The Flora of Stodmarsh National Nature Reserve

Alex Lockton, February 2023

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Summary

Stodmarsh NNR is a large nature reserve, by English standards, in the valley of the Great Stour below Canterbury. It is a river floodplain filled with swamps, willow carr, grazing marshes, ditches and pools, and is about 500 ha in extent. At the western end of the reserve is a huge heap of coal mine waste, around which there are large, shallow lakes which formed when the land subsided in the 1930s into the pits below.

The purpose of the current survey was to document the flora and vegetation of the more natural parts of the NNR as fully as possible, in order to identify its features of interest and to inform the management. I have visited the reserve many times over the last 11 years (2013-2023) and identified as many species as possible. The report also includes many records by others, both recent surveys and older data from literature and herbaria. Well over 400 species of vascular plants have now been recorded on the reserve. They are listed here in some detail to inform future surveyors of this site.

There are various features for which Stodmarsh is considered important. For decades it has been known as a bird watching site, particularly attractive for migratory species on the subsidence lakes around the coal tip. Another aspect that is often mentioned is the reedbed, which again has primarily an ornithological interest. For decades it has been considered a potential breeding site for bitterns, although their numbers remain low. Looking back at previous monitoring exercises, the orchids on the spoil heap and some calcicolous plants along the Lampen Wall have attracted much of the botanical attention in the past. One feature of particular importance is the Nationally Rare pondweed *Potamogeton acutifolius*, which occurs in some of the ditches and had been known here since the 19th century. Two rare snails, *Segmentina nitida* and *Vertigo moulinsiniana*, are also found in the ditches; and there is a species of moth, the Kentish Neb, *Monochroa niphognatha*, which occurs nowhere else in Britain, and probably breeds in *Persicaria amphibia* in the ditches.

The studies presented here show that the real value of this site has not been fully appreciated until recently. The most important features are the fields of grassland that have never been ploughed or reseeded, and the ditches that run between them. They preserve some elements of the vegetation that arose when the area was first reclaimed from saltmarsh, about 1000 years ago, which suggests that these fields are some of the oldest unimproved grasslands in Britain.

The vegetation is certainly exceptional. There are communities such as the *Hordeum secalinum* grassland, which is not described in the National Vegetation Classification, and others such as the species-rich *Eleocharis palustris* swamp, which deserve greater recognition. Rare and uncommon plants occur in large numbers and the reserve certainly ranks as a nationally important site for its vegetation at least as much as for its fauna.

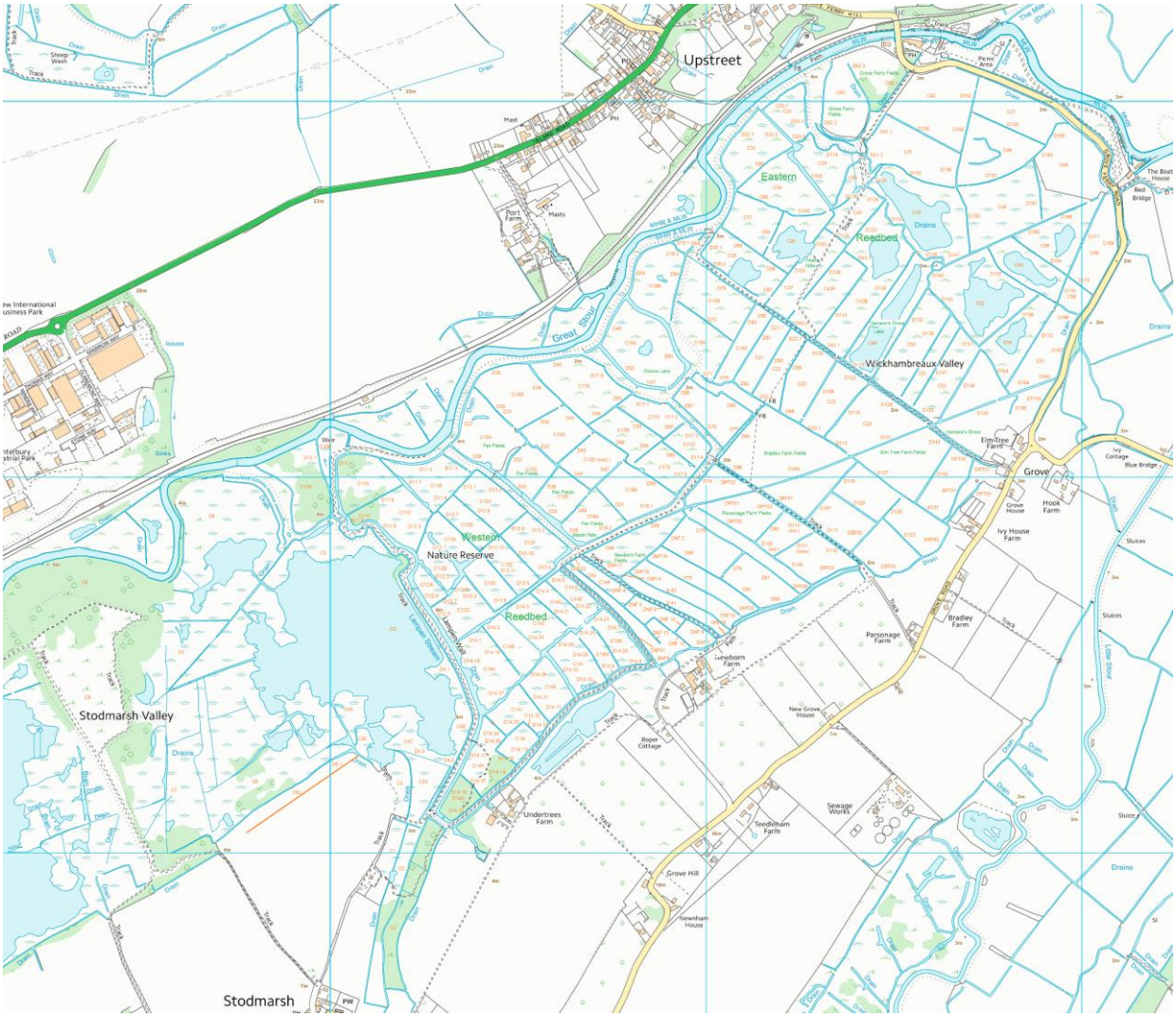
The history of Stodmarsh as a reserve reflects some common trends in the British landscape over the last hundred years or so. What originally brought it to the attention of naturalists was when the farmland in the westernmost section was abandoned because of the mine. In the absence of intensive farming and shooting, the wildlife briefly flourished. At that time, the remaining farmland was considered commonplace and lacking in interest.

As time has passed, the western parts have scrubbed over or succeeded to reedswamp, and the features that originally made it so exciting have declined. Attention has gradually switched to the fields in the east which have been added to the reserve. Under relaxed conservation management, these are now strikingly similar to the area in the west that originally attracted the naturalists. The long grass and low swamp support a host of plant and animal species, including birds of prey, while the open ditches are rich in rare and scarce plants, snails and water beetles. In every case, the specialities are coastal species that reflect the origins of the habitat. While this has happened at Stodmarsh, almost all the other grazing marsh in Kent, which was once such a common and unremarkable habitat, has been drained and subject to increasingly intensive agricultural management.

The fields at Stodmarsh are now a rare and invaluable remnant of an ancient, slightly brackish coastal grazing marsh of a quality possibly not equalled elsewhere in Britain. It is essential that it continues to be protected, managed and appreciated for its magnificent wildlife and distinctive vegetation.

Site Plan

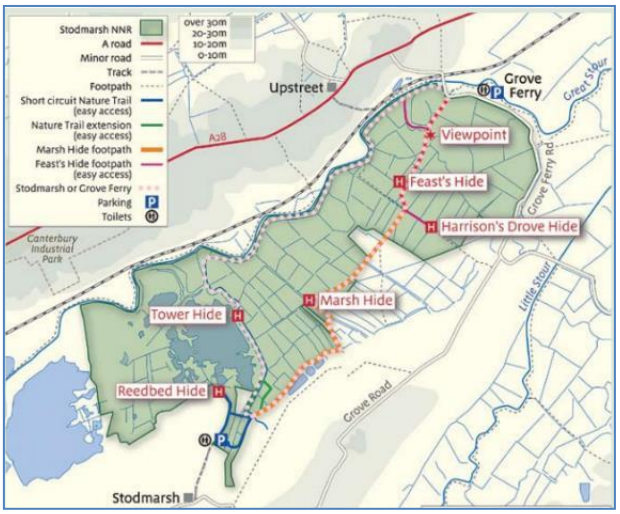
Showing compartment and ditch numbers.



Introduction

A Site Flora is a rather challenging product of botanical recording, being a compilation of everything that is known about the site, with analysis of the features of most importance and any changes that can detected from the records. It is not a mere *report*, but is a re-examination of the ecology and conservation of a site using the evidence that has been gathered over the years, combined with new observations of what is actually there now. The aim is to accept nothing without question. If we read that sharp-leaved pondweed occurs at Stodmarsh, we interpret that as a set of questions such as, Is there sharp-leaved pondweed at Stodmarsh? If so, where? And how much? A statement like 'Stodmarsh is a river valley peatland important for its reedbeds,' becomes, 'Is it a peatland?' and, 'Are the reedbeds particularly important?' Anyone who has made a statement about Stodmarsh is providing a valuable hypothesis which can be tested and evaluated in the light of new evidence. Surprisingly, many of the most widely accepted and often-repeated claims relating to Stodmarsh are easily disproven in the light of the new information that Natural England and the naturalist societies have been accumulating over the years.

In this account you can read many instances where someone has made a statement or observation that I have evaluated as incorrect. No criticism is intended. People should not fear getting something wrong. Nobody's knowledge is ever perfect, but if they refuse to say anything because of that, then nothing will ever be accomplished. I too have made and withdrawn many records and comments whilst writing this report. The aim here is to evaluate what we know and present it for further study and analysis. It is over to you to read this report and, if you like, find the mistakes and improve upon our knowledge of the site. You can only do that by publishing your own thoughts.



There is a huge amount of information about Stodmarsh if one searches thoroughly enough. Natural England supports and encourages studies and research of all kinds, especially on National Nature Reserves. Our understanding of the ecology and the value of the site has advanced dramatically in recent decades, and the rate of accumulation of knowledge increases with time. The current version of this report follows on from my drafts over the last nine years and incorporates many revisions. I have vacillated about whether to include the colliery tip, on the grounds that it is not typical of the rest of the reserve; in this version I have excluded it for that reason. Most of the NNR is a wonderful example of a semi-natural ancient habitat, and to include the ruderals and curiosities of the spoil heap would just confuse the account.

The account that follows is based on historical records plus my numerous surveys since 2013, with various friends and colleagues, most of which produced only a few incidental records each time. I have looked for all the species previously recorded and tried to make as full a list for the site as possible. Anything that I cannot find or that has not been seen by someone reliable in recent years is marked with a dagger (†) in the species list section. All recorders, both historical and living, are credited for their records and precise details are given of anything that I have seen, in order to make this report as useful as possible to other researchers and to anyone visiting the site.

This document is not indexed, but if you have the pdf version you can easily find entries for a species by searching {ctrl + f} for its scientific name (which in the main entries is always given in full, not abbreviated). The contents page also allows rapid navigation if you press the {ctrl} button and click on a heading. Compartment numbers are standardised for searching, as C1, C2 etc, and ditches in the same way (D1, D2…). There is also a database on which this report is based, which often contains more details than are given here.

This report is available from the web site of the Botanical Society of Britain and Ireland, www.bsbi.org/kent and the Internet Archive, www.archive.org.

History

Botanical records can be extracted from a variety of places, including herbaria, published reports and Floras, magazine articles, scientific papers, and web sites. There is currently no comprehensive database of historical records for Kent, so it is not easy to find records relating to Stodmarsh specifically, but this is what I have managed to compile so far.

The earliest records traced are from the Floral Guide to East Kent, 1839, by Henry Matthew Cowell (1808-1866) of Faversham. This includes several short lists for the Stodmarsh area, supplied by correspondents. Rev T.H.M. Bartlett produced a list of plants at Sturry, 'in the marshes.' This might well have been west of the current NNR (although still within the SSSI) but, in those days, before the coal mine, there was no difference in the habitat. Bartlett recorded *Alisma plantago-aquatica*, *Hydrocharis morsus-ranae*, *Lycopus europaeus*, *Nymphaea alba* and *Valeriana officinalis*. These are all characteristic species of the site now.

Miss Kenrick is credited with records of *Symphytum officinale* and *Utricularia vulgaris*, 'in ditches near Sturry.' William Masters found *Butomus umbellatus*, *Lysimachia nummularia*, *Malva moschata*, *Myosotis scorpioides* and *Ranunculus lingua* – the latter at 'Grove Ferry, banks of the Stour.' Miss Sankey also noticed the *Symphytum officinale* and added *Papaver argemone* on the banks of the river at Grove Ferry.

These lists between include many of the characteristic species of the habitat, and three that we would now consider Nationally Scarce, showing that the vegetation was very similar in the early 19th century to what is there now. The most curious loss is the Comfrey, *Symphytum officinale*. This is now virtually absent from the lower reaches of the Stour and has been replaced by Russian Comfrey, *Symphytum ˣuplandicum*, but we know Kenrick and Sankey did not confuse them because the latter was not introduced to Britain until 1870. There is no obvious reason why Common Comfrey should have disappeared from the easternmost parts of Kent. The other plant on these lists not currently recorded in the reserve is Prickly Poppy, *Papaver argemone*. This is an arable weed that would probably have been much commoner then, as a casual scattered around and about. As it was not necessarily within the reserve, I have omitted it from the rest of this report.

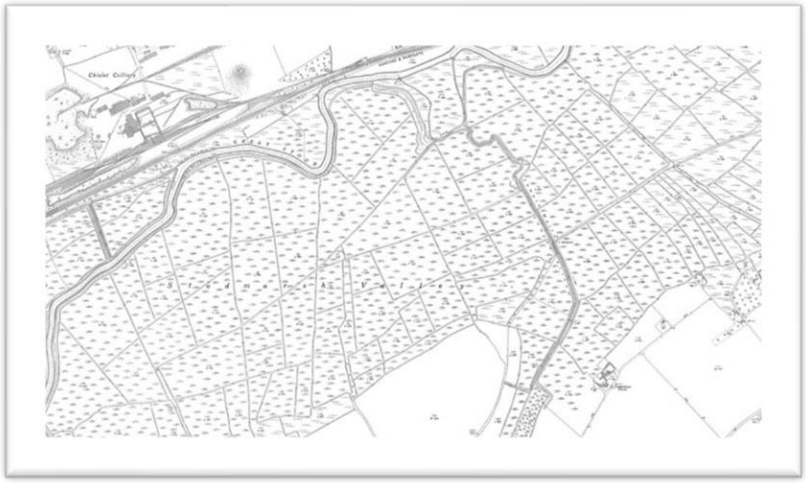
Some of the records in Cowell's Floral Guide are also reproduced in Hanbury & Marshall's 1899 Flora of Kent, but that publication also contains many original records by the authors and other contributors. Frederick Janson Hanbury (1851-1938) started recording for the Flora in about 1875, and most of his records and specimens with known dates from this part of the county are from that year. For this reason, I have used 1875 for all his records. Most of these are very precisely localised to the NNR, with descriptions such as 'Trenches between Stodmarsh and Grove Ferry.' His records give a very good sense of the character of the site, and most of the species are still present (the most interesting exceptions being *Menyanthes trifoliata* and *Wolffia arrhiza*).

Species recorded by F.J. Hanbury, ca. 1875

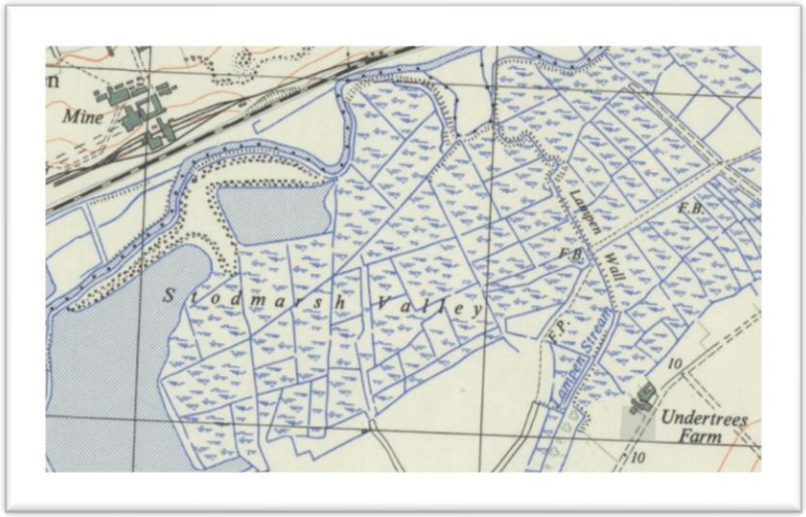
Baldellia ranunculoides
Callitriche obtusangula
Ceratophyllum demersum
Chara vulgaris
Epilobium tetragonum
Lemna gibba
Lysimachia nummularia
Menyanthes trifoliata
Myriophyllum spicatum
Nymphaea alba
Oenanthe aquatica
Oenanthe fistulosa
Oenanthe fluviatilis
Potamogeton perfoliatus
Potamogeton pusillus
Ranunculus circinatus
Ranunculus lingua
Ranunculus sardous
Rorippa sylvestris
Scutellaria galericulata
Spirodela polyrhiza
Stuckenia pectinata
Triglochin palustris
Utricularia vulgaris
Wolffia arrhiza
Zannichellia palustris

Other contributors to the 1899 Flora were less prolific. The most significant addition was *Potamogeton acutifolius*, found by George Dowker in the 1890s at 'Withamdrew, west of the Little Stour-Newnham Valley,' which is a pretty good description of our site. Walter Waters Reeves (1819-1892) added *Hydrocotyle vulgaris* to the site list. Edward Shearburn Marshall (1858-1919) added just one species: *Schoenoplectus tabernaemontani*.

After the Flora of Kent there was something of a hiatus in recording for nearly half a century. During this time the Chislet Colliery was established in 1914 by the Anglo-Westphalian Coal Syndicate, and in 1919 they started extracting coal from beneath the Stodmarsh Valley. Because the bedrock is soft (London clay?), the workings were prone to collapse, and they had to pump huge quantities of cement into the ground to stabilise the mine. Nevertheless, the pits regularly fell in, and the ground above began to subside. What had originally been wet grazing marsh now turned into shallow lakes in a process that continued into the 1940s.



Stodmarsh Valley in the 1920s. The colliery had been established but the pits had not yet collapsed.



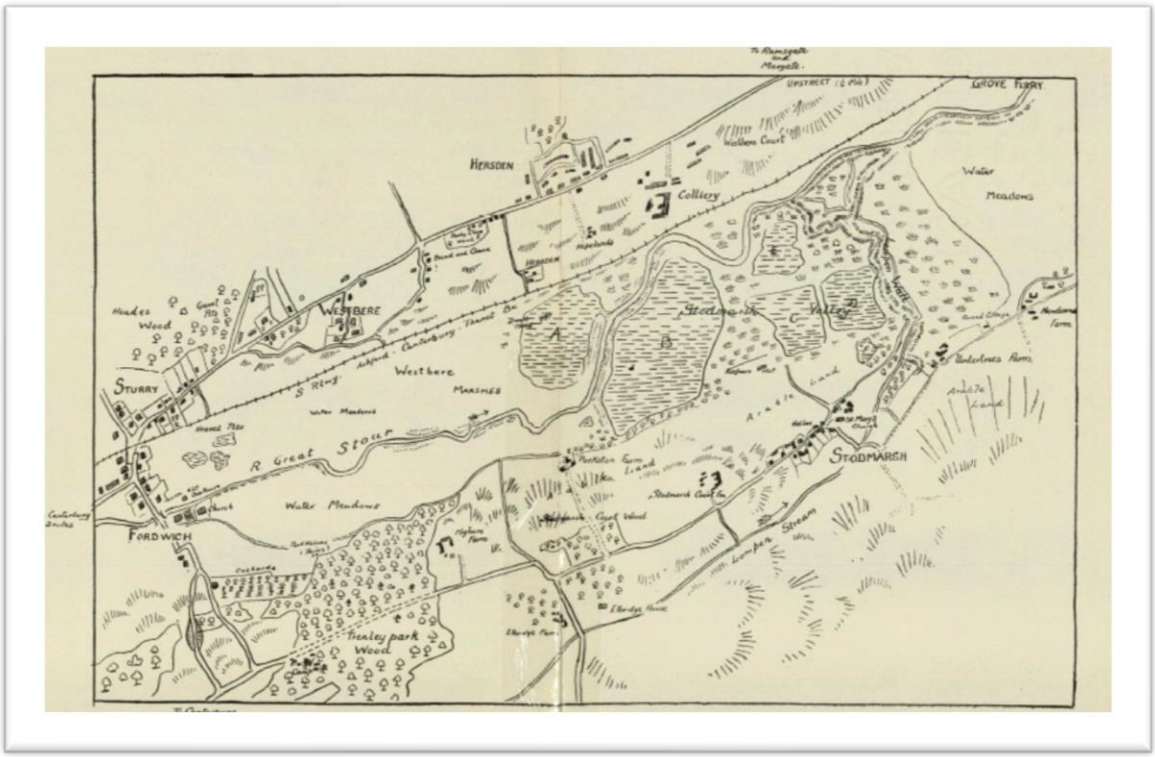
The same area in the 1930s. The subsidence lakes started to open up in the late 1920s and continued to expand into the '40s. Note the spoil heap beginning to take shape opposite the mine.

