably under-recorded because of its minute size (*c.* 1mm). An underground pitfall trap set inside the rotten interior of a beech stump at West Tofts, Stanford Training Area, VC 28, TL8392, produced one specimen in each of the periods 14 August–10 September and 10 September–12 October 2012. The only other Norfolk records were in 2003, when specimens were caught in aerial vane traps in various locations within Felbrigg Park

and Great Wood during a survey for the National Trust by Peter Kirby.

LATRIDIIDAE

Cartodere constricta

The mould beetle *Cartodere constricta* appears to be somewhat infrequently recorded in Britain (NBN Gateway 2013), although it has no national rarity status. Two examples were caught at Weston Park, 24 June–9 July 2012. The only other Norfolk record is from Overstrand cliffs, VC 27, TG2540, on 13 October 1987.

LEIODIDAE

Leiodes cinnamomea Notable B

The larvae of *Leiodes* feed in subterranean fungi, e.g. truffles, mainly in either sandy soils e.g. heaths and coastal dunes, or in woodland. The adult beetles are rarely seen during daytime but can be found by sweeping vegetation in the evening or at night, particularly when the weather is warm and humid. *L. cinnamomea* is associated with Beech trees on chalky or sandy soils. Andrew Duff found a specimen in an mv light trap at 'Natural Surroundings', Glandford, VC 27, TG047407 on 13 November 2012. The only previous Norfolk records are from Felbrigg Great Wood in 1975, by Tony Irwin, and the King's Lynn area in 1908, by E.A. Atmore (Edwards, 1909).

MELANDRYIDAE

Phloiotrya vaudoueri Notable B

The larvae of this scarce saproxylic beetle live in soft dead deciduous wood, mainly of Beech and oak. It was added to the Norfolk list by Martin Rejzek, who reared several adults from larvae found in dead Buckthorn *Rhamnus catharticus* at Attlebridge Hills, VC 27, TG1416 on 16 December 2001. The second county record was provided by two specimens caught at Weston Park, 24 July–21 August 2012. It is interesting to note that both of these records were from the same 10km square, even though the sites are several miles apart; this may be coincidence but it could indicate that the species has a very restricted distribution in Norfolk.

MONOTOMIDAE

Rhizophagus cribratus Photo. p.46

Less frequently found under bark than most other members of this genus, *Rhizophagus cribratus* occurs mainly at the roots of deciduous trees, although it has also been recorded from leaf litter, fungi, carrion and dry dung (Peacock 1977). It was found twice in 2012, the first modern county records: one specimen at Weston Park, 24 June–9 July, and another singleton at Stanford Training Area, VC 28, TL 908944, 7–14 August, in an underground pitfall trap next to a dead oak tree. The only other Norfolk record was from Earlham, Norwich, by Edwards (1893).

Rhizophagus perforatus

Rhizophagus perforates was first found in Norfolk in 2010 (Collier 2012), in VC 28, and it has now also been found in VC 27, at Weston Park, 24 June–9 July. It is a mainly subterranean species, occurring in decaying, mouldy organic matter, but is also occasionally found under bark (Peacock, 1977).

SCARABAEIDAE

****Aphodius arenarius*** Notable B

Many species of dung beetle have declined in recent decades, almost certainly due, at least in part, to the widespread use of ivermectin-type worming treatments for horses and cattle. These compounds remain toxic to many invertebrates long after the dung has been deposited. *Aphodius putridus* may be less affected by this than other dung beetles because it also occurs in sheep and rabbit dung, particularly on dry, chalky or sandy soils (Hyman 1992). A single specimen was found in a pitfall trap in very sandy soil near rabbit burrows at Weeting Heath, VC 28, TL757883, 8 May–2 June 2012, the first county record. Although nine traps were placed around the rabbit

warren and a total of 36 traps were used on the site for much of the year between April and September, no further specimens were found. The site was also being grazed by sheep for most of the trapping period.

STAPHYLINIDAE

Hypnogyra angularis Notable A

This scarce rove beetle is usually found in hollow trees, often beneath bird nests or in ant nests, or occasionally under bark. Its distribution appears to be restricted to the southern half of England and Wales. *Hypnogyra angularis* was added to the Norfolk list by Andrew Foster, who found it at Stanford Training Area, VC 28, TL8895 on 26 March 1986. It has now been found at a different part of Stanford Training Area, TL8392: one specimen in an underground pitfall inside a rotten Beech stump, 10 September–12 October 2012. These are the only Norfolk records.

****Mycetoporus piceolus*** Notable

Some species groups within the genus *Mycetoporus* are difficult to identify, with several species not being included in Joy (1932), and there has been considerable confusion over names; the status and distribution of some species have therefore not yet been fully established. However, *M. piceolus* is recorded as being associated with dry, chalky or sandy soils (Hyman 1994), which matches the habitat at Weeting Heath, VC 28, TL758884, where one specimen (det. Peter Hammond) was caught in a pitfall trap, 8 May–2 June 2012. Although this is the only known county record, it is likely that other Norfolk specimens exist in collections, perhaps incorrectly determined, or, in my case, amongst Breckland heath pitfall trap material waiting to be identified. Small and difficult to identify staphylinids can often end up being amongst the last beetles to be examined.

****Tachyporus scitulus*** RDB K–Insufficiently Known

This rarely recorded rove beetle is known from only a few well-drained sandy sites in Britain, (Roger Booth pers. comm.). A single specimen (det. confirmed Roger Booth) was caught in a pitfall trap at Weeting Heath, VC 28, TL757883, 4–24 September 2012. Although this is the first Norfolk record, *T. scitulus* is known from Suffolk Breckland (Welch and Hammond, 1996), so its discovery in Norfolk is not unexpected.

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Vascular plants

Richard Carter & Bob Ellis

An early find by Richard Carter in March 2012 was Early Meadow-grass *Poa infirma* on gravelly ground at the base of a car-park tree near St Nicholas Church in Kings Lynn. This appears to be the first West Norfolk (VC28) record, though given its recent spread in similar situations in other southern counties it was probably only a matter of time before it turned up.

A Norfolk Flora Group visit to Syderstone was rewarded with one of the largest populations of Smooth **Cat's-ear** *Hypochaeris glabra* that most members of the group had ever seen (growing on former arable fields recently returned to the Common). But better still was the find of about 20 non-flowering plants of **Mudwort** *Limosella aquatica* on mud at the edges of a drying-out pond near the village. Though the species occurs as a rarity in East Norfolk, this is the first record of this native species in West Norfolk since 1916.

The group was unable to relocate **Petty Whin** *Genista anglica* at Syderstone, so Bill Boyd's report that the species has appeared in areas under restoration to heath by NWT at Grimston Warren is especially good news.

Another record from a Norfolk Flora Group meeting was a single plant of **Dense-flowered Fumitory** *Fumaria densiflora* on disturbed ground in forestry at Hockwold. There are very few records of this taxon from West Norfolk (VC28), and none previously from this part of the county. Also in forestry areas, a record of the hybrid buckler-fern *Dryopteris ×deweveri* by Bob Ellis and Mary Ghullam at Shouldham Warren was only the fourth record in VC28.

Slender Hare's-ear *Bupleurum tenuissimum* was never a common plant in West Norfolk (VC28) and is feared to be declining. Searching for it specifically, Richard Carter found it in September 2012 on the edges of a sea-wall car-park at Thornham, about 250m from an old locality for the species. Nearby a patch of **Alternate Water-milfoil** *Myriophyllum alterniflorum* in the dyke behind the sea-wall seems to be only the second record in VC28 (having been first recorded by Robin Stevenson near Kings Lynn).

Further to the report in 2011, Tim Inskipp reports a small spread westwards in the population of **Marsh Sowthistle** *Sonchus palustris* at Nordelph.

Small-fruited Yellow-sedge *Carex oederi* Retz. was found at the margins of a two year old scrape near the edge of Filby Broad in 2012. This is only the second record in Norfolk since 2000, the first being Upton Fen in 2005 (it was seen again at the same location in 2007). It was recorded twice for Beckett Bull & Stevenson (1999); from Adcock's Common, East Walton and from Beeston Regis Common but the latter was accidentally omitted from the book, possibly because it had been reported by a previous name, *C. serotina*. The nomenclature of the yellow-sedges has been revised several times. Until the publication of the third edition of Stace (2010), we knew it as *C. viridula* subsp. *viridula*. Petch and Swann (1968) knew it as *C. serotina* and documented it from 11 locations. Nicholson (1914) knew it as *C. Œderi* Retz., as we do now (though we no longer use the diphthong, nor do we capitalise specific epithets taken from proper names). He described it as "rather rare" and he documented it from 19 locations including several brought forward from Trimmer (1866). Trimmer himself knew the plant by the same name

but from a different authority: *C. Œderi* Ehrh. Although under this authority it now considered to be a synonym for **Pill Sedge** *C. pilulifera*, it is clear from Trimmer's habitat description for *C. Œderi* and his separate listing for *C. pilulifera* L. that he intended *C. oederi* as we know it. It is probable that Ehrhart was generally thought to be the appropriate authority at the time – for example Babington (1851) uses the same in his *Manual of British Botany*.

2012 records for species classified as Endangered or Vulnerable on the Red Data List in 'new' tetrads since *A Flora of Norfolk* was published are as follows:

Endangered

Fine-leaved Sandwort *Minuartia hybrida*
Snettisham, TF63X (Richard Carter).

Vulnerable

Stinking Chamomile *Anthemis cotula*
Billingford, TM17U, in sugar beet, by a game crop (triticale, millet etc.) and on a roadside verge.

Rye Brome *Bromus secalinus*
This species continues to spread both in arable fields and other disturbed ground.

Dersingham, TF63Q (Richard Carter).

Barsham, TF93D (Flora Group).

Billingford, TM17U (Bob Ellis & Emily Swan).

Good-King-Henry *Chenopodium bonus-henricus*
Tasburgh, TM20D, a single plant.

Opposite-leaved Pondweed *Groenlandia densa*
Somerton, TG42Q (Sharon Yardy).

Frogbit *Hydrocharis morsus-ranae*
Salhouse, TG31C (Bob Ellis & Mary Ghullam).

Ditches at Calthorpe Broad NNR, TG42D (Flora Group).

Smooth Cat's-ear *Hypochaeris glabra*
Syderstone, TF83G (Flora Group), abundant.

Corpusty, TG12E (Simon Harrap), a few plants.

Weasel's-snout *Misopates orontium*
Old Catton, TG21G (Bob Leaney), in allotments.

Whorled Water-milfoil *Myriophyllum verticillatum*
Catfield Common, TG42A (Flora Group)

Prickly Poppy *Papaver argemone*
Strumpshaw, TG30N, in barley.

Prickly Saltwort *Salsola kali* subsp. *kali*
East Runton, TG24B (Flora Group).

Night-flowering Catchfly *Silene noctiflora*
Claxton, TG30G, in maize.

Blakeney, TG04B (BSBI field meeting), edge of bean field.

Hindringham, TF93T (Bob Ellis & Bob Leaney), in oilseed rape.

Barsham, TF93D (Flora Group).

Corn Spurrey *Spergula arvensis*
Shouldham Warren, TF61V (Flora Group), forestry ride.

Billingford, TM17U, by a game crop (triticale, millet etc.).

Beeston St Andrew, TG21L (Bob Leaney), cereal field margin.

Bacton, TG33A (Bob Ellis & Mary Ghullam), edge of barley field.

Aldeby, TM49G, edge of maize.

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Bryophytes

Robin Stevenson & Mary Ghullam

The last report in this series (Stevenson & Ghullam 2009) covered the years 2006-2008. This report covers 2009-2012, a period that has produced several new county or vice county records, and also been good for refinding species that have not been seen for some time at known sites, and for providing additional sites for some rarer species. Additions to the county are prefixed by two asterisks **, new vice-county records by a single asterisk. Where the species has been reinstated to the county flora after a gap of 50 years or more, then the asterisk is enclosed within brackets.

Nomenclature follows Hill *et al.* 2008.

Species

Abietinella abietinum Confirmation of an occurrence first noted in the early 1980s. This is one of a group of plants which, in Norfolk, are Breckland specialists. Gravelpit Wood, Weeting (TL748885), 24 January 2010, NBG.

Acaulon muticum This very tiny moss, not seen in the County since the 1960s (Petch & Swann 1968), has been found three times recently. Sloley (TG29382450), 8 February 2009 on roadside bank, MG; Felbrigg Hall (TG19043894), 17 March 2009, lakeside bank MG; Horsford Rifle Range (TG192179), 8 January 2011, NBG, on the top of a large anthill.

Anomodon viticulosus A decidedly uncommon ancient woodland indicator species. Woodrising (TF9702), 17 March 2012, NBG.

(**)***Antitrichia curtipendula*** Last seen in Norfolk in the late 19th century, this extremely pollution-sensitive species was found a few years ago in Cambridgeshire, not far from the new Norfolk locality on the outskirts of Wisbech (TF479078) 6 March 2012, epiphytic on a pear tree, CRS.

Aphanorhegma patens One of a group of plants found in the drawdown zone of ponds and reservoirs, but virtually impossible to name unless in fruit. The record for Stanta was from Fowlmere (TL878896), 21 December 2011, CRS. It was also found twice in VC 27: at St Benet's Abbey (TG382158), 5 August 2010, MG, and at Gawdy Hall Big Wood, Redenhall (TM25208516), 2 October 2011, NBG, on a woodland ride.

Barbilophozia attenuata Members of this genus are probably all on the edge of their range in Norfolk, so colonies have a habit of appearing and disappearing. A healthy colony was found at North Wootton, Ling Common (TF6519323932), 18 Feb 2011, CRS, near to where it had been found in the past. A single colony was also found in VC 27, on a Sweet Chestnut stump at Marsham Heath (TG16672390), 28 November 2009, NBG.

Bryum bornholmense Found in a second 10km square in VC 27 on two adjacent heathland sites. Marsham Heath (TG17302345), 28 November 2009, NBG, and Cawston Heath (TG1623) 30 October 2010, in a rabbit burrow, NBG.

****Bryum intermedium*** On unshaded marly sediment at the edge of a pond, Holme-next-the-Sea (TF70814477), 2008, DTH. (This record was not included in the last account as it had not been notified to the VC recorder.)

Campyliadelphus chrysophyllus* This specimen, with unusually short-nerved

leaves, was found on the base of a gravestone at All Saints Church, Hethel (TG171004), 24 June 2011, RF.

Campyliadelphus elodes A rare species of rich-fen habitats. Sculthorpe Moor (TF9030) 4 March 2012, NBG. Also re-found on Scarning Fen (TF9812) 27 March 2012, NBG.

Cinclidotus fontinaloides Known from a number of sites in VC 27 on wood and trees at the edge of rivers, but found growing, rather unusually, on an asbestos roof at Thurlton Churchyard (TM41699833), 22 January 2011, NBG.

Cirriphyllum crassinervium The third record of this species from the county as a whole was made at Saxlingham Nethergate (TM229973), 14 November 2009, NBG. It was found on imported limestone in a rockery, as in one of the previous occurrences. A fourth record was made on sections of an old lime-mortared wall surrounding Castle Acre Priory (TF8137315012), 13 July 2011, CRS & RWE.

Cololejeunea minutissima A second record for West Norfolk of a species that appears to be spreading nationally; on a roadside oak at West Bilney (TF6998113280), 6 April 2010, CRS. Also the second and third records for East Norfolk: on Sycamore at Whitwell Common (TG09002089), 17 January 2009, NBG; on oak at Sheringham Park (TG13014163), 7 May 2010, MG.

Dicranum polysetum Roydon Common (TF6883223100), 8 December 2011, in heathland, CRS. There are only a handful of records for this handsome species from the county.

* *Didymodon nicholsonii* New to West Norfolk, on a pavement in North Runcton (TF6415) 2 Jan 2012, CRS.

Entosthodon fasicularis Only the second record for VC27, this was found in fruit, growing with *Sphaerocarpos texanus*, on bare soil on a grassy ride at Sheringham Park (TG13214182), 11 April 2012, MG.

Ephemerum recurvifolium This minute moss is easily overlooked and so probably under-recorded. Found on the clay sides of a dyke (a common enough habitat), by the side of the A47 near Antioch Farm, Tilney (TF54351505), 11 November 2009, CRS.

**Fissidens gracilifolius* Found at three separate sites during a mammoth churchyard survey undertaken by Richard Fisk in the summer of 2011. Winfathing (TM109859), at the base of the church wall, 16 May; Tivetshall St. Margaret (TM163870), at the base of a tomb, 21 June; Fersfield (TM065828), on a grave, 1 July.

Fossombronia foveolata This nationally scarce plant was recorded from Sugar Fen back in the early 1980s but had not been seen in the intervening years until re-found at TF69322081, 24 July 2011, CRS. It was also found, for the first time in VC 27 (*) since 1936 (Petch & Swann 1968), fruiting abundantly, at Buxton Heath, Hevingham (TG17372156), 9 September 2010, MG.

Fossombronia wondraczeckii A new 10km square record for this species. Wicken Field Nature Reserve, Leziate (TF68631855), 10 August 2010, CRS.

**Grimmia trichophylla* Found twice during the Richard Fisk's churchyard survey. Billingford (TM168790), 16 May 2011; on the brick capping of the churchyard wall of Holy Trinity, Loddon (TM363987), 23 May 2011.

Hennediella heimii This is a coastal species which, like some vascular plants, has moved inland along salted road verges. Sides of the A47, Terrington St John (TF536148), 22 April 2012.

(**Leptobarbula berica* Not seen in the County since 1967 (Petch & Swann 1968),

this tiny plant was found growing in the corner of a glass house in the walled garden of Gawdy Hall, Redenhall (TM24978538), 2 October 2011, NBG.

**Leptodon smithii* A Mediterranean species that is largely confined to the south coast, the discovery of this plant growing on a pear tree just outside Wisbech (TF4707) was fairly extraordinary. 7 March 2012, CRS.

Leucodon sciuroides A pollution-sensitive species that appears to be becoming commoner as an epiphyte. Holkham Dunes NNR (TF8699545255), 12 September 2010, CRS.

Lophocolea semiteres See photo, p.42. This alien liverwort had only been recorded in VC 27 once before, but was found growing both in woodland at Birch Hole Plantation, Little Barningham (TG117339), 6 February 2011, NBG, and on sand dunes at North Denes, Great Yarmouth (TG531101), 25 March 2011, MG & RWE and on Blakeney Point, in a grassy area on the north tip of Long Hill (TG01014639), 11 December 2012, RWE & MG.

Lophozia bicrenata Only the third record for the County, this small liverwort was found, fruiting, at the Horsford Rifle Range (TG19351802), 8 January 2011, NBG.

Lophozia excisa Another scarce liverwort. Holkham Dunes NNR (TF86934546), 6 March 2011, MG.

Lophozia ventricosa Holkham Dunes NNR (TF8645), 6 March 2011, NBG. Although this is one of the commoner leafy liverworts in the county, its presence helps to confirm this site as a liverwort 'hot-spot' in the county.

**Nowellia curvifolia* Previously known in Norfolk only from the Holkham area, this tiny rust-coloured leafy liverwort was found growing on a large, fallen, decorticated Scots Pine near Aylsham, (TG12), 2 June 2011, RC.

***Odontoschisma denudatum* This plant, new to Norfolk, was found growing on damp rotting wood at Holkham Dunes NNR (TF87994536), 6 March 2011, AP.

***Orthotrichum pumilum* Oxburgh Hall near Wisbech (TF4707), 8 March 2013, CRS. This Red Data book species was last seen in Norfolk in 1907 when Burrell recorded it from a chestnut tree in Aylmerton. Like several other 'pollution recoverers', it probably originated from spores blown in from the Low Countries.

Orthotrichum striatum A clean air, pollution-sensitive species which turned up in several orchards in the Fens in the course of a survey financed by Norfolk County Council, December 2009-January 2010, CRS.

Orthotrichum tenellum Several orchards in the Fens December 2009-January 2010, CRS, and also a second record for East Norfolk, on Ash in a garden at Saxlingham Nethergate (TG20816974), 14 November 2009, NBG.

**Pellia neesiana* Boggy streamside, Sturston Nursery STANTA (TL886959), 2010, ALB.

***Phascum cuspidatum* **var** *papillosum* Derby Fen (TF7020), 27 January 2011, CRS. While searching this site for *Rhodobryum roseum* (see below), a small, rather distinctive looking colony of *Phascum cuspidatum*, was found. This was sent off to the national referee, who identified it as var *papillosum*, new to Norfolk.

Phascum cuspidatum **var** ***piliferum*** A47, Terrington St John (TF536148), 22 April 2013, CRS. Like *Hennediella heimii* (above), this is a coastal variety which occurs on salted road margins.

Platygyrium repens Bustards Lane, Walpole St. Andrew (TF5118), 24 September 2009, CRS. This is the first record from an

orchard, and a new 10km square record. This inconspicuous species only occurs (or is only spotted?) sporadically.

Pogonatum nanum Horsford Rifle Range (TG19341804), 8 January 2011, NBG. This moss may be under-recorded, as it can only be determined when fruiting.

Pogonatum urnigerum This distinctive moss has been found three times recently in the East, but only in small patches. Great Wood, Felbrigg (TG19713996), 6 May 2009, MG; Marsham Heath (TG17252402), 28 November 2009, NBG; Horsford Woods (TG19901880), 8 January 2011, NBG.

****Pohlia drummondi*** Crostwight Heath (TG345300), 4 March 2004, ALB. This specimen was sent by ALB to CRS for checking. It was put to one side for 'mature consideration', and then lost. When refound, and submitted to the Bryological Society Recorder for mosses, it was confirmed as new to Norfolk.

****Polytrichum commune* var *perigoniale*** This variety of *P. commune*, undoubtedly overlooked, was found on a woodland ride at Heath Farm Plantation, Horsford (TG201187), on 8 January 2011, NBG.

Polytrichum strictum Found growing in *Sphagnum* hummocks, this species always seems to have been rare in the county. Catfield Fen Butterfly Conservation reserve, (TG36942113), 17 October 2010, NBG.

Porella platyphylla Woodrising (TF9702), 17 March 2012, NBG. Another ancient woodland indicator, although it is, perhaps, more frequent on old lime-mortared walls.

Racomitrium canescens Rare in the county, although it appears to have been much commoner in the past (Petch & Swann 1968). Bawsey Country Park (TF6659619574), 24 October 2009, CRS. Also refound in Shouldham Warren (TF679104), 14 Aug. 2012, CRS.

Rhodobryum roseum Visits on 25 January 2011 by CRS to Sugar Fen SSSI (TF6920) and Derby Fen (TF7020) revealed large populations of this relatively rare moss on many of the anthills that are abundant on both sites. Embarrassingly, although Sugar Fen had been visited on many previous occasions, it had been missed on all of them.

(*) ***Rhytidiadelphus loreus*** This apparently increasing woodland moss has been recorded recently at a number of sites in the county, although never in large amounts. Sites include Barningham Hall, Matlaske (TG15233544), 1 March 2009, NBG; Drayton Drewray (TG17611621), 27 November 2011, NBG; Ling Common, North Wootton (TF65422415), 17 May 2010, CRS; and Bawsey Country Park ((TF66521914) 19 May 2010, CRS (this last record was inadvertently omitted from a recent account of the bryophytes of the site (Stevenson 2011)). In the UK this is primarily a northern and western species and it seems likely that East Anglian occurrences may originate from the Low Countries, where it is relatively common.

Riccia cavernosa Usually found in the drawdown zone of meres and ponds in the west of the county, it appeared in abundance on the mud of the recently dug out pond at Top Common, Beeston Regis (TG165428), 7 August 2010, FF and then three days later a few thalli were found on the Felbrigg Hall estate (TG197381), 10 August 2010, MG. Possibly its spores had lain undisturbed in the mud of the pond for years, awaiting suitable conditions.

Ricciocarpos natans One of very few aquatic liverworts, this species seems to occur only sporadically, so it was good to see it in abundance in several dykes on the outskirts of Southery (TL6394), 8 September 2009, CRS & JG.

Sanionia uncinata A second record for VC27, on a poplar tree by the lake in the grounds of UEA (TG197071), 5 October 2009, CRS, and a record of the plant in fruit, on an oak tree on Ling Common, North Wootton (TF653240), 27 July 2011, CRS.

Schistidium apocarpum ss. Only recently confirmed as a new VC record, owing to a reassessment of specimens by the bryophyte referee, this was found growing on a tarmac path in Hockering Wood (TG0714), 6 December 1997, NBG.

Scleropodium cespitans A second vice-county record of a species that is normally found growing in damp ground. On this occasion it was found in Denver Churchyard (TF6101), 30 September 2012, CRS.

***Sphaerocarpos* sp.** North and South Creake area (TF8433 & TF8537), 5 January 2011, CRS. There are two species but it is impossible to separate them unless fruit is present; unfortunately the plants were not ripe, so an accurate determination was impossible. This genus has a specialised habitat - stubble fields. The majority of recent records have all been from East Norfolk, and these are the first records for West Norfolk since 1958 (Petch & Swann 1968).

Sphagnum subnitens A rather unexpected find in coastal pine woods! Holkham Dunes NNR (TF87994536), 6 March 2011, AP.

Syntrichia latifolia This not uncommon moss is usually found growing at the base of trees close to water, but is increasingly appearing on tarmac. Found initially along a 300m strip of road at Woodbastwick Hall (TG33771612), 8 January 2012, NBG, it was found again on similar substrate at Denton (TM282874), 1 December 2012, NBG.

(*)Tortella flavovirens Re-found for VC27 on Blakeney Point NNR by RWE in July 2012, but could not be confirmed until better material was collected later in the year, when it was found scattered along the Point from the Hood eastwards, growing with Rock Sea-lavender *Limonium binervosum* ssp *anglicum*, (TG02594590), RWE & MG.

*****Tortula schimperi*** Following a revision of the subspecies of *Tortula subulata*, this moss has been raised to the rank of species. First found, new to Norfolk, at Stow Bardolph (TF6305) in West Norfolk, 28 Jan 2012, RJF. Subsequently found new to VC27* in Denton churchyard (TM283873), 1 December 2012, NBG.

T. subulata A decidedly local species. Woodrising (TF9703) 17 March 2012, RJF.

Recorders

ALB - Alec Bull; AP - Alex Prendergast; CRS - Robin Stevenson; DTH - David Holyoak; FF - Francis Farrow; JG - Jonathan Graham; MG - Mary Ghullam; NBG - Norfolk Bryology Group; RC - Richard Carter; RJF - Richard Fisk; RWE - Bob Ellis.

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Fungi

Tony Leech

With the revival of the Norfolk Fungus Study Group, records of new and interesting Norfolk fungi continue to be received. Some of the more interesting are described below.

Mushrooms

What is the difference between a mushroom and a toadstool? Toadstool is not a scientific term but usually refers to any cap fungus in an informal fairytale or folklore context. The term mushroom is used in so many different ways that it, too, lacks precise meaning. Americans use the term in a wide sense, applying it to any macro fungus; using, for example, the term 'shelf mushroom' instead of 'bracket fungus'. Increasingly, in Britain, 'mushroom' is used to describe any agaric (including boletes) but in its narrowest sense is applied to only those fungi in the genus *Agaricus*. There are over 40 of these in Britain and with the advent of Geoffrey Kibby's guide (2011) attempts at identification are often successful.

Mushroom surprise of the year appeared in Joseph Hubbard's polytunnel at Hindolveston (TG0329) in the form of *Agaricus gennadii*, a medium-sized mushroom with a swollen stipe and distinctively pointed base (photo, p.43). There are barely 20 records for this species in Britain, mostly, but not in this case, associated with conifers. The fungus was first seen in June and has fruited regularly since. This was Joseph's introduction to the fascination of fungi and with his keen eye he soon picked out Rosy Wood Mushroom *A. dulcidulus* and *A. phaeolepidotus* at the Dinosaur Adventure Park Bioblitz (TG1017) in August. Both of these species had previously been found only twice in Norfolk. Also on its third appearance was *A. porphyrocephalus* in a Holt (TG0839) garden. Its occurrence in March was remarkable because only one of the 80 or so other British records were made outside the period between July and December. Curiously, this was also the only one, like the Holt specimen, found under Yew *Taxus baccata*.

Pink dung fungi

Literally hundreds of fungus species occur on herbivore dung – usually as their only substrate. But most are small – and some minute (see Table 1). Not so *Bolbitius coprophilus*, an inkcap-like fungus up to 75mm high with a conical cap. It was not so much their size as their abundance which impressed when thousands appeared on dungy-straw in two open-sided cattle shelters at Briston (TG 0533) in May. Their identity was a puzzle until the delicate pink flush was noted on the caps of young specimens (photo, p.43). This fungus is not new to Norfolk as it was seen by Anne Andrews on a dung heap at Honing, Norfolk in 2004 when she observed that the dung appeared pink at a distance. Just three other British records for *B. coprophilus* are documented, all from the Surrey/ Berkshire area since 1998.

Nail fungus returns

And on to pony dung. The Nail Fungus *Poronia punctata* was formerly widespread in Britain but is now very uncommon. It is listed as 'Endangered' in Red Data Book edn.2, and is a Biodiversity Action Plan species. Since 1970, almost all records have been from the New Forest area. With the exception of a doubtful record from Holme in 1982 (Leech *et al.* 2011), the fungus has not been recorded in Norfolk since 1944 when it was found at Horsford Heath (by Ted Ellis). Since then, a second species,

Poronia erici, has been described from Rabbit dung but is now known also to occur on pony dung (Leech *et al.* 2011). With this knowledge it was assumed that the *Poronia* sp. collected by Jonathan Spencer and Andy Palles-Clarke (Forestry Commission) on Hockwold Heath (TL7589) in March would *be P. erici.* The small spores established, however, that the fungus was in fact Nail Fungus *Poronia punctata.*

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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
Agarics				
Clitocybe agrestis	Watermill Broad TF7795	ARL	1	Sandy field
Coprinopsis cordispora	Lenwade (Dinosaur Park) TG1017	ARL	1	Wallaby dung
Cortinarius cinnamomeoluteus	Sutton Fen RSPB. TG3723	ARL	1	Carr woodland
Parasola schroeteri	Felbrigg. TG1939	ARL	0	Grassy ride
Pluteus aurantiorugosus	Bayfield. TG0440	Andrew Cannon [ARL]	1	Dead elm
Psilocybe subcoprophila	Lenwade (Dinosaur Park) TG1017	ARL	0	Manured grassland
Gasteromycetes				
Battarrea phalloides	Watermill Broad TF7795	ARL	9	Bank under pine
Geastrum corollinum	The Nunnery Reserve (BTO). TL8680	Dave Leech [ARL]	7	Woodland bank
Spindle fungi				
Ramaria abietina	Lynford Arboretum. TL8293	ARL	1	Under conifer
Jelly fungi				
Guepiniopsis buccina	Ken Hill Woods, Snettiaham. TF6734	ARL	0	Fallen oak branch
Discomycetes				
Lasiobolus ciliatus	Lenwade (Dinosaur Park) TG1017	ARL	0	Wallaby dung
Thecotheus pelletieri	Sheringham Park TG1341	ARL	0	Cow dung
Thelebolus microsporus	Watermill Broad TF7795	ARL	0	Muntjac dung

To mark the centenary of the National Trust's acquisition of Blakeney Point, the Norfolk & Norwich Naturalists' Society was invited to organise, and subsequently publish, surveys and assessments of wildlife on Blakeney Point National Nature Reserve. We are grateful to the National Trust staff, County Recorders and others who have worked to make this possible.

Peter Lambley (editor)

Josh Herron

From an aerial photograph by Mike Page.

Professor Francis Oliver and the recognition of Blakeney Point as a nature reserve

Andy Stoddart

Blakeney Point's great botanical interest has long been noted. The Cambridge botanist Charles Babington had visited as early as 1834, collecting plants and noting in his journal that 'we went upon the bank of shingle that divides the marshes and the harbour from the open sea. Walked as far as the Blakeney Meals'. It was, however, a botanist from University College London who was to secure Blakeney Point's lasting contribution. His name was Francis Wall Oliver. Following trips to Germany in 1885 and 1886, during which he associated with the country's leading plant geographers, Oliver developed a keen interest in ecology and in 1888, at the age of twenty-four, became Head of the Botany Department at University College, London. By 1890 he had followed in his father's footsteps and become its Quain Professor.

Oliver's early scientific pursuits were focused on palaeobotany but he soon became most interested in studying the vegetation of maritime habitats, undertaking a number of field trips to the Channel Islands and to northern France. Between 1904 and 1907 he made a particular study of the saltmarshes and dunes of Brittany's Bouche d'Erquy, the results of which were published in *New Phytologist*..

Visiting Blakeney for the first time in 1908, in order to recuperate from a bout of pleurisy, he was quick to recognise the area's scientific potential, in particular the further opportunity to study mobile vegetation systems rather than traditional static botany. Blakeney Point, he soon realised, was a botanist's dream, the perfect natural laboratory. Its relentless westward growth and constant reshaping by the sea meant that a complete range of successional stages was visible in one place. Here could be studied the slow succession of vegetation to a state of relative stability as well as the consequences of sudden and dramatic `disruptions'. The Point, noted Oliver with enthusiasm, revealed `the operations of Nature in its most dynamic form' and he swiftly transferred his attentions to this exciting new study site.

Oliver gained rapid agreement to establish a field station on the Point, and the old Lifeboat House was purchased in 1910 for the sum of fifty pounds. This marked the beginning of a long and productive relationship between UCL and Blakeney Point, and Oliver took students here for at least a fortnight every summer until he retired in 1929. He also made many other visits, either with colleagues or advanced students. In 1913 a purpose-built laboratory was constructed further back in the dunes and the Point became, in Oliver's words, 'the theatre of systematic studies at the hands of organised parties'.

Oliver was clearly enthralled with his discovery of Blakeney Point and conspired to spend as much time there as possible, noting wryly that 'the immediate problem... which confronts the ecologist attached to a seat of learning is how to make good his escape from his urban laboratory for the six summer months'.

All this activity was to result in a wealth of published work by Oliver, his colleagues and his students, much of which appeared in *New Phytologist, Journal of Ecology* or the *Transactions of the Norfolk and Norwich Naturalists' Society*. Most notable was a series of twenty-nine `Blakeney Point Publications' covering subjects as varied

as topography, vegetation (including pioneering aerial surveys), the tern colony and the food of Rabbits.

Amongst the most important is Oliver's 1912 paper in *New Phytologist* on 'The shingle beach as a plant habitat', the first classification of different types of shingle beach and the first attempt to link these types to the vegetation they each support. In 1913 he published 'Some remarks on Blakeney Point, Norfolk' in the first issue of *Journal of Ecology*, publishing in the same journal in the same year 'Vegetation on mobile ground as illustrated by *Suaeda fruticosa* on shingle', a collaboration with another prominent UCL botanist and ecologist (and later to be Oliver's successor as Quain Professor of Botany) Edward James Salisbury.

