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# RÉSUMÉ OF THE PRESIDENTIAL ADDRESS GIVEN TO THE SOCIETY ON DECEMBER 10th 1982

by BRUCE ROBINSON

## Introduction

As a relative newcomer to the society I must express my admiration of the way in which members' interest is nurtured and retained. It is a technique the society seems to have perfected and it is due, in part, to the length of each season's programme and to its infinite variety, and more particularly, to the great enthusiasm of hard-working officials. It is also due, I am equally sure, to an increasing public interest in and an awareness of the out-doors.

At the same time the society's desire is to enlarge its membership, perhaps by attempting to bridge the difficult gap between the technical and the more easily digestible; to widen the appeal of the society. Nevertheless, it is not easy to shape a more popular appeal while continuing, in parallel, the traditional role of specialist research and recording. It is a continuing debate in a number of disciplines including, I believe, archaeology.

I am, of course, very anxious to pass on to you my recognition of the fact that the office of President is a considerable honour, and one I deeply appreciate.

I am not a historian or an archaeologist, but rather, an amateur with an amateur's interest in Norfolk landscape and history, and with a particular interest in its many tracks and lanes. What I would like to do, therefore, is to use the Peddars Way as a starting point to enable me to talk in more general terms about the tracks and roads of the county.

## Water

While out walking with tent and rucksack I have noticed on a number of occasions how, after a few days, personal priorities undergo a fundamental change and generally become distilled into five basics — food, drink, shelter, weather, and the state of one's feet. I do not believe they can have changed much over the centuries, and like to think the Romans may have suffered from blisters, too.

Another basic priority is the crossing of water which, for the Romans, was a major problem and a major accomplishment. In the circa 50 miles length of the Peddars Way in Norfolk it still crosses, even today, at least ten rivers and streams, while the recent discussion paper on the proposed Long Distance Footpath had to examine in considerable detail the provision and cost of footbridges, particularly over the rivers Little Ouse and Thet.

In Norfolk the Romans seem to have provided fords, not bridges, presumably because fords were easier to construct, cheaper, and possibly less vulnerable to attack and deterioration. It is not known if any of these fords were paved. According to the Norfolk Archaeological Unit at Gressenhall there exist records of the remains of only one (possible) Roman bridge in Norfolk, at Downham West.

At the Blackwater ford crossing of the river Little Ouse (Rushford/Knettishall) it is not absolutely clear where the ford was sited. The contours of the river have altered over the years, and the best crossing places do not necessarily remain in precisely the same place. However, the line of the Peddars Way can be traced on both sides of the river, and the fact that they are not in absolute alignment suggests that the builders may have constructed a dog-leg or Z-bend so that the road could



approach the river. It was a fairly common device. Faden's map of Norfolk (1797) indicates a number of tracks converging at this point. A number of parish boundaries and the county boundary may also be found here, suggesting that Blackwater ford is a crossing place of some antiquity.

The name Blackwater (which is fairly common in Norfolk, and elsewhere) is generally interpreted as meaning 'dark coloured water'. It is interesting that if the Little Ouse river is waded at this point the traveller inevitably leaves a very large area of disturbed and discoloured water. In consequence I have often wondered if the name Blackwater suggests crossing places, or if water courses bearing this name have or had a high ratio of fords.

At Droveaway ford, Thorpe (Woodlands) Farm, near Brettenham, which has a number of archaeological sites in the vicinity, it is again uncertain precisely where the Peddars Way crossed the river Thet. One field on the Brettenham side of the river was once known as Money Field, because of coin finds. An excavation in the area in the 1930s revealed the method of construction of the Peddars Way (from local materials) at this point, and the existence of a sort of gravel pavement or layby.

The line of the Roman road can be traced on both sides of the river, and again, it is not in precise alignment. An agger or causeway carried the road across presumably marshy ground as it approached the river. There may have been another dog-leg here, too.

At Fring Cross, on the Sedgford-Fring road, the Peddars Way crosses the Heacham river. Sometimes in summer this portion is completely dry; at other times the ford is little more than a large, shallow puddle.

### **Pre-Roman period**

The Norfolk landscape was already criss-crossed by countless tracks when the Romans arrived. The earliest trails presumably appeared after c.8000 b.c. when the last of the ice and meltwaters retreated. It may not have been until the arrival of settled Neolithic communities, and the demands of agriculture, trade and wheeled transport, etc., that any system of significance began to emerge. Even then it was presumably spontaneous, basically local, and unmaintained. However, it is thought that Iron Age trackways probably contribute more lines to modern maps than any other human factor.

One problem is the difficulty of identification. Lines of communication which have undergone hundreds of changes over hundreds of years leave few clues as to their actual origin and none, of course, are in their original state. Even so there are a number of pre-Roman possibilities in the county, among them Green Lane at Ringstead, Norwich Long Lane near Fakenham, and the better known examples of the Harling Drove and the Icknield Way. Near Larlingford (where according to Rainbird Clarke three Medieval routes -from Thetford — via East Wretham, Bridgham Heath and Brettenham — all converged before progressing to Atleborough) there is a 100 yard fragment of track (undated, but possibly Iron Age) which leads in the direction of the river.

The Cowell Stone, a glacial erratic, may have been a Roman milestone, though the matter is uncertain. It does mark the place where an east-west Roman road crossed the theoretical line of the Icknield Way (pre-Roman, but later Romanised). The crossroads and the stone also mark parish and Hundred boundaries. It does seem to have been a marker for many centuries, but it is not known when it first ar-

rived at its present position, which is to the side of the A1122 not far from the junction of the A47.

As for the Icknield Way, little is known about it. It may have had its origins in animal migration routes, but it is not known if it actually reached the sea. Nor is it known if it was the only such route or if it was particularly important. All that can be surmised is that there was a line of communication somewhere along the upper/lower slopes of the chalk ridge.

It would not have been a single continuous track. The 'way' may have been a swathe of tracks open to weather and obstruction, wear and tear, a cluster of routes which by or during the Medieval period probably coalesced into one single track. This is the line generally marked on OS maps and the line which can be traced across north-west Norfolk along B and unclassified roads. Smugglers' Road in the Stanford Battle Area is another possible example of this.

It must, however, have been meandering, for in the absence of a national plan, or a system of repair, even the growth of a small bush could be enough to cause travellers to deviate from a straight line. In terms of multiple tracks it has been suggested, for example, that in the Gayton/Grimston area the Icknield may have had an 'all weather' route to the east of a slightly shorter 'summer' track; while at Thetford (the 'people's ford') it is thought the Icknield route crossed the river in at least three places — at Nuns Bridges, Red Castle and Ditchingford.

The 'old straight track' theory does not make much sense. There is also a danger that in becoming obsessed with the Icknield Way we may overlook other routes in the county of equal if not greater historical significance.

### **Some Historic Routes**

One interesting route is the Harling Drove, or Great Fen Road, which once stretched from Hockwold towards Roudham, though the precise line and length is unknown. The Great Fen Road was a pre-Roman track, later improved and used by the Romans, and later still, used by drovers.

Another major route (in the historical sense) is the Peddars Way which might be summarised as the most important, most substantial and best preserved Roman road in Norfolk. It is considered to be of military design and proportions and was originally built on a massive scale.

Some Iron Age tracks were undoubtedly incorporated into the Roman road system which, as it developed, must have been a considerable undertaking. Because of lost and doubtful stretches an accurate count of the mileage of roads built in Norfolk is not possible. However, about 240 miles of roads, lanes and tracks are known, while an additional 80 miles at least seem possible. The original total was almost certainly much higher.

Nearly 50 per cent of the Peddars Way (Ixworth, Suffolk, to Holme, Norfolk) also represents parish boundaries. The name (Peddars Way) is not Roman and is not exclusive. It is probably Medieval and may once have been a general term for a footpath. On the other hand Norwich once (c.1780) had a ped market, peds being semi-circular baskets generally used for carrying produce.

During the last decade there has been an enormous increase of interest in recreational walking. The newly formed (1981) Peddars Way Association has over one hundred members, and interest will certainly grow even further once the county's Long Distance Footpath (Knettishall-Holme-Cromer) is finally opened.



Incidentally, I would like to pay tribute to James (Willie) Wilson, a member of this society, who died recently. Mr. Wilson was the author of the Long Distance Path feasibility study, and will be remembered, among many other things, as one of the chief architects of the route.

Yet another road, the most recent in historical terms, is also the most used and probably the least recognised. It is celebrated by the Dial monument opposite a layby on the A11 between Wymondham and Besthorpe. It commemorates the bequest of money for the building of the turnpike between Wymondham and Attleborough, and is dated 1675.

Edwin Rose, of the Archaeological Unit (whose assistance in these matters I readily and gladly acknowledge) defines the three 'ages' of planned national road building in this country as Roman, Turnpike and Modern Motorway, with everything else merely tinkering and bodging. The Peddars Way (for example) represents the first, the Dial monument (in general terms) the second. The monument, once topped by a sundial, does not, alas, indicate when the turnpike was actually built. The Act allowing construction was not passed until 1695 — 20 years later. Assuming this to be the rough date of construction, however, then the Wymondham to Attleborough turnpike was probably the first in Norfolk and may have been one of the earliest in the country aside from the London-to-York.

The toll system was unpopular and a challenge to those determined not to pay. The drovers and herds, disliking the surfaces and the tolls, avoided them. The system also took a long time to develop. It is additionally confusing that some routes were turnpiked merely in part and some not at all. Even so, by 1845 White's Directory was able to claim that Norfolk's (presumably main) roads were mostly better than elsewhere. There is little doubt that, despite its general unpopularity the toll system did help to establish a network of improved roads and turned a multiplicity of muddy tracks into systems of single routes.

It is difficult to realise that up to the turn of the century most roads, other than main roads and roads in towns, were little more than what we would now describe as muddy green lanes.

## **Farms and Fields**

It is difficult to ignore the contribution to the landscape of the unclassified roads, green lanes, paths and bridleways. They represent the forgotten/abandoned residue of Iron Age routes, farm tracks, field entrances, enclosure tracks, Medieval roads and boundaries. Many are the relics of earlier road systems, though a majority are quite impossible to date.

In 1976, incidentally, Norfolk's return to the Department of Transport showed the county possessed about 10,250 miles of roads of all kinds. Of these, about one-third were unclassified roads.

The Dartington Amenity Research Trust's Green Lanes Survey (1979, for the Countryside Commission) examined the question of green lanes in considerable detail and recommended, among other things, Path Preservation Orders, as presently for trees and buildings.

The Parliamentary Enclosures had a profound impact on the landscape and some of the effects can still be seen in the positioning of farms at the end of tracks, in fragments of field boundaries, sections of tracks and stretches of public rights of way.



Enclosures also help to explain the presence of some (modern) hard-surface lanes with unusually wide verges on one or perhaps both sides. After many of the commons were enclosed the boundaries of some lanes/roads were delineated by hedges or ditches leaving a width sufficient for wagons or herds. Later, when the time came to lay a hard surface it would have been unnecessary (and costly) to have asphalted the full width.

### **Bits and Pieces**

There are no known pilgrim, salt or drove roads in Norfolk, by which I mean roads specifically constructed by or for pilgrims, salters or drovers. What the area does have is a wide selection of routes which were, at some point, used for these purposes.

Routes, however, do tend to change. One example is the Norwich-King's Lynn link, which continues to wander in a vaguely southerly direction. The old Bawdeswell-North Elmham link was replaced by Dereham-Swaffham, which has itself been partially replaced by the Dereham-Swaffham bypass routes. Before very long we will have forgotten that in the 1970s the main route was through Wendling, Little Fransham and Necton. Some redundant pieces of the 'old' A47 are already 'preserved' as laybys and gravel dumps.

Roads can also exert influence of their own. It will be interesting to see if Hethersett crosses the present A11 to join up with the church once the proposed Cringleford-Wymondham link is built.

There are many examples of interesting and curious fragments left over from the centuries of modification and change. The cross at Mount Ephraim (Pilgrim's Walk, Weeting), for example, once marked the meeting place of two Medieval roads. Off Bradcar Lane, Shropham, is a track which still leads to a ford; while a public right of way on the Icknield Way (not far from Narborough) is 'protected' by a redundant railway bridge which still straddles a redundant and largely refilled cutting of the old Swaffham railway. Near the Devil's Ditch (Garboldisham) a public right of way has been squeezed by boundary fences to a width of about a yard.

### **Environment**

Of Edwin Rose's suggested three phases of national road building — Roman, Turnpike and Modern Motorway — Norfolk has missed out completely on the latter. What it has instead is a good collection of modern bypasses, and it is interesting to note that the speed of modern traffic on these bypasses is beginning to create new no-go areas. Some of these largely untrodden verges are beginning to resemble minor nature reserves. The Dereham bypass already provides a hay crop — just as the old Forncett station embankment once provided hay for London's railway horses.

The landscaping of new roads is given a high priority. A fixed percentage, usually about one per cent of capital cost of a road scheme, is allocated towards remedial landscaping. It is invariably used for the planting of new bushes and trees.

Perhaps we should pay even more attention to our verges and to landscaping. These new green areas may be more important and valuable than we think. One recent newspaper report suggested that because of construction work about 50,000 acres of land 'disappear' every year.

# AN ECOLOGICAL AND AMENITY SURVEY OF NORFOLK'S DISUSED RAILWAYS

by DR. R. LEANEY

Birds Place, Buxton, Norfolk.

Between 1979 and 1982 a survey of disused railways in Norfolk was carried out by members of the Norfolk and Norwich Naturalists' Society. The purpose was to obtain a record of an unusual and important habitat that is disappearing and deteriorating rapidly, and to collect information which could be of use in selecting a few stretches for conservation.

## Background

The tracks and margins of railway lines have long been well known for wildflowers. Edwardian postcards show trains stopping for passengers to pick attractive grassland flowers and more recently many a railway journey has been enlivened by glimpses of species such as Oxe-eye Daisy (*Chrysanthemum leucanthemum*) and primrose (*Primula vulgaris*) in unusual profusion.

Amongst botanists railways have been notable for the spread and persistence of flowering plants which otherwise have been very restricted in distribution in this country, often confined to coastal sand or shingle, or to bare banks, walls and other scarce open inland habitats. The spread of Oxford Ragwort (*Senecio squalidus*) from the Oxford Botanical Gardens along the Great Western Railway system is a well known example (Kent, 1964), but many others are recorded. A rare toadflax, (*Linaria supina*), has most of its inland sites on railway cinder, while the hawkweed (*Hieracium zygophorum*) has its only British site on a railway verge in the Eastern Region (Sell and West), 1980. Certain plants such as Small Toadflax (*Chaenorhinum minus*), frequent on railway tracks but rare elsewhere, and Spear-leaved Willowherb (*Epilobium lanceolatum*), are found on railway sites north of their usual range. This is further evidence for the unusual conditions railways provide for plant growth, conditions which can be expected to effect the abundance of more common and widespread species as well as the rarities.

A large number of other plants especially associated with railway habitats have been described, among them *Cochleria danica*, *Cerastium atrovirens*, *Sedum acre*, *Senecio viscosus* and *Corrigola litoralis* on the tracks, and various *Hieracia*, *Diplotaxis tenuifolia*, *Dianthus barbatus*, and *Chamaenerion angustifolium* on embankments (Lousley, 1970).

Despite the known potential of railways, comparatively little work has been carried out on them. A few local studies have been made on disused lines, at Teriotdale in Scotland (Braithwaite, 1976) and Kingsbridge in Devon (Burns, 1964), as well as in Cambridgeshire (Perring and Huxley, 1965) and Dorset (Jarman, 1974), but the only fairly large study was made in 1968 by Messenger, who carried out a complete survey of used and disused railways in Rutland.

Since 1977 the Institute of Terrestrial Ecology has instituted a random sample survey of British Rail land over the whole country, but this survey is confined to used lines.

The present survey set out to cover all the disused railways in Norfolk, but by the end of four years only about 115 km out of the 308 km of disused line had been covered. The shortfall is largely accounted for by the three lines running east

from King's Lynn and those running north and south from Yarmouth. All these sections, however, are predominantly level and experience has shown that such sections tend to be of less ecological interest. Not only do they usually have a less diverse and unusual flora, but, compared with cuttings and embankments, they much more commonly have sections that have been grazed, dumped on, lost to agricultural or used as access tracks by local farmers.

Experience from the first year showed that cuttings, and to a lesser extent, embankments, tended to support the most interesting flora, a conclusion born out by quadrat analysis in the ITE survey. By concentrating subsequent efforts on those sections, and on sections in the chalk areas of West and Central Norfolk, as well as on lines expected from past observations to be rich, it is felt that the majority of the best sites have been surveyed. Over 90% of cuttings and embankments have been recorded.

The main sites likely to be of interest that have not been covered are cuttings at Mintlyn, East Winch, West Bilney and Sandringham in the West, and near Bradwell, Belton and Fritton in the south-east.

### **Closure of Norfolk Lines**

The earliest of the surviving lines to be closed were the Mundesley — Cromer and Wells — Burnham lines, both abandoned in 1953, the latter following Coastal flooding. The Melton Constable — Themelthorpe line was closed in 1960 and the Drayton — Lenwade line in 1970. Otherwise all lines in Norfolk were closed in the period 1963-1969.

At the time of survey the great majority of lines and therefore been unmanaged for around 15 years.

### **The Structure of Railways**

The surface of tracks are composed of a 'ballast' of blast furnace slag or 'clinker', with very large particles some inch or two in diameter, beneath which is often laid a thin layer of ash or cinder ballast. Sometimes, especially in wet areas, there may be further layers beneath this of shingle and then of sand, producing an exceptionally well drained and stable surface.

In the making of the light railway between Stalham and Melton Constable, however, a simple shingle ballast from quarries near Kelling and Corpusty was largely used, without overlying cinders or clinker.

When a line goes out of use the rails are taken up but the track is left intact. However, most stretches have passed into private ownership and the farmers concerned have sometimes removed the surface clinker for road mending. Usually the thin layer of cinders beneath has been removed to, but fairly frequently cinder ballast remains at the edges in small patches. Usually the majority of the track where clinker has been removed is composed of varying mixtures of sand and gravel, but in some places the underlying earth may be exposed.

When passing through rolling country cuttings were made and the excavated material was often used to construct nearby embankments. In mid and west Norfolk, where it is near the surface, chalk may be exposed in cuttings, and embankments of almost pure chalk erected on adjacent sections. A very good example of such an embankment supporting a very rich and pure chalk flora, remains just south of Narborough.



## The Ecology of Disused Railway Lines

No detailed work has been done on the ecological factors determining the unusual flora of railways, but it is possible to speculate on some of the factors likely to be involved.

While lines are in use they are regularly sprayed with herbicide, this having taken place at least since the nineteen thirties. Used tracks are therefore virtually devoid of plant life, which is confined largely to the grass track verges, and to sidings and goods yards where spraying is irregular, and where the surfacing is often of sand and gravel more favourable to plant growth than the clinker ballast of the track proper.

One may surmise that many plants of the early colonisation phase of abandoned tracks spread from sidings, but that when conditions became favourable for establishment of grassland species on the track these derive from local sources, especially from the banks. Perring and Huxley, in their study of the abandoned Oxbridge line, found at this stage a strong correlation between species on the track and on the adjacent grass banks.

There has been controversy in the past as to whether plants first colonise and spread along used lines in a random manner, or whether used lines provide unusual conditions for dispersal. It has been suggested that the draught of passing trains can disperse propagules along the line, but Dony (1974) pointed out that the net direction of movement with trains passing equally in both directions might be expected to be nil.

This, in fact, may not be the case, for propagules released from the parent plant must find niches where they are unaffected by further draught in order to germinate, and when they do so some of the next generation of propagules could do the same. However, Dony and Milne-Redhead found three coastal species (*Cerastium atrovirens*, *Cochleria danica* and *Corrigola litoralis*) on tracks in Bedfordshire to which they must have spread at a rate of a mile a year, and it is difficult to see how this could have been achieved in this manner.

It is possible that propagules could settle preferentially in sheltered cuttings or in the lee of embankments in the same way as aphids settle in the sheltered areas beside hedges. However, it seems likely that the unusual flora of railways is to be explained chiefly by unusual conditions for establishment and persistence of species that have arrived in random fashion from elsewhere.

On the track itself it is clearly the persistence of an unusually open and competition-free habitat, without the accompanying disturbance encountered on cultivated land, which determines the occurrence of many scarce species. Many of these, such as Blue Fleabane (*Erigeron acer*), Hare-foot Trefoil (*Trifolium arvense*), Basil-thyme (*Acinos arvensis*), Squirrel-tail fescue (*Vulpia bromoides*) and fern grass (*Catapodium rigidum*) cannot grow as weeds but require open habitats, so that they are of very restricted occurrence away from areas of very poor soils like the Brecks.

Species such as these are sometimes known as thermoxerophilic, implying that they have a positive requirement for hot dry substrates. In fact most studies on species characteristic of bare nutrient — poor substrates show that they grow there not because conditions are optimal for their growth, but because they can compete more successfully in such conditions with nutrient demanding species, for if protected from competition they grow better on substrates with higher nutrient levels. Conversely it has been shown that many small creeping and rosette perennials on



dunes, species similar to those found on railway tracks, can be eradicated simply by the addition of fertiliser solutions, which enable grasses such as Red fescue (*Festuca rubra*) to take over (Willis, 1963).

When the clinker is intact the track is at first very inimical to plant growth, as the very large interstices of the clinker at first retain no water or nutrients, and here only a few deep-rooted species such as Rose-bay Willowherb (*Chamaenerion angustifolium*) and Wild Strawberry (*Fragaria vesca*) are likely to be found, obtaining nourishment from deeper layers of the track material. Only when the large air spaces fill with plant debris and wind blown mineral particles to form a soil, will a wider variety of shorter rooted plants establish themselves.

Clinker does not support lichens or bryophytes and the plant materials which accumulate must be derived mainly from vegetation on the track verges. In the present survey it was noticeable that clinker tracks overshadowed by trees and shrubs often supported very coarse herbage presumably supported by leaf fall.

On tracks surfaced with mixtures of sand and gravel, however, some water and nutrients will occur in the uppermost layers and a large variety of small short-rooted plants with low water and nutrient requirements can quickly become established as well as larger, longer rooted species with higher nutrient requirements such as Cat's Ear (*Hypochoeris radicata*) and Ragwort (*Senecio jacobaea*), rooting into deeper layers.

In both types of track nutrient levels will gradually build up with the establishment of closed grassland, or sometimes of coarse herbage made up of species such as Stinging Nettle (*Urtica dioica*) and Bracken (*Pteridium aquilinum*), this being more likely to happen where the track is overshadowed by trees and shrubs. Finally comes the arrival of shrubs and trees from the track verges. The present survey suggests that, if the material of the track is a mixture of sand and gravel, this process may be indefinitely postponed by trampling, but it would seem that clinker is too stable for this to happen. Therefore, although slag may colonise more slowly, removing it may eventually be beneficial to the flora if the line is to be walked over, as long as sand and gravel is left underneath. If pure sand remains this is too unstable to support any worthwhile flora.

When considering the grassy track verges the ecological factors determining the unusual flora are less obvious. Any extensive old grassland not sprayed with herbicide or fertilizer is obviously now of conservation significance, but clearly other factors have made the grassland of cuttings especially interesting.

The most obvious feature of cuttings with interesting floras is that their grass is composed of short and fine leaved species such as Fescues and Bents, rather than of coarse and tussocky species such as Oat-grass (*Arrhenatherum elatius*) and Cock's-foot (*Dactylis glomerata*). The latter species, especially Oat-grass, dominate many level sections of line and also most of Norfolk's roadside verges, and are well known to be associated on the whole with a poor flora. Most interesting road verge floras occur in short fine swards on chalk, on very poor soils, or on steep well drained banks.

There are many factors that could result in short swards in railway cuttings. Obviously free drainage due to slope is likely to be an important one, but the exposure of subsoils creating immature nutrient poor soils could be significant, and increased insolation of south facing slopes could also have some effect, though this factor is more likely to influence the flora in other ways. It is known that some

species such as Stemless thistle (*Cirsium acaulon*) occur north of their normal range on south facing slopes because increased insolation enables them to ripen their seeds in such situations. However, all these factors apply as much to embankments as to cuttings, and the only occasion that any marked difference was noticed between north and south facing slopes was on the exceptionally free draining chalk embankment at Narborough, where the flora on the south facing banks is markedly richer.

One factor that could specifically enhance the flora of cutting is grazing by rabbits, which are found in much higher numbers on cuttings than on other sections of line. This is most likely to be the case in calcareous areas, for chalk floras are known to be especially favoured by short swards and to withstand grazing well. Just south of Walsingham are three deep cuttings with much evidence of rabbit activity and with rich chalk floras. These floras are similar to that found nearby in a shallow cutting at Wighton, where the grass is longer and there is little evidence of rabbit activity, but at Walsingham there is unusually abundant marjoram (*Origanum vulgare*) not found on the Wighton cutting, and it is also noticeable that tree and scrub growth is minimal, presumably due to erosion and the selective grazing of tree seedlings by rabbits. It would appear therefore that rabbit grazing can maintain chalk floras and even enhance them, while preventing reversion to scrub, perhaps indefinitely.

In non-calcareous areas, however, rabbit grazing appears less likely to have favourable effects. When grazing is heavy classical rabbit resistant floras develop, as at Wortwell, comprised of species protected from grazing by rapid vegetative growth, hairiness, prickliness or unpalatability. These floras occur elsewhere in cuttings and although interesting ecologically seldom contain attractive or scarce species. It is possible, however, that lesser degrees of rabbit grazing can favour such species on occasions in non-calcareous areas.

The exposure of immature soils, free drainage, unusual insolation and rabbit grazing may all have contributed in the past to the special floras of cuttings and embankments, when compared with other unimproved grasslands, and may continue to do so, but it seems that regular cutting was the chief factor and that now this has ceased these factors are of comparatively little significance. The present survey shows that most railway grasslands away from calcareous areas are now dominated by coarse grass species and show a low diversity of herbs, even on cuttings and embankments. The large species lists and continuing interest of disused railways for flowering plants are not on the whole due to the presence of extensive rich grassland communities such as are found on traditionally maintained meadowland, but to the development of an unusually large number of different habitat niches in addition to grassland.

On the tracks the presence of clinker, cinders, and different mixtures of sand and gravel, together with different degrees of trampling gives a mosaic of different conditions for plant growth. At the edge of the track grass encroaching from the verges creates a thin short sward which is very favourable to the growth of smaller grassland herbs, which are no longer able to survive in the coarser grassland of the verge itself. This region often supports some of the most interesting species, as will be described later.

On the verges themselves the interaction of different soil types, slope, rabbit grazing and varying degrees of shade, again produce a large number of different habitat riches. On very steep shady banks erosion and shade produced a very open

habitat supporting woodland and hedgerow species, especially where Ash had colonised rather than Hawthorn, while just above the track edge there is often a characteristic bare and partially shaded area supporting a sparse flora in which species of *Hieracium* are typically found.

These new niches have compensated in some degree for the deterioration of the railway grasslands due to cessation of cutting, which was carried out in the days of steam to prevent the accumulation of combustible mats of dead grass. Cutting ceased on used lines, which the demise of steam, roughly at the same time that disused railways became abandoned, so that one would expect that the grassland had deteriorated in much the same way on used and disused lines. An analysis of the ITE survey findings for Norfolk used lines produced only about thirty species not found in the disused railway survey, the total for disused lines being over five hundred, so that this would seem to be the case.