By the 1940s the area to the west of the Lampen Wall had become a morass of subsidence lakes with expanding mounds of spoil springing up between them. The land was in the hands of an 'enlightened gentleman' who managed it for hunting and shooting (King George came to shoot Teal in 1946), and wildlife was beginning to return to an area that had been managed intensively for centuries. Reeds spread from the ditches into the lake margins and the fields began to scrub over. This attracted new species of birds, and there were even sightings (and, unfortunately, shootings) of the rare Bittern, *Botaurus stellaris*. Newbarns Farm was described at this time as a 'Mecca for ornithologists.' By contrast, the towpath along the Stour was free for anyone to shoot, and local miners and other commoners would turn up with a variety of weapons to take a pot-shot at anything they could find including, sometimes, each other. Everywhere else was let to shooting syndicates or used for hunting.

This description is given in the 1947 Annual Report of the Kings School, Canterbury, Natural History Society and Field Club, which that year was devoted to a study of Stodmarsh. It marked the beginning of the modern interest in the site and must have been highly influential in the establishment of the National Nature Reserve. The Kings School naturalists, led by their president, the arts teacher David Stainer (1897-1979), naturally focused their efforts on the area to the west of the Lampen Wall:

> 'It is understandable that the lake area and the Lampen Wall should have received most attention. It is an ornithological paradise, lovely, remote and interesting under all conditions, the lakes, blue or steely grey, the reeds green, or tawny yellow. The head-gear and slag heaps of the colliery, softened

and made remote by Winter mists, add to, rather than detract from, the strange beauty of the scene; and, as evening gathers, the ducks come fighting in against the pale sky, and the long straggling flights of rooks go cawing home to Trenley Park. Looking Westward from the Wall, overgrown in Summer with tall purple teasels, the great Bell Harry tower of the Cathedral can just be seen above the trees at Fordwich.'



Plan of the Kings School survey area in 1947 by David Stainer. The water meadows to the east, as far as Grove Ferry, were considered less important and were omitted from this map to 'save space.'

This focus on the birds of the subsidence lakes has influenced the management of the reserve for the last seventy years. They considered that the importance of the area was due to the reedbeds and the mining, not to the long history of grassland and ditch management. For them it was an industrial, not a rural, landscape. For the bittern, of course, they were correct, but for just about everything else in the reserve, the key thing had been the cessation of intensive farming and shooting after centuries of consistent grazing. As soon as the management was relaxed, the wildlife began to flourish.

Cyril Wilfred Ward (1907-1978), the biology master at Kings School from 1945 to 1955, took responsibility for botanical recording. He invited Francis Rose to join their excursions, and between them they recorded some 30 species of plants. I have excluded their *Potamogeton praelongus* from the list below, on the grounds that it has never otherwise been found in Kent, but otherwise their identifications seem reliable.

Species recorded by C.W. Ward & F. Rose in 1947

Butomus umbellatus
Callitriche sp.
Carex acutiformis
Carex pendula
Carex remota
Ceratophyllum demersum
Chara sp.
Elodea canadensis
Epilobium tetragonum
Equisetum palustre
Galium palustre
Groenlandia densa
Hippuris vulgaris
Hydrocharis morsus-ranae
Juncus effusus
Lemna minor
Lemna trisulca
Lycopus europaeus
Menyanthes trifoliata
Myriophyllum verticillatum
Oenanthe fistulosa
Oenanthe fluviatilis
Potamogeton crispus
Potamogeton lucens
Potamogeton natans
Stuckenia pectinata
Potamogeton perfoliatus
Spirodela polyrhiza
Stellaria palustris

From the 1940s onwards Francis Rose (1921-2006), the academic and author of popular identification guides, was active collecting materials for his proposed Ecological Flora of Kent. Although this was never completed, his records are beginning to emerge from unpublished documents and specimens. The main source is a publication called 'What Happened to Francis Rose's Flora of Kent?' which has been re-assembled by Geoffrey Kitchener from many scraps of manuscript.

In the late 1940s and 1950s several people made interesting records at Stodmarsh, according to Rose's compilations. Most notable was Leonard W. Wilson (1887-1951), a former tax inspector who had retired to Thanet, who found *Potamogeton acutifolius* near Grove Ferry in 1950. This is the first definite record for the reserve, because Dowker's 1899 site is not very precisely defined. Rose considered it unconfirmed but very likely, and it seems reasonable to treat it as a valid record now. Wilson also recorded *Eriophorum angustifolium* at the 'east end' of Stodmarsh in 1949. This is a very curious find, and it would surely only have been accepted by Rose if he had been confident that it was correct. It is the best evidence we have for a mire at Stodmarsh, although it is not obvious where it could have been.

In about 1950, R.E. Wood submitted several interesting records. He found the orchids *Anacamptis morio* in the meadows and *Dactylorhiza fuchsii* on the Lampen Wall, and added *Allium vineale*, *Carex divisa*, *Carex paniculata* and *Hypericum tetrapterum* to the site list. It is a curious list of oddities – all additions – which suggests that there was a site list of some sort available, to which new species could be added.

Miss M.E. Millward found *Carex rostrata* in 1958. This is another species of mires, and nobody has ever recorded it since. There is, however, good reason to believe it: apart from Francis Rose's acceptance of the record, it was also recorded in the nearby Newnham Valley (TR2360) by N.F. Stewart in 1987. If the habitat was suitable there, it may well have been at Stodmarsh as well.

Rose added to the list the rare dandelion *Taraxacum hygrophilum* in grazing marsh to the west of the reserve in 1951. Between 1949 and 1961 he made a number of other additions.

New species recorded by F. Rose ca. 1949-1961

Alopecurus geniculatus
Azolla filiculoides
Carex divulsa
Eleocharis palustris
Eleocharis uniglumis
Glyceria maxima
Iris pseudacorus
Juncus articulatus
Juncus gerardii
Oenanthe lachenalii
Phragmites australis
Potamogeton friesii
Sparganium erectum

In 1963 and 1964 P.W. Wilberforce added a few things to the site list, notably *Bolboschoenus maritimus*, *Carex otrubae*, *Elytrigia repens* and *Juncus subnodulosus*. The first three are very common on the reserve but the latter is now only found at Higham Farm.

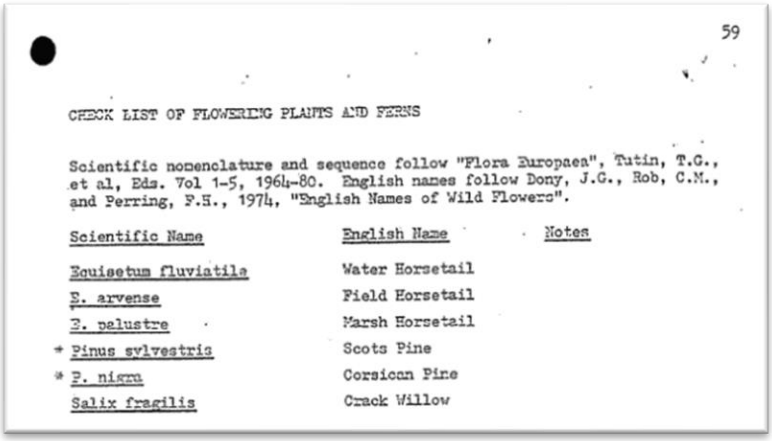
The Nature Conservation Review, edited by Derek Ratcliffe, was published in 1977. This summarises the ecology of all the most important sites in Britain, and Stodmarsh is assigned Grade 1 status. The aim was to focus attention on the very best places and make sure that they were adequately protected.

The NCR largely reprises the account of the Kings School naturalists, listing Stodmarsh as a peatland and describing it as a 'good example of southern eutrophic flood-plain mire' with 'uniform beds of *Phragmites communis*' and 'inundated meadows… developed on ground flooded by colliery subsidence.' The birds are particularly praised as 'an outpost of the Norfolk Broads avifauna.' There is, however, some recognition of the botanical value of the dykes, with the following rather curious list of plants. This list must have been provided by Francis Rose, and it seems to focus not so much on the characteristic species found there, but on the exceptional ones, some of which had only been reported once. The record of *Ceratophyllum submersum* has not yet been traced, and vol. 1 of Rose's manuscript flora (where it would have been repeated) is lost.

Dyke species of Stodmarsh listed in the *Nature Conservation Review*

[Ceratophyllum submersum]
Comarum palustre
Glyceria maxima
Hydrocharis morsus-ranae
Juncus subnodulosus
Menyanthes trifoliata
Oenanthe fistulosa
Phragmites australis
Ranunculus lingua
Ranunculus sardous
Rorippa palustris
Rumex hydrolapathum
Schoenoplectus tabernaemontani
Stellaria palustris
Thalictrum flavum
Triglochin palustris
Utricularia vulgaris
Veronica catenata
Wolffia arrhiza

Natural England has scientific files on all SSSIs and NNRs, inherited from its predecessors the NCC and English Nature. These scientific files often go back to the 1960s, or even earlier, but in the case of Stodmarsh there is nothing dated earlier than the late 1970s. The files are now available only in digitised form. One of the earliest documents in the file is a 'check list of flowering plants and ferns,' which starts on page 59, suggesting that it comes from a longer report that I have not seen. The check list is undated and anonymous but seems to have been referred to by Barter (see below) as 'Forbes, J.E. (1978). Species list for Stodmarsh NNR.'



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CHECK LIST OF FLOWERING PLANTS AND FERNS

Scientific nomenclature and sequence follow "Flora Europaea", Tutin, T.G., et al, Eds. Vol 1-5, 1964-80. English names follow Dony, J.G., Rob, C.M., and Perring, F.H., 1974, "English Names of Wild Flowers".

Scientific Name	English Name	Notes
Equisetum fluviatile	Water Horsetail	
E. arvense	Field Horsetail	
E. palustre	Marsh Horsetail	
* Pinus sylvestris	Scots Pine	
* P. nigra	Corsican Pine	
Salix fragilis	Crack Willow	

Forbes had studied for an MSc at Wye College in the 1970s and was based at the NCC regional office at Wye. His checklist includes some 254 species, including several rare and interesting plants, such as *Samolus valerandi*, which had not been detected before. It also contains many species which seem likely to have been on the spoil heap, and I have excluded them from this report if that seems to be the case. This leaves some 167 new plants for the parts of the reserve covered here, all of which are common (although it is somewhat surprising to find the first record of *Lotus tenuis* at this late date).

In 1978 Gillian Barter surveyed several SSSIs in Kent, including Stodmarsh, where she made short lists for some of the ditches (Barter, 1979). Although these were numbered, I do not have the map showing where they were.

Eric George Philp (1930-2013) dominated botanical recording in Kent in the latter half of the 20th century. He was the curator of Maidstone Museum and the BSBI county recorder. His first Atlas of the Kent Flora was published in 1982 and was based on records collected between 1971 and 1980. I have used 1979 as the date for all of them, in order to place them clearly within the 1970s without exaggerating their antiquity. The Atlas contains tetrad (2 km x 2 km square) maps of all species in the county but, unfortunately for us, no further details of even the rarest plants. As there is no tetrad that falls entirely within the NNR, it is not possible to be certain that any species was actually recorded in the reserve; but it seems a reasonable conclusion that many of them were, especially the more characteristic species of the site. The recorders' names are given only in a list at the front of the Atlas, so the records here are all assigned to Philp personally.

By this method of compiling data, Philp's 1982 Atlas adds some 31 species to the site list, many of which are ruderals along the paths, such as *Lamium purpureum* and *Vulpia myuros*. However, it does contain the first records of *Bidens cernua*, *Elodea nuttallii*, *Glyceria notata* and *Veronica beccabunga*, which are uncommon plants of the ditches.

The Site of Special Scientific Interest was first designated in 1951 and it was re-notified (under the 1981 Wildlife & Countryside Act) in 1984. This establishes an obligation on the landowner to preserve the features of interest described, or to restore them if they become damaged or degraded. Within the NNR, the landowner is Natural England. As recently as 1984 the SSSI statement was giving roughly the same account of the site as that of the 1940s, stating that the site 'contains a wide range of habitats including open water, extensive reedbeds, scrub and alder carr,' but dismissing the grassland as 'cattle-grazed pasture' of interest only for waders. It describes the wetland plants as occurring 'where the reed has been cut.' The dykes are mentioned almost as an aside, for having *Potamogeton acutifolius* and *Wolffia arrhiza* (although the *Wolffia* was probably long gone).

Stodmarsh, by Ian Castle, c. 1980, from Philp's Atlas. Note the low vegetation in the meadows and the sparsity of tree cover in the landscape, leaving the ditches in full sunlight.

It is interesting to consider how someone could have looked at the site pictured by Ian Castle (above), or at the numerous maps that were available, and somehow failed to notice that it was primarily a grassland. The answer may be partly due to inertia, simply because previous accounts were being copied, but there could be more revealing reasons. Firstly, it must be remembered that ornithologists had always been the primary movers of the conservation of Stodmarsh. Because of this, there was little information available on the plants, snails, beetles and other important species of the site until recently. It is only really since the 1990s that more comprehensive natural history surveys have taken place, changing our view of the site's importance. Secondly, the nature of the habitat has been changing since the land was taken into conservation ownership. Some of the best fields at Stodmarsh are now at the southern end (C57 etc.), but only a few years ago these were dry agricultural grasslands (Stephen Etherington, *pers. comm*.). In the Phase 1 survey of Kent (1991-1994) they were mapped as improved grassland. Undoubtedly this is how they must have appeared, but re-wetting under Natural England's stewardship has shown that in fact they were not agriculturally improved, but simply drained and heavily grazed. While one could paint the bittern as the villain of the piece – causing vast swathes of good quality habitat to be lost under sprawling reedbed and then resolutely failing to establish a viable population – it must also be remembered that without the bittern there would be no nature reserve at all. Nobody at the time realised that grazing marshes were either valuable or threatened. The bittern has been a highly effective flagship species, but as a keystone it leaves something to be desired.

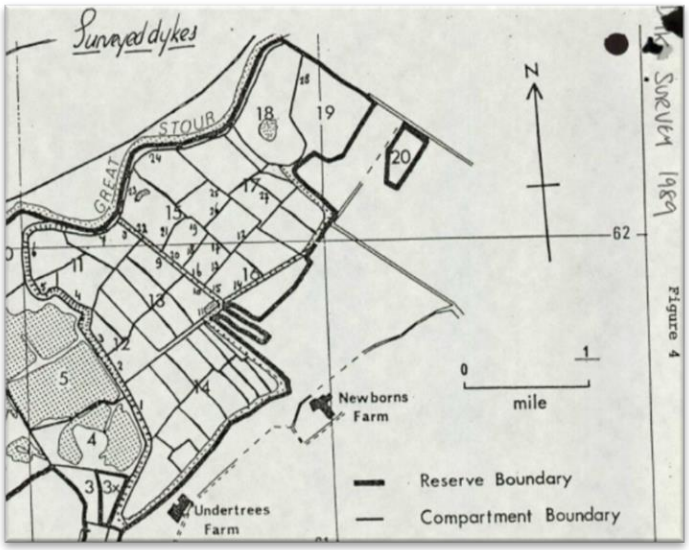
Over the following decade or two, the NCC vacillated over what they considered most important about Stodmarsh. There are several rare plant monitoring reports in which people have counted plants and drawn detailed maps of where they were. Inevitably, these efforts focused on the western parts of the reserve, which were believed to be the best areas. However, by this time all the characteristic plants had vanished from there and so eclectic things were chosen instead, such as a clump of *Atropa belladonna* and a patch of *Spergularia marina* on the Lampen Wall. These were probably introductions of little significance, ecologically. A lot of effort went into recording the orchids on the spoil heap, but they were just common species (the *Spiranthes spiralis* had not yet appeared). Other plants that were monitored included *Lepidium latifolium*, *Ranunculus lingua* and *Stellaria palustris*, which were sensible choices, but no particular attempt ever seems to have been made to protect their habitat and two of them seem to have since gone from the site, swamped under reeds.

Gradually, the attention of the NCC and, later, English Nature and Natural England, began to shift towards the ditches. In 1989 Paul Glading undertook a ditch survey in the eastern part of the NNR. I have not been able to trace this, but later in the same year Agnes van Dongen and David Painter looked at the western parts, from the Lampen Wall to the Oxbow Lake. They followed the techniques developed by Heather Twigg for the Shropshire

Union (now the Montgomery) Canal, with separate lists for the aquatics, marginals and banks, combined with transects.

Van Dongen's & Painter's survey seems pretty accurate, but I propose some corrections to their data. *Potamogeton obtusifolius* should be changed to *P. friesii*, which seems the most likely alternative. *Schoenoplectus lacustris* should probably be changed to *S. tabernaemontani* because the latter was generally treated as a subspecies in the 1980s and often ignored. At Stodmarsh *S. lacustris* is mainly (but not exclusively) in the river while *S. tabernaemontani* is generally in the ditches. Their '*Triplex inundata*' was mysterious, but I did find an old herbarium sheet that used the name *Atriplex inundata* as a synonym for *Atriplex patula*, so I suppose that is what was intended. In reality, they had probably misidentified *Chenopodium album*. *Ranunculus bulbosus* and *Lotus corniculatus* may have been confused for *R. sardous* and *L. tenuis*. Finally, their *Salix* sp. can be treated as *atrocinerea*; although there are other willows around C11, this species is always commonest.

My intention is not to denigrate van Dongen's and Painter's efforts by suggesting these changes. When carrying out a monitoring exercise, someone is generally visiting a site they do not know well and they are expected to identify everything they see, whether it is flowering or not. It is inevitable that errors creep in. Somebody making a simple site list can ignore anything they are not sure of but, if you did that when making a list that was intended to be used for comparison with later surveys, that would be an error of omission; so there is no solution other than to do your best. However, if we want to be able to use the monitoring data as intended, we have to be able to correct errors to make it compatible with later surveys.



Ditches surveyed by van Dongen and Painter, 1989. Their reedbed dykes are numbered 1-11 and the meadow dykes 12-27

Once one has standardised a survey like this, it is possible to perform analyses on the data (see appendix 7). For example, van Dongen and Painter divided their plots into 11 'reedbed dykes' in C11-C14 and 16 'meadow dykes' in C15-C17. Their survey provides the first hint of the effect that reedbeds were having on the habitat. Their reedbed ditches were less species rich (average 25.8 species, SD = 6.2, range 19-37) than the meadow ditches (average 31.6 species, SD = 6.8, range 16-45). They also contained fewer axiophytes – only 11 in total, compared with 26 in the meadow ditches, at a lower frequency (4.3 axiophytes/ditch in the reedbeds vs. 9.9 axiophytes/ditch in the meadows) and, crucially, they lacked *Potamogeton acutifolius*, which was present in 3 of the meadow ditches. These differences are quite apparent in the results tables without attempting a statistical analysis, as the meadows list occupies two pages compared to the single page for the reedbeds.

Just a few years later there was a much more extensive survey by Natural England staff (Williams, 1996). The surveyors were Brian Banks, Vicky Elder, Patrick McKernon, Phil Williams, Rob Cameron and Belinda Wiggs, whom I have abbreviated in my database to Williams, Banks and Elder because most systems won't accept such a long string of names (in this report they are referred to simply as 'Williams *et al.*'). They surveyed a total of 169 ditches within the SSSI, of which 143 were within the current NNR boundary or on adjacent farmland. Ditches were numbered by order of their eastings, i.e. from left to right on the map. Because of this, the numbers seem to leap up and down the page and do not relate to compartment numbers in any way, but they are easy enough to find if you know the system. The map is given on p. 3 and is used throughout this report as the basis of the ditch numbering system (although I have also assigned numbers for any missing ditches, based on their compartment).

Their methodology was based on that of Alcock & Palmer (1985), being essentially lists of aquatics, emergents and bank species along a 20 m stretch of each ditch, without estimating abundance. On the whole, their identifications seem to be very accurate. I might suggest provisionally changing *Scirpus lacustris* to *Schoenoplectus tabernaemontani*, for the reason given above. They did not attempt to identify their charophyte, but I think it might as well be recorded as *Chara vulgaris*. Similarly, their *Carex acutiformis/riparia* could be

treated as *riparia*, as the other is very rare on the site. They also did not distinguish between *Potamogeton berchtoldii* and *pusillus*, which is a sensible decision; I might suggest that one could also throw *trichoides* into the mix.

Not all plants were recorded by this survey, only a limited number of ditch species. Nevertheless, they collected 1,362 records of 80 species, and made notes on whether the ditches were wet or dry, or choked with reeds. The largest number of plants in any ditch was 30 (in D28) and, at the other end of the scale, several had none at all. The most frequent plants were *Carex riparia* and *Phragmites australis*, both of which were found in 92 of the 136 ditches with anything in them.