Oliver retired from UCL in 1929 and took up a post at the Egyptian University, Cairo the following year. Here he continued with his studies of vegetational succession, now in a desert context, and was lauded by his new students as the 'Mohammed of Botany'. He left this institution in 1935 to live thirty miles west of Alexandria at Burg-el-Arab, remaining here even when closely approached by Rommel's forces in 1942. Oliver returned to England in 1950 and died the following year.

Oliver's greatest legacy is widely considered to be his pioneering work in the study of vegetation as a dynamic system. However, Oliver's most significant contribution to ecology was perhaps not his own research at all but his influence over the career of a young student and protégé named Arthur George Tansley, destined to become Britain's most influential and most-lauded ecologist of the early twentieth century. Whilst still at Cambridge Tansley attended classes held at UCL by Oliver and from 1893 to 1906 he was Oliver's assistant, helping him with his studies of coastal vegetation and working to establish the university as the leading centre of botanical study and teaching

Tansley's already successful career soon went from strength to strength. In 1913 came the formation of the British Ecological Society, with Tansley installed as its first President, and he soon became Editor of its new *Journal of Ecology*, the very first issue of which contained Oliver's paper on Blakeney Point.

Acquisition by the National Trust

During the latter part of the nineteenth century, movements for access to green spaces for public recreation, and to restrict the hunting of birds, were gaining momentum. By the turn of the century, a powerful voice was calling not just for an isolated reserve here or there but for a whole network of reserves right across the country. Prominent banker and entomologist, Nathaniel Charles Rothschild articulated a whole new vision of nature conservation, arguing for the protection not just of individual species but also of their habitats. Rothschild was clear: legislation and education would not, in themselves, preserve Britain's wildlife. It was also necessary to buy land.

However, although encouraged by the work of the National Trust, Rothschild was frustrated with the reactive nature of its acquisitions. With no plan to secure the best sites, the Trust merely acquired whatever came its way and was not actively involved in seeking protection for the most important and vulnerable areas. As a result, Rothschild and three colleagues formed the Society for the Promotion of Nature Reserves in 1912, partly to obtain the support of wealthy and influential individuals of the time. Naturally, Rothschild's personal wealth and wider connections placed him in an ideal position to undertake this role but he often put up the money himself, purchasing both Wicken Fen in Cambridgeshire and Woodwalton Fen in Huntingdonshire.

But there was also another motivation behind the formation of the SPNR. This was to put pressure on the National Trust. The

aim of the Society was not to own land itself but to identify and survey those sites most in need of protection, to raise funds for their acquisition and then to hand them over to the Trust for ongoing management.

Rothschild was very careful to forge links with the leading scientific figures of the day, and the inclusion on the SPNR Council of Arthur Tansley, Edward Salisbury and, as the representative of the National Trust, Francis Oliver, goes a long way towards explaining the first significant acquisition facilitated by Rothschild's new organisation.

With the death of the sixth Lord Calthorpe in 1911, his entire estate on the north Norfolk coast, including Blakeney Point, came onto the market. Agreement had already been reached with Oliver for the Point to be used for 'marine horticulture' (the study of botany) and further agreement was now reached for it to be sold as a separate lot. With the finances provided by an anonymous benefactor (Rothschild of course) and a smaller contribution from the Fishmongers' Company, the Point was sold to Alexander Crundall of Surbiton, Surrey, then transferred to the National Trust in August 1912 to become its forty-ninth acquisition and its first coastal property. Indeed Blakeney Point was the first coastal nature reserve in the country.

Oliver's role was key. He led a public appeal for funds and his position on both the Executive Committe of the National Trust and the Council of the SPNR ensured that the Trust accepted his recommendation to acquire Blakeney Point. Until this point the Trust's focus had been on buildings, ancient monuments and sites with high historical or cultural importance and, given the Point's obvious deficiencies in these areas, it should clearly have been turned down. Furthermore, the Trust, and indeed the wider public, showed little enthusiasm at the time for coastal landscapes. However, Oliver's emphasis of the Point's value as a scientific laboratory carried the day. The Trust's Provisional Council clearly took the point, noting that:

> To the ornithologist, the botanist and physiographist, Blakeney is a veritable treasure; it is a resting-place for summer migrants and hundreds of birds may be seen here, the plant-life is of peculiar interest, while the formation of the shingle beaches and dunes with the curious 'hooks' afford an admirable illustration of the action of wind and waves.

Following its acquisition, the Executive Committee of the Trust agreed to allow Oliver and UCL to continue with their work and to build a laboratory there in 1913. The Trust also agreed to take on responsibility for the Watcher, Bob Pinchen.

In acquiring Blakeney Point, the National Trust had broken the mould. It had agreed to take over and manage a property not to protect a historic site or building nor for any clearly stated desire to protect public amenity or natural beauty but for a much more utilitarian reason: to protect its value to the scientific community as an outdoor laboratory and research facility. This was a wholly new direction for the Trust, its 1912 Report noting that 'the Council... feels that this may be the beginning of what may eventually prove to be an important development of the work of the Trust and may enable it to enlist the sympathies of naturalists and scientists'.

Adapted from *Shifting Sands: Blakeney Point and the Environmental Imagination* by Andy Stoddart, 2013. Available from the author.

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Breeding birds of Blakeney Point

Ajay Tegala

The history of breeding birds on Blakeney Point's has shown changing trends and management approaches. The Point is undoubtedly most notable for its breeding tern populations. In 1901 the *Blakeney and Cley Wild Bird Protection Society* was formed and Bob Pinchen was recruited as a Watcher to 'look after' the tern colony during the breeding season. He was later employed by the National Trust when they acquired the Point in 1912 (Stoddart 2013). At that time Common Tern *Sterna hirundo* was the most abundant breeding tern on the Point and was known to have bred on the Point since at least 1830 (Taylor *et al.* 1999). Visitors were permitted to wander through the tern colony, but Pinchen marked nests with sticks as well as looking out for egg collectors (Pinchen 1935). Thanks to protection, Common Tern increased from 140 pairs to 2,000 by 1923. There were 100 pairs of Little Terns *Sternula alba* in 1912 and from 1922 Arctic Terns *Sterna paradisaea* started to breed in small numbers (Stoddart 2013). Sandwich Terns *Sterna sandvicensis* first started to breed in 1920, having previously been very rare along the coast, and increased to 1,500 pairs by 1929 (Stoddart 2013). The fifth species of tern to have bred on the Point is Roseate *Sterna dougalli;* breeding was first recorded in 1922, when there were four pairs, with two pairs nesting most years until 1930; breeding behaviour was last witnessed in the late 1990s (Stubbings 2012).

During Ted Eales' time as National Trust warden on the Point (1939-1979), there were 1,000-2,000 pairs of Common Terns breeding each year, but they were eventually overtaken by Sandwich Terns, with over 3,500 breeding pairs in 1979 (Eales 1986). Early on in his time as warden, Eales began fencing off the tern colony to prevent people walking in and causing disturbance (Eales 1986); this management approach continues today. Since Eales' retirement, Sandwich Tern numbers have fluctuated, depending on breeding success on nearby Scolt Head Island, with Blakeney the sole Norfolk breeding site in the last few years (Stubbings 2012). In 2013 a record 4,120 Sandwich Terns bred on the Point. Common Terns have declined steadily, with under 100 pairs since 2009 and only 48 in 2013. The Arctic Tern population on the Point has always been small, although a peak of more than 20 pairs was recorded over a seven-year period in the 1990s (Stubbings 2012).

The sand and shingle beaches on the Point are ideal habitat for nesting Little Terns, but the peak count has only ever reached 216 pairs - in 1975 (Stubbings 2012). In 2011, 160 pairs comprised 8% of the UK population, making the Point the most important UK site for Little and Sandwich Terns that year (Stubbings 2012). Little Terns face many pressures, varying from a range of avian and mammalian predators to high tides washing out nests and in the past two summers Little Terns have experienced low productivity. Thanks to EU funding, the National Trust have just entered a five-year project to put more time and resources into Little Tern research and conservation on the Point, with the aim of increasing their breeding productivity. The National Trust has also began a Sandwich Tern colour-ringing project in partnership with the British Trust for Ornithology, ringing nestlings in the colony in order to find out more about their post-breeding behaviour.

Following a shift from shooting to conservation at the start of the 20th century, various species of bird increased. For example, Oystercatchers *Haematopus ostralegus* returned as a breeding species in 1906, following previous persecution (Stoddart 2013). In the past decade there has been consistently over 100 pairs of Oystercatchers on the Point. Ringed Plovers *Charadrius hiaticula*, by contrast, have undergone a decline from 100 to 15 breeding pairs over the last two decades (Stubbings 2012). In 2012 Avocets *Recurvirostra avocetta* bred on the shingle ridge (Stubbings 2012), doing so again in 2013 and expanding their range westwards. A species that has increased in the past few years is Grey Partridge *Perdix perdix*, from one pair in 2008 to eight or nine pairs in 2013. Other current breeding birds on the Point include Common Redshank *Tringa totanus*, Barn Swallow *Hirundo rustica* and Skylark *Alauda arvensis*, with healthy populations of Meadow Pipit *Anthus pratensis* and Linnet *Carduelis cannabina*. A number of species have ceased to breed, including Northern Wheatear *Oenanthe oenanthe*, which last bred in 1936, although present each year In recent springs they have shown signs of setting up territories although not actually going on to breed. Maybe Northern Wheatear will once again breed on the Point.

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Seals on Blakeney Point

Paul Nichols

Blakeney Point is home to thriving colonies of both Common Seal *Phoca vitulina* and Grey Seals *Halichoerus grypus*. Indeed, it is one of very few places in the world where both species can be seen together, usually hauled out on the very western end of the Point and on the sand bars that become exposed at low tide around the north-western end of the Point.

Common Seals

Common Seals have been associated with Blakeney Point since time immemorial, and freely interchange with those in the Wash. The Wash population was reduced from 1962 to 1970 by commercial pup hunting, prompted by an increased price for pelts. Hunting continued up to 1970, when the Conservation of Seals Act was introduced. After this licenses were granted for restricted kills, but no such licenses have been granted since 1973, helping the population to increase (Reed & Tidman 1990). Further setbacks occurred, however, in 1988 and 2002 when outbreaks of Phocine Distemper Virus (PDV) hit the colony, reducing it from 750 to 300 individuals in 1988 and from 700 to 580 in 2002 (Wood 2005). The highest counts of Common Seals on Blakeney Point are in August and early September (see Table 1). In 2013 the peak count of 326 was made on 4 September.

Grey Seals

Grey seals are, in contrast to Common Seals, a recent addition to the fauna of Blakeney Point, first being seen in small numbers in the mid-1980s. They first bred in the winter of 2000-2001, when 25 pups were born (Wood 2005). Since that date the colony has rapidly increased in size. In 2012-2013, 1,222 pups were born, making it the third largest colony in the country that year, after the Farne Island in Northumberland and Donna Nook in Lincolnshire.

Table 1. Peak low tide seal haul out counts on Blakeney Point (2005-2013).

Year	Grey Seal	Common Seal
2005	382	536
2006	426	530
2007	546	596
2008	644	514
2009	446	389
2010	720	327
2011	387	460
2012	924	386
2013	932	326

Pupping

Grey seals start pupping in late October at Blakeney. They give birth to a silky-white, fur-covered pup. This fur is warm but not totally waterproof, so the pup is land-bound for the first three weeks of its life while it moults into its adult sea-going coat. During this period the pup also puts on weight; starting life at 15kg, it trebles it weight to 45kg in three weeks. This it achieves by suckling its mother's extremely rich milk, which is 60% fat. Pups eat the equivalent of six blocks of butter a day during the weaning period.

Common Seals start pupping from June to early August, but very few are born on the Point (a maximum of 10 a year). Most are born in the Wash. In contrast to Grey Seal pups, the silky-white natal fur is shed inside the womb of the female. The first time we see them, they look like miniature adults, with full waterproof coats.

Conflicts

The increase in the Grey Seal population may cause some problems as the high tide haul-out areas are very close to large numbers of ground-nesting birds, in particular terns. On big tides the seals are forced up into these areas, potentially crushing both eggs and chicks. The behaviour of Grey Seals may worsen this problem, as compared to Common Seals, Greys tend to haul-out further from the water's edge and to remain longer, increasing the likelihood of nest destruction (Wood 2005).

During the winter months traditionally there are fewer Common Seals present on the Point, although a small number usually remain. Since the establishment of a breeding colony of Greys, the Commons have difficulty in hauling out on the at high tide. This is due to the territorial nature of Grey Seals while pupping and mating. In the future, Common Seals may be forced out of the area completely at this time of year (SCOS 2004).

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Butterflies and moths of Blakeney Point

Paul Nichols, Richard Porter & Ajay Tegala

Butterflies

Blakeney Point supports a number of breeding butterflies. These include Dark Green Fritillary *Argynnis aglaja*, Small Copper *Lycaena phlaeas*, Grayling *Hipparchia semele*, Common Blue *Polyommatus icarus* and Gatekeeper *Pyronia tithonus*. A total of 28 species have been recorded on the Point.

The first comprehensive surveys were made in 2002 when Richard Porter started systematically recording along a six kilometre transect from Cley Beach car park to the Lifeboat House. The transect encompasses the shingle ridge and compacted dunes. Each year from 12 to 60 transects were undertaken between April and October, but most regularly during July and August. The highest annual count, irrespective of brood, for the four commonest resident species is shown in Table 1. The annual fluctuations are difficult to interpret, and the short run of data makes it unwise to speculate on trends. However, the high counts for all four species in 2006 is particularly noticeable and probably reflects the good summer, as do the high counts in 2013, when the population of Common Blues was the highest recorded. Some of the rather low counts from 2007 to 2012 might have been influenced by a series of northerly winter gales heaping shingle onto breeding areas where larvae hibernate.

Table 1. Highest annual count of the four commonest resident butterflies on Blakeney Point 2002-2013. Recorded on standard six kilometre transects from Cley beach car park to the Lifeboat station, via the dunes.

Year	Small Copper	Common Blue	Gray-ling	Gate-keeper
2002	35	9	57	52
2003	125	17	108	76
2004	153	5	57	52
2005	46	4	27	28
2006	210	23	159	155
2007	59	1	17	2
2008	48	12	38	38
2009	18	51	36	25
2010	9	6	12	21
2011	41	11	31	35
2012	20	2	27	20
2013	125	64	69	63

In 2007 a butterfly transect was set up at the Point in conjunction with Butterfly Conservation. A circular transect is undertaken every week from April to September around the main dunes. The transect showed 2012 to be a particularly poor year for butterflies. However 2013 has been significantly better with July and August regularly producing around 10 species and sometimes in excess of 100 individuals.

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Influxes of migrant butterflies occur

regularly, but unpredictably. There have been some spectacular arrivals, the most notable being of Painted Ladies *Vanessa cardui* in 2009, when an estimated 5,000 flew west on the 28 May. The largest arrival and passage of Small Whites *Pieris rapae* was on the 1 August 2013, with a westerly movement of over 10,000 individuals during the day.

Moths

A Robinson trap is run regularly in the 'garden' behind the Lifeboat House throughout the summer. Species regularly recorded include the coastal specialists Archers Dart *Agrostis vestigialis* and the micro moth *Agdistis bennetii*. Among the larger moths regularly caught are the Garden Tiger *Arctia caja* and Large Yellow Underwing *Noctua pronuba*.

Cinnabar *Tyria jacobaeae* and Six-spot Burnet *Zygaena filipendulae stephensa* breed on the Point, and the larvae and adults are often visible. Other day-flying moths include the Forester *Adscita statices*, Yellow Shell *Camptogramma bilineata bilineata* and Yellow Belle *Semiaspilates ochrearia*; there are often hundreds of migrant Silver Y moths *Autographa gamma* and occasionally also Hummingbird Hawkmoth *Macroglossum stellatarum*. The larvae of Emperor *Saturnia pavonia*, Drinker *Euthrix potatoria*, Privet Hawkmoth *Sphinx ligustri*, Eyed Hawkmoth *Smerinthus ocellata* and Elephant Hawkmoth *Deilephila elpenor* are often seen, also clusters of Spindle Ermine *Yponomeuta irrorella* and Brown-tail *Euproctis chrysorrhoea*. Throughout the 2000s the distinctive Puss Moth *Cerura vinula* larvae were easily viewable on the White Poplars *Populus alba* in the Plantation. These were gradually out-competed by White Satin *Leconia salicis* larvae, and Puss Moth larvae have not been seen on the poplars for the last two years. Hornet Moths *Sesia apiformis* have been recorded in the Plantation during the last three years.

Other insects

There have been sudden and unexpected arrivals of other species of migrant insects. Over 100,000 Turnip Sawflies *Athalia rosae* were estimated on the 30-31 July 2006, and an estimated 20,000 on the 5 August 2008. Seven-spot Ladybirds *Coccinella 7-punctata* numbered an estimated 50-75 million between the 25 July and 3 August 2009 (based on a grid-square count), reflecting the huge numbers along the Norfolk coast. The largest influx of Small Red-eyed Damselfly *Erythromma viridulum*, a rare migrant, was on 5 August 2007, when 246 were counted on the *Suaeda* bushes along the shingle-ridge.

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Blakeney Point Orthoptera

David Richmond

Seven species of orthoptera have been recorded from Blakeney Point and the shingle ridge connecting it to Cley. These comprise four grasshopper species and three bush-crickets, with two of the latter being recent colonists which may not yet be fully established.

Common Green Grasshopper *Omocestus viridulus* Seen on the Hood in 2013, being previously unknown from the reserve. Significantly, 2013 was a very hot year with several dispersal movements noted for this species.

Field Grasshopper *Chorthippus brunneus* Regularly recorded from the Hood and the vicinity of the Watch House. There are no records from the Point itself but it may have been overlooked there.

Lesser Marsh Grasshopper *Chorthippus albomarginatus* and **Mottled Grasshopper** *Myrmeleotettix maculatus* The commonest species, found at the Watch House, the Hood and among the dune hollows and lichen-based substrates of the Point.

Short-winged Conehead *Conocephalus dorsalis* An established resident of the saltmarsh edge and dune systems throughout the area and has even been observed stridulating from the highest point of the Hood.

Long-winged Conehead *Conocephalus discolor* Only recorded on a single occasion in September 2012, stridulating from a patch of willowherb north-east of the Old Lifeboat House. This species was first recorded in Norfolk in 2000 and is now well established on waste ground and field margins throughout the county, but is unusual in dune habitats. It remains to be seen if it can become established on the Blakeney Point reserve.

Roesel's Bush-cricket *Metrioptera roeselii* Another recent colonist, first recorded in the county in 1997 and first recorded from the Point in August 2011, when there was a single male stridulating among Shrubby Seablite *Sueda vera* and Sea Couch *Elytrigia atherica*. In August 2012 a number of males were heard at the Hood on an extremely hot day, but could not be heard a month later, implying that they may have been transient, dispersing macropterous males from mainland populations. A further single individual was heard at the Hood in September 2013, but there is, as yet, no evidence of an established breeding colony on the Reserve.

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Blakeney Point Bumblebees

David Richmond

Nine species of bumblebee and two species of cuckoo bumblebee have been recorded from Blakeney Point and the floristically rich areas of the Hood and the shingle ridge near to the Watch House. All but one were confirmed to be present during a June 2012 visit to the Hood by Dr Nick Owens (NO). Unattributed records in the list below relate to that visit and give details of forage plants.

***Bombus hortorum*:** On Sea Campion and Common Catsear.

***Bombus hypnorum*:** Two on Common Catsear; the first records for the Point for this recent coloniser.

***Bombus jonellus*:** One on Biting Stonecrop, an interesting record for a species more usually associated with heathland. It was recorded again in 2013, along the shingle ridge, by both Richmond and Owens.

***Bombus lapidarius*:** On Sea Holly at the Point (DR 2005) and on Common Birdsfoot Trefoil, Biting Stonecrop and Common Catsear at the Hood (NO 2012).

***Bombus lucorum*:** Many on Biting Stonecrop.

***Bombus muscorum*:** A worker on Sea Pea on the shingle ridge toward Cley (DR August 2011) and a worker on Common Catsear on the Hood (NO June 2012), reflecting the recent resurgence of observations of this species along the north Norfolk coast. Most recently it has been seen on Sea Bindweed among the sand dunes at the Point (DR July 2013).

***Bombus pascuorum*:** On the shingle bank flora in the vicinity of the Watch House (DR 2012).

***Bombus pratorum*:** Paul Cobb reported workers on Tree Lupins at the Point in June 1970. This is the only known record.

Bombus sylvestris: On Biting Stonecrop at the Hood, an interesting record in the light of comments about its host species (cuckoo of *B.pratorum* and possibly *B.jonellus*).

Bombus terrestris: On Sea Holly at the Point (DR 2005) and on Sea Campion and Common Catsear at the Hood (NO 2012).

Bombus vestalis: On Common Catsear at the Hood (NO 2012) and on Sea Bindweed at the Point (DR 2013; cuckoo of *B.terrestris*).

It is not clear whether these observations of bumblebees relate to individuals from nests within the Blakeney Point reserve, or whether they represent long distance foraging from the mainland. Given that the latter would involve single journey flight distances of over a kilometre and that the commoner species have been seen regularly over a number of years, residence on the Point seems the more likely. Spring visits to look for newly emerged queens might shed some light on this.

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Bee and wasp records from Blakeney Point

Nick Owens

Introduction

The bees and wasps of Blakeney Point have received relatively little attention. This article provides a list of recent records made by the author, together with those records already on the county database.

Bees

Andrena haemorrhoa Males abundant on Sea Campion *Silene maritima*, May 2012.

Apis mellifera **Honeybee** Worker on Sea Campion, May 2012. Not common on the Point.

Bombus barbutellus **Barbut's Cuckoo Bumblebee** Male on Common Ragwort *Senecio jacobaea*, June 2012. A thinly distributed species which is parasitic on *B. hortorum*.

Bombus campestris **Field Cuckoo Bumblebee** Male on Spear Thistle *Cirsium vulgare*, August 2013. A scarce species in the county, parasitic on *B. pascuorum* and possibly *B. muscorum*.

Bombus hortorum **Garden Bumblebee** Workers on Sea Campion and Common Catsear *Hypochaeris radicata*, June 2012.

Bombus hypnorum **Tree Bumblebee** A worker of this recently colonising species on Common Catsear, June 2012.

Bombus jonellus **Heath Bumblebee** A male on Biting Stonecrop *Sedum acre*, June 2012. Two fresh queens, with several workers and males, all on Biting Stonecrop, June 2013.

Bombus lapidarius **Red-tailed Bumblebee** A common species on the Point. Males and workers seen on Common Birdsfoot Trefoil *Lotus corniculatus*, Biting Stonecrop, bramble *Rubus fruticosus* agg. and Common Catsear in 2011 (RFP) and 2012. Males seen patrolling the edge of Shrubby Seablite *Sueda vera* scrub, probably searching for virgin queens, in August 2013.

Bombus lucorum **White-tailed Bumblebee** A common species on the Point. A male on Common Sea-lavender *Limonium vulgare*, July 2012 and a worker on Biting Stonecrop, June 2012.

Bombus muscorum **Moss Carder Bumblebee** One seen in June 2012 on Common Catsear and five in June 2013 on Biting Stonecrop and Common Birdsfoot Trefoil. A solitary worker was observed on Common Sea-lavender in August 2013. This is a scarce species in the county, now apparently confined to the north coast (Owens and Richmond 2012).

Bombus pascuorum **Common Carder Bumblebee** Worker September 2011 (RP). Scarce on the Point.

Bombus rupestris **Hill Cuckoo Bumblebee** Male on Rosebay Willowherb *Chamerion angustifolium*, August 2013. A scarce species in the county, parasitic on the very common *B. lapidarius*.

Bombus sylvestris **Four-coloured Cuckoo Bumblebee** Male on Biting Stonecrop, June 2012 and June 2013. It is possible that *B. sylvestris* on Blakeney Point is parasitising *B. jonellus*, since its usual host, *B. pratorum*, seems uncommon or absent.

Bombus terrestris **Buff-tailed Bumblebee** A queen on Sea Campion and Common Catsear, June 2012 and a male on sea-lavender, July 2012. Workers common on sea lavender, August 2013. Queens of this species observed dispersing/migrating along the Point in April 2009 (Owens 2009).

***Bombus vestalis* Vestal Cuckoo Bumblebee** A male seen on Common Catsear, June 2012. Males and a female on Sea Holly *Eryngium maritimum,* August 2013. A common species which is parasitic on *B. terrestris.*

Coelioxys sp. One seen in dunes near the old lifeboat station, August 2013, but not captured. This was probably *C. conoidea,* the parasite of *Megachile maritima.*

***Colletes halophilus* Saltmarsh Bee** A Biodiversity Action Plan priority species (Strudwick 2011) that has been recorded on the point since at least 1997, when it was found at TG 00 46 (APF); it has probably been present for much longer. Two nest aggregations, both numbering 500-1000 nest holes, were recorded in August 2011, at grid references TG 0274 4586 (site 1) and TG 0164 4624 (site 2). The nests were very closely packed over an area of several square metres on a level (site 1) or sloping (site 2) sandy substrate with short, sparse grass and Thrift *Armeria maritima.* These two nesting aggregations have been present for several years and were still present in 2012 (RFP pers. comm.) and 2013. In late August 2013, both sites covered about $10m^2$. Site 1 contained 500–1000 holes and site 2 about 400 holes. Males were observed taking nectar from Common Sea-lavender, but *C. halophilus* is said to specialise in Sea Aster *Aster tripolium* pollen, with emergence appearing to coincide with the flowering of Sea Aster. A pollen sample was taken from two female bees and its microscopic appearance compared with samples of pollen from Common Ragwort and Sea Aster; the sample from the bees matched Sea Aster. Further nest aggregations are known from the Morston quay area and at two sites on Stiffkey marshes, the larger one at TF 984 447 estimated at 50m in length in 2013 (G. Lubbock pers.com.).

Dasypoda hirtipes A Notable B species of mining bee found in the Brecks and at most Norfolk dune sites (Strudwick 2011), oligolectic on members of the Asteraceae, such as ragwort. A male netted in August 2011; Blakeney Point is close to the northern edge of its range in the British Isles.

Lasioglossum leucopus Two females taken in a water trap in June 2013. A very small bee with a green cuticle and a round face, widely distributed in the British Isles.

Lasioglossum minutissimum One female taken in a water trap in June 2013. A common species in the south of England.

Lasioglossum smeathmanellum One female taken in a water trap in June 2013. Widespread in the county.

Lasioglossum punctatissimum A female in May 2012. A small fairly common mining bee found in sandy habitats.

Megachile leachella (= M.dorsalis) Female and males in June and July 2012. Nest sites observed in sand close to the eastern end of the Point. This is a Notable B species of leaf-cutter bee, close to the northern edge of its known British Isles range in North Norfolk. Males have green eyes

Megachile maritima Recorded 1971 (EAE) at TF 99 46 (Far Point). A large, dark leaf-cutter bee confined in Norfolk to the coast and the Brecks.

Wasps

***Ammophila sabulosa* Common Sand-wasp** Female, June and July 2012; male and female, August 2013. A large wasp with a red and black abdomen that preys on lepidoptera larvae.

Ancistrocerus scoticus On Sea Campion in May and fairly numerous on Thrift and Biting Stonecrop in June 2012. Males observed flying repeatedly from plant to plant, probably seeking mates but also taking nectar. Female taken in water trap, August 2011 (DW). A mainly coastal species that has declined inland. Seven previous Norfolk records. Builds a mud nest in holes in stones etc.

Anoplius infuscatus Female in water trap, July 2011 (DW). A spider-hunting wasp that preys on wolf spiders (Lycosidae).

Arachnospila wesmaeli Female in water trap close to the old lifeboat station, August 2013. A spider-hunting wasp with only two previous Norfolk records. Found in habitats with loose sand. RDB3.

Dryudella pinguis Male netted at TG 106 462 (the Hood), June 2012. The male of this scarce black and red wasp has a characteristic white facial mark. Nymphs of hemiptera are used as prey. There are ten previous Norfolk records, from the Brecks and Winterton Dunes, with only one other post-2000 record (Strudwick 2012).

Episyron rufipes Recorded in June 2012 (three males), July 2012 (a female) and August 2013 (a female). This spider-hunting wasp with red legs and white spots on the abdomen is abundant in the county.

Gorytes quadrifasciatus Female in July 2012. Preys on adult spittle bugs *Philaenus spumarius*.

Oxybelus uniglumis Male and female, June 2012. A small wasp that takes flies and impales them on its sting to drag them into the nest. Nests in sandy ground.

Philanthus triangulum **Bee Wolf** Recorded 1997 (APF). A black and yellow wasp that takes Honeybees. Often nests in clusters.

Podalonia hirsuta Males in water trap, August 2011 (DW). A large black and red wasp with a mainly coastal distribution that hunts noctuid moth caterpillars.

Tachysphex nitidus Male caught in water trap near the old lifeboat station, August 2013. This all-black wasp hunts grasshoppers and is scarce nationally. The Point is the eighth site for Norfolk.

Vespula germanica **German Wasp** Recorded 1971 (EAE).

Discussion

This short list inevitably gives an incomplete picture of the bees and wasps present on Blakeney Point, but it is hoped that it will encourage further studies. It is to be expected that the Point would support quite a wide range of aculeate species: sandy substrates offer plenty of nest sites for mining bees and wasps while the dune, saltmarsh and shingle habitats provide a wide range of pollen for bees, nectar for bees and wasps and invertebrate prey as food for wasp larvae. The microclimate created by the dune habitats on the Point allows some aculeate species to survive at the northern edge of their range, for example *Dasypoda hirtipes* and *Megachile leachella*.

The almost complete loss of Rabbits from the Point since the 1980s (E. Stubbings pers. comm.) may have resulted in a more luxuriant flora, benefitting bees and wasps and other insects. There is, however, a possibility that the lack of Rabbit grazing will allow rank grass to cover aculeate nest sites, such as those of *Colletes halophilus*. The dune flora can dry up by late summer leaving little nectar for bees. However, nectar sources continue on the saltmarsh in the form of *Aster tripolium* and *Limonium vulgare* well into September, and this is exploited by bumblebees, Honeybees and the *Aster* specialist *Colletes halophilus*. From the conservation perspective, Blakeney Point has significant importance for this last species and also for dune specialists such as *Arachnospila wesmaeli* , *Dasypoda hirtipes* and *Dryudella pinguis*.

Blakeney Point is visited by migratory insects including butterflies, moths and hoverflies. There has also been evidence of spring migration/dispersal of queen bumblebees along the Point (Owens 2009).

Scolt Head offers a similar range of habitats to Blakeney Point, though with more scrub. The bees and wasps of Scolt Head have been studied by Murray (2006). Species recorded on Scolt Head but not yet on

Dune Brittlestem ***Psathyrella ammophila.***

Blakeney Point Fungi

See p.153

Photos: Tony Leech

Cortinarius cf. ***pratensis.*** Below, and right, growing with Sand Sedge *Carex arenaria*.

Left below: **Dune Waxcap** ***Hygrocybe conicoides.***

Right below. ***Peziza varia*** **on Brown Hare pellet.**

Blakeney Point are: *Ammophila pubescens*, *Argogorytes mystaceus*, *Bombus bohemicus*, *Cerceris arenaria*, *C. ruficornis*, *C.rybyensis*, *Dolichovespula norwegica*, *D.saxonica*, *D.sylvestris*, *Ectemnius* sp. *Evagetes* sp., *Mellinus arvensis*, *Nomada* sp., *Podalonia affinis*, *Sphecodes* sp., *Stelis* sp.

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EAE = Ted Ellis
APF = A.P. Foster
DW = Doreen Wells
RFP = Richard Porter

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Richard Porter pointed out the *Colletes halophilus* nest sites and also provided records of bumblebees. Tim Strudwick provided records from the county database.

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The beetles of Blakeney Point

Martin Collier

The records

For such a long-established and popular nature reserve, very little beetle recording seems to have been done at Blakeney Point before the meetings arranged by the National Trust in recent years. For example, only 87 species had been recorded for the entire period up to 2008, but the total then increased to 255 by the end of 2012. Similarly, of the 708 records currently available, 578 (82%) are from the period 2009 to the end of 2012. The lack of data before 2009 is probably due, in part at least, to the difficulty of access, which requires a boat trip or a very long walk on shingle. Coleopterists can visit similar coastal habitats much more easily at other sites nearby, such as Holkham and Salthouse.

A meeting on 12 and 13 September 2009 was attended by four Coleopterists who between them produced a list of 189 beetles, including four Red Data Book species and many with Nationally Notable status. Several more species were added during another meeting on 14 and 15 July 2012. Further visits at different times of the year, especially spring and early summer, would undoubtedly increase the species list even further.

The habitats

Not surprisingly, many of the beetle species recorded at Blakeney Point are associated with the large areas of sand dune, shingle and saltmarsh habitats for which the reserve is renowned. These beetles have, in many cases, developed life cycles and physical adaptations specifically to cope with the demanding conditions of these coastal habitats. One of the most important microhabitats is beach strandline debris, which attracts high concentrations of a wide range of invertebrates. The decomposing seaweed etc. is used as a source of food and shelter by these invertebrates and many beetles are often present, including predatory species. Even some types of beach flotsam, especially timber, can provide valuable shelter for several species. Carrion is also very important for many beetles and several of the rarest species at Blakeney have only ever been found in this habitat: for example, the small Red Data Book rove beetle *Phytosus nigriventris*, which has not yet been found anywhere else in Norfolk. Any attempts to tidy up the beaches by removing 'litter' should therefore be limited to materials considered to be particularly unsightly or hazardous to wildlife, such as glass, metal and plastic.

The beetles

255 beetle species have been recorded from Blakeney Point, from 34 different families. The two families with the highest numbers of species are Staphylinidae (rove beetles – 75 species) and Carabidae (ground beetles – 46 species), representing approximately 7% and 12% respectively of the British species in these families. No less than 39 of the recorded species (15% of the total) have Red Data Book or Nationally Notable status and three of these, *Bruchus atomarius*, *Leiodes ciliaris* and *Phytosus nigriventris*, have not yet been recorded anywhere else in the county.

A full species list is provided in Appendix 1 and brief accounts are given below for beetles of particular interest due to their national or county status. Most of these particular species are unfortunately rather small and somewhat plain in appearance so some of the more photogenic beetles occurring at Blakeney Point are shown on p.100. Species are listed in alphabetical

Blakeney Point beetles

Broscus cephalotes.
Photo: Frank Köhler.

Ocypus ophthalmicus.
Photo: Frank Köhler.

Panagaeus bipustulatus.
Photo: Frank Köhler.

***Cetraria aculeata* with *Cladonia rangiformis*.** Dunes near laboratory.

***Caloplaca crenulatella*.** On concrete by the hut.

Lichens on Blakeney Point.

See p.143

Photos: P.W. Lambley.

Below: ***Cladonia foliacea* in fruit**. Yankee Ridge.