This similarity between used and disused railway floras and the fact that they are deteriorating in much the same way, makes it important to identify sections of disused as well as used line for conservation. Surveys like the present one should therefore be a valuable adjunct to the national ITE survey of used lines.

## Methods

Lengths of line selected for survey were divided into sections for recording purposes. During 1979, when the Stalham to Aylsham line was covered, these sections were approximately 1 Km in length, but in subsequent years they were longer on the whole, usually between 1.5 and 3 Km.

Each section was walked by small groups of observers for approximately 3 hours, nearly always on one occasion only, and surveying was carried out between the end of April and mid-September. Full lists of flowering plants and ferns were made, and all birds and butterflies seen were recorded. Other groups, such as moths, lichens and mosses were recorded when the specialist knowledge was available. The abundance of vascular plants was recorded on most sections using the usual five point abundance scale, so that some sort of comparison would be possible later, for instance for management purposes.

Since each section was only surveyed once on the whole the species found represent very much the minimum present. Visits early and late in the season will have very much under recorded flowering plants and butterflies, and records of butterflies and birds will have been influenced by weather conditions. For these reasons the scoring for butterflies and birds takes account of suitable habitat as well as actual species recorded.

Notes were also taken for each section of the attractiveness of the line itself and of surrounding countryside, so that some idea of the amenity value of each section could be gained.

## Findings

### General Vegetation

A rough analysis was made of scrub cover using a scoring system of 1-5 and the average figure obtained was 2.6, indicating that the disused railway lines as a whole are at present roughly half scrubbed over. No sections were completely overgrown and even in the very few where the grass verges were completely scrub covered inva-



sion virtually never extended across the track, progress being impeded on occasions, however, by rank herbage such as Stinging nettles and Bracken.

It seemed that the stretches showing most scrub growth were shallow cuttings and embankments, with level sections next and deep cuttings the least scrubbed. It was noticeable that embankments often show large areas dominated by tree saplings, especially Ash and Sycamore, whereas cuttings and level sections are more likely to support true scrub of prickly species such as Hawthorn, Bramble and Blackthorn. The likely explanation of these observations is that higher rabbit populations occur in the seclusion of cuttings and level sections than on exposed embankments, and that selective grazing of tree seedlings tends to prevent all but the prickly species from becoming established on these stretches. In a few very deep cuttings the combination of grazing by very high rabbit populations and erosion may prevent scrub and tree growth, at least for a very long time.

The predominant invading species in most areas are Hawthorn and Bramble, characteristically with many scattered young Oaks. Blackthorn, Goat Sallow, Dog Rose, Ash and Sycamore are also frequent. In heathland areas Silver Birch (*Betula pendula*) is often dominant, and in chalk areas Ash is more frequent and sometimes dominant, with Dogwood (*Thelycrania sanguinea*), Purging Buckthorn (*Rhamnus catharticus*) and Sweet Briar (*Rosa rubiginosa*) more common and on occasions abundant. In a few heathland sites large areas of bank are sometimes dominated by Bracken, Ling or Gorse.

### Verge Floras

As described the coarse grassland now found on most track verges in non-calcareous areas is not rich in herbs. However, it is notable for vigorously growing and attractive species such as Field Scabious (*Knautia arvensis*), Knapweed (*Centaurea nemoralis* agg.), Meadow Vetchling (*Lathyrus pratensis*), Tufted Vetch (*Vicia cracca*), and Toadflax (*Linaria vulgaris*), and continues to support good populations of 'Brown' butterflies, especially of Meadow Browns and Ringlets, as will be described below. It is probably the butterflies rather than the flowers that are now the most important feature of these coarse grasslands.

On a few non-calcareous verges with shorter grass swards, especially in cuttings or on very light soils, the flora is richer, with species such as Meadow Saxifrage (*Saxifraga granulata*), Oxe-eye Daisy (*Chrysanthemum leucanthemum*), Wild Strawberry (*Fragaria vesca*), Harebell (*Campanula rotundifolium*), Sheep's-bit (*Jasione montana*), Orpine (*Sedum telephium*), Spotted Orchid (*Dactylorhiza fuchsii*) or the Hawkweed (*Hieracium umbellatum*). Along the lower margins of shaded cutting banks hedgerow species such as Primrose (*Primula vulgaris*), Common Violet (*Viola riviniana*) and Herb Bennet (*Geum urbanum*) occur, and in this region the scarce hawkweeds *Hieracium anglorum* and *H. perpropinquum* are frequent in small numbers.

The grass verges in calcareous regions are almost always much richer. On sections between Swaffham and Narborough an extremely rich flora is found with up to 20 calcicoles, a very large proportion of the Norfolk chalk flora. These include Felwort (*Gentianella amarella*), Stemless Thistle (*Cirsium acaulon*), Small Scabious (*Scabiosa columbaria*), Hairy Rock-cress (*Arabis hirsuta*), Glaucous Sedge (*Carex flacca*), Pyramidal Orchid (*Anacamptis pyramidalis*), Ploughman's Spikenard (*Inula conyza*), Thyme (*Thymus pulegioides*), Dropwort (*Filipendula vulgaris*) and Carline



Thistle (*Carlina vulgaris*). While on the Narborough embankment Marjoram and Purging Buckthorn are as common as anywhere in Norfolk.

On the Wells - Fakenham line the banks in most sections also contain a rich chalk flora with up to 11 calcicoles. On these sections there is a very varied flora with higher species totals than on the purer chalk grasslands, perhaps partly due to rabbits. A large range of interesting species occur such as Tall Broomrape (*Orobancha elatior*), Wild Clary (*Salvia horminoides*), Dark Mullein (*Verbascum nigrum*), Soapwort (*Saponaria officinalis*), Vervain (*Verbena officinalis*), Gromwell (*Lithospermum officinale*) and locally abundant Cowslip (*Primula veris*). Other lines with a chalk flora are found near Docking and in central Norfolk.

On lines in central Norfolk, namely those between Swaffham and Watton, Swaffham and East Dereham, those running north and west of Melton Constable and that running south-east from Wymondham, interesting floras occur. These floras are associated with chalky boulder clay and have a mixture of calcicoles and plants typical of heavy soils such as Rough Hawkbit (*Leontodon hispidus*), Hedge Bedstraw (*Galium mollugo*), Fairy Flax (*Linum catharticum*), Wild Basil (*Clinopodium vulgare*), Small Scabious (*Scabiosa columbaria*), Kidney Vetch (*Anthyllis vulneraria*), and Burnet Saxifrage (*Pimpinella saxifraga*) in the first group, and Hawkweed Ox-tongue (*Picris hieracoides*), Sping Restharrow (*Ononis spinosa*), Hoary Ragwort (*Senecio erucifolius*) and Hoary Plantain (*Plantago media*) in the second group.

### Track Floras

The floras of tracks composed of sand and gravel, of cinders and of clinker are quite different in the early stages of colonisation, but become more similar as grass invades. Examples of typical floras of each type are listed in table I.

On sand and gravel the most widespread and abundant herbs at first seem to be Ragwort (*Senecio jacobaea*), Cat's-tail (*Hypochoeris radicata*), Ribwort Plantain (*Plantago lanceolata*) and Yarrow (*Achillea millefolium*). Also common are the Mouse-ears (*Cerastium holosteoides* and *C. glomeratum*), Wild Carrot (*Daucus carota*) and Spear Thistle (*Cirsium vulgare*), while Wall Speedwell (*Veronica arvensis*), Hairy Bittercress (*Cardamine hirsuta*), Parsley Piert (*Aphanes arvensis* agg.) the Thyme-leaved Sandworts (*Arenaria serpyllifolia* and *A. leptoclades*), Dandelion (*Taraxacum officinale*), Black Medick (*Medicago lupulina*), Hop Trefoils (*Trifolium campestre* & *T. dubium*) and the Sow Thistles (*Sonchus asper* and *S. oleraceus*) are all frequent. More occasional are Field Woodrush (*Luzula campestris*) Soft Trefoil (*Trifolium striatum*), Daisy (*Bellis perennis*), Wall pepper (*Sedum acre*) and Slender Cudweed (*Filago minima*). While Common Cudweed (*Filago germanica*) is more typical of rabbit grazed banks and Mouse-ear Hawkweed (*Pilosella officinarum*) is more characteristic of cinder patches.

The grasses that first invade sandy and grassy tracks with these herbs are *Bromus mollis*, *Festuca rubra*, *Poa annua*, *Vulpia bromoides*, *V. myuros*, *Aira praecox*, *A. caryophyllea* and *Catapodium rigidum*, all of which are frequent. Non-flowering plants are represented by lichens especially species of *Cladonia* and *Peltigera*. *Cladonia fimbriata* and *Peltigera canina* being the most frequently found species. Mosses such as *Brachythecium rutabulum* are rather scarce.

Patches of cinder track are rather rare and usually of small extent so that chance colonisation is likely to determine the flora to a large extent. It is thus dangerous to describe a 'typical flora', except in the case of the most regular and abundant

species. These seem to be Mouse-ear Hawkweed (*Pilosella officinarum*), the lichen *Cladonia fimbriata*, Wild Strawberry (*Fragaria vesca*), St. John's Wort (*Hypericum perforatum*), the Thyme-leaved Sandworts (*Arenaria serpyllifolia* and *A. leptocladus*) and Early Forget-me-not (*Myosotis ramosissima*), while Storksbill (*Erodium cicutarium*), Basil Thyme (*Acinos arvensis*) and the lichen *Peltigera canina* are all frequent. Mosses including *Ceratodon purpureus* occasionally become dominant.

When cinder communities are undisturbed by rabbit activity, they are often dominated by closed pure growths of Mouse-ear Hawkweed, sometimes with areas also dominated by *Cladonia* or Wild Strawberry. It is noticeable that such areas support very little grass and that larger herbs have as yet rarely established themselves. At Hunworth Foxglove (*Digitalis purpurea*) grows only to the rosette stage on cinders, which is clearly inimical to plant growth and may take a very long time to become invaded by coarse herbage and scrub.

It is difficult to define a typical early flora of clinker tracks, as it is made up in any one case of just a few of many possible species. It is more the process of colonisation described previously that is characteristic, with large long-rooted herbs being succeeded by smaller herbs and then by grassland communities as the spaces between the very large particles fill up with soil materials. The first species to colonise may be Wild Strawberry, Rose-bay Willowherb, Ragwort or, more occasionally, Sticky Groundsel (*Senecio viscosus*) or Oxford Ragwort (*Senecio squalidus*). At a later stage a wide variety of the small species found on the other track materials can establish themselves, before a thin grassy covering develops in which species characteristic of grassland may for a while find an unusual competitive advantage. This is the stage reached in the example from Ingoldisthorpe.

As was expected a number of scarce or local species were found in unusual frequency or abundance on the tracks surveyed. The chief of these were Wild Strawberry, often abundant, Rat's-tail Fescue (*Vulpia myuros*), quite a common finding sometimes in some abundance, Basil Thyme (*Acinos arvensis*), Hare's-foot Trefoil (*Trifolium arvenses*), Blue Fleabane (*Erigeron acer*), Centaury (*Centaureum erythraea*) and Small Toadflax (*Chaenorhinum minus*).

Being composed of similar materials, tracks mostly have floras which vary little from region to region and which bear little relation to the soil types in their vicinity, though this is not the case between Swaffham and Narborough where the tracks are now surfaced with calcareous materials. Here the Eyebright (*Euphrasia memorosum* var. *calcareae*) is extremely abundant along with Ploughman's Spikenard (*Inula conyza*), Kidney Vetch (*Anthyllis vulneraria*) and other calcicoles, as well as Breckland specialities like Glabrous Rupturewort (*Herniaria glabra*) and Sickle Medick (*Medicago falcata*). At Felmingham damp sand has been left after removal of more superficial layers and this unusual track material supports two rarities, the catchfly *Silene gallica* ssp. *quinquevulnera*, and the rush *Juncus tenuis*.

At the edge of the track there is often a zone where grass has begun to encroach from the verges. This short and rather open sward supports more delicate grassland species than can now survive on the banks, characteristic species being St. John's Wort (*Hypericum perforatum*), Hop Trefoil (*Trifolium campestre*), Lesser Yellow Trefoil (*T. dubium*), Black Medick (*Medicago lupulina*) and Common Vetch (*Vicia sativa* agg.). As colonisation proceeds these species, together with grasses, spread across the track, sometimes together with Kidney Vetch or Wild Basil in calcareous regions, before being superseded by coarser herbage and scrub.



It is on these thinly grassed track edges that many scarce and rare plants now occur. Examples of the former are Dark Mullein (*Verbascum nigrum*), Hoary Mullein (*V. pulverulentum*), Wild Clary (*Salvia horminoides*) and Burnet Saxifrage (*Pimpinella saxifrage*), while the rarities *Lotus tenuis* and *Lepidium heterophyllum* are also to be found in this zone in unusual frequency. *Lotus tenuis* occurs at four sites, compared with four previous records for Norfolk, while *Lepidium heterophyllum* occurs in three.

Of the classical railway track species, Sticky Groundsel, Small Toadflax and Wall-pepper were all found, though only the last two with any frequency. Classical verge species recorded were Rose-bay Willowherb, Ox-eye daisy, Primrose, various *Hieracia* and *Diplotaxis tenuifolia*. Of all these species, Rose-bay Willowherb would appear to be the only one increasing.

One of the interesting features of the survey was the light shed on the distribution of certain scarce or local species. Railways, being a widely distributed network of unimproved grassland in close proximity to farmland, should reflect the past distributions of plants on adjacent agricultural grasslands now ploughed up or improved. Furthermore, a fairly systematic recording of species present on railways would, in the case of plants characteristic of road verges and waste ground, indicate distribution patterns obscured by the effects of random and chance recording.

One unexpected finding was the restriction of Salad Brunet (*Poterium sanguisorba*) to lines between Wells and Fakenham and around Melton Constable, the species being consistently absent from the extremely rich and purer chalk floras found further south-west, notably between Swaffham and Narborough.

Also of interest was the confinement of the rare English Stonecrop (*Sedum anglicum*), Orpine (*Sedum telephium*), Harebell (*Campanula rotundifolium*), Meadow Saxifrage (*Saxifraga granulata*) and Tree Lupin (*Lupinus arboreus*) to lines in the north-east of the county. This finding presumably relates to the preference of all these species for light soils, but fuller analysis of the data might well produce more unexpected distribution patterns, like that for Salad Burnet.

The value of railways as records of past distribution patterns may not be confined to plants. Other groups, especially those with limited powers of spread, such as grasshoppers, molluscs and some of the Lepidoptera, could repay study from this point of view.

A notable feature of the survey was the frequent occurrence of a wide variety of scarce plant species in addition to those already mentioned. This is indicated by the very high total of flowering plants, over 500. Special mention should also be made of the discovery of *Oenothera stricta*, a first record for Norfolk, near Sidestrand.

## Lepidoptera

One of the most striking findings was the wide distribution of Brown butterflies (*Satyridae*), which was found on virtually every section visited in June or July. The survey would suggest that these species occur on every stretch of line apart from those few where scrub growth is almost complete. The most widespread and abundant species encountered was the Meadow Brown (*Maniola jurtina*), but the Gatekeeper (*Pyronia tithonius*) and Ringlet (*Aphantopus hyperantus*) were also frequent, sometimes in very large numbers. The Small Heath (*Coenonympha pamphilus*) occurred on a few sections with short sparsely grassed areas. The Wall Butterfly (*Lasiommata megera*) was seen on one occasion.

Other butterflies encountered fairly frequently were the Small Copper (*Lycaena phlaeas*), recorded from 6 sections, the Common Blue (*Polyommatus icarus*), recorded from 8, and the Small Skipper (*Thymelicus sylvestris*), seen on 10. The Brimstone (*Gonepteryx rhamni*) was seen on 3 sections and the Orange Tip (*Anthocaris cardamines*) on 2. The more migratory Nymphalidae were recorded as quite frequent visitors, but it was difficult to know whether they were breeding.

Since no night trapping was carried out only a very superficial idea was gained of the moth fauna. Day flying moths were frequently seen and were quite common on some sections, especially Stody - Ingmote Hill, Attlebridge, and Wighton - Walsingham. The Cinnabar (*Callimorpha jacobaea*) and the Yellow Shell (*Euphyia bilineata*) were the most widespread species. Twenty five species were recorded including the Mullein Moth (*Cucullia verbasci*), the Emperor (*Saturnia pavonia*), the Large Emerald (*Geometra papilionaria*), Latticed Heath (*Chiasma clathrata*), and Buff Footman (*Lithosia deplana*). Six-spotted Burnets (*Zygaena filipendulae*) were quite common on a few sections.

## Birds

Lack of time precluded any proper study of breeding bird populations, but a fair range of scrub and grassland breeding species were seen during the summer and can reasonably be assumed to breed. The most widespread were Grey Partridge (*Perdix perdix*), Red-legged Partridge (*Alectoris rufa*), Turtle dove *Streptopelia turtur*, Dun-nock (*Prunella modularis*), Whitethroat (*Sylvia communis*), Lesser Whitethroat (*Sylvia curruca*), Willow Warbler (*Phylloscopus trochilis*), Robin (*Erithacus rubecula*), Blackbird (*Turdus merula*), Yellowhammer (*Emberiza citrinella*), Goldfinch (*Carduelis carduelis*), Linnet (*Acanthis cannabina*) and Redpoll (*Acanthis flammea*).

A Nightingale (*Luscinia megarhynchos*) was recorded on one section and on 2 sections visited frequently Green Woodpeckers (*Picus viridis*) were regularly seen. The high ant populations of many stretches of line may well be important to this species. Family parties of Red-legged Partridges and Redpolls were seen and a notable feature was the abundance of breeding Lesser Whitethroats. Turtle Doves were usually abundant throughout the breeding season and a party of over 90 on an embankment at Little Dunham in mid-August may well have been locally bred birds.

Lesser Whitethroats and Turtle Doves both need particularly well grown hedges for breeding and are both very sensitive to the kind of severe hedge trimming that has become so widespread in Norfolk over the last 10 years (Bull, Mead and Williamson, 1976). Their abundance as breeding birds is therefore a good indication of the value of disused railways as refuges for species displaced from agricultural land by hedge attenuation. A further indication is the fact that virtually all the commonly encountered species were typical scrub and hedge nesting species.

The suitability of disused railways for scrub breeding species is enhanced by the fact that Bramble and Hawthorn are the two commonest scrub species present. Bramble is the favoured breeding site of *Sylvia* Warblers and Hawthorn the most important secondary site for the Lesser Whitethroat (Mason, 1976). The presence of large amounts of unimproved grassland with its invertebrate fauna is also significant, especially for species such as the Whitethroat and Willow Warbler, which are known to depend to a large extent on grass and small herbage for nesting food supplies (Murton, 1971).



As with butterflies, the scoring system includes a special section for birds and takes account of suitable habitat as well as of birds actually seen. Any score of 3 or over indicates good breeding habitat.

### Other Fauna

As would be expected with the presence of much sparsely grassed warm sand and gravel, ants and grasshoppers were frequent and sometimes quite abundant on the tracks. No unusual snails were noted in non-calcareous areas but on the chalk a greater variety were found, as between Wighton and Walsingham and at Narborough. The only reptiles seen were the occasional Common Lizard (*Lacerta vivipara*) and one Adder (*Vipera berus*), while the only notable mammals were Foxes (*Vulpes vulpes*), which were fairly frequent and Stoats (*Mustela erminea*). Two possible sets of the Badger (*Meles meles*) were also found.

The data collected could be of interest to anyone wanting to make further studies of any of these groups. On ecological grounds and from the information collected, it would seem that Ants, Grasshoppers and, in calcareous areas, Snails, are the most likely groups to repay further study.

### Scoring

In order to give an easily accessible measure of the conservation and amenity importance of each section of line, a scoring system has been devised similar to that used in the Society's Ecological Review of the Yare Valley (Watts, Hornby, Lambley and Ismay, 1976).

The present score gives most weight to botanical interest, especially to the presence of scarce, interesting or attractive species, with rarities and total counts being given rather less weight. Ideally much more weight would have been given to butterflies, but the records obtained were too haphazard to justify a high score, which would have made the overall conservation score unreliable.

The scoring system used is as follows:—

- |  |                |
|--|----------------|
| (a) Total no. of vascular plants (up to 40 = 1; 40-80 = 2; 80-120 = 3; 120-160 = 4; 160-200 = 5)   | Max. score 5   |
| (b) Number of vascular plant rarities (Number of species recorded in Norfolk less than 15 times, multiplied by 2)  | Max. score 10  |
| (c) Number of interesting, attractive or scarce vascular plants (Total divided by 2)   | Max. score 15  |
| (d) Presence of typical railway habitat (unscrubbed cutting or embankment slopes; ballasted track; rough assessment)   | Max. score 5   |
| (e) Presence of unusual habitat types (chalk, damp sand, cinders; rough assessment)  | Max. score 5   |
| (f) Presence of Butterflies or good Butterfly habitat (Poor habitat = 0; fair habitat = 1; good habitat = 2; some seen and/or very good habitat = 3; good numbers seen = 4; wide variety seen = 5) | Max. score 5   |
| (g) Presence of Birds of good Bird habitat (as for butterflies)  | Max. score 5   |
| (h) Total Nature Conservation Score  | Max. score 50  |
| (i) Views  | Max. score 20  |
| (j) Attractiveness of line itself  | Max. score 20  |
| (k) Educational and Research Value   | Max. score 10  |
| (l) Total Amenity Score  | Max. score 50  |
| (m) Total Conservation Score   | Max. score 100 |
| (n) Grade (0-20 = 5; 21-40 = 4; 41-60 = 3; 61-80 = 2; 81-100 = 1)  | Max. score 5   |

The Total Nature Conservation Score is an indication mainly of botanical interest, but it is to be hoped that the scores for butterflies and birds will be useful pointers to further studies. Further information on these and other groups can be found in the text earlier, but more detail can be given on request. The amenity scores should give some help in deciding which stretches would best be suited to recreational or educational use. The full scoring analysis is shown in Table II.

### Summary of Conservation Value

The Conservation Value of disused railways can be assessed in various different ways. It is proposed to consider the problem from the viewpoint first of the whole system, secondly at parish level, and lastly from the view point of individual sections of outstanding interest. Each of these view points is relevant to different practical ways in which conservation measures could be worked out.

The survey covered roughly 73.5 miles of railway comprising roughly 440 acres of land. Over five hundred species of vascular plant were recorded, which is a very high count for this area of land, much higher than most nature reserves of similar acreage.

This number includes 13 rarities (species or forms recorded in Norfolk less than 15 times) which are *Silene gallica* ssp. *quinquevulnera*, *Hieracium anglorum*, *Juncus tenuis*, *Lotus tenuis*, *Lepidium heterophyllum*, *Oenothera stricta* (first record for Norfolk), *Sedum anglicum*, *Euphrasia nemorosa* var. *calcareae*, *Hieracium aurantiacum*, *Hypericum montanum*, *Melampyrum pratense*, *Epipactis helleborine* and *Barbarea intermedia*. More important though, the system as a whole must support a high proportion of the Norfolk populations of a good number of scarce plants, especially the seven track specialities listed earlier, and of some butterflies, notably the Meadow Brown, Ringlet, Gatekeeper and Common Blue, all of which are becoming increasingly scarce with the loss of unimproved agricultural grassland and deterioration in road verge habitats.

The large and widespread populations of these scarce plants and butterflies on disused railways is justification for attempts to conserve a large proportion of the system, for instance by designation as long distance paths. Unfortunately much of this ecological interest will disappear unless scrub can be controlled. This seems at the moment to be impossible, except perhaps for a few rich areas, though economic improvement in the future could change the situation.

It is also helpful to consider the importance of railways at the farm and parish level. Unless a farm contains herb rich marsh, fen or woodland, it is unlikely to support nowadays more than about 40-50 species of flowering plants, whereas a disused railway running through it will often support twice this number. In addition, a simple calculation will reveal that the disused railway could increase the bird nesting population of the farm by up to 2½ times, with up to 7 times the species breeding (Leaney, 1982), presuming that the farmer has cut down his hedges to three foot high, as is usually the case. Furthermore, because of unusual habitat features, such as slope, and unusual substrates, the railway will usually contain a good number of plants and butterflies not found in the parish or on other grassland remnants, such as road verges and the churchyard.

Disused railways therefore represent a definite amenity for a parish, a place where parishioners can see in a small area a good variety of plants, butterflies and birds, that they are unlikely to see elsewhere in the vicinity. Co-operation between

the owner and the Parish Council to arrange scrub control by scouts or other volunteers, and to designate lines as footpaths or nature study areas for local schools, could therefore be well worthwhile.

Disused railways are mainly characterised by a thin scattering of scarce plants and butterflies, rather than by the presence of concentrated rich animal and plant communities. Nevertheless, quite a number of such areas have been identified, and they deserve special attention by planning authorities and conservation organisations as possible reserves.

Notable among these are the three surviving sections between Swaffham and Narborough, and the Wells-Fakenham line, especially the sections between Wighton and Houghton St. Giles. All these sites support short chalk grassland on steep, well-drained slopes. Although quite a number of areas of level chalk grassland occur in West Norfolk around a few fens and on old common land such as Thompson Common, Foulden Common, Lambs Common and East Walton Common, typical short chalk grassland of "downland" type is of extreme rarity in Norfolk. Apart from these railway lines it occurs only at Warham Camp, Cockthorpe Common and Ringstead Downs, together with one or two remnants of the Devil's Dyke.

The Swaffham-Narborough and Wells-Fakenham stretches are therefore of great importance. Evidence from the Ecological Data Bank at the Norwich Castle Museum shows that only Warham Camp and Cockthorpe Common are now comparable with the remaining Swaffham-Narborough sections. The embankment at Narborough, in fact, supports more calcicolous flowering plant species than either of these sites in a similar acreage, and could be the richest chalk site left in the county. Certainly it is richer by all accounts, and from Data Bank evidence, than the Norfolk Naturalist Trust's only chalk grassland reserve at Ringstead Downs.

A number of lines were identified which, because of their combined attractiveness and ecological interest, warrant retention and management as long distance footpaths. Outstanding among these are the lines between Wells and Fakenham, Melton Constable and Holt, Weybourne Heath and Kelling Heath (though at present this is being re-opened as a railway), Drayton and Lenwade, and North Walsham and Mundesley. As will be seen, the scoring for these stretches shows that all of them, in terms of attractiveness, views and ecology, are at least as deserving of conservation as the stretch between Stalham and Aylsham which was recently been designated by the County Council as a long distance footpath.

There are undoubted difficulties in designating these lines as further long distance footpaths, as they are privately owned, but in a county very lacking in footpaths and views it would be a great shame if these routes were lost to public use. The first three especially have some of the most beautiful views to be encountered in Norfolk, and by a happy coincidence are also of considerable ecological interest, while the last two are attractive and interesting walks conveniently close to centres of population.