This survey creates a sizeable resource for future monitoring of the reserve and for analysing patterns in the distribution of the species. One of the aims expressed by the author was that relatively dreary ditches in the newly-acquired eastern part of the NNR should become better in time, under conservation management. This has definitely happened. Another issue raised by this report is that of the effect of reedbeds on the plants of the ditches. They found that *Utricularia vulgaris* thrived in the wide fleets within the reedbeds, but that the ditches in the grazing marsh were much more species-rich overall, and especially for the rare pondweeds. Species richness, they found, was enhanced by 'moderate grazing pressure which creates muddy margins and gaps suitable for colonisation and yet does not suppress plant growth.' The report also mentions that some of the ditches were slightly saline, and concludes:

> 'The value of brackish ditches on this site is not as great as those of freshwater ditches, and therefore contamination of the grazing marsh with brackish water from the river should be avoided where possible. The main interest relating to brackish ditches is the nationally scarce bank species *Carex divisa*, which was recorded in 12% of the ditches. However, this species is probably present in the grazing sward as well as along the ditch banks, and its occurrence is probably a result of soil salinity rather than salinity levels in the ditches.'

This conclusion is surely not correct. Of course, complete inundation by seawater would be disastrous for many of the species at Stodmarsh, but the mild salinity of the ditches is an essential attribute of the site. In addition to *Carex divisa*, which they mention, *Bolboschoenus maritimus*, *Carex distans*, *Juncus gerardii*, *Stuckenia pectinata* and *Zannichellia palustris* all benefit from some salinity. There are several other characteristic plants, and numerous rare animals which are distinctly coastal in their habitat, and salinity is in fact the crucial factor that makes Stodmarsh so important.

A second ditch survey was undertaken by Williams in 1998, just two years after the first one, but after sufficient delay that some of the ditches in the extension had been restored. This survey followed the same technique as the earlier one: lists of characteristic ditch species over 20 m lengths. It shows some interesting trends: D157, for example (at the south-eastern end) increased from 7 to 14 species, while nearby D158 went from 4 to 11. Unfortunately, it looks as if the changes are due more to sampling method than to anything else: D157, for instance, seems to have 'lost' *Lemna minor* and *Hydrocharis morsus-ranae*, and 'gained' *Phragmites australis*, *Sparganium erectum* and *Spirodela polyrhiza*. There is no apparent pattern to such changes, which can only really be to do with which specific section of the ditch is being looked at, and which species were ignored.

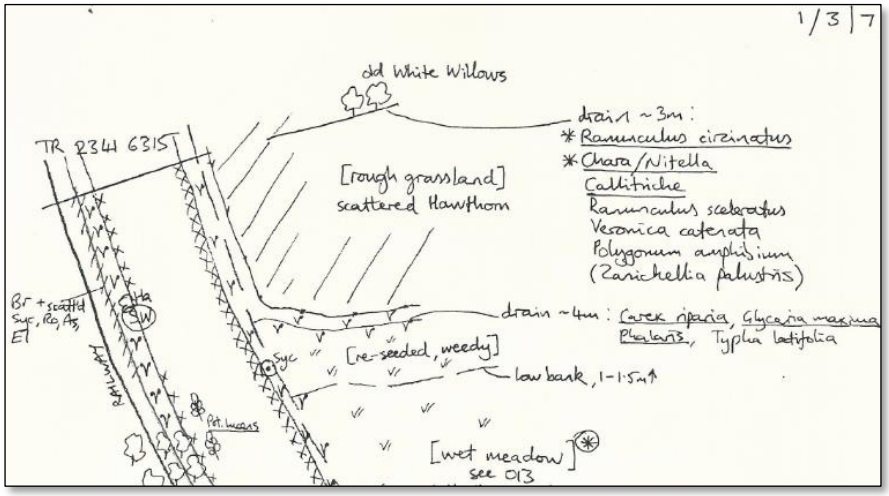
Williams also experimented with a second way to analyse the ditch data. Using Twinspan – a statistical process developed by Mark Hill at the Centre for Ecology and Hydrology, which clusters sets of species lists into groups based on their similarity – he came up with six communities, or types of ditch. The results have never been published but are reproduced here in full for the benefit of posterity. I am not sure that it is a useful classification system. Twinspan will produce such end groups from any data set it is presented with, even if there is no real difference between the samples, and at first glance there does not seem to be any significant variation between these communities. Group 00 stands out, but those seem to be reed-choked ditches with very little in them. Unfortunately, there is no Bladderwort in the samples, so the hypothetical '*Utricularia* fleet community' is not tested. To determine whether these are real communities or not, one would hope to be able to correlate them with an independent variable such as salinity, nutrient level, or management history.

Williams's analysis of the 1998 ditch data, showing the communities derived by Twinspan

Communities (Endgroups)	O	1	OO	O1	1O	11
number of ditches	32	34	13	19	17	17
Algae filimentous	I	V		II	V	V
Callitriche obtusangula		I			I	I
Ceratophyllum demersum	II	I		III	I	
Chara sp	I	IV	I	II	III	III
Elodea nuttallii	III	II		IV	III	
Enteromorpha	II	I		III	I	I
Hydrocharis morsus ranae	III	II		IV	I	II
Lemna minor	III	I	I	IV	I	I
Lemna trisulca	III	III	I	V	III	III
Myriophyllum spic	I	I		I	I	
Potamogeton acutifolius		I			I	
Potamogeton crispus	I			I		
Potamogeton friesii	II	I		II	II	
Potamogeton lucens		I			I	I
Potamogeton natans		III			I	III
Potamogeton pectinatus	I	I		I	I	I
Potamogeton pusillus	I			III		
Ranunculus circinatus	I			I		
Ranunculus seedling	I	II	I	I	III	I
Rorippa nasturtium aquaticum	I			I		
Spirodella polyrhiza	II			III		
Alisma lanceolata		I			II	I
Alisma plantago aquatica		II			I	III
Apium nodiflorum	I	I		I	I	I
Berula erecta		I				I
Bulboschaenus maritimus		I				I
Butomus umbellatus		I			I	
Carex acutiformis/riparia	IV	III	IV	IV	III	IV
Eleocharis palustris	I	I		I	I	I
Glyceria maxima	I			I		
Iris pseudacorus	I	I	II			I
Oenanthe fistulosa	I	I	I			I
Phragmites australis	V	V	V	V	V	V
Ranunculus sceleratus		II		I	III	
Rumex hydrolapathum	I	I	I			I
Sparganium emersum		I				I
Sparganium erectum	II	IV		IV	III	IV
Typha angustifolia	I	I		I		I
Typha latifolia	I	I	I	I	II	I
Veronica anagalis aquatica		I				I
Carex distans	I	I		I	I	
Carex disticha	I	I	I	I	I	
Carex divisa	I	I		I	I	I
Carex hirta	I	I	I	I		I
Carex otrubae	I	I	I	II	I	
Epilobium hirsutum	I		II	I		
Filipendula ulmaria	I			I		
Galium palustre	I			I		
Juncus articulatus	I	II		II	II	III
Juncus bufonius	I	I	I	I	I	
Juncus effusus	I		I			
Juncus inflexus	III	II	II	III	III	II
Lycopus europaeus	I		I			
Lysamachia vulgaris		I			I	
Mentha aquatica	I	I	II			II
Myosotis caespitosa		I			I	
Phalaris arundinacea	I			I		
Polygonum amphibium	I	II		II	II	II
Polygonum lapathifolium	I	I		I	I	I
Pulicaria dysenterica	I	I	I	II		I
Samolus valerandi	I	II	I	I	I	III
Scutelaria gariliculata	II	I	III	II	I	
Percentage scrub cover			53.85	10.53	17.65	35.29
Percentage ditch choked			76.92	5.26	11.76	5.88
Percentage ditch dry			7.69	0	5.88	0
Average ditch width (m)			3.69	8.21	7.12	9.88
Average conductivity (micro-siemens)			1874	1145	1223	1258
Average pH			8.52	8.79	8.92	9.00
Average number of species	8.16	8.71	4.62	10.58	8.41	9.00
Total number of species	48	53	22	43	36	36

Community names	
O	Lemna minor
1	Algae filimentous, Chara sp., Sparganium erectu
OO	Phragmites australis, Carex acutiformis/riparia -
O1	Lemna spp. - spp. rich
1O	Potamogeton friesii, Ranunculus spp.
11	Potamogeton natans, Alisima plantago aquatica,

In 1991 a River Corridor Survey was carried out by C. Dyson for the National Rivers Authority. A copy is held by the Kent Biological Records Centre. This provides a map of the river and its environs, with notes on the vegetation, and it is a valuable addition to our knowledge (more for the precise locations of rare plants than anything else).



Part of a river corridor survey diagram by C. Dyson, 1991

The Kent Biodiversity Action Plan (Kent County Council, 1997) gives a strategy for nature conservation throughout the county, and mentions the importance of Stodmarsh for grazing marsh, open water and reedbeds, although it particularly favours the latter. It states that there were 149 ha of reedbed within the reserve at that time, and that half (40 ha) of a recently-purchased extension of 78 ha (largely of grazing marsh near Grove Ferry) was due to be converted to reedbed. It also sets a target of 200 ha of new reedbed to be created within the reserve over the next 50 years which, assuming no further extensions were acquired, would mean the submersion of the entire site.

The only other mention of Stodmarsh in the BAP was about water vole, which was to be conserved by controlling mink. All this is barely an advance on the original evaluation by the Kings School naturalists in the 1940s, and it curiously fails to consider the irony of flooding ancient species-rich meadows to create a dreary, uniform reedbed; something that could as easily be done on farmland or a post-industrial site.

In 2003 Chris Newbold visited Stodmarsh as part of a project commissioned by Natural England to survey *Potamogeton acutifolius*, Sharp-leaved Pondweed, throughout its range in Britain. He failed to find it and reported that it was therefore extinct at all its known sites in Kent. However, on the way back to the car park he happily found it in a different ditch (DPF01, TR23106195) to the ones he had looked at, and announced that he had discovered a new site. There was some justification for this, as this ditch was outside the Natural England property (albeit still within the NNR) and represented a new 1 km square for the species.

There are some issues with Newbold's report. Firstly, within the reserve he seems to have focused his attention solely on the grid reference TR230620, which is a location where *P. acutifolius* has never actually been recorded. I suspect this was simply a site centroid and was never intended to be taken literally – it simply meant 'at Stodmarsh, somewhere.' Site centroids are commonly used by various organisations in lieu of accurate grid references, but they can be misleading. Then there is Newbold's 'new' site in DPF01: I have visited that area several times since 2013, and that ditch contains *P. friesii*, but not *acutifolius*; however, it is not possible to state conclusively that it was not there. Fortunately, his conclusion that it was otherwise extinct in Kent has proven to be wrong, as it has now been rediscovered in almost all its previously-known sites (Kitchener, 2020). There is in fact plenty of *P. acutifolius* throughout Stodmarsh, and all the indications are that there always has been.

Returning to the subject of reedbeds, in 2009 the RSPB, with funding from Natural England, undertook an intensive survey of five reedbeds throughout Britain, including Stodmarsh, to demonstrate that they are important for non-avian wildlife. They called it their Bringing Reedbeds to Life project (Hardman, 2011), and there are copious reports available on the web about all the work they undertook. Reading between the lines, the project seems to have been designed to allay concerns that reedbeds might not be as advantageous to wildlife as had generally been believed. The results provide a mass of data, some of which is evidently of high

quality. It deserves a thorough independent analysis, which we can hope will one day be forthcoming, much as the ditch survey data from the 1990s is now attracting attention. From my own brief examination of the results, it seems to show consistently that the rare and interesting species they found were actually confined to the ditches, with wet and dry reedbeds being of declining interest for a wide range of species. The only creatures found amongst the reeds were specialists such as certain moths whose larvae live within the stems of *Phragmites*. The only reason they are uncommon is because reedbed itself is a fairly localised habitat.

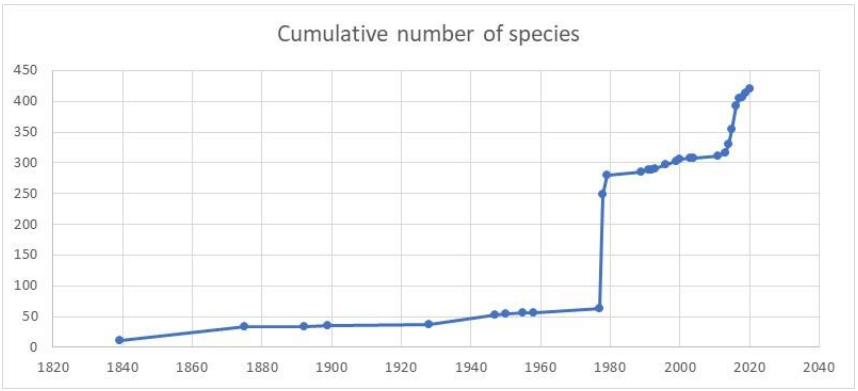
The RSPB's botanical work focused on submerged aquatics in 8 sample points throughout the reserve. It is not possible from their report to work out where any particular plant was found. They recorded sixteen species including, apparently, *Potamogeton compressus* (never recorded in Kent and presumably an error for *P. friesii*), *Juncus bulbosus* (*J. bufonius*, perhaps) and *Myriophyllum spicatum* (*M. verticillatum*). Despite two apparent records of Nationally Scarce plants, they concluded that 'no species with a conservation or rarity status were found' and that the 'botanical diversity of reedbeds [is] limited' (Mackley, Harris & Hardman, 2010). Following a familiar pattern, the rarities were in fact in the open ditches.

In a departure from tradition, the current version of the Biodiversity Action Plan, the Kent Biodiversity Strategy (Kent Nature Partnership, 2020), makes no mention of creating reedbeds at all, but calls for the restoration of 2,000 ha of grazing marsh throughout the county (ironically, to be led by the RSPB). It can take time for people's views to change on issues like this, but it seems to be slowly becoming apparent that the establishment of new reedbeds may be appropriate in certain situations and less so in others. The only mention of Stodmarsh in the Strategy is as a site for water voles.

In 2010 Eric Philp published his second Atlas, the *New Atlas of the Kent Flora*, again on a tetrad basis, so we cannot be confident about the location or date of anything. This adds five or six new species to the site list, including *Sonchus palustris*, one of the Nationally Scarce plants. This is one of the few plants that thrives in reedbeds and it might well have been introduced deliberately, as the nearest site is many miles away. At Stodmarsh it seems to be able to thrive amongst dense reeds, although Mountford (1994) considered that cutting reeds occasionally is vital to its conservation.

Since 2010 botanical recording in Kent has been transformed by the establishment of the Kent Botanical Recording Group, led by Geoffrey Kitchener and Sue Buckingham. The KBRG has several very competent botanists, and they collect full lists by monad (1 km square), enormously increasing the detail of the surveys and the number of records collected. The Botany Group has made quite a few records at Stodmarsh so far, most particularly a list of 128 species made on a single day in 2014. In the same year Alfred Gay found 79 species on the colliery tip, including some rarities. It was added to by a KBRG visit the following year.

My own surveys have taken place since 2013. I have visited the site many times and at all seasons, making detailed records of interesting species, recording quadrats and looking for plants that have been found previously. Specimens and photographs have been collected to ensure that identifications are correct, and often the evidence is presented here so that the reader can also be confident of them.



The rate at which new species have been recorded at Stodmarsh

This survey coincided with a major operation in the strengthening of the river embankment in 2015 and 2016, which introduced a large number of alien species to the site, including most of the recent gains. Some were planted in the subsequent restoration, while others were inadvertently introduced. Some of these are so

transitory and irrelevant to the ecology of the site that they do not seem worth including in this report, although the records can be found in the database associated with this survey:

Arabidopsis thaliana (Thale Cress), *Bromus racemosus* (Smooth Brome), *Bryonia dioica* (White Bryony), *Camelina sativa* (Gold-of-pleasure), *Cichorium intybus* (Chicory), *Diplotaxis muralis* (Annual Wall-rocket), *Echinochloa crus-galli* (Cockspur), *Erodium cicutarium* (Common Stork's-bill), *Euphorbia helioscopia* (Sun Spurge), *E. lathyris* (Caper Spurge), *E. oblongata* (Balkan Spurge), *E. peplus* (Petty Spurge), *Fumaria officinalis* (Common Fumitory), *Geranium lucidum* (Shining Cranesbill), *G. rotundifolium* (Round-leaved Cranesbill), *Lepidium didymum* (Lesser Swine-cress), *Malva moschata* (Musk Mallow), *M. neglecta* (Dwarf Mallow), *Mercurialis annua* (Annual Mercury), *Myosotis sylvatica* (Wood Forget-me-not), *Onopordum acanthium* (Cotton Thistle), *Papaver somniferum*, (Opium Poppy), *P. rhoeas* (Common Poppy), *P. dubium* (Long-headed Poppy), *Phalaris canariensis* (Canary-grass), *Silene latifolia* (White Campion), *Solanum lycopersicum* (Tomato), *S. nigrum* (Black Nightshade), *Thlaspi arvense* (Field Penny-cress) & *Triticum aestivum* (Bread Wheat).

In 2019 Natural England decided to undertake a full survey of the ditches as part of their national programme to assess the conservation value of all SSSIs. Mags Cousins, from the England Field Unit, led some initial surveys, focusing on plants and invertebrates. However, the Coronavirus pandemic intervened, and the programme stalled until 2022, when a team recruited from Natural England staff locally devoted many days to the project. It was led by Ken Obbard with Phil Williams and Dominique Groen-Stocker in charge of scientific procedures. Over 200 ditches were sampled, using the Alcock & Palmer sampling methodology (wetland plants along a 20 m stretch). Voucher specimens were collected of any new or difficult species encountered, and photographs were uploaded to iRecord and/or PlantNet for independent verification.

The survey has produced an enormous amount of information, more than any previous survey. *Triglochin palustris* (possibly not seen since the 1950s) was re-found in two ditches amongst the grazed fields, with *Carex distans* (last seen in 1998) also in one of those. The likely reason for these rediscoveries is simply that we were permitted to survey in early July, while in previous years we had been asked not to enter those fields before late August to avoid disturbing breeding birds. Other finds happened because the survey necessitated visits to many otherwise inconspicuous places: *Chara hispida* turned up in a couple of ditches and *Rumex pulcher* (both new to the site) in one of the meadows in the farmland.

Two of the sites surveyed were outside the NNR, including for the first time Hoplands Farm, an extension of the floodplain on the other side of the Stour. This had *Ranunculus lingua* in some abundance in one meadow, which is an unusual habitat for a plant that normally grows in wet woodland or ponds. This species was last recorded within the NNR in 1948, so it is not quite restored to the site list but, as the Hoplands fields are now under the management of the Kent Wildlife Trust, it is at least within the general area of conservation land (and within the SSSI). *Oenanthe fluviatilis* was also found outside the NNR (at Higham Farm) in a ditch that connects to the river, extending the known distribution of that species back into the territory it appears to have lost since the 1940s. *Carex paniculata* was still present there in the only ditch where it had been found in 1998.

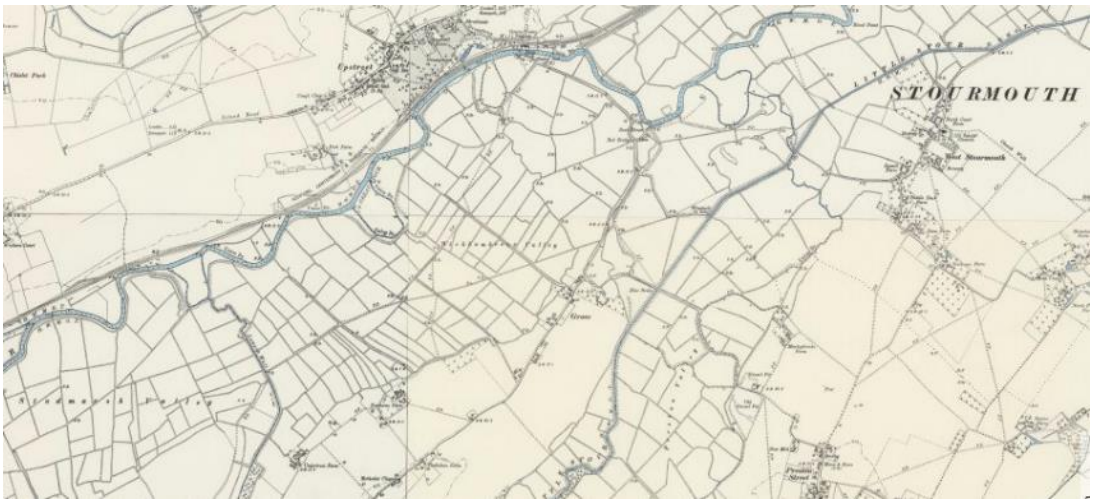
This was the first time since the 1980s that some of the ditches in the western reedbed had been surveyed, and therefore the first opportunity to find out what the real effect of dense reedbed is on the flora. Unsurprisingly, the narrow ditches, which are fully shaded, had almost no aquatic plants at all; but the wider ones (which Williams calls 'fleets'), especially those that run north-south, are in full sunlight. Some of these contained huge quantities of *Potamogeton acutifolius* and *Utricularia vulgaris*, others had *P. coloratus*, *P. lucens* and *P. trichoides* in quantity. Many had *Chara vulgaris*, one had *C. hispida*, and one had a *Nitella* (probably *N. flexilis*), new to the site list. The quality of these ditches clearly improves with distance from the Lampen Stream, and the quantity of algae decreases dramatically along this gradient, which seems consistent with the general view that reedbeds improve water quality.