Above: **Community dominated by *Xanthoria parietina* on a low shingle ridge near the Long Hills**

Left: ***Bryoria fuscescens* with *Cladonia rangformis*.** Yankee Ridge

Table 1. Blakeney Point beetles with Red Data Book (RDB) status and their habitat associations

Species (Family)	Status*	Habitat and comments
Atomaria scutellaris (Cryptophagidae)	RDB K	Varied but including saltmarshes.
Hypocaccus metallicus (Histeridae)	RDB 3	Sand dunes – dung and carrion.
Corticarina truncatella (Latridiidae)	RDB K	Strandline debris and at plant roots etc.
Melanophthalma transversalis (Latridiidae)	RDB K	Strandline debris and at plant roots etc.
Clanoptilus barnevillei (Melyridae)	RDB 3	Dune slack vegetation.
Aleochara binotata (Staphylinidae)	RDB K	Coastal dung and carrion.
Phytosus nigriventris (Staphylinidae)	RDB K	Beach carrion.

* As defined in Hyman, 1992 & 1994. RDB 3 = Rare. RDB K = Insufficiently Known

order of family, then genus and species. Nomenclature follows Duff (2012) and the national status shown after the species name is as given in the 'National Reviews' (Hyman, 1992 & 1994).

CHRYSOMELIDAE

Bruchus atomarius Notable B

This local but widespread species has been found on a range of vetches *Vicia* spp. and other Fabaceae and the majority of records are from the southern half of England and Wales (Cox 2007). Paul Lee recorded it from Blakeney Point on 22 August 2006 and I am not aware of any other Norfolk records.

CRYPTOPHAGIDAE

Atomaria scutellaris RDB K - Insufficiently Known

Formerly a very scarce species, this beetle has been expanding its range in recent years and its status therefore needs downgrading. I found one example on 15 July 2012 by grubbing in debris around the base of a Yellow Horned Poppy on shingle. There are Norfolk records from two other sites: Hilborough in 1999 and 2000, and Brancaster saltmarshes in 2007.

HISTERIDAE

Gnathoncus rotundatus

This beetle is normally found in birds' nests, especially those of raptors, or on carrion. Mark Telfer found a single example in the remains of a dead seal on 12 September 2009, only the third Norfolk record and the first since *c.* 1965.

Hypocaccus metallicus RDB 3 – Rare

Although this scarce species has only been recorded from a few English counties on the east and south coasts, it is not uncommon in the sand dunes of north Norfolk, with at least 20 post-1980 records. It supposedly feeds in coastal dung and carrion but almost all the examples I have seen have just been crawling on the sand. It was recorded at Blakeney Point in 2004, 2009 and 2012.

LATRIDIIDAE

Corticarina truncatella RDB K – Insufficiently Known

This small mould beetle has only been found in a few British coastal sites, with the majority of records being from various localities along the north Norfolk coast. It was first recorded at Blakeney Point in 2004 and then found several times during the 2009 and 2012 meetings. It is usually found by grubbing in moss and at plant roots, or in strandline debris.

Melanophthalma transversalis RDB K – Insufficiently Known

The British and Norfolk distributions of this beetle are quite similar to that of *Corticarina truncatella*, although it also occurs inland, and it is found in similar habitats. It was

recorded three times at Blakeney Point during the 2009 meeting.

LEIODIDAE

Leiodes ciliaris Notable

Species of *Leiodes* are thought to feed and breed in underground fungi and are rarely found above ground during the day; they therefore tend to be under-recorded. I took one example of *L. ciliaris* by evening sweeping on 12 September 2009 and another was caught in a pitfall trap set by National Trust staff during the same week. This species is found mainly in coastal sand dunes and, although widespread in Britain, these were the first county records.

NITIDULIDAE

Nitidula carnaria

Colin Welch found a single example of this carrion beetle in a dead Sandwich Tern on 13 September 2009. There are only two other Norfolk records, both from the 19th Century.

STAPHYLINIDAE

Aleochara binotata RDB K - Insufficiently Known

The larvae of rove beetles in the genus *Aleochara* are obligate parasites of certain species of Diptera and the adult beetles are therefore most frequently found in dung or carrion. Some species, including *binotata*, seem to prefer coastal sites. The beetle was first recorded in Norfolk in 2005, by David Gibbs at Titchwell RSPB reserve, and Mark Telfer found it in carrion at Blakeney Point on 12 September 2009. It has subsequently been recorded at two other north Norfolk sites and is obviously well established along this stretch of coast.

Myrmecocephalus concinnus

This immigrant rove beetle was added to the British list in 1944. Although now quite widespread, it still seems to be scarce. I found *M. concinnus* at Lopham Fen in 1997 (Jones 2001) and Tony Allen found it at Blakeney Point on 12 September 2009. These would appear to be the only county records.

Ocypus ophthalmicus Notable A Photo p.100

This large predatory rove beetle can be quite intimidating when it curls up its abdomen in a scorpion-style threat posture, although of course it cannot sting. It is superficially similar to the common Devil's Coach-horse *Ocypus olens*, but is smaller and with a distinct blue sheen on the forebody, particularly noticeable in sunlight. It has a scattered British distribution but most recent records are from East Anglia, where it usually occurs in Breckland heath and coastal habitats. It was recorded at Blakeney Point on several occasions between 1997 and 2011.

Oligota pusillima

The status and distribution of this species is uncertain because of taxonomic confusion – British material for '*pusillima*' having been found to be a mix of *pusillima* and *pumilio* (Williams 1970). Both species are expected to be fairly common, although somewhat surprisingly there are no old published Norfolk records for '*pusillima*'. It is therefore worth putting on record that the true *pusillima* was found at Blakeney Point by Tony Allen on 12 September 2009. (It was first found in the county by K. Haysom (identified by R.G. Booth) in May 2000, at Hilborough.) The other species, *pumilio*, has so far been recorded from three sites in Norfolk: Swanton Novers Wood in 1974 by S.A. Williams, Old Buckenham Fen in 1982 by J.A Owen and P.M. Hammond, and Burnham Overy in 1984 by A.B. Drane.

Phytosus nigriventris RDB K - Insufficiently Known

Hyman (1994) lists seven vice-counties with records before 1970 but only one, Dorset, in the period since 1969. Mark Telfer found two examples (one in each of two different areas) at Blakeney Point on 12 September 2009, the first Norfolk records. I found a further specimen on 14 July

Sand-hill Screw-moss *Syntrichia ruraliform,is a pioneer species on sand dunes., see p.132*

Photo: C.R. Stevenson.

Tortella flavovirens (see p.137).

Photo: C.R. Stevenson

Rock Sea-lavender *Limonium binervosum*. Often associated with the moss, *Totrtella flavovirens* (see p. 137). For distribution on Blakeney Point see p.117.

Photo: *C.R. Stevenson.*

2012, in sand underneath a dead bird. The small size (*c.* 3mm) and black and yellow colouration makes this beetle quite difficult to detect amongst grains of sand, perhaps contributing to the paucity of records. There are many Norfolk coastal records for *P. balticus*, however, a similarly coloured but even smaller species found in the same habitat, so *nigriventris* would appear to be a genuinely scarce beetle, at least in this county.

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Appendix 1. Coleoptera recorded from Blakeney Point

Arranged in alphabetical order by family then genus and species. Nomenclature follows Duff (2012). National status (Nb, RDB K etc.) as given in Hyman (1992 & 1994).

Anthicidae
Cordicollis instabilis
Omonadus floralis
Omonadus formicarius
Apionidae
Apion frumentarium
Apion haematodes
Ceratapion carduorum
Protapion fulvipes
Pseudaplemonus limonii **Nb**
Stenopterapion tenue
Byrrhidae
Simplocaria semistriata
Cantharidae
Cantharis nigra
Carabidae
Agonum marginatum
Amara aenea
Amara apricaria
Amara convexior
Amara ovata
Amara similata
Amara tibialis
Anchomenus dorsale
Bembidion iricolor
Bembidion maritimum
Bembidion minimum
Bembidion normannum
Bembidion obtusum
Bembidion properans
Bembidion quadrimaculatum
Bradycellus harpalinus
Broscus cephalotes Photo p.100
Calathus ambiguous **Nb**
Calathus cinctus
Calathus fuscipes
Calathus melanocephalus
Calathus mollis
Cillenus lateralis **Nb**
Curtonotus aulicus
Demetrias monostigma **Nb**
Dicheirotrichus gustavi
Dicheirotrichus obsoletus **Nb**
Dyschirius salinus
Dyschirius thoracicus
Elaphropus parvulus **Nb**
Harpalus affinis
Harpalus anxius
Harpalus rufipes
Harpalus servus **Nb**
Loricera pilicornis
Masoreus wetterhallii **Na**
Notiophilus substriatus
Panagaeus bipustulatus **Nb**
Photo p.100
Paradromius linearis
Pogonus chalceus
Pogonus littoralis **Nb**
Pterostichus nigrita
Syntomus foveatus
Trechus fulvus **Nb**
Trechus obtusus
Trechus quadristriatus
Chrysomelidae
Aphthona euphorbiae
Bruchus atomarius **Nb**
Bruchus rufimanus
Cassida rubiginosa
Cassida viridis
Cassida vittata
Chaetocnema concinna
Chaetocnema hortensis
Cryptocephalus fulvus
Cryptocephalus pusillus
Gastrophysa polygoni
Longitarsus jacobaeae
Longitarsus luridus
Longitarsus melanocephalus
Longitarsus parvulus **Na1***
Longitarsus pratensis
Neocrepidodera transversa
Oulema melanopus
Oulema rufocyanea/melanopus agg.
Sphaeroderma rubidum
Sphaeroderma testaceum
Clambidae
Calyptomerus dubius
Cleridae
Necrobia rufipes
Coccindellidae
Chilocorus renipustulatus
Coccidula rufa
Coccinella septempunctata
Coccinella undecimpunctata
Harmonia axyridis
Hippodamia variegate **Nb**
Propylea quattuordecimpunctata
Psyllobora vigintiduopunctata
Rhyzobius litura
Scymnus frontalis
Subcoccinella vigintiquattuorpuncta
Corylophidae
Corylophus sublaevipennis
Cryptophagidae
Atomaria linearis
Atomaria scutellaris **RDB K**
Atomaria testacea
Cryptophagus denticulatus
Micrambe ulicis
Curculionidae
Ceutorhynchus obstrictus
Ceutorhynchus pallidacylus
Hypera arator
Otiorhynchus ovatus
Philopedon plagiatum
Polydrusus pulchellus **Nb**
Sibinia arenariae **Nb**
Sibinia primita **Nb**
Sitona hispidulus
Sitona lepidus
Sitona lineatus
Tychius picirostris
Dermestidae
Dermestes murinus
Dermestes undulates
Heteroceridae
Heterocerus fenestratus
Heterocerus flexuosus
Heterocerus fossor
Histeridae
Gnathoncus communis
Gnathoncus rotundatus
Hypocaccus dimidiatus **Nb**
Hypocaccus metallicus **RDB 3**
Margarinotus purpurascens
Saprinus planiusculus **Nb**
Saprinus semistriatus
Hydraenidae
Ochthebius auriculatus **Nb**
Ochthebius dilatatus
Ochthebius marinus **Nb**
Hydrophilidae
Cercyon littoralis
Cercyon terminatus
Cercyon tristis **Nb**
Enochrus bicolor **Nb**
Megasternum concinnum
Sphaeridium bipustulatum
Sphaeridium lunatum
Sphaeridium scarabaeoides
Hygrobiidae
Hygrobia hermanni
Latridiidae
Cartodere nodifer
Corticaria crenulata
Corticaria impressa
Corticarina minuta
Corticarina truncatella **RDB K**
Cortinicara gibbosa
Melanophthalma transversalis **RDB K**
Leiodidae
Catops nigricans
Leiodes ciliaris **N**
Leiodes furva **N**
Nargus velox

*Status no longer valid – now common.

Lucanidae
Dorcus parallelipipedus
Malachiidae
Anthocomus rufus
Clanoptilus barnevillei **RDB 3**
Malachius bipustulatus
Monotomidae
Monotoma bicolor
Nitidulidae
Glischrochilus hortensis
Meligethes aeneus
Meligethes carinulatus
Nitidula carnaria
Omosita colon
Oedemeridae
Oedemera lurida
Oedemera nobilis
Phalacridae
Olibrus aeneus
Olibrus affinis
Olibrus liquidus
Stilbus oblongus
Stilbus testaceus
Ptiliidae
Ptenidium punctatum
Ptinidae
Anobium punctatum
Scarabaeidae
Aegialia arenaria
Anomala dubia
Aphodius distinctus **Nb**
Phyllopertha horticola
Scirtidae
Cyphon laevipennis
Scraptiidae
Anaspis garneysi
Silphidae
Necrodes littoralis
Nicrophorus investigator
Nicrophorus vespillo
Silpha tristis
Thanatophilus sinuatus
Staphylinidae
Acrotona aterrima
Alaobia trinotata
Aleochara bilineata
Aleochara binotata **RDB K**
Aleochara bipustulata
Aleochara grisea
Aleochara lanuginosa
Aleochara punctatella
Aloconota gregaria
Amischa analis
Amischa decipiens
Anotylus inustus
Anotylus tetracarinatus
Bledius bicornis **Na**
Bledius spectabilis
Bledius subniger
Bledius unicornis
Brachygluta fossulata
Cafius xantholoma
Coprophilus striatulus
Creophilus maxillosus
Cypha longicornis
Cypha pulicaria **N**
Datomicra nigra
Diglotta mersa
Drusilla canaliculata
Gabrius nigritulus
Gyrohypnus fracticornis
Habrocerus capillaricornis
Halobrecta flavipes
Heterothops binotatus
Lathrobium fulvipenne
Leptacinus intermedius
Leptacinus pusillus
Lobrathium multipunctum
Megalinus glabratus
Microdota amicula
Mocyta amplicollis
Mocyta fungi
Mocyta orbata
Myrmecocephalus concinnus
Nehemitropia lividipennis
Ocypus olens
Ocypus ophthalmicus **Na**
Photo p.100
Oligota parva
Oligota pusillima
Omalium laeviusculum
Omalium riparium
Othius angustus
Othius laeviusculus
Philonthus carbonarius
Philonthus cognatus
Philonthus concinnus
Philonthus politus
Philonthus succicola
Phytosus balticus
Phytosus nigriventris **RDB K**
Platystethus nitens
Quedius boops
Quedius levicollis
Quedius nitipennis
Quedius semiobscurus
Quedius simplicifrons
Rugilus orbiculatus
Sepedophilus nigripennis
Stenus ater **Nb**
Stenus clavicornis
Stenus ossium
Sunius propinquus
Tachyporus dispar
Tachyporus hypnorum
Tasgius ater
Tasgius globulifer
Thinobaena vestita
Xantholinus linearis
Xantholinus longiventris
Tenebrionidae
Crypticus quisquilius **Nb**
Lagria hirta
Melanimon tibialis
Phaleria cadaverina
Phylan gibbus

Sea Campion *Silene uniflora*, Blakeney Point, May 2009. See p.116. *Photo*: R.F. Porter.

Sea-heath *Frankenia laevis*, Blakeney Point, July 2012. See p.117. *Photo*: R.F. Porter.

Sea-kale *Crambe maritima*. On the shingle ridge with Blakeney Harbour beyond, June 2003. See p.119. Photo: R.F. Porter.

***Yucca Yucca gloriosa*.** With the Plantation and Old Laboratory beyond, Blakeney Point, January 2013. See p.128. *Photo*: R.F. Porter.

The distribution and abundance of the plants of Blakeney Point, Norfolk

Richard Porter

Dedicated to Dr DJB White - a pioneer of plant study on Blakeney Point

Introduction

Between 1999 and 2013 I recorded the plants of Blakeney Point, Norfolk, a six kilometre shingle and sandy spit that starts immediately west of the Cley beach car park and continues westwards to form the northern boundary of Blakeney Harbour (Figure 1). From 2003 to 2009 a concerted effort was made to systematically assess their distribution and abundance using an adapted version of the DAFOR scale, in order to prepare a plant atlas. This was first published on the National Trust's website (Porter 2013), but that is updated, and amended, by this paper.

This does not pretend to be, nor should it be regarded as, a definitive flora of Blakeney Point. No attempt has been made to compare the data with that in the detailed account given by Pearson *et al.* (2007), which summarise the known status up to that date (although without access to the atlas data in this paper). Thus the two should be considered as complementary. However, for comprehensiveness, species not recorded during the current study, but listed in Pearson *et al.* (2007), are given in an appendix.

During this present study a total of plant 228 taxa or aggregates were recorded from 1999 to 2013, of which 38 would appear to be new to Blakeney Point as they are not listed in Pearson *et al.* (2007). This brings the provisional total of plant taxa recorded on the Point to 294, of which over 35 have not been recorded since 1970 (see appendix).

The atlas must be seen as a 'snap-shot in time.' Blakeney Point is a dynamic ecosystem and even in the four years following the completion of the atlas there have been changes in plant distribution with some species expanding their range noticeably e.g. Sea Spurge. The abundance of several others has changed due to environmental pressures: northerly winter gales and resultant shingle movements in 2008 and 2010, heavy rainfall in summer 2012 and the continuing effects of lack of Rabbit grazing have all impacted on the Point's flora, but these are not discussed here.

English and scientific names follow those of Stace (2010). Threatened species and those for which Great Britain has an international responsibility (having more than 25% of the World population) are appropriately indicated in the species' accounts, following Cheffings & Farrell (2005) and also summarised in Table 1. Note that there are no Endangered species on Blakeney Point.

Methods

To collect data for the atlas Blakeney Point was divided into 22 half kilometre (500m x 500m) recording squares. These are shown in Figure 1, which also shows the Point's main habitats: the shingle ridge, the dunes and dune slacks and the saltmarsh. It should be noted that 'Far Point' continues to extend its journey westwards and projects much further than shown on the map.

From 2003 to 2009 each half km square was visited regularly from March to October at least, and in each square the number of plants of each species was counted or

Table 1. Plants on Blakeney Point which are Red Listed in Great Britain, for which GB has more than 25% of the World population and which are Rare or Scarce. After Cheffings & Farrell (2005) and JNCC – see references for details.

Species	Red List Status in GB	More than 25% world population in GB	National status
Frosted Orache *Atriplex laciniata*		Yes	
Perennial Glasswort *Sarcocornia perennis*			Scarce
One-flowered *Salicornia pusilla*		Yes	Scarce
Shrubby Sea-blight *Suaeda vera*			Scarce
Prickly Saltwort *Salsola kali*	Vulnerable		
Sea Mouse-ear *Cerastium diffusum*		Yes	
Ray's Knotgrass *Polygonum oxyspermum*		Yes	
Lax-flowered Sea-lavender *Limonium humile*		Probably	Scarce
Matted Sea-lavender *Limonium bellidifolium*			Rare
Rock Sea-lavender *Limonium binervosum*		Yes	
Sea-heath *Frankenia laevis*	Near Threatened	Possibly	Scarce
Sea Pea *Lathyrus japonicus*			Scarce
Hound's-tongue *Cynoglossum officinale*	Near Threatened		
Smooth Cats-ear *Hypochaeris glabra*	Vulnerable		
Common Cudweed *Filago vulgaris*	Near Threatened		
Grey Hair-grass *Corynephorus canescens*	Near Threatened		Rare
Heath Dog-violet *Viola canina*	Near Threatened		
Eelgrass *Zostera marina*	Near Threatened		
Dwarf Eelgrass *Zostera noltii*	Vulnerable		Scarce
Curved Hard-grass *Parapholis incurva*			Scarce

estimated and the abundance recorded as follows:

Rare: plant recorded in fewer than six one-metre squares (NB there are 250,000 one-metre squares in each half km square).

Occasional: plant recorded in 6 - 50 one-metre squares.

Frequent: plant recorded in 51 to 500 one-metre squares.

Abundant: plant recorded in more than 500 one-metre squares.

In addition all plant species observed outside the atlas period were recorded.

Results

All species that are an important component of a coastal floral community are mapped, in addition to those that were found to be widespread. For other less widespread species just a simple statement of their distribution is given, including the 0.5km square in which they occurred (Figure 1). In the case of grasses mapping has not been attempted for some species due to difficulty of ensuring correct identification and quantifying abundance in every recording unit. All species observed from 1999 to 2013 are listed, together with date seen if outside the atlas recording period of 2003 – 2009.

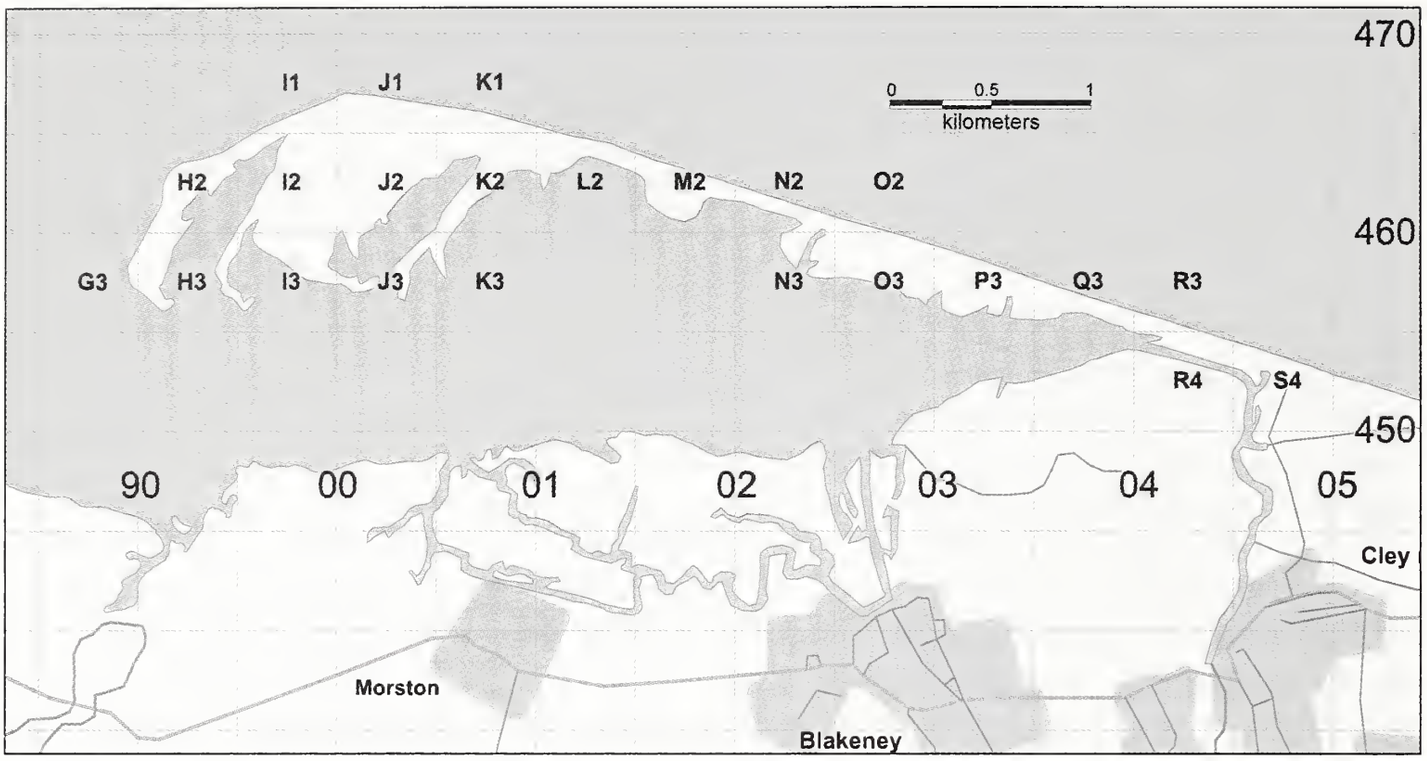
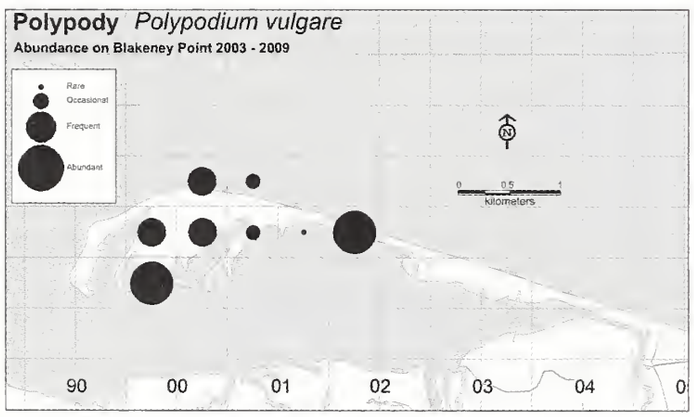


Figure 1. Plant atlas recording squares, 500 x 500m.

Species list

Polypody *Polypodium vulgare* agg.
A plant confined to the stable dunes. No attempt was made to separate the two species of this aggregate: *P. vulgare* and *P. interjectum*. [map]



Male-fern *Dryopteris filix-mas*
Rare in stable dunes in K2.

Broad Buckler-fern *Dryopteris dilatata*
Rare in stable dunes in I3 and K2; occasional in M2.

Corsican Pine *Pinus nigra*
One large tree, presumably that originally planted (see Pearson *et al.* 2007), and about six small trees in the Plantation, I2.

Clematis *Clematis orientalis/tangutica*
One plant discovered on Near Point (H3) in September 2012. This non-native species was probably originated as a wind-blown, or bird-assisted, seed.

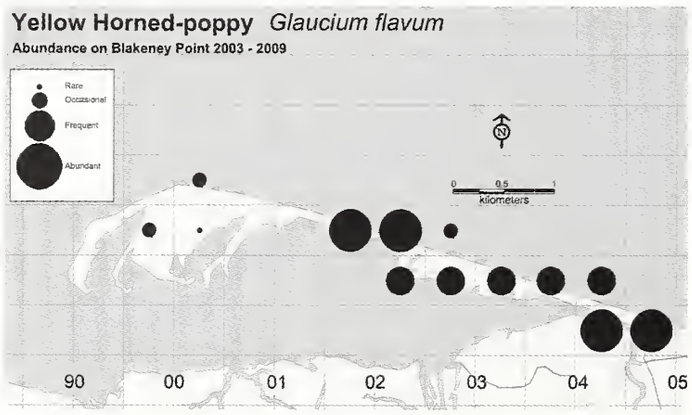
Bulbous Buttercup *Ranunculus bulbosus*
Occasional in R3, Rare in N3 and Q3.

Lesser Meadow-rue *Thalictrum minus*
Rare in J2 where 2-3 plants at the edge of the dunes in Great Sandy Low.

Common Poppy *Papaver rhoeas*
Rare in H2, one plant on Middle Point.

Opium Poppy *Papaver somniferum*
Occasional in M2, where present on shingle ridge on highest tide-line. The origin of this non-native species is speculative but was probably carried as a seed on clothing, fur or machinery, or even in a bird's gut.

Yellow Horned-poppy *Glaucium flavum*
One of the most characteristic plants of the shingle ridge. [map]



Common Fumitory ***Fumaria officinalis***
Rare in S4, where found on stabilised shingle at the extreme eastern end of the shingle ridge.

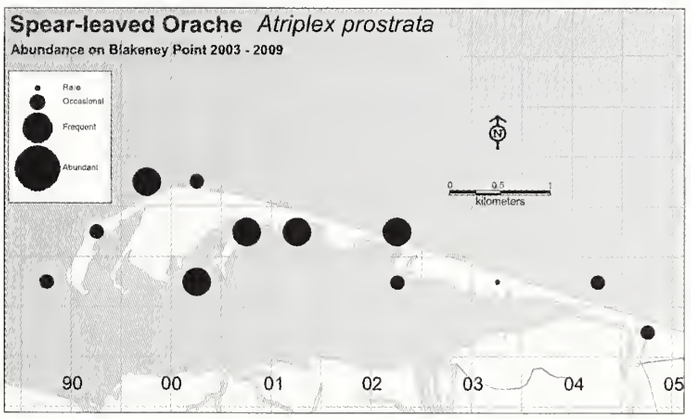
Common Nettle ***Urtica dioica***
Frequent in the Lifeboat House garden, I3.

Small Nettle ***Urtica urens***
Rare in I3, where found in the Lifeboat House garden.

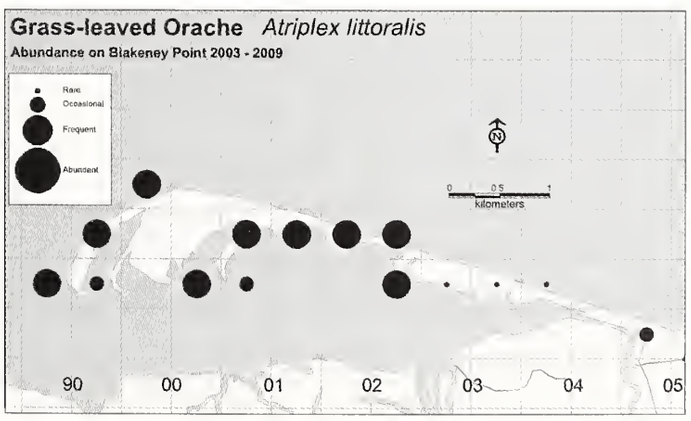
Downy Birch ***Betula pubescens***
One well-established tree in the Lifeboat House garden, I3. It is most likely this was planted.

Fat Hen ***Chenopodium album***
Frequent in G3 & H2, Occasional in J2 and rare in H3.

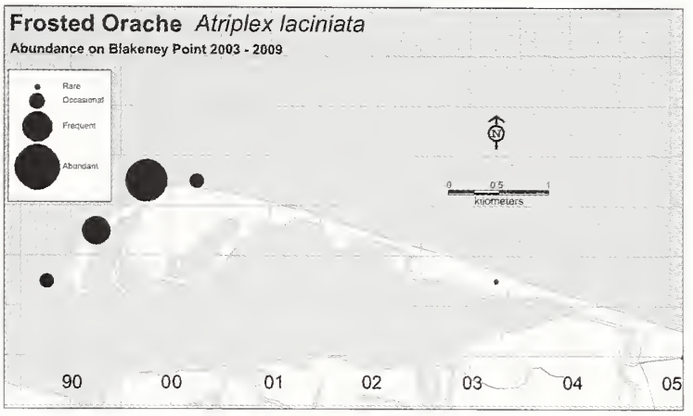
Spear-leaved Orache ***Atriplex prostrata***
Mainly found, with other oraches, on the inner (harbour) strand-line. [map]



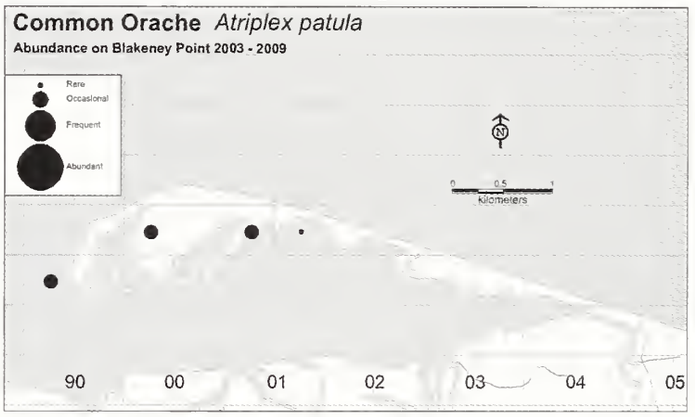
Grass-leaved Orache ***Atriplex littoralis***
Mainly found, with other oraches, on the inner (harbour) strand-line. [map]



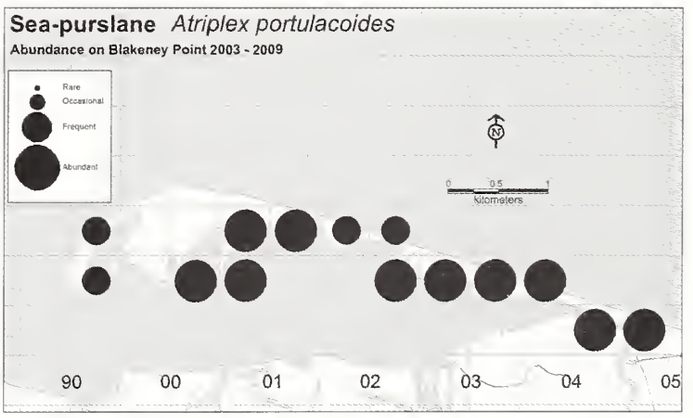
Frosted Orache ***Atriplex laciniata***
Apart from one plant on the shingle ridge, found only on the westernmost Point (Far Point) on the upper areas of the sandy beaches. Great Britain has more than 25% of the World population of this species (Cheffings & Farrell 2005). [map]



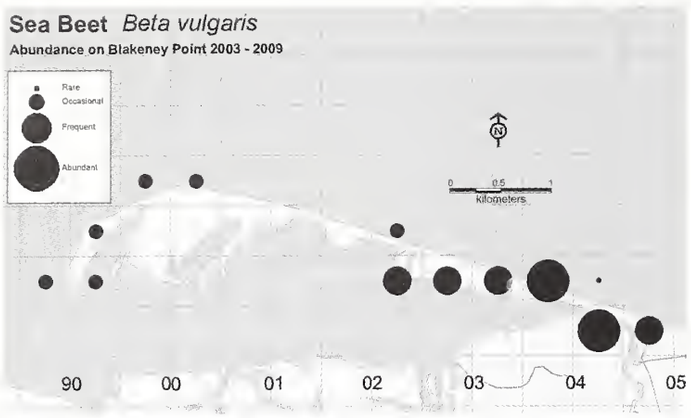
Common Orache ***Atriplex patula***
As with the other oraches, this is a plant of the strand-line. [map]



Sea-purslane ***Atriplex portulacoides***
A dominant plant of the saltmarsh. [map]

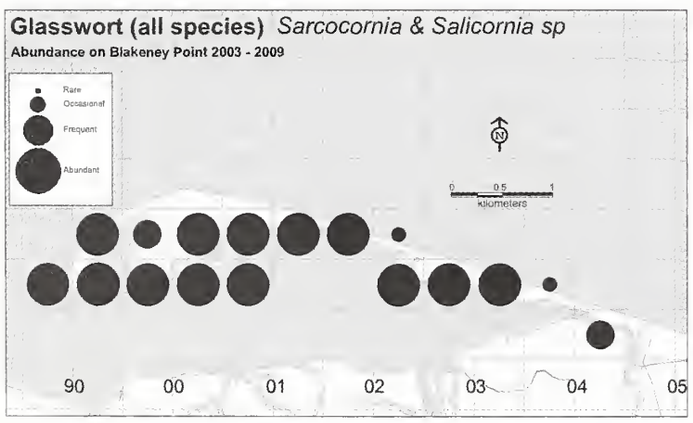


Sea Beet ***Beta vulgaris maritima***
One of the characteristic plants of the shingle ridge, notably the eastern stretch. [map on p.114]



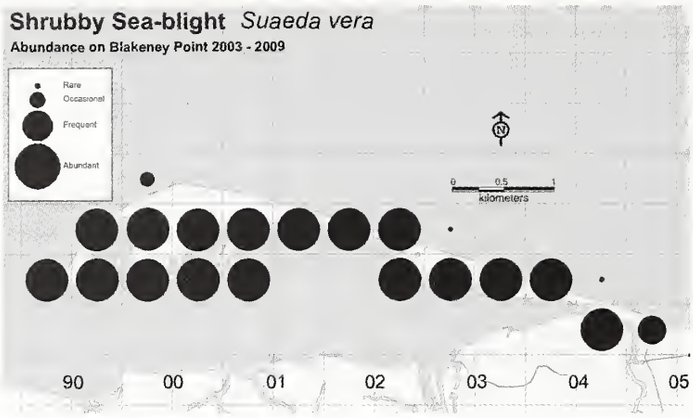
Glasswort (all species) ***Sarcocornia & Salicornia* sp.**

Glassworts have been mapped collectively because of the difficulty of identifying and precisely mapping the abundance of individual species. During the study period the following species were identified: Perennial Glasswort *Sarcocornia perennis*, One-flowered *Salicornia pusilla*, Purple Glasswort *S. ramosissima*, Common Glasswort *Salicornia europaea* and Long-spiked Glasswort *S. dolichostachya*. For full details of all glasswort taxa recorded on Blakeney Point see Pearson *et al.* (2007). Note that Great Britain has more than 25% of the World population of the Nationally Scarce *Salicornia pusilla* (Cheffings & Farrell 2005, JNCC); *Sarcocornia perennis* is also a Nationally Scarce plant (JNCC). [map]



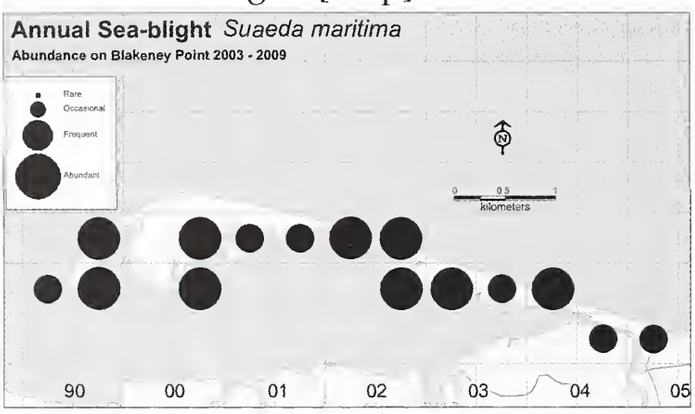
Shrubby Sea-blight ***Suaeda vera***

The characteristic, and often dominant, plant of the shingle ridge. This species is a Nationally Scarce in the UK (JNCC) and at Blakeney Point is at the northern edge of its range. [map]



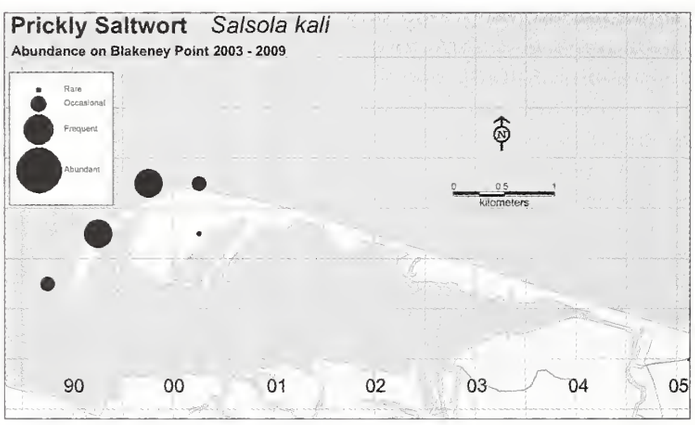
Annual Sea-blight ***Suaeda maritima***

One of the common plants of the saltmarsh fringes. [map]



Prickly Saltwort ***Salsola kali***

Only found at the western end of the Point, mostly near the upper strand-line of Far and Middle Point. Listed as Vulnerable in Great Britain (Cheffings & Farrell 2005). [map]



Blinks ***Montia fontana***

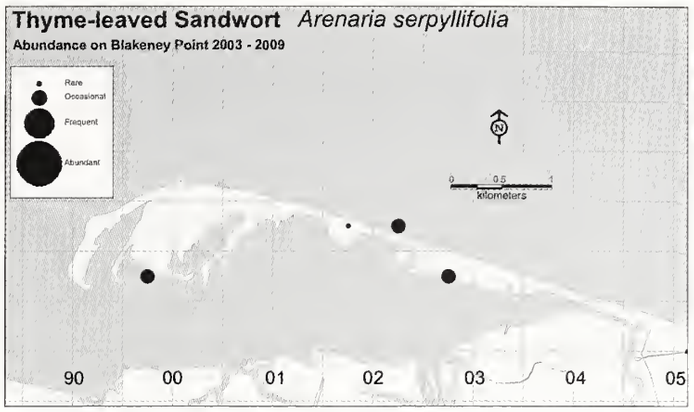
Rare neat Watch House in N3 (2010).