A number of other sections should be singled out as having very high nature conservation scores, with unusually good numbers of scarce plants and good varieties of butterflies and birds. These sections, at Felmingham, Corpusty, Attlebridge, Knapton, and between Stody and Ingmote Hill, also deserve consideration as reserves. It is possible that organisations such as the British Butterfly Conservation Society, local Natural History Societies, or schools, could run them as reserves and arrange scrub control in co-operation with the owner. Two other sec-



tions, Mundesley to Gimmingham and at Ovington, have similar high nature conservation scores but are unattractive and difficult to walk because of fragmentation and impenetrable vegetation respectively.

Since most lines are bound to be left unmanaged, it is important to consider their importance when they completely scrub over. Lines passing through farms with the usual three foot hedges would go on supporting the majority of those farm's breeding birds, both in terms of population and of species, for a very long time. A network of such scrubbed lines throughout the county would act as a valuable refuge for species dependent for nesting on scrub or well grown hedges, besides providing much food and sheltered roosting sites for wintering thrushes and other species (Hughes, 1977). In the very long term, scrub would give way to oak, ash, or sycamore woodland, and the importance for nesting would diminish unless maintained by occasional coppicing.

### **Management of Disused Railways for Nature Conservation**

The survey of many stretches of railway at different stages of colonisation suggests that the fauna and flora associated with the grassland does not significantly deteriorate until scrub cover reaches about 50 per cent, while the breeding bird population is likely to be maximal at this point. It is therefore suggested that, if scrub control is possible, it should, as a general rule, aim to prevent scrub cover progressing beyond this point.

Our observations would also suggest that once clinker ballast begins to be invaded by coarse herbage or scrub it could profitably be removed to expose the sand and gravel beneath. This is more unstable and its interesting flora could thus be maintained by the trampling of walkers, or if this were not sufficient, by the periodic use of a harrow or cultivator pulled by a tractor. Removal of clinker should ideally be carried out in steps and at a stage when interesting species still present on less overgrown sections can colonise newly exposed sand and gravel. The clinker should not be removed if pure sand or topsoil is exposed underneath.

Scrub could profitably be coppiced in rotation for this can double or treble the breeding population (Williamson, 1968; Wilson, 1978). Scattered trees should be left for species such as Chaffinch, Yellowhammer and Lesser Whitethroat, where breeding is dependent on the presence of song posts.

Otherwise management would be along well established principles with controlled grazing or infrequent cutting where possible to enhance the grassland flora.



**Table I**  
**Examples of Track Floras**

Abundance	Cinders (Hunworth)	Sand and Gravel (Honing)	Clinker (Ingoldisthorpe) (late colonisation phase)
Abundant	<i>Hieracium pilosella</i>	<i>Plantago lanceolata</i> <i>Hypochaeris radicata</i>	
Common	<i>Veronica arvensis</i> <i>Fragaria vesca</i> <i>Cladonia fimbriata</i> <i>Hypericum perforatum</i> <i>Myosotis ramosissima</i>	<i>Plantago lanceolatum</i> <i>Hypochaeris radicata</i>	<i>Trifolium dubium</i> <i>Trifolium campestre</i> <i>Festuca rubra</i> <i>Trisetum flavescens</i>
Frequent	<i>Aphanes arvensis</i> agg. <i>Ceratodon purpureus</i> <i>Geranium molle</i>	<i>Senecio jacobaea</i> <i>Luzula campestris</i> <i>Taraxacum officinale</i> agg. <i>Achillea millefolia</i> <i>Cerastium glomeratum</i> <i>Cerastium holosteoides</i> <i>Daucus carota</i>	
Occasional	<i>Erodium cicutarium</i> <i>Arabidopsis thaliana</i> <i>Senecio jacobaea</i> <i>Arenaria serpyllifolia</i> <i>Rumex acetosella</i> agg. <i>Peltigera</i> sp. <i>Digitalis purpurea</i> (Rosette stage only) <i>Brachythecium rutabulum</i>	<i>Veronica arvensis</i> <i>Bellis perennis</i> <i>Trisetum flavescens</i> <i>Holcus lanatus</i> <i>Poa trivialis</i> <i>Agrostis stolonifera</i> <i>Peltigera</i> sp. <i>Polystichum juniperum</i> <i>Plantago lanceolata</i>	<i>Tragopogon pratensis</i> <i>Dactylis glomerata</i> <i>Arrhenatherum elatius</i> <i>Heracleum sphondylium</i> <i>Daucus carota</i> <i>Centaurea nigra</i> <i>Centaurea scabiosa</i> <i>Vicia hirsuta</i> <i>Artemisia vulgaris</i>

**Review of Sections** (With Total Conservation Scores out of 100).

1. SIDESTRANT-OVERSTRAND (263392 - 254400) 27/8/80 50

Fairly attractive. *Centaurea scabiosa*, *Sherardia arvensis*, *Hieracium aurantiacum*, *Centaureum erythraea*, *Vulpia bromoides*, *Aira caryophyllea*, *Fragaria vesca*, *Trifolium arvense*, *Verbascum thapsus*, *Erigeron acer*, *Silene gallica*, *Pimpinella saxifrage*, *Oenothera stricta* (First Norfolk Record).

2. TRIMINGHAM-SIDESTRAND (274388 - 263392) 2/9/80 54

Attractive with good views. *Anthyllis vulneraria*, *Erigeron acer*, *Centaurea scabiosa*, *Acinos arvensis*, *Hieraceum* sp., *Senecio viscosus*, *Aira caryophyllea*, *Lupinus arboreus*, *Ornithopus perpusillus*. Small Copper and Common Blue.

3. MUNDESLEY-GIMINGHAM (309366 - 290377) 30/7/80 57  
Fragmented and not very attractive. *Linaria purpurea*, *Erigeron acer*, *Lupinus arboreus*, *Trifolium arvense*, *Sedum anglicum*, *Vulpia bromoides*, *Leontodon hispidus*, *Spergularia rubra*, *Aira caryophyllea*, *Aira praecox*, *Centaurea scabiosa*, *Anthyllis vulneraria*, *Senecio erucifolius*, *Melilotus* sp., *Lepidium heterophyllum*, *Hippophae rhamnoides*, *Ononis repens*, *Dactylorhiza fuchsii*, *Hieracium perpropinquum*, *Phyllitis scolopendrium*, *Centaureum erythraea*. Meadow Browns and Six Spotted Burnets common.
4. NORTH WALSHAM-KNAPTON (283312 - 302331) 16/7/80 61  
*Aira praecox*, *Aira caryophyllea*, *Asplenium adiantum-nigrum*, *Carex muricata*, *Centaureum erythraea*, *Centaurea scabiosa*, *Dactylorhiza fuchsii*, *Dryopteris filix-mas*, *Fragaria vesca*, *Hieracium anglorum*, *Hieracium perpropinquum*, *Lepidium heterophyllum*, *Pimpinella saxifraga*, *Sedum anglicum*, *Sedum telephium*, *Vulpia bromoides*, *Trifolium medium*. Good butterflies reported by British Butterfly Conservation Society.
5. STALHAM (368253 - 364256) 25/4/79 20  
Unattractive with some dumping. *Viola tricolor*, *Aira praecox*.
6. STALHAM-EAST RUSTON (364256 - 359261) 25/4/79 34  
Quite attractive, some dumping. *Fragaria vesca*, *Primula vulgaris*.
7. STALHAM-EAST RUSTON (359261 - 355265) 25/4/79 32  
Quite attractive with good views. Like last two sections surveyed too early for many plant species. Good Brown Butterfly habitat.
8. EAST RUSTON (355265 - 351268) 20/6/79 36<sup>4</sup>  
Quite attractive with good views. *Teucrium scorodonia*, *Erica cinerea*, *Senecio viscosus*, *Scrophularia nodosa*, *Barbarea vulgaris*.
9. EAST RUSTON (351268 - 345272) 20/6/79 38  
Attractive with good views. *Vulpia bromoides*, *Symphytum* × *uplandicum*, *Barbarea intermedia*.
10. EAST RUSTON (345272 - 338271) 14/8/79 24  
Unattractive. *Campanula rotundifolia*, *Hieracium umbellatum*.
11. HONING (338271 - 334270) 20/5/79 27  
Quite attractive views. *Primula vulgaris*.
12. HONING (334270 - 327274) 20/5/79 45  
Attractive. *Primula vulgaris*. *Scrophularia nodosa*, *Carex flacca*, *Fragaria vesca*, *Ajuga reptans*, *Fragaria vesca*, *Centaurea scabiosa*.
13. HONING (327274 - 323275) 21/4/79 9/5/79 22/8/79 44  
Attractive. *Scrophularia nodosa*, *Ribes nigrum*, *Valeriana officinalis*, *Primula vulgaris*, *Cardamine amara*, *Aira caryophyllea*, *Lepidium heterophyllum*.
14. HONING (323275 - 317276) 6/6/79 22/8/79 46  
Attractive. *Vulpia bromoides*, *Aira caryophyllea*, *Catapodium rigidum*, *Gen-*

*taurium erythraea*, *Erigeron acer*, *Sedum acre*, *Lepidium* sp., *Primula vulgaris*, *Carex divulsa*.

15. BRIGGATE (317276 - 314276) 13/8/79 31  
Unattractive, much dumping. *Centaurium erythraea*, *Jasione montana*, *Verbascum thapsus*, numerous garden casuals.
16. BENGATE (314276 - 306275) 16/5/79 13/8/79 34  
Quite attractive. *Aira caryophylla*, *Aira praecox*, *Jasione montana*, *Carex hirta*, *Fragaria vesca*, *Primula vulgaris*.
17. TUNGATE (269296 - 262290) 7/8/79 25/7/79 53  
Attractive. *Aira praecox*, *Sedum telephinum*, *Foeniculum vulgare*, *Gentaurea scabiosa*, *Campanula rotundifolia*, *Erigeron acer*, *Fragaria vesca*, *Senecio viscosus*, *Senecio erucifolius*, *Hieraceum umbellatum*, *Centaurium erythraea*. Abundant Butterflies and other insects.
18. BRYANT'S HEATH (262290 - 253287) 18/7/79 38  
Quite attractive. *Fragaria vesca*, *Hieracium anglorum*, *Hieracium perpropinquum*, *Aira praecox*, *Aira caryophylla*, *Dactylorhiza maculata* ssp. *ericetorum*, *Luzula multiflorum*, *Hypericum pulchrum*, *Dryopteris carthusiana*.
19. FELMINGHAM (253287 - 245286) 17/79 72  
Attractive. *Lotus tenuis*, *Lupinus arboreus*, *Trifolium subterraneum*, *Trifolium arvense*, *Trifolium strictum*, *Polygala serpyllifolia*, *Centaurium erythraea*, *Fragaria vesca*, *Dactylorhiza fuchsii*, *Sedum telephinum*, *Calamintha ascendens*, *Sisymbrium orientale*, *Onopordum acanthium*, *Anemone nemorosa*, *Silene gallica* ssp. *quinquevulnera*, *Juncus tenuis*, *Hieracium anglorum*. Abundant Butterflies.
20. FELMINGHAM (245286 - 236285) 6/79 39  
Attractive. *Trifolium arvense*, *Vulpia bromoides*, *Aira caryophylla*, *Carex muricata*, *Vulpia myuros*, *Fragaria vesca*, *Hieracium anglorum*.
21. TUTTINGTON (236285 - 229283) 3/7/79 50  
Attractive. *Carex hirta*, *Carex muricata*, *Fragaria vesca*, *Lotus tenuis*.
22. TUTTINGTON (229283 - 223282) 14/7/79 53  
Very attractive. *Fragaria vesca*, *Thelycrania sanguinea*. Abundant birds, butterflies and other insects.
23. TUTTINGTON (223282 - 214282) 7/79 8/79 56  
Very attractive. *Fragaria vesca*, *Agrimonia odorata*, *Carex muricata*, *Centaurium erythraea*. Common Lizard, abundant butterflies and birds.
24. AYLISHAM (214282 - 207282) 27/6/79 16/8/79 34  
Not very attractive. *Trifolium arvense*, *Centaurium erythraea*, *Lotus tenuis*. Adder, abundant butterflies.
25. AYLISHAM (197278 - 193277) 20/6/79 35  
Quite attractive. *Carex muricata*, *Carex divulsa*, *Vulpia bromoides*, *Lupinus polyphyllus*, *Asparagus officinalis*, *Phyllitis scolopendrium*.



26. AYLSHAM (193277 - 187277) 27/6/79 50  
Quite attractive. *Cardamine flexuosa*, *Centaurea scabiosa*, *Fragaria vesca*, *Vulpia bromoides*, *Trifolium striatum*, *Lupinus polyphyllus*, *Ophrys apifera*.
27. ST. OLAVES CUTTING  
Not surveyed, but full details available from the Norfolk Naturalist's Trust. A very rich flora, with over 200 plant species (this number including a good bryophyte and lichen flora) as well as *Botrychium lunaria*, *Carex arenaria* and *Linum catharticum*. Is being preserved by owners for amenity and conservation purposes.
28. BROOME (343908 - 349911) 30/6/82 40  
Fairly attractive. *Geranium pyrenaicum*, *Allium vineale*, *Vulpia myuros*.
29. WORTWELL 30/6/82 45  
Fairly attractive. *Geranium pyrenaicum*, *Senecio viscosus*, *Turritis glabra*. Interesting rabbit resistant flora.
30. WYMONDHAM (118012 - 146997) 1979 51  
*Campanula rotundifolia*, *Carduus acanthoides*, *Centaurea scabiosa*, *Cerastium arvense*, *Chaenorhinum minus*, *Galium mollugo*, *Geranium mollugo*, *Malva moschata*, *Pastinaca sativa*, *Plantago media*, *Senecio viscosus*, *Trifolium arvense*, *Verbascum nigrum*, *Vulpia myuros*, *Hypericum tetrapterum*, *Centaurium erythraea*, *Trifolium hybridum*, *Melilotus altissima*, *Primula veris*, *Saxifraga granulata*.
31. DRAYTON (175138 - 166155) 6/5/80 51  
Quite attractive. *Saxifraga granulata*, *Fragaria vesca*, *Centaurea scabiosa*, *Clinopodium vulgare*, *Prunus padus*, *Cardamine amara*, *Cardamine flexuosa*, *Myosotis ramosissima*, *Thymus* sp., *Carex hirta*, *Hieracium umbellatum*, *Saxifraga tridactylites*, *Aira praecox*.
32. DRAYTON (166155 - 155167) May 1980 44  
Quite attractive. *Acinos arvensis*, *Aira caryophyllea*, *Aira praecox*, *Carex muricata*, *Centaurea scabiosa*, *Cerastium arvense*, *Fragaria vesca*, *Hieracium umbellatum*, *Montia perfoliata*, *Myosotis ramosissima*, *Orobanche minor*, *Saxifraga granulata*, *Sedum album*, *Teesdalia nudicaulis*, *Vulpia bromoides*.
33. ATTLEBRIDGE (155167 - 129175) 5/8/80 79  
Attractive. *Acinos arvensis*, *Aira caryophyllea*, *Centaurea scabiosa*, *Centaurium erythraea*, *Carex spicata*, *Clinopodium vulgare*, *Campanula rotundifolia*, *Epipactis helleborine*, *Fragaria vesca*, *Hieracium perpropinquum*, *Hieracium anglorum*, *Lupinus arboreus*, *Lysimachia nemorum*, *Ornithopus perpusillus*, *Origanum vulgare*, *Pimpinella saxifraga*, *Sedum reflexum*, *Thymus pulegoides*, *Verbena officinalis*, *Vaccinium myrtillus*. Abundant butterflies, moths and other insects.
34. LENWADE (129175 - 113180) 11/6/80 34  
Unattractive. *Aira praecox*, *Calamintha ascendens*, *Fragaria vesca*, *Ornithopus perpusillus*, *Rhamnus catharticus*, *Saxifraga granulata*, *Vulpia bromoides*, *Vulpia myuros*, *Antirrhinum majus*, *Lupinus arboreus*.

35. CORPUSTY (110301 - 121285) 1979 40  
Unattractive. *Acinos arvensis*, *Aira praecox*, *Centaurea scabiosa*, *Clinopodium vulgare*, *Fragaria vesca*, *Silene noctiflora*, *Myosotis ramosissima*, *Pimpinella saxifraga*, *Saxifraga granulata*, *Sedum telephinum*, *Trifolium arvense*, *Amsinckia intermedia*. Abundant butterflies.
36. CORPUSTY (091305 - 110301) 1979 68  
Attractive. *Acinos arvensis*, *Agrimonia odorata*, *Aira praecox*, *Calamintha ascendens*, *Campanula rotundifolia*, *Centaureum scabiosa*, *Clinopodium vulgare*, *Fragaria vesca*, *Mycelis muralis*, *Scrophularia nodosa*, *Sedum telephinum*, *Sherardia arvensis*, *Trifolium arvense*, *Vulpia bromoides*, *Centaureum erythraea*. Abundant butterflies and birds, Fox and other mammals.
37. MELTON CONSTABLE (041332 - 024333) 29/4/81 47  
Fairly attractive. *Myosotis ramosissima*, *Poterium sanguisorba*, *Fragaria vesca*, *Trifolium striatum*, *Moehringia trinervia*, *Primula vulgaris* (abundant), *Listera ovata*, *Adoxa moschata*, *Dryopteris dilatata*, *Scrophularia nodosa*, *Acinos arvensis*.
38. MELTON CONSTABLE (041332 - 039341) 26/5/81 35  
Not very attractive. *Poterium sanguisorba*, *Fragaria vesca*, *Leontodon hispidus*, *Senecio viscosus*, *Myosotis ramosissima*, *Cardaria draba*, *Aira praecox*.
39. STODY — INGMOTE HILL (050354 - 064374) 10/6/81 83  
Extremely attractive with fine views. *Chaenorhinum minus*, *Clinopodium vulgare*, *Ophrys apifera*, *Centaurea scabiosa*, *Vulpia bromoides*, *Trifolium arvense*, *Saxifraga granulata*, *Catapodium rigidum*, *Fragaria vesca*, *Vulpia myuros*, *Trifolium striatum*, *Leontodon hispidus*, *Orobanche minor*, *Orobanche elatior*, *Carex muricata*, *Aira caryophylla*, *Briza media*, *Aira praecox*, *Acinos arvensis*, *Hieracium* sp., *Myosotis ramosissima*, *Cerastium arvense*, *Centaureum erythraea*, *Senecio erucifolius*, *Scabiosa columbaria*. Good butterflies, moths and other insects.
40. WEYBOURNE HEATH — KELLING HEATH (118419 — 102415) 12/5/81  
Extremely attractive with fine views. *Saxifraga granulata*, *Galeobdolon luteum*, *Hypericum montanum*, *Scrophularia nodosa*, *Fragaria vesca*, *Myosotis ramosissima*, *Galium cruciata*, *Vicia lathyroides*, *Ornithopus perpusillus*, *Aira praecox*, *Crassula tillaea*.
41. LITTLE RYBURGH (962294 - 967303) 17/6/81 45  
Fairly attractive. *Dactylorhiza praetermissa*, *Vulpia bromoides*, *Dactylorhiza fuchsii*, *Aira praecox*, *Hypericum tetrapterum*, *Epilobium tetragonum*, *Valeriana dioica*, *Lychnis flos-cucui*, *Polygala serpyllifolia*, *Carex flacca*, *Veronica catenata*, *Listera ovata*, *Myosotis discolor*, *Fragaria vesca*, *Trifolium striatum*.
42. KETTLESTONE (969306 - 982322) 2/7/82  
Completely in-filled with sandy material. Weed species only.
43. WIGHTON-WALSINGHAM (936402 - 935384) 17/6/80 67  
Very attractive. *Centaurea scabiosa*, *Poterium sanguisorba*, *Pastinaca sativa*, *Orobanche elatior*, *Orobanche minor*, *Fragaria vesca*, *Anthyllis vulneraria*, *Plan-*

*tago media*, *Onobrychis viciifolia*, *Thelycrania sanguinea*, *Primula veris*, *Senecio erucifolius*, *Salvia horminoides*, *Arabis hirsuta*, *Chaenorhinum minus*, *Cerastium arvense*. Moths very common.

44. WALSINGHAM (935378 - 923357) 24/6/80 87  
Extremely attractive. *Centaurea scabiosa*, *Thelycrania sanguinea*, *Poterium sanguisorba*, *Pastinaca sativa*, *Rosa pimpinellaefolia*, *Orobanche minor*, *Orobanche elatior*, *Fragaria vesca*, *Medicago arabica*, *Trifolium hybridum*, *Salvia horminoides*, *Scabiosa columbaria*, *Foeniculum vulgare*, *Lathyrus latifolius*, *Mentha* × *niliaca*, *Verbena officinalis*, *Galium mollugo*, *Saponaria officinalis*, *Chaenorhinum minus*, *Arabis hirsuta*, *Primula veris*, *Leontodon hispidus*, *Senecio erucifolius*, *Erigeron acer*, *Pimpinella saxifraga*, *Anthyllis vulneraria*, *Lotus tenuis*, *Origanum vulgare*, *Cynoglossum officinale*, *Lithospermum officinale*, *Inula conyza*. Moths very common.
45. HOUGHTON ST. GILES-EAST BARSHAM (923357 - 913327) 2/7/80 78  
Extremely attractive. *Fragaria vesca*, *Origanum vulgare*, *Primula veris* (abundant), *Salvia horminoides*, *Thelycrania sanguinea*, *Vulpia bromoides*, *Centaurea scabiosa*, *Senecio erucifolius*, *Pastinaca sativa*, *Verbascum nigrum*, *Leontodon hispidus*, *Rhamnus catharticus*, *Plantago media*, *Chaenorhinum minus*, *Catapodium rigidum*, *Cardaria draba*, *Melampyrum pratense*, *Anthyllis vulneraria*. Good birds, Fox earth.
46. HELHOUGHTON (842266 - 859269) 24/6/81 40  
Fairly attractive. *Carex hirta*, *Centaurea scabiosa*, *Chaenorhinum minus*, *Dactylorhiza fuchsii*, *Epilobium tetragonum*, *Fragaria vesca*, *Galium mollugo*, *Hypericum maculatum*, *Leontodon hispidus*, *Silaum silaus*, *Polygala serpyllifolia*, *Scrophularia nodosa*, *Senecio viscosus*, *Vulpia bromoides*.
47. SPORLE (837105 - 845117) 15/8/81 53  
Attractive. *Carex muricata*, *Mentha* × *verticillata*, *Senecio erucifolius*, *Galium mollugo*, *Pimpinella saxifraga*, *Linum catharticum*, *Fragaria vesca*, *Centaureum erythraea*, *Leontodon hispidus*, *Vulpia myuros*, *Epilobium hirsutum* × *adenocaulon*. Good butterflies and birds.
48. GREAT FRANSHAM (886135 - 888135) 15/8/81 31  
Fairly attractive. *Pimpinella saxifraga*, *Linaria purpurea*, *Orobanche minor*, *Polygala vulgaris*.
49. GREAT FRANSHAM (888135 - 894135) 17/9/81 45  
Attractive. *Pimpinella saxifraga*, *Galium mollugo*, *Thelycrania sanguinea*.
50. CRANE'S CORNER, WENDLING (927132 - 912133) 17/9/81 42  
Attractive. *Senecio erucifolius*, *Fragaria vesca*, *Plantago media*, *Pimpinella saxifraga*, *Galium mollugo*.
51. CRANE'S CORNER, WENDLING (917132 - 927132) 17/9/81 19  
Unattractive, partially in-filled with top soil. *Senecio erucifolius*, *Galium mollugo*, *Pimpinella saxifraga*.
52. STONEBRIDGE-HOCKHAM HEATH (927910 - 928931) 7/7/82 45  
Very attractive at north end, but further south rather overgrown and part graz-



- ed. *Ononis repens*, *Diplotaxis tenuifolia*, *Cynoglossum officinale*, *Ornithopus perpusillus*, *Amsinckia intermedia*, *Fragaria vesca*, *Rhamnus catharticus*, *Asplenium adiantum-nigrum* (abundant), *Phyllitis scolopendrium*. Abundant Brown butterflies and other insects at northern end.
53. HOCKHAM and BRECKLES HEATH (928931 - 936949) 7/7/82 54  
 Varied and attractive in parts. *Pastinaca sativa*, *Erigeron acer*, *Dipsacus fullonum*, *Acinos arvensis*, *Aira caryophyllea*, *Centaurium erythraea*, *Ononis repens*, *Thymus pulegoides*, *Saponaria officinalis*. Abundant brown butterflies.
54. THOMPSON COMMON (936949 - 941965) 7/7/82 27  
 Quite attractive. *Centaurea scabiosa*, *Dactylorhiza praetermissa*. Frequent brown butterflies.
55. OVINGTON-SAHAM TONEY (915022 - 914045) 22/7/81 67  
 Not very attractive, very overgrown in places. *Galium mollugo*, *Thelycrania sanguinea*, *Picris hieracoides*, *Prunus padus*, *Rhamnus catharticus*, *Fragaria vesca*, *Anthyllis vulneraria*, *Viburnum opulus*, *Linum catharticum*, *Dactylorhiza fuchsii*, *Listera ovata*, *Leontodon hispidus*, *Clinopodium vulgare*, *Bromus ramosus*, *Ononis spinosus*, *Vulpia myuros*, *Saxifraga tridactylites*, *Centaurium erythraea*, *Vulpia bromoides*, *Rosa arvensis*, *Hypericum hirsutum*, *Galeopsis bifida*, *Chaenorhinum minus*.
56. HOLME HALE (883069 - 893067) 26/8/81 46  
 Fairly attractive. *Galium mollugo*, *Melilotus altissima*, *Picris hieracioides*, *Thelycrania sanguinea*, *Senecio erucifolius*, *Verbascum nigrum* × *pulverulentum*.
57. NORTH PICKENHAM (858073 - 866072) 26/8/81 29  
 Not very attractive, much dumping. *Trifolium arvense*, *Fragaria vesca*, *Centaurea scabiosa*, *Pimpinella saxifraga*, *Clinopodium vulgare*.
58. WOOD FARM, SWAFFHAM (831090 - 847078) 18/8/81 42  
 Not very attractive. *Clinopodium vulgare*, *Fragaria vesca*, *Centaurium erythraea*, *Viburnum opulus*, *Bromus ramosus*, *Leontodon hispidus*, *Senecio viscosus*.
59. LITTLE FRIARS' THORNES, SWAFFHAM (797094 - 802094) 7/7/81 53  
 Quite attractive short deep cutting. *Pastinaca sativa*, *Senecio erucifolius*, *Rhinanthus minor*, *Thelycrania sanguinea*, *Inula conyza*, *Linum catharticum*, *Arabis hirsuta*, *Carlina vulgaris*, *Plantago media*, *Euphrasia nemorosa* var *calcarea*, *Lactuca virosa*, *Cynoglossum officinale*, *Hieracium* sp. (abundant). Good butterflies.
60. BROOM COVERT, SWAFFHAM HEATH (780097 - 774101) 7/7/81 50  
 Quite attractive cutting. *Inula conyza*, *Origanum vulgare*, *Thymus pulegoides*, *Pastinaca sativa*, *Linum catharticum*, *Minuartia hybrida*, *Arabis hirsuta*, *Filipendula vulgaris*, *Rhamnus catharticus*, *Lactuca virosa*, *Centaurium erythraea*, *Calamintha ascendens*, *Acinos arvensis*, *Cirsium acaulon*, *Anacamptis pyramidalis* (abundant), *Herniaria glabra*, *Cerastium arvense*.
61. NARBOROUGH (750118 - 760108) 12/8/81 16/6/82 7/8/82 73  
 Attractive embankment. *Origanum vulgare* (abundant), *Euphrasia nemorosa* var

*calcarea* (abundant), *Pastinaca sativa*, *Rhamnus catharticus* (abundant), *Plantago media*, *Leontodon hispidus*, *Campanula rotundifolia*, *Inula conyza*, *Scabiosa columbaria*, *Cerastium arvense*, *Anacamptis pyramidalis*, *Ononis repens*, *Centaurea scabiosa*, *Thyme pulegoides*, *Phyllitis scolopendrium*, *Cirsium acaulon*, *Fragaria vesca*, *Briza media*, *Carlina vulgaris*, *Centaureum erythraea*, *Anthyllis vulneraria*, *Linum catharticum*, *Arabis hirsuta*, *Pimpinella saxifraga*, *Medicago falcata*, *Gentianella amarella*, *Carex flacca*, *Chaenorhinum minus*. Extremely abundant and varied butterflies (14 species), and moths. Good scrub nesting habitat.