Ecology and vegetation

Tracing the origins of the vegetation at Stodmarsh, one can start with the end of the last Ice Age, about 13,000 years ago. At that time the area was well above sea level, about 100 m up, and the landscape would have developed from tundra to forest over a period of a few thousand years. It would presumably have been willow, birch, juniper and pine scrub initially, but some of these species disappeared as the climate warmed until about 5,000 years ago, when it was warmer than now. By this time all the large herbivores had been eliminated from the landscape by hunters, and broadleaf woodland would likely have dominated the area. The river Stour may have been bigger and, of course, it would have been well above the tides, so at Stodmarsh there would have been freshwater vegetation, quite likely boggy, even peaty, despite the calcareous influence of the chalk downs above. There would probably have been oak woodland on the dry ground and alder woodland along the river valley.

By Roman times things had changed significantly. The sea had risen to almost its modern level as a result of the ice melting and the isostatic subsidence of the landmass, and the Wantsum Channel had opened up between mainland Kent and Thanet. This was an arm of the sea which came as far inland as Fordwich, just below Canterbury. Stodmarsh was on the shore and the vegetation was almost certainly saltmarsh. Even now the fields are only 2 m above mean sea level, and they would be regularly flooded by high tides if it were not for the sea defences. Riverine and estuarine silt was deposited across the valley, creating shallow, level basin. By about 1,000 years ago the Wantsum Channel had silted up and Stodmarsh was left inland, easily protected by an embankment along the river, which is shown on the earliest Ordnance Survey maps precisely as it is now. By this time Stodmarsh was therefore fed mainly by rainwater and the runoff from adjacent fields.

It was this period when Stodmarsh was saltmarsh or brackish grazing meadow that was the main determinant of the habitat there now, and it has evidently never been wooded, ploughed or altered much since then. It is reasonable to assume that the vegetation gradually changed from saltmarsh to grassland, as the drains were dug to improve the fields for agriculture. A similar sequence took place on other coastal plains, as at the nearby Minster Marshes and Ash Level, and further afield at Reculver and Seasalter. There are many similarities in the vegetation between these sites, and many relics in the form of salt-tolerant or predominantly coastal species. It is likely that these would slowly disappear as the freshwater influence displaces the salt, but that has been a slow process, and some of the species there now have presumably persisted for centuries. Future sea level rise may well reverse this process.



Ordnance Survey six-inch map (1896) of the Stodmarsh area (from the National Library of Scotland web site), showing the distinctive landscape pattern of the reclaimed estuaries. Note the field boundaries in the same places as they are now, except where mining subsidence has since created lakes.

There is a possible alternative explanation for the presence of salt-tolerant plants at Stodmarsh, which is that they arrived in the 1953 flood or otherwise recently, but I think this can be discounted. Although there are few historical records of these species at Stodmarsh specifically, they were generally recorded from nearby sites such as Stourmouth, Preston and Sturry, and so the scarcity of records from Stodmarsh is simply because the area was

not particularly distinctive at that time, compared with the surrounding marshes. A single flooding event could hardly have modified the soil so much that the vegetation communities were permanently changed.

There are now fourteen main habitats at Stodmarsh: rivers, subsidence lakes, artificial ponds, open ditches, clogged ditches, wet reedbed, dry reedbed, meadow, paths, hedges, willow scrub, alder carr, riparian woodland and the spoil heap. It seems reasonable to describe four of these as relatively natural and ancient: the rivers, open ditches, meadows and alder carr. These are the habitats that have existed for centuries, and which would have been carefully maintained by diligent medieval farmers. The rest would have been seen as a waste of valuable productive land, to be minimised or eliminated altogether. These four habitats are therefore the most ancient – and ancientness is an attribute that cannot be created, and which is therefore particularly important for nature conservation.

One can envisage that before the deep coal mining began in the early 20th century, Stodmarsh was essentially a matrix of flat, level fields of grassland divided by a grid of regularly maintained drainage ditches. There would have been no trees, no lakes or ponds, no hedges, no reedbed. It would have been a very uniform habitat, with more-or-less the same species in field after field, ditch after ditch. The same habitat would have stretched for miles from Fordwich down to the sea below Sandwich. There would have been little diversity within this area, but it would have had a very particular distinctiveness, for this reclaimed coastal habitat only exists in this form in certain parts of south-east England.

Taking the habitats in the order listed above, (1) the river itself is outside the NNR but within the SSSI and SAC. It has been extensively modified by dredging and canalisation. The water of the Stour is very turbid along the entire length of the NNR (the turbidity starts abruptly at the 'Tidal Lake' (TR207612); above that it is perfectly clear) but aquatic plants are surprisingly abundant beneath the opaque surface. The most common species are *Sagittaria sagittifolia*, *Stuckenia pectinata* and *Potamogeton lucens*. *Oenanthe fluviatilis*, however, is long gone and *Myriophyllum spicatum* is about to disappear from this stretch. The river is quite heavily used for boating. The much smaller Lampen Stream is similarly confined to its channel, but the water is clear and there are beds of *P. lucens* and *Callitriche obtusangula*. I have not explored it except from the bridges, so it might reward further study.

The subsidence lakes (2) date from the 1920s and 1930s and were created when a thin seam of coal was removed from the underlying bedrock, causing the land to collapse in a fairly uniform way for a distance of just a metre or two. The main lake (C5) is said to be surprisingly shallow, and it is reported that the field patterns are still visible beneath the water. The most surprising aspect of these lakes is the almost complete absence of aquatic plants. I do not know why this is: it could be heavy metal toxicity from the spoil heap, grazing by fish or waterfowl, or some other reason. Natural England attribute it to eutrophication from the Stour and have recently (2018-2019) installed a dam to prevent any further inflow of water.

By contrast, the artificial pools (3) are species-rich and varied. The marsh pool (C16A) is full of *Utricularia vulgaris* and *Butomus umbellatus*; Harrison's Drove pool (C44) has *Potamogeton acutifolius*, various batrachian *Ranunculi*, *Hippuris vulgaris* and abundant *Crassula helmsii*; the viewing platform pool (C45) has *Stuckenia pectinata* and *Zannichellia palustris* with *Crassula*; whereas the dipping platform pool (C35) and Feast Hide pool (C37) have the same vegetation as is found in the ditches.

These open ditches (4) are without doubt the most significant feature of Stodmarsh. The species-richness and variety are extraordinary, and they contain virtually all the notable features of the site, including *Potamogeton acutifolius*, the water snails *Segmentina nitida* and *Vertigo moulinsiana*, the diving beetle *Hydrophilus piceus*, water voles *Arvicola amphibius*, the moth *Monochroa niphognatha*, which in Britain occurs only at Stodmarsh, and numerous Odonata. I have not attempted to classify the ditches by vegetation, but it is noticeable that some are dominated by pondweeds (*P. acutifolius* and *P. friesii*), some by *Myriophyllum verticillatum* or *Ceratophyllum demersum*, and others by charophytes or bladderwort *Utricularia vulgaris*. Many of them contain brackish-water species such as *Bolboschoenus maritimus* and they almost all have *Hydrocharis morsus-ranae*.

Non-native plants are not uncommon: in recent years *Crassula helmsii* has started to spread throughout the ditches, and several have been completely covered in *Azolla filiculoides* or *Lemna minuta*. *Elodea canadensis* and *E. nuttallii* are both common throughout.

Maintenance of the ditches is clearly one of the most important functions of site management, both to control the water level and for nature conservation purposes. The method used for this looks very dramatic: all the vegetation is dredged out and dumped with the silt on an adjacent field. This process creates, over time, raised embankments along the edges of the fields which support a different type of vegetation to the level grasslands; often scrub or tall herb. There is remarkably little left in the channel of these ditches following dredging, and algae tends to dominate the newly restored watercourses. But recolonization from adjacent ditches happens quickly. It is not known whether this process permanently changes the flora and fauna or, if the original ecosystem recovers, how long that takes.

Clogged ditches (5) are very different to the cleared ones. These occur where emergent plants such as *Phragmites australis*, *Sparganium erectum*, *Typha latifolia* and *angustifolia*, *Glyceria maxima* and *Schoenoplectus tabernaemontani* fill the channel. Submerged aquatics soon disappear, but other uncommon plants such as *Oenanthe fistulosa*, *Baldellia ranunculoides* and *Samolus valerandi* sometimes persist on the margins, at least for a while. Botanically, the best clogged ditches are the ones which are grazed by cattle and therefore not too overgrown.

Wet reedbed (6) is less species-rich than a clogged ditch, because the shade is much deeper. Although it is difficult to survey, there appears to be very little that can survive in a uniform reedbed. A small amount of *Galium palustre* and possibly a few plants of *Typha latifolia* and *Sonchus palustris* is all that might be found in a typical area. Curiously, however, when these reedbeds are cut, the growth of other species is remarkable. *Hippuris vulgaris* can flourish. There are, however, very few patches of cut wet reeds, and the clearings only last one summer before the reedbed closes over again.

An RSPB study (Hardman, 2010) found that dry reedbed (7) is better for Diptera (flies) than ditches or wet reedbed. It certainly is not better for plants. At Stodmarsh you might be lucky to find a patch of *Urtica dioica* in an acre of dry reeds, and even that would only be along a track.

The meadows (8) are arguably the second most important habitat at Stodmarsh, and the one that originally made up the majority of the land cover. The vegetation of the grassland is explored in more detail in the following section on communities. It ranges from wet sedge or rush pasture to summer-dry *Hordeum secalinum* grassland, and some of the communities are unique to coastal marshes. The damper areas have rarities such as *Potamogeton coloratus*, *Alisma lanceolatum* and *Veronica catenata* amongst stands of *Eleocharis palustris* and *Agrostis stolonifera*, while the drier grassland has swards of *Trifolium fragiferum*, *Lotus tenuis*, *Carex divisa* and *Juncus gerardii*.

Much of the species diversity in the site is concentrated along the paths (9), several of which are made from imported material on embankments. There used to be patches of *Atropa belladonna* and *Spergularia marina*, and in recent times there have been many weeds and adventives. Of more interest are things like *Sison segetum* and *S. amomum*, which are found mainly on the path sides. From the point of view of maintaining the character of the reserve, it would seem better to do away with the paths altogether, and simply have tracks through the fields (as happens at the middle of the reserve, in C22).

Hedges (10) are not a natural feature of the reserve except at the westernmost end, where it abuts arable fields. However, 'hedges' as linear strips of scrub have sprung up or been planted along several paths and ditches, and around bird hides. Planted species include *Salix triandra*, *Crataegus monogyna* and *Cornus sanguinea*; apparently self-sown ones include a wide variety of tree species from *Quercus robur* and *Fraxinus excelsior* to *Juglans regia* and *Prunus cerasifera*. The main effect of these hedges on the vegetation is to act as a source for more woody species to invade the grassland, and in some places whole fields are being colonised by saplings within a year, if left unmown.

One of the few plants that can effectively invade reedbeds is *Salix atrocinerea*, and this is happening rapidly in several parts of the reserve, forming willow carr (11). At first this carr remains very uniform, containing little other than willow and reeds, but the shade cast by the trees soon reduces the dominance of *Phragmites*, allowing other species such as sedges and horsetails to become established. In places along the Lampen Stream the carr has a variety of other willows, including *S. alba*, *S.* x*fragilis*, *S. triandra*, *S. viminalis*, S. x*holosericea* and *S.* x*mollissima*. Removal of willow scrub is one of the significant annual management tasks on the reserve, although willow leaf beetle and beavers are useful allies in this process.

Willow carr eventually succeeds to *Alnus glutinosa* carr (12), which I suspect is the third and least abundant semi-natural habitat at Stodmarsh. It occurs only at the western end, in compartments 2, 14G and 14H. It is very species-rich with a number of uncommon species such as *Lysimachia vulgaris*, *Urtica galeopsifolia* and *Lysimachia nummularia*. The rare hybrid *Myosotis* x*suzae* is found in this habitat. The most detrimental aspect of this woodland is that the ditches in it become very shaded and lose most of their aquatics. *Lemna minuta* seems to be the main beneficiary. There does not seem to be any reason to drain an alder carr, though, so unless such a ditch is integral to the hydrology of the site, the easiest solution might be to allow it to silt up.

Alongside the river Stour the riparian woodland (13) is very different in character, because it is growing on the mineral spoil of the embankment. This woodland is dominated by *Salix* x*fragilis* and *S. viminalis*. Being frequently inundated by the river, it is silty and eutrophic; by summer there is abundant *Urtica dioica*. A few species are largely restricted to this habitat: *Armoracia rusticana*, *Symphytum* x*uplandicum* and *Oenanthe crocata* are common. Since about 2020, beavers have been common along the river, and they have spread into the reserve in some abundance. Although there are trails and signs of some tree felling, their effect appears to have been limited so far, and there are no signs of dams, which is probably because there is already so much suitable habitat for them.

The spoil heap (14) itself is part of the NNR. There is no public access, partly because the lichen-rich biological soil crust is considered to be vulnerable to trampling. This area is now about 50% dry birch woodland and 50% open vegetation characteristic of dry, nutrient-poor soil. It is essentially a weed community, composed of grassland plants, ruderals and a few halophytes. Many of the species are spring ephemerals such as *Trifolium scabrum*, and by late summer the habitat can appear very dry and barren, although *Spiranthes spiralis* is abundant. As this area is so different to the rest of the reserve, it is not included in the remainder of this account.

Finally, there is one more natural habitat which seems to have been lost from the site (or may indeed never have been present at all – see appendix 2). In his MS Flora of Kent, Francis Rose lists the 'relict fenlands of East Kent' as being Ham, Wingham, Preston, Stodmarsh and Dungeness Open Pits. Rodwell (1977) also describes the NNR as being 'a good example of southern eutrophic flood-plain mire.'

These are valley mires where typically *Sphagnum* has developed over sedge peat and uncommon plants such as *Eriophorum angustifolium* and *Menyanthes trifoliata* might occur. These have been recorded at Stodmarsh but are not there now. There is conflicting evidence about where the fen might have been: C.W. Ward said, 'east end of Stodmarsh,' but records of some of these species appear to have been west of the Lampen Wall. It seems possible that the fenland has disappeared under reedbed, in which case it could potentially be restored one day.

Vegetation Communities

The grassland at Stodmarsh is primarily coastal grazing marsh, a freshwater habitat with a distinctive element of salt-tolerant species that make it quite different to inland flood meadows. The main component is *Hordeum secalinum*, Meadow Barley, generally with *Agrostis stolonifera* and a suite of coastal species such as *Ranunculus sardous*, *Lotus tenuis*, *Trifolium fragiferum*, *Juncus gerardii* and *Carex divisa*. Curiously there is no NVC classification of this community, although there are obvious similarities to SM16 *Festuca rubra* saltmarsh. The lack of a *Hordeum secalinum* grassland is a well-known omission from the NVC. If the sward at Stodmarsh is typical, it could be named *Hordeum secalinum – Agrostis stolonifera* grassland, and it probably occurs in similar situations around the Thames Estuary and along the East Anglian coast.

As the *H. secalinum* grassland dries out it turns slowly into MG6 *Cynosurus cristatus* or, less likely, to MG5 *Festuca rubra* grassland, and this process can be seen in various stages of succession in a few places at Stodmarsh.

Towards the wetter areas, the proportion of *Agrostis stolonifera* in the sward increases, sometimes until this species forms almost a monoculture. There is a small proportion of *Alopecurus pratensis* here, but it is clearly not an *A. pratensis* grassland. I suggest that this is just the wetter end of the *Hordeum – Agrostis* community.

In places there are wet hollows in grazed fields filled with *Alopecurus geniculatus*, Marsh Foxtail. This is a good example of MG13 *A. geniculatus* grassland in its characteristic form, typically in small patches. These hollows often dry up in the summer, and this plus cattle trampling are possibly key to the formation of the community. It is of limited interest ecologically.

Where the fields are more permanently damp, and possibly less heavily grazed, *Eleocharis palustris* makes an appearance (occasionally with *Crassula helmsii*). Sometimes there is a rather surprising sward of *Agrostis stolonifera* and *E. palustris*, which is probably the S19c *Eleocharis palustris–Agrostis stolonifera* community mentioned in the NVC, which is mainly coastal. It was woefully under-sampled in the NVC survey, with just 11 quadrats in total, and possibly none from southern England.

The S19 at Stodmarsh is quite unlike the uniform, species-poor community described, which occurs in freshwater lakes and pools elsewhere. It is vegetation of the highest importance, ecologically, with an array of rare species. The best stands have abundant *Baldellia ranunculoides*, *Alisma lanceolatum*, *Veronica catenata*, *V. scutellata* and even *Potamogeton coloratus*. At Stodmarsh, this is the most characteristic habitat for those species.

S19 *Eleocharis palustris* swamp

Also in the wetter parts of fields there is succession to a number of other swamp communities, most commonly S6 *Carex riparia* swamp, but also S5 *Glyceria maxima* and possibly S18 *Carex otrubae* swamp. These are not particularly noteworthy, but the S14 *Sparganium erectum* near the marsh hide is interesting for its abundance of *Butomus umbellatus*.

Where the fields have been flooded and left ungrazed, the main community that develops is S4 *Phragmites australis* swamp. This is the most species-poor variety of reedbed, and one of the least species-rich of all vegetation communities, being dominated almost 100% by common reed. It has some value in water quality management and for certain species of birds, but it is almost entirely devoid of botanical interest, except in two regards. Firstly, it seems to have become a suitable habitat for *Sonchus palustris*, Marsh Sow-thistle, which is a Nationally Scarce plant that has become quite abundant at Stodmarsh since it appeared (or was introduced) in the 1990s. Secondly, when these reedbeds are cut, there arises a very diverse and interesting community of low-growing swamp species such as *Hippuris vulgaris* and *Oenanthe aquatica*. I believe there is considerable scope for creating high quality habitat at Stodmarsh by regular cutting of areas of wet reedbed if an economical way can be found to do this.

Wherever the reedbeds are slightly drier, or eutrophicated by river water or other nutrient inputs, the reed swamp is S26 *Phragmites australis-Urtica dioica* fen, which is a more species-rich community that tends to be full of stinging nettle and, often, bramble. There are some more welcome additions, however, such as *Lythrum salicaria*, *Epilobium hirsutum* and *Eupatorium cannabinum*; but no axiophytes.

Most of the ditches at Stodmarsh contain A3 *Hydrocharis morsus-ranae* community, which is quite a rare vegetation type, found in coastal marshes and fenland in southern England. A3 is not considered to be a particularly interesting community: apart from the *Hydrocharis*, which is a Nationally Scarce plant, its only interesting constituent is *Wolffia arrhiza*, which has not been found at Stodmarsh since the 1960s. However, the difference between A3 and the more species-rich A4 is small. A4 is *Hydrocharis morsus-ranae–Stratiotes aloides* community, and in the NVC is based entirely on samples recorded in the Norfolk Broads. This seems a fairly obvious example of over-sampling in a small area, which one could argue has caused a spurious division of the *Hydrocharis*

A3 *Hydrocharis morsus-ranae* community

vegetation into two contrasting communities. It makes more sense to have a broader concept of the H3 *Hydrocharis morsus-ranae* vegetation which allows for species such as *Myriophyllum verticillatum* and *Utricularia vulgaris*. A4 could be relegated to subcommunity status. John Rodwell also suggests that this might be the case in his account of the aquatic communities (Rodwell, 1995). For our purposes, however, we can consider the ditches to be A3, and note that it is far more species-rich and ecologically important than expected.

In the ditches, and on the edges of lakes, there are tall swamps of S13 *Typha angustifolia* and small areas of S20 *Schoenoplectus tabernaemontani* and S12 *T. latifolia* swamps.

Finally, along the rivers, there is some woodland. On the banks of the Gt Stour is W6 *Salix* ^{x}*fragilis* woodland: the typical community of eutrophic lowland rivers in England. Characteristic species include several willows, alder and poplar. The willows are of particular interest to botanists because Purple and Almond willows, *Salix purpurea* and *S. triandra*, have been planted here, and there are some uncommon hybrids.

Between the stands of woodland, the riverbank has OV26 *Epilobium hirsutum* tall herb, which can contain some uncommon species such as *Rorippa amphibia*.

The reedbeds have a tendency to succeed to W1 *Salix atrocinerea* carr, which is almost as monotonous as the reedbed it replaces, but along the Lampen Stream the more mature woodland is W5 *Alnus glutinosa* carr, which is typical of peaty soils along mesotrophic rivers. It may not be the best example of W5 in Britain, but it does contain some characteristic species such as *Urtica galeopsifolia* and *Lysimachia vulgaris*, and it is of high conservation value.

W5 *Alnus glutinosa* woodland

Species list

Chara vulgaris L., Common Stonewort: occasional in ditches and pools, most abundantly in ditches around C41, C42 and C47 in 2016. Most plants seem to be var. *vulgaris*, which is a plant with few obvious features; var. *longibracteata* is occasional, and has curved, downward pointing spine cells on the stems (just visible in the picture below); while var. *papillata* is rare (I have only found it in D77 and D152) and has similar spine cells as well as two rows of well-developed stipulodes.

Chara vulgaris var. longibracteata

Chara globularis Thuill., Fragile Stonewort: rare, in D99, in the middle of the reserve at TR232623 in 2015 (det. T.J. Pankhurst). There appear to be just three previous records of this species in Kent, each with only sketchy details. All charophytes should probably be considered axiophytes because of their requirement for clear water, although they do tend to come and go quite quickly.

Chara hispida L., Bristly Stonewort: newly found in 2022 in ditches 79, 91 and 14,21 (TR230617, TR231617 & TR225616, respectively). This is an axiophyte of calcareous fens.