Springbeauty ***Claytonia perfoliata***

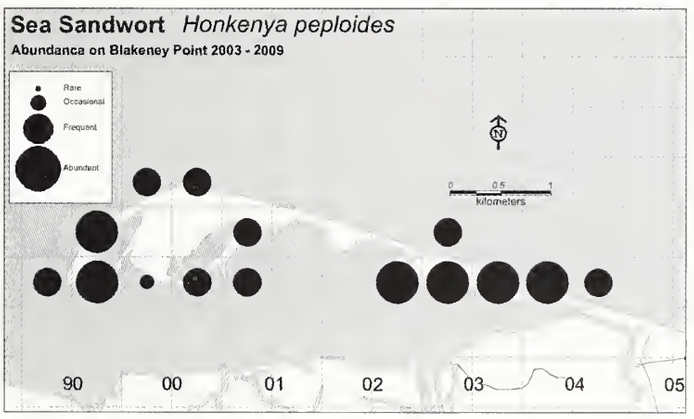
Occasional in dunes in H3 & I3.

Thyme-leaved Sandwort ***Arenaria serpyllifolia***

This annual is probably more widespread than mapped, as it is easily overlooked. [map on p.115]

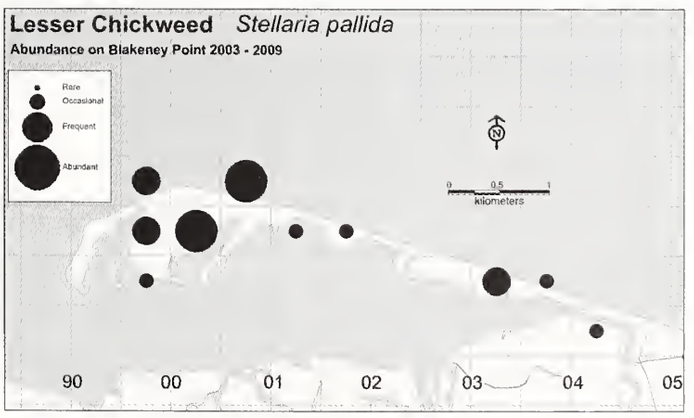


Sea Sandwort *Honckenya peploides*
One of the characteristic plants of the shingle ridge, especially along the strandlines and areas where there is a build up of sand amongst the shingle; it is also abundant on the sandy areas on Middle and Far Point, but not found in the dunes. [map]

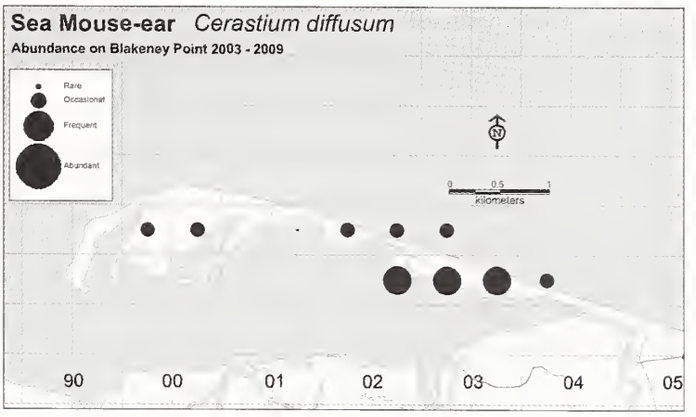


Common Chickweed *Stellaria media*
Occasional in I2, Rare in H3 and N3.

Lesser Chickweed *Stellaria pallida*
This chickweed is especially abundant on areas of compacted sandy-shingle. [map]



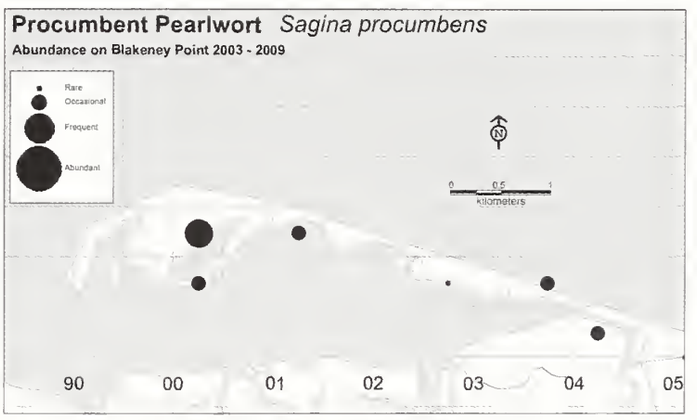
Sea Mouse-ear *Cerastium diffusum*
Occurs most frequently on the stabilised shingle on the shingle ridge. Great Britain has more than 25% of the World population of this species (Cheffings & Farrell 2005). [map]



Common Mouse-ear *Cerastium fontanum*
Frequent in H3, I2 and R4, Occasional in P3 and Q3.

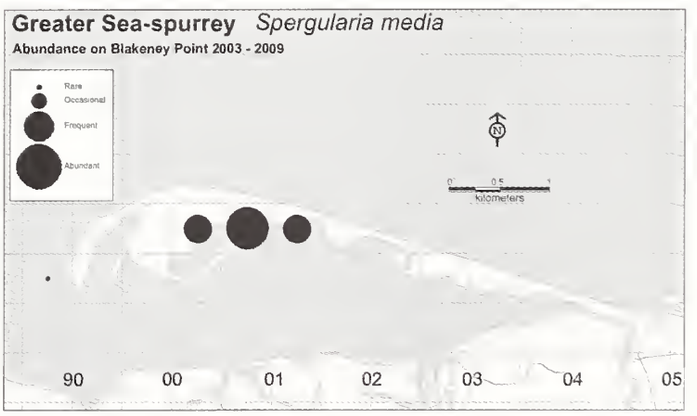
Sticky Mouse-ear *Cerastium glomeratum*
Occasional in I2 and I3.

Procumbent Pearlwort *Sagina procumbens*
This annual is probably more widespread than mapped, as it is easily overlooked. [map]

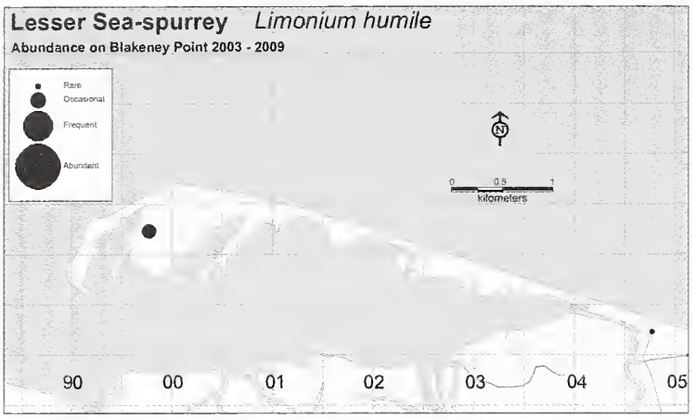


Sea Pearlwort *Sagina maritima*
Rare in I3.

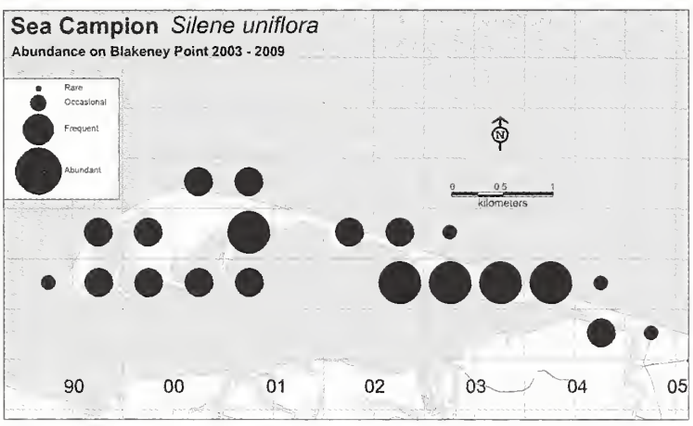
Greater Sea-spurrey *Spergularia media*
A common plant of the fringes of the saltmarsh in the western bays and by far the commoner of the two *Spergularia* species. [map]



Lesser Sea-spurrey *Spergularia marina*
Surprisingly an uncommon plant, recorded in only two of the recording squares, though this may have been due to it being overlooked amongst Greater Sea-spurrey. [map]



Sea Campion *Silene uniflora*
Widely distributed and one of the characteristic plants of the shingle ridge. Photo p.108. [map]

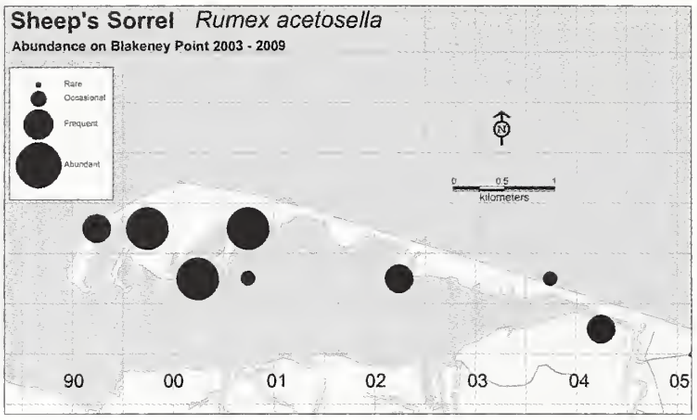


Ray's Knotgrass *Polygonum oxyspermum*
Rare on edges of compacted dunes in H2, J1 & J2. Great Britain has more than 25% of the World population of this species (Cheffings & Farrell 2005).

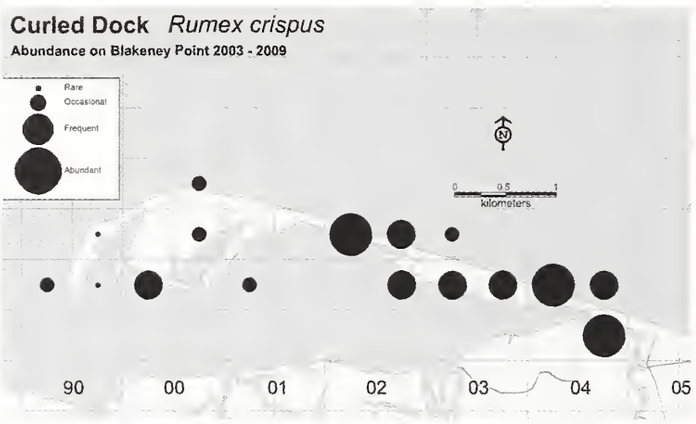
Knotgrass *Polygonum aviculare*
Occasional in J3 and Rare in S4.

Equal-leaved Knotgrass *Polygonum arenastrum*
Rare in J2, where one plant at the edge of the dunes.

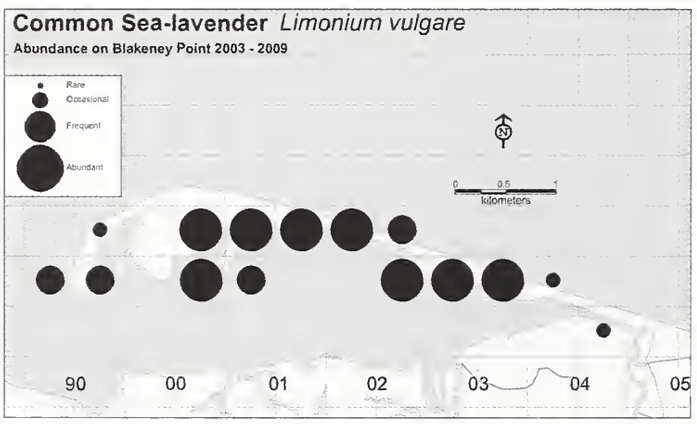
Sheep's Sorrel *Rumex acetosella*
Patchily distributed and most abundant on the lateral spits. [map]



Curled Dock *Rumex crispus* **ssp.** *littoreus*
One of the characteristic plants of the shingle ridge.



Common Sea-lavender *Limonium vulgare*
The most colourful plant of the saltmarsh. [map]

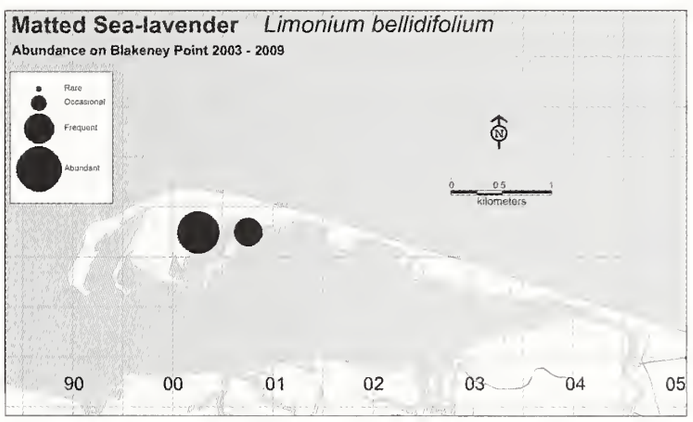


[Lax-flowered Sea-lavender *Limonium humile***]**
Rare (one plant) in the saltmarsh in M2, but because of the difficulty of identification I do not feel confident in ruling out a hybrid with *L. vulgare*. Interestingly, however, in August 2005 Colin Dunster (*in litt.*) photographed a plant, one of five, showing the full suite of characters of *humile* in the same area of saltmarsh as my plant (between The Hood and Long Hills). In most Norfolk

saltmarshes tall plants of hybrid origin are occasionally found in the absence of the parent *L. humile* and these are believed to be the result of historical hybridisation followed by back crossing with *L. vulgare* (Colin Dunster & Bob Ellis *in litt.*). Great Britain probably has more 25% of the world population of this Nationally Scarce species (Cheffings & Farrell 2005, JNCC).

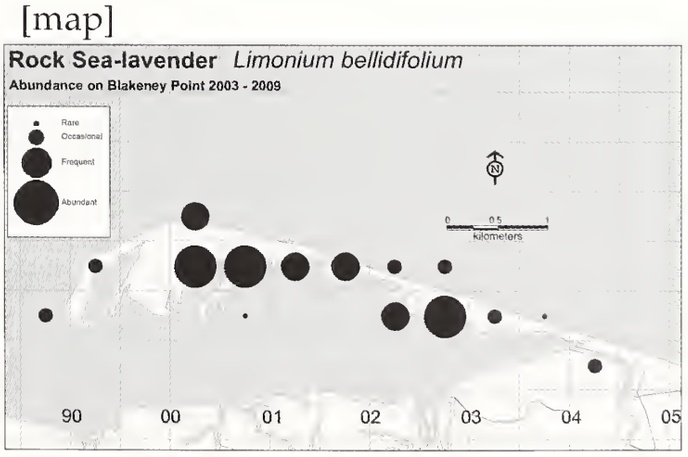
Matted Sea-lavender *Limonium bellidifolium*

A plant of the dune slacks, inundated during very high tides. Abundant in Great Sandy Low in J2, Frequent in K2. Nationally Rare in the UK (JNCC). Blakeney Point is at the northern edge of its global range. [map]



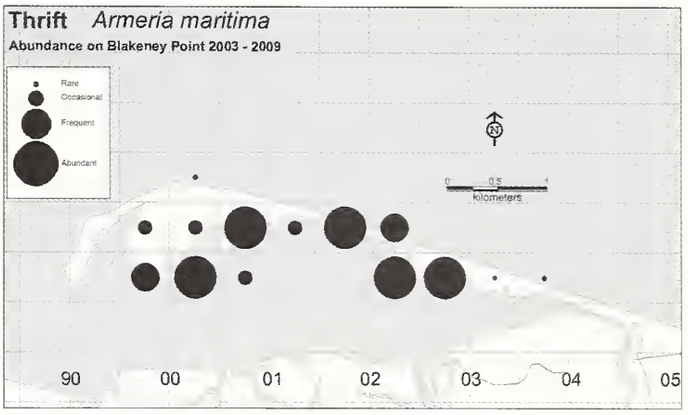
Rock Sea-lavender *Limonium binervosum*

Often forms large patches and typically found in drier areas that are rarely, or only occasionally, inundated by high tides. Great Britain has more than 25% of the World population of this species (Cheffings & Farrell 2005); the form found in Norfolk is ssp *anglicum*, which according to Stace (2010) is endemic to Norfolk and Lincolnshire. Photo p.104. [map]



Thrift *Armeria maritima*

A characteristic plant of the older lateral spits, where the impacted sands and gravels have become vegetated with grasses. [map]



Common Mallow *Malva sylvestris*

Rare in S4 at the eastern end of the shingle ridge.

Common Dog Violet *Viola riviniana*

Rare in I3 (2013)

Heath Dog-violet *Viola canina*

Frequent in grass-covered dunes in I3, Occasional in I2 and J2. Near Threatened in Great Britain (Cheffings & Farrell 2005).

Field Pansy *Viola arvensis*

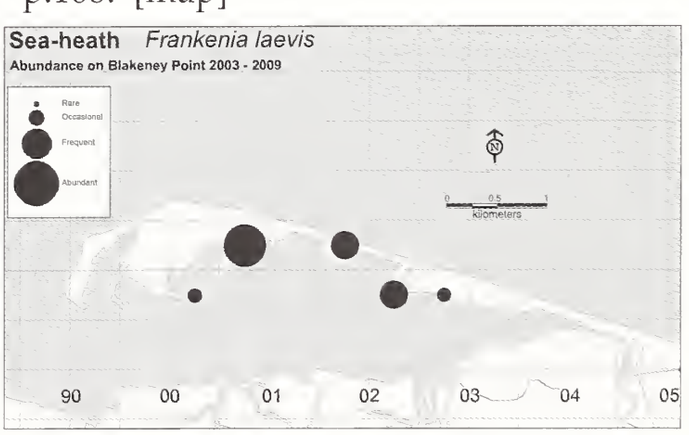
Rare in dunes in H2 and R4.

Tamarisk *Tamarix gallica*

Rare, with one clump of bushes by the Old Laboratory in I2. This non-native species was planted in 1912 (Pearson *et al.* 2007).

Sea-heath *Frankenia laevis*

Patch-forming on areas of compacted sandy-shingle. Near Threatened and Nationally Scarce in Great Britain (Cheffings & Farrell 2005, JNCC). Photo p.108. [map]



White Bryony *Bryonia dioica*
Rare in I2 by the Old Laboratory.

White Poplar *Populus alba*
Frequent in, and spreading from, the Plantation in I2. Originally planted in 1916/1917 (Pearson *et al.* 2007).

Willow *Salix* **sp.**
Isolated very small bushes occurred on the inner, more stable, side of the shingle ridge in L2, P3 and Q3. By 2013 only two remained (both in L2) and had reached a height of one metre. Study of photographs suggested both were Grey Willow *Salix cinerea* (Bob Ellis *in litt*). This was supported by examination of the twigs in autumn which showed ridges under the bark, which rules out Goat Willow *S. caprea*. Whilst such ridges do not rule out Eared Willow *S. aurita*, that species is rare in Norfolk, mostly confined to wet, acid areas, and far less likely to turn up on the wind. However caution is necessary as the unusual habitat and stressful conditions of a wind-blown shingle beach at the edge of the sea could result in atypical growth (Bob Ellis *in litt*).

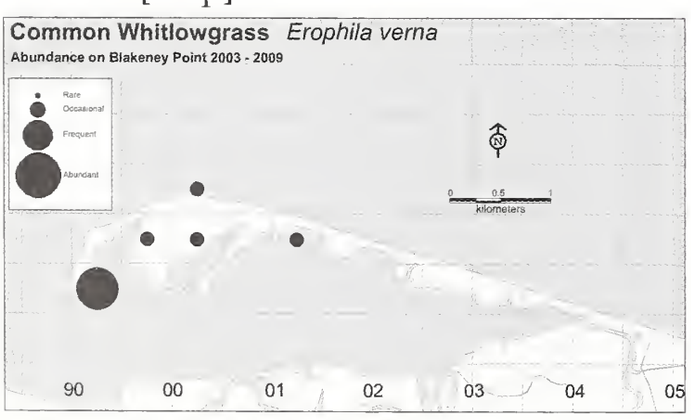
Hedge Mustard *Sisymbrium officinale*
Occasional in H3 and N3.

Thale-cress *Arabidopsis thaliana*
Frequent in I2.

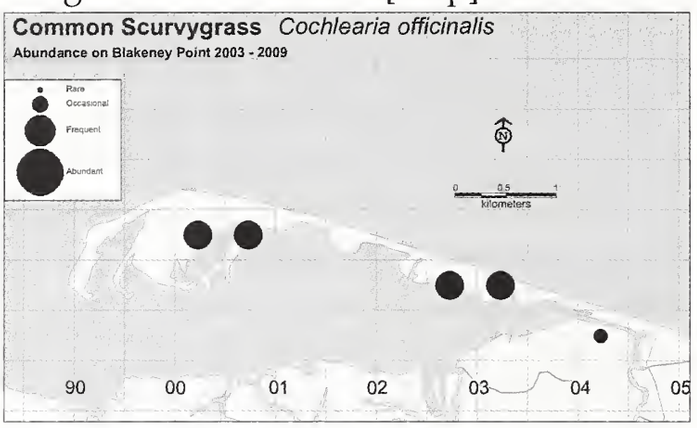
Cuckooflower *Cardamine pratensis*
Rare in dunes in J2.

Hairy Rock-cress *Arabis hirsuta*
Occasional in the stable dunes in I2.

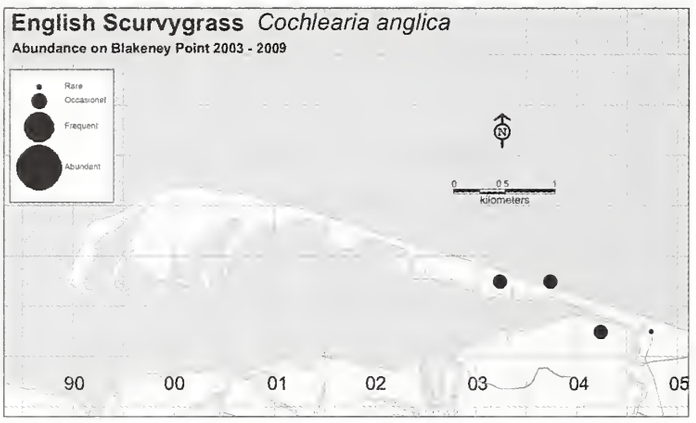
Common Whitlowgrass *Erophila verna*
Patchily distributed, mostly in the stable dunes. [map]



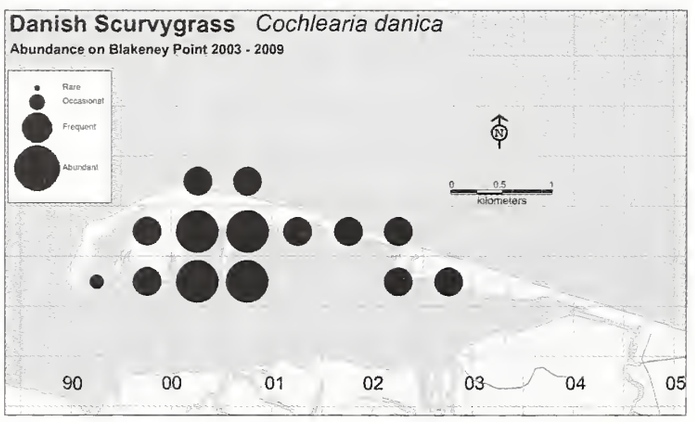
Common Scurvygrass *Cochlearia officinalis*
The second commonest scurvygrass.Like the other scurvygrasses it occurs on the edge of the saltmarsh. [map]



English Scurvygrass *Cochlearia anglica*
The rarest of the scurvygrasses, but probably overlooked. A dedicated survey of this group would almost certainly refine the distribution map. [map]



Danish Scurvygrass *Cochlearia danica*
The commonest and most widespread scurvygrass, flowering earliest in the year. [map]



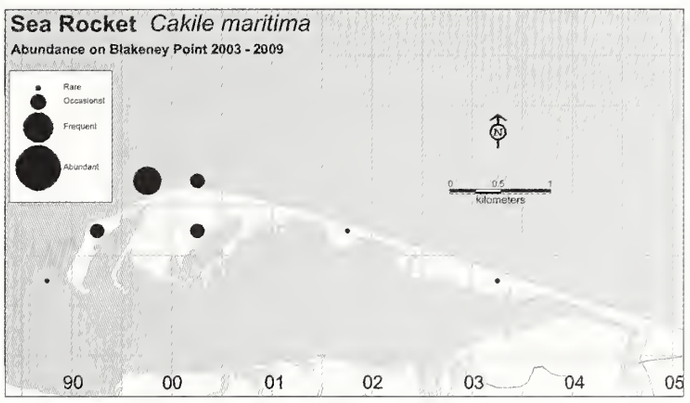
Shepherd's Purse *Capsella bursa-pastoris*
Frequent at the edge of the dunes in H3.

Swine-cress *Coronopus squamatus*
Rare (one plant) in S4 on a compacted

earth mound at the extreme eastern end of the shingle ridge.

Oil-seed Rape ***Brassica napus***
Rare (one plant) in H3 on Middle Point. This widely cultivated non-native species probably originated as a seed carried on clothing, fur or machinery, or even in a bird's gut.

Sea Rocket ***Cakile maritima***
Found mainly along the sandy, seaward strandline at the western end of the Point. [map]



Sea-kale ***Crambe maritima*** Photo p.109.
Rare in O3 on the shingle ridge, with one main clump and two minor clumps, the latter being destroyed in northerly gales and huge shingle movements in 2010.

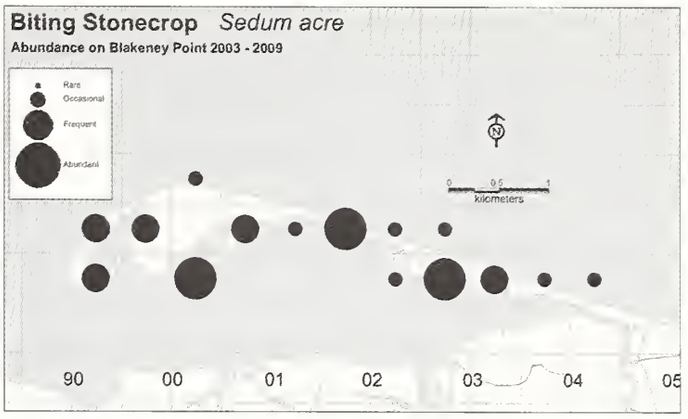
Weld ***Reseda luteola***
Occasional in compacted sandy grassland in I2.

Cyclamen ***Cyclamen*** **sp.**
One plant found in dunes in I2 in October 2011. This non-native species probably originated as a seed carried on clothing, fur or machinery, or even in a bird's gut.

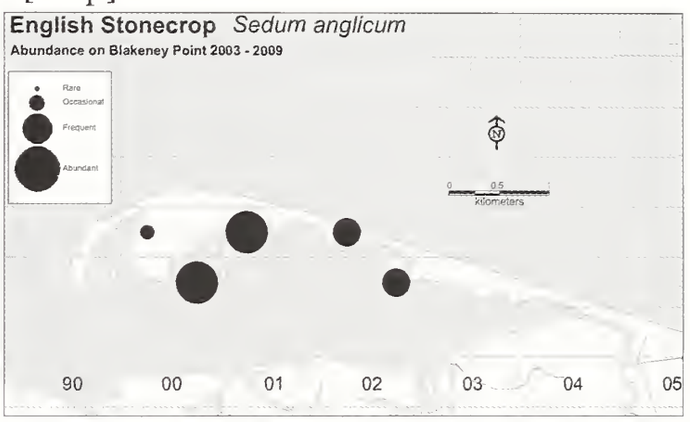
Scarlet Pimpernel ***Anagallis arvensis***
Occasional in grassland in H2 and L2, Rare in I2 and M2.

Sea-milkwort ***Glaux maritima***
Abundant in J2 and Frequent in I2, where shallow hollows are inundated during high tides.

Biting Stonecrop ***Sedum acre***
A characteristic plant of the stabilised shingle and lateral spurs where the sand has compounded. [map]

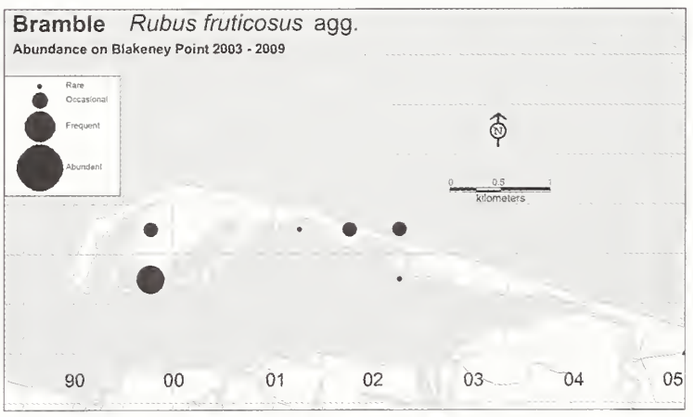


English Stonecrop ***Sedum anglicum***
Much less common than Biting Stonecrop, but found in similar habitats. [map]



Raspberry ***Rubus idaeus***
Rare in I2 on stabilised dunes. Its origin is speculative but possibly the result of bird-dispersed seed.

Bramble ***Rubus fruticosus*** **agg.**
Patchily distributed on the stabilised dunes. No attempt was made to identify the component taxa in this aggregate. For further information see Pearson *et al.* (2007). [map]



Dewbury ***Rubus caesius***
Frequent in the dunes in I2.

Silverweed ***Potentilla anserina***
Occasional in I2 and J2 (notably Glaux Low), Rare in S4.

Dog-rose *Rosa canina*

Rare in I2 and I3.

Wild Plum *Prunus domestica*

Three small plants at the Hood in M2, probably originating from stones discarded by birdwatchers or walkers.