62. DOCKING (762377 - 756375) 7/7/81 31  
Not very attractive. *Salvia horminoides*, *Centaurea scabiosa*, *Pastinaca sativa*.
63. EAST HALL, SEDGEFORD (729374 - 718374) 7/7/81 33  
Fairly attractive. *Pastinaca sativa*, *Salvia horminoides*, *Origanum vulgare* (abundant), *Verbascum pulverulentum* (abundant).
64. DERSINGHAM (681307 - 678333) 7/7/82 50  
Attractive with good views over excellent bird habitat including large reed bed and sallow scrub. *Oenothera* sp., *Acinos arvensis*, *Campanula rotundifolia*, *Centaurea scabiosa*.
65. SNETTISHAM (668335 - 663347) 7/7/81  
Quite attractive, nice views. *Centaureum erythraea*, *Pastinaca sativa*, *Carex muricata*, *Salvia horminoides*, *Sedum acre*. Good number of Small Heaths and other brown butterflies. Of some conservation importance. (Only partially surveyed, not scored).
66. HOLT (072384 - 076384) 28/8/81  
Attractive. *Solidago virgaurea*, *Scabiosa columbaria*, *Orobanche elatior*, *Centaurea scabiosa*, *Acinos arvensis*. Brown butterflies and lizards reported. Of some conservation importance. (Only partially surveyed, not scored).

**Table II — Table of Scores**

*Abbreviations*

TCNS = Total Nature Conservation Score      TCS = Total Conservation Score  
TAS = Total Amenity                              G = Grade  
S = Section Numbers  
Scores in brackets are estimated.

NATURE CONSERVATION SCORES							TNCS	AMENITY			TAS	TCS	G	S
a	b	c	d	e	f	g	h	i	j	k	l	m	n	
(5)	(10)	(15)	(5)	(5)	(5)	(5)	(50)	(20)	(20)	(10)	(50)	100	1-5	
3	4	12	2	0	2	3	26	5	15	4	24	50	3	1
2	0	8	3	0	4	3	20	15	15	4	34	54	3	2
3	4	17	2	0	4	2	32	10	10	5	25	57	3	3

NATURE CONSERVATION SCORES							TNCS	AMENITY			TAS	TCS	G	S
a	b	c	d	e	f	g	h	i	j	k	l	m	n	s
(5)	(10)	(15)	(5)	(5)	(5)	(5)	(50)	(20)	(20)	(10)	(50)	100	1-5	
3	4	17	3	0	4	3	34	10	10	7	27	61	2	4
2	0	3	0	0	2	1	8	5	5	2	12	20	5	5
2	0	3	1	0	1	3	10	10	10	4	24	34	4	6
1	0	4	1	0	2	2	10	10	10	2	22	32	4	7
2	0	4	2	0	0	3	11	10	10	5	25	36	4	8
2	2	6	1	0	0	2	13	10	10	5	25	38	4	9
1	0	4	1	0	3	3	12	5	5	2	12	24	4	10
1	0	3	1	0	3	2	10	10	5	2	17	27	4	11
2	0	7	2	0	0	3	14	10	15	6	31	45	3	12
3	2	12	2	1	0	3	23	5	10	6	21	44	3	13
3	0	10	2	0	3	3	21	10	10	5	25	46	3	14
3	0	6	1	0	3	3	16	5	5	5	15	31	4	15
2	0	9	1	0	3	2	17	10	5	2	17	34	4	16
2	0	10	3	0	4	3	22	10	15	6	31	53	3	17
2	4	10	1	0	0	2	19	5	10	4	19	38	4	18
4	8	19	3	1	3	1	39	10	15	8	33	72	2	19
2	0	7	2	0	1	2	14	10	10	5	25	39	4	20
2	2	6	3	0	3	3	19	10	15	6	31	50	3	21
2	0	7	3	0	4	4	20	5	20	8	33	53	3	22
1	0	7	3	0	4	4	19	10	20	7	37	56	3	23
1	2	6	1	0	4	2	16	10	5	3	18	34	4	24
2	0	7	2	0	2	2	15	5	10	5	20	35	4	25
2	0	9	3	0	3	2	19	10	15	6	31	50	3	26
														(2-3) 27
2	0	6	2	0	3	3	14	10	10	4	24	40	4	28
2	2	6	3	0	3	2	18	5	15	7	27	45	3	29
4	0	15	2	0	(2)	(2)	25	(10)	(10)	6	26	51	3	30
3	0	14	2	2	2	3	26	10	10	5	25	51	3	31
2	0	12	2	0	2	4	20	10	10	4	24	44	3	32
4	2	24	3	1	4	3	41	15	15	8	38	79	2	33
3	0	13	2	0	0	3	21	5	5	3	13	34	4	34
3	0	15	1	0	5	3	27	(5)	(5)	3	13	40	4	35
4	2	15	3	0	5	5	34	(10)	(15)	9	34	68	2	36



NATURE CONSERVATION SCORES							TNCS	AMENITY			TAS	TCS	G	S
a	b	c	d	e	f	g	h	i	j	k	l	m	n	s
(5)	(10)	(15)	(5)	(5)	(5)	(5)	(50)	(20)	(20)	(10)	(50)	100	1-5	
2	0	10	2	1	2	4	21	5	15	6	26	47	3	37
2	0	7	2	1	2	2	16	5	10	4	19	35	4	38
4	0	22	4	4	3	3	40	20	15	8	43	83	1	39
2	2	13	3	1	1	3	25	20	15	5	40	65	2	40
3	0	15	1	2	0	1	22	10	10	3	23	45	3	41
														5 42
2	0	15	4	4	3	2	30	15	15	7	37	67	2	43
4	2	25	4	4	3	2	44	20	15	8	43	87	1	44
3	2	17	4	3	3	4	36	20	15	7	42	78	2	45
3	0	14	3	0	2	2	24	0	10	6	16	40	4	46
2	0	11	3	2	4	4	26	5	15	7	27	53	3	47
(1)	0	3	(2)	0	3	3	12	5	10	4	19	31	4	48
(1)	0	4	(3)	1	3	3	15	10	15	5	30	45	3	49
(1)	0	3	3	2	2	3	13	15	10	4	29	42	3	50
1	0	4	2	1	2	2	12	0	5	2	7	19	5	51
2	0	10	2	0	4	2	20	10	10	5	25	45	3	52
(2)	0	8	2	1	4	1	18	15	15	6	36	54	3	53
(2)	0	7	1	0	3	1	14	0	10	3	13	27	4	54
4	4	22	2	3	2	3	40	10	10	7	27	67	2	55
2	0	10	3	2	2	2	21	10	10	5	25	46	3	56
2	0	9	1	0	1	3	16	0	10	3	13	29	4	57
2	0	9	2	2	3	3	21	5	10	6	21	42	3	58
2	2	12	4	4	4	3	31	0	15	7	22	53	3	59
2	0	14	4	4	3	1	28	0	15	7	16	50	3	60
3	2	23	3	5	5	3	44	10	10	9	29	73	2	61
(1)	0	4	2	2	4	3	16	0	10	5	15	31	4	62
(1)	0	3	3	2	3	1	13	10	5	5	20	33	4	63
(2)	0	8	2	0	2	1	15	15	15	5	35	50	3	64
														(2-3) 65
														(2-3) 66

## Summary

This survey has shown that even fifteen years after abandonment Norfolk's Disused Railways still have much ecological interest. A few sections are rich enough to be considered as Naturalist Trust Reserves, a good number of longer stretches have a combined ecological richness and attractiveness which would make them extremely valuable as long distance footpaths, and many short sections warrant management as short footpaths, nature reserves or school nature study areas.

Encroachment by scrub, however, has reached a point where rapid deterioration of both ecological richness and attractiveness will occur in the next 5 to 10 years. It is hoped that this survey will help to ensure that the proper decisions are made before this deterioration occurs and also encourage surveys in other parts of the country. Our finds indicate that such surveys are most likely to be valuable if they concentrate on cuttings, especially in calcareous areas.

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I would like to thank Ernest Daniels, Alec Bull and Peter Lambley for their help in setting up and supervising the survey; especially Ernest Daniels, who supervised a large number of sessions and also the many Society members who helped with the recording. I should also like to thank Mr G. Kenworthy of British Rail for information on track structure and dates of line closure, and Mr Martin Shaw of Norfolk County Council Planning Department for supplying details of County Council owned stretches. I would also like to thank Norfolk County Council for giving a grant towards the publication of this work.

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## FUNGUS GROUP REPORT

by R. E. EVANS

Chanterelle, Welbourne, Norfolk

This year we have enjoyed many fungus forays, and the favourable weather has affected both the quantity and the number of species. At Thompson Common we recorded 125 species, Brooke Wood 109 and at Wheatfen 103.

There has been a growing interest in fungi over the last few years in the Society, this is evidenced by the number of members attending. Good books are now available such as Roger Phillips' 'Mushrooms', which will enable the beginner to identify many that he finds.

Space does not permit a complete list of all finds, but notable species recorded were:

*Cortinarius helvelloides* — Lolly Moor  
*C. bolaris* — Bawdeswell Heath  
*C. sanguineus* — Swanton Morley  
*Amanita gemmata* — Sparham pools  
*Boletus impolitus* — Sparham pools

*Laccaria purpureobadia* — Winterton  
 Dunes  
*Leptopodia atra* — U.E.A. grounds  
*Leucoscypha leucotricha* — Thompson  
 Common  
*Tephrocye anthrocophila* — Hockering  
 Wood



## 1982 WEATHER SUMMARY

by T. B. NORGATE

Quarry Lane, Lyng, Norfolk.

**JANUARY** — The sunniest January for 23 years but the overall mean temperature of 2.7°C (37°F) was almost 1°C (nearly 2°F) below normal. Air and ground frosts were above normal in occurrence.

Sunshine was 87% above normal and was recorded on 17 days, whilst it was dry, with 12 consecutive rainless days in the middle of the month. Hail fell on 2 days and light snow on 4.

**FEBRUARY** — The mean temperature was nearly 1°C above normal and frosts were less frequent than usual. The month ended with the warmest day, 12.2°C (54°F) since the end of November.

Sunshine was a little above average with 8 sunless days in the middle of the month. It was the driest February for 11 years and there was no snow.

**MARCH** — Another month with the mean temperature 0.5°C above normal, the maximum of 15.6°C (60°F) was reached on the 25th. There were, however, slightly more ground frosts than usual. Sunshine hours were 50% above average, the best since 1967. There were, in fact, only 3 sunless days and 3 with more than 10 hours recorded. North Norfolk had the highest rainfall partly due to thundery activity in the middle of the month, which was then followed by a dry week.

**APRIL** — A very dry month, particularly south of Norwich and towards The Fens where under 10mm (0.4") was recorded. The dry spell was mostly in the last 3 weeks. Temperatures were again 0.5°C above normal influenced by the warm first week, yet the number of frosts was more frequent than usual. Some sunshine was recorded every day, though 6 had only 1 hour each. The total was 23% above average, and it was the sunniest April since 1968.

**MAY** — Thunder was recorded on 5 days, the first this year and rainfall amounts varied considerably:— under 43mm (1.68") at Gooderstone to almost 95mm (3.75") at Swannington.

Temperatures were slightly above normal, reaching 20°C (68°F) on 8 days and 23.5°C (74.3°F) twice. Sunshine was again on the high side with no sunless days and double figures being recorded 11 times.

**JUNE** — Again thunderstorms on 11 or 12 days caused very variable amounts of rain particularly on the 5th when about half the month's rain fell. Amounts varied from nearly 75mm. (3") to over 200mm (8") at Bradenham. Over half of this fell in about 100 minutes, accompanied by large hailstones, which is rated by the Met. Office as a 'very rare fall'; much damage was caused to fruit trees. A mean temperature of 15°C (59°F) was just 1°C above average, thanks largely to a very warm first 8 days. Sunshine amounts were about 75% of normal, only 1 day scoring double figures.

**JULY** — A dry month, especially in the second half. Most rain falling in thunderstorms. Bradenham had the highest total with just over 60mm (about 2.5"), whereas Stratton Strawless recorded only 3.6mm (0.14").

Temperatures were slightly above average, maxima exceeding 21°C (70°F) 4.

times and touching 27°C (80.5°F) on the last day of the month. It was the warmest July since 1976, and sunshine was also slightly above average.

**AUGUST** — This month was marginally warmer than July with a maximum of 30.7°C (87.3°F) on the 3rd. This was followed on the next day by a severe thunderstorm accompanied by hail and over 25mm (1") of rain. Pinnacles on both the church towers at Salle and Heydon were struck within 10 minutes of each other. Thunderstorms occurred on other days, bringing over 100mm (4") of rain for the month in the Norwich area. The south and extreme west of the county had only half this amount. Sunshine were just above normal with only 2 days without any and there were 7 days with over 10 hours.

**SEPTEMBER** — There was a heat-wave in the middle of the month culminating in maxima of 26.5°C and 27°C (just under and over 80°F) on the 17th and 18th. This helped to push the mean for the month to almost 1°C above average.

Again thundery activity caused heavy rain particularly on the 5th when 75mm (3") fell in the Aylsham and North Walsham areas; this was followed by 12 dry days. Sunshine hours were about 10% above normal and there were only 4 sunless days and 2 had double figures.

**OCTOBER** — It was the first time since January that the mean temperature was below average but only by 0.5°C. The first autumn frosts were recorded — 6 ground and 1 slight air frost.

It was the wettest October since 1892 with only Loddon and Raveningham recording under 100mm (4"). Overall the amount averaged 134mm (5.25") with over 150mm (6") in several parts of the county. There were 21 rain days. Not surprisingly sunshine figures were 75% of normal and it was the dullest October since 1976.

**NOVEMBER** — The mean temperature was well above average despite 3 air frosts at the very end of the month and 9 on the ground. This is less than the usual frequency. Sunshine hours were nearly 5% above average despite 10 sunless days, 6 of which occurred in the first week. Rainfall amounts were close to normal; Loddon had the highest with 88.5mm (3.5") and Ingham the lowest with under 50mm (2").

**DECEMBER** — Except for a sprinkling on the coast at Great Yarmouth and Gorleston the month was snow free, the first such December since 1972. Rainfall was a little above average, with most falling on the 8th and 9th (25-30mm or 1.25").

Despite a mild week at the end of the month, the mean temperature was about normal. However, the number of air frosts was 14, that is 50% in excess of normal, and ground frosts were also more frequent than usual. Sunshine figures were about 30% above average despite 11 sunless days.

**THE YEAR** — The high incidence of thunder was outstanding, the writer's rainfall chart being annotated with 26 such days. The nearest approach to this figure was 23 in 1969. This indicated very unstable conditions and exceptional amounts of rain were recorded in June and October especially. Much of the county had double its average in these months particularly at Bradenham and Swaffham.

Apart from these 2 months most others had sunshine in excess of normal by 8%. It was the sunniest year since the two hot years of 1975 and 1976. (Note the correction to the 1981 sunshine figures).

The mean temperature was 9.7°C (49.5°F), which is nearly 0.5°C above normal, despite the fact that January, October and December were all below their averages. In recent years 1976 was the last to have a warmer mean, though only by 0.1°C. Nevertheless, the number of air and ground frosts was slightly above normal. The incidence in the number of days with snow falling was only 4 counting 'sleet days' as half each.

### 1982 Weather

	MEAN TEMPERATURE		NO. OF AIR AND		SUNSHINE HOURS	
	GROUND FROSTS		GROUND FROSTS			
	°C	°C				
	<i>1982</i>	<i>Avg.</i>	<i>1982</i>	<i>Avg.</i>	<i>1982</i>	<i>Avg.</i>
Jan.	2.7	3.6	15/25	10.4/17.6	78.3	41.9
Feb.	4.3	3.6	7/13	10.0/18.1	65.4	61.2
March	5.8	5.3	6/18	6.7/16.9	166.8	108.0
April	7.9	7.4	3/14	3.1/11.8	176.7	143.0
May	11.5	11.2	1/11	0.5/4.5	237.2	189.6
June	15.0	14.0	—	0.1/1.0	150.6	196.7
July	16.2	15.8	—	0/0.2	193.1	183.0
August	16.3	15.9	—	0/0.1	186.2	180.6
Sept.	14.6	13.7	—	0.1/0.9	164.1	149.1
Oct.	10.2	10.7	1/6	0.3/5.8	73.4	100.8
Nov.	7.9	6.6	3/9	5.6/12.1	70.8	67.5
Dec.	3.7	4.0	14/20	9.1/17.3	57.6	43.3
Year	9.7	9.3	50/116	45.9/106.3	1620.2	1464.7



	RAINFALL		DAYS		DAYS	
	mm.		WITH SNOW/HAIL		WITH THUNDER	
	1982	<i>Avg.</i>	1982	<i>Avg.</i>	1982	<i>Avg.</i>
Jan.	36.3	58.4	3.5/2	3.8/0.5	—	0.1
Feb.	13.8	45.0	—	4.0/0.7	—	0.2
March	57.3	42.7	0.5/6	3.3/0.8	—	0.5
April	14.0	39.9	—/2	1.6/1.5	—	1.3
May	65.1	41.7	—/2	0.1/0.3	5	0.6
June	111.2	43.2	—/1	0.1/0.5	11	2.4
July	22.3	57.9	—	—	4	2.4
August	83.6	54.9	—/1	—	3	2.4
Sept.	75.6	53.6	—	—/0.1	2	0.9
Oct.	140.2	62.7	—	—/0.4	—	0.7
Nov.	67.8	71.1	—/1	2.1/1.1	1	0.5
Dec.	50.4	57.7	—	2.9/0.7	—	0.2
Year	737.6	628.6	4/15	17.9/6.6	26	12.2

*Erratum* There was an error in the sunshine total given in the 1981 Report (T.N.N.N.S. 26(1) p.52). It should have been 1444.0 hours i.e. almost average; the last para. but one should therefore be amended.

# BOTANICAL RECORDERS' REPORT

by E. L. SWANN

282, Wootton Road, King's Lynn.

## New Species

*Viola odorata* L., var. *imberbis* (Leight.) Henslow Sweet Violet

Native. Lacking the hairs at base of petals.

West: 83, Denton churchyard, 1982, RPL & ELS.

*Vicia benghalensis* L.

Casual.

East: 01, E. Tuddenham, garden weed, 1982, ALB.

*Oenothera perangusta* Gates var. *perangusta*

Casual. A Canadian species. For description see *Watsonia*, 14, 1, 1982.

East: 30, rubbish tip in parish of Bergh Apton, 1982, ETD.

*Physalis philadelphica* Lam.

Casual.

East: 09, Stacksford near Old Buckenham, 1982, ALB.

*Sambucus racemosa* L.

Red-berried Elder

Naturalised alien. Natural regeneration occurs.

East: 31, How Hill, Ludham, 1982, ETD.

*Lagarasiphon major* (Ridl.) Moss

Curly Water Thyme

Casual. An aquarium plant.

East: 29, Brooke, village pond, 1982, ETD.

## Additional Records

*Myosurus minimus* L.

Mouse-tail

Native. Wet meadow.

East: 13, Little London near Corpusty, Mrs. M. A. Brewster

*Fumaria parviflora* Lam.

Native. Very local. Calcareous arable land.

West: 88, north of Fowlmere, edge of rye field, ALB.

*Spergularia marina* (L.) Griseb.

Lesser Sea-spurrey

Native. Although usually a littoral species the following records show it to be an inland adventive.

East: 20, Bixley; Framingham Pigot; 30, Thurton; Hellington; 39, Stockton, all by ETD.

*Amaranthus hybridus* L., subsp. *hybridus*

Pigweed

Casual. Weed of arable land and occasionally on rubbish tips.

West: 91, Beetley tip, ETD, RPL & ELS.

*Linum bienne* Mill.

Pale Flax

Native. Much rarer than formerly.

East: 20, Trowse and Yelverton, ETD.

*Medicago minima* (L.) Bartal.

Small Medick

Native. A characteristic Breckland species.

West: 79, Cranwich Camp, locally frequent, RPL & ELS; 88, north of Chapel Farm; RPL & ELS; near Croxton, RPL & ELS; 89, Sturston Warren, abundant, ALB.

- Trifolium glomeratum* L. Clustered Clover  
Native. In dry places usually near the sea.  
West: 74, Barrow Common, Brancaster, 1977, ETD.
- Lathyrus tuberosus* L. Earth-nut Pea  
Nat. alien. Rare. Grassland and hedge banks.  
East: 02, Hindolvestone, 1979, ETD, RPL & ELS.
- Potentilla recta* L., var. *sulfurea* DC. Sulphur Clover  
Established alien.  
West: 73, Docking marl pit, abundant, Mr & Mrs KAB; 88, Croxton Heath, one plant, CPP & ELS.
- Rosa multiflora* Thunb.  
Nat. alien.  
West: 83, Syderstone, roadside, 1980, ALB.
- Amsinckia intermedia* F. v M. Tarweed  
Est. alien. Weed of arable land, increasing.  
West: 71, Westacre, CPP & ELS.  
East: 10, near Bowthorpe Hall, edge of cornfield, G.F.W. Hart.
- Trachystemon orientalis* (L.) G. Don Abraham, Isaac & Jacob  
West: 92, North Elmham, near Saxon cathedral, ETD.
- Moyosotis sylvatica* Hoffm. Wood Forget-me-not  
Native. Rare.  
East: 19, Flordon; 20, Bramerton, shady hedgebank; Thorpe St. Andrew, wood, all by ETD.
- Nicandra physalodes* (L.) Gaertn. Apple of Peru, Shoo Fly  
Casual.  
West: 62, King's Lynn, garden weed, Colin Drew det. ELS.
- Verbascum nigrum* × *pulverulentum*  
(*V.* × *wirtgenii* Franch).  
Native hybrid.  
East: 11, Honingham, 1979, several plants by roadside, ETD.
- Linaria repens* (L.) Mill Pale Toadflax  
Casual. Garden-escape.  
East: 10, Wymondham, old wall, ETD.
- Kickxia spuria* (L.) Dumort Round-leaved Fluellen  
Native. Rare arable weed of light soils.  
East: 29, dykeside at entrance to Brooke Wood, ALB, RPL & ELS; 39, Hales, in stubble field, with *K. elatine*, ETD.
- Phacelia tanacetifolia* Benth.  
Casual. Second record.  
East: 12, Sea Palling, garden weed, P. Roe det. EAE.
- Sambucus ebulus* L. Danewort; Dwarf Elder  
Denizen. Rare.  
East: 11, Honingham, ALB; 30, near Limpenhoe, large stand, ETD; 32, Stalham-Ingham, two large colonies by roadside, R. M. Leaney.
- Rudbeckia laciniata* L. 'Garden Glow' (Amer.)  
Casual. Garden-escape.



West: 81, Newton-by-Castleacre, fen, RPL & ELS; 89, West Tofts, in woodland, CPP & ELS.

East: 10, Cringleford, wet wood, ETD.

*Galinsoga parviflora* Cav.

Gallant Soldier

Est. alien. Increasing. Usually a garden weed.

West: 61, Blackboro' End, gravel pit, non-radiate form, RPL & ELS; 63, Heacham, garden weed, Mrs JWW.

*G. ciliata* (Raf.) Blake

Shaggy Soldier

Est. alien. Becoming more frequent.

West: 61, King's Lynn, ELS.

East: 09, Stackford near Old Buckenham, ALB; 21, Wroxham, R. M. Leaney.

*Artemisia absinthium* L.

Wormwood

Status doubtful. Rare.

West: 61, South Lynn, bypass, RS.

*Centaurea diluta* Ait.

Lesser Star Thistle; N. African Knapweed

Casual. Rare.

West: 91, Beetley tip, RPL.

East: 14, Beeston Common, KCD det. ELS; 30, Surlingham, EAE.

*Hieracium perpropinquum* (Zahn) Druce

Hawkweed

Native. Locally frequent. Wood margins, hedgebanks and heaths.

West: 63, Ken Hill, Snettisham, CPP.

*Luronium natans* (L.) Raf.

Floating Water-plantain

Nat. alien. Rare. Broads only.

East: 42, drainage dykes, Potter Heigham, 1975, RJD.

*Leucorum aestivum* L.

Summer Snowflake

Casual. Much rarer than *L. vernum*.

West: 92, North Elmham, near Saxon cathedral, ETD.

East: 10, Cringleford, PWL; 11, Honingham, ALB; 31, Ranworth, PGL.

*Arum italicum* Mill

Italian Lords-and-Ladies

Casual. Garden-escape.

East: 10, Cringleford, wet wood, 1981, ETD, RPL & ELS.

*Poa bulbosa* L.

Bulbous Meadow-grass

Native. Formerly regarded as very rare except at Gt. Yarmouth where it was first found in 1800 but now both widespread and abundant along the Norfolk coast.

West: 63, Snettisham beach, RPL; Heacham, CPP; 64, Hunstanton, RPL & ELS; Holme-next-the-Sea, abundant on golf links, RPL; 94, Brancaster, RCLH.

East: 24, Cromer cliffs, PGL comm. ETD.

*Apera interrupta* (L.) Beauv.

Dense Silky-bent

Native. Confined to West Norfolk.

West: 63, Castle Rising, RPL; 70, Langwade Cross, CPP & ELS; 79, Didlington, ELS; 99, Wretham Belt, abundant along edge of arable field, CPP & ELS.

*Phleum phleoides* (L.) Karst.

Purple-stem Cat's-tail

Native. A Breckland species.

West: 79, Cranwich Camp, one large plant, RPL & ELS.

*Puccinellia distans* (L.) Parl.

Reflexed Salt-marsh-grass.

Native. Although associated with salt-marshes and muddy estuaries this species is

becoming common along road verges inland with other halophytes (see *Spergularia marina*).

East: abundant along the A146 from E20, Trowse to Gillingham (E49). ETD.

*Setaria italica* (L.) Beauv.

Italian Millet

Casual. Usually on tips.

East: 30, Hellington, ETD.

*S. viridis* (L.) Beauv.

Green Bristle-grass

Casual. Uncommon. Usually on tips.

West: 63, Heacham tip, RPL & ELS; 61 Blackborough End tip RPL & ELS.

*Panicum capillare* L.

Witch Grass

Casual. Arable fields (carrots) and tips.

West: 91, Beetley tip, ETD, RPL & ELS.