†*Ophioglossum vulgatum* L., Adder's-tongue: in C39 at TR23196220 (Daphne Mills, 18/5/2014). I cannot find it there but have no reason to doubt the record, although to judge from the grid reference there is a possibility that it may have been buried under spoil when D99 was dredged in the winter of 2014/15. This is an axiophyte of species-rich grassland and is rare in this part of the county.

Equisetum fluviatile L., Water Horsetail: frequent throughout in ditches and pools. This is an axiophyte of clean water habitats, found in S5 *Glyceria maxima*, S6 *Carex riparia* and S13 *Typha angustifolia* swamps and W5 *Alnus glutinosa* woodland.

Equisetum arvense L., Field Horsetail: occasional throughout, in grassland and hedge bottoms, and often extending into the edges of swamps and ditches, in S26 *Phragmites australis* swamp. Around the boardwalk C14H it grows in standing water.

Equisetum palustre L., Marsh Horsetail: mainly at the Grove Ferry end of the reserve, where it is abundant in C62. A good identification tip for this species is to find cones on vegetative stems, as it is otherwise easy to confuse with *E. arvense*.

Azolla filiculoides Lam., Water Fern: completely covering a couple of ditches around C33, near the river at Grove Ferry, in 2020. It was also in a ditch near the Marsh Hide that year, where it had also been present in the 1980s (van Dongen & Painter). By June 2022 it was smothering the pool in front of the hide. A few weeks later it had disappeared, for reasons unknown (although, conceivably, the very hot weather may have been a factor), leaving a muddy pond that lacked the macrophytes such as *Utricularia*, which had been abundant before.

Asplenium scolopendrium L., Hart's-tongue: a couple of plants on the sides of shady ditches in C14, at the western end of the reserve. This was a new addition to the list in 2022, and reflects the increasing maturity of the woodland.

Polystichum setiferum (Forskal) Moore ex Woynar, Soft Shield-fern: one plant in scrub by the path through C14H (TR22496121) in 2020; not previously recorded. This is a woodland indicator, and its arrival reflects the increasingly shady conditions in this part of the site.

Dryopteris filix-mas (L.) Schott, Common Male Fern: occasional in scrub and woodland, especially around the mouth of the Lampen Stream. It is a common plant in Kent but almost absent from Thanet.

Dryopteris carthusiana (Vill.) H.P. Fuchs, Narrow Buckler-fern: one plant seen (in May 2016) in W5 *Alnus glutinosa* woodland at TR22416120 (C14H). This is an axiophyte of acid, peaty soils.

Dryopteris dilatata (Hoffm.) A. Gray, Broad Buckler-fern: occasional in woodland in C11 and C14. Another fern that is increasing as a coloniser of secondary woodland.

Taxus baccata L., Yew: one self-sown sapling in scrub by the Lampen Wall, TR223613, in 2017.

Nymphaea alba L., White Water-lily: scattered throughout in ditches and pools. A native species of lakes and ditches with mesotrophic water. It has been known at Stodmarsh since 1839 (T.H.M. Bartlett, 'in ditches near Sturry') and is undoubtedly native here. It is a component of the A3 *Hydrocharis morsus-ranae* vegetation.

Nuphar lutea (L.) Smith, Yellow Water-lily: scattered throughout, in ditches and pools; more frequent than *N. alba.* This is more of a river plant than white water-lily, being found in Kent mainly along the Beult, Medway and Stour (Philp, 2010). It is tolerant of more eutrophic conditions.

Ceratophyllum demersum L., Rigid Hornwort: fairly frequent in ditches throughout. First recorded here by F.J. Hanbury c. 1875 and recorded many times since. Where it is found, it is often abundant, and it is quite tolerant of quite eutrophic conditions, but it is not common in Kent. The records of *C. submersum*, Soft Hornwort, in the Nature Conservation Review (Ratcliffe, 1977) and Forbes's 1978 Checklist may have been errors for this species.

Caltha palustris L., Marsh Marigold: rare, in wet grassland by Lampen Stream near the car park (C2, TR221609) and in alder carr nearby. It was found by Williams *et al.* (1996) in D128 and D152 but I have not seen it in any of the ditches. It may be decreasing due to the succession of grassland to reedswamp and scrub, or it may have been cleared out by dredging. It is considered an axiophyte of wet grassland and carr.

Clematis vitalba L., Traveller's Joy: occasional along the river path and the Lampen Wall. This is an uncharacteristic species for the site, being typical of calcareous soils. Possibly the bank was built up at some point using limestone brought in from elsewhere.

Ranunculus acris L., Meadow Buttercup: occasional in grassland throughout.

Ranunculus repens L., Creeping Buttercup: occasional along paths and in grassland throughout.

Ranunculus sardous Crantz, Hairy Buttercup: abundant in the meadows and along grassy paths. First recorded here by F.J. Hanbury in about 1875, it is characteristic of coastal grazing marshes in north Kent, typically in *Hordeum secalinum* grassland, and it could be a useful axiophyte except that it can also be found on disturbed ground, along paths and even on arable field margins.

Ranunculus sceleratus L., Celery-leaved Buttercup: occasional in ditches, rills and muddy areas in grazed fields. It also springs up quickly in areas of cut S4 *Phragmites australis* fen. This is a common plant of muddy places that can tolerate low to high levels of fertility.

†*Ranunculus lingua* L., Greater Spearwort: recorded by William Masters in 1839 ('Banks of the Stour, Grove Ferry') and subsequently by numerous surveyors until 1987 (Natural England) when it was in compartments 6 and 7 (TR218611 & TR216610). It is still present in wet meadows at Hoplands Farm (TR208615), which are within the SSSI and have recently been taken on by the Kent Wildlife Trust. Its loss from within the NNR is probably due to the conversion of meadows to reedbed. It is an axiophyte of coastal marshes and brackish ditches in Kent.

Ranunculus flammula L., Lesser Spearwort: rare, in *Alopecurus geniculatus* grassland in C22 (TR232623) in 2014 and in D99 (TR231622) in 2020. It has previously only been recorded by Forbes in 1978. An axiophyte of slightly acid wetlands in Kent.

Ranunculus trichophyllus Chaix, Thread-leaved Water-crowfoot: occasional in the ditches but not recorded prior to 2015, possibly because of uncertainty about identification. These plants have small flowers (petals 5 mm) with a semi-circular or lunate nectar pit and no laminar leaves; the petals are not contiguous. It is an axiophyte in Kent.

Ranunculus aquatilis L., Common Water-crowfoot: rare, in pools in C15A (TR224621) and C44 (TR234622). This is a common pond plant in Kent, but it had not been recorded at Stodmarsh before 2014; it is distinguished from the following by its round nectar pits and shorter peduncles, and from the previous species by its contiguous petals.

Ranunculus peltatus Schrank, Pond Water-crowfoot: in shallow water in the scrape in front of Harrison's Drove Hide, C44 (TR234623). These plants had peduncles elongating in fruit to 5 cm or more and pear-shaped nactar pits on the petals. This species is considered scarce in Kent.

Ranunculus circinatus Sibth., Fan-leaved Water-crowfoot: rather sporadic in its occurrence in ditches and pools. It was scarce in the pool in front of Harrison's Drove Hide (TR23436229, C44) in 2016 but it has recently become more widespread, in D22.2 (M. Cousins, 2019) and the recently dredged D84 and D86.

It was first recorded by F.J. Hanbury at 'Grove Ferry' in about 1875 and there are occasional records of it since then. This is an axiophyte of low-nutrient open water, mostly in coastal parts of Kent.

Ficaria verna Huds., Lesser Celandine: abundant along the rivers and in hedges around the Stodmarsh car park; a common plant of damp soils everywhere.

Thalictrum flavum L., Meadow-rue: a sizeable patch in the field margin at Stodmarsh Court Farm (TR21846114) which is just within the NNR, and further west at Higham Farm (still within the SSSI, TR19876022). This is an axiophyte of riparian grassland and woodland. At Court Farm the margin is cut but ungrazed, whereas as Higham it is around a pool next to a farm track, where cattle frequently drink. The only other current site for it in East Kent is also by the Gt Stour, near Wye (L. Rooney, 2011).

Ribes rubrum L., Red Currant: occasional in the woodland in C2.

Ribes nigrum L., Black Currant: in open, wet woodland in C2. This is arguably a native species of W6 *Salix* ˣ*fragilis* woodland in Britain, and it could be counted as an axiophyte in this habitat; but there is a counter argument that it is an ancient introduction, and it has spread to these woods (as has Red Currant).

Crassula helmsii (Kirk) Cockayne, New Zealand Pigmyweed: abundant in the pools in front of the bird hides, most notably at the Marsh Hide (C16A), Harrison's Drove (C44) and the viewing platform (C45). It also spreads into wetland vegetation in places like C15 and C59. This species is listed on Schedule 9 of the Wildlife & Countryside Act as an invasive non-native weed but efforts to control it are largely in vain. The mite *Aculus crassulae* was introduced in 2018 but so far there is little sign of any reduction. It thrives in permanently wet areas in full sunlight and recently has been spreading in the ditches.

Myriophyllum verticillatum L., Whorled Water-milfoil: frequent throughout, in ditches and pools. This is an axiophyte of base-rich still water which was first recorded here by Ward and Rose in 1947. Some of the smaller plants have leaves in whorls of 4, which would normally key out to *M. spicatum*, but late in the year they develop turions, so they must be *verticillatum*. This may account for several records over the years of *M. spicatum*, but I have not found that species in the reserve.

† *Myriophyllum spicatum* L., Spiked Water-milfoil: in the Stour at Grove Ferry (TR2363, C. Osborne, 2014). It was also recorded by F.J. Hanbury in c. 1875 'between Stodmarsh and Grove Ferry.'

Lotus tenuis Waldst. & Kit ex Willd., Narrow-leaved Bird's-foot-trefoil: frequent in grassland. An axiophyte of neutral grassland and grazing marsh; it occurs in the *Hordeum secalinum* grassland. This is one of the plants of the coastal element in the Stodmarsh flora. It was listed by Forbes in 1978 but was otherwise overlooked until 2012, when it was found by Colin Osborne. Some of the older records of *L. corniculatus* therefore seem likely to be errors for this species.

Lotus corniculatus L., Common Bird's-foot-trefoil: occasional in grassland, but much rarer than the above species. Large plants growing along the path at TR228619 (S. Buckingham, 2018) are the introduced var. *sativus* Hyl., which suggests that a seed mix might have been used there at some point.

Lotus pedunculatus Cav., Large Bird's-foot-trefoil: in wet grassland and fen by the Lampen Stream near the Stodmarsh car park, at TR221609 (C2).

Vicia cracca L., Tufted Vetch: occasional in fen by the paths in C2 (TR221609 & TR221612).

Vicia sativa L., Common Vetch: occasional in grassland.

Ervum tetraspermum L., Smooth Tare: a large patch by a path in C17C (TR23416285) in 2014.

Lathyrus pratensis L., Meadow Vetchling: occasional in grassland and hedges.

Lathyrus nissolia L., Grass Vetchling: occasional in grassland towards the middle of the reserve (C21-C23).

Medicago lupulina L., Black Medick: occasional in grassland and on paths.

Medicago arabica (L.) Huds., Spotted Medick: locally abundant in the dry meadows near Grove Ferry (C42, C46 & C47); otherwise mainly as a casual weed along paths.

Trifolium repens L., White Clover: frequent in grassland and on paths.

Trifolium fragiferum L., Strawberry Clover: frequent in meadows and occasional along paths. This is an axiophyte of coastal grazing marshes; it occurs in the *Hordeum secalinum* grassland.

Trifolium campestre Schreb., Hop Trefoil: a few plants in the car park at the Stodmarsh end and some scattered patches along paths.

Trifolium dubium Sibth., Lesser Trefoil: occasional in grassland.

Trifolium micranthum Viv., Slender Trefoil: rare, along the path to Grove Ferry (TR23466296) in 2016.

Trifolium pratense L., Red Clover: frequent in the grassland. There is a robust agricultural strain (var. *sativa*) with hollow stems that occurs along the river path, having been sown there in 2015/16 as part of a seed mix.

Prunus cerasifera Ehrh., Cherry Plum: although not recorded before 2014, this tree is scattered throughout, along paths, in the car park and along the river.

Prunus spinosa L., Blackthorn: occasional in hedges and scrub.

Prunus domestica L., Wild Plum: I have only seen one tree, along the path at Harrison's Drove, TR234622.

Prunus avium (L.) L., Wild Cherry: rare, in coppiced hazel woodland at the western end (C1, TR222610).

Pyrus communis L., Pear: one tree on the Lampen Wall at TR22366143.

Malus domestica Borkh., Apple: a few scattered trees, in a hedge near the car park (TR22116097), on the riverbank at TR23026284, and in the lane to Parsonage Farm (TR230620).

Malus × *purpurea* (E. Barbier) Rehder, Purple Crab: a couple of shrubs in a planted hedge in C62.

Sorbus aucuparia L., Rowan: in a hedge by the Stodmarsh car park.

Crataegus persimilis Sarg., Broad-leaved Cockspur-thorn: one tree by the road in C62 (TR23516310), presumably planted but established now in otherwise native scrub.

Crataegus monogyna Jacq., Hawthorn: occasional in hedges and scrub, especially in lanes around the edges

and along the river path. Many of the trees in the fields appear to be intermediate between *monogyna* and *laevigata*, although the flowers all seem to have just one style and so are closer to *monogyna*.

Crataegus laevigata (Poiret) DC., Midland Hawthorn: one small tree in woodland by the path in C14H. It has red petals and could be a self-sown specimen of the cultivar 'Crimson Cloud.'

Filipendula ulmaria (L.) Maxim., Meadowsweet: scattered throughout, in ditches and swamps.

Rubus fruticosus L., Bramble: occasional throughout in hedges, scrub and any patches of grassland that have not been mown recently.

Potentilla anserina L., Silverweed: locally abundant in grassland and swamp.

Potentilla reptans L., Creeping Cinquefoil: frequent along paths and occasional in grassland.

†*Comarum palustre* L., Marsh Cinquefoil: in a 'dike by the Lampen Wall' in 1952, according to R.E. Wood (det. E. Scott). This is a very rare plant in Kent and an axiophyte of mires, typically occurring amongst *Sphagnum* moss. The habitat there has been lost to reedbed and scrub.

Fragaria ananassa (Duchesne) Duchesne, Garden Strawberry: a couple of plants by the path to the Reedbed Hide, TR22146122, in 2017. Presumably planted there but persisting for some time.

Geum urbanum L., Wood Avens: occasional in hedges and scrub.

Agrimonia eupatoria L., Agrimony: occasional in grassland.

Rosa arvensis Huds., Field Rose: in woodland at the western end, TR222610.

Rosa canina L. agg., Dog Roses: occasional in hedges and scrub throughout. I have not attempted to identify the individual species.

Ulmus glabra Huds., Wych Elm: several shrubs in wet woodland by the path in C2 (TR222610), and one tree by the side of the road at Grove Ferry (C62).

Ulmus procera Salisb., English Elm: occasional in hedges and scrub around the edges.

Ulmus minor Mill., Small-leaved Elm: rare, in the hedge of the lane by the Stodmarsh car park.

Humulus lupulus L., Hop: occasional in hedges and wet woodland at the Stodmarsh end, spreading in recent years along the Lampen Wall.

Urtica dioica L., Stinging Nettle: frequent in woodland and around bird hides; scattered throughout.

Urtica galeopsifolia Wierzb. ex Opiz, Fen Nettle: abundant in W5 *Alnus glutinosa* woodland along the Lampen Stream at the west end of the reserve, compartments 2 & 14 (conf. M.F. Godfrey). Some plants are very tall, up to about 8 ft. in height. It is recognisable by its narrow leaves and it has less sting than common nettle. There are no old records of this in Kent because it was not widely recognised as a British species until recently.

Quercus cerris L., Turkey Oak: one small shrub in a hedge alongside the Lampen Stream by C14.

Quercus robur L., Pedunculate Oak: rare but scattered throughout.

Juglans regia L., Walnut: a couple of saplings, about 5 ft. high, by paths at TR22316120 and TR23066273.

Betula pendula Roth., Silver Birch: surprisingly rare - a few trees in a hedge in the middle of the reserve at TR229619 and one sapling in a hedge by a ditch at TR225612.

Alnus glutinosa (L.) Gaertn., Alder: frequent in woodland and by the river. This is the most characteristic plant of W5 alder carr which occurs along the Lampen Stream at the western end of the reserve. Some of the alders are dying of 'alder pox' (*Phytophthora alni*). In the picture below the tree on the left is dead, the one in the middle is diseased and has a thin crown, while a third tree on the right is healthy. This is quite normal in cases of alder pox, which rarely wipes out a population, but it often weakens trees sufficiently that they are eventually replaced by willows.

Alnus glutinosa with *Phytophthora alni* infestation

Corylus avellana L., Hazel: in hedges and scrub at the western and eastern ends.

Corylus maxima Mill., Filbert: a purple cultivar, planted along the path from Grove Ferry, TR234630.

Euonymus europaeus L., Spindle: a small patch in scrub on the edge of C62 (TR234630).

Hypericum perforatum L., Perforate St John's-wort: a small patch by the side of the path to Grove Ferry (TR234629) in 2019.

Hypericum tetrapterum Fries, Square-stalked St John's-wort: on the edge of one of the Parsonage Farm Fields at TR23086210.

Populus ˣ*canadensis* Moench cv. 'Robusta', a hybrid Black Poplar: in wet woodland by the Lampen Stream in C14H (TR222610) and at the western end of the reserve (C7I and C6F, TR212610). This is a commonly planted tree that is suited to river floodplains.

Salix ˣ*fragilis* L., Crack-willow: occasional in woodland and by the river. This is one of the characteristic species of W6 riparian woodland, of which there are some good stands by the Stour and in C14 (and, to a lesser extent, in C6 and C7). It is considered to be a hybrid because it is reputed not to produce viable seed, but it reproduces freely from broken-off branches.

Salix alba L., White Willow: in wet woodland in C14 and a few scattered trees in hedgerows elsewhere, sometimes, maybe, marking boundaries or access points. It is planted wherever it occurs and is considered an archaeophyte (ancient introduction) in Britain, but it is a suitable tree for W6 *Salix* ˣ*fragilis* woodland and mature specimens are a valuable part of the habitat.

Salix triandra L., Almond Willow: a sizeable stand by the Stour at TR22726241 and planted as cover around some hides. This is considered to be an archaeophyte in Britain, although it is well naturalised in some places. In Kent it is generally not so well naturalised, and the stands at Stodmarsh appear planted.

Salix ˣ*mollissima* Hoffm. ex Elwert. (*triandra* x *viminalis*), Sharp-stipuled Willow: a patch of scrub near the Stour at TR220619 (13th July 2016, conf. I.V. Belyaeva). This appears to be a spontaneous hybrid, not previously recorded in Kent.

Salix purpurea L., Purple Willow: several trees on the banks of the Stour, TR22796254. This looks like an old withy bed; the trees were probably planted, originally, but are thriving here. *Salix purpurea* is not native in Kent.

Salix viminalis L., Osier: occasional along the Stour and by a pond at TR232626; also planted around some of the hides. In 2021 many trees in the western part of the reserve (C10 & C11) were completely defoliated by the Willow Leaf Beetle *Plagiodera versicolora*, but whether the damage is long-lasting remains to be seen.

Salix ˣ*holosericea* Willd. (*viminalis* x *atrocinerea*), Silky-leaved Osier: a couple of shrubs by the river path (TR22766249, 2015, conf. I.V. Belyaeva, and TR223622), and by ditches at the western end (C6F, TR217610 and C14G, TR223611).

Salix caprea L., Goat Willow: a few shrubs along the edge of the swamp by the path to the reedbed hide (C3, TR221612).

Salix x quercifolia Sennen ex Goerz (*caprea* x *atrocinerea*), Grey x Goat-willow: a couple of shrubs by the river path at TR22166182 and TR22766248.

Salix atrocinerea Brot., Grey Willow: locally abundant throughout. This can be a very invasive species, sometimes filling shallow ponds or coming to dominate wetlands. This is one of the few species that can colonise the reedbeds and in places it has to be cleared to prevent succession to woodland. Many of the trees in C11 and C16 have recently been infested by Willow Leaf Beetle, however, and some are dead.

Geranium dissectum L., Cut-leaved Crane's-bill: occasional in disturbed areas.

Geranium pusillum L., Small-flowered Crane's-bill: in a field gateway in C20 (TR23226219).

Geranium molle L., Dove's-foot Crane's-bill: occasional in grassland.

Geranium robertianum L., Herb-robert: occasional in scrub, mainly along the riverbank.

Lythrum salicaria L., Purple-loosestrife: occasional in wet woodland, swamps and ditches.

Epilobium hirsutum L., Great Willowherb: frequent throughout in reedbeds, swamps and wet woodland.

Epilobium parviflorum Schreb., Hoary Willowherb: occasional in marshy grassland and wet woodland.

Epilobium tetragonum L., Square-stalked Willowherb: rare in grassland in C23 (TR233622, conf. G.D. Kitchener). Previously recorded (as *E. adnatum*) by F.J. Hanbury c. 1875, 'between Stodmarsh and Grove Ferry.'

Epilobium ciliatum Raf., American Willowherb: frequent in a recently cut area by the boardwalk, (C14H, TR224612).

Chamerion angustifolium (L.) Holub, Rosebay Willowherb: a few plants in reedbeds by the path in C11C (TR220618).