Apple *Malus domestica*

Rare near the Plantation (one plant) in I2 and at the Hood in M2, probably from apple cores discarded by birdwatchers or walkers.

Hawthorn *Crataegus monogyna*

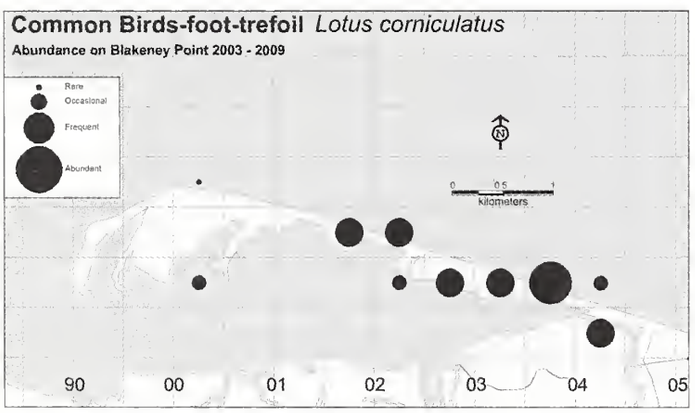
Rare in I2.

Silver Wattle *Acacia dealbata*

Rare in I2, where one plant at the side of the boardwalk running through the dunes. The origin of this non-native species is speculative but a seed may have been introduced on the boot of a walker or by birds.

Common Bird's-foot Trefoil *Lotus corniculatus*

A typical plant of the shingle ridge [map]

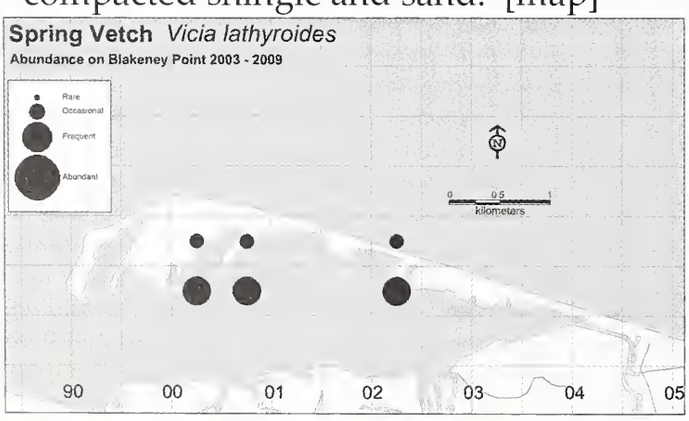


Common Vetch *Vicia sativa*

One plant in dunes in J2 (2013).

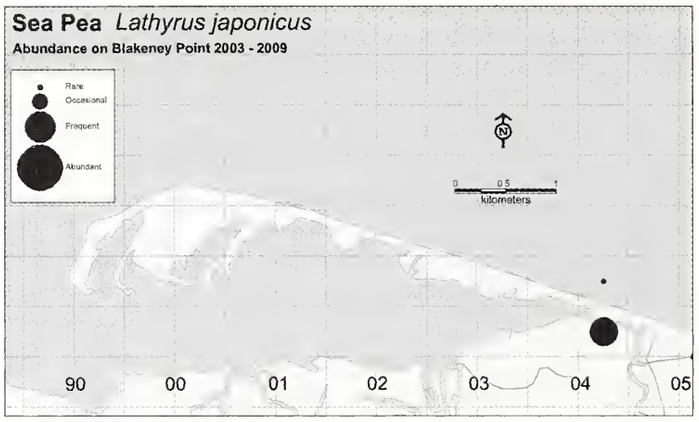
Spring Vetch *Vicia lathyroides*

Mostly found in grassy areas on compacted shingle and sand. [map]



Sea Pea *Lathyrus japonicus*

Frequent on the more compacted shingle at the eastern end of the shingle ridge where probably introduced, EA Ellis having sown seeds in this spot in 1954 (Pearson *et al.* 2007). A Nationally Scarce species (JNCC). [map]



Hop Trefoil *Trifolium campestre*

Frequent at the Hood in M2, Rare in N2 and N3.

Lesser Trefoil *Trifolium dubium*

Frequent near Watch House in N3.

Knotted Clover *Trifolium striatum*

Occasional on short grass by Watch House in N3.

Rough Clover *Trifolium scabrum*

Occasional on short grass by Watch House in N3.

Bird's-foot Clover *Trifolium ornithopodioides*

Rare on short grass by Watch House in N3.

Hare's-foot Clover *Trifolium arvense*

Occasional at the Hood in M2 and near the Watch House in N3.

Tree Lupin *Lupinus arboreus*

Occasional in I2 and I3, notably in and near Lifeboat House garden, Rare in J3. This non-native species was originally planted but no date is recorded (see Pearson *et al.* 2007).

Gorse *Ulex europaeus*

Rare in J2, where one bush in the dunes.

Great Willowherb *Epilobium hirsutum*

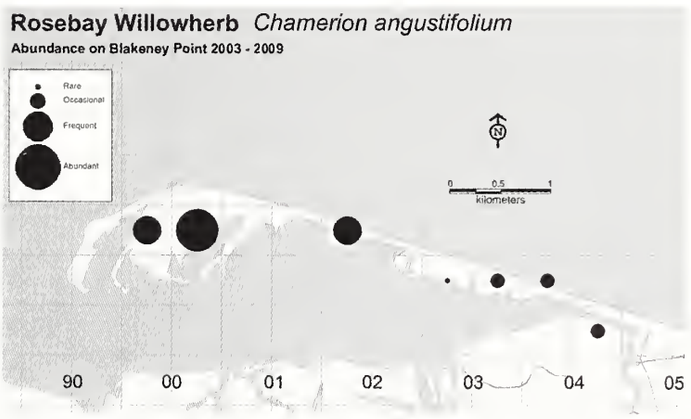
Frequent on the shingle ridge in Q3, Occasional in L2 and M2.

Hoary Willowherb *Epilobium parviflorum*
Occasional on the shingle ridge in P3 and Q3, Rare in H2.

Square-stalked Willowherb *Epilobium tetragonum*
Occasional on Middle Point in H2.

American Willowherb *Epilobium ciliatum*
Frequent on the shingle ridge in R4, Occasional at the Hood in M2, Rare in L2, N2 and Q3.

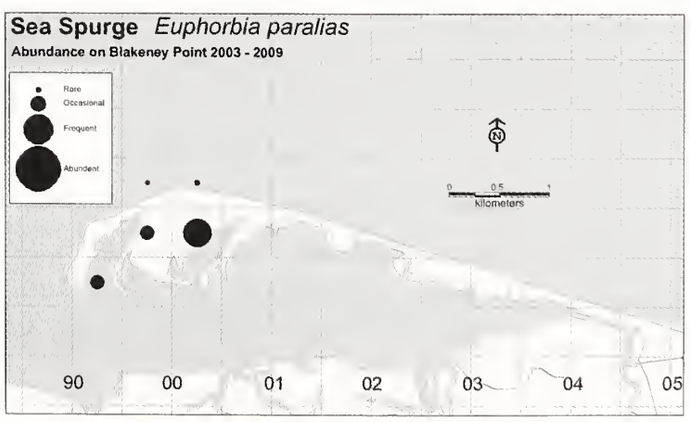
Rosebay Willowherb *Chamerion angustifolium*
A typical plant of the more established dunes, which it can form large patches. [map]



Spindle *Euonymus europaeus*
Occasional in I2, notably in the Plantation and nearby dunes. Pearson *et al.* (2007) suggest these originated from bird-sown seeds or were possibly planted.

Caper Spurge *Euphorbia lathyris*
Occasional in I2, in and near the Lifeboat House garden. Plants of this non-native invasive species were pulled up by the wardens when discovered.

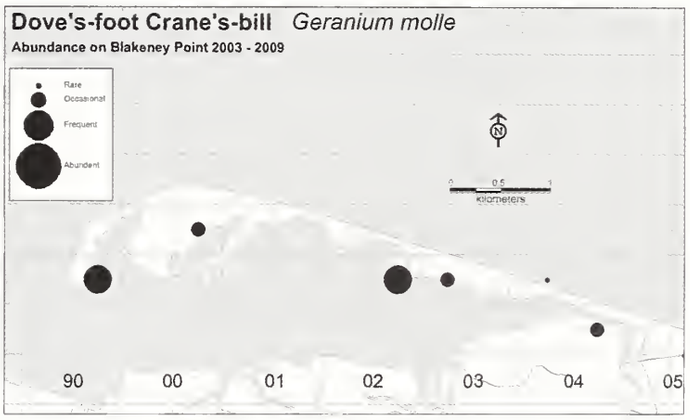
Sea Spurge *Euphorbia paralias*
Over 300 plants were counted in 2008, mostly on the edge of the dunes and especially around Great Sandy Low. It is clear from Pearson *et al.* (2007) that this plant, first recorded in 1959, is rapidly increasing. [map]



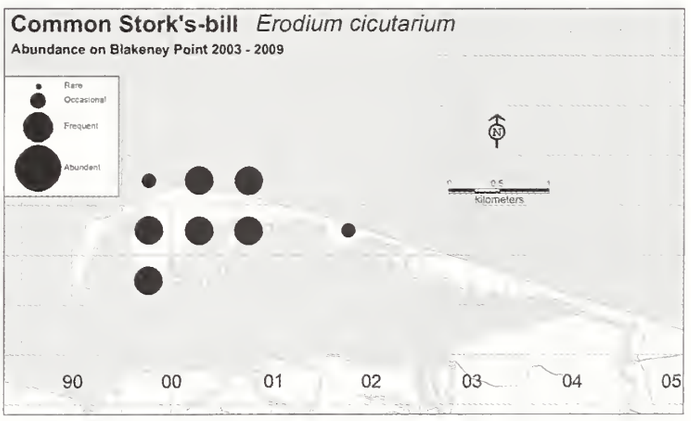
Sycamore *Acer pseudoplatanus*
Rare; one large tree and three small trees in the Plantation (I3). Planted in 1916/1917 (Pearson *et al.* 2007).

Cut-leaved Cranesbill *Geranium dissectum*
Six plants in S4 (2013).

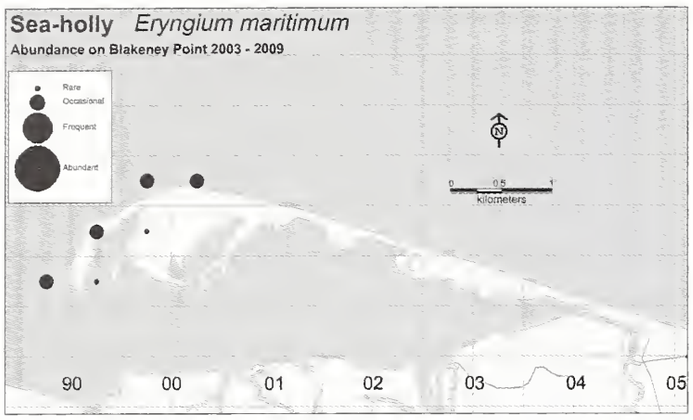
Dove's-foot Crane's-bill *Geranium molle*
Sparsely distributed on grassy areas and stabilised sand. [map]



Common Stork's-bill *Erodium cicutarium*
A common and unobtrusive plant of the stabilised, grassy dunes. [map]



Sea-holly *Eryngium maritimum*
Only found on the westernmost dunes, often amongst Marram. [map p.122]



Cow Parsley *Anthriscus sylvestris*
One plant in I2 (2013).

Bur Chervil *Anthriscus caucalis*
Abundant at the Hood in M2 and near the Watch House in N3, Frequent in I3 and Occasional in I2.

Alexanders *Smyrnium olusatrum*
Rare in S4 at eastern end of the shingle ridge.

Hogweed *Heracleum sphondylium*
Rare in H2 and K2.

Wild Carrot *Daucus carota*
One plant found in Q3 on the shingle ridge in 2012.

Black Nightshade *Solanum nigrum*
Rare in J2.

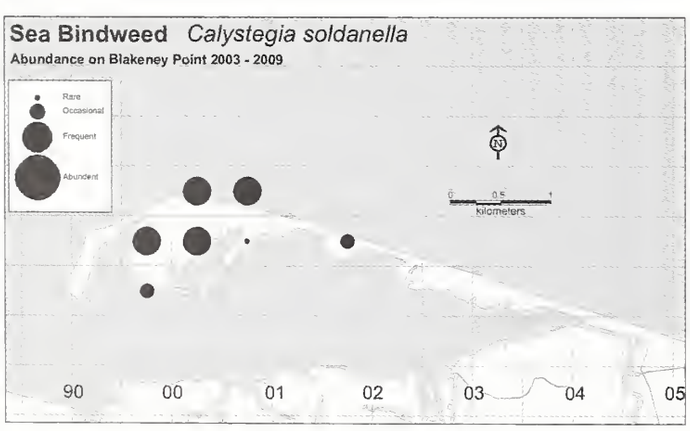
Bittersweet *Solanum dulcamara*
Occasional in I2, Rare in I3.

Potato *Solanum tuberosum*
Rare in M2 where one plant found on the Hood. Its origin is speculative!

Field Bindweed *Convolvulus arvensis*
Occasional in J2, Rare in I2.

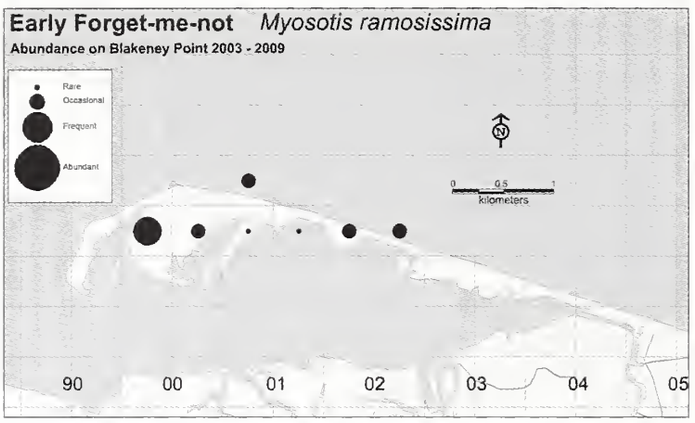
Hedge Bindweed *Calystegia sepium*
Occasional in J2.

Sea Bindweed *Calystegia soldanella*
A characteristic plant of the dunes. [map]



Bugloss *Anchusa arvensis*
Occasional in I3, in the Lifeboat House garden.

Early Forget-me-not *Myosotis ramosissima*
Scattered, mostly on grassy areas. [map]



Hound's-tongue *Cynoglossum officinale*
Frequent in I2 and I3, Occasional in I1. Near Threatened in Great Britain (Cheffings & Farrell 2005).

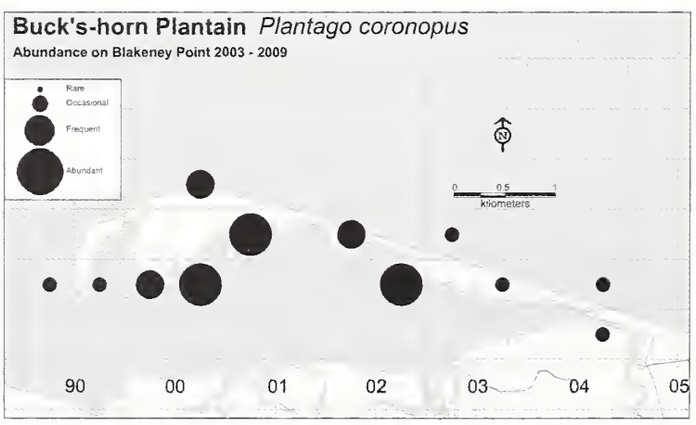
Marsh Woundwort *Stachys palustris*
Rare on the Hood in M2.

Black Horehound *Ballota nigra*
Rare in H3 and S4

Red Dead-nettle *Lamium purpureum*
Occasional in I2 and I3.

Ground Ivy *Glechoma hederacea*
Frequent in K3, forming a large patch on a grassy stretch of Yankee Ridge.

Buck's-horn Plantain *Plantago coronopus*
The commonest plantain, especially on flat, impacted sand. [map]



Sea Plantain *Plantago maritima*
Frequent in K2, Rare in J2.

Greater Plantain *Plantago major*
Occasional on compacted shingle in S4.

Ribwort Plantain *Plantago lanceolata*
Frequent in N3, Rare in S4.

Wild Privet *Ligustrum vulgare*
Rare in I2 in the Lifeboat House garden, where presumably planted.

Foxglove *Digitalis purpurea*
Rare in I3 in the Lifeboat House garden, Occasional (one clump) in dunes in J2.

Heath Speedwell *Veronica officinalis*
Occasional on the Hood in M2.

Wall Speedwell *Veronica arvensis*
Occasional in N3.

Common Field-speedwell *Veronica persica*
Rare in dunes on Middle Point in H3.

Red Bartsia *Odontites vernus*
Rare in dunes on Middle Point in H3.

Yellow-rattle *Rhinanthus minor*
Occasional in grassy dune hollows in K2.

Sheep's-bit *Jasione montana*
Rare in grassy dune hollows in J2 and K2; has increased considerably since 2009 and Occasional in both squares in 2013.

Lady's Bedstraw *Galium verum*
Found mainly in grassy areas on compacted sandy-shingle. Frequent on the Hood in M2, Occasional in the dunes in I2, Rare near the Watch House in N2.

Common Cleavers *Galium aparine*
Occasional in I2 and N3, Rare in J3, O3, Q3 and R4.

Elder *Sambucus nigra*
A scattered distribution in the stable dunes. Occasional in I2 and I3, Rare in K2 and L2.

Honeysuckle *Lonicera periclymenum*
Rare in I2 where one plant in the Plantation, presumably originating from a bird-sown seed.

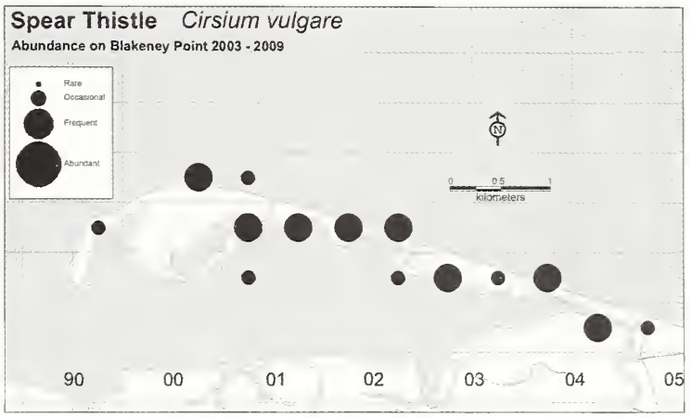
Common Cornsalad *Valerianella locusta*
Occasional in N3, where a small patch in grasses near the Watch House.

Red Valerian *Centranthus ruber*
Rare in the dunes on Middle Point in H3.

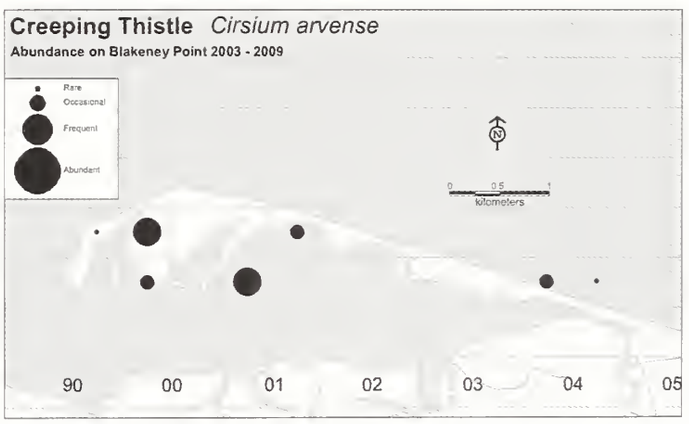
Lesser Burdock *Arctium minus*
Rare on compacted shingle in S4.

Musk Thistle *Carduus nutans*
Rare on compacted shingle in R4.

Spear Thistle *Cirsium vulgare*
The commonest thistle on the Point, especially on the shingle ridge. [map]

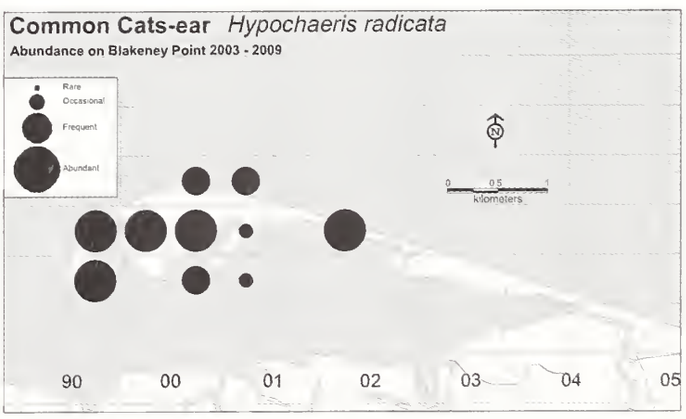


Creeping Thistle *Cirsium arvense*
Rather casually and unpredictably distributed. [map]

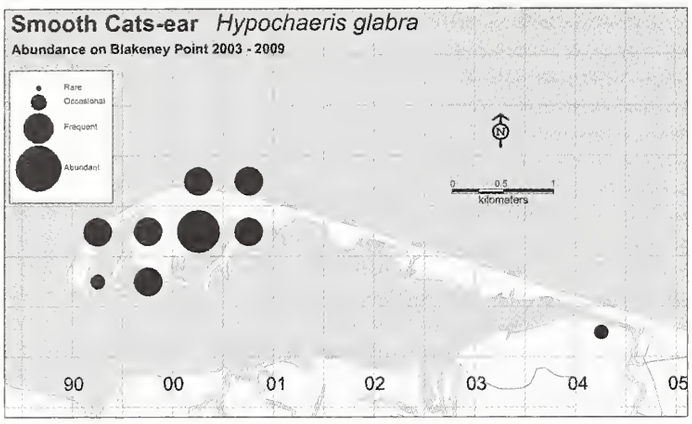


Marsh Thistle *Cirsium palustre*
Rare in a dune hollow in I2, where three plants found.

Common Cat's-ear *Hypochaeris radicata*
One of the typical plants of the stabilised dunes and vegetated dunes, forming swathes of yellow in summer. [map]



Smooth Cat's-ear *Hypochaeris glabra*
Common, but easily overlooked amongst the Common Cat's-ear, especially as it only opens in the sun. Vulnerable in Great Britain (Cheffings & Farrell 2005). [map]



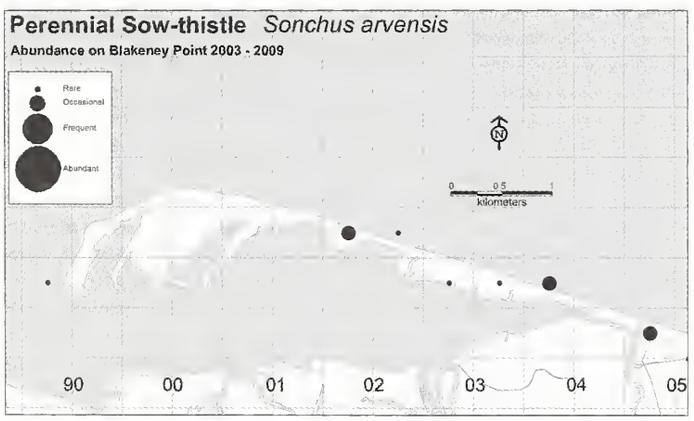
Autumn Hawkbit *Leontodon autumnalis*
Rare in R4.

Lesser Hawkbit *Leontodon saxatilis*
Rare in the grassy, stable dunes in I2, J2, Q3 and R4.

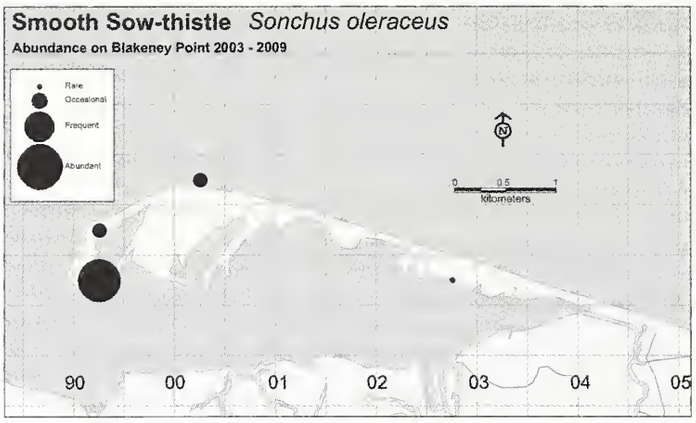
Bristly Oxtongue *Picris echioides*
Rare on shingle in L2.

Goatsbeard *Tragopogon pratensis*
Occasional in the dunes in I2.

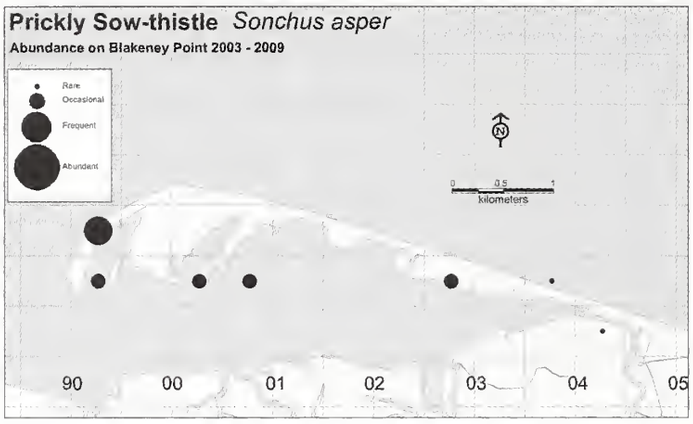
Perennial Sow-thistle *Sonchus arvensis*
Scattered on the more compacted areas of the shingle ridge. [map]



Smooth Sow-thistle *Sonchus oleraceus*
Has a more clumped distribution than the other sow-thistles. [map]



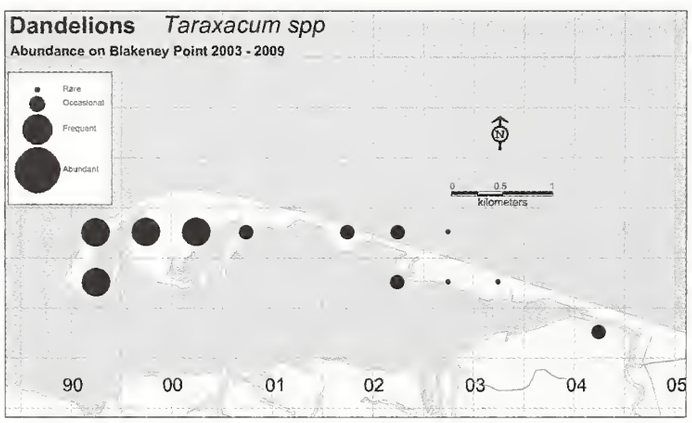
Prickly Sow-thistle *Sonchus asper*
Patchily distributed, but absent from the main dunes. [map]



Great Lettuce *Lactuca virosa*
Found mainly in the stable dunes. Frequent in J2, Occasional in I2 and Rare in K3. Increased noticeably during the years of the atlas.

Dandelions *Taraxacum* **spp.**
No attempt was made to identify any of the component taxa in this difficult genus. [map]

For fuller details see Pearson *et al.* (2007).



Rough Hawksbeard *Crepis biennis*
The rarest of the hawksbeards. Occasional in Q3, Rare in O3.

Smooth Hawksbeard *Crepis capillaris*
Abundant in grassy areas in I2, Frequent

in K2, Occasional in J2, N2 and R4, Rare in M2, P3 and S4.

Beaked Hawksbeard *Crepis vesicaria*
Abundant on Middle Point in H3, Occasional in H2 and N2, Rare in M2.

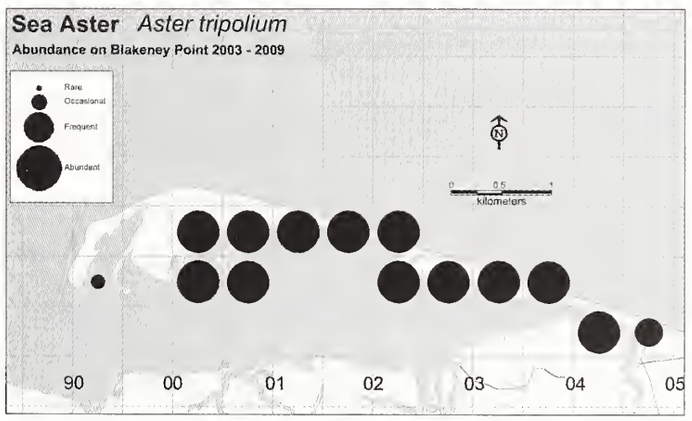
Mouse-ear-hawkweed *Pilosella officinarum*
Occasional in I2, Rare in J2 and K2.

Fox-and-cubs *Pilosella aurantiaca*
A single plant in the dunes in J2 in 2012.

Common Cudweed *Filago vulgaris*
Mainly found in the compacted sandy-shingles. Frequent in H2, Occasional in J1 and J3, Rare in H3 and R4. Near Threatened in Great Britain (Cheffings & Farrell 2005).

Small Cudweed *Filago minima*
Rare in the stable dunes in J1.

Sea Aster *Aster tripolium*
One of the characteristic plants of the saltmarsh. [map]

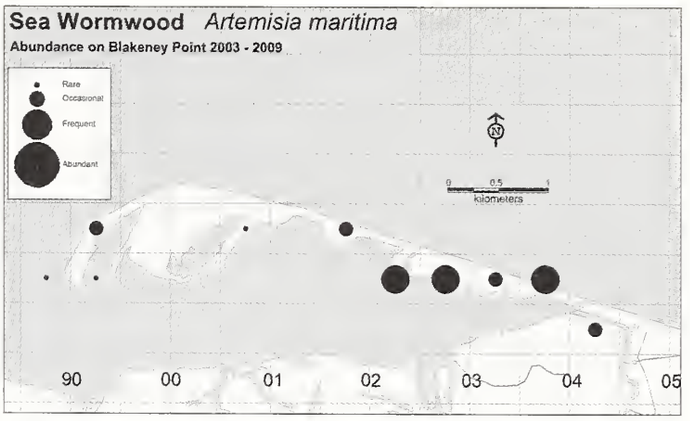


Blue Fleabane *Erigeron acer*
Occasional in dunes in H2 and J2.

Canadian Fleabane *Conyza canadensis*
Frequent in the compacted dunes in H2 and I1, Rare in same habitat in K2 and R4.

Daisy *Bellis perennis*
Occasional in grassland in N3 and R4, Rare in H3.

Sea Wormwood *Seriphidium maritimum*
A patch forming plant found mainly on areas of compacted sandy-shingle on the shingle ridge. [map]

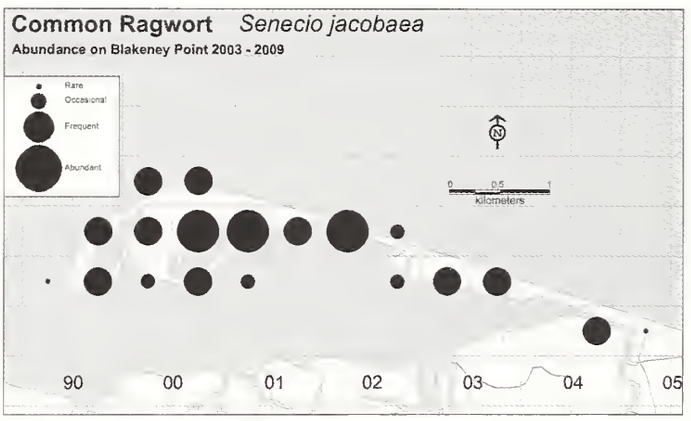


Mugwort *Artemisia vulgaris*
Rare in I3.

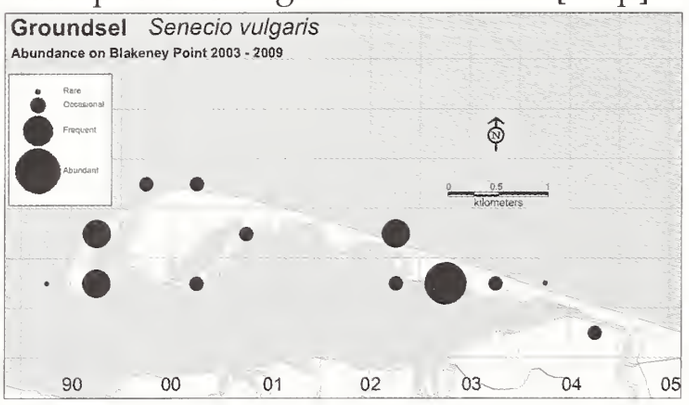
Yarrow *Achillea millefolium*
Rare in L2.

Sea Mayweed *Tripleurospermum maritimum*
Occasional in P3 and Q3 on the shingle ridge; Rare in O3 and G3 (on Far Point).

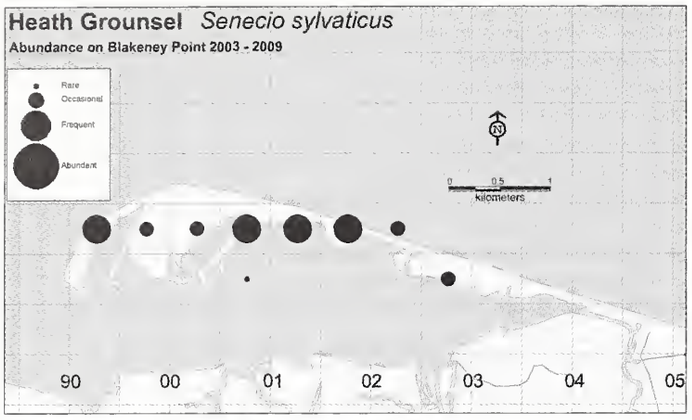
Common Ragwort *Senecio jacobaea*
A characteristic plant of both the shingle ridge and the dunes. [map]



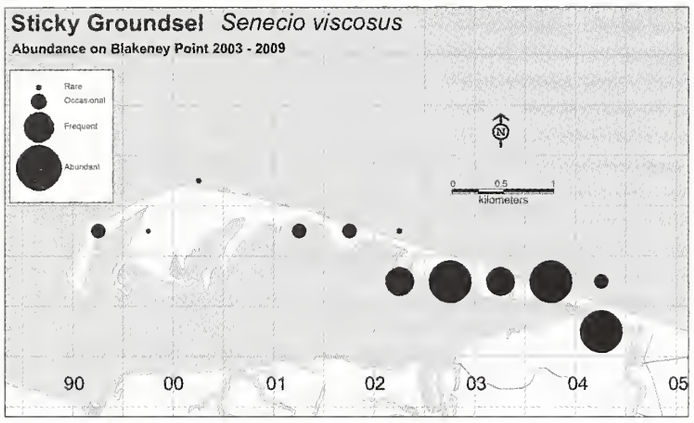
Groundsel *Senecio vulgaris*
A scattered distribution on both compacted shingle and in dunes. [map]



Heath Grounsel *Senecio sylvaticus*
An easily overlooked plant with a scattered distribution, mostly on compacted sand in the dunes, amongst grasses. [map p.126]



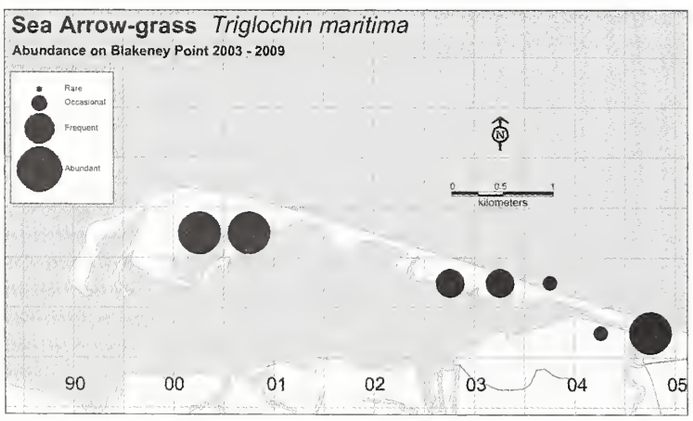
Sticky Groundsel *Senecio viscosus*
One of the characteristic plants of the shingle ridge. [map]



Colt's-foot *Tussilago farfara*
Occasional on compacted shingle in R4, Rare in dunes in H2.