*P. miliaceum* L.

Common Millet

Casual. Frequent on tips; a favourite bird-food.

East: 20, Trowse; Arminghall; Framingham Pigot; Yelverton; Bixley; 30, Hellington; Thurton; 39, Hales; Loddon, Stockton, all by ETD.

*Digitaria sanguinalis* (L.) Scop.

Hairy Finger-grass

Casual. Uncommon on tips, garden weed and road verges.

West: 91, Beetley tip, ETD, RPL & ELS.

East: 01, E. Tuddenham, garden weed, ALB; 20, Framingham Pigot; Yelverton; Trowse; Bixley; 30, Thurton; 39, Stockton, all on road verges, ETD.

### BRYOPHYTES

Two of us (RPL & ELS) together with R. Stevenson have studied the mosses on some 74 churches and the following are some of the more interesting species.

*Pottia starkeana* (Hedw.) C. Müll., var. *conica* (Schleich. ex Schwaegr.) Chamberlain

Rare. The first record.

West: 51, Tilney All Saints, 1982, RS conf. M. O. Hill

*Barbula trifaria* (Hedw.) Mitt.

Rare.

West: 51, Tilney All Saints, RS; 80, South Pickenham, RPL & ELS.

*Bryum pallescens* Schleich. ex Schwaegr.

Rare. The first record.

West: 84, Burnham Westgate, 1982, RPL & ELS conf. E. C. Wallace.

*Fissidens pusillus* (Wils.) Milde var. *tenuifolius* (Boul.) Podp.

Rare.

West: 91, Beeston, RPL & ELS.

*Grimmia trichophylla* Grev., var. *trichophylla*

Rare although it is strange that this species occurring in 81 vice-counties has not been found in Norfolk until 1982, its first record.

West: 60, South Runcton, RPL & ELS det. RPL.

*Hypohypnum luridum* (Hedw.) Jenn., var. *luridum*

Rare.

West: 80, South Pickenham, RPL & ELS conf. Mrs Joan Appleyard.

### Recorders

ALB — Alec L. Bull

JWW — J. W. Wells

PWL — P. W. Lambley

CPP — C. P. Petch  
EAE — E. A. Ellis  
ELS — E. L. Swann  
ETD — E. T. Daniels

KAB — K. A. Beckett  
KHB — K. H. Bull  
KCD — K. C. Durrant  
PGL — P. G. Lawson

RJD — R. J. Driscoll  
RCLH — R. C. L. Howitt  
RPL — T. P. Libbey  
RS — R. Stevenson



# THE FLORA OF HARFORD RUBBISH TIP

by GEOFFREY WATTS

Barn Meadow, Frost's Lane, Gt. Moulton, Norfolk.

## Introduction

Between 1921 and 1973 most of the domestic refuse of Norwich was carted to the southern fringe of the city and dumped on low-lying marshland bounded in part by the River Yare and by the Norwich-Thetford railway line. The deposited rubbish was covered with a layer of soil and ashes, and allowed to decompose, settle and consolidate. Over a period of time this Corporation rubbish tip became of increasing botanical interest because of a number of factors. Domestic refuse frequently contains plant propagules from a number of sources, such as the flower garden, vegetable garden, kitchen, aviary and other areas. The decomposition of the refuse may raise the temperature of the capping soil substantially (Darlington, 1969; Watts & Watts, 1979) thus providing conditions for the germination and growth of the seeds of many plants not usually hardy in this country. Thus propagules of native plants in the capping soil grew alongside a variety of alien plants from propagules in refuse mixed into the surface soil, and this blend of primary colonisers was scattered across a mosaic of differing surface temperatures.

## Plant Records

The Tip was visited by individuals and groups of botanists, and since the mid-1950's records of their findings have been accumulating. The author has gathered these records from published accounts, from records at the Castle Museum, from County Recorders, from personal communications and from surveys. A summary listing 379 species and subspecies was produced in 1970 and circulated to regular Tip visitors and recorders, and this was acknowledged in the 'Supplement to the Flora of Norfolk' (Swann, 1975, p.62). Since that time another survey has been completed, and all likely recorders have been circulated, the results being gathered into this account now totalling 467 species and subspecies.

In the species list the source of each record is quoted, and these fall chiefly into five categories coded as follows:

(a) Records from the Norfolk and Norwich Naturalists' Society excursion to the Tip on September 17th, 1960. Fifteen members took part, and plant lists were compiled by Miss R. M. Barnes, Mr E. A. Ellis and Mr E. L. Swann, together totalling 191 species.

(b) Records collected by Miss R. M. Barnes (now Mrs. Race) between October, 1958, and November, 1963, in the course of nine visits to the Tip, some in company with other botanists including Dr J. G. Dony, Mr J. E. Lousley and Mr E. L. Swann (see Barnes 1960, 1967, 1970). The final list (Barnes, 1970) incorporates the species noted on the N.N.N.S. 1960 excursion — given here under (a) — although many of these species will also have been encountered on other visits between 1958 and 1963.

(c) Records collected by Mr J. H. Silverwood from visits in July, 1963, September, 1963 and June, 1964, to the area of waste ground beside the Abattoir adjacent to the Tip, together totalling 128 species.

(d) Records from the Norfolk and Norwich Naturalists' Society excursion to the Tip on September 14th, 1969. Seventeen members attended, and plant lists were

compiled by Mr A. Copping, Miss D. Maxey, Mr J. H. Silverwood, Mr E. L. Swann and the author, together totalling 238 species.

(e) Records from a recording visit to the Tip on October 14th, 1973, by a group comprising Mr E. T. Daniels, Mr P. G. Lawson, Mr R. P. Libbey, Mr E. L. Swann and the author, together totalling 279 species.

Additional records have been received from the following botanists whose initials appear in the list:

Copping, A. .... AC Hubbard, C. E. .... CEH Silverwood, J. H. .... JHS  
 Daniels, E. T. .... ETD Lawson, P. G. .... PGL Swann, E. L. .... ELS  
 Hanson, C. G. .... CGH Libbey, R. P. .... RPL Watts, G. D. .... GDW  
 Howitt, R. C. L. ... RCLH Tuck, Miss G. .... GT Young, M. .... MY

### Composition of the Flora

An attempt has been made to assess the status of the species recorded using the classification offered in the 'Flora of Norfolk' (Petch & Swann, 1968, p.35) which in turn follows that of Lousley, 1952. The categories are as follows:

**Natives** ('Nat') — Species believed to have been in Britain before man, or to have immigrated without his aid by using their natural means of dispersal, or to have arisen *de novo* here.

**Doubtful Natives** — Species with a long history in Britain but which are suspected of having been introduced by human agency.

**Denizens** ('Den') — Species growing in natural or semi-natural communities and not dependent for their persistence on human disturbance of the habitat.

**Colonists** ('Col') — Species which grow only in habitats created and maintained by human activities. These are mainly weeds of cultivation restricted to arable fields and disturbed ground.

**Aliens** — Species believed to have been introduced by the intentional or unintentional agency of man.

**Naturalised Aliens** ('NatAl') — Introduced species which are naturalised in natural or semi-natural habitats.

**Established Aliens** ('EstAl') — Introduced species which are established only in man-made habitats.

**Casuals** ('Cas') — Introduced species which are uncertain in place or persistence, i.e. not naturalised or established. Given the large number of casuals involved in this account, this category has sometimes been extended as follows: 'BiCas' — casuals from cage-bird seeds; 'GrCas' — casuals from grain; 'HoCas' — casuals from horticultural material.

Applying this scheme to the Harford findings, results in the following census which may be compared with the county census (Petch & Swann, 1968).

	<i>Norfolk plants</i>		<i>Harford Tip plants</i>	
	No.	%	No.	%
Natives .....	982	62.8	180	38.5
Denizens.....	19	1.2	6	1.3
Colonists.....	77	4.9	51	10.9
Naturalised aliens.....	79	5.0	18	3.8
Established aliens.....	84	5.3	33	7.1

	Norfolk plants		Harford Tip plants	
	No.	%	No.	%
Casuals	218	14.0	170	36.5
			(incl. BiCas	17.5 3.8
			GrCas	10.5 2.3
			HoCas	105 22.5)
Doubtful status	20	1.2	—	—
Hybrids	84	5.3	9	1.9
	<u>1563</u>		<u>467</u>	

The high percentages of both colonists and casuals (particularly casuals of horticultural origin) in the Harford figures are worthy of note.

### Acknowledgements

I am grateful to those recorders who have submitted lists and who have dealt patiently with my enquiries, to Eric Swann for his advice and encouragement, and to the late Charles Hubbard for his interest and forbearance.

### SUMMARY OF PLANT SPECIES RECORDED FROM HARFORD TIP, 1958-1973

<i>Nigella damascena</i> L. (Love-in-a-Mist)	HoCas	d	
<i>Delphinium ambiguum</i> L. (Larkspur)	GrCas/HoCas	b	d
<i>Delphinium orientale</i> Gay (Eastern Larkspur)	HoCas	c	e
<i>Ranunculus repens</i> L. (Creeping Buttercup)	Nat	a	d e
<i>Ranunculus bulbosus</i> L. (Bulbous Buttercup)	Nat	a	
ssp. <i>bulbosus</i>			
<i>Aquilegia</i> sp. (Garden Columbine)	HoCas		d
<i>Thalictrum flavum</i> L. (Meadow Rue)	Nat		e
<i>Papaver rhoeas</i> L. (Field Poppy)	Col	a c	d e
<i>Papaver dubium</i> L. (Smooth Long-headed Poppy)	Col	c	
<i>Papaver argemone</i> L. (Long Prickly-headed Poppy)	Col		d
<i>Papaver somniferum</i> L. (Opium Poppy)	HoCas	a c	d e
ssp. <i>hortense</i> Hussenot			
<i>Chelidonium majus</i> L. (Greater Celandine)	EstAl	a	d e
<i>Eschscholtzia californica</i> Cham. (Californian Poppy)	HoCas	c	
<i>Fumaria officinalis</i> L. (Common Fumitory)	Nat	a c	d e
<i>Brassica oleracea</i> L. (Cabbage, Kale, etc.)	HoCas	a c	d e
<i>Brassica napus</i> L. (Rape, Cole, Swede)	HoCas		e
<i>Brassica rapa</i> L. (Turnip)	HoCas	a	e
<i>Brassica juncea</i> (L.) Czern (Chinese Mustard)	GrCas	b	e JHS-1969
<i>Brassica nigra</i> (L.) Koch (Black Mustard)	Col	a b	d e
<i>Rhynchosynapis cheiranthos</i> (Tall Wallflower Cabbage) (Vill.) Dandy	Cas		CGH-1970
<i>Sinapis arvensis</i> L. (Charlock)	Col	a	d e
<i>Sinapis alba</i> L. (White Mustard)	NatAl	a b	e
<i>Hirschfeldia incana</i> (L.) (Hoary Mustard) Lagreze-Fossat	EstAl		d e



<i>Diplotaxis muralis</i> (L.) DC (Wall Rocket)	EstAl	a b c	e	
<i>Raphanus raphanistrum</i> L. (Wild Radish)	Col	a c	d e	
<i>Raphanus sativus</i> L. (Garden Radish)	HoCas	a b		
<i>Rapistrum rugosum</i> (L.) All. (Wild Rape)	BiCas	a	d e	
ssp. <i>rugosum</i>				
<i>Rapistrum rugosum</i> (L.) All. (Wild Rape)	BiCas	b	e	
ssp. <i>orientale</i> (L.) Rouy & Fouc.				
<i>Rapistrum hispanicum</i> (L.) Crantz	Cas	b		
var. <i>hirsutum</i> (Cariot) O. E. Schulz				
<i>Lepidium sativum</i> L. (Garden Cress)	HoCas	a	d e	
<i>Lepidium campestre</i> (L.) R. Br. (Pepperwort)	Col	c		
<i>Lepidium ruderalis</i> L. (Narrow-leaved Pepperwort)	Nat	a	d e	
<i>Coronopus squamatus</i> (Forsk.) Aschers. (Swine-cress)	Nat		d	
<i>Coronopus didymus</i> (L.) Sm. (Lesser Swine-cress)	Col	b		ETD/RPL/ELS-1972
<i>Cardaria draba</i> (L.) Desv. (Hoary Pepperwort) ssp. <i>draba</i>	EstAl	c		
<i>Iberis umbellata</i> L. (Candytuft)	HoCas		d	
<i>Thlaspi arvense</i> L. (Field Penny-cress)	Col		e	
<i>Capsella bursa-pastoris</i> (Shepherd's Purse) (L.) Medic	Nat	a c	d e	
<i>Lunaria annua</i> L. (Honesty)	HoCas	b	d	
<i>Lobularia maritima</i> (L.) Desv. (Sweet Alison)	HoCas	a	d e	
<i>Bertoraa incana</i> (L.) DC (Hoary Alison)	EstAl	c		RCLH-1959 JHS-1969 ETD-1972
<i>Armoracia rusticana</i> (Horse Radish) Gaert., Mey. & Scherb	EstAl	a c	d e	
<i>Rorippa sylvestris</i> (Creeping Yellow-cress) (L.) Besser	Nat	c		
<i>Rorippa islandica</i> (Marsh Yellow-cress) (Oeder) Borbas	Nat		d	
<i>Matthiola incana</i> (L.) R.Br. (Stock)	HoCas		e	
<i>Matthiola bicornis</i> (Night-scented Stock) (Sibth & Sm.)	HoCas			RCLH-1959
<i>Malcomia maritima</i> (L.) R.Br. (Virginia Stock)	HoCas	a	e	
<i>Erysimum cheiranthoides</i> L. (Treacle Mustard)	Col	a b c	d e	
<i>Cheiranthus cheiri</i> L. (Wallflower)	NatAl		e	
<i>Alliaria petiolata</i> (Garlic Mustard) (Bieb.) Cavara & Grande	Nat		d e	
<i>Sisymbrium officinale</i> (Hedge Mustard) (L.) Scop. var. <i>officinale</i>	Nat	a c	d e	
var. <i>leiocarpum</i> DC	Nat	a	e	
<i>Sisymbrium loeselii</i> L.	Cas	c		
<i>Sisymbrium orientale</i> L. (Eastern Rocket)	EstAl	a b	e	
<i>Sisymbrium altissimum</i> L. (Tall Rocket)	EstAl	a b c	d	
<i>Camelina sativa</i> (L.) Crantz (Gold of Pleasure)	BiCas	b	d	
<i>Descurainia sophia</i> (L.) Webb ex Prantl (Flixweed)	Col		d e	

<i>Reseda luteola</i> L. (Dyer's Rocket)	Nat	a	c	d	e
<i>Reseda lutea</i> L. (Wild Mignonette)	Nat	a	c	d	e
<i>Reseda odorata</i> L. (Mignonette)	HoCas			d	
<i>Viola</i> × <i>wittrockiana</i> Gams (Garden Pansy)	HoCas				e
<i>Viola tricolor</i> L. ssp. <i>tricolor</i> (Wild Pansy)	Nat			d	
<i>Viola arvensis</i> Murr. (Field Pansy)	Nat	a	c	d	e
<i>Hypericum perforatum</i> L. (Common St. John's Wort)	Nat		c		e
<i>Silene dioica</i> (L.) Clairv. (Red Campion)	Nat				e
<i>Silene alba</i> (Mill.) E.H.L. Krause (White Campion)	Nat	a	c	d	e
<i>Silene vulgaris</i> (Moench) Garcke (Bladder Campion)	Nat	a			
<i>Lychnis coronaria</i> (L.) Desv. (Rose Campion)	HoCas		b		
<i>Dianthus barbatus</i> L. (Sweet William)	HoCas			d	
<i>Vaccaria pyramidata</i> Medic. (Cow Cockle)	BiCas				ETD-1972
<i>Saponaria officinalis</i> L. (Soapwort)	EstAl				e
<i>Gypsophila elegans</i> Bieb. (Annual Gypsophila)	HoCas	a			
<i>Cerastium biebersteinii</i> DC	Cas				e
<i>Cerastium tomentosum</i> L. (Dusty Miller)	EstAl		b		e
<i>Cerastium holosteoides</i> Fr. (Mouse-ear Chickweed)	Nat	a	c		e
<i>Myosoton aquaticum</i> (L.) Moench (Water Chickweed)	Nat		b		e
<i>Stellaria media</i> (L.) Vill. (Chickweed)	Nat	a	c	d	e
<i>Sagina ciliata</i> Fr. (Ciliate Pearlwort)	Nat				ETD/RPL/ELS-1972
<i>Arenaria serpyllifolia</i> L. (Thyme-leaved Sandwort)	Nat	a	c		e
<i>Arenaria leptoclados</i> (Lesser Thyme-leaved Sandwort) (Rchb.) Guss.	Nat	a			
<i>Spergula arvensis</i> L. (Corn Spurrey)	Nat	a			
<i>Amaranthus caudatus</i> L. (Love-lies-bleeding)	HoCas	a	b		ETD/RPL/ELS-1972
<i>Amaranthus quitensis</i> K.B.K.	Cas		b		
<i>Amaranthus retroflexus</i> L. (Pigweed)	GrCas			d	e
<i>Amaranthus hybridus</i> L. (Pigweed)	GrCas	a			
<i>Amaranthus albus</i> L. (Tumbleweed)	GrCas	a	b	d	
<i>Amaranthus blitoides</i> S. Wats.	Cas				e
<i>Chenopodium album</i> L. (Fat Hen)	Col	a	c	d	e
<i>Chenopodium ficifolium</i> Sm. (Fig-leaved Goosefoot)	Col	a			e
<i>Chenopodium murale</i> L. (Nettle-leaved Goosefoot)	GrCas				RPL/ELS-1972
<i>Chenopodium urbicum</i> L. (Upright Goosefoot)	Cas				ETD/RPL/ELS-1972
<i>Chenopodium rubrum</i> L. (Red Goosefoot)	Col	a		d	e
<i>Chenopodium probstii</i> Aellen	Cas				GT-1969
<i>Beta vulgaris</i> L. (Beetroot, Sugar Beet, etc.) ssp. <i>vulgaris</i>	HoCas	a			e
<i>Atriplex littoralis</i> L. (Shore Orache)	Nat				e
<i>Atriplex hastata</i> L. sensu lato (Hastate Orache)	Nat	a			e
<i>Atriplex patula</i> L. (Common Orache)	Nat	a			e
<i>Atriplex hortensis</i> L. (Garden Orache)	HoCas			d	e RCLH-1959
<i>Salsola pestifer</i> A. Nels. (Russian Thistle)	GrCas			d	

<i>Kochia densiflora</i> Turcz.	GrCas			e
<i>Kochia scoparia</i> (L.) Schrad. (Burning Bush)	HoCas			e
<i>Tetragonia tetragonoides</i> (New Zealand Spinach) (Pallas) D. Kuntze	HoCas			PGL-1972
<i>Spinacea oleracea</i> L. (Spinach)	HoCas			CGH-1971
<i>Malva sylvestris</i> L. (Common Mallow)	Nat	a	c	d e
<i>Malva neglecta</i> Wallr. (Dwarf Mallow)	Nat			d e
<i>Lavatera trimestris</i> L.	HoCas			d
<i>Althaea rosea</i> (L.) Cav. (Hollyhock)	HoCas	a		d e
<i>Linum usitatissimum</i> L. (Cultivated Flax)	BiCas	a b		d ETD/RPL/ELS-1972
<i>Geranium pyrenaicum</i> Burm. f. (Mountain Cranesbill)	EstAl		c	
<i>Geranium dissectum</i> L. (Cut-leaved Cranesbill)	Nat		c	
<i>Geranium rotundifolium</i> L. (Round-leaved Cranesbill)	Den			d e
<i>Geranium molle</i> L. (Dove's-foot Cranesbill)	Nat	a	c	e
<i>Geranium pusillum</i> L. (Small-flowered Cranesbill)	Nat		c	d
<i>Geranium robertianum</i> L. (Herb Robert) ssp. <i>robertianum</i>	Nat			d
<i>Erodium cicutarium</i> (L.) L'Herit (Common Storksbill) ssp. <i>cutarium</i>	Nat	a	c	e
<i>Tropaeolum majus</i> L. (Nasturtium)	HoCas			e JHS-1969
<i>Oxalis europaea</i> Jord. (Upright Yellow Sorrel)	HoCas			e
<i>Oxalis articulata</i> Savigny	HoCas		b c	e
<i>Oxalis corymbosa</i> DC	HoCas			e
<i>Impatiens glandulifera</i> Royle (Policeman's Helmet)	NatAl			d
<i>Acer negundo</i> L. (Box Elder)	HoCas			d
<i>Acer pseudoplatanus</i> L. (Sycamore)	Den		c	d e
<i>Acer campestre</i> L. (Field Maple)	Nat			d
<i>Aesculus hippocastanum</i> L. (Horse-chestnut)	Den		c	d e
<i>Ilex aquifolium</i> L. (Holly)	Nat			d e
<i>Vitis vinifera</i> L. (Grape Vine)	HoCas			d e
<i>Parthenocissus quinquefolia</i> (Virginia Creeper) (L.) Planch.	HoCas	a		
<i>Lupinus arboreus</i> Sims (Tree Lupin)	EstAl			e
<i>Lupinus polyphyllus</i> Lindl. (Lupin)	HoCas			d
<i>Laburnum anagyroides</i> Medic. (Laburnum)	HoCas			d e
<i>Sarothamnus scoparius</i> (L.) Wimmer ex Koch (Broom)	Nat			e
<i>Medicago sativa</i> L. (Lucerne)	EstAl	a	c	d e
<i>Medicago</i> × <i>varia</i> Martyn ( <i>M. falcata</i> × <i>sativa</i> )	Hybrid			d
<i>Medicago lupulina</i> L. (Black Medick)	Nat/EstAl	a	c	d e
<i>Melilotus officinalis</i> (L.) Pall. (Common Melilot)	Col	a	c	d e
<i>Melilotus alba</i> Medic. (White Melilot)	Col		b	d
<i>Melilotus indica</i> (L.) All. (Small-flowered Melilot)	Cas			d e
<i>Trifolium dubium</i> Sibth. (Lesser Yellow Trefoil)	Nat		c	e
<i>Trifolium campestre</i> Schreb. (Hop Trefoil)	Nat	a	c	d e



<i>Trifolium hybridum</i> L. (Alsike Clover)	Col	b	
<i>Trifolium repens</i> L. (White Clover)	Nat	a c d e	
<i>Trifolium arvense</i> L. (Hare's-foot)	Nat	a e	
<i>Trifolium pratense</i> L. (Red Clover)	Nat/EstAl	a b c d e	
<i>Trifolium subterraneum</i> L. (Subterranean Clover)	Nat		ETD-1974
<i>Psoralea dentata</i> DC.	Cas	b	
<i>Galega officinalis</i> L. (Goat's Rue)	HoCas		JHS-1962
<i>Robinia pseudoacacia</i> L. (Acacia)	NatAl		d e
<i>Colutea arborescens</i> L. (Bladder Senna)	HoCas	b e	
<i>Vicia hirsuta</i> (L.) S.F. Gray (Hairy Vetch)	Nat	c d	
<i>Vicia lutea</i> L. (Yellow Vetch)	EstAl		ETD/RPL/ELS-1972
<i>Vicia sativa</i> L. ssp. <i>sativa</i> (Cultivated Vetch)	Cas	a d	
<i>Vicia sativa</i> L. (Common Vetch)	Nat	a c e	
ssp. <i>angustifolia</i> (L.) Gaud.			
<i>Vicia faba</i> L. (Broad Bean, Horse Bean)	HoCas	a d	
<i>Lathyrus aphaca</i> L. (Yellow Vetchling)	Cas		ETD-1972 AC-1973
<i>Lathyrus hirsutus</i> L. (Hairy Vetchling)	BiCas		ETD-1972
<i>Lathyrus latifolius</i> L. (Everlasting Pea)	EstAl		d e
<i>Lathyrus odoratus</i> L. (Sweet Pea)	HoCas		AC/PGL-1972
<i>Kerria japonica</i> (L.) DC. (Jew's Mallow)	HoCas	d	
<i>Rubus idaeus</i> L. (Raspberry)	Nat	d	
<i>Rubus fruticosus</i> agg. (Blackberry)	Nat	a c d e	
<i>Rubus ulmifolius</i> Schott fil.	Nat		e
<i>Potentilla argentea</i> L. (Hoary Cinquefoil)	Nat	c	
<i>Potentilla reptans</i> L. (Creeping Cinquefoil)	Nat	a c e	
<i>Fragaria</i> × <i>ananassa</i> Duchesne (Garden Strawberry)	EstAl	b d e	
<i>Aphanes arvensis</i> L. (Parsley Piert)	Nat	c	
<i>Rosa canina</i> L. (Dog Rose)	Nat	a c e	
<i>Prunus amygdalus</i> Batsch (Almond)	HoCas	b	
<i>Pyracantha coccinea</i> M.J. Roem. (Firethorn)	HoCas	a	
<i>Crataegus monogyna</i> Jacq. (Hawthorn)	Nat	a d e	
<i>Sorbus aucuparia</i> L. (Mountain Ash)	Nat		d
<i>Pyrus communis</i> L. (Pear)	Den	a	
<i>Malus sylvestris</i> Mill. (Crab Apple)	Nat	a	
ssp. <i>sylvestris</i>			
<i>Malus sylvestris</i> (Cultivated Apple)	HoCas	a e	
ssp. <i>mitis</i> (Wallr.) Mansf.			
<i>Sedum spurium</i> M. Bieb.	HoCas		e
<i>Sedum acre</i> L. (Wall-pepper)	Nat		d e
<i>Ribes nigrum</i> L. (Black Currant)	Nat		d e
<i>Lythrum salicaria</i> L. (Purple Loosestrife)	Nat		d
<i>Lythrum junceum</i> Banks & Sol.	HoCas		RPL-1972
<i>Epilobium hirsutum</i> L. (Great Hairy Willow-herb)	Nat	a c d e	
<i>Epilobium adenocaulon</i> Hausskn.	NatAl	b e	
<i>Epilobium obscurum</i> Schreb.	Nat		e
<i>Chamaenerion angustifolium</i> (Rosebay Willow-herb) (L.) Scop.	Nat	a c d e	
<i>Oenothera biennis</i> L. (Evening Primrose)	EstAl	a c d e	
<i>Oenothera erythrosepala</i> Borbas	EstAl	b e	
<i>Clarkia elegans</i> Dougl. (Clarkia)	HoCas		AC/PGL-1972
<i>Hedera helix</i> L. (Ivy)	Nat		d e