Circaea lutetiana L., Enchanter's-nightshade: a good patch on the edge of the reedswamp by a hide, TR234628.

Acer platanoides L., Norway Maple: one small shrub in the hedge by the path in C11D (TR220618).

Acer campestre L., Field Maple: in the hedge of the lane into the reserve from the Stodmarsh car park; and along the river path at TR223622, where it was presumably planted in a hedge.

Acer pseudoplatanus L., Sycamore: rare, but scattered throughout.

Malva sylvestris L., Common Mallow: occasional along paths.

Reseda luteola L., Weld: rare, along the Lampen Wall and the river path in a few places.

Capsella bursa-pastoris (L.) Medikus, Shepherd's-purse: occasional in field gateways and along paths.

Barbarea vulgaris R. Br., Winter-cress: on muddy ground in C10A, in an area recently cleared of scrub for flood defence works in 2018.

Rorippa palustris (L.) Besser, Marsh Yellow-cress: a few plants in scattered locations, as on the path at TR23126216 and by the lake near the Tower Hide at TR221617.

†*Rorippa sylvestris* (L.) Besser, Creeping Yellow-cress: recorded by F.J. Hanbury c. 1875 (Hanbury & Marshall, 1899) (as *Nasturtium sylvestre*) 'by the river near Grove Ferry.'

Rorippa amphibia (L.) Besser, Great Yellow-cress: one patch in tall herb by the river at TR23026284 in 2015 (det. T.C.G. Rich). This is an axiophyte of riverbanks; it occurs in S26d *Epilobium hirsutum* vegetation. There are currently only a few known sites for it in East Kent.

Nasturtium officinale W.T. Aiton, Watercress: occasional in ditches.

Armoracia rusticana P. Gaertn., B. Mey. & Scherb., Horseradish: several plants on the river bank at TR23366312.

Cardamine pratensis L., Cuckooflower: occasional throughout in wet woodland and on the banks of ditches.

Cardamine flexuosa With., Wavy Bittercress: occasional in wet woodland at the Stodmarsh end.

Cardamine hirsuta L., Hairy Bittercress: occasional along gravel paths at the western end.

Lepidium latifolium L., Dittander: large stands in three places close to the river and scattered elsewhere. This is normally a coastal plant, growing on shingle beaches and in rough grassland near the sea. It is also found along the River Stour as far inland as Canterbury. It is Nationally Scarce and in its natural habitat could arguably be an axiophyte, but it is also widely established outside its natural range. At Stodmarsh it is thriving and noticeably increasing, forming some extensive stands.

Lepidium draba L., Hoary Cress: rare, along paths and around Harrison's Drove hide.

Lepidium coronopus (L.) Al-Shehbaz, Swine-cress: rare, in field gateways and path edges.

Brassica rapa L., Wild Turnip: occasional weed on paths.

Brassica nigra (L.) Koch, Black Mustard: rare casuals on the Lampen Wall and river embankment.

Sinapis arvensis L., Charlock: occasional along paths and on disturbed ground.

Hirschfeldia incana (L.) Lagr.-Fossat, Hoary Mustard: occasional on the Lampen Wall and on disturbed ground.

Sisymbrium officinale (L.) Scop., Hedge Mustard: on disturbed ground at Harrison's Drove hide and in the car park at the Stodmarsh end.

Alliaria petiolata (M. Bieb.) Cavara & Grande, Garlic Mustard: occasional in hedges and by paths, particularly in the alder carr at the western end.

Persicaria amphibia (L.) Gray, Amphibious Bistort: frequent in pools, ditches and marshy grassland.

Persicaria maculosa Gray, Redshank: occasional in disturbed areas and along paths.

Persicaria lapathifolia (L.) Gray, Pale Persicaria: on bare ground seasonally inundated places, as along a newly laid path at TR234628 and in hollows in C15.

Persicaria hydropiper (L.) Spach, Water-pepper: rare, in a swamp at TR23266260.

Polygonum depressum A. Cunn. ex Meisn., Equal-leaved Knotgrass: occasional along paths.

Polygonum aviculare L., Knotgrass: occasional along paths and in trampled fields.

Fallopia convolvulus (L.) Á. Löve, Black Bindweed: in woodland by the Stour and by paths.

Rumex acetosa L., Common Sorrel: rare, in grassland by paths.

Rumex hydrolapathum Huds., Water Dock: frequent in ditches. This is an axiophyte of rivers and wetlands; it occurs in A3 *Hydrocharis morsus-ranae*, S5 *Glyceria maxima* and S6 *Carex riparia* vegetation. The hybrid *Rumex* ˣ*schreberi* Hausskn. (*hydrolapathum* x *crispus*) has been found in D36.

Rumex crispus L., Curled Dock: occasional in fields.

Rumex conglomeratus Murray, Clustered Dock: occasional in ditches and swamps.

Rumex sanguineus L., Wood Dock: occasional in the woodland.

Rumex pulcher L., Fiddle Dock: rare, in a meadow in at Newborns Farm (TR232617).

Rumex obtusifolius L., Broad-leaved Dock: occasional on the edges of paths.

Stellaria media (L.) Villars, Chickweed: occasional, on paths and bare patches in grassland.

Stellaria holostea L., Greater Stitchwort: along the lane from the Stodmarsh car park and along the path towards the Reedbed hide.

†*Stellaria palustris* Retz, Marsh Stitchwort: found by Miss Belton in 1928 ('marsh SW of Grove Ferry') and seen there by various people until at least 1955 (Francis Rose). The Nature Conservancy Council had a plan showing it by a ditch by the river at TR226623 ('two plants') in 1987, but it has not been recorded since then. This is an axiophyte of fens and sedge swamps, often by rivers.

Stellaria aquatica (L.) Scop., Water Chickweed: rare, in wet woodland near the Lampen Stream in C2 (TR222610). Previously recorded on the banks of the Stour by C. Dyson in 1991. This is an axiophyte of riverbanks and wet woodland.

Cerastium fontanum Baumg., Common Mouse-ear: occasional in car parks and along paths.

Cerastium glomeratum Thuill., Sticky Mouse-ear: rare, on paths.

†*Scleranthus annuus* L., Annual Knawel: listed in Francis Rose's manuscript Flora as having been recorded at Stodmarsh by F.J. Hanbury at some unknown date, and by himself in 1949. He describes it as a plant of open sandy ground on heaths and arable fields. This may have been on a spoil heap or in a field outside the reserve. It is considered an axiophyte of acid grassland.

†*Spergularia marina* (L.) Griseb., Lesser Sea-spurrey: formerly known along the Lampen Wall at TR220620, where it was recorded by NCC surveyors in 1985 and 1987. It was presumably a casual here.

Spergularia rubra (L.) J.S. & C. Presl, Sand Spurrey: occasional in the grazed meadows in the middle of the reserve (C15 and C17) in 2019 and 2021; previously recorded only on the colliery tip.

Silene ˣhampeana Meusel & K. Werner (*latifolia* x *dioica*), Hybrid Campion: a few plants near the marsh hide at TR221617 in 2016.

Silene dioica (L.) Clairv., Red Campion: occasional in woodland and hedges.

Silene flos-cuculi (L.) Clairv., Ragged Robin: occasional in ditches and swamps.

Atriplex prostrata Boucher ex DC., Spear-leaved Orache: scattered, in field gateways and on trampled ground. It also thrives on the spoil banks that are created when the ditches are cleared.

Chenopodium album L., Fat-hen: occasional along paths and on dried mud in seasonal pools.

Lipandra polysperma (L). S. Fuentes, Uotila & Borsch, Many-seeded Goosefoot: a few plants on the side of a path at TR23356290 in 2015 and near the car park in 2017.

Oxybasis rubra (L.) S. Fuentes, Uotila & Borsch, Red Goosefoot: occasional in dried-up pools and rills, most abundant in an ephemeral pool in C15A, where some of the plants were infected by what I presume is the fungus *Physoderma pulposum*. This seems to severely weaken the host.

Physoderma pulposum on Oxybasis rubra

†*Montia fontana* L., Blinks: recorded at Stodmarsh in ca. 1950 by "J.O.", according to Francis Rose's manuscript Flora. The record seems very vague, and the site may not have been within the reserve, but it seems possible. Blinks is an axiophyte of acid grassland.

Cornus sanguinea L., Dogwood: a few shrubs in hedges and planted around hides.

Lysimachia vulgaris L., Yellow Loosestrife: in the woodland at the western end and by a ditch at TR23266216. This is an axiophyte of riverbanks and wet woodland; it is primarily in W5 *Alnus glutinosa* woodland.

Lysimachia nummularia L., Creeping-Jenny: occasional along the sides of ditches and in wet woodland at the western end. First recorded in 1839 'between Grove Ferry and Stodmarsh' by William Masters. An axiophyte of marshy grassland and wet woodland.

Lysimachia arvensis (L.) U. Manns. & Anderb., Scarlet Pimpernel: rare, along paths.

Samolus valerandi L., Brookweed: frequent in ditches throughout, but especially at the Grove Ferry end (TR237630) where the ditches in cattle-grazed fields can be lined with it. This is a scarce and declining plant in Kent, and an axiophyte of unimproved grazing marshes.

Galium palustre L., Common Marsh-bedstraw: frequent in swamps, reedbeds and wet woodland.

Galium album Mill., Hedge Bedstraw: on track sides and by the river.

Galium aparine L., Cleavers: rare, in hedges.

Vinca minor L., Lesser Periwinkle: a well-established patch near the mouth of the Lampen Stream, C11A (TR22016207).

†*Symphytum officinale* L., Common Comfrey: recorded in Cowell's 1839 Floral Guide for East Kent by Miss Sankey and Miss Kenrick (independently). It is described by Hanbury & Marshall (1899) as common in all districts of the county, but it is now virtually absent from the NE part of Kent.

Symphytum ˣ*uplandicum* Nyman, Russian Comfrey: abundant along the path by the Stour from TR231629 to TR234628.

Symphytum orientale L., White Comfrey: a planted patch just outside the Feast hide.

Pentaglottis sempervirens (L.) Tausch ex L. Bailey, Green Alkanet: occasional along the river path.

Myosotis scorpioides L., Water Forget-me-not: occasional in ditches and swamps.

Myosotis ˣ*suzae* Domin (*scorpioides* x *laxa*), Water x Tufted Forget-me-not: many plants in the alder carr at the western end of the reserve (TR222610) in 2019 (conf. D. Welch).

Myosotis laxa Lehm, Tufted Forget-me-not: frequent in ditches, woodland and swamps.

Myosotis arvensis (L.) Hill, Field Forget-me-not: on gravel paths at the western end.

Convolvulus arvensis L., Field Bindweed: occasional along paths.

Calystegia sepium (L.) R. Br., Hedge Bindweed: frequent in sedge swamps, reedswamp and woodland. This is the native species of bindweed that is typical of wetlands and relatively infertile soils. All plants are the glabrous form (ssp. *sepium*) and a few plants along the river path have pink corollas with white stripes (f. *colorata* (Lange) Dörfl.).

Calystegia ˣ*lucana* (Ten.) G. Don (*sepium* x *silvatica*), Hybrid Bindweed: abundant along the river bank, and a few scattered plants elsewhere, where the parents meet, as on the edge of a reedswamp at the base of the colliery tip, TR212613. This is a fairly common hybrid in Kent, and it is interesting to see how it grows on the boundaries of the parents' habitats.

Calystegia silvatica (top), ˣlucana (middle) and sepium (bottom)

Calystegia silvatica (Kit.) Griseb., Large Bindweed: rare, in field hedges around the edges, in C41 (TR23426290) and along Harrison's Drove. This is the non-native species that is typical of gardens and arable field hedges, not necessarily on damp soils.

†*Atropa belladonna* L., Deadly Nightshade: recorded along the Lampen Wall, around TR223614, by NCC surveyors in 1987 (2 plants). This is an axiophyte of base-rich grassland and woodland; it is most likely to have been a casual in this site, having been introduced with stones used for the embankment.

Solanum dulcamara L., Bittersweet: frequent in ditches and swamps.

Fraxinus excelsior L., Ash: a few trees by the river and numerous saplings in wet woodland.

Ligustrum vulgare L., Wild Privet: planted around hides and near the car park; also apparently self-sown along the Lampen Wall.

Digitalis purpurea L., Foxglove: a few plants on the Lampen Wall at TR22056185.

Veronica scutellata L., Marsh Speedwell: rare, in an S19 *Eleocharis palustris* swamp in C59 (TR240626). In

1996 it was found by Williams *et al.* in D54 (TR228625) & D73 (TR229624). This is an axiophyte of wetlands which is quite rare in Kent. The plants found were *V. scutellata* var. *scutellata*.

Veronica beccabunga L., Brooklime: rare, in a ditch in C1, in cut reedbed in C8D and in cleared scrub in C10A.

†*Veronica anagallis-aquatica* L., Blue Water-speedwell, has been recorded several times during ditch surveys. I have not seen it there myself, but it does occur on the Little Stour nearby and it seems entirely possible.

Veronica catenata Pennell, Pink Water-speedwell: occasional in ditches, pools and swamps. This is an axiophyte of species-rich wetlands. Although it is a perennial, it usually seems to act as an annual here. For example, it was exceptionally abundant on drying mud in a pool in C15A (TR22446208) in 2016; but there was almost none the following year. Wherever it occurs, it seems to be infested by with the galls of the weevil *Gymnetron villosulum* Gyllenhal, which destroy most of the seed.

Veronica persica Poiret, Common Field-speedwell: rare, on disturbed ground in fields.

Veronica chamaedrys L., Germander Speedwell: rare, in grassland and in woodland by the river.

Veronica arvensis L., Wall Speedwell: occasional along paths.

Plantago coronopus L., Buck's-horn Plantain: rare, on paths.

Plantago major L., Greater Plantain: locally abundant on paths and in field gateways.

Plantago lanceolata L., Ribwort Plantain: frequent in the grassland.

Hippuris vulgaris L., Mare's-tail: locally abundant in ditches, pools and marshy grassland. This is an axiophyte, and Stodmarsh is an exceptionally good site for it with large populations in some areas.

Callitriche platycarpa Kuetz., Various-leaved Water-starwort: abundant in a ditch at the Grove Ferry end, C62 (TR234630) (det. R.V. Lansdown).

Callitriche obtusangula Le Gall, Blunt-fruited Water-starwort: abundant in the Lampen Stream at TR22196090.

Scrophularia auriculata L., Water Figwort: occasional in ditches towards western end (C5, C11 & C14).

Buddleja davidii Franchet, Butterfly-bush: a well-established patch on the bank by the river, TR231629.

Utricularia vulgaris L., Greater Bladderwort: abundant in some of the pools and ditches (confirmed F.J. Rumsey, BM), particularly in the lake in front of the Marsh Hide. It has been recorded here since at least 1839 (Miss Kenrick) and Stodmarsh is one of the key areas for it in East Kent. It has flowered prolifically every year that I have surveyed, despite its reputation as a shy flowerer. Since 2018 it appears to have spread significantly, becoming abundant in recently dredged ditches. This is an axiophyte of base-rich waters.

Stachys sylvatica L., Hedge Woundwort: rare, in hedges at the Stodmarsh end.

Stachys palustris L., Marsh Woundwort: in swamp by the lake (C5C), on the riverbank and in damp grassland

within the oxbow (C18A). This is an axiophyte of rivers and wetlands.

Ballota nigra L., Black Horehound: occasional in the tall grass beside the paths, throughout.

Lamium album L., White Deadnettle: rare, on path sides.

Lamium purpureum L., Red Deadnettle: rare, on path sides.

Galeopsis bifida Boenn., Bifid Hemp-nettle: rare, in reed swamp by the Lampen Stream, C2 (TR221609).

Scutellaria galericulata L., Skullcap: locally abundant in woodland at the western end and in swamps throughout. Plants in the wood grow very large, up to 150 cm tall with leaves 10 cm x 3 cm.

Glechoma hederacea L., Ground-ivy: occasional in hedges; rare on ditch-banks. Alongside the nature trail through the swamp at the western end (TR224612), there are numerous plants which in 2019 were infested with the gall-causing insect *Liposthenes glechomae* (Kieffer).

Liposthenes glechomae galls

Prunella vulgaris L., Selfheal: rare, along paths and in grassland.

Lycopus europaeus L., Gipsywort: occasional in ditches and reedswamp; recorded here since 1839 (T.H.M. Bartlett).

Mentha aquatica L., Water Mint: frequent throughout.

†*Menyanthes trifoliata* L., Bogbean: recorded by F.J. Hanbury 'between Stodmarsh and Grove Ferry' in about 1875 and in the western part of the reserve by the C.W. Ward and F. Rose in 1947 but it has not been seen since then.

Arctium lappa L., Greater Burdock: occasional throughout on disturbed ground by paths and on the riverbank.

Arctium minus (Hill) Bernh., Lesser Burdock: rare, along paths.

Cirsium vulgare (Savi) Ten., Spear Thistle: occasional on disturbed ground.

Cirsium arvense (L.) Scop., Creeping Thistle: occasional in grassland.

Centaurea nigra L., Common Knapweed: occasional along the Lampen Wall, where it has been for many years. It is also now present on the river path, where there is a showy form with pseudo-radiate flowers (sometimes called ssp. *rivularis* (Brot.) Cout.) which was presumably introduced with a seed mix in 2016 and has persisted for some time.

Ornamental variety of Centaurea nigra, in 2020

Cichorium intybus L., Chicory: casual along the Lampen Wall and on paths, sometimes. Presumably from discarded birdseed brought in by bird watchers.

Lapsana communis L., Nipplewort: occasional on paths and disturbed ground throughout.

Hypochaeris radicata L., Cat's-ear: occasional in grassland and along paths.

Scorzoneroides autumnalis (L.) Moench, Autumnal Hawkbit: occasional in grassland and along paths.

Leontodon saxatilis Lam., Lesser Hawkbit: frequent in the meadows.

Picris hieracioides L., Hawkweed Oxtongue: a small clump by the river path at TR226623 in 2016 and a large number of plants alongside the path to Grove Ferry at TR234629 in 2019.

Helminthotheca echioides (L.) Holub, Bristly Oxtongue: scattered throughout, mainly along paths.

Tragopogon pratensis L., Goat's-beard: a few plants along path sides, scattered throughout.

Sonchus palustris L., Marsh Sow-thistle: thriving in the reedbed, originally towards the Grove Ferry end, but spreading throughout in recent years. It is a Nationally Scarce species, thought to be declining in Britain, but it first turned up at Stodmarsh in the 1990s, where it may have been introduced deliberately or brought in by birds. (Several 19th century records for the marshlands around the Wantsum Channel were dismissed at the time as errors for *S. arvensis*, and I don't think the recent appearance at Stodmarsh refutes that conclusion.)

Sonchus arvensis L., Perennial Sow-thistle: occasional along paths and around fields.

Sonchus oleraceus L., Smooth Sow-thistle: rare, but scattered throughout.

Sonchus asper (L.) Hill, Prickly Sow-thistle: rare, but scattered throughout.

Lactuca virosa L., Greater Lettuce: occasional along the Lampen Wall at TR22326156 and by the path near the Marsh Hide (C. Osborne, 2016).

Taraxacum officinale Weber, Dandelion: occasional in grassland and along paths. The following varieties have been recorded:

- *hygrophilum* Soest occurs in grazing marshes at Higham Farm, west of the NNR but within the SSSI. This is its only known site in Britain, where it was discovered by Francis Rose in 1949.
- *pseudohamatum* Dahlst. is a common ruderal plant that is found along paths (TR228615, T.C.G. Rich, 2016).
- *pulchrifolium* Markl. is also a common ruderal of path sides (TR222610, Rich, 2016).

Crepis capillaris (L.) Wallr., Smooth Hawk's-beard: occasional on disturbed ground by paths.

Crepis vesicaria L., Beaked Hawk's-beard: occasional along the river path.

Pilosella officinarum F. Schultz & Schultz-Bip., Mouse-ear-hawkweed: locally abundant in grassland on the Lampen Wall at TR22076184.

Gnaphalium uliginosum L., Marsh Cudweed: rare, on mud in C23 (TR233622) in 2014.

Pulicaria dysenterica (L.) Bernh., Common Fleabane: frequent along paths and occasional in meadows. When growing in sedge swamp it can reach a considerable height, up to 1.5 m in some places, when normally it would not be expected to exceed about 50 cm.

Symphyotrichum laeve (L.) Á & D. Löve var. *concinnum* (Willd.) G.L. Nesom, Delicate Michaelmas-daisy: occasional along the muddy margins of the Stour above Grove Ferry, in W6 *Salix* ˣ*fragilis* woodland. This identification is by Geoffrey Kitchener and confirmed by Arthur Chater. The plants have very pale ligules and the tops of the stems seem more hairy than typical. The Michaelmas-daisies are a complex group of horticultural plants from North America, and it is unusual to find them well established in such a remote spot.

Erigeron floribundus (Kunth) Sch. Bip., Bilbao's Fleabane: on a track by the Lampen Stream in C10B (TR219620) in 2020.

Erigeron sumatrensis Retz., Guernsey Fleabane: a casual on the Lampen Wall, TR222616, in 2015, and in grassland in C62 in 2020.

Bellis perennis L., Daisy: occasional, on paths and in meadows.

Artemisia vulgaris L., Mugwort: occasional on paths, especially by the river.