Sunflower *Helianthus annuus*
Rare in J1, where one plant found along the strandline. This widely cultivated non-native species presumably resulted from a seed carried on clothing, fur or machinery, or even in a bird's gut.

Sea Arrow-grass *Triglochin maritima*
Found in varying degrees of abundance on the fringes of the saltmarsh. [map]



Eelgrasses – Zosteraceae
Three species of this mud-growing family were identified but only the distribution of *Zostera angustifolia* was cursorily determined (below). For details of *Zostera marina* (Eelgrass) and *Zostera noltii* (Dwarf Eelgrass) see Pearson *et al.* (2007). *Zostera marina* is Near Threatened and *Zostera noltii* Vulnerable and Nationally Scarce in Great Britain (Cheffings & Farrell 2005, JNCC).

Narrow-leaved Eelgrass ***Zostera angustifolia***
Frequent in I2, Occasional in H2, on mudflats inundated at high tide.

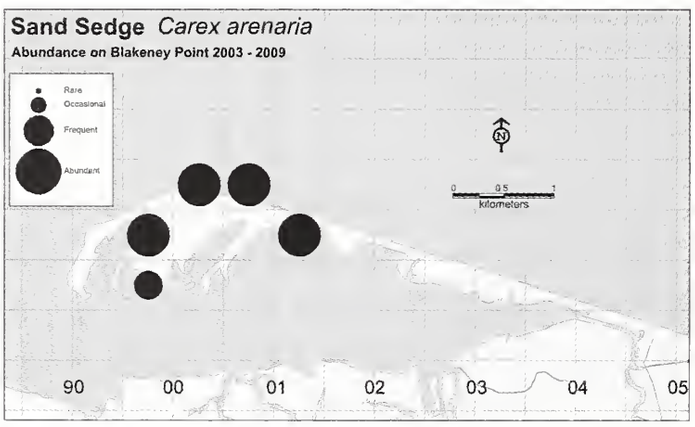
Saltmarsh Rush *Juncus gerardii*
Frequent in J2, in the low areas occasionally inundated on the highest tides, notably Glaux Low.

Toad Rush *Juncus bufonius*
Occasional/Frequent in I2 and J2, in the low areas occasionally inundated on the highest tides.

Sea Rush *Juncus maritimus*
Found in J2 (Glaux Low) and M2 (the Hood), but abundance not recorded.

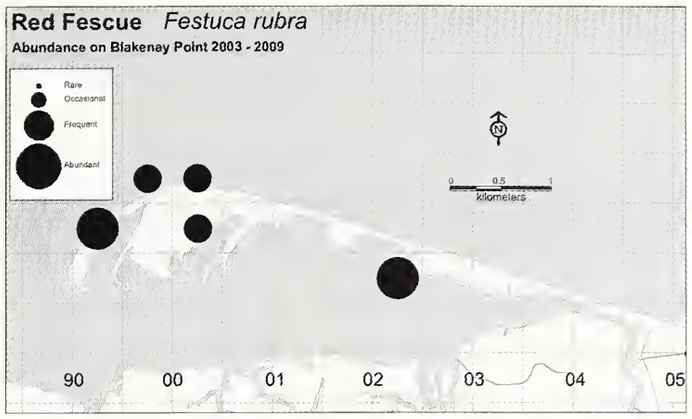
Field Woodrush *Luzula campestris*
Abundant in M2 on the Hood.

Sand Sedge *Carex arenaria*
Abundant in the stabilised dunes. [map]



Greater Pond Sedge *Carex riparia*
Occasional in I3 in stabilised dunes in Lifeboat House garden.

Red Fescue *Festuca rubra*
No attempt was made to differentiate between this taxon and Rush-leaved Fescue *F.* (*rubra*) *arenaria* - a plant of the dunes. For discussion see Pearson *et al.* (2007). [map p.127]

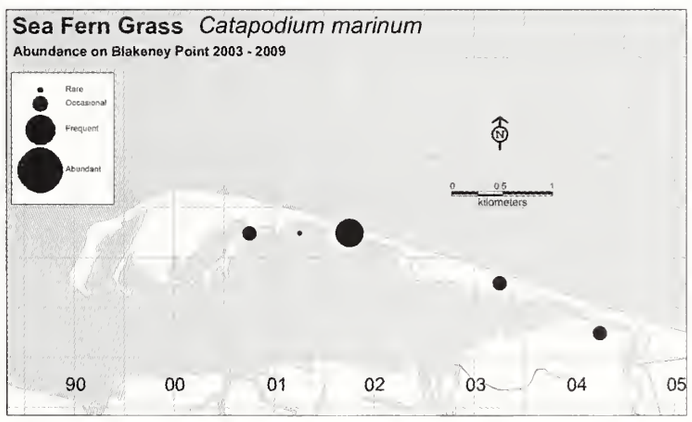


Common Saltmarsh-grass *Puccinellia maritima*
Found on the edge of the saltmarsh in varying degrees of abundance, but its distribution was not mapped.

Annual Meadow Grass *Poa annua*
Occasional in N3, Rare in G3.

Spreading Meadow-grass *Poa humilis*
Recorded on the dunes, but distribution not mapped.

Sea Fern-grass *Catapodium marinum*
Sparsely distributed on the more compacted sandy-gravels of the shingle ridge. [map]



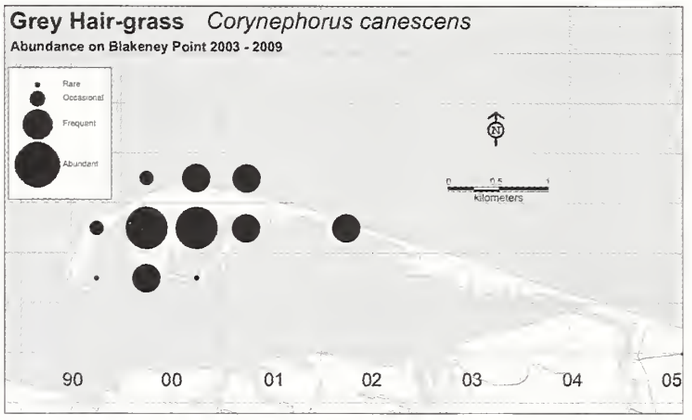
Curved Hard-grass *Parapholis incurva*
Found in J2 and K2, but abundance not recorded. A Nationally Scarce species (JNCC).

False Oat-grass *Arrhenatherum elatius*
Occasional in O3.

Wild-oat *Avena fatua*
Rare in H3, presumably originating from a seed carried on clothing, fur or machinery, or even in a bird's gut.

Yorkshire-fog *Holcus lanatus*
Frequent in M2, Occasional in R4.

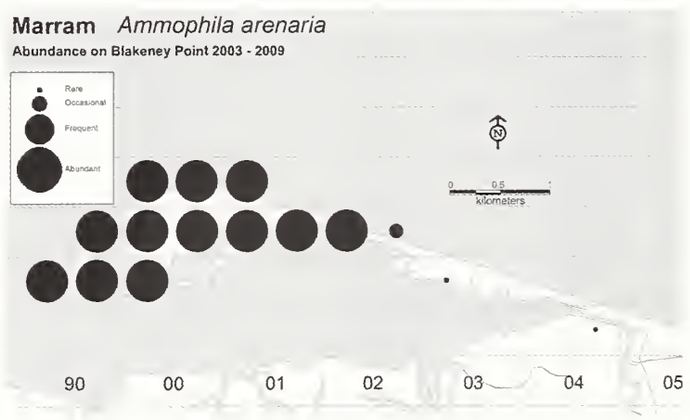
Grey Hair-grass *Corynephorus canescens*
Widespread on the compacted dunes, and after Marram, the commonest grass. A Nationally Rare and Near Threatened species in Great Britain (Cheffings & Farrell 2005, JNCC). Blakeney Point is one of its strongholds. [map]



Early Hair-grass *Aira praecox*
Found on the stabilised dunes and lateral spits, but distribution and abundance not mapped.

Creeping Bent *Agrostis stolonifera*
Found commonly in J2, K2 and M2, but distribution and abundance not mapped.

Marram *Ammophila arenaria*
The dominant plant of the dunes. [map]

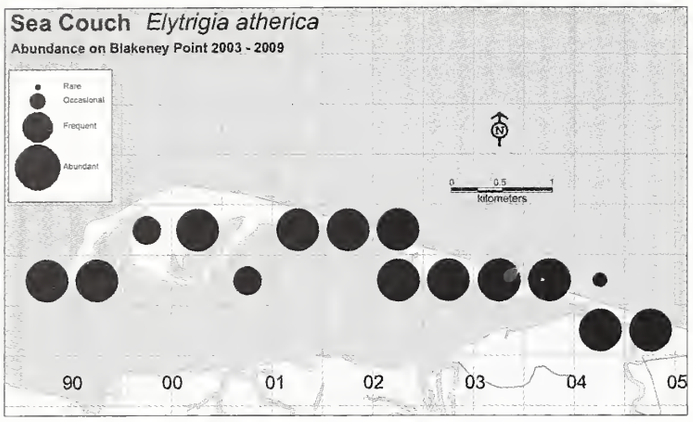


Sand Cat's-tail *Phleum arenarium*
Occasional in H2, I3, J1 and J2.

Soft Brome *Bromus hordeaceus*
Frequent at the Watch House in N3.

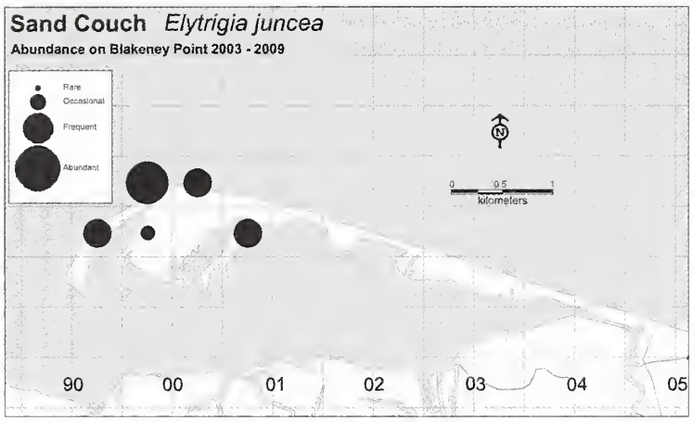
Common Couch-grass *Elytrigia repens*
Rare in S4.

Sea Couch *Elytrigia atherica*
One of the commonest grasses on Blakeney Point. [map p.128]



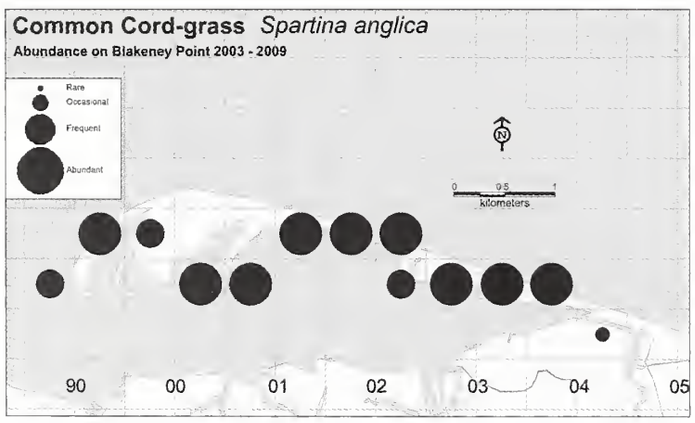
Sand Couch *Elytrigia juncea*

Far less common than Sea Couch and found mainly on the dunes. [map]



Lyme-grass *Leymus arenarius*

Rare or occasional on the shingle ridge and compacted sandy-shingle. [map]

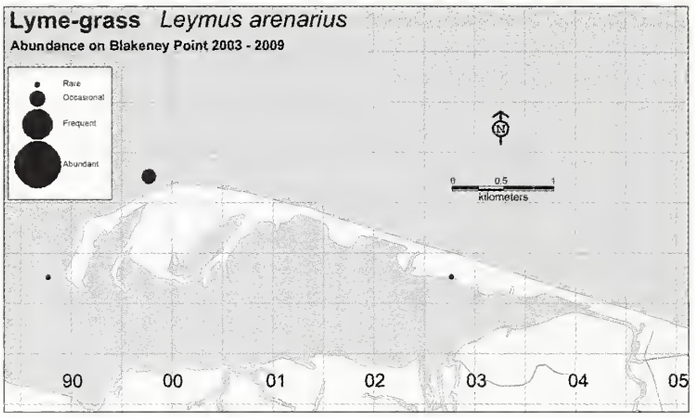


Common Reed *Phragmites australis*

Abundant in S4, Frequent in R4 and Rare in Q3.

Common Cord-grass *Spartina anglica*

A widespread component of the saltmarsh and often co-dominant with Sea Purslane. Seeds of this highly invasive hybrid species were introduced to the mudflats in 1925 - see Pearson *et al.* (2007) for a full account. [map]



Bluebell *Hyacinthoides non-scripta*

Occasional in L2, where small colony of up to 80 plants in the dunes.

Daffodil *Narcissus pseudonarcissus*

Occasional in I2, where small clump near the Old Laboratory, the bulbs were originally planted (Pearson *et al.* 2007).

Asparagus *Asparagus officinalis*

Occasional in I2 and I3. Planted in the Plantation and Lifeboat House garden, probably around 1957 (Pearson *et al.* 2007).

Yucca *Yucca gloriosa*

Occasional in the dunes in I2. Photo p.109.

NB. Pearson *et al.* (2007), who cite planting in 1912, recorded this as *Y. recurvifolia*, which is now treated as a variety of *gloriosa*.

Marsh Helleborine *Epipactis palustris*

Rare in dunes on Middle Point, in H3, where one plant found in 2008.

Pyramidal Orchid *Anacamptis pyramidalis*

Rare in the dunes in I2, where up to five plants recorded in several years.

Southern Marsh-orchid *Dactylorhiza praetermissa*

Rare in dunes in I2, where two plants found in 2009.

Common Spotted-orchid *Dactylorhiza fuchsii*

Rare in the dunes in J2, where two plants found in separate localities (one in 2007 and one in 2012).

Acknowledgements

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Thanks go to Dick Newell for helpful discussions on methodology, Ajay Tegala for adapting my plant data spreadsheet into a form compatible with that of the National Trust's recording system, Ant Maddock of the Joint Nature Conservation Committee for advice on Plant Red Lists and Victoria Francis who gave me so much encouragement to first put the atlas on the NT website.

I would especially like to thank Bob Ellis, the BSBI recorder for East Norfolk, and Simon Harrap for invaluable comments on the draft of this paper and help with identification of difficult species.

Finally, and most importantly, I must thank Branwell Govier, the NT's Conservation Data Officer, who patiently prepared the distribution maps.

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APPENDIX 1. Plant species not recorded during this 1999 – 2013 survey but listed in Pearson *et al.* (2007), which see for full details.

The year of the last observation, when known, is given in parentheses. Note that over half have not been recorded for at least 40 years.

Adder's Tongue *Ophioglossum vulgatum* (1971)
Black Spleenwort *Asplenium adiantum-nigrum* (1970)
Lady-fern *Athyrium felix-femina*
Creeping Buttercup *Ranunculus repens*
Salicornia obscura
Salicornia procumbens
Salicornia nitens
Salicornia fragilis
Little Mouse-ear *Cerastium semidecandrum*
Knotted Pearlwort *Sagina nodosa* (no recent records)
Annual Pearlwort *Sagina apetala* (no recent records)
White Campion *Silene latifolia* (*c.* 100 years ago)
Black Bindweed *Fallopia convolvulus* (2004)
Common Sorrel *Rumex acetosa* (*c.* 100 years ago)
Tree Mallow *Lavatera arborea* (2003)
Eastern Balsam Poplar *Populus balsamifera* (no recent records)
Flixweed *Descurainia sophia* (1960)
Horse-radish *Armoracia rusticana*
Meadowsweet *Filipendula ulmaria* (1959)
Bramble sp. *Rubus ulmifolius* (1986)
Bramble sp. *Rubus arenarius* (1980)
Parsley-piert *Aphanes arvensis* (1956)
Burnet Rose *Rosa pimpinellifolia*
Japanese Rose *Rosa rugosa* (2002 – removed by wardens)
Kidney Vetch *Anthyllis vulneraria* (2004)
White Clover *Trifolium repens* (2004)
Sea Buckthorn *Hippophae rhamnoides* (1959)
Broad-leaved Willowherb *Epilobium montanum* (2004)
Annual Mercury *Mercurialis annua* (1934)

Tomato *Lycopersicon esculentum* (2004)
Viper's-bugloss *Echium vulgare* (1959)
Oysterplant *Mertensia maritima* (1921)
Changing Forget-me-not *Myosotis discolor* (*c.* 1913)
Skull-cap *Scutellaria galericulata* (1965)
Gipsy-wort *Lycopus europaeus* (1956)
Field Madder *Sherardia arvensis*
Heath Bedstraw *Galium saxatile* (1964)
Teasel *Dipsacus fullonum* (1966)
Rough Hawkbit *Leontodon hispidus* (1956)
Filago arvensis (1969)
Common Fleabane *Pulicaria dysenterica* (1985)
Jointed Rush *Juncus articulatus* (1964)
Hairy Woodrush *Luzula pilosa* (1958)
False Fox-sedge *Carex otrube* (1956)
Distant Sedge *Carex distans* (1959)
Long-bracted Sedge *Carex extensa* (1984)
Yellow Sedge *Carex viridula* (1966)
Sheep's Fescue *Festuca ovina* (1966)
Perennial Rye-grass *Lolium perenne* (1958)
Squirreltail Fescue *Vulpia bromoides* (1956)
Crested Dog's-tail *Cynosurus cristatus* (1958)
Smooth Meadow-grass *Poa pratensis*
Cock's-foot *Dactylis glomerata* (1959)
Fern-grass *Catapodium rigidum*
Hard-grass *Parapholis strigosa*
Yellow Oat-grass *Trisetum flavescens* (1958)
Crested Hair-grass *Koeleria cristata* (2004)
Creeping Soft-grass *Holcus mollis* (2002)
Sweet Vernal-grass *Anthoxanthum odoratum* (1958)
Common Bent *Agrostis capillaries* (1962)
Barren Brome *Anisantha sterilis* (1958)
Bearded Couch *Elymus caninus* (1959)
Wall Barley *Hordeum murinum*
Small Cord-grass *Spartina maritima* (*c.*100 years ago)
Red-hot Poker *Kniphofia* sp. (cultivar) (2000)
Yellow Iris *Iris pseudacorus* (1955)

A hundred years of bryophytes at Blakeney Point

Mary Ghullam

Introduction

It is a hundred years since the National Trust acquired Blakeney Point, but even before its acquisition its ecology and geomorphology had been much studied (Oliver & Salisbury 1913), and this continues today. As well as the ongoing studies of the University College of London, the Point's habitats and plant communities have been used as a basis for Tansley's vegetation classifications (Tansley 1939), Salisbury's work on dunes (Salisbury 1952), JNCC reports on both sand dunes and shingle in the 1990s (Doarks *et al.* 1990; Sneddon *et al.* 1994), Rodwell's fifth volume on British plant communities(the national vegetation classification (NVC), Rodwell *et al.* 2000), and most recently the New Naturalist volume, *Vegetation of Britain and Ireland* (Proctor 2013).

Initially cryptogams did not figure largely in the accounts (Oliver & Salisbury 1913). However, possibly spurred on by Watson's account of bryophytes and lichens of calcareous soils, based on the west coast of Britain (Watson 1918) and Watson's recording at Blakeney (Oliver 1929), P.W. Richards undertook a similar survey in 1927 (Richards 1929). His findings underpin the bryophyte element of subsequent discussionsof Blakeney Point's ecology until at least the 1990s. Indeed,his article is cited as a reference in the New Naturalist's *Mosses & Liverworts* (Porley&Hodgetts 2005).

The initial impetus for the current research and article came from an invitation from the National Trust for Norfolk naturalists to mark the centenary of the Trust's acquisition by recording on the Point. Further impetus to record the bryophytes in particular came when an unusual moss was discovered on the Marrams in VC27[1], and two days were spent by R.W. Ellis and M. Ghullam in October and December 2012 on the Point recording bryophytes, initially to the Hood in VC27 and then from the Lifeboat House eastwards in VC28. A third visit was made in September 2013 when the absence of pupping Grey Seals and nesting terns enabled access to areas west of the Lifeboat House. Unfortunately the area of Long Hills (other than its most northerly tip) was not recorded. Richards, by contrast, spent a whole fortnight surveying the bryophytes on Blakeney Point and he was well aware even this was not enough time (Richards 1929). His article provides a detailed account of the cryptogamic vegetation of the dunes, including their different stages of succession; the shingle banks and the lows (see note 3 below). This article will review the bryophytes recorded on the Point over the last hundred years, updating the list in the light of more recent records and the recent survey, and then focus on one moss in particular.

The liverworts of Blakeney Point

In all five species of liverwort and thirty eight species of moss[2] have been recorded on the Point to date (see Appendix 1). Liverworts are rare on Blakeney Point[3].

1 For recording purposes the Point is divided into two Watsonian vice counties: VC27 East Norfolk and VC28 West Norfolk. The dividing line lies just west of the Hood.

2 Nomenclature follows Hill *et al.*2008 unless otherwise stated or when quoting. As a result, the number of *Bryum* species in particular has been reduced, owing to changes in taxonomy.

3 The lows at Blakeney, founded on permeable shingle (unlike dune slacks elsewhere), are not permanently moist and can be flooded by very

Only two were recorded by Richards, mainly at the Hood (Richards 1929). He suggested the reason for this was that the Hood, being the oldest of the dunes, had moister soils than elsewhere. In the current survey one of these liverworts, Common Threadwort *Cephaloziella divaricata*, was also found at the Hood, on the eroding, over-hanging edge of the dune, among the roots of vegetation. This seems to be the type of habitat that is moist enough for liverworts to survive, especially if the edge is north facing or shaded by overhanging vegetation. Indeed, *C. divaricata* was found by Richards in another similar habitat - growing round the roots/in the shelter of *Psamma* (Marram *Ammophila arenaria*)[4]. Three species of Crestwort have also been found the 21st century, not, however, at the Hood, but in VC28. Bifid Crestwort *Lophocolea bidentata*, (the only other liverwort recorded by Richards) was present mixed in with *C. divaricata*, while Variable-leaved Crestwort *Lophocolea heterophylla* was on litter in shaded Polypody tussocks (Stevenson 2001). Possibly the most interesting Crestwort recorded was Southern Crestwort *Lophocolea semiteres* (see photo p.). This alien species from the Southern Hemisphere was unknown in Britain before 1955. Several small patches were found at the northern tip of Long Hills, growing in a grassy area with Sand Sedge *Carex arenaria*. It has been found in Norfolk on other dunes at Holkham and North Denes, Great Yarmouth, and growing on maritime shingle in Suffolk (Sanford & Fisk 2010). The most surprising of the liverworts is Dilated Scalewort *Frullania dilatata*. This relatively common epiphytic liverwort was found growing not on trees but on a north-facing dune slope amongst Marram, with *L. bidentata* and *C. divaricata* growing nearby (P.W.Lambley pers. comm.). Known to be slightly salt-tolerant, it is found rarely on saline soils or in coastal habitats (Hill *et al.* 2007) and does not seem to have been recorded in Norfolk or Suffolk (R. Fisk pers. comm.) in this type of habitat, prior to this record.

high tides. This means that the typical dune slack liverwort flora is absent from the Point.

4 Names used here follow modern nomenclature of Stace 2010, unless obviously quoting.

The mosses of Blakeney Point

The core mosses of the Point have changed very little in the hundred years since Watson (in Oliver 1929) and Richards were recording, as might be expected. All the species listed by Richards in his table, showing the general course of bryophyte succession on the dunes, have been seen this century, with the exception of Big Shaggy-moss *Rhytidiadelphus triquetrus* (Richards 1929).

The dunes

As Richards found, the fore-dunes facing the sea, and the youngest areas of the Point to the far west, have no bryophytes. It is not until one reaches the landward side of the fore-dunes, the yellow dunes and some younger ridges between areas of saltmarsh, that mosses are found. Those that Richards cited as pioneer species (Redshank *Ceratodon purpureus*, Capillary Thread-moss *Bryum capillare*[5], Sand-hill Screw-moss *Syntrichia ruralis* var. *ruraliformis* (see photograph p.104). and Whitish Feather-moss *Brachythecium albicans)* were all present in the recent survey. All have the ability to cope with being buried in sand. Richards studied in detail how the classic sand dune moss *S. ruralis* var. *ruraliformis* behaved and managed to spread across the dunes on Blakeney Point. Of particular interest was its ability to form new colonies from detached plants by putting up lateral branches along a supine main stem. On the underside, as this stem rotted away, rhizoids formed, making each branch into a new plant.The important role of such mosses in ensuring dune stability and

5 Richards himself only considered that the-*Bryum* might be *B. capillare*, as none was found actually fruiting in 1927.

allowing fixed dunes to begin to develop is often not fully appreciated (White 1989).

On these mobile, or early, dunes there are large areas of *Bryum* species, virtually none fruiting. Most of these appeared to be *B. capillare*, but a number of other *Bryum* species were recorded by Watson and Richards that were not found in the present survey. It is impossible, however, to identify a number of *Bryums* without good fruiting material. Watson found this a problem, making educated guesses on the identification of some (Oliver 1929)[6]. Drooping Thread-moss *Bryum algovicum* var. *rutheanum*, a classic early colonizer, and Archangelic Thread-moss *Bryum archangelicum* were, however, recorded (Richards 1929, Oliver 1929) and later seen by Swann in 1955 (Swann 1982). It is probable, given careful searching for capsules at the right time of the year, that these two species are still present.

As the dunes become fixed and grey with lichens, larger and more pleurocarpous species of moss are encountered. All the most common species recorded by Watson and Richards occurred in the recent surveys, although a number of their scarcer species were not recorded. Very few new species were recorded in 2012 and 2013 in either the semi-fixed or grey fixed dunes. As the dunes become less mobile, such species as Cypress-leaved Plait-moss *Hypnum cupressiforme*, Great Plait-moss *Hypnum cupressiforme* var. *lacunosum* and Rough-stalked Feather-moss *Brachythecium rutabulum* begin to appear and these were recorded both by Richards and in 2012-2013. These species form mats or wefts between the vegetation. Such creeping species as *B. albicans* and smaller acrocarpous pioneer species are still present, however, especially where there is disturbance. Indeed, *B. albicans* can be found throughout all the stages of dune succession. The younger dunes at Blakeney are more calcareous than the older dunes, especially the oldest at the Hood, and this gives rise to some variation in the species present. Salisbury noted that pH values in the youngest dunes ranged from 7.2 to 7.4 and in the oldest from 5.5 to 7 (Salisbury 1952). In the current survey, the more calciphile *H. cupressiforme* var. *lacunosum* was not found in VC27, being replaced by *H. cupressiforme*, although the former was recorded there by Richards. It is possible that with acidification caused by sulphur dioxde pollution the dunes are slightly more acid now than even in the 1950s, although there is clearly considerable variation across the Point. The calcicolous Streaky Feather-moss *Brachythecium glareosum*, an occasional moss of semi-fixed dunes, was found on grey dunes on the headland by Watson, and by Summerhayes on the outer edge of the dunes at the Hood (Oliver 1929), but was not seen in the recent surveys. It can, however, be easily missed, although Richards makes no mention of it in his paper. Also not found in the current survey was Don's Thread-moss *Bryum donianum*, found by Watson on a grey dune at the top of Long Low (Oliver 1929).

The Hood, as the oldest and most isolated group of dunes on the Point, has been both much studied and cited as an example of fixed dune evolution. (Oliver & Salisbury 1913, Tansley 1939). It figures in many of the bryophyte species recorded by Watson, Richards and others (Oliver 1929) and Richards has it as his culmination of cryptogamic succession of the dunes as 'the cryptogamic vegetation as a whole is very like that of an inland grass-heath' (Richards 1929). Where the vegetation was dense there are fewer lichens and the mosses were the more vigorous, taller pleurocarpous species such as Neat Feather-moss *Pseudoscleropodium purum*, Heath Plait-moss *Hypnum jutlandicum* and *Rhytidiadelphus triquetrus*, all of which were recorded by Richards. In addition,

6 Watson suggested *Bryum turbinatum* as a probable species on the Marrams, but the specimen was reassessed by A.C.Crundwell and determined as *B. inclinatum* (now *B. archangelicum*) (Swann 1975).

Watson recorded Glittering Wood-moss *Hylocomium splendens* and Springy Turf-moss *Rhytidiadelphus squarrosus*, but these could not be found by Richards in 1927, despite much searching. In the recent survey, of all these, only *H. jutlandicum* was seen at the Hood, although *P. purum* was recorded in VC28 in 2001 (Stevenson 2001). Lodge says that *R. triquetrus* was present in fairly large quantities on the older shingle ridges, probably near the Watch House, around the beginning of the 1960s, although, again, it was not seen there more recently(Lodge 1989)[7].

According to Richards, where the vegetation on the Hood was shorter and less dense (the vegetation of the Hood was dominated by Sand Sedge), other smaller species, such as Bristly and Juniper Haircaps *Polytrichum piliferum* and *P. juniperinum* respectively, were found. Broom Fork-moss *Dicranum scoparium* was also present. All these three species, as also *H. jutlandicum*, are species of acid heathland. All were recorded recently, although *P. piliferum* was not seen on the Hood, but in 2001 in VC28. One species, found at the Hood in the current survey, would not have been present in Richards' day: Star Heath-moss *Campylopus introflexus*, an alien species from the Southern Hemisphere unknown in Britain until 1941(Porley & Hodgetts 2005). As the name suggests, it is well adapted to acid heathland conditions and has the ability to spread both vegetatively and through its abundant capsules. Summerhayes found Awl-leaved Screw-moss *Tortula subulata* on the outer part of the dunes at the Hood (Summerhayes in Oliver 1929), but there seems to be no mention of it since, although it is known to grow on maritime shingle (Swann 1982).

Richards considered the Hood to have the most species-rich bryoflora of the Blakeney Point dunes (and indeed of the Point in general), recording fourteen species in the areas of taller vegetation.

The shingle

Loose shingle is a pretty hostile environment for bryophytes and it is not until it becomes reasonably stable and pockets of sand, silt and humus gather (often sheltered around the base of maritime vegetation, such as Sea Campion *Silene uniflora*), that bryophytes get established on landward slopes. Richards recorded twelve species on the main shingle bank and the Marrams, while Watson seems to have added a further eight (Oliver 1929).Where bryophytes did manage to gain a hold on the shingle, in Richards' view (Richards 1929), it was *Bryum* species that were initially prominent, but as the stability increased the cryptogamic vegetation altered and lichens began to dominate, especially in very dry areas, such as the lateral banks of the Marrams. Other mosses gained a foothold in grassier areas. Very few of the bryophytes found on the shingle were not recorded in other habitats. Indeed, Richards considered that the bryoflora of the shingle was very similar to that of the grey dunes, although poorer (Richards 1929).

Among the bryophytes specifically mentioned in relation to the shingle and not elsewhere were a number of acrocarpous mosses, including Pale Thread-moss *Bryum pallens*, fruiting on the main shingle bank, *Bryum algovicum* var. *rutheanum*, *Bryum archangelicum* and other unidentified *Bryums*. Watson found Wall Screw-moss *Tortula muralis* and Common Cord-moss *Funaria hygrometrica* on the high shingle of the Marrams (Oliver 1929). Some pleurocarpous mosses also found a niche in this habitat, including Creeping and Clustered Feather-mosses *Amblystegium serpens* and *Rhynchostegium confertum* respectively, which also occurredon high shingle. Only the two mentioned above by Watson were found in the recent survey.

7 Lodge's article is a reprint from earlier editions of the compilation and would date from 1964 (see White 1989).

Most of the mosses seen on the shingle by earlier bryologists are still present either on the shingle or elsewhere on the Point. There are, however, a few additional mosses that were not recorded by them. One of these is a species of *Bryum* - Bicoloured Bryum *Bryum dichotomum* – that could well have been one of the *Bryums* not identified by Richards. Another was Great Hairy Screw-moss *Syntrichia ruralis* var. *ruralis*, which is very close in appearance to the ubiquitous *S.ruralis* var. *ruraliformis*. Var. *ruralis* was found in the current survey on the main bank, to the east of the Marrams. Richards was surprised not to find any *Barbula* species anywhere on the Point, despite searching. However, two species, Bird's-claw Beard-moss *Barbula unguiculata* and Lesser Bird's-claw Beard-moss *Barbula convoluta* var. *convoluta* were found in the current survey on the shingle of VC27. Both *Barbula* species are found in coastal habitats, the former associated with *Tortella flavovirens*[8], at least at the Hood and, for example, at Languard in Suffolk (Porley & Hodgetts 2005).

Neither Richards nor the current survey recorded any bryophytes in the saltmarshes of the Point. There is, however, one moss whose absence from the Point was not highlighted by Richards (unlike the *Barbula* species): Heim's Pottia *Hennediella heimii*, a halophyte, which, although not mentioned in Burrell (1914) for Blakeney, was considered by him to be locally common. It might be expected either in the saltmarsh or in the transitional zone between marsh and shingle and, indeed,Porley found it growing with other bryophytes at the Hood, in the SM21 *Suaeda vera* - *Limonium binervosum* saltmarsh community of the NVC (Rodwell*et al.*2000) (Porley&Hodgetts 2005). It can fruit abundantly and at any time of the year, so, despite its size, is unlikely to be missed. Its appearances, however, can be sporadic and this may explain its apparent absence in both surveys.