<i>Chaerophyllum temulentum</i> L. (Rough Chervil)	Nat	a		
<i>Anthriscus sylvestris</i> (L.) Hoffm. (Cow Parsley)	Nat	a	d	e
<i>Coriandrum sativum</i> L. (Coriander)	HoCas			ETD/RPL/ESL-1972
<i>Smyrniolum olusatrum</i> L. (Alexanders)	NatAl			e
<i>Conium maculatum</i> L. (Hemlock)	Nat	a	c	d e
<i>Bupleurum lancifolium</i> Hornem.	BiCas			AC/PGL-1972
<i>Apium nodiflorum</i> (L.) Lag. (Fool's Watercress)	Nat			e
<i>Ammi majus</i> L.	GrCas			d e
<i>Aegopodium podagraria</i> L. (Ground Elder)	EstAl			d e
<i>Aethusa cynapium</i> L. (Fool's Parsley)	Col	a		
<i>Foeniculum vulgare</i> Mill. (Fennel)	Col	b	d	e
<i>Pastinaca sativa</i> L. (Wild Parsnip)	Nat	a		e
<i>Heracleum sphondylium</i> L. (Hogweed)	Nat	a	c	d e
<i>Daucus carota</i> L. ssp. <i>carota</i> (Wild Carrot)	Nat	a	c	d e
<i>Daucus carota</i> (Cultivated Carrot) ssp. <i>sativus</i> (Hoffm.) Hayek	HoCas	a		
<i>Cucurbita pepo</i> L. (Vegetable Marrow)	HoCas	a		d e
<i>Cucumis melo</i> L. (Melon)	Cas			CGH-1971
<i>Bryonia dioica</i> Jacq. (White Bryony)	Nat		c	e
<i>Mercurialis perennis</i> L. (Dog's Mercury)	Nat			d e
<i>Mercurialis annua</i> L. (Annual Mercury)	Col	a		d e
<i>Euphorbia lathyris</i> L. (Caper Spurge)	EstAl	a		
<i>Euphorbia helioscopia</i> L. (Sun Spurge)	Col	a		d e
<i>Euphorbia peplus</i> L. (Petty Spurge)	Col			d e
<i>Euphorbia exigua</i> L. (Dwarf Spurge)	Col			d
<i>Euphorbia uralensis</i> Fisch. ex Link	Col	a	b c	e
<i>Euphorbia</i> × <i>pseudovirgata</i> ( <i>E. virgata</i> × <i>esula</i> ) (Schur) Soo	Hybrid			e
<i>Euphorbia esula</i> L. (Leafy-branched Spurge)	Col		b	
<i>Euphorbia amygdaloides</i> L. (Wood Spurge)	Nat			e
<i>Polygonum aviculare</i> L. (Knotgrass)	Nat	a	c	d e
<i>Polygonum persicaria</i> L. (Willow Weed)	Nat	a		d e
<i>Polygonum lapathifolium</i> L. (Pale Persicaria)	Col		b	
<i>Polygonum convolvulus</i> L. (Black Bindweed)	Col	a	c	e
<i>Polygonum cuspidatum</i> (Japanese Knotweed) Sieb. & Zucc.	EstAl			d e
<i>Polygonum baldschuanicum</i> Regel. (Russian Vine)	EstAl			e
<i>Polygonum senegalense</i> Meisn. (Senegal Knotweed)	HoCas			RPL/ELS-1972
<i>Fagopyrum esculentum</i> Moench (Buckwheat)	BiCas	a		
<i>Rheum rhabonticum</i> L. (Rhubarb)	HoCas			CGH-1971
<i>Rumex acetosella</i> L. (Sheep's Sorrel)	Nat		c	
<i>Rumex acetosa</i> L. (Sorrel)	Nat	a	c	e
<i>Rumex crispus</i> L. (Curled Dock)	Nat	a	c	d e
<i>Rumex obtusifolius</i> L. (Broad-leaved Dock) ssp. <i>obtusifolius</i>	Nat	a	c	d e
<i>Rumex crispus</i> × <i>obtusifolius</i>	Hybrid			e
<i>Urtica urens</i> L. (Small Nettle)	Nat			d e
<i>Urtica dioica</i> L. (Stinging Nettle)	Nat	a	c	d e
<i>Urtica dioica</i> var. <i>inermis</i>	Nat			e
<i>Humulus lupulus</i> L. (Hop)	Nat	a		

<i>Cannabis sativa</i> L. (Hemp)	BiCas	a b	d	
<i>Ulmus carpiniifolia</i> agg. (Smooth Elm)	Nat		d	
<i>Ulmus procera</i> Salisb. (English Elm)	Nat	c		
<i>Betula pendula</i> Roth (Silver Birch)	Nat		d	
<i>Betula pubescens</i> Ehrh. (Downy Birch)	Nat		e	
<i>Alnus glutinosa</i> (L.) Gaertn. (Alder)	Nat		d e	
<i>Quercus robur</i> L. (Common Oak)	Nat	a	e	
<i>Populus</i> × <i>canadensis</i> (Black Italian Poplar)	NatAl		d	
Moench var <i>serotina</i> (Hartig) Rehd.				
<i>Salix alba</i> L. (White Willow)	Nat	b	e	
<i>Salix viminalis</i> L. (Common Osier)	Nat		d	
<i>Salix caprea</i> L. (Goat Willow)	Nat		e	
<i>Anagallis arvensis</i> L. (Scarlet Pimpernel)	Col	a c	d e	
<i>Buddleja davidii</i> Franch. (Buddleia)	EstAl	b	d e	
<i>Fraxinus excelsior</i> L. (Ash)	Nat		d	
<i>Syringa vulgaris</i> L. (Lilac)	NatAl		d e	
<i>Ligustrum vulgare</i> L. (Common Privet)	Nat	c	e	
<i>Ligustrum ovalifolium</i> Hassk. (Broad-leaved Privet)	NatAl		d	
<i>Nemophila menziesii</i> Hook & Arn. (Baby Blue Eyes)	HoCas			AC/PGL-1972
<i>Cynoglossum officinale</i> L. (Hound's-tongue)	Nat	a		
<i>Pentaglottis sempervirens</i> (L.) Tausch (Alkanet)	NatAl		e	
<i>Anchusa arvensis</i> (L.) Bieb. (Bugloss)	Col	a c	e	
<i>Myosotis scorpioides</i> L. (Water Forget-me-not)	Nat		e	
<i>Myosotis sylvatica</i> Hoffm. (Wood Forget-me-not)	Nat		e	
<i>Echium vulgare</i> L. (Viper's Bugloss)	Nat	b		
<i>Convolvulus arvensis</i> L. (Bindweed)	Col	a c	d e	
<i>Calystegia sepium</i> (L.) R.Br. (Great Bindweed) ssp. <i>sepium</i>	Nat	a	d e	
<i>Calystegia sepium</i> ssp. <i>sylvatica</i> (Kit.) Maire	EstAl	a c	d e	
<i>Lycium chinense</i> Mill. (Duke of Argyll's Tea-plant)	NatAl	b	e	
<i>Atropa belladonna</i> L. (Deadly Nightshade)	Nat		e	
<i>Hyoscyamus niger</i> L. (Henbane)	Nat	a		
<i>Nicandra physalodes</i> (L.) Gaertn. (Apple of Peru)	HoCas	a b	d e	
<i>Physalis alkekengi</i> L. (Bladder Cherry)	HoCas	b	e	JHS-1969
<i>Solanum dulcamara</i> L. (Bittersweet)	Nat		d e	
<i>Solanum nigrum</i> L. (Black Nightshade)	Col	a c	d e	
<i>Solanum nigrum</i> var. <i>flavum</i> Dum.	Col	b		
<i>Solanum rostratum</i> Dunal. (Kansas Thistle)	HoCas			CGH-1970
<i>Solanum tuberosum</i> L. (Potato)	HoCas	a	d e	
<i>Lycopersicon esculentum</i> Mill. (Tomato)	HoCas	a	d e	
<i>Datura stramonium</i> L. (Thorn-apple)	NatAl	a	e	
<i>Nicotiana glauca</i> Link & Otto (Tobacco plant)	HoCas		e	JHS-1969
<i>Petunia</i> hybrid cult.	HoCas	a	d	
<i>Verbascum thapsus</i> L. (Aaron's Rod)	Nat	a c	d	
<i>Verbascum phlomoides</i> L. (Woolly Mullein)	HoCas	a b		
<i>Verbascum pulverulentum</i> Vill. (Hoary Mullein)	Nat	b	d e	
<i>Verbascum nigrum</i> L. (Dark Mullein)	Nat			RCLH-1959



<i>Antirrhinum orontium</i> L. (Lesser Snapdragon)	Col		e	
<i>Antirrhinum majus</i> L. (Snapdragon)	EstAl	a	d e	
<i>Nemesia strumosum</i> Benth. (Nemesia)	HoCas			JHS-1969
<i>Linaria purpurea</i> (L.) Mill. (Purple Toadflax)	EstAl	b	d e	
<i>Linaria vulgaris</i> Mill. (Toadflax)	Nat	a c	e	
<i>Linaria maroccana</i> Hook. f. (Garden Toadflax)	HoCas		d	
<i>Cymbalaria muralis</i> (Ivy-leaved Toadflax) Gaertn., Mey & Scherb.	Den	b	e	
<i>Digitalis purpurea</i> L. (Foxglove)	Nat		e	
<i>Veronica longifolia</i> L.	HoCas	b	d e	
<i>Veronica arvensis</i> L. (Wall Speedwell)	Nat	c		
<i>Veronica persica</i> Poir. (Buxbaum's Speedwell)	Col	a c	e	
<i>Odontites verna</i> (Bell.) Dum., ssp. <i>serotina</i> (Wettst.) E.F. Warb. (Red Bartsia)	Nat	b		
<i>Orobanche elatior</i> Sutton (Tall Broomrape)	Nat		e	
<i>Verbena officinalis</i> L. (Vervain)	Nat			JHS-1962
<i>Mentha aquatica</i> L. (Water Mint)	Nat		e	
<i>Mentha × gentilis</i> L. ( <i>Mentha arvensis</i> × <i>spicata</i> )	Hybrid		d	
<i>Mentha spicata</i> L. (Spearmint)	NatAl	a		
<i>Mentha × niliaca</i> ( <i>M. longifolia</i> × <i>rotundifolia</i> ) Juss. ex Jacq.	Hybrid	a	d e	
<i>Salvia reflexa</i> Hornem.	HoCas	b	d	JHS-1963
<i>Salvia verticillata</i> L.	HoCas	a		
<i>Salvia horminoides</i> Pourr. (Wild Clary)	Nat	a		
<i>Salvia officinalis</i> L. (Garden Sage)	HoCas		d	
<i>Prunella vulgaris</i> L. (Self-heal)	Nat	a	d	
<i>Stachys annua</i> (L.) L.	HoCas		c	
<i>Stachys sylvatica</i> L. (Hedge Woundwort)	Nat		d e	
<i>Ballota nigra</i> L. (Black Horehound) ssp. <i>foetida</i> Hayek	Nat	a c	d e	
<i>Lamium amplexicaule</i> L. (Henbit)	Col		e	
<i>Lamium hybridum</i> Vill. (Cut-leaved Dead-nettle)	Col		e	
<i>Lamium purpureum</i> L. (Red Dead-nettle)	Col	a c	e	
<i>Lamium album</i> L. (White Dead-nettle)	Col	a	d e	
<i>Nepeta × faassenii</i> Bergmans (Garden Catmint)	HoCas	b		
<i>Glechoma hederacea</i> L. (Ground Ivy)	Nat	a	d	
<i>Plantago major</i> L. (Great Plantain)	Col	a c	d e	
<i>Plantago media</i> L. (Hoary Plantain)	Nat	b		
<i>Plantago lanceolata</i> L. (Ribwort Plantain)	Nat	a c	d e	
<i>Plantago coronopus</i> L. (Buck's-horn Plantain)	Nat	a	e	
<i>Plantago indica</i> L.	BiCas	b		
<i>Campanula medium</i> L. (Canterbury Bell)	HoCas		d	
<i>Campanula persicifolia</i> L.	HoCas			CGH-1970
<i>Lobelia erinus</i> L. (Garden Lobelia)	HoCas	b	d	
<i>Galium aparine</i> L. (Goose-grass)	Nat	a c	d e	
<i>Sambucus nigra</i> L. (Elder)	Nat	a c	d e	
<i>Viburnum opulus</i> L. (Guelder Rose)	Nat		e	

<i>Dipsacus fullonum</i> L. ssp. <i>fullonum</i> (Wild Teasel)	Nat	a b	e	
<i>Dipsacus fullonum</i> (Fuller's Teasel) ssp. <i>sativus</i> (L.) Thell.	HoCas		d e	
<i>Knautia arvensis</i> (L.) Coult. (Field Scabious)	Nat	a c	d	
<i>Helichrysum monstrosum</i> L. (Everlasting Flower)	HoCas			RPL/ELS-1972
<i>Helianthus annuus</i> L. (Annual Sunflower)	BiCas/HoCas	a	d e	
<i>Helianthus tuberosus</i> L. (Jerusalem Artichoke)	HoCas	a c	d	
<i>Helianthus rigidus</i> (Perennial Sunflower) (Cass.) Desf.	HoCas	a	d e	
<i>Rudbeckia laciniata</i> L.	HoCas			JHS-1962
<i>Rudbeckia bicolor</i> Nutt.	HoCas		d e	
<i>Galinsoga ciliata</i> (Rafn) Blake	EstAl			ETD/RPL/ELS-1972
<i>Ambrosia artemisiifolia</i> L. (Roman Wormwood)	GrCas/HoCas		d	
<i>Guizotia abyssinica</i> (L.f.) Cass (Niger)	BiCas	a b	d e	
<i>Cosmos bipinnata</i> Cav. (Mexican Aster)	HoCas	a	d	
<i>Tagetes patula</i> L. (French Marigold)	HoCas	a	d e	
<i>Senecio jacobaea</i> L. (Ragwort)	Nat	a c	d e	
<i>Senecio squalidus</i> L. (Oxford Ragwort)	EstAl	a c	e	
<i>Senecio vulgaris</i> L. (Groundsel)	Col	a c	d e	
<i>Senecio squalidus</i> × <i>vulgaris</i>	Hybrid			ETD-1974
<i>Tussilago farfara</i> L. (Coltsfoot)	Nat	a	d e	
<i>Calendula officinalis</i> L. (Garden Marigold)	HoCas	a	d e	
<i>Pulicaria dysenterica</i> (L.) Bernh. (Fleabane)	Nat		d	
<i>Solidago canadensis</i> L. (Golden-rod)	HoCas	a	d e	
<i>Solidago gigantea</i> Ait. (Golden-rod)	HoCas		e	
<i>Aster novi-belgii</i> L. (Michaelmas Daisy)	HoCas	a	d e	
<i>Aster lanceolatus</i> Willd. (Michaelmas Daisy)	HoCas		e	
<i>Aster salignus</i> Willd. (Michaelmas Daisy)	HoCas		e	
<i>Callistephus chinensis</i> (L.) Nees (Chinese Aster)	HoCas	a	d	
<i>Dahlia variabilis</i> L. (Dahlia)	HoCas		d e	
<i>Conyza canadensis</i> (L.) Cronq. (Canadian Fleabane)	NatAl	a c	d e	
<i>Bellis perennis</i> L. (Daisy)	Nat	a c	d e	
<i>Eupatorium cannabinum</i> L. (Hemp Agrimony)	Nat	a	d e	
<i>Anthemis tinctoria</i> L. (Yellow Chamomile)	HoCas	b		
<i>Achillea ptarmica</i> L. (Sneezewort)	Nat		d	
<i>Achillea millefolium</i> L. (Yarrow)	Nat	a c	d e	
<i>Tripleurospermum maritimum</i> (Scentless Mayweed) (L.) Koch ssp. <i>inodorum</i> (L.) Hyl. ex Vaarama	Col	a c	d e	
<i>Matricaria matricarioides</i> (Pineapple Weed) (Less.) Porter	NatAl	a c	d e	
<i>Chrysanthemum segetum</i> L. (Corn Marigold)	Col	b		
<i>Chrysanthemum leucanthemum</i> L. (Ox-eye Daisy)	Nat	c	e	RCLH-1961
<i>Chrysanthemum maximum</i> (Ramond) DC.	HoCas		d e	RCLH-1961
<i>Chrysanthemum parthenium</i> (L.) Bernh. (Feverfew)	EstAl	b c	d e	
<i>Chrysanthemum vulgare</i> (L.) Bernh. (Tansy)	Col	a c	d e	

<i>Chrysanthemum morifolium</i> Ramat.	HoCas			e
<i>Artemisia vulgaris</i> L. (Mugwort)	Nat	a	c	d e
<i>Artemisia absinthium</i> L. (Wormwood)	Nat		b c	d e
<i>Arctium minus</i> Bernh., ssp. <i>nemorosum</i> (Lej.) Syme	Nat			d e
<i>Carduus nutans</i> L. (Musk Thistle)	Nat	a	c	d e
<i>Carduus acanthoides</i> L. (Wetted Thistle)	Nat	a		
<i>Carduus crispus</i> L. (Wetted Thistle)	Cas		c	
<i>Cirsium vulgare</i> (Savi) Ten. (Spear Thistle)	Col	a	c	d e
<i>Cirsium arvense</i> (L.) Scop. (Creeping Thistle)	Col	a		d e
<i>Onopordon acanthium</i> L. (Scotch Thistle)	EstAl		c	e CGH-1970
<i>Centaurea scabiosa</i> L. (Greater Knapweed)	Nat	a		d e
<i>Centaurea cyanus</i> L. (Cornflower)	HoCas		b	d
<i>Centaurea moschata</i> L.	HoCas		b	
<i>Centaurea diluta</i> Ait. (Desert Knapweed)	BiCas/HoCas	b	d	ETD/RPL/ELS-1972
<i>Carthamus tinctorius</i> L. (Safflower)	HoCas			d e
<i>Cichorium intybus</i> L. (Chicory)	EstAl	a	c	d
<i>Lapsana communis</i> L. (Nipplewort)	Col		c	d e
<i>Hypochoeris radicata</i> L. (Cat's Ear)	Nat	a		e
<i>Leontodon autumnalis</i> L. (Autumnal Hawkbit)	Nat	a		e
<i>Picris echioides</i> L. (Bristly Ox-tongue)	Col		b	d
<i>Tragopogon pratensis</i> L. (Goat's Beard) ssp. <i>minor</i> (Mill.) Wahlenb.	Nat		b	
<i>Lactuca sativa</i> L. (Cultivated Lettuce)	HoCas	a		e
<i>Lactuca serriola</i> L. (Prickly Lettuce)	GrCas		b	
<i>Sonchus arvensis</i> L. (Corn Sow-thistle)	Col	a		e
<i>Sonchus oleraceus</i> L. (Sow-thistle)	Col	a	c	d e
<i>Sonchus asper</i> (L.) Hill (Spiny Sow-thistle)	Col	a	c	e
<i>Crepis capillaris</i> (L.) Wallr. (Smooth Hawk's-beard)	Nat	a	c	e
<i>Crepis vesicaria</i> L. (Beaked Hawk's-beard) ssp. <i>taraxacifolia</i> (Thuill.) Thell.	Col			e
<i>Taraxacum officinale</i> Weber (Dandelion)	Nat	a	c	d e
<i>Asparagus officinalis</i> L. (Asparagus) ssp. <i>officinalis</i>	EstAl	a		d e
<i>Allium cepa</i> L. (Cultivated Onion)	HoCas	a		d e
<i>Phoenix dactylifera</i> L. (Date Palm)	Cas	a	b	d
<i>Iris pseudacorus</i> L. (Yellow Flag)	Nat			e
<i>Iris germanica</i> L.	HoCas			e
<i>Iris</i> spp.	HoCas		b	d
<i>Crocsmia</i> × <i>crocsmiflora</i> (Montbretia) (Lemoine) N.E.Br.	HoCas		b	d
<i>Carex riparia</i> Curt. (Great Pond-sedge)	Nat			e
<i>Bromus sterilis</i> L. (Barren Brome)	Nat	a		d
<i>Bromus willdenowii</i> Kunth. (Rescue Grass) ( <i>Bromus unioloides</i> H.B.K.) MY-1968	Cas			e
<i>Bromus mollis</i> L. (Soft Brome)	Nat		c	d
<i>Agropyron repens</i> (L.) Beauv. (Couch-grass)	Nat	a	c	d e
<i>Agropyron repens</i> var. <i>aristatum</i> Baumg.	Nat		c	
<i>Triticum aestivum</i> L. (Wheat)	GrCas/BiCas	a		d e
<i>Hordeum murinum</i> L. (Wall Barley)	Nat	a	c	d e
<i>Hordeum vulgare</i> L. (Six-rowed Barley)	Cas	a		d
<i>Hordeum distichon</i> L. (Two-rowed Barley)	Cas			d



<i>Hordeum jubatum</i> L. (Fox-tail Barley)	Cas			CEH/GDW-1967 GDW-1968
<i>Glyceria maxima</i> (Hartm.) Holmb. (Reed Sweet-grass)	Nat		e	
<i>Festuca rubra</i> L., ssp. <i>rubra</i> (Red Fescue)	Nat	c	d e	
<i>Festuca pratensis</i> Huds. (Meadow Fescue)	Nat		e	
<i>Festuca arundinacea</i> Schreb. (Tall Fescue)	Nat		d	
× <i>Festulolium holmbergii</i> ( <i>F. arundinacea</i> × <i>Lolium perenne</i> ) (Dorfl.) P. Fourn.	Hybrid			AC/PGL-1972
<i>Lolium perenne</i> L. (Perennial Rye-grass)	Nat	a	c d e	
<i>Lolium multiflorum</i> Lam. (Italian Rye-grass)	NatAl	a	d e	
<i>Lolium</i> × <i>hybridum</i> Hausskn. ( <i>L. multiflorum</i> × <i>perenne</i> )	Hybrid			GDW-1971
<i>Lolium rigidum</i> Gaud.	Cas			GDW-1968
<i>Lolium temulentum</i> L. (Darnel)	BiCas			GDW-1968
<i>Lolium temulentum</i> L. var. <i>arvense</i> Lilj (Darnel)	BiCas	a	d e	
<i>Lolium multiflorum</i> × <i>temulentum</i>	Hybrid			GDW-1968
<i>Vulpia myuros</i> (L.) C.C. Gmel. (Rat's-tail Fescue)	Nat			GDW-1968
<i>Poa annua</i> L. (Annual Meadow-grass)	Nat	a	c d e	
<i>Poa nemoralis</i> L. (Wood Meadow-grass) var. <i>glaucantha</i> (Gaud.) Reichb.	Nat			RPL/ELS-1972
<i>Poa palustris</i> L. (Swamp Meadow-grass)	Den			CEH-1967
<i>Poa pratensis</i> L. (Meadow-grass)	Nat	a	c d	
<i>Briza maxima</i> L. (Large Quaking-grass)	HoCas			CEH-1967 GDW-1968
<i>Dactylis glomerata</i> L. (Cocksfoot)	Nat	a	c d e	
<i>Cynosurus cristatus</i> L. (Crested Dog's-tail)	Nat		c d e	
<i>Arrhenatherum elatius</i> (False Oat-grass) (L.) J. & C. Presl	Nat	a	c d e	
<i>A. elatius</i> forma <i>biaristatum</i> (Peterm.) Bartram	Nat		e	
<i>Avena sativa</i> L. (Cultivated Oat)	Cas		d e	
<i>Avena fatua</i> L. (Common Wild Oat)	NatAl	a	c d e	
<i>Avena fatua</i> var. <i>glabrata</i> Peterm.	NatAl		d	
<i>Avena byzantina</i> C. Koch (Algerian Oat)	Cas			CEH-1967
<i>Trisetum flavescens</i> (L.) Beauv. (Yellow Oat-grass)	Nat	a	c	
<i>Deschampsia caespitosa</i> (L.) Beauv. (Tufted Hair-grass)	Nat		e	
<i>Holcus lanatus</i> L. (Yorkshire Fog)	Nat		c d e	
<i>Holcus mollis</i> L. (Creeping Soft-grass)	Nat		e	
<i>Phalaris canariensis</i> L. (Canary Grass)	BiCas	a b	d e	
<i>Phalaris arundinacea</i> L. (Reed Canary-grass)	Nat		e	CGH-1971
<i>Apera spica-venti</i> (L.) Beauv. (Loose Silky-bent)	Nat		d	
<i>Agrostis canina</i> L. ssp. <i>montana</i> Hartm. (Brown Bent)	Nat	a	d	
<i>Agrostis castellana</i> Boiss. & Reut. (Highland Bent)	Cas			AC-1972
<i>Agrostis tenuis</i> Sibth. (Common Bent)	Nat		c d e	
<i>Agrostis stolonifera</i> L. (Creeping Bent) var. <i>stolonifera</i>	Nat	a	c d e	
<i>Agrostis gigantea</i> Roth. (Black Bent)	Nat		c d e	

<i>Lagurus ovatus</i> L. (Hare's-tail)	HoCas		d e	GDW-1967,8
<i>Phleum bertolonii</i> DC. (Smaller Cat's-tail)	Nat		d	
<i>Phleum pratense</i> L. (Timothy Grass)	Nat	a c	d e	
<i>Alopecurus myosuroides</i> Huds. (Black Grass)	Nat		c d	
<i>Monerma cylindrica</i> (Thintail) (Willd.) Coss & Dur.	Cas			
	GDW-1971	AC/PGL-1972		ETD/RPL/ELS-1972
<i>Phragmites communis</i> Trin. (Common Reed)	Nat	b	d e	
<i>Beckmannia syzigachne</i> (Steud.) Fernald (Sloughgrass)	Cas			AC/PGL-1972 ETD/RPL/ELS-1972
<i>Echinochloa crus-galli</i> (L.) Beauv. (Cockspur Grass)	Cas	b	d e	
<i>Echinochloa crus-galli</i> (Cockspur Grass) var. <i>brevisetata</i> (Doell) Neilr.	Cas			AC-1971
<i>Echinochloa colonum</i> (L.) Link (Jungle Rice)	Cas		d e	
<i>Echinochloa frumentacea</i> Link (Billion-dollar Grass)	Cas		d e	GDW-1968
<i>Echinochloa utilis</i> Ohivi & Yabuno (Japanese Millet)	Cas		e	AC-1971
<i>Setaria viridis</i> (L.) Beauv. (Green Bristle- grass)	Cas	a b	d e	
<i>Setaria italica</i> (L.) Beauv. (Foxtail Millet)	BiCas	a b	d e	
<i>Setaria glauca</i> (L.) Beauv. (Yellow Bristle- grass)	Cas		d e	GDW-1968
<i>Digitaria adscendens</i> (H.B.K.) Henrard (Finger Grass)	Cas			AC-1972
<i>Panicum miliaceum</i> L. (Common Millet)	BiCas	a b	d e	
<i>Zea mays</i> L. (Maize)	Cas		d e	GDW-1968
<i>Sorghum caffrorum</i> Beauv. (Kaffir Corn)	Cas			GDW-1968
<i>Sorghum bicolor</i> (L.) Moench (Sugar Sorghum)	Cas			GDW-1969
<i>Sorghum halepense</i> (L.) Pers. (Johnson Grass)	Cas		e	GDW-1968

(The nomenclature follows Clapham, Tutin and Warburg, 'Flora of the British Isles' second edition, 1962, except for the grasses where the list is based on Hubbard, 'Grasses', second edition, 1968).

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## FRESHWATER RECORDER'S REPORT

by R. J. Driscoll

Nature Conservancy Council, P.O. Box 6, George Street, Huntingdon.

During 1982 surveys of aquatic plants in the Norfolk Broads and surveys of the dykes that drain the associated marshlands yielded the following interesting records.