Achillea millefolium L., Yarrow: occasional along the paths. It does not seem to be a component of the natural sward in the meadows, but it is fairly frequent along the edges of the paths, where it can grow to a considerable size; I measured several plants in 2020 which were up to 120 cm tall – considerably bigger than allowed in the textbooks.

Leucanthemum vulgare Lam., Oxeye Daisy: occasional by paths.

Matricaria chamomilla L., Scented Mayweed: in field gateways.

Matricaria discoidea DC., Pineapple Weed: in field gateways and along paths.

Tripleurospermum inodorum (L.) Schultz-Bip., Scentless Mayweed: locally frequent on disturbed ground.

Senecio inaequidens DC., Narrow-leaved Ragwort: a sizeable patch by the side of the path to Grove Ferry (TR234629) in 2019. This is an introduced species that usually turns up on roadsides; presumably brought here on machinery.

Senecio squalidus L., Oxford Ragwort: rare, in field gateways and by paths.

Senecio vulgaris L., Groundsel: occasional on paths.

Jacobaea vulgaris Gaertn., Common Ragwort: occasional throughout.

Jacobaea erucifolia (L.) P. Gaertn., B. Mey. & Scherb., Hoary Ragwort: occasional in grassland and by paths.

Tussilago farfara L., Colt's-foot: a few patches, scattered along the paths; it is only really abundant on the river path at about TR227624.

Bidens cernua L., Nodding Bur-marigold: abundant on drying mud in a shallow, ephemeral pool in C15A (TR224621) and in a ditch in C11. It is rather rare in East Kent, and considered to be declining, so this is an important site for it. It is an axiophyte of wetlands, including ponds and ditches.

Bidens tripartita L., Trifid Bur-marigold: occasional on the edges of pools and ditches, and by the river. This is an axiophyte of wetlands by rivers; it occurs in S26 *Phragmites australis* vegetation and W6 *Salix* ˣ*fragilis* woodland. It is also quite rare in Kent, where it is considered to be primarily a plant of eutrophic rivers.

Eupatorium cannabinum L., Hemp-agrimony: occasional along the edges of swamps and abundant by the lake at TR221617.

Adoxa moschatellina L., Moschatel: in the hedge of the lane at Stodmarsh (TR221610).

Sambucus nigra L., Elder: occasional throughout.

Viburnum opulus L., Guelder-rose: in wet woodland at the western end and planted around hides elsewhere.

Lonicera periclymenum L., Honeysuckle: in hedges around the edges of the reserve.

Valeriana officinalis L., Common Valerian: in swamps and open woodland at the western end (C2); recorded here since 1839 (T.H.M. Bartlett).

Dipsacus fullonum L., Wild Teasel: occasional, scattered throughout.

Hedera helix L., Ivy: frequent in woodland, hedges and scrub.

Hydrocotyle vulgaris L., Marsh Pennywort: rare in a few ditches (D40, D51 & D60).

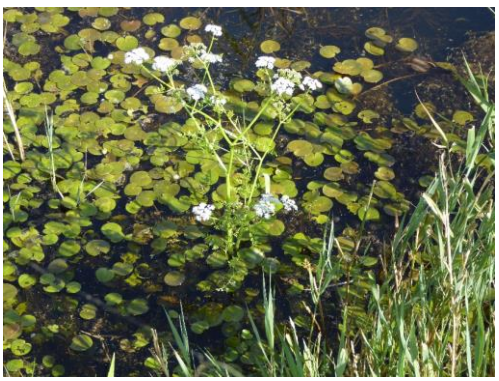
Oenanthe fistulosa L., Tubular Water-dropwort: frequent in ditches and swamps, where it has been known here since the 1870s (F.J. Hanbury). It is a wetland axiophyte and a plant that is said to be declining rapidly in Britain. At Stodmarsh, it grows on the margins of ditches in A3 *Hydrocharis morsus-ranae* vegetation or around S5 *Glyceria maxima*, S6 *Carex riparia* and S13 *Typha angustifolia* swamps. Occasionally it is found in wet of MG13 *Alopecurus geniculatus* grassland adjacent to the ditches. The population size seems to be about stable, having been recorded in 48 ditches in 1996 and 58 in 2022.

†*Oenanthe lachenalii* C.C. Gmel., Parsley Water-dropwort: collected by F. Rose in 'swampy fen-meadow' at Stodmarsh in 1955 (MNE).

Oenanthe crocata L., Hemlock Water-dropwort: frequent by the river and in wet woodland; also rarely, but increasingly, along ditches.

†*Oenanthe fluviatilis* (Bab.) Coleman, River Water-dropwort: recorded by F.J. Hanbury c. 1875 'between Stodmarsh and Grove Ferry.' This was probably in the river, and it is still present upstream at Canterbury, although it did turn up in 2022 in one of the ditches at Higham Farm (within the SSSI but outside the NNR) that connect to the river.

Oenanthe aquatica (L.) Poiret, Fine-leaved Water-dropwort: rare, in a patch of cut reedswamp in C27 (TR23246251) and in a ditch in C13A (TR222618). Previously recorded (as *O. phellandrium*) by F.J. Hanbury, c. 1875, and by van Dongen and Painter in several places in 1989. This is an axiophyte of peaty wetlands.



Berula erecta (Huds.) Cov., Lesser Water-parsnip: abundant in all the ditches. This is a wetland axiophyte.

Helosciadium nodiflorum (L.) W.D.J. Koch, Fool's Water-cress: occasional in ditches.

Smyrnium olusatrum L., Alexanders: rare, along paths on the edge of the reserve.

Anthriscus sylvestris (L.) Hoffm., Cow Parsley: occasional throughout.

Torilis japonica (Houtt.) DC., Upright Hedge-parsley: occasional in grassland and hedges.

Daucus carota L., Wild Carrot: rare, along paths.

Silaum silaus (L.) Schinz & Thell., Pepper-saxifrage: rare in long grass by paths in several places and in the meadow in C18A.

Heracleum sphondylium L., Hogweed: occasional in grassland and woodland. Along the river path (TR226623) there are some exceptionally large plants, well beyond the normal range of variation for this species.

Sison amomum L., Stone Parsley: occasional in long grass on the edges of paths.

Sison segetum L., Corn Parsley: on the riverbank path at TR230626 in 2016 and in C49 in 2021, but not persisting in either place. It has been known here since 1978 (Forbes).

Conium maculatum L., Hemlock: occasional, by paths and on ditch banks, especially along the path running east from the Marsh Hide.

Angelica sylvestris L., Wild Angelica: in woodland at the western end and along the Stour.

Arum maculatum L., Lords-and-ladies: in scrub around the edges of the reserve.

Arum italicum Miller, Italian Lords-and-ladies: one clump under hazel trees near the car park.

Spirodela polyrhiza (L.) Schleiden, Greater Duckweed: occasional in the ditches. Known here since the 1870s (F.J. Hanbury).

Lemna gibba L., Fat Duckweed: occasional in the ditches. Known here since the 1870s (F.J. Hanbury).

Lemna minor L., Common Duckweed: abundant in ditches throughout.

Lemna minuta Kunth, Least Duckweed: locally abundant in ditches, most commonly in the shaded ones in the woodland at the western end. First recorded here by Williams *et al.* in 1996.

Lemna trisulca L., Ivy-leaved Duckweed: abundant in all the ditches and pools.

†*Wolffia arrhiza* (L.) Horkel ex Wimm., Rootless Duckweed: in 'trenches between Stodmarsh and Grove Ferry' (F.J. Hanbury, 1875) and seen in the vicinity of Grove Ferry by Francis Rose in the 1950s and Mrs Brickenden in 1962. It was also listed by Forbes in 1978, but this may have been a compilation of the earlier records. It is considered to be Nationally Scarce plant and an axiophyte of grazing marshes.

Sagittaria sagittifolia L., Arrowhead: abundant in the Stour from Fordwich to Stodmarsh, becoming less common towards Grove Ferry, where the river becomes tidal and silty. Most of the long, narrow streamers that can be seen floating in the water are the leaves of this species (the remainder are mostly *Butomus umbellatus*), but only in late summer do the characteristic arrowhead-shaped leaves emerge.

Baldellia ranunculoides (L.) Parl., Lesser Water-plantain: scattered populations on the sides of ditches and in rills. Over the last few years, it has occurred in C23, C44, C57, C59 and D70 (in particularly large quantities in C57 & C59), on the edge of S4 *Phragmites australis* or S19 *Eleocharis palustris* swamps. In the 1996, Williams *et al.* found it in D46, D47, D67 & D73. It is an axiophyte of seasonally inundated muddy (or sandy/gravelly) places and oligotrophic conditions, in full sunlight. The plants at Stodmarsh are all ssp. *ranunculoides*, with numerous flowers in a whorl and petals that are not quite contiguous.

Alisma plantago-aquatica L., Water-plantain: occasional throughout, in shallow ditches, and sometimes abundant in ephemeral pools. Recorded since at least 1839 (T.H.M. Bartlett).

Alisma lanceolatum With., Narrow-leaved Water-plantain: scattered throughout in pools and ditches. I have seen it in C23, C44, C57, C59, D77, D82 & D169. The ditches survey in 1996 found it in D28, D41, D65, D74 & D84, and in 2009 Osbourne recorded it in wet woodland in C2. It is an axiophyte of rivers and canals and is uncommon in East Kent.

Butomus umbellatus L., Flowering Rush: abundant in the pond in front of the Marsh Hide, at TR226618; scattered elsewhere, including in the Stour. It is an axiophyte of rivers and canals. First recorded by W. Masters in 1839.

Hydrocharis morsus-ranae L., Frogbit: abundant in water bodies throughout. This is an axiophyte of ditches and ponds; it is characteristic of A3 *H. morsus-ranae* community and extends into the more open fens such as T13 *Typha angustifolia* vegetation and cut stands of S4 *Phragmites australis*. First recorded in 1839 by T.H.M. Bartlett.

Elodea canadensis Michaux, Canadian Waterweed: occasional in ditches and pools.

Elodea nuttallii (Planch.) H. St John, Nuttall's Water-weed: abundant in ditches and pools.

Triglochin palustris L., Marsh Arrowgrass: very rare on the grazed margins of ditches in fields at the centre of the reserve (D17.5, TR229619 & D58, TR228619). It was previously recorded by Hanbury in 1875, 'between Stodmarsh and Grove Ferry' and by Francis Rose in 1955. This is an axiophyte of marshy grassland.

Potamogeton natans L., Broad-leaved Pondweed: occasional in ditches and pools.

Potamogeton coloratus Hornem., Fen Pondweed: one sizeable patch in S19 *Eleocharis palustris* swamp in C57 (TR23956242) and two patches in ditches (D112 (TR233618) & DPF03 (TR231619). This is a Nationally Scarce plant and an axiophyte of fens. It was previously recorded at nearby Newnham Valley in 1997, but in Kent it is otherwise only known around Ham.

Potamogeton lucens L., Shining Pondweed: abundant in the Stour and the Lampen Stream and occasionally in ditches. I have seen it in D11.4, D43 and D47. It was also recorded in D31 and D51 by Williams *et al*. in 1996 and in five other ditches by Painter & van Dongen in 1989. This species is typical of rivers, ditches and ponds where calcareous water drains off chalk hills. It was first recorded ('at the western end') by Ward & Rose in 1947.

†*Potamogeton perfoliatus* L., Perfoliate Pondweed: recorded by F.J. Hanbury c. 1875, 'between Stodmarsh and Grove Ferry' and in about 1950 by R.G. Williams, according to Francis Rose's unpublished Flora. It was most likely in the river.

Potamogeton friesii Rupr., Flat-stalked Pondweed: frequent in ditches and pools, possibly more in the western part of the reserve. This species was first recorded here by E.G. Philp in 1958 (det. J.E. Dandy & G. Taylor, MNE). It can be quite abundant and, owing to its pointed leaves, could easily be mistaken for *P. acutifolius*, so recording must be done with care. The only place it is found in East Kent is in the lower parts of the catchment of the Stour.

Potamogeton pusillus L., Lesser Pondweed: in the lake in front of Harrison's Drove Hide (C44, TR234622, 2014) and in a swamp in C1 (TR221610, 2017). It was first recorded here by F.J. Hanbury c. 1875 (although a voucher specimen would normally be required for a record as old as this) and has been seen several times since then, notably by E.G. Philp & J. Bevan in 2000 and during the ditch survey of 1996, although it might be better to consider the latter as records of *P. pusillus* agg., incorporating either of the following two taxa.

Potamogeton berchtoldii Fieber, Small Pondweed: rare, in ditches. In 2022 it was found in D57, D60 & D64. It has previously been listed by Forbes in 1978 and by E.G. Philp & J. Bevan in 2000, in unspecified places.

Potamogeton trichoides Cham. & Schldl., Hairlike Pondweed: occasional in ditches and ponds. This species is easily overlooked, and it was first recorded by N.F. Stewart in 1993.

Potamogeton acutifolius Link, Sharp-leaved Pondweed: widespread in the ditches and lakes, more frequent in the central part of the reserve. It can be difficult to separate from *P. friesii* in the field and collecting voucher specimens is highly recommended if records are to be accepted. This is a Nationally Rare pondweed, first found at Stodmarsh by G. Dowker ('Withamdrew, west of the Little Stour-Newnham Valley') in the 19th century (Hanbury & Marshall, 1899). Its habitat is calcareous, mesotrophic water in Norfolk and the south-east of England. As one of the key species at Stodmarsh it would be desirable to know if the population changes, but this is difficult to do. In 1996 Williams *et al.* found it in just 6 (4%) of 169 ditches surveyed, whereas in 2022 it was in 18 (10%) of 182, which at first glance seems like a clear increase; but the samples were neither random nor systematic. We can say for certain, though, that it has spread into areas that were previously dry. In 2021 seeds were collected from D98 and D23.1 (TR232621) by Stephanie Miles and Jennifer Peach for the Millennium Seed Bank.

Potamogeton crispus L., Curled Pondweed: occasional in ditches. A plant collected in D14.37 in 2021, which was under a blanket of *Lemna minuta* and in a wooded area, was a completely un-curly form (but det. C.D. Preston).

Stuckenia pectinata L., Fennel Pondweed: frequent in the Stour, rare in the pond at Harrison's Drove (TR234622) and occasional in ditches. Previously recorded here by F.J. Hanbury in 1875 and by E.G. Philp in 1958 (MNE). It was found to be widespread in the ditch survey of 1996 (Williams *et al*.). It is typical of sluggish lowland rivers and brackish ditches around the coast.

†*Groenlandia densa* (L.) Fourr., Opposite-leaved Pondweed: recorded by C.W. Ward in 1947, possibly with Francis Rose. This would have been at the western end, around where the spoil heap now is. In his unpublished Flora, Rose mentions a 1949 record for Fordwich Marshes, which could be the same place.

Zannichellia palustris L., Horned Pondweed: occasional in ditches and ponds. It has previously been recorded by F.J. Hanbury in 1875 and C. Dyson in 1991, and there were several records of it in the 1996 ditch survey. This species seems to have declined dramatically in East Kent recently.

Epipactis helleborine (L.) Crantz, Broad-leaved Helleborine: two plants beside the main path towards the western end (TR225613) in 2022; a new addition to the reserve and a sign of maturing woodland.

†*Dactylorhiza fuchsii* (Druce) Soó, Common Spotted-orchid: on the Lampen Wall in c. 1950 (R.E. Wood). It is still common on the spoil heap but seems not to occur in the meadows at all.

Dactylorhiza praetermissa (Druce) Soó, Southern Marsh-orchid: in a damp grassy sward on the margin of a potato field at Stodmarsh Court Farm (TR217610), which is just within the NNR at its western end; it is also on the colliery tip, where it has been known since at least 1987.

Anacamptis pyramidalis (L.) Rich., Pyramidal Orchid: one plant by D165 (TR239629) in 2019 (M. Cousins). This is a calcicole and a surprising addition to the site list, although it was recorded in the vicinity of the colliery tip by Philp in the 1990s.

†*Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase, Green-winged Orchid: recorded by R.E.

Wood in about 1950 ‘NE of Stodmarsh.’ This was once a very common plant in meadows, but it suffered a catastrophic decline in the 20th century and is now uncommon. It is considered an axiophyte of neutral to calcareous grasslands.

Iris pseudacorus L., Yellow Iris: occasional throughout in ditches and damp meadows.

†*Allium vineale* L., Wild Onion: growing on the Lampen Wall in about 1950 (R.E. Wood).

Narcissus spp., Daffodils: there are occasional clumps of daffodils planted by paths in various places. Most conspicuous are the numerous clumps of the double-flowered form, *Narcissus* 'Telamonius Plenus' along the path in front of Undertrees Farm (C14, TR224611). There is also a patch of the brightly-coloured *Narcissus* ‘Tahiti’ by the bench at the beginning of C14 (TR223610).

Hyacinthoides non-scripta (L.) Chouard ex Rothm., Bluebell: at the base of the hedge along the lane from the Stodmarsh car park and, in 2020, one plant near the path in C14H; possibly a sign of natural succession in this area of secondary woodland.

Asparagus officinalis L., Asparagus: a patch by the river path at TR22336215. This could be the same place where it was recorded by Mrs Brickenden in 1962.

Sparganium erectum L., Branched Bur-reed: frequent throughout, in ditches and swamps, and along the margin of the rivers. In 1955 Francis Rose recorded ssp. *neglectum* (Beeby) K. Richt. (MNE), whereas plants in Ditch 17.1 (TR228622) in 2021 were ssp. *microcarpum* (Neuman) Domin.

Sparganium emersum Rehmann, Unbranched Bur-reed: occasional in ditches around the middle of the reserve (D49, D56 & D65).

Typha latifolia L., Great Reedmace: occasional in swamps and ditches. This species is more tolerant of eutrophication and typical of enriched sites than *T. angustifolia*, but its distribution within the reserve appears to be fairly random.

Typha ˣ*glauca* Godr. (*latifolia* x *angustifolia*), Hybrid Reedmace: rare, in reedswamp at the base of the colliery tip (TR212613) and along the edge of D28 in C15A (TR22366208).

Typha angustifolia L., Lesser Bulrush: abundant in pools and occasional in swamps and ditches. It also occurs around the lakes, forming a fringe to the *Phragmites* reedswamp in the deeper water. It is an axiophyte of pools and ditches.

†*Juncus subnodulosus* Schrank, Blunt-flowered Rush: reported by P.W. Wilberforce from ‘Stodmarsh’ in 1964, according to notes in Francis Rose’s unpublished Flora. It was also listed by Ratcliffe (1977) and Forbes (1978), but these could be repeats of the earlier record. There is some *J. subnodulosus* in the meadows at Higham Farm (TR202604), immediately west of the reserve and within the SSSI, but none has been found within the NNR.

Juncus articulatus L., Jointed Rush: frequent throughout, on the sides of ditches and in marshy grassland.

Juncus acutiflorus Ehrh. ex Hoffm., Sharp-flowered Rush: very rare. I have only found one stand of it, in a swamp in C57 (TR239623).

Juncus gerardii Loisel., Saltmarsh Rush: occasional in marshy grassland, along a path by C30, around the pool in C44, and in the sward in C19A. Williams *et al.* found it in D67, D79, D80 & D102 in 1996. This is an

axiophyte of salt marshes and coastal grazing meadows.

Juncus bufonius L., Toad Rush: occasional along paths and in wet hollows.

Juncus inflexus L., Hard Rush: frequent to abundant throughout.

Juncus effusus L., Soft-rush: occasional in ditches and fields throughout; the var. *subglomeratus* occurs in C23 (TR23306223).

Juncus conglomeratus L., Compact Rush: rare, seen only in C19C (TR23156243) in 2013. The only previous record is by Forbes (1978).

†*Eriophorum angustifolium* Honck., Common Cottongrass: recorded by C.W. Ward at the 'east end of Stodmarsh' in 1949.

Bolboschoenus maritimus (L.) Palla, Sea Club-rush: occasional in ditches throughout, and around some of the pools. An axiophyte of coastal grazing marshes. Stodmarsh is one of its most inland sites for it in the county, reflecting the coastal element in the vegetation.

Schoenoplectus lacustris (L.) Palla, Common Club-rush: in patches all along the Stour as it runs past, but I have not found it within the reserve at all.

Schoenoplectus tabernaemontani (C.C. Gmel.) Palla, Grey Club-rush: occasional in ditches and swamps. First recorded here by E.S. Marshall in the late 19th century (Hanbury & Marshall, 1899), in 'ditches near Grove Ferry, in profusion.' This is an axiophyte of coastal wetlands. Several records of *S. lacustris* in the 1980s and '90s can be included here, as this was considered a subspecies in some Floras at the time and was therefore overlooked.

Eleocharis palustris (L.) Roem. & Schult., Common Spike-rush: frequent to abundant throughout in wet grassland, swamps and ditches. In 1955 Francis Rose collected a specimen which was identified by Max Walters as ssp. *macrocarpa* Walters (now called ssp. *palustris*), which is the less common of the two subspecies; it only occurs in the south of the country. It is considered a wetland axiophyte.

†*Eleocharis uniglumis* (Link) Schult., Slender Spike-rush: recorded by Francis Rose in about 1950. This is an axiophyte of coastal grazing marshes and fens and is much rarer than *E. palustris*.

†*Carex paniculata* L., Greater Tussock-sedge: listed by Francis Rose in about 1950 as having been found by R.E. Wood at an unspecified location. It is known elsewhere in the SSSI, but not within the NNR. It is an axiophyte of base-rich wetland habitats.