8 *Tortella flavovirens* was recorded by Richards on the shingle, but will be dealt with below.

The Lows

With such a dynamic system as Blakeney Point there are a large variety of subtly different habitats and ecological niches. There are considerable variations in such characters as salinity, moisture, pH and exposure as well as the stability and nature of the substrate and age of the structure, let alone the impact of humans and animals. Between the main three habitats of sand dune, shingle and saltmarsh there are transitional areas, in particular (and characteristic of Blakeney) the 'lows'. Richards defined them as 'hollows between the dunes liable to occasional flooding by the tide'. Oliver (1913) points out that the shingle lows of the Point are very variable as to position, height above sea level and actual form. Some are isolated from the sea, so when occasionally and irregularly flooded, the salt water dries up by percolation through the shingle and evaporation. Others are open to the sea and so more like saltmarsh. As a result of these variations, the surface of the lows can be bare (shingle), muddy, sandy or mud overlaid with sand (Oliver 1913, White 1989). In some the silt can form a crust. Some of the lows also retain rain water[9].

Richards highlights one specific moss as living permanently in the lows. This is Yellow Crisp-moss *Tortella flavovirens*. He cites, however, a few species as temporary colonists coming in from neighbouring dunes between tidal incursions. These include *Syntrichia ruralis* var. *ruraliformis*, *Brachythecium albicans* and *Bryum argenteum*, often in very small amounts or dying after flooding (Richards 1929). In the current survey *Ceratodon purpureus* was found, growing with Grey Hair-grass *Corynephorus canescens*, on the edge of Glaux Low.

Casual Species

Virtually all the bryophytes in Appendix 1

9 Richards noted that Long Low had standing pools of fresh water for much of 1925 (Richards 1929).

are known to occur, at least occasionally, in coastal habitats in Norfolk – sand dunes, shingle and the edge of saltmarshes (see, for example, Swann's (1982) comments about specific species). The exceptions are casuals which are unlikely to persist when exposed to saline conditions. Watson's record of Grey-cushioned Grimmia *Grimmia pulvinata* growing on a shell is unexpected (Oliver 1929). Like *G. pulvinata*, Wall Screw-moss *Tortula muralis* is more at home on man-made structures such as buildings and walls and was found recently at Blakeney Point on concrete near the Lifeboat House as well as on a loose building block, possibly thrown up by the sea on to the shingle. Pea Bryum *Bryum ruderale* and Crimson-tuber Bryum *Bryum rubens* are primarily arable species, found inland on soil, gravel and sand and their tubers may possibly have got to Blakeney on machinery.

A case study: Yellow Crisp-moss *Tortella flavovirens* at Blakeney Point

History in Norfolk and the Point

Tortella flavovirens, formerly known as *Trichostomum flavovirens*, (see photo p.104) was first recorded in Norfolk by E.H. Holmes from the sandhills at Hunstanton in 1900 (Dixon 1901). By the publication of the *Flora of Norfolk* (Burrell 1914) it had been found elsewhere, including in VC27 at Weybourne. Burrell's entry for the species reads 'rather rare. Sandy ground near the sea' (Burrell 1914). There is no mention, however, of its being found at Blakeney Point and it seems that it was not until Richards studied the bryophytes of the Point that it was recorded there, in bot

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h VCs (Richards 1929). Indeed, in his revised systematic list of bryophytes for the Point, drawn up from his and other bryologists' records, it is his own records for *T. flavovirens*, and not those of W.H. Burrell, V.S. Summerhayes or W. Watson that are quoted (Oliver 1929). His entry reads; '*Trichostomum flavovirens* Bruch. On high shingle, descending into the zone of *Suaeda fruticosa*[10]; Marrams, main bank and Hood; sparingly in Long Low. Richards' paper remains the basis for future citations of the presence of *T. flavovirens* at Blakeney Point in VC27 (grid square E04) in subsequent Norfolk Floras, although it is not mentioned for VC28 (Petch & Swann 1968, Beckett *et al.* 1999). It had been recorded on the Point, however, more recently prior to the publication of these two later floras, as Lodge stated that it was present in the 1950s (Lodge 1989). These records fail to appear on the current British Bryological Society's main database. The 2008 BBS Checklist also puts VC27 in brackets for the species, signifying that it had not seen in the whole of the vice county, including the eastern part of the Point,since the beginning of 1960 (Hill *et al.* 2008). Nor was it found, despite searching, in VC28 during the 2001 visit of the Norfolk and Suffolk Bryological Group to the Point. Porley & Hodgetts (2005), however, state that it was locally abundant at the Hood. Porley (pers. comm.) recently confirmed that he had recorded it there in February 2003.

Current survey and distribution

In July 2012 R.W. Ellis, while sampling a quadrat for the BSBI pilot Surveillance Scheme on the Marrams, came across a heavily eroded bryophyte. This appeared to be *T. flavovirens* but the specimen was so poor that certain identification was impossible. It was decided to try to refind the moss later in the year, when plants might be in a better state. The distribution of the species across the Point, resulting from this subsequent survey, is illustrated in Figure 1.

T. flavovirens is a species known to tolerate a certain degree of salt, surviving very occasional tidal inundation (Hill *et al.* 2007). As such it is often found on the upper edge

10 *Suaeda vera*.

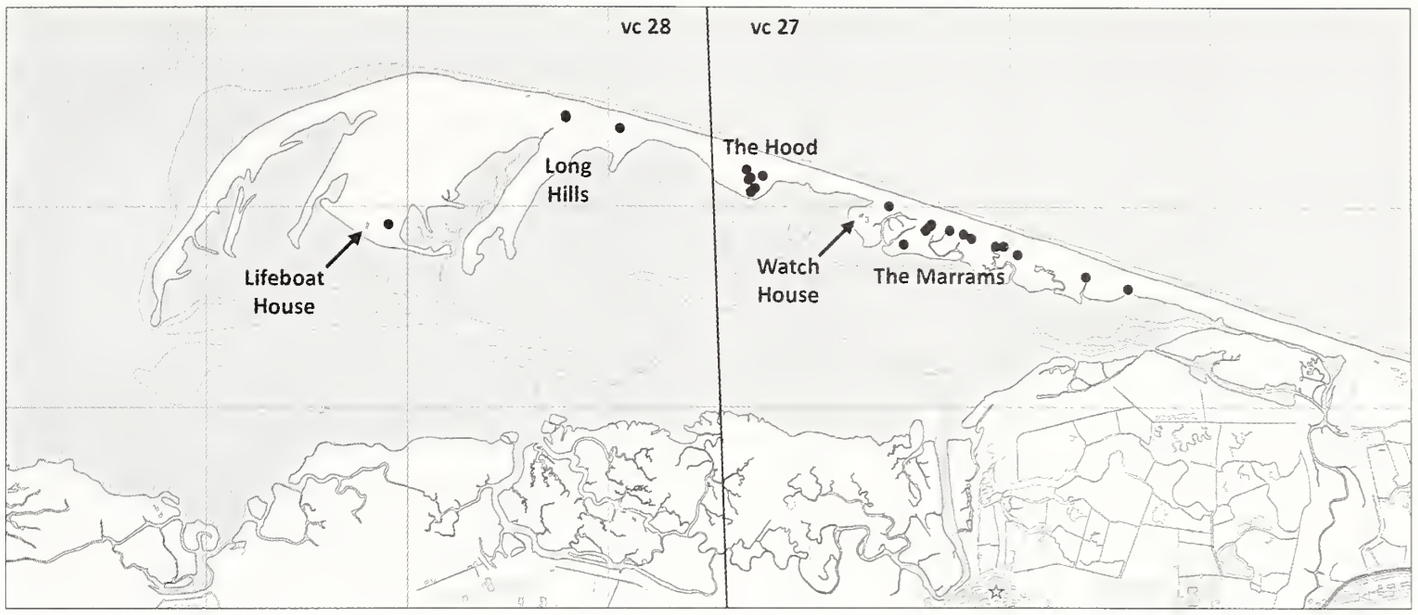

Figure 1. The distribution of Yellow Crisp-moss *Tortella flavovirens* at Blakeney Point in 2012. Contains Ordnance Survey data © Crown copyright and database right [2013].

of saltmarshes and in the transitional zone between saltmarsh and sand or shingle. The received wisdom of where to find *T. flavovirens* most frequently, at least in Norfolk, seems to be in association with Shrubby Sea-blite *Suaeda vera* in this transitional zone (Beckett *et al.* 1999). It is said to grow in carpets under the Sea-blite and around its moribund bases (Porley & Hodgetts 2005), although they also note that at the Hood on Blakeney Point it is also found in the more open Shrubby Sea-blite – Rock Sea-lavender saltmarsh community (NVC SM21, Rodwell *et al.* 2000) with other bryophytes as well as Thift and Sea-heath. Despite its presence in this NVC community Rodwell fails to mention the moss in the description of SM21, although Blakeney Point was clearly used as a source of data. The only relevant NVC community where it is specifically mentioned(also based partly on Blakeney Point data), is that of the SD19 *Tortulo-Phleetum arenariae* dune annual community (Rodwell *et al.* 2000).

The initial search for *T. flavovirens* covered the area up to the Hood (VC27). As Figure 1 demonstrates, it was found in a number of sites and in every case it was growing with Rock Sea-lavender *Limonium binervosum* ssp. *anglicumm* (see photograph, p.105). In fact in only one of the areas searched, where the latter grew, was it not found. Although it *was* occasionally found near *S. vera*, it was not growing under or near the base of that species. Associated with the *Limonium* patches were such species as Thrift *Armeria maritima*, Buckshorn Plantain *Plantago coronopus*, Red Fescue *Festuca rubra*, Common Couch *Elytrigia repens* and *Cladonia* lichens, as well as the *Suaeda*. In the original area where it was first found there was also Sea-heath *Frankenia laevis*. In most cases neither the *Limonium* patches nor the *T. flavovirens* were extensive, but adjacent to the Hood (just to the east,below the dunes), there was an area of low where both the *Limonium* and *T. flavovirens* were locally frequent. This fits in with Porley & Hodgetts comments (2005). Where *Tortella* was growing with *F.laevis* the substrate was siltier. In other cases it grew on sand, often at the edge of, or in pockets over, shingle.

Despite being relatively easy to find in the area up to the Hood, when a search was made in VC28, both from the Lifeboat House east and beyond to the west, the picture changed. Only three small patches of *Tortella* were found, although there were plenty of areas of *Limonium binervosum* ssp. *anglicum*.Two of these patches were associated with *S.vera*, growing close to the base of the bush on slightly raised ground.

L. binervosum was also present in the vicinity of all three and in one case Sea-purslane *Atriplex portulacoides* was also present.

Discussion

So how might the differences between the distribution of *T. flavovirens* in VC28 and 27 be explained? Why was it present in virtually all areas with *Limonium binervosum* ssp. *anglicum* in VC27 and absent in those in VC28, where there was even more seemingly suitable habitat? Why was it rarely found under the *Suaeda* along the edge of the saltmarsh and then only in VC28? Why was it missing from Long and other lows, where Richards (1929) mentions it, although in a similar area of low near the Hood? One explanation might be the variation in the degree of tidal inundations between lows and other areas in VC28 and 27. Lodge (1989) states that after the 1953 floods it virtually disappeared from the Point, although it had reappeared by 1959. In his view *T. flavovirens* cannot tolerate being submerged for long, and this attribute also seems to be confirmed by Hill *et al.* (2007). Richards (1929) however, in the summary to his article says:

> 'In the "lows" ... only one bryophyte, *Trichostomum flavovirens*, lives permanently, but mosses from the neighbouring dunes invade the low between successive inundations.'

He seems to be suggesting that *T. flavovirens* is possibly more tolerant of inundation and salt than might be expected and therefore not so subject to annual fluctuations linked to tidal variations over time, as Lodge suggests. However, Blakeney Point has changed since the time Richards did his research and the degree and frequency of inundations may have altered just enough to change the balance in certain areas. Moreover, as Oliver and others have pointed out, the lows are very variable, in terms of position, form and surface, apart from the actual vegetation present (see White 1989).These differences may go some way to explaining why some of the lows in VC28 did not have *T. flavovirens*.

The possible effect of Rabbits and Brown Hares

The above does not explain, however, why there is so little *T. flavovirens* under the *Suaeda*, where it might have been expected and where, indeed, Richards noted it, growing in large patches round the roots (Richards 1929). One of the attributes of *T. flavovirens* is that it prefers to grow in full light[11], often in full sunlight (Hill *et al.* 2007). Indeed, most of the places where it was found in VC27 at Blakeney Point would fit this. In the past Blakeney Point has 'suffered' from Rabbits. In 1913 it was said that the whole system of Long Hills seemed to be a warren. Particularly affected was, among other plants, *Limonium binervosum* and according to Rowan (1913) the extent of the damage to *Suaeda vera* could hardly be imagined. The Rabbits were wiped out following a myxomatosis outbreak in 1954 but by the summer of 1959 they were back. This virtually coincides with the period to which Lodge (1989) attributes the loss and reappearance of *T. flavovirens* following the 1953 floods. Over this period White(1961) undertook a series of permanent transect surveys on the Point, studying the alteration in vegetation following the demise of the rabbits. With the increase in grassland and less bare ground, smaller mosses such as *Ceratodon purpureus* and *Syntrichia ruralis* var. *ruraliformis* did not compete well with the thicker grass growth, while larger mosses such as *Dicranum scoparium* became more widespread. His observations on the effect on bryophytes would appear to be supported by the research of A.S. Watt in excluding Rabbits in Breckland, which he quotes, 'The absence of smaller mosses from the ungrazed [...exclosures...] may be attributed to their inability to endure competition with taller vegetation or to

11 It can grow, however, in partially shaded situations, such as under the pines on Holkham dunes.

survive under the shade of it...'(White 1961, citing Watt 1957).

The Rabbit population fluctuated, following subsequent outbreaks of myxomatosis in the 1980s and 1990s and currently there are no or virtually no rabbits on the Point. Instead there is a considerable population of Brown Hares (NT, pers. comm.). These changes in the Rabbit population and the replacement of Rabbits by Brown Hares with their different behavior and feeding habits have undoubtedly had an effect on the bryophytes. It is certainly possible that the reduction in the 'annual hard pruning' of *Suaeda vera* by the Rabbits may have meant more shading of what had been the carpets of *Tortella* recorded by Richards, leading to a reduction in its distribution in this habitat. Also the*Tortulo-Phleetum arenariae* dune annual community is one that takes advantage of gaps in semi-fixed or stable dune swards caused by drought or local disturbance, and the latter can be caused by Rabbits. *T. flavovirens* is occasional in this minor and local community, although too much rabbit activity can have a reverse effect on the community – it is clearly a fine line (Rodwell *et al.* 2000).The change from Rabbits to Brown Hares and, indeed, increased visitor numbers, could all be contributing to alterations in this community's distribution and the *Tortella* associated with it.

It may be significant that the initial demise of the Rabbit population and the heavy flooding in the 1950s virtually coincided, possibly having a doubly detrimental effect on the moss and that its reappearance in the summer of 1959 coincided with the reappearance of the rRabbits (Lodge 1989 and White 1961). Lodge states, however, that by the 1960s *Tortella* was fairly common. This would be after a subsequent outbreak of myxomatosis.

Neither changes to Rabbit populations nor heavy flooding can adequately explain the virtual dearth of *T. flavovirens* in VC28 and its local frequency in VC27 at present. Variations within the Point, especially the nature of the lows and the degree that they are open to flooding, provide a slightly more plausible explanation.

Conclusion

What is clear is that there are considerable gaps in knowledge about both *Tortella* and the bryophytes of the Point. In an area as large, dynamic and complex as Blakeney Point there is certainly much more to be explored and understood. Richards' work laid the foundation for the study of the bryophytes of Blakeney Point almost ninety years ago. Now, a hundred years after the National Trust took over responsibility for the Point, seems a good time to revisit in detail the bryoflora of the Point. It is hoped that this article will act as the start of this process.

Acknowledgements

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Appendix 1 notes. Attribution of records.

1 P. Lambley (pers. comm.)

2 All 2012 records and some 2013 by M. Ghullam & R.W. Ellis

3 Norfolk & Suffolk Bryological Group (Stevenson 2001)

4 R. Porley (pers. comm.)

5 Cited in Lodge (1989), but reprinted from 1964

6 E.L. Swan (1982)

7 P.W. Richards (Oliver 1929)

8 W. Watson (Oliver 1929) (cited in Petch & Swan incorrectly as E.V. Watson)

9 V.S. Summerhayes (Oliver 1929)

Appendix 1. Systematic list of bryophytes recorded at Blakeney Point. Nomenclature after Hill *et al.* (2008) . * Date of publication. ** Richards and before. See notes on p.

Species	English name	Latest Year	Prior to 1930**	Most recent VC	Note
Liverworts-Marchantiophyta					
Frullaniaceae					
Frullania dilatata (L.) Dumort.	Dilated Scalewort	2013		28	1
Lophocoleaceae					
Lophocolea bidentata (L.) Dumort.	Bifid Crestwort	2013	Y	28	1
Lophocolea heterophylla (Schrad.) Du mort.	Variable-leaved Crestwort	2001		28	3
Lophocolea semiteres (Lehm.) Mitt.	Southern Crestwort	2012		28	2
Cephaloziellaceae					
Cephaloziella divaricata (Sm.) Schiffn.	Common Threadwort	2012/2013	Y	27/28	2/1
Mosses - Bryophyta					
Polytrichaceae					
Polytrichum piliferum Hedw.	Bristly Haircap	2001	Y	28	3
Polytrichum juniperinum Hedw.	Juniper Haircap	2012	Y	27&28	
Funariaceae					
Funaria hygrometrica Hedw.	Common Cord-moss	2012	Y	27	
Grimmiaceae					
Grimmia pulvinata (Hedw.) Sm.	Grey-cushioned Grimmia	1929*	Y	n.a.	8
Ditrichaceae					
Ceratodon purpureus (Hedw.) Brid.	Redshank	2012	Y	27&28	
Dicranum scoparium Hedw.	Broom Fork-moss	2012	Y	27&28	
Leucobryaceae					
Campylopus introflexus (Hedw.) Brid.	Heath Star Moss	2012		27&28	
Pottiaceae					
Tortella flavovirens (Bruch) Broth.	Yellow Crisp-moss	2012	Y	27&28	
Barbula convoluta var. *convoluta* Hedw.	Lesser Bird's-claw Beard-moss	2012		27	
Barbula unguiculata Hedw.	Bird's-claw Beard-moss	2012		27	
Tortula subulata Hedw.	Awl-leaved Screw-moss	1929*	Y	27	9
Tortula muralis Hedw.	Wall Screw-moss	2012/2001	Y	27/28	2/3
Hennediella heimii (Hedw.) R.H.Zander	Heim's Pottia	2003		27	4
Syntrichia ruralis var. *ruralis* (Hedw.) F.Weber & D.Mohr	Great Hairy Screw-moss	2012		27	
Syntrichia ruralis var. *ruraliformis* (Besch.) Delogne	Sand-hill Screw-moss	2012	Y	27&28	
Bryaceae					
Bryum species	Thread-mosses	2012	Y	27&28	
Bryum pallens Sw. ex anon.	Pale Thread-moss	1927	Y	n.a.	7
Bryum algovicum var. *rutheanum* (Warnst.) Crundw.	Drooping Thread-moss	1955	Y	27	6

Species	English name	Latest Year	Prior to 1930**	Most recent VC	Note
Bryum archangelicum Bruch & Schimp.	Archangelic Thread-moss	1955	Y	27	6
Bryum donianum Grev.	Don's Thread-moss	1929*	Y	28	8
Bryum capillare Hedw.	Capillary Thread-moss	2012	Y	27&28	
Bryum argenteum Hedw.	Silver-moss	2012	Y	28	
Bryum dichotomum Hedw.	Bicoloured Bryum	2012		27&28	
Bryum ruderale Crundw. & Nyholm	Pea Bryum	2001		28	3
Bryum rubens Mitt.	Crimson-tuber Thread-moss	2012		27	
Amblystegiaceae					
Amblystegium serpens (Hedw.) Schimp.	Creeping Feather-moss	1929*/1927	Y	27/n.a.	8/7
Brachytheciaceae					
Pseudoscleropodium purum (Hedw.) M.Fleisch.	Neat Feather-moss	1927/2001	Y	27/28	7/3
Rhynchostegium confertum (Dicks.) Schimp.	Clustered Feather-moss	1929*	Y	27	8
Rhynchostegium megapolitanum (Bland ow ex F.Weber & D.Mohr) Schimp.	Megapolitan Feather-moss	2003		27	4
Kindbergia praelonga (Hedw.) Ochyra	Common Feather-moss	2012	Y	27&28	
Brachythecium albicans (Hedw.) Schimp.	Whitish Feather-moss	2012	Y	27&28	
Brachythecium glareosum (Bruch ex Spruce) Schimp.	Streaky Feather-moss	1929*	Y	27/28	9/8
Brachythecium rutabulum (Hedw.) Schimp.	Rough-stalked Feather-moss	2012	Y	27&28	
Hypnaceae					
Hypnum cupressiforme Hedw.	Cypress-leaved Plait-moss	2012	Y	27&28	
Hypnum cupressiforme var. *lacunosum* Brid.	Great Plait-moss	2013	Y	28	2
Hypnum jutlandicum Holmen & E.Warncke	Heath Plait-moss	2013	Y	27&28	2
Hylocomiaceae					
Rhytidiadelphus triquetrus (Hedw.) Warnst.	Big Shaggy-moss	1964*	Y	27	5
Rhytidiadelphus squarrosus (Hedw.) Warnst.	Springy Turf-moss	1929*	Y	27	8
Hylocomium splendens (Hedw.) Schimp.	Glittering Wood-moss	1929*	Y	27	8

The lichens of Blakeney Point

Peter Lambley

Summary

Blakeney Point has been studied for its lichen flora for almost 100 years. I consider that 141 species of lichens have been acceptably recorded from the Point during that period, though complications with taxonomic concepts over time mean that remains an approximate figure. Of the total, 31 species have been recorded for the first time in the period since 1968. This probably reflects better understanding in some groups and investigation of underworked habitats rather than any real increase in species richness.

Introduction

Blakeney Point has a long history of lichen research and was the subject of one of the very early papers on lichen ecology in the British Isles (McLean 1915) - one of the first to recognise the importance of lichens as part of the ecosystem. The author, R.C. McLean, later became a Professor of Botany at Cardiff University. As McLean notes in the introduction to his paper, 'Blakeney Bank and Headland are themselves known to ecologists as one of the chief centres of experimental ecology in this country'. McLean's paper provides a sound basis for understanding the lichens at that time. It is difficult, however, to interpret changes in the flora because of advancements in the understanding in lichen taxonomy over the last hundred years, and especially in the last forty. Some genera which are important at Blakeney, for example *Caloplaca*, are understood very differently now and taxonomic revision and change still continues. McLean's paper was followed by another important paper by Richards (1929) and a shorter paper by Knight (1936). Following the formation of the British Lichen Society in 1958 there was a resurgence in the study of lichens in Britain in the 1960s, as exemplified by the work on Blakeney Point by D. H. Brown & R. M. Brown (Brown & Brown 1968, 1969). These publications included a summary of all the records to date and attempted as far as possible to comment on the earlier records made by McLean, Richards, Knight and Watson. Since then the author has made a number of visits to Blakeney Point to record the lichens. The key visits were made in 1982 with Dr Tony Fletcher, a specialist in marine and maritime lichens, in 2009 and in 2012 with Mark Powell, with two additional visits by the author in 2013. Lichen nomenclature follows Smith et al. (2009). Flowering plant nomenclature follows Stace (2010).

Lichen habitats

Shingle

Blakeney Point was surveyed for its shingle communities and the results published by Sneddon & Randall (1993). Lichen communities are best developed on areas of stable shingle, mostly found on the laterals that have developed from the main shingle ridge, notably the Long Hills and its extension Yankee Ridge.

A more maritime community has developed on the landward side of the ridge at a slightly lower level and this then grades into the saltmarsh. This lower community is included in the National Vegetation Classification (NVC) SM25 (Rodwell 2000) and is characterised by bushes of Shrubby Sea-blite *Suaeda vera*. In places, however, it is quite open with only a few bushes. The lowest lichens on the shore are *Verrucaria* spp., notably *V. maura* and *V. ditmarsica*, sometimes with the lichenicolous fungus *Stigmidium marinum*. This community is

often best developed under the shade of the *Suaeda* as long as the siltation is not too great. Still within the SM25 *Suaeda vera* community but a little higher up is an area of shingle embedded in sand and silt which supports a scattered growth of vascular plants including Rock Sea-lavender *Limonium binervosum*, Sea Heath *Frankenia laevis*, Annual Seablite *Suaeda annua*, stunted Shrubby Seablite and Sea Purslane *Atriplex portucaloides*. Growing in this community on the pebbles, which are generally 2-3cm in size, are *Xanthoria parietina* (sometimes abundant), together with *Caloplaca marina*, *Lecanora helicopsis* and *Rinodina oleae*. See photograph p.101.

Higher upon Yankee Ridge in particular is a community named in the NVC as SH33 *Plantago coronopus-Armeria maritima-Festuca rubra* grassland. This is developed on a thin veneer of sand over consolidated shingle. In McLean's time extensive dunes covered the area but these blew away in the late 1930s apart from the northern end of Yankee Ridge. The nature of the substrate results in bryophytes and lichens having a competitive advantage over vascular plants. As a result the lichen community is well developed with a carpet of *Cladonia rangiformis/furcata* and in places *C. foliacea* (see photograph, p.101). In 1982 *Bryoria fuscescens* was noted growing amongst small patches of the moss *Polytrichum piliferum* (see photograph, p.101). At that time it was relatively easy to find, but by 2012 only 18 thalli were found after a lot of hard searching, mostly in the vicinity of TG0065.4623. In 2013 a relatively short search failed to find it, though it may still occur. There had, however, appeared to be a decline in the extent of *Polytrichum* at the expense of *Cladonia furcata* and *C. rangiformis*. Previous records on the Point of *Bryoria fuscescens* were from fence posts. Elsewhere on the North Norfolk coast it was known from the East Hills at Wells, growing on *Polytrichum* with *Usnea articulata*, until *c.* 1990 when the site was found to be covered with blown sand and the community apparently buried.

Small pebbles (*c.* 20- 30mm across) in this community are colonised by a number of lichens including *Rhizocarpon reductum* (the most frequent), *Buellia aethalea, B. stellulata* and *Micarea erratica*. Less frequently *Lecanora muralis, L. stenotropa* and *Tephromela atra* are found, the latter was considered by Brown & Brown (1969) as being common, but this does not seem to be the case now.

Oyster shells and the scattered bones of seals and rabbits provide another substrate where *Caloplaca marina, Lecanora albescens* and *Diplotomma alboatrum* occasionally occur.

Sand dunes

The small cup lichens, in particular *Cladonia fimbriata* and *C. humilis*, form pioneer communities on the younger dunes, and also occur around the edges of blow-outs and other bare sandy areas. Over large areas of the dune system, however, *Cladonia rangiformis* is the dominant lichen, though it is not always easy assess its frequency in relation to *C. furcata* (in the past *C. furcata* has been considered to be the more common, but sampling over the dunes suggests that the reverse is the case; in places, however, as on the Hood, much of the material is in a fragmented state which makes it difficult to separate the two). There is no apparently clear separation in habitat preferences, though *C. furcata* may be more frequent on the older dunes. The distinctive *Cladonia foliacea* is dominant in some parts of the Great Sandy Low and around some of the old blow-outs, also in other areas where there is a thin veneer of sand over shingle (as on the edge of the Long Hills where, unusually, it is often found in fruit). *Cetraria aculeata* is particularly frequent in both the Great Sandy Low and the edge of the Long Hills, though it does occur occasionally throughout the lichen-rich dune areas (see photograph, p.101). On the older dunes, for example the Beacon Hills,

the reindeer lichens – *Cladonia arbuscula, C. ciliata* var *tenuis* and *C. portentosa* – are conspicuous, forming large cushions. Of these *C. arbuscula* appears to be the most common, though in some areas (e.g. east of the laboratory and on the Long Hills) *C. ciliata* var. *tenuis* is frequent.

Peltigera spp. are mostly recorded from the Beacon Hills and the area to the east of the laboratory. The most common is *P. canina*; in the past there has been confusion with *P. membranacea*, but material on Blakeney seems to be the former. *Peltigera hymenina* is locally frequent, for example in the area east of the laboratory, where it often grows partly buried in the turf, as does *P. didactyla*.

Species that require stable bryophyte turf are uncommon, though *Diploschistes muscorum* was recorded by Brown & Brown (1968) and has been seen on the dunes at Gun Hill, Burnham Overy. More recently *Bacidia herbarum* and *B. bagliettoana* have been found very occasionally in this habitat on the point. This is also a record from 2013 of *Polyblastia agraria* on the margins of the Hood close to the saltmarsh; in Norfolk, it is otherwise known only from Burnham Overy dunes.

Richards (1929) remarked on the presence of normally epiphytic species growing on the ground. This is now known to be a not uncommon feature on dune systems and other places where bare sand has been exposed, as in gravel workings and sand pits. *Evernia prunastri* and *Hypogymnia physodes* are the most frequent species. There are also records of *Platismatia glauca*, including one made by the author in 1970, but it has not been seen in more recent surveys. This species was formerly much more common in Norfolk but has probably declined because of the changing air pollution environment. *Flavoparmelia caperata* was found by Knight (1936) but there have been no subsequent records. At one stage this species was abundant at Orford Ness in Suffolk but again there are no recent records from that site.

In one small area north-east of the Long Hills on shingle with a veneer of sand there is a sward of *Physcia adscendens*. It is possible that this is the explanation for reports of *Anaptychia ciliaris* by Knight (1936); whilst it occasionally grows on stone or rock it is an unlikely species here.

Trees, bushes and other plant material

This is not surprisingly a limited habitat on Blakeney Point but nevertheless the trees in the plantation (White Poplar *Populus alba)* and a small clump of shrubs (Elder *Sambucus nigra* and Tamarisk *Tamarix gallica*) around the UCL dormitory support a number of species including *Hypogymnia physodes, Lecanora confusa, L. umbrina, Lecidella elaeochroma f. elaeochroma, Melaelixia subaurifera, Parmelia sulcata, Phaeophyscia orbicularis, Punctelia subrudecta, Ramalina farinacea, R. canariensis, Scoliciosporum chlorococcum* and *Strangospora pinicola.*

The native shrub Shrubby Sea-blite *Suaeda vera* is very abundant, growing in two main NVC communities. A feature of the *Suaeda* is the abundance of *Xanthoria parietina* (see photograph, p.101), often in its shade form with a rather greenish colouration (it is often the host to the lichenicolous fungus *Xanthoriicola physciae,* which is easily recognised by the smutty look of the infected thallus). The most notable species is, however, *Caloplaca suaedae,* which was described as new to science by O.L. Gilbert & B. Coppins (in Gilbert 2001) although previously known to the author. It is most often found on slightly moribund *Suaeda* where more light is able to get into the shrub and is particularly frequent at the edge of The Hood. Very occasionally at Blakeney it will also grow on dead twigs of Sea Purslane. Elsewhere in North Norfolk it is occasional to frequent in this habitat, but otherwise it is only known in the world from Chesil Beach in Dorset. At Blakeney it is associated with *Lecanora hagenii, Xanthoria parietina*

and less frequently *Physcia adscendens* and *P.tenella*. (*Caloplaca suaedae* almost certainly accounts for the otherwise curious record of *Caloplaca luteoalba* growing on *Suaeda* twigs made by Knight (1936) and possibly also a record of *C. cerina*; *Caloplaca luteoalba* is largely confined to elms *Ulmus* but does have a resemblance to the newly described *C. suaedae*.)

Lecanora zosterae, a distinct member of the *Lecanora dispersa* group, is often found on tussocks of Thrift *Armeria maritima* and sometimes Rock Sea-lavender. It can be abundant in this habitat, as on the higher shingle at the Long Hills. *Caloplaca phloginia* has also been seen in this habitat on Scolt Head, but not so far at Blakeney. The one specimen of *Usnea subfloridana*, which I found in 1970, was on decaying Marram *Ammophila arenaria*.

Man-made substrates

There are a number of man-made habitats on Blakeney Point, including the following:

(i) Old bricks and concrete around the buildings

(ii) Driftwood and other materials e.g. fibreglass panels

(iii) Wooden structures e.g. fence posts, seats

(iv) Buildings

The nature of these habitats is that some, including bricks and concrete, can be in place for a long time whilst other features, such as drift wood and parts of temporary buildings, are relatively impermanent. This gives rise to a turnover in the species recorded - species colonising as habitats become available but then becoming extinct as they deteriorate or are destroyed.

The brick and concrete immediately around the UCL dormitory hut was examined in detail in 2012 and the following species were recorded: *Caloplaca arcis, C. crenulatella, C. polycarpa, Lecania inundata, Lecanora albescens, L. muralis, Lecidella stigmatea, Phaeophyscia orbicularis* and *Verrucaria viridula*. A small piece of embedded concrete on Yankee ridge had *Lecanora campestris*, otherwise apparently absent from the Point.

Drift wood is a relatively rare habitat but on the edge of the Great Sandy Low several pieces were found which supported an assemblage of lichens including: *Amandinea punctata, Cladonia rangiformis, Lecanora muralis, L. symmicta, Placynthiella icmalea, Physcia tenella, Trapeliopsis flexuosa* and *Xanthoria parietina*. Near the Great Sandy Low on a large piece of fibre-glass, probably originating from a roof, the following species were found: *Buellia aethalea, Candelariella vitellina, Hypogymnia tubulosa, Lecanora muralis, Melanelixia glabratula, Parmelia sulcata, Physcia tenella, Punctelia subrudecta, and Xanthoria polycarpa.*

Other wooden structures supported *Lecanora conizaeoides*, as on the old telegraph post. A seat near the lifeboat station had *Cyphelium notarisii* in 2009, but this could not be found in 2012. This is a species of fences and other wooden structures and is local in Britain, occurring mostly near the coast in eastern England. Likewise the roof of one of the huts had a colony of *Flavoparmelia soredians* in 2009 but by 2012 this had been re-roofed and the colony lost.

The wreck of the Yankee at the distal end of the Long Hills is an example of a longer term man-made structure. It was constructed with timber and concrete in a iron/metal framework. Species recorded on it include the following:. *Caloplaca citrina, C. dichroa, C. maritima, Diploica canescens, Lecanora albescens, L. crenulata, Lecidella scabra, Physcia adscendens, Rinodina oleae, Xanthoria candelaria*, and *X. parietina*.

One habitat that is apparently missing from Blakeney Point but present elsewhere on the North Norfolk coast is the wooden structures used to protect the edges of channels and sea walls (as at Burnham

Overy). Species growing on these include *Caloplaca maritima* and the Red Data Book species *Cliostomum corrugatum*. It is possible that these may be present on the Point and should be looked for.