### **Plumatella fungosa** (Pallas)

The bryozoa or 'moss animalcules' are a group of organisms that used to thrive in the Norfolk Broads but has declined as a result of the general deterioration in water quality. However, on 14 August 1982 M. J. Jackson and myself, while carrying out a survey of aquatic plants, found several colonies of *Plumatella fungosa* living on pieces of rope and waterlogged wood dredged from the bottom of Malthouse Broad (grid. ref. TG 36-14-). The identification was confirmed by P. J. Chimonides at the British Museum (Natural History) and specimens were deposited in that institution and in the Castle Museum, Norwich.

### **Ranatra linearis** (L.)

I caught a single specimen of *Ranatra linearis*, the water-stick-insect, in a dyke filled with *Myriophyllum verticillatum* L. that drained the marshes south of Horsey Mere on 27 August 1982 (grid ref. TG 454215). Although *Ranatra* has been recorded from Broadland before it is decidedly uncommon. The present record is the only specimen that has been seen during a survey of the Broadland dyke fauna that has involved over 1,200 visits to some 850 dykes since 1972.

### **Ilyocoris cimicoides** (L.)

The water bug *Ilyocoris cimicoides* is widely distributed in Broadland dykes although it is usually found in small numbers. On 17 July 1982 several members of the Norfolk and Norwich Naturalists' Society attending a field meeting at Wickhampton sampled the dyke fauna of the marshes in 1 Km grid squares TG 43-05- and TG 44-05-. *Ilyocoris* was found in unusually large numbers and was the most common species of bug recorded.

### **Dugesia tigrina** Girard

*Dugesia tigrina* is an American species of flatworm that was first recognised in Great Britain in 1956. Since then it has been found in several parts of the British Isles. On 15 August 1982 M. J. Jackson and myself found *D. tigrina* to be the most common species of flatworm in Fritton Lake (grid ref. TG 40 and TM 49). In places the lake bottom consists of pebbles and in one such area on the north side of the lake (grid ref. TG 48-01-) the density of *D. tigrina* exceeded 4,000 animals per square metre.



# FRESHWATER CRAYFISH IN NORFOLK

by ROY BAKER

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## Introduction

Freshwater crayfish (*Austropotambius pallipes* Lereboullet) are widely distributed in the rivers and streams of Norfolk, especially in the becks and upper reaches of rivers. They are absent from much of Broadland and Fenland where the embanked rivers move sluggishly through alluvial plains. Where crayfish do occur their numbers vary from site to site and on occasions they may be described as being abundant. In 1970 Mr Robin Smith collected over two hundred specimens in two hours at Ringland on the River Wensum. In this survey three methods of collecting were used to record presence of crayfish. Net sweeping through emergent vegetation, especially that dominated by water cress and water celery, proved to be the most effective method, whilst setting traps with bait rarely caught any specimens even at sites where crayfish were known to be present. The third method relied on direct observations of the stream or river bed. This method could only be used in shallow, clear waters with flint, stone or chalk beds, e.g. in the upper reaches of the Wensum. Crayfish normally feed at night on smaller aquatic animals and plant food and they are less frequently seen moving about by day.

During the winter months crayfish are less evident since they hide in crevices and mud burrows. In Norfolk rivers most burrows are shallow but they have been recorded up to one metre deep in mud. This habit of burrowing may explain the name since the old English style of writing it was *crevis* or *crevice* and it is thought that *cray* is a phonetic spelling of the syllable *cre*. The word *crevis* is either derived from the French name *écrevisse* or from the low Dutch *crevik*. The former derivation is the most accepted.

There are few early records for crayfish in Norfolk. T. Southwell noted their presence in the upper reaches of the river Yare, Wensum, Bure, Ant, Glaven and Wissey in 1879 and Robert Gurney in his natural history diaries recorded them in the first quarter of this century. Records for the last five decades have been generously given by members of the *Norfolk and Norwich Naturalists' Society* and by members of the public.

## River Wensum

The solid geology of the area drained by the Wensum is Senonian Chalk which is exposed on the river bed at a number of sites, although alluvium and river gravels dominate for most of its length. The Wensum and its tributaries have been managed by man for many centuries and the presence of weirs and mills alter the flow and depth of the river. Crayfish are common along the whole length of the Wensum and in some sites they can be described as being abundant. The upper reaches above Fakenham offer habitats of fast flowing waters over stones and flints, whilst in the environs of Norwich the waters are slow flowing and deeper. E. A. Ellis observed great numbers of crayfish exposed in the river above Norwich Waterworks when the river was partially drained from time to time during the 1939-1945 period. At Fye Bridge Percy Trett collected numerous specimens hiding in beer mugs discarded from the Mischief Tavern in 1978.

### **River Tud**

The Tud is a small tributary of the Wensum. The head waters flow over chalky flints but for most of its length the river flows over silty beds with stretches of gravels. Crayfish are found along the length of the Tud but they are never very common.

### **River Yare**

Crayfish are common at many sites along the Yare above its confluence with the Wensum. Many of the favoured sites are at fords where chalk and flints are exposed and where the current flows faster through shallower waters. The Yare is a river where weirs and mills control water levels and create variable flows.

### **River Tas**

This small river which joins the Yare at Trowse is a good habitat for crayfish, especially in the shallower, faster running head waters.

### **River Bure**

Crayfish are common in the Bure and its tributaries above Coltishall. Robert Gurney observed in his diaries that the tributary which flows through a lake at Thurning abounds with crayfish and J. A. Jackson in 1978 confirmed their continued presence in the stream. Jackson also observed herons feeding on crayfish at Thurning. The Mermaid stream was stocked with crayfish in 1890 but few seemed to survive the first few years. Today the stream has numerous specimens. At Frettingham a full sized crayfish was swallowed by a pike.

### **River Glaven**

Crayfish have been recorded from the Glaven for over a century but in the present time they are uncommon. This apparent scarcity may be a reflection on the predatory behaviour of otters which live along the river and adjacent Cley marshes. Vincent Weir and K. E. Banister (1977) *Tran. of Norfolk and Norwich Nat. Soc. Vol. 24 p.85* recorded numerous crayfish remains in otter spraints at Cley during 1969-1970 but between 1973-74 only two crayfish were found in the spraints.

### **River Stiffkey**

J. N. Rounce of Fakenham studied this river in some detail but he failed to find crayfish. E. T. Daniels recorded one specimen in a small tributary at Kettlestone in 1966.

### **River Thet**

E. Smallwood recorded a single crayfish at the Thet at East Harling bridge in 1977.

### **River Little Ouse**

There are few records for the Little Ouse and of these two are over fifty years old. C. Lawrence observed specimens at Rushford and Santon Downham in 1926 and the single recent record is at Euston by T. Stark in 1977.

### **River Wissey**

For over a century there have been records of crayfish in the upper reaches of the Wissey. Today they are distributed from the Battle Area to Stoke Ferry, where they are common in the waterworks.

## River Ant

Crayfish recorded by T. Southwood in 1879, but there are no recent records.

There are no records for crayfish from the rivers Chet, Burn, Mun, Tiffey, Babingley, Great Ouse, Thurne, Lark or Waveney, although R. Riches in 1977 recorded a specimen from a small beck leading into the Waveney at Starston. Robert Gurney in his diary on 28th October 1926 observed that, 'There are no crayfish in the River Nar and I sincerely hope that there never will be. They do a great deal of harm to a trout stream.' Why the Nar should exclude crayfish remains a mystery since above Narborough it flows over river gravels and through water cress beds which in other rivers favour crayfish. Recent searches have failed to find crayfish in the Nar.

The full list of crayfish records for Norfolk are maintained in the Data Bank at the Castle Museum, Norwich and in the Nature Conservancy Council, Bracondale, Norwich.





Figure 1 Craefiech distribution in Norfolk rivers (Craefiech presence in colour)

## SOME NORFOLK LEAF-MINING MOTHS

by S. A. MANNING

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### Introduction

Since the publication of Volume I of *The Moths and Butterflies of Great Britain and Ireland* (Heath, 1976) I have checked the work's provisional vice-county distribution maps against my own records. I find that, as the result of studies of leaf-mines found in 1955 and of collecting undertaken during the years 1980-82, eight species of leaf-mining moths may be added to the Norfolk list. These records are indicated by means of an asterisk (\*). The remaining records are of species new to one of the two Norfolk vice-counties (vice-county 27, East Norfolk; v.c. 28, West Norfolk).

In each case the name of the moth is followed by that of its foodplant.

- Antispila pfeifferella* (Hübner). Dogwood, *Cornus sanguinea* L.  
v.c. 27: Earlham Park, Norwich, 28 July 1955.
- Ectoedemia angulifasciella* (Stainton). Wild rose, *Rosa* sp.  
v.c. 27: Felthorpe, 5 October 1980; Mousehold Heath, Norwich, 12 October 1982.
- E. rubivora* (Wocke). Bramble, *Rubus* sp.  
v.c. 28: Shouldham Lane, Swaffham, 8 October 1980.
- Eriocrania haworthi* Bradley. Birch, *Betula pubescens* Ehrh.  
v.c. 27: Felthorpe, 8 June 1980.
- \**E. salopiella* (Stainton). Birch, *Betula pubescens* Ehrh.  
v.c. 27: Felthorpe, 8 June, 1980.
- E. sangii* (Wood). Birch, *Betula pendula* Roth.  
v.c. 27: Haveringland Great Wood, 16 May 1981.
- E. sparrmannella* (Bosc). Birch, *Betula pubescens* Ehrh.  
v.c. 27: Felthorpe, 8 June 1980.
- \**E. subpurpurella* (Haworth). Oak, *Quercus robur* L. except at Bacton Wood where *Quercus petraea* (Matt.) Liebl.  
v.c. 27: Felthorpe, 1 June 1980; Stratton Strawless, 8 June 1980;  
East of Ludham, 6 June 1981; Bacton Wood, 13 June 1981.
- Johanssonia acetosae* (Stainton). Sorrel, *Rumex acetosa* L.  
v.c. 27: Horsford Heath, 12 August 1955.
- \**Stigmella assimilella* (Zeller). Grey poplar, *Populus canescens* (Aiton)  
v.c. 27: Mousehold Heath, Norwich, 2 November 1980.
- S. basiguttella* (Heinemann). Oak, *Quercus robur* L.  
v.c. 27: Crostwick, 27 July 1980; Felthorpe, 3 August 1980;  
Mousehold Heath, Norwich, 31 August 1980, 12 October 1982.
- \**S. centifoliella* (Zeller). Wild rose, *Rosa* sp.  
v.c. 27: Brooke Wood, 16 September 1980.
- \**S. fragariella* (Heyden). Common agrimony, *Agrimonia eupatoria* L.  
v.c. 27: Felthorpe, 3 August 1980.  
v.c. 28: Weeting-with-Broomhill, 9 September 1980.
- S. glutinosae* (Stainton). Alder, *Alnus glutinosa* (L.) Gaertner.  
v.c. 27: Hellesdon Mill Lane, Norwich, 5 October 1980.
- S. ruficapitella* (Haworth). Oak, *Quercus robur* L.  
v.c. 28: Shouldham Lane, Swaffham, 8 October 1980; Hempton, 13 October 1980.

- \**S. splendidissimella* (Herrich-Schäffer). Bramble, *Rubus* spp.  
v.c. 27: Mousehold Heath, Norwich, 12 October 1982.  
v.c. 28: Shouldham Lane, Swaffham, 8 October 1980.
- \**S. svenssoni* (Johansson). Oak, *Quercus robur* L.  
v.c. 27: Holt Country Park, 26 August 1982.
- \**S. tiliae* (Frey). Lime, *Tilia* spp.  
v.c. 27: Mousehold Heath, Norwich, 31 August 1980; Cromer, 6 September 1980; Earlham Park, Norwich, 7 September, 1980; Old Buckenham, 26 October 1980; Bacton Wood, 22 August 1981.  
v.c. 28: Weeting-with-Broomhill, 9 September 1980; St. Peter's Garden, Fakenham, 13 October 1980.

### Acknowledgements

I thank Lieut. Col. A. M. Emmet for his generous help and encouragement and my sister, Mrs M. M. Cowles, for help with transport.

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NOTES ON THE LEPIDOPTERA OF THE PALLING  
WAXHAM — WINTERTON SANDHILLS

by T. N. D. PEET

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The sand dunes of the east Norfolk coast from Sea Palling to Winterton are a region of important conservation concern. The area is a valuable breeding site for the Natterjack toad, an important landfall for migrant birds, and there are some scarce resident lepidoptera, outlined below. Over the past twenty years I have made many day-time observations, some nocturnal mercury-vapour expeditions, and in addition there are several M.V. records from nearby Hickling which reflect the wind blown movements of coastal moths. There appear to be no recent publications on the lepidoptera of this area.

From the group of Pyralid moths, two local species thrive. *Platytes alpinella* Hb. was first noted in 1982, with several examples to M.V. light. It is known as a scarce, southern coastal insect, the larva of which is apparently undescribed. *Anerastia lotella* Hb. of which the larva feeds on marram, has been taken twice, its distribution is entirely confined to coastal districts.

The flowers of the dune slacks in high summer show off the local butterflies at their best. The most notable is a small colony of the Small Pearl-bordered Fritillary (*Boloria selene* D. & S.) usually thought of as a woodland butterfly, but flourishing here in scrubby open country. I have twice seen a second brood in very hot years. Faster, difficult to catch and best seen feeding on thistle heads is the large and elegant Dark Green Fritillary (*Argynnis aglaja* Linn.). The peak emergence of this butterfly is the last week of July, and this colony has appeared stable over the years I have visited the area. Flying at the same time, but not stopping to feed are large numbers of male Oak Eggars (*Lasiocampa quercus* Linn.). This moth is widespread over the grazing marshes around Horsey Mere and Hickling.

The real treasure and indeed rarity of this area is fortunately a small and inconspicuous insect. This is the Pygmy Footman (*Eilema pygmaeola* Doubl.) found only at two coastal sites in Kent apart from this Norfolk locality. At rest, the moth looks like a Crambid. It comes freely to light, and has been noted at Horsey Gap, Winterton, and windblown to Hickling. It appears to be common, and not under any recognisable threat short of wholesale destruction of the habitat.

Typically specialised coastal residents include the Sand Dart (*Agrotis ripae* Hubn.), Archer's Dart (*Agrotis vestigialis* Hufn.) which is also frequent in the Breck, and from marram grass the Shore Wainscot (*Leucania litoralis* Curt.), and from lyme grass the Lyme Grass Wainscot (*Photedes elymi* Treit.). This latter moth may be found in large numbers at dusk sitting on the foodplant at Sea Palling, and indeed this is the best way to observe the females which fly only reluctantly.

Daytime walks along the dune slacks have produced examples of the Purple Bordered Gold (*Idaea muricata* Hufn.), a tiny, very local moth, and specimens of the Silver hook (*Eustrotia uncula* Cl.) an insect usually associated with marshland. Large numbers of Burnet moths may be seen in July and August, and among them examples of the scarce and local Forester (*Adscita sticticus* Linn.).

Human pressure on the dunes is considerable, but probably does little damage to insects. Building of chalets, ploughing or other development on the marginal dune slacks is far more of a threat to the wildlife of this delightful piece of the Norfolk coast.

I am grateful for the help and enthusiasm of Mr John Buxton of Horsey Hall.

# BROADLAND DYKES: THE LOSS OF AN IMPORTANT WILDLIFE HABITAT

by R. J. DRISCOLL

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## Introduction

The value of hedges as habitats for a wide range of animals and plants is generally known (Pollard et al 1974). A number of surveys have documented the destruction of hedgerows that has taken place since the Second World War as a result of agricultural improvement (Baird and Tarrant 1973).

In Broadland and other lowlying parts of Britain large areas of marshland are drained by extensive networks of dykes or ditches. Until recently these marshes were used primarily for grazing stock and the dykes acted as field boundaries or 'wet hedges' as well as draining the land.

The value of these dykes as wildlife habitats has only recently been recognised. Over 206 species of aquatic animal and 169 species of aquatic plant were recorded from Broadland dykes during surveys carried out during the 1970's (Driscoll 1975, 1976). Several of these animals and plants have very restricted distributions in Great Britain e.g. *Aeshna isosceles* (Müll.), *Anisus vorticulus* Troschel, *Potamogeton acutifolius* Link and *Stratiotes aloides* L. Broadland dykes are the last refuge of some of these species.

Apart from the present study no quantitative study of dyke removal has been carried out in Broadland although Westmacott and Worthington (1974) mapped the loss of dykes in part of Cambridgeshire since 1945 and Green (1974) mapped dykes improved with MAFF grants in part of Huntingdonshire since 1940. Detailed surveys of the network of dykes at Somerton and Winterton (corresponding to Hap-pisburgh — Winterton Internal Drainage Board sub area 1) were carried out in 1973 and 1981.

In 1973 the area was largely grazing marsh, drained by an extensive network of dykes that differed little from the network shown on the OS 1:10560 maps (Driscoll and Lees 1973). By 1981 most of the marshland was under cereals. The drainage network had been improved by replacing most of the subsidiary dykes with plastic underdrainage pipes and deepening and profiling the main drains (see Figure 1). Between 1973 and 1981 33.5% of dykes were filled in (see Table 1). This probably represented the largest proportion of dykes that could be economically removed.

In terms of habitat loss 33.5% may not seem catastrophic. However virtually all of the remaining 66.5% of dykes are now being intensively managed and the faunas and floras have been impoverished as a result (Driscoll 1983). In other parts of Broadland it might be possible to remove a higher proportion of dykes and dyke removal could pose a serious threat to some species that are virtually restricted to Broadland dykes.

## Acknowledgements

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**Table 1**  
Length of dykes in Happisburgh to Winterton Internal Drainage Board sub-area 1.

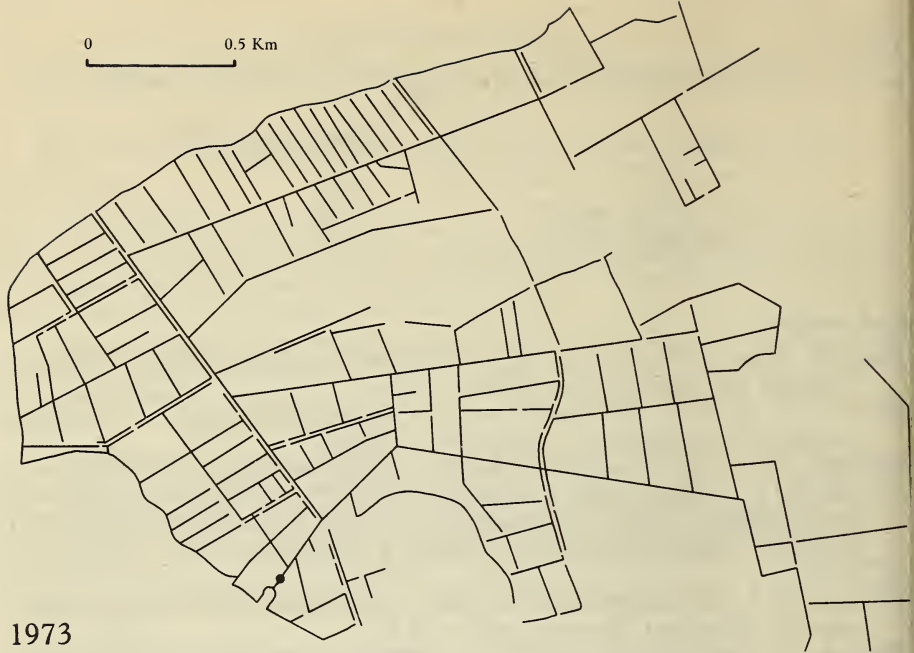
<i>Date</i>	<i>Dyke Length (Km.)</i>
pre 1930 (O.S. 1:10560 map)	50.48
1973 (field survey)	51.22
1981 (field survey)	34.06

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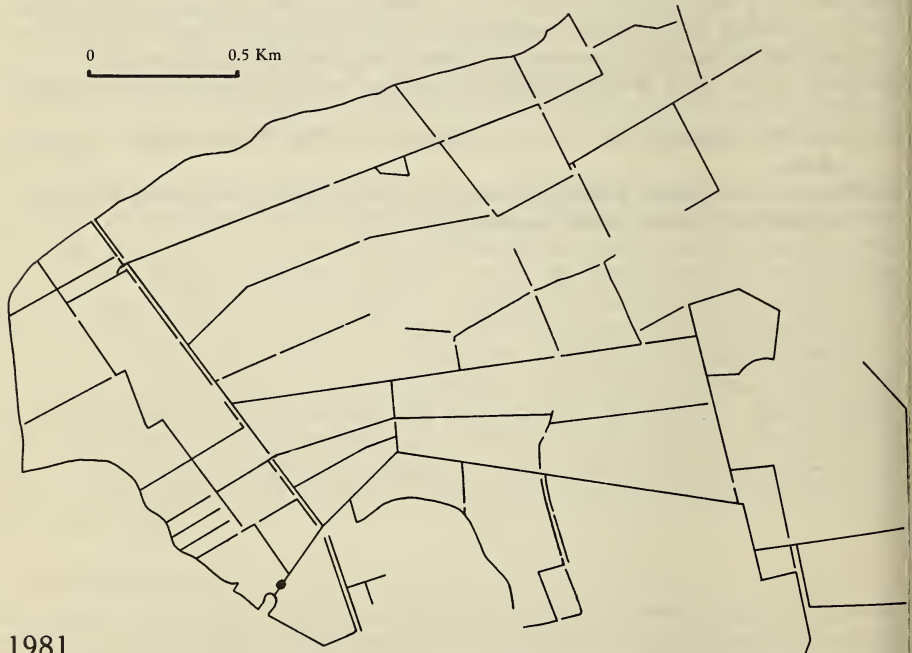


0 0.5 Km



1973

0 0.5 Km



1981

**Figure 1.** Maps showing the network of dykes in Happisburgh - Winterton Internal Drainage Board sub-area 1 in 1973 and 1981.

# THE RIVER GLAVEN

By ROY BAKER

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## Introduction

Descriptions of Norfolk rivers show that they meander sluggishly through flat open valleys and, other than at man-made weirs, they lack the flow and turbulence of more mountainous streams. The River Glaven in North Norfolk is a partial exception. It starts in the hummocky hills of the Cromer-Holt ridge a few kilometres east of Holt, flows quickly in a south-westerly direction to Hunworth Green and then turns northwards to the coast at Cley. The river valley is narrow in many places and the low hills enclosing it contrast with the open flatness seen in other East Anglian river valleys. Geologists and geographers have made many studies of the Glaven valley in their attempts to understand the Pleistocene of East Anglia, archaeologists and historians have examined the neolithic barrows of Salthouse and Kelling heaths, the ancient hill fort at Hunworth and the recent changes at Cley; but naturalists have been attracted mainly to the estuary at Cley and they have rather neglected the rest of the river. This paper describes the flora and fauna of the Glaven from its origins in the Cromer-Holt ridge to its estuarine outfall west of Cley-next-the-Sea nineteen kilometres later.

## Name

Ekwall (1928) favoured the idea that *Glaven* was probably a backformation from *Glandford*. The element *Glam* may be derived from the Old English *gleam* meaning merriment and, if this is correct, *Glandford* would mean the 'ford where sports were held'. Cozens-Hardy (1965) noted that the old spelling for Glandford was *Glamford* and that in a document of about 1300 the name *Glamenee* was used in describing land abutting the river. Ekwall pointed out that a second derivation of the name could be considered from the Welsh *Glan* meaning pure but he considered this to be less likely. In a description of some property at Hunworth in 1446 the river was called *Glavene*.

## Geology

The whole area drained by the Glaven rests on Senonian (Upper) Chalk. This occasionally outcrops on the valley sides near Cley. The lower reaches of the river flow over chalk, although the valley sides throughout its length are largely developed on glacial deposits. The dominant feature is the Cromer-Holt Ridge which is essentially a morainic dump of sands and gravels representing the terminal moraine of a North Sea ice sheet of the Anglian Glaciation. The ridge lies west from Overstrand to West Beckham and thence south-west to Edgefield. It is in the broad inland part of the ridge southeast of Holt that the River Glaven has its headstreams.

North of the Cromer Ridge near Holt are two sandur plains described by West (1957) and Sparks & West (1964) as the Kelling and Salthouse Outwash Plains. They are thought to be the outwash remains of a retreating ice front which stood first at Kelling Heath with an escape south over Briston Gap, and then at Salthouse Heath with a drainage back into the ice. With this latter phase the kames, kame terraces and the crevasse infilling of Blakeney Downs Ridge (formerly known as the

Blakeney Esker) may be associated. Sparks and West argue that these outwash plains are related to two successive stages of ice-front positions in a period of ice stagnation and decay. The bedded sands and gravels of the Kelling Outwash Plain abutt the northern bank of the Glaven south-west of Holt and the river now cuts through the southermost part near Hunworth Green as it turns northwards to the sea. At Holt Mill the river valley is steep sided and it appears to have recently dissected the outwash plain. The Salthouse Plain is smaller and it is thought to have drained northwards through a mass of fissured and stagnating ice along the present line of the Glaven valley in glacial times. This sub-glacial drainage gave rise to the kames and kame terraces around Glandford. In his earlier paper West (1957) suggested that in the Wolstonian ice-age an ice lobe filled the valley near Glandford and that the Blakeney Ridge formed in the standing water with the melt waters flowing southwards, but in their later joint paper Sparks and West (1964) noted the difficulties of reconciling this with the proposed sub-glacial drainage through the ice in the opposite direction. They suggest that both processes could have occurred during short periods of glacial push and decay. They proposed that these features were formed during the Wolstonian glaciation. Straw (1960) argued that the Glaven valley formed as post-glacial erosion features, a view rejected by Sparks and West.

A more recent question has been raised by Shotton et al (1977) who argue that no Wolstonian till was deposited in East Anglia and they, therefore, infer that no part of the region was glaciated during this period. If this is correct then only the Anglian ice sheet covered Norfolk and the Devensian ice sheet reached the area around Hunstanton. The county was free of ice in the intervening Wolstonian (Allison 1975). The origin of the outwash plains, kames and kame terraces must consequently be looked for in the post-Marley Drift (Anglian) period or the pre-Hunstanton Till (Devensian) period. The whole of the river system may have been formed before the Wolstonian as the Anglian ice sheets retreated, although Funnell (1976) thought it likely that the present East Anglian river systems were essentially established by the end of the Wolstonian glaciation at around 130,000 years B.P.

### **Recent History**

The recent history of the river valley has been greatly influenced through the harnessing of its water power by man. Domesday records show numerous water mills along the Glaven from Bodham to Glandford. Water was an important source of power for grain milling and it was only in the late 12th C. that windmills developed in England. At Hunworth there has been a mill since before the Conquest and many mills recorded in Domesday must have pre-dated the Norman invasion. At Holt Mill Pond there has been a mill since the reign of Edward I. The original Domesday mills have long since disappeared but a few survive from the last century. The two pairs of stones at Holt Mill were driven by turbines until the mid-70's and even today the mill at Letheringsett remains as a working mill, albeit driven by diesel since 1940. Recent work on the conversion of Letheringsett Mill back to water wheel power has included the re-excavation of the mill pond upstream of the mill. The three storey brick mill at Thornage is in a poor state of repair, although the largely wooden water wheel remains in fairly good order. Other mills, such as those at Glandford and Hunworth, have been converted into houses. The influence of mills on the river flow can be seen at Holt Mill and at Letheringsett Mill where water is ponded back above the mill and flow is minimal. Below the mills the water runs faster and with some turbulence.



The 17th C. saw the embankment of parts of the Norfolk coast by Dutch engineers. Work began on the embankment of the marshes at Cley, Salthouse and Blakeney in the early to mid-1600's. Basil Cozens-Hardy (1927) has given a full description of this period but the salient feature in this study is the embankment and road building in 1823 across the Glaven along the line of the present coastal road. Before 1823 tides flooded the Glaven estuary as far as Glandford and both Cley and Wiveton had been important coastal harbours.

In the 18th and 19th C. the fashion amongst wealthy landowners was to build their country houses in parkland settings. At Bayfield Hall an artificial lake was made as part of the landscaping of the valley. To prevent this lake from silting up a Victorian extravaganza tunnel was built into the valley hillside in the late 19th C. to carry most of the waters past the lake. The whole enterprise took thirteen years to complete and to this day it diverts much of the Glaven past the lake.

Richard Gurney purchased the Hempstead estate about 1803 and subsequently he built a dam across the river as part of a landscaping project and to form a duck decoy. This decoy is now known as Selbrigg Pond and until 1845 it was a very productive decoy. One thousand teal were taken in the winter of 1834-5. The accounts of Hempstead Decoy for 1831-2 are held in the Norwich Record Office and these show that 38 ducks and 95 teal were sent to London and sold for £5.14s. Today the decoy waters are still retained by a wall with a small outflow weir and it is a shallow pond of up to 2 metres depth covering an area of less than an hectare.

Man continues to change the river to meet his needs. In the later 1970's a lake was excavated at Edgefield Hall to form a trout farm and fishing site. This remains a flourishing industry and illustrates how the pattern of the river valley is controlled, as it has been for centuries, to meet changing roles.

### **Land Use**

The upper reaches of the Glaven flow through poor land largely given over to forestry or which remains as heathland. In the middle and lower reaches the dominant land use is pasture and parkland until it reaches the sea at Cley. There is a trout farm at Glandford and near Holt gravel is worked on the valley sides.

### **Survey Methods**

The River Glaven and its tributaries were surveyed during the period 1978-81. Sampling involved the examination and recording of the aquatic, marginal and bank flora. The submerged vegetation was collected using hand nets or grapples. The aquatic fauna was sampled by hand collecting or net sweeping.

Species lists were compiled for each site using a subjective scale of abundance for each species. These species lists were used to prepare distribution maps for each species recorded in the survey. Appendix 1 contains a complete list of the animals and plants recorded during the survey.

Copies of the field notes, species lists, distribution maps and a map showing sites have been deposited in the Norfolk Biological Data Bank at the Castle Museum, Norwich, where they are available for inspection.

### **Survey Data**

The small headstreams of the River Glaven arise in the low hills and shallow valleys of the land on the northern side of the Cromer-Holt Ridge in the parishes of Bodham and Baconsthorpe. Local people consider a spring in a small ditch-like

waterway between the 15th C. Baconsthorpe Castle and Lower Farm to be the source of the Glaven but equal precedence could be given to the headstreams arising at Bodham Farm beyond Baconsthorpe Wood or near Lower Bodham church. The headstreams are little more than ditches with minimal water flow in summer. The stream bed is formed of silt, stones and flints. In places the vegetation is dominated by watercress (*Rorippa nasturtium-aquaticum* agg), water forget-me-not (*Myosotis scorpioides*) and celery-leaved crowfoot (*Ranunculus sceleratus*). The fauna is typical of this type of Norfolk stream with *Gammarus pulex*, *Pisidium nitidum* and *Potamopyrgus jenkinsii* abundant. Caddis fly larvae of *Anabolia nervosa* occur and occasional specimens of the water beetle *Ilybius fuliginosus*.

The headstreams descend quickly to their confluence above Selbrigg Pond. Selbrigg is enclosed by reedswamp of *Phragmites communis* and *Carex acutiformis* with alder and willow carr. The open waters are dominated by fennel-leaved pondweed (*Potamogeton pectinatus*) and *Ranunculus circinatus*. Holmes (1979) observed that *R. circinatus* is characteristic of slow flowing pools and it will not tolerate either fast currents or base poor waters of depths greater than 1 metre. Whilst abundant at Selbrigg it does not occur elsewhere in the Glaven. Canadian pondweed (*Elodea canadensis*), curled pondweed (*Potamogeton crispus*), hornwort (*Ceratophyllum demersum*), and the duckweeds, *Lemna minor* and *Lemna trisulca* are all common. The shallow waters of the pond are rich in aquatic life. Snails are abundant with *Bithynia tentaculata*, *Lymnaea peregra*, *Valvata piscinalis*, *Gyraulus albus*, *Anisus vortex*, *Planorbis carinatus*, *Acroloxus lacustris*, *Sphaerium corneum* and swan mussels *Anodonta cygnea* all being common. The rare *Anisus vorticulus* occurs in the edge waters. Selbrigg Pond is of considerable interest for the presence of larvae of the mayfly *Caenis robusta* which has been noted previously at Wheatfen Broad, Scoulton Mere, Ringmere, West Mere Tofts, Bagmore Pit (Watson 1974) and the River Wensum at Castle Farm (Baker, Driscoll and Lambley 1978). A visit with Dr Garth Foster and Mr Magnus Sinclair in April 1981 produced only thirteen species of water beetles and Dr Foster advanced the theory that the paucity of the beetle fauna in the reedswamp is related to the age of the reed beds dating from only 1803. Many of the typical reedswamp beetles do not invade new areas easily. The list of water beetles is given below.

<i>Noterus clavicornis</i> (Degeer)	<i>Ilybius ater</i> (Degeer)
<i>Hyphydrus ovatus</i> (L.)	<i>Hydrobius fuscipes</i> (L.)
<i>Hygrobia inaequalis</i> (Fab.)	<i>Anacaena globulus</i> (Paykull)
<i>Hydroporus incognitus</i> (Sharp)	<i>A. limbata</i> (Fab.)
<i>H. palustris</i> (L.)	<i>Enochrus testaceus</i> (Fab.)
<i>H. pubescens</i> (Gyllenhal)	<i>Limnebius truncatellus</i> (Thunberg)
<i>Agabus sturmi</i> (Gyllenhal)	

Below the weir the river is fast flowing over a stony bed. Small stands of starwort (*Callitriche platycarpa*), water forget-me-not and brooklime (*Veronica beccabunga*) are found near the banks. The river here is enclosed by woodland and considerable shading occurs. Post (1981) recorded the larvae of the blackfly *Simulium argyneatum* below the weir in the fast turbulent waters. Normally the larvae are confined to natural and artificial lake outlets, although Post found that several of the twelve Norfolk sites are not associated with weirs and lakes. On larger stones pupal cases of *Simulium ornatum* were noted in autumn 1981 below the out-



fall. A single specimen of the net filtering caddis larva *Hydropsyche siltalai* was found in the fast flowing river.

There is a marked contrast in the flora and fauna of Selbrigg Pond and Holt Mill Pond which is shallow, heavily silted and has no aquatic macrophytes. The edges are dominated by reedswamp and alder carr. Numerous ducks frequent the pond and not surprisingly the wildfowl leech *Theromyzon tessulatum* is common. Near the outfall weir a few species of molluscs and aquatic insects occur but their numbers are low. Of the water bugs only *Sigara falleni* is common, whilst only single specimens of *Sigara distincta* and *Notonecta glauca*, which are characteristic of reedbeds, are recorded.

The river below Holt Mill is shallow, fast flowing over stones and flints. It is enclosed for much of its length by coniferous plantations and alder-willow carr. Numerous rivulets add water to the Glaven from the Kelling Outwash Plain, especially in the area bordered by Holt Lowes. The name *Lowes* signifies an ancient burial place, but it has been known to naturalists through the interesting series of small mires along the valley slopes. Near Edgefield the river is bordered by grazing marshes and at the Hall a new lake has been dug for trout fishing.

The upper section of the river may be said to end at the abrupt turn northwards at Hunworth Green. The valley opens out and the current flow slackens. The mill at Hunworth ponds back the waters for about 10 metres. Horned pondweed (*Zanichellia palustris*), starwort and Canadian pondweed are abundant. Spiked water-milfoil (*Myriophyllum spicatum*) is common. Five species of leech are recorded from this section during 1979-80. *Glossiphonia complanata*, *Erpobdella octoculata*, *Theromyzon tessulatum*, and *Helobdella stagnalis* are ubiquitous in the Glaven but the single record for *Hemiclepsis marginata* is of interest. It is a leech of standing waters and slowly flowing rivers where it is parasitic on fish. Dr E. A. Ellis has noted its presence in some Yare broads and one specimen was collected in the River Wensum near Lenwade by the authors in 1979 and Watson (1974) recorded it in Ringmere and Rush Mere. Little is known of its distribution in Norfolk other than its otherwise comparative rarity.

At and below Hunworth the Glaven receives waters from two small tributary streams from the west. The valley widens and the river is bordered by grazed pastures. It is two metres wide and in places is over half a metre deep. Starwort, horned pondweed, watercress, spiked water-milfoil are common. *Ranunculus penicillatus* var. *calcareous* becomes increasingly common downstream and in places forms dominant stands. Holmes (1979) notes that this species has a similar requirement for fast flowing rivers as the variety *penicillatus* but it is more tolerant of less rapidly flowing rivers such as the Glaven. A feature of the Glaven valley is the presence of the bright yellow monkey flower (*Mimulus guttatus*) which is a naturalised alien. Ellis (1980) observed that it occurs in greatest abundance where streams and rivers flow fast and flood their banks in winter, thus aiding seed dispersal. The monkey flower was introduced into England in 1812 from North America and has spread throughout the country. It is found mainly in Norfolk along the Glaven and Bure. Mayfly larvae are abundant in this mid-section of the river. *Baetis rhodani* and *Ephemerella ignita* are very common, whilst *Ephemera danica* Mull is widespread but in smaller numbers.

Below Letheringsett the river is diverted through a culvert and tunnel to bypass Bayfield Park lake. The lake is shallow and silted. Few aquatic plants grow in



its waters and since it is surrounded by grazed parkland it has little biological interest, other than as a major refuge for geese and ducks.

At Glandford the river is four metres wide, shallow and bordered by grazed pasture. Starwort, Canadian pondweed, brooklime, spiked water-milfoil, horned pondweed, water forget-me-not and fennel-leaved pondweed form localised stands. One addition to the aquatic flora in the lower reaches of the Glaven is slender pondweed (*Potamogeton berchtoldii*).

Below Glandford Mill the river meanders through grazing water meadows with numerous dykes. At Wiveton the river is three metres wide and up to two metres deep. It is densely vegetated with starwort, fennel-leaved pondweed, curled pondweed, spiked water-milfoil, hornwort, horned pondweed, slender pondweed, Canadian pondweed and the unbranched bur-reed (*Sparganium emersum*). The dykes are dominated by watercress, brooklime and duckweeds. Petch and Swann (1968) reported *Ceratophyllum submersum* from the Wiveton ditches but the present survey failed to find the species. The ditches and river offer a variety of habitats for fauna. The water beetles *Haliphys lineatocollis* (Marshall), *Haliphys fluviatilis* and *Stictotarsus 12 pustulatus* (Fabr.) are common, whilst *Hydroporus palustris* and *Elmis aenea* are present. Driscoll in his survey of East Norfolk dykes found *Hydroporus palustris* to be widely distributed and the commonest of the *Hydroporus* species. The American immigrant species of flatworm *Dugesia tigrina* is found at Wiveton. The fish leech *Piscicola geometrica* is an uncommon species.

Between Wiveton and the Cley sluice the river is shallow, silted and comparatively unvegetated. Fennel-leaved pondweed, starwort, unbranched bur-reed and watercress form localised stands. The section is characterised by the presence of *Enteromorpha intestinalis* Link which may reflect the brackish waters near the sluices.

Below the sluices the Glaven becomes truly estuarine and the river banks are covered with salt marsh plants, sea couch grass, sea aster and sea purslane typical of the North Norfolk coast.

### **Stody Beck**

This is a small stream which rises west of the village of Stody. It is fast flowing, shallow and with a sandy-silty bed. In most places the beck is densely vegetated with watercress, water forget-me-not, wild celery (*Apium nodiflorum*), and creeping bent (*Agrostis stolonifera* var. *palustris*). A single female *Agabus paludosus* collected in 1980 is indicative of the nature of this beck. This species of water beetle is found in small shallow streams with thick vegetation. It is a common species of watercress beds. Driscoll recorded a single species from freshwater dykes draining grazing marshes at Repps and Potter Heigham in 1974.

### **Thornage Beck**

This is the largest of the Glaven tributaries which joins the river some way above Thornage Mill. It is fed by a considerable watershed. The Lobb's valley branch arises west of Melton Constable before it joins the main branch from Gunthorpe. Both branches of the stream run through boulder clays and sandy gravels. They are often overgrown with watercress, water mint (*Mentha aquatica*), brooklime, water forget-me-not, creeping bent, narrow-leaved water parsnip (*Berula erecta*) and in the lower sections horned pondweed. The beck sustains many of the small fish typical of headstreams. The three-spined stickleback and miller's thumb are common.

## Acknowledgements

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## Appendix 1

List of plants recorded during 1978-83 in River Glaven Survey.

### SPECIES

### HABITAT

#### EQUISETINEAE

*Equisetum palustre* L.

A                      B                      E

\*

#### ANGIOSPERMAE

*Agrostis stolonifera* L.

\*

\*

## SPECIES

## HABITAT

	A	B	E
<i>Alisma plantago-aquatica</i> L.	*		
<i>Alnus glutinosa</i> (L.) Gaertn.			*
<i>Apium nodiflorum</i> (L.) Lag.		*	
<i>Arrhenatherum elatius</i> (L.) Presl.			*
<i>Berula erecta</i> (Huds.) Coville		*	
<i>Callitriche platycarpa</i> (Kutz.)	*		
<i>Caltha palustris</i> L.		*	
<i>Carex acutiformis</i> Ehrh.		*	
<i>C. paniculata</i> L.		*	
<i>C. riparia</i> Curt.		*	
<i>C. spicata</i> Huds.		*	
<i>Ceratophyllum demersum</i> L.	*		
<i>Conium maculatum</i> L.		*	
<i>Elodea canadensis</i> Michx.	*		
<i>Epilobium angustifolium</i> L.			*
<i>E. hirsutum</i> L.			*
<i>E. palustre</i> L.			*
<i>Eupatorium cannabinum</i> L.			*
<i>Fraxinus excelsior</i> L.			*
<i>Filipendula ulmaria</i> (L.) Maxim.			*
<i>Galium aparine</i> L.			*
<i>Geranium pratense</i> L.			*
<i>G. robertianum</i> L.			*
<i>G. sylvaticum</i> L.			*
<i>Glyceria maxima</i> (Hartm.) Holmberg		*	
<i>Hypericum perforatum</i> L.			*
<i>Iris pseudacorus</i> L.		*	
<i>Juncus effusus</i> L.			*
<i>J. inflexus</i> L.		*	
<i>Lemna polyrrhiza</i> L.	*		
<i>L. minor</i> L.	*		
<i>L. trisulca</i> L.	*		
<i>Malva sylvestris</i> L.			*
<i>Mentha aquatica</i> L.		*	
<i>Mimulus guttatus</i> DC.			*
<i>Myosotis scorpioides</i> L.		*	
<i>Myriophyllum spicatum</i> L.	*		
<i>Phalaris arundinacea</i> L.		*	
<i>Potamogeton berchtoldii</i> Fieb.	*		
<i>P. crispus</i> L.	*		
<i>P. pectinatus</i> L.	*		
<i>Populus</i> spp.			*
<i>Pulcaria dysenterica</i> (L.) Bernh.			*
<i>Ranunculus circinatus</i> Sibth.	*		
<i>R. penicillatus</i> var. <i>calcareous</i> Cook			*
<i>R. repens</i> L.			*
<i>R. sceleratus</i> L.		*	



SPECIES	HABITAT		
	A	B	E
<i>Rhododendron ponticum</i> L.			*
<i>Rorippa nasturtium-aquaticum</i> agg.		*	
<i>Rubus</i> spp.			*
<i>Rumex conglomeratus</i> Murr.			*
<i>R. crispus</i> L.			*
<i>Salix</i> spp.			*
<i>Scirpus lacustris</i> L.		*	
<i>Scrophularia aquatica</i> L.			*
<i>Solanum dulcamara</i> L.			*
<i>Sonchus arvensis</i> L.			*
<i>Sparganium emersum</i> Rehm.	*		
<i>S. erectum</i> L.		*	
<i>Stachys sylvatica</i> L.			*
<i>Typha angustifolia</i> L.		*	
<i>Urtica dioica</i> L.			*
<i>Veronica beccabunga</i> L.		*	
<i>V. catenata</i> Pennell		*	
<i>Zannichellia palustris</i> L.	*		
<i>Viburnum opulus</i> L.			*
<b>HEPATIGAE</b>			
<i>Conocephalum conicum</i> (L.) Underw.	*	*	*
<b>ALGAE</b>			
<i>Enteromorpha intestinalis</i> (L.) Link	*		
<i>Cocconeis placentula</i> Ehrenb.	*		
<i>Spirogyra</i> spp. Link	*		
<i>Vaucheria sessilis</i> (Vauch.) DC.	*		
Number of species of macrophyte	15	22	32
Total number of species of macrophyte		69	
Total number of species of macrophyte, bryophyte and alga		74	
A submerged and floating flora	B emergent and marginal flora		E bank flora

## Appendix 1a

List of animals recorded during 1978-83 in River Glaven survey.

### PORIFERA

*Ephydatia fluviatilis* (L.)

### PLATYHELMINTHES: TURBELLARIA

*Polycelis nigra* (Mull.)

*Dugesia tigrina* Girard

*Dendrocoelum lacteum* (Mull.)

### MOLLUSCA: GASTROPODA

*Valvata piscinalis* (Muller)

*Anisus vorticulus* (Troschel)

*Potamopyrgus jenkinsi* (Smith)

*Gyraulus albus* (Muller)

*Bithynia tentaculata* (L.)

*Hippeutis complanatus* (L.)

*Physa fontinalis* (L.)

*Segmentina nitida* (Muller)

*Lymnaea stagnalis* (L.)  
*Lymnaea peregra* (Muller)  
*Planorbis carinatus* (Muller)  
*Anisus vortex* (L.)

#### LAMELLIBRANCHIA

*Anodonta cygnae* (L.)  
*Sphaerium corneum* (L.)

#### ANNELIDA: HIRUDINEA

*Piscicola geometrica* (L.)  
*Theromyzon tessulatum* (Mull.)  
*Hemiclepsis marginata* (Muller)

#### ARTHROPODA: CRUSTACEA

*Asellus aquaticus* (L.)  
*Asellus meridianus* Racovtza  
*Crangonyx pseudogracilis* Bousfield

#### INSECTA

*Baetis rhodani* (Pictet)  
*Cloeon dipterum* (L.)  
*Ephemerella ignita* (Poda)  
*Ephemera danica* Mull.  
*Caenis moesta* Bengtsson  
*Caenis robusta* Eaton  
*Sympetrum striolatum* (Charpentier)  
*Coenagrion mercuriala*  
*Coenagrion puella* (L.)  
*Gerris lacustris* (L.)  
*Sigara dorsalis* (Leach)  
*Sigara distincta* (Fieb.)  
*Sigara falleni* (Fieb.)  
*Corixa punctata* (Illinger)  
*Notonecta glauca* (L.)  
*Sialis lutaria* (L.)  
*Limnephilus decipiens* (Kolenati)  
*Limnephilus lunatus* Curtis  
*Silo pallipes* (Pict.)  
*Anabolia nervosa* Curtis  
*Athripsodes bilineatus* (L.)  
*Athripsodes aterrimus* (Stephens)  
*Hydropsyche siltalai* Döhler  
*Hydropsyche instabilis* Curtis  
*Noridobia ciliaris* (L.)  
*Rhyacophila dorsalis* Curtis  
*Mystacides longicornis* (L.)  
*Simulium argyneatum* (Meigen)  
*Simulium ornatum* Meigen

#### ARACHNIDA

*Hygrobatas longipalpis* (Hermann)  
*Hygrobatas fluviatilis* (Strom)

*Ancylus fluviatilis* (Muller)  
*Acroloxus lacustris* (L.)  
*Succinea putris* (L.)

*Pisidium milium* (Held.)  
*Pisidium nitidum* Jenyns

*Glossiphonia complanata* (L.)  
*Helobdella stagnalis* (L.)  
*Erbodella octoculata* (L.)

*Gammarus pulex* (L.)  
*Austropotamobius pallipes* (Lereboullet)  
*Cyclops* sp.

*Nemotelus* sp.  
*Chironomus* sp.  
*Hydropodura aquatica* (L.)  
*Brychius elevatus* (Panzer)  
*Haliphus fluviatilis* Aube  
*Haliphus lineatocollis* (Marsham)  
*Noterus clavicornis* Degeer  
*Hyphyrus ovatus* (L.)  
*Hygrotus inaequalis* (Fab.)  
*Hydroporus incognitus* Sharp  
*Hydroporus palustris* (L.)  
*Hydroporus pubescens* (Gyllenhal)  
*Potamonectes depressus*  
*Potamonectes elegans* (Panz)  
*Platambus maculatus* (L.)  
*Agabus sturmi* (Gyllenhal)  
*Agabus paludosus* (Fab.)  
*Illybius ater* (Dgeer)  
*Ilybius fuliginosus* (Fab.)  
*Stictotarsus 12 — pustulatus* (Fabr.)  
*Gyrinus* sp.  
*Anacaena globulus* (Paykull)  
*Anacaena limbata* (Fab.)  
*Laccobius* sp.  
*Enochrus testaceus* (Fab.)  
*Hydrobius fuscipes* (L.)  
*Elmis aenea* (Muller)  
*Limnius volckmari* (Panzer)  
*Limnebius truncatellus* (Thunberg)

*Sperchon setiger* (Thor.)  
*Atractides spinipes* (Koch)

*Hygrobates nigromaculatus* Lebert.  
*H. fluviatilis* Strom.

*Arrenurus* sp.  
*Lebertia* sp.

CHORDATA: OSTEICHTHYES

*Salmo trutta* L.  
*Esox lucius* L.  
*Rutilus rutilus* (L.)  
*Nemacheilus barbatulus* (L.)  
*Anguilla anguilla* (L.)

*Cottus gobio* L.  
*Gasterosteus aculeatus* L.  
*Scardinius erythrophthalmus* (L.)  
*Tinca tinca* (L.)  
*Perca fluviatilis* L.

THE FROGHOPPER

*PHILAENUS SPUMARIUS* L., (*HOMOPTERA, CERCOPIDAE*)

by K. C. DURRANT,

St. Quentin, 18, The Avenue, Sheringham.

Often called the Spittle fly or White-eyed frog hopper, it is by far the most common and widespread of the many species of Cercopidae Homoptera. It is most conspicuous in the spring and early summer when the patches of froth appear on a wide variety of plants. This is caused by the nymph who after sucking the sap exudes a fluid from the anus and by forcing air into it produces the familiar froth or cuckoo-spit with which it surrounds itself for protection from dessication and to some extent from its enemies. Adults are all vaguely frog-like and jump when disturbed, hence the name frog hopper.

Eggs are laid in autumn either singly or in small batches of up to 30, hatching in May of the following year. The nymphs remain feeding in the spume for 4 to 5 weeks before becoming adult in early July, they can be found up until late October.

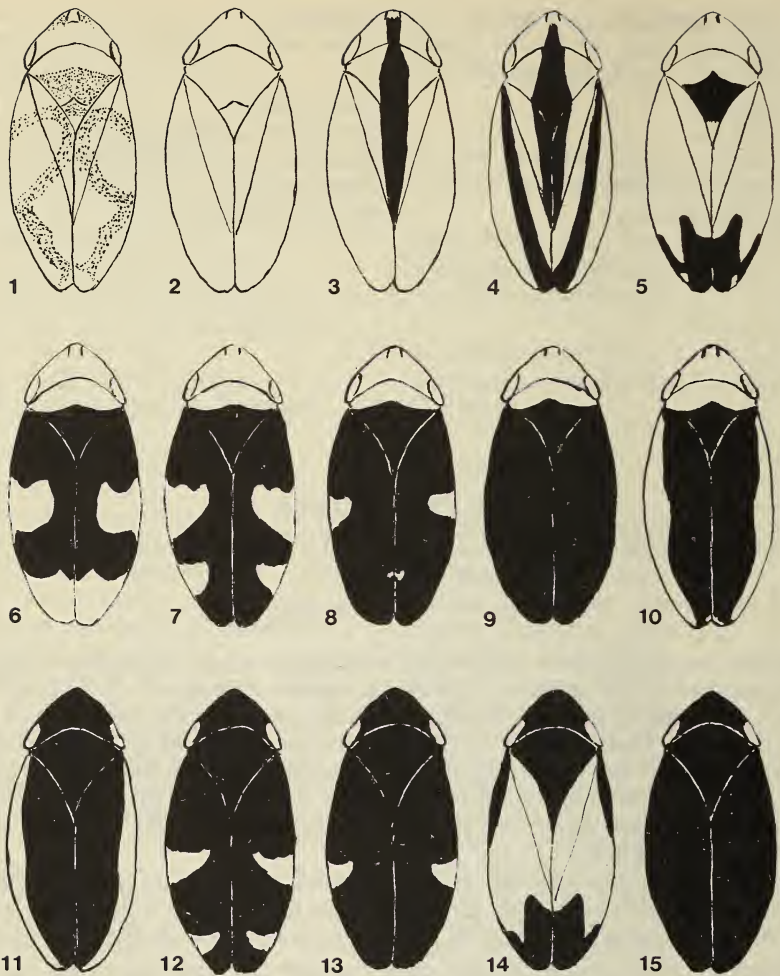
Adults are very variable in wing colour pattern markings which are basically brown with darker markings. There are a number of distinctly marked named colour forms which fall into 2 groups i.e. pale coloured heads and dark coloured heads. Interbreeding occurs between all forms and intermediates frequently occur.

The solitary wasp *Argogorytes mystaceus* (L.) stores its larval cells with the nymphs, which it drags from their surrounding spume. The dipteran *Verralia aucta* (Fall.) has frequently been recorded parasitising adult females and has also been bred from them. Large numbers of nymphs are taken by game chicks, whose heads are often found covered in froth.

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Forms of *Philaenus spumarius* (L.)

Fig. 1. *Typica* is always pale with a mottled pattern, which is very variable. This form is very abundant and is genetically recessive to the other forms.

Fig. 2. This illustrates the pattern of 3 forms which only differ in colour. *Populi* Fab. is yellowish grey, *Pallidus* Zett. is yellow and *Rufescens* Mel. is rufous.

Fig. 3. *Vittata* Fab.

Fig. 10. *Marginella* Fab.

Fig. 4. *Trilineata* Schrank.

Fig. 11. *Lateralis* L.

Fig. 5. *Praeusta* Fab.

Fig. 12. *Quadrinaculata* Schrank.

Fig. 6. *Fasciata* Fab.

Fig. 13. *Albomaculata* Schrank.

Fig. 7. *Apicalis* Germ.

Fig. 14. *Ustulata* Fall.

Fig. 8. *Gibba* Fab.

Fig. 15. *Leucothorax* L.

Fig. 9. *Leucocephala* L.



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