Notes on species

Species listed by Brown & Brown 1968 but considered unlikely by them and also by the author

Bacidia inundata (W&R) A freshwater species considered unlikely by Brown & Brown; I agree.

Cetraria muricata Recorded by Brown & Brown but doubtful if it is really separable from *C. aculeatum*.

Cladonia alpestris Recorded by McLean but not a British species.

Cladonia mitis Based on a record by A.L. Smith. A species which might occur but no convincing material has yet been found.

Cladonia rangiferina Recorded by McLean but probably unlikely as it was most likely confused with other *Cladonia*s in the section *Cladina*, although a small colony was found on Horsey Dunes in 2012 so it is just possible that it occurred.

Collema limosum & Collema tenax tenax Considered by Brown & Brown to be unlikely; without supporting material should be deleted.

Protoparmelia badia (as *Lecanora badia)* Not seen by any recorders since McLean; based on ecological and biogeographical preferences unlikely.

Rhizocarpon hochstetteri Only recorded by McLean who considered it to be frequent. Whilst possible it is more likely that it was confused with other *Rhizocarpon* species.

Other species considered doubtful by the author

Anaptychia ciliaris (Knight 1936). Reported as growing on the ground but normally a species growing on trees or stonework. Blakeney is an unlikely habitat.

Calicium viride (Knight 1936). Unlikely because of the lack of a suitable habitat.

Caloplaca atroflava (McLean 1915 & Knight 1936). Most likely a misidentification for *Caloplaca holocarpa,* though there is material in the Natural History Museum from the Brecks so it is possible.

Caloplaca cerina (Knight 1936)Probably *Caloplaca suaedae.*

Caloplaca luteoalba (Knight 1936)Probably *Caloplaca suaedae.*

Caloplaca flavorubescens as C.aurantiaca (Brown & Brown, 1968)Whilst possible more likely to be confused with *C. crenulatella, C. maritima* or *C. polycarpa*

Species recorded since Brown & Brown (1968)

Bacidia herbarum
Caloplaca arcis
Caloplaca crenulatella
Caloplaca dichroa
Caloplaca lactea
Caloplaca polycarpa
Caloplaca saxicola
Caloplaca suaedae
Cyphelium notarissi
Diplotomma alboatrum
Flavoparmelia soredians
Lecania inundata
Lecanora albescens
Lecanora crenulata
Lecanora hagenii
Lecanora saligna
Lecanora stenoptropa
Lecidella carpathica
Lecidella scabra
Lecidella stigmatea
Polyblastia agraria
Punctelia subrudecta
Pyrenocollema halodytes
Ramalina canariensis
Scoliciosporum chlorococcum
Stigmidium marinum
Strangospora pinicola
Trapelia coarctata
Usnea subfloridana
Verrucaria ditmarscica
Verrucaria mucosa

Evidence of change since 1968 in the lichen flora

Despite comparing the previous papers published on the Point's lichens it is difficult to find any evidence of clear trends, although Brown & Brown (1968) note that the lower shingle areas have been greatly reduced by siltation and extensive growth of *Suaeda vera*. This trend appears to be continuing. The other noticeable difference appears to be a reduction in diversity of the *Cladonia* species. Although *Cladonia*s remain dominant over large areas, the amount of *C. macilenta, C. floerkeana, C. ramulosa, C. cornuta* and *C. subulata* in particular appears to have declined. Most of the species recorded for the first time since 1968 are either recent segregates (especially species closely related to *Caloplaca citrina, C. holocarpa* and *Lecanora dispersa*), or those that have been newly described or overlooked.

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Appendix 1. Species recorded from Blakeney Point 1915 – 2013

Key: +(i) records made by author 1970; +(ii) records made by R. Bailey (1968).
+? some uncertainty over the record.

Habitats: sax = saxicolous (on flint pebbles, cement, concrete & brick; t = on soil (terricolous); c = on bark (corticolous); l = on wood (lignicolous); c/l = on bark (corticolous) and wood (lignicolous).

Name	Name recorded in Brown & Brown	McLean 1915	Richards 1929	Knight 1936	Brown & Brown 1968	1983	2009 & 2012-13	Habitat
Acarospora fuscata					+			sax
Acarospora smaragdula					+			sax (shells)
Amandinea punctata	*Buellia punctata*				+		+	c/l
Aspicilia caesiocinereia	*Aspicilia gibbosa*	+						sax
Bacidia bagliettoana	*Bacidia muscorum*				+			t
Bacidia herbarum						+		t
Bryoria fuscescens	*Alectoria jubata*				+	+	+	t
Buellia aethalea					+		+	sax
Buellia stellulata				+	+			sax
Buellia subdisciformis						+		sax
Caloplaca arcis							+	sax
Caloplaca cerina			+					
Caloplaca citrina sl.					+	+	+	Sa/c/t
Caloplaca crenularia	*Caloplaca ferruginea*	+		+	+	+		sax
Caloplaca crenulatella							+	sax
Caloplaca decipiens					+			
Caloplaca dichroa							+	sax
Caloplaca flavescens				+			+	sax
Caloplaca flavorubescens	*Caloplaca aurantiaca*			+	+	+		sax
Caloplaca holocarpa					+	+	+	sax
Caloplaca lactea							+	sax
Caloplaca marina			+	+	+		+	sax
C. polycarpa	*Caloplaca oasis*						+	sax
Caloplaca saxicola						+	+	sax
Caloplaca suaedae							+	c
Candelariella aurella f. *aurella*					+	+	+	sax
Candelariella vitellina f. *vitellina*					+		+	t+ other
Catilaria chalybeia var. *chalybeia*		+		+		+		?
Catillaria lenticularis				+	+			?
Cetraria aculeata	*Cornicularia aculeata*	+	+	+	+	+	+	t
Cetraria muricata	*Cornicularia muricata*				+			t
Cladonia arbuscula subsp. *squamosa*		+			+	+	+	t
Cladonia caespiticia					+			
Cladonia cervicornis subsp. *cervicornis*					+(ii)			t
Cladonia chlorophaea			+		+	+	+	t
Cladonia ciliata var. *ciliata*							+	t

Name	Name recorded in Brown & Brown	McLean 1915	Rich-ards 1929	Knight 1936	Brown & Brown 1968	1983	2009 & 2012-13	Habitat
Cladonia ciliata var. *tenuis*					+	+	+	t
Cladonia coniocraea					+	+		t
Cladonia fimbriata					+	+	+	t
Cladonia floerkeana		+	+		+	+		t
Cladonia foliacea		+	+	+?	+	+	+	t
Cladonia furcata subsp. *furcata*		+	+	+	+	+	+	t
Cladonia furcata subsp. *subrangiformis*					+			t
Cladonia glauca					+			t
Cladonia gracilis					+		+	t
Cladonia humilis	*Cladonia conista*				+		+	t
Cladonia macilenta	*Inc. Cladonia bacillaris*				+	+		t
Cladonia parasitica						+		t
Cladonia pocillum					+			t
Cladonia portentosa	*Cladonia impexa*				+		+	t
Cladonia pyxidata					+	+	+	t
Cladonia ramulosa	*Cladonia pityrea*	+			+	+	+	t
Cladonia rangiformis		+	+	+	+	+	+	t
Cladonia scabriuscula			+					t
Cladonia squamosa var. *squamosa*					+	+		t
Cladonia subulata					+	+	+	t
Cliostomum griffithii	*Catillaria griffithii*				+	+	+	c/plant debris
Cyphelium notarisii							+	l
Diploica canescens	*Buellia canescens*			+	+		+	sax
Diplosclistes muscorum	*Diplosclistes scruposus var bryophilus*				+			t
Diplotomma alboatrum						+	+	sax
Evernia prunastri		+	+		+	+	+	t
Flavoparmelia caperata	*Parmelia caperata*		+					t
Flavoparmelia soredians							+	roof felt
Hypogymnia physodes	*Parmelia physodes*	+	+	+	+	+	+	t
Hypogymnia tubulosa	*Parmelia tubulosa*		+		+		+	l
Lecania erysibe			+		+			sax
Lecania inundata							+	sax
Lecanora actophila					+			sax
Lecanora albescens						+	+	sax
Lecanora campestris				+			+	sax
Lecanora chlarotera					+		+	c
Lecanora confusa							+	c
Lecanora conizaeoides					+		+	l
Lecanora crenulata						+	+	sax
Lecanora dispersa					+	+	+	sax
Lecanora expallens					+	+	+	c
Lecanora hagenii	*Under L. dispersa*	+?	+?	+?	+?		+	c/l
Lecanora helicopsis			+	+			+	sax

Name	Name recorded in Brown & Brown	McLean 1915	Rich-ards 1929	Knight 1936	Brown & Brown 1968	1983	2009 & 2012-13	Habitat
Lecanora muralis		+			+	+	+	sax
Lecanora pulicaris							+	c
Lecanora saligna							+	l
Lecanora stenoptera							+	l/sax
Lecanora symmicta	*Lecidea symmicta*			+	+		+	c
Lecanora umbrina	*Under L. dispersa*	+?	+?	+?				c/l
Lecanora varia					+		+	l
Lecanora zosterae	*Lecanora hageni f. zosterae*				+	+	+	Plant debris
Lecidella carpathica							+	sax
Lecidella elaeochroma f. *elaeochroma*							+	c
Lecidella pulveracea	*Lecidea pulveracea*			+				l
Lecidella scabra							+	sax
Lecidella stigmatea							+	sax
Lepraria incana					+			
Melanelixia fuliginosa	*Parmelia glabratula* subsp *fuliginosa*	+?	+?				+	l
Melanelixia subaurifera					+		+	l
Micarea erratica	*Lecidea erratica*		+	+	+		+	sax
Micarea misella	*Lecidea asserculorum*				+			l
Myriospora heppii	*Acarospora heppii*				+			shells
Parmelia saxatalis		+	+		+			
Parmelia sulcata					+	+	+	c,l
Peltigera canina		+	+	+	+		+	t
Peltigera didactyla	*P. spuria*				+		+	t
Peltigera hymenina	*P. polydactyla*		+		+		+	t
Peltigera rufescens		+	+		+	+	+	t
Phaophyscia orbicularis	*Physcia orbicularis*			+	+		+	l
Physcia adscendens				+	+		+	c,l,sax
Physcia caesia					+		+	sax
Physcia tenella		+		+	+	+	+	c,l, sax
Physconia distorta	*Physcia pulverulenta*			+				c
Placynthiella icmalea					+		+	l
Placynthiella uliginosa	*Lecidea uliginosa*		+		+			
Platismatia glauca	*Cetraria glauca*				+ (i)			l + plant debris
Polyblastia agraria							+	on moss
Punctelia subrudecta							+	l
Pyrenocollema halodytes						+		shell
Ramalina canariensis							+	c
Ramalina farinacea					+	+	+	c
Rhizocarpon hochstetteri		+?						sax
Rhizocarpon reductum	*Rhizocarpon obscuratum var. reductum*	+	+	+	+		+	sax
Rhizocarpon richardii	*Rhizocarpon constrictum*				+			sax
Rinodina oleae	*Rinodina subexigua*	+	+	+	+	+	+	sax
Scoliciosporum chlorococcum							+	c

Name	Name recorded in Brown & Brown	McLean 1915	Rich-ards 1929	Knight 1936	Brown & Brown 1968	1983	2009 & 2012-13	Habitat
Strangospora pinicola							+	c
Stigmidium marinum	Lichenicolous fungus					+	+	on lichen
Tephromela atra	*Lecan ora atra*	+		+	+	+	+	sax
Trapelia coarctata							+	sax
Trapeliopsis flexuosa	*Lecidea aeruginosa*				+		+	l
Trapeliopsis granulosa	*Lecidea granulosa*				+	+		t
Usnea hirta			+?					
Usnea subfloridana					+(i)			t, plant debris
Verrucaria ditmarsica						+	+	sax
Verrucaria halizoa		+		+	+			sax
Verrucaria maura		+		+	+	+		sax
Verrucaria mucosa						+		sax
Verrucaria muralis					+		+	sax
Verrucaria nigrescens				+	+	+		sax
Verrucaria viridula				+			+	sax
Xanthoria calcicola	*Xanthoria aureola*	+		+	+		+	sax
Xanthoria candelaria s.l.					+		+	l
Xanthoria parietina		+		+	+	+	+	c,sax, t
Xanthoria polycarpa				+	+		+	l
Xanthoriicola physciae	Lichenicolous fungus						+	on lichen
Totals 141		**27**	**27**	**34**	**91**	**49**	**94**	

Fungi on Blakeney Point

Tony Leech

It may come as a surprise that fleshy fungi can be found on sand dunes at all, but a number of species even occur on the bare sand amongst Marram *Ammophila arenaria*. It has been estimated (Spooner & Roberts 2005) that 33 species of macrofungus are known in Britain only from sand dunes. The total number of fungal species recorded from Blakeney Point is currently 90, a modest total, at least in part because visits from fungus recorders have been few. Ted Ellis recorded only six species in three visits but his primary purpose was probably non-mycological; Reg and Lil Evans did no better and were it not for two visits by Alec Bull in the 1990s the species list would look meagre indeed. In the past few years the present author has made a number of brief visits and added further species. For the purpose of recording, Blakeney Point is defined as the land along the shingle ridge west of Cley Beach and north of Blakeney Harbour and so includes the dunes of The Hood on the south side of the ridge as well as the mycologically productive 'lawns' around the Watch House. The fungi recorded (Appendix 1) are predominantly agarics, reflecting both the paucity of dead wood and the lack of recorder effort for smaller species.

The dune specialists

Two species of true mushroom, *Agaricus devoniensis* and *A. litoralis*, occur on bare sand on the Blakeney dunes, often buried up to their 'necks'. Interestingly, all the specimens of *A. devoniensis* examined had predominantly two-spored basidia and consequently larger spores than normal. Basidia are the peg-like cells on the gills on which the spores are produced. Almost always, four spores are formed on each basidium but two-spored variants are known and these are sometimes elevated to species status. I can find no record of two-spored forms of *A. devoniensis*. A smaller and rather nondescript agaric, the Brittlestem *Psathyrella ammophila* (see photograph, p.97), occurs in the same habitat.

Moving inland a little, but still in dunes with bare sand, the mushroom-like Cavalier, *Melanoleuca cinereifolia*, a scarce species in Britain, is distinguished by its grey-coloured gills. The more widespread Dune Waxcap *Hygrocype conicoides* (see photograph, p.97) is somewhat variable in colour but often deeper crimson than its meadow counterpart (Blackening Waxcap *H. conica*). The Dune Stinkhorn *Phallus hadriani* erupts from a pinkish 'egg' – and smells much sweeter than the regular Stinkhorn *Phallus impudicus* which does not occur in this habitat.

The remaining dune specialist, *Mycena chloranthes*, is a much smaller, pale greenish fungus. Although it is on Spooner and Roberts (2005) list of fungi restricted to dunes, this fungus has in fact been recorded widely inland in Norfolk by Reg Evans. It would be interesting to confirm these records.

Grassland and soil fungi

An attempt has been made in Appendix 1 to group recorded species according to habitat or substrate. The distinction between grassland species and those growing on soil (but not associated with trees) is a somewhat arbitrary one. Here it is based on general knowledge of habitats (from field guides) rather than on knowledge of where the fungus has actually been found on Blakeney Point. Many grassland fungi are found only where the nutrient levels are low and the turf is short – precisely the

conditions on many fixed dunes. A number of 'grassland' fungi actually associate with mosses rather than grasses.

A number of the agarics recorded, including *Agaricus ducidulus, Clitocybe fragrans Clitocybe nebularis Collybia dryophila* and *Hygrophoropsis aurantiaca,* are generally found on leaf litter, a material virtually absent on Blakeney Point. This probably indicates that our knowledge of habitat preference is inadequate but in some cases confirmation of identity would be helpful.

Dung fungi

The droppings of Brown Hare *Lepus europaeus*, slightly larger than those of the Rabbit *Oryctolagus cuniculus*, are abundant on the dunes. A very large number of mostly very small fungi occur on herbivore dung but are rarely seen in the field. They make their appearance when the dung is collected and kept in a moist chamber. Four of those found recently have not hitherto been recorded in Norfolk, an indication that this substrate has received little attention from the county's mycologist. In 2008 a sample of incubated dung produced a cup fungus almost as large as the pellet itself (see photograph, p.97). The specimen was initially identified as *Peziza fimeti*, but it has recently been recognised that a more widespread species, the Layered Cup *Peziza varia*, also occurs on dung (Merdari *et al.* 2012) and that specimens with smaller spores, like that from Blakeney Point, should be referred to it

A possible mycorrhizal association

Most tree species benefit from an ectomycorrhizal association with a basidiomycete fungus, nearly all of them agarics or boletes. Mineral nutrients from the fungal decomposition of humus are taken up through the roots of the tree or transported directly into the tree through connections between fungal hyphae and the roots. The fungus benefits from photosynthetic products (sugars) passing from the tree to the fungus via the same connections Not unexpectedly, in view of the paucity of woody species on Blakeney Point, only four of the species recorded are likely to mycorrhizal. It is now appreciated that the majority of vascular plants form mycorrhizal associations but for most non-woody species these do not involve fungi with prominent fruiting bodies.

In 2009, and again in 2011, a number of small, orange-brown *Cortinarius* species (webcaps) were found on fixed dunes on the Point (see photographs, p.97). Webcaps in this group are notoriously difficult to name but the species has been tentatively identified as *Cortinarius pratensis*, despite the very young gills being more deep yellow than orange. This identification has been supported, on the basis of photographs and descriptions, by Klaus Høyland (University of Oslo, Norway). It has been recorded from Scotland, Wales and the Republic of Ireland but not, until now, from England.

All *Cortinarius* species have hitherto been considered to form mycorrhizal associations with woody vascular plants, although not all of these would be classed as trees. A few of them are associated with dwarf willow species (e.g. *Salix repens*) and, more recently, have been found with Common Rockrose *Helianthemum nummularium* and Mountain Avens *Dryas octopetala*. These could be described as 'woody sub-shrubs' but none are present at Blakeney Point. It has been noted in the literature (Knudsen & Vesterholt 2012) that *Cortinarius pratensis*, however, occurs in dry grassland, sometimes in the absence of woody species.

In 2002, however, Harrington & Mitchell (2002) reported, on the basis of morphological evidence and DNA work, that *Cortinarius cinnamomeus* (very close to *C. pratensis*) was mycorrhizal with both Glaucous Sedge *Carex flacca* and Pill Sedge *Carex pilulifera.* In 2009, Peter Roberts reported in his column in *British Wildlife*

that he had found what he identified as *C. pratensis* with *Carex flacca* in grassland in Glamorganshire, again away from trees.

The only *Carex* species recorded from Blakeney Point (Pearson *et al.* 2007) is Sand Sedge *Carex arenaria*, which grows abundantly around all the specimens of *C. pratensis* observed. Mere juxtaposition does not prove a mycorrhizal association and specimens of the fungus and adjacent sedge collected in November 2013 have been sent to Dr Gareth Wyn Griffith of the University of Aberystwyth for his laboratory toinvestgate whether a biological connection between the two species can be established.

Comparison with other Norfolk dunes

Perhaps more than with most groups, the number of species of fungus recorded at a site is dependent on recorder effort but the numbers recorded at Holme Dunes NNR (121) and Winterton Dunes NNR (101) are comparable with the number at Blakeney Point. All of these figures are much lower than the number from Holkham NNR where 580 species have been recorded. One of the reasons is that there are many more habitats at Holkham, including mature pine trees and a good range of deciduous ones. At Blakeney there is also a more limited range of vascular plant species to act as hosts for microfungi. Success begets success and as one of the national mycological hotspots Holkham has attracted experts over a long period. A bonus for them is that at Holkham mycology can start in the car park but at Blakeney a 3 km walk is necessary.

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Appendix 1. Fungi recorded from Blakeney Point.

Scientific name	English name	Group	First rec.	Recorder	Habitat etc
Agaricus bernardii		agaric	1987	ALB	Grassland
Agaricus campestris	Field Mushroom	agaric	1999	ALB	Grassland
Agaricus devoniensis		agaric	2009	ARL	Dune specialist
Agaricus litoralis		agaric	1999	ALB	Dune specialist
Agaricus ducidulus	Rosy Wood Mushroom	agaric	1999	ALB	Soil, non-mycorrhizal
Agaricus subperonatus		agaric	2000	REE	Soil, non-mycorrhizal
Agrocybe pediades	Common Fieldcap	agaric	2013	ARL	Soil, non-mycorrhizal
Bovista nigrescens	Brown Puffball	gastero	1999	ALB	Grassland
Bovista plumbea	Grey Puffball	gastero	1999	ALB	Grassland
Clavulinopsis fusiformis	Golden Spindles	spindle	1999	ALB	Grassland
Clitocybe barbularum		agaric	2013	ARL	Dunes
Clitocybe diatreta		agaric	1987	ALB	Soil, non-mycorrhizal
Clitocybe fragrans	Fragrant Funnel	agaric	1987	ALB	Soil, non-mycorrhizal

Scientific name	English name	Group	First rec.	Recorder	Habitat etc
Clitocybe metachroa		agaric	1987	ALB	Soil, non-mycorrhizal
Clitocybe nebularis	Clouded Funnel	agaric	1989	REE	Soil, non-mycorrhizal
Clitocybe phyllophila	Frosty Funnel	agaric	1999	ALB	Soil, non-mycorrhizal
Clitocybe rivulosa	Fool's Funnel	agaric	1987	ALB	Grassland
Clitocybe sinopica		agaric	1987	ALB	Soil, non-mycorrhizal
Clitopilus hobsonii		agaric	1999	ALB	Dead wood
Collybia dryophila	Russet Toughshank	agaric	1997	ALB	Soil, non-mycorrhizal
Collybia erythropus	Redleg Toughshank	agaric	1997	ALB	Dead wood
Conocybe pilosella		agaric	1999	ALB	Dead wood
Coprinellus micaceus	Glistening Inkcap	agaric	1999	ALB	Dead wood
Coprinopsis cinerea		agaric	1987	ALB	Dead herbaceous material
Coprotus luteus		disco	2013	ARL	Hare dung
Cortinarius pratensis		agaric	2011	ARL	Grassland
Crepidotus cesatii		agaric	2011	ARL	Dead wood
Crinipellis scabella	Hairy Parachute	agaric	1987	ALB	Dead herbaceous material
Dacrymyces stillatus	Common Jelly Spot	jelly	1999	ALB	Dead wood
Entoloma sericeum	Silky Pinkgill	agaric	1987	ALB	Grassland
Galerina laevis		agaric	1987	ALB	Grassland
Galerina pumila	Dwarf Bell	agaric	1987	ALB	Grassland
Galerina vittiformis	Hairy Leg Bell	agaric	2009	ARL	Grassland
Handkea excipuliformis	Pestle Puffball	gastero	1999	ALB	Soil, non-mycorrhizal
Handkea utriformis	Mosaic Puffball	gastero	2009	ARL	Grassland
Hygrocybe conicioides	Dune Waxcap	agaric	2011	ARL	Dune specialist
Hygrocybe virginea	Snowy Waxcap	agaric	1987	ALB	Grassland
Hygrophoropsis aurantiaca	False Chanterelle	agaric	1999	ALB	Soil, non-mycorrhizal
Hypholoma ericaeoides		agaric	1999	ALB	Soil, non-mycorrhizal
Hypholoma udum	Peat Brownie	agaric	1987	ALB	Soil, non-mycorrhizal
Hypocopra planispora		micro asco	2013	ARL	Hare dung
Inocybe dulcamara		agaric	1987	ALB	Ectomycorrhizal
Laccaria laccata	Deceiver	agaric	2009	ARL	Soil, non-mycorrhizal
Lepiota brunneoincarnata	Deadly Dapperling	agaric	1999	ALB	Soil, non-mycorrhizal
Lepista flaccida	Tawny Funnel	agaric	2009	ARL	Soil, non-mycorrhizal
Lepista nuda	Wood Blewit	agaric	1987	ALB	Soil, non-mycorrhizal
Lepteutypa hippophaëa		micro asco	1988	REE	Dead herbaceous material
Leptosphaeria acuta	Nettle Rash	micro asco	1988	REE	Dead herbaceous material
Leptosphaeria doliolum		micro asco	1988	REE	Dead herbaceous material
Leucoagaricus leucothites	White Dapperling	agaric	1999	ALB	Soil, non-mycorrhizal
Leucoagaricus sublittoralis		agaric	1999	ALB	Soil, non-mycorrhizal
Lichenomphalia umbellifera	Heath Navel	agaric	1987	ALB	Soil, non-mycorrhizal
Lycoperdon lividum	Grassland Puffball	gastero	1999	ALB	Grassland
Lycoperdon pyriforme	Stump Puffball	gastero	1999	ALB	Dead wood
Lyophyllum connatum	White Domecap	agaric	1987	ALB	Soil, non-mycorrhizal
Macrolepiota excoriata		agaric	1999	ALB	Soil, non-mycorrhizal
Macrolepiota mastoidea	Slender Parasol	agaric	1999	ALB	Soil, non-mycorrhizal

Scientific name	English name	Group	First rec.	Recorder	Habitat etc
Marasmius androsaceus	Horsehair Parachute	agaric	1999	ALB	Soil, non-mycorrhizal
Marasmius oreades	Fairy Ring Champignon	agaric	1987	ALB	Grassland
Melanoleuca cinereifolia		agaric	2009	ARL	Dune specialist
Mycena chlorantha		agaric	2009	ARL	Dune specialist
Mycena epipterygia	Yellowleg Bonnet	agaric	1999	ALB	Dead herbaceous material etc.
Mycena leptocephala	Nitrous Bonnet	agaric	1987	ALB	Grassland
Mycena pura	Lilac Bonnet	agaric	2009	ARL	Soil, non-mycorrhizal
Omphaliaster asterosporus		agaric	1987	ALB	Grassland
Omphalina pyxidata		agaric	1987	ALB	Grassland
Panaeolina foenisecii	Brown Mottlegill	agaric	1999	ALB	Grassland
Panaeolus papilionaceus	Petticoat Mottlegill	agaric	1987	ALB	Grassland
Peniophora quercina		crust	2011	ARL	Dead wood
Peziza varia		disco	2008	ARL	Hare dung
Phallus hadriani	Sand Stinkhorn	gastero	1999	ALB	Dune specialist
Psathyrella ammophila	Dune Brittlestem	agaric	1953	EAE	Dune specialist
Psilocybe crobula		agaric	2009	ARL	Dead herbaceous etc.
Psilocybe montana	Mountain Brownie	agaric	1987	ALB	Grassland
Puccinia punctiformis		micro basid	1934	EAE	On living plant
Puccinia recondita		micro basid	1934	EAE	On living plant
Ramaria decurrens	Ochre Coral	spindle	2004	TWD	Soil, non-mycorrhizal
Rhytisma acerinum	Sycamore Tarspot	micro asco	2013	ARL	On living plant
Rickenella fibula	Orange Mosscap	agaric	1999	ALB	Grassland
Ripartites tricholoma	Bearded Seamine	agaric	1999	ALB	Soil, non-mycorrhizal
Russula exalbicans	Bleached Brittlegill	agaric	2009	ARL	Ectomycorrhizal
Russula sardonia	Primrose Brittlegill	agaric	1987	ALB	Ectomycorrhizal
Sordaria macrospora		micro asco	2013	ARL	Hare dung
Stigmidium marinum		micro asco	1983	PWL	On lichen
Stropharia coronilla	Garland Roundhead	agaric	1999	ALB	Grassland
Thecaphora seminis-convolvuli		micro basid	1981	EAE	On living plant
Torula herbarum		micro asco	1988	REE	Dead herbaceous etc.
Trichodelitschia munkii		disco	2013	ARL	Hare dung
Tricholoma terreum	Grey Knight	agaric	1989	REE	Ectomycorrhizal
Uromyces beticola		micro basid	1934	EAE	On living plant
Uromyces chenopodii		micro basid	1934	EAE	On living plant
Uromyces limonii		micro basid	1988	REE	On living plant
Vascellum pratense	Meadow Puffball	gastero	1999	ALB	Grassland
Xanthoriicola physciae		micro asco	2013	PWL	On lichen

Recorders: ALB Alec Bull
ARL Tony Leech
EAE Ted Ellis
PWL Peter Lambley
REE Reg Evans
TWD Trevor Dove

The role of the National Trust in the modern era

Victoria Egan

In its 101st year of caring for Blakeney Point, the National Trust continues to protect this iconic stretch of coastline, significant not only for its nature conservation value, for which it is internationally important, but also as an extremely popular destination for the local community and visitors alike.

Blakeney Point comprises large areas of inter-tidal mud and sand, shingle, sand dunes and saltmarsh. These four habitats are managed with a largely non-intervention approach, enabling this ever-changing landscape to be shaped by the tides and sculpted by the wind. The National Trust make small tweaks, focussing on minimising any impact upon the environment through visitor pressure, for example laying boardwalks over fragile fixed dunes and monitoring activities that could damage the site.

Whilst the habitats largely look after themselves, it is a different story for the rare and characteristic species of Blakeney Point. For birds such as Little Tern, Sandwich Tern, Avocet and Ringed Plover that choose to nest directly on the shingle, a number of measures are put in place to ensure their breeding success. These include seasonal access and dog restrictions at the most sensitive areas, breeding bird cordons, predator control, associated signs and extensive monitoring.

Ever since the ecological value of Blakeney Point was first recognised, research and monitoring has significantly contributed to our understanding of the area and to this day continues to underpin conservation management decisions. Professionals, enthusiasts, students and staff observe and record the breadth of species groups present and the species list continues to grow each year, including fungi, wasps, bees, breeding birds and plants.

Today, the number of people looking after this special place has grown from a single Watcher in 1912 to a team of up to 14 National Trust staff (General Manager, Countryside Manager, Coastal Rangers and seasonal assistants, Visitor Services Manager and seasonal assistants, Administrator), supported by volunteers and researchers. Over the last century the nature reserve has doubled in size from 507ha on Blakeney Point to the 1,117ha Blakeney National Nature Reserve. The day-to-day management of Blakeney Point is undertaken by the Coastal Ranger, supported by two seasonal assistants, based in the Lifeboat House for six months of the year. Further support is provided by the wider ranger team and overseen by the Countryside Manager and General Manager for the Norfolk Coast property. Led by the Visitor Services Manager, a team of visitor reception staff help to highlight the wildlife and happenings on the Point and provide conservation messages. This is only part of the picture as the National Trust work collaboratively in successful partnerships with a range of individuals, the local community, interest groups, landowners, statutory bodies, charities and many others who collectively contribute to, support and influence our work.

As our work has grown to protect the conservation interest and infrastructure on the Point itself (such as the newly-refurbished Lifeboat House, which is part visitor centre and part Rangers'

accommodation), so to have our costs and we are continually seeking opportunities to fund our work through membership, grant income and National Trust enterprises in the wider property. Whereas at one time our work was limited to the Point itself we now look outside our boundaries and consider external influences such as, for example, the growth of offshore wind developments, the introduction of new marine legislation and climate change, and advocate our support or raise concerns where we have the opportunity to shape thinking.

Whilst historically Blakeney Point may only have been accessible to a privileged few, today people are welcomed to enjoy the opportunities and wildlife present and experience the special qualities and spirit of the place. Through sharing the breadth of our work, engaging with visitors and promoting conservation messages, visitors and those who have an interest in the area have greater opportunities to understand the role of the National Trust and support our work, balancing access with the conservation interest for future generations to enjoy.

Blakeney Point lies within the wider Blakeney National Nature Reserve stretching from Salthouse to Stiffkey. The Norfolk Coast National Trust property is also made up of Brancaster Estate and beach, Horsey windpump and Heigham Holmes. Updates from the team are posted at www.norfolkcoastnationaltrust.blogspot.com Please phone 01263 240241 to find out more about our work and events across the property.

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The tidal surge in north Norfolk, December 2013

Richard Porter

The night of Thursday 5th December 2013 saw the Norfolk coast take a frightening and severe battering from a tidal surge in the North Sea which, coupled with exceptionally high tides and gale-force winds, resulted in the worst flooding for 60 years. Many of our important wildlife reserves were seriously impacted. Cley Nature Reserve was covered with sea water to a depth of two meters, as was the Blakeney Freshes. The well-maintained powerful sluices at Cley quickly removed the flood water, unlike those on the Freshes, where the water remained for several weeks. The flooding of such an important freshwater grazing marsh could result in the greatest long-term ecological change of the tidal surge as well as affecting the livelihoods of the graziers.

On Blakeney Point the dune cliffs were seriously scoured and the shingle ridge, from Cley to the Long Hills, smothered and smoothed by even more shingle to a depth of up to one and a half meters, transforming much of it into a barren landscape, devoid of *Suaeda* and other vegetation. This is an important breeding area for Oystercatchers, Ringed Plovers and especially Little Terns and it may well be necessary to provide boxes, pipes and other shelters for their chicks in the short-term.

When a tidal surge pounds the coast birds can fly off and are probably the least affected of all groups. Vegetation will recolonise or grow back through the shingle, albeit slowly for some species. But the greatest impact is likely to be on the smaller mammals and invertebrate populations. Brown Hares, Stoats, Weasels and voles will have certainly succumbed to the surging tide and it will be many years before the populations of butterflies and moths recover. There will be no food plants along the shingle ridge for the important populations of Small Coppers and Graylings and the small *Salix* bushes that were the home of Eyed Hawk-moth caterpillars are no longer there.

It was a surprise that most of the Grey Seal pups in the rookery survived. Over 1,200 were counted the day after the surge and it has turned out to be a record year. There were some positive impacts. For example the Sandwich Tern breeding areas on Far Point may have been improved by opening up vegetated areas and many rats – a serious tern predator - will have been drowned. Also with much vegetation washed up along the shoreline from damaged saltmarshes and dunes to the west it will be interesting to see if 2014 produces any 'new plants' for the Point.

We must not miss this opportunity to study both the short and long-term impact of this tidal surge on the populations and distributions of the fauna and flora of Blakeney Point, especially as we have very good base-line data on plants, birds, mammals, butterflies and moths.

See photographs opposite.

26 December 2013

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Grey Seals in Lifeboat Station garden, 9 December 2013. Sea water reached many areas not previously inundated.

The aftermath of the tidal surge saw areas of Blakeney Point inundated by sand. 9 December 2013.

BLAKENEY POINT AFTER THE TIDAL SURGE

Dec 2013.

Photos: Richard Porter.

Left. **Over 75% of the vegetation on the shingle ridge Blakeney Point was smothered by shingle.**

Below, left. **The flooded hides at Cley.** Parts of Cley Marshes and Blakeney Freshes were flooded with sea water for several weeks. 6 December 2013.

Below, right. **The aftermath of the tidal surge saw vegetation from saltmarshes to the west strewn along the tideline of Blakeney Point.** December 2013.

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