Carex otrubae Podp., False Fox-sedge: frequent throughout in ditches, wet grassland and swamp.

Carex divulsa Stokes ssp. *leersii* (F.W. Schultz) W. Koch, Grey Sedge: one large clump by the path near Grove Ferry, TR23496301 (conf. M.S. Porter); previously recorded here by Francis Rose in about 1950.

Carex disticha Huds., Brown Sedge: occasional in swamps throughout.

Carex divisa Huds., Divided Sedge: locally abundant along paths and in some of the grassland; this is an axiophyte of coastal grazing marshes, and Stodmarsh is about as far inland as it reaches. Its presence here demonstrates the maritime influence on the vegetation.

Carex remota L., Remote Sedge: occasional in the woods at the western end.

†*Carex leporina* L., Oval Sedge: recorded by C.W. Ward in 1950; possibly toward the western end of the reserve.

Carex hirta L., Hairy Sedge: a few patches, mostly along the paths.

Carex acutiformis Ehrh., Lesser Pond-sedge: in just a few places throughout the reserve (C2, C8, C59 & D99).

Carex riparia Curtis, Greater Pond-sedge: abundant throughout.

†*Carex rostrata* Stokes, Bottle Sedge: collected in 1958 by M.E. Milward (MNE).

†*Carex pendula* Huds., Pendulous Sedge: recorded by C.W. Ward in 1947 and by Williams *et al.* in D114 (TR233628) in 1996. This is an often-invasive native woodland plant which does not seem to have persisted.

Carex flacca Schreb., Glaucous Sedge: in grassland in several places, such as C22, C23 and C59.

Carex distans L., Distant Sedge: very rare, just a couple of clumps in D17.5 (TR229619) in 2022. It was previously recorded by Williams *et al.* (1996) in D71, D89 and D102 in 1996 and then in D51, D54, D157 & D161 in 1998. This is an axiophyte of coastal grazing marshes which may have declined as a result of the expansion of reedbed or because of the drastic ditch clearance operations.

Carex acuta L., Slender Tufted-sedge: a few clumps in swamp along D60 (TR22966230) (det. A.O. Chater) and in woodland in C2. This is a new tetrad for the species, which is scarce in East Kent. It also occurs by ditches at Stodmarsh Court Farm and Higham Farm (the latter outside the NNR but within the SSSI). *Carex acuta* is an axiophyte of lowland river valleys, growing either along the side of rivers or in sedge swamps in the floodplain.

Glyceria maxima (Hartman) O. Holmb., Reed Sweet-grass: frequent throughout, in swamps and ditches, and along the edge of the river.

Glyceria fluitans (L.) R. Br., Floating Sweet-grass: occasional in ditches and rills.

Glyceria declinata Breb., Small Sweet-grass: in a ditch at TR23036205.

Glyceria notata Chevall., Plicate Sweet-grass: occasional in wet grassland in C17 & C57, and formerly recorded by Williams *et al.* in several ditches (73, 83 & 107) in 1996.

Brachypodium sylvaticum (Huds.) P. Beauv., False-brome: occasional in the woods and hedges.

Schedonorus arundinaceus (Schreb.) Dumort., Tall Fescue: only abundant along the path in front of the Marsh hide, but there are scattered clumps in grassland elsewhere. The plants here have uncharacteristically glabrous auricles, but the identification has been confirmed by C.A. Stace.

Lolium perenne L., Perennial Rye-grass: frequent along paths and in meadows.

Lolium ˣ*boucheanum* Kunth (*perenne* x *multiflorum*), Hybrid Rye-grass: a few clumps in field gateways and on paths at the eastern end in 2015 (conf. C.A. Stace), and subsequently sown in great abundance along the river path after the regrading work that winter. It has declined considerably since then and has now almost disappeared again (by 2019).

Festuca rubra L., Red Fescue: occasional on drier ground, scattered throughout. There is surprisingly little red fescue at Stodmarsh, considering that it is one of the most common grasses of unimproved meadows in England.

Festuca ovina L., Sheep's-fescue: a few patches on the Lampen Wall.

Vulpia bromoides (L.) Gray, Squirrel-tail Fescue: frequent along the Lampen Wall.

Vulpia myuros (L.) C.C. Gmel., Rat's-tail Fescue: occasional along the Lampen Wall.

Dactylis glomerata L., Cock's-foot: occasional throughout.

Cynosurus cristatus L., Crested Dog's-tail: locally frequent in grassland at the Grove Ferry end; scattered in other meadows.

Arrhenatherum elatius (L.) P. Beauv., False Oat-grass: frequent along paths.

Avena fatua L., Wild Oat: rare, as a casual on waste ground by the path to Grove Ferry.

Trisetum flavescens (L.) P. Beauv., Yellow Oat-grass: occasional in the easternmost (driest) fields (C42, TR236630) and along the path to Grove Ferry.

Anthoxanthum odoratum L., Sweet Vernal Grass: rare, in grassland by the path in C30 (TR230626).

Phalaris arundinacea L., Reed Canary-grass: frequent throughout. There are plants in the woodland at the western end with culms up to 2.4 m, which is somewhat greater than the maximum size given in descriptions of this species (Cope & Gray, 2009). This probably due to the exceptionally favourable growing conditions.

Holcus lanatus L., Yorkshire-fog: occasional throughout, in dry grassland and swamps.

Agrostis capillaris L., Common Bent: occasional in dry grassland.

Agrostis stolonifera L., Creeping Bent: frequent in swamps and marshy grassland. This is one of the main grasses making up the sward of the meadows at Stodmarsh.

Alopecurus pratensis L., Meadow Foxtail: occasional in marshy grassland and swamps.

Alopecurus geniculatus L., Marsh Foxtail: frequent in marshy grassland and swamps.

Phleum pratense L., Timothy: occasional in grassland.

Phleum bertolonii DC., Smaller Cat's-tail: occasional in grassland.

Poa infirma Kunth, Early Meadow-grass: recorded by S. Buckingham in 2011 and subsequently by L. Rooney in 2014, along paths. This species has been spreading on Britain in recent years and is now quite common in Kent, although it is generally not found in semi-natural places.

Poa annua L., Annual Meadow-grass: occasional on paths and in grassland.

Poa trivialis L., Rough Meadow-grass: occasional throughout.

Poa pratensis L., Smooth Meadow-grass: occasional in meadows.

Poa nemoralis L., Wood Meadow-grass: rare, on the Lampen Wall at TR223612. This is a woodland grass, typically found on dry banks.

Bromus racemosus L., Smooth Brome: rare, by a track in C17 in 2016.

Bromus hordeaceus L., Soft-brome: occasional in grassland and by paths.

Anisantha sterilis (L.) Nevski, Barren Brome: occasional by paths. A very large form, with flowers at the upper limit of the range for this species, occurs beside the river path under scrub.

Elytrigia repens (L.) Desv., Common Couch: occasional in swamps and by paths throughout. It is abundant in the sward within the oxbow lake (C18A) where some of the plants have very long awns – up to 10 mm, sometimes. It is not, however, *E. canina*, as the anthers are too long (c. 5 mm) and the plants are not tufted.

Hordeum secalinum Schreb., Meadow Barley: abundant in meadows. This is the most characteristic species of the old, unimproved fields. It is a plant of coastal pastures and it is particularly abundant on the London clay where salt marshes have been drained and improved for agriculture.

Phragmites australis (Cav.) Trin. ex Steudel, Common Reed: abundant throughout, mainly in fields that have been deliberately flooded to encourage its growth. Historically, it would have been largely confined to the ditches, and even there it would have been strictly controlled to keep the ditches flowing, but when the lakes formed as a result of subsidence in the 1920s, it became locally abundant and was soon colonised by characteristic bird species such as bitterns and reed warblers.

Changes in the flora

It is rarely easy to be precise about changes in the flora of a site or an area. Large scale conversion of habitat to farmland of course makes an obvious difference but, in the case of a site like Stodmarsh, the gradual spread of trees, the inadvertent and deliberate flooding of farmland to create reedbeds and lakes, and the relaxation of farming practices, makes for a gradual transition that is difficult to document.

A few key changes stand out. A hundred years ago, Stodmarsh had little reedbed, no lakes and few trees. As far as we can tell, it was all fairly intensively grazed grassland with regularly cleared drainage ditches between the fields. Wild animals were trapped or shot, apparently leaving little wildlife (although, despite this, it was still apparently a 'Mecca' for birdwatchers). Here I have attempted to trace how these large-scale habitat changes are reflected in the species composition. The table below lists all the species recorded at Stodmarsh by date class, using the records from the mid-19th century onwards.

Excluding hybrids, difficult plants and casuals, we can identify some 89 species which appear to have arrived at Stodmarsh in the last few decades, and some 25 that seem to have gone. Dividing these up by the 13 habitat types described above, these occur as follows.

It seems unlikely that the (1) rivers have gained any species, as both *Callitriche obtusangula* and *Sagittaria sagittifolia* were probably just overlooked previously (the latter mistaken for *Sparganium emersum*). However, there has been one loss: *Oenanthe fluviatilis*. This occurs upstream at Canterbury, where the river is shallow and clear, but it would seem unlikely in the Stodmarsh reaches, where the water is deep and murky. The reason for this could be that the coal mine subsidence changed the way sediment accumulates in this part of the river (see appendix 2 for details). On a positive note, it turned up in a ditch at Higham Farm (outside the NNR) in 2022, which shows that it would quickly recolonise if the river habitat was restored.

The (2) subsidence lakes appear to offer little to the ecology of the area, as very few species have been recorded in them. *Phragmites australis* and *Typha angustifolia* thrive on the margins, but those species are also present elsewhere. The (3) artificial ponds, on the other hand, do seem to have added a few plants to the site list (no losses, of course, as there were no such ponds in the past). The most obvious of the gains is *Crassula helmsii*, which occurs in all of the birdwatching ponds and is presumably spread by wild fowl. Until recently this was its only habitat within the site, and I suspected this might be due to enrichment of the ponds by bird droppings, but in the last year or two *Crassula* has expanded into numerous ditches as well. *Ranunculus aquatilis*, *R. peltatus* and *R. trichophyllus* are all additions which occur mainly in the ponds. They are difficult to identify and sporadic in appearance, and could have been overlooked previously, but I suspect that these shallow pools are particularly favourable to them.

The (4 & 5) open and clogged ditches do seem to have suffered some serious losses. *Groenlandia densa*, *Potamogeton perfoliatus*, *Ranunculus lingua*, *Stellaria palustris* and *Wolffia arrhiza* are all axiophytes (the pondweed, however, might have been in the river). These do point to a change of habitat, possibly less brackish conditions, as *G. densa*, *R. lingua* and *W. arrhiza* all seem to be associated with coastal habitats in Kent. A population of *R. lingua* was recently found at Hoplands Farm, on the other side of the river. This shows how consistent management of the meadows there has conserved a species that was lost in the NNR because of succession to reedbed or swamp. The apparent gains are less certain. *Carex acuta* and *Potamogeton trichoides* could very easily have been overlooked, and only *Lemna minuta* seems to be a real gain. As with some of the other gains, it is an introduced species.

Wet and dry reedbeds (6 & 7) offer little opportunity for either gains or losses, given the small number of species that occur therein. The arrival of *Sonchus palustris* in the 1990s is the only real change.

There is good reason to believe that (8) the meadows have changed significantly since the reserve was created. If the records are to be believed, a dozen species have been lost, most of them axiophytes. *Anacamptis morio*, *Dactylorhiza fuchsii* and *Montia fontana* are plants of dry grassland. The rest, *Carex leporina*, *C. rostrata*, *Comarum palustre*, *Eleocharis uniglumis*, *Eriophorum angustifolium*, *Juncus subnodulosus*, *Menyanthes trifoliata* and *Oenanthe lachenalii* are plants of base-rich mires. It is a shocking change to the reserve to have lost this entire habitat. In all probability, it is now submerged under reedbed. Given that there is so much land between Fordwich and Grove Ferry that could have been used instead, and the destruction of the Stodmarsh fen can only be described as a disastrous miscalculation for nature conservation in Kent. In more recent times, however, some of the lost ground has been made up. The fields at the SE end of the reserve were described as improved

grassland in the 1990s. This is where *Juncus acutiflorus*, *Potamogeton coloratus* and *Veronica scutellata* have been spotted as additions to the reserve list. In drier areas, *Anacamptis pyramidalis*, *Carex flacca* and possibly *Ophioglossum vulgatum* have been found recently. Whether *Crepis capillaris*, *Dactylorhiza praetermissa*, *Epilobium parviflorum*, *Galeopsis bifida* and *Glyceria declinata* are really additions or were just previously overlooked is uncertain.

Paths (9) have had a significant effect on the turnover of species, with four losses (*Allium vineale*, *Atropa belladonna*, *Scleranthus annuus* and *Spergularia marina*) and dozens of gains, many of which are purely temporary. The more persistent ones are *Bromus racemosus*, *Cardamine flexuosa*, *C. hirsuta*, *Cerastium glomeratum*, *Cichorium intybus*, *Daucus carota*, *Epilobium ciliatum*, *Erigeron floribundus*, *E. sumatrensis*, *Ervum tetraspermum*, *Festuca ovina*, *Fragaria ananassa*, *Geranium pusillum*, *G. rotundifolium*, *Gnaphalium uliginosum*, *Hypericum perforatum*, *Iris foetidissima*, *Lipandra polysperma*, *Lolium* x*boucheanum*, *Lotus corniculatus* var. *sativus*, *Lysimachia arvensis*, *Myosotis arvensis*, *Pentaglottis sempervirens*, *Picris hieracioides*, *Plantago coronopus*, *Senecio inaequidens*, *Silaum silaus*, *Smyrnium olusatrum*, *Spergularia rubra*, *Symphytum orientale*, *S.* x*uplandicum*, *Trifolium campestre* and *Veronica arvensis*. Some of these are quite abundant and have a significant effect on the ecology of the reserve, but few would persist if the traditional field management was reinstated throughout.

Hedges (10) are also a major cause of change within the site. Except on the very edges of the reserve, they are all fairly recent in origin and have been either deliberately planted or allowed to develop along the side of paths and ditches. Gains to the site list in this habitat include *Acer platanoides*, *Arctium minus*, *Arum italicum*, *Asplenium scolopendrium*, *Calystegia silvatica*, *Circaea lutetiana*, *Corylus maxima*, *Crataegus laevigata*, *Crataegus persimilis*, *Digitalis purpurea*, *Dryopteris dilatata*, *D. filix-mas*, *Epipactis helleborine*, *Euonymus europaeus*, *Juglans regia*, *Lapsana communis*, *Malus* x*purpurea*, *Malva sylvestris*, *Poa nemoralis*, *Polystichum setiferum*, *Prunus avium*, *P. cerasifera*, *Pyrus communis*, *Quercus cerris*, *Rosa arvensis*, *Salix caprea*, *S. purpurea*, *Salix triandra*, *Sorbus aucuparia*, *Taxus baccata*, *Ulmus glabra*, *U. procera* & *Vinca minor*. Among these additions are several which reflect a general transition from brackish grazing marsh to dry woodland as a consequence of the increasingly effective flood defences.

Willow scrub (11) is so species-poor that there are no losses or additions, although in places it is obvious that *Salix viminalis* and *S. atrocinerea* have expanded enormously. The (12) Alder carr, however, has the potential to transform the vegetation of the reserve. The woodland at the very western end is fairly old and natural, but within the floodplain it is all new. The only definite gain so far is *Dryopteris carthusiana*, but arguably *Urtica galeopsifolia* and *Myosotis* x*suzae* are beneficiaries of the spread of this type of woodland.

There has been more turnover in the plants of the riverbanks and riparian woodland (13). The losses are *Carex paniculata*, *Rorippa sylvestris* and *Symphytum officinale*, although there is still *C. paniculata* at Higham Farm and on the opposite side of the river (still within the SSSI). The decline of *S. officinale* in Kent is a bit of a mystery, but in the Stodmarsh area could be linked to the increase in shade along the riverbanks. Gains in the riparian vegetation include *Rorippa amphibia*, *Stellaria aquatica* and *Symphyotrichum laeve*. Perhaps the most likely explanation of these changes is simply that there must be a natural rate of turnover within any smallish area, so the three losses are balanced by the same number of gains, although one of the gains is a non-native.

Ellenberg Indicator Values

British plants have been assigned values by Hill *et al*. (1999), building on work by the German ecologist Heinz Ellenberg, which reflect how each species favours a particular level of light (L), moisture (F), acidity (R), fertility (N) and salinity (S). As the species present at Stodmarsh change over time, large-scale trends in the ecosystem, such as increasing levels of fertility caused by atmospheric deposition or surface water contamination, can be detected by examining the Indicator Values of the plants.

In the analyses below, I have used tables to present a visualisation of the data in order to see if any trends stand out. Readers might wonder whether a formal statistical analysis would be more appropriate, but the data was not collected for the purpose of addressing a hypothesis, and if you simply run multiple tests on such a data set, any apparently significant results are likely to be meaningless. A better process is to inspect the data to see if any trends stand out, formulate a hypothesis to explain any such observations, and only subsequently to design an experiment to formally test that hypothesis.

Light

In an analysis of Light (L) values, Stodmarsh has never had any plants of dense shade (values 1-3: habitats with less than 5% illumination) but it does have some (17 species) with L = 4. The mean of the year of the first record

of these species is 1998 (range: 2015-2021), which is consistent with the observation above that the woodland has expanded dramatically in recent decades. The corresponding average dates for plants of increasing light tolerance are progressively earlier so that, for L = 8 plants (greater than 40% illumination) the typical first record was in 1975 (n = 85, range: 1875-2019). There are only two L = 9 plants (*Schoenoplectus tabernaemontani* and *Arctium lappa*), which were found in 1899 and 1978, respectively.

The same analysis for dates of the most record produces a less obvious trend, with fairly recent numbers for all categories. This agrees with the analysis above that shows that most species have been effectively conserved within the reserve. There is, however, some indication that the more shade-intolerant plants may be declining, as the average date of the last record for L = 8 plants is as long ago as 2009, before the current survey began.

Ellenberg Value for L	Average first record	Average last record
4	1998	2017
5 (semi-shade)	1983	2015
6	1981	2016
7 (well-lit places)	1965	2014
8	1975	2009
9 (full sunlight)	1939	2018

Fertility

There is (was) only one plant (*Eriophorum angustifolium*) at Stodmarsh with an N (for Nitrogen, indicative of overall fertility) value of 1, which is typical of ombrotrophic mires. One plant does not make a general trend, and we know from the analysis above that the fen was destroyed sometime in the mid- to late-20th century. There are, however, more N = 2 plants (n = 8, range: 1958-2021), which gives us more data to work with. Two of these (*Juncus acutiflorus*, *Spergularia rubra*) have turned up for the first time very recently, and there is good reason to think that these are genuine gains. This demonstrates that there is still plenty of low-nutrient habitat within the reserve, in the grassland and the swamps. No plants of eutrophicated or polluted habitats have arrived. There is no obvious suggestion of any losses due to a change in trophic levels, either.

The conclusion from this analysis is that there has been no trend towards a generally more enriched environment at Stodmarsh. This runs counter to the generally prevailing conditions, whereby atmospheric deposition, fertiliser runoff and pollution of rivers from sewage outflows has led to diffuse eutrophication of the countryside.

Ellenberg Value for N	Average first record	Average last record
1 (extremely infertile)	1949	1949
2	1982	2011
3	1974	2007
4	1968	2013
5 (intermediate fertility)	1978	2014
6	1974	2015
7 (richly fertile)	1964	2015
8	1970	2009
9 (extremely rich, polluted)	1978	2015

Moisture

In contrast to the results for fertility, moisture (F, from the German Feuchtigkeit) seems to show some obvious trends. There is a very clear progression for the dates of first records, from the aquatics (F = 12) in the 1920s (n = 20, range: 1839-2015) through to the plants of dry (F = 3) ground in the 1990s (n = 3, range: 1978-2019). This could well include some element of bias, as early botanists would not have bothered to make a note of dry ground species such as *Vulpia myuros*. On the other hand, there is no indication whatsoever that the aquatics have been disappearing, as the dates of last record do not change across the spectrum of tolerances. This fits in well with what we know about the site, where wetland has been maintained and expanded, while raised paths have also been constructed.

Ellenberg Value for F	Average first record	Average last record
3 (dry ground)	1992	2017
4	1991	2015
5 (moist soils)	1986	2016
6	1989	2016
7 (constantly damp)	1958	2012

8	1961	2010
9 (saturated ground)	1970	2007
10	1949	2012
11 (under water)	1939	2017
12	1923	2012

Reaction

The acidity or alkalinity of the water and soils in a site are reflected by the R value associated with the plants that are present. There is an important distinction here between a direct measurement of pH and the R value assigned to a species, which reflects how the plant responds to a changing acidity over time. In some ways, R is more informative than any one measure of pH.

The table seems to show nothing of any significance. What looks at first sight to be the recent appearance of a highly acid habitat (R = 3) turns out to be merely the arrival of *Sorbus aucuparia*, a tree that naturally occurs in acid woodland, but which has been spreading throughout the country recently. The rather anomalous date for the last record of fairy acidophilous species (R = 4) is due to the disappearance of the patch of mire habitat which had *Menyanthes trifoliata*, *Eriophorum angustifolium* and *Carex rostrata* in the 1940s. Otherwise, this category is not exceptional (n = 14, range: 1947-2021).

Ellenberg Value for R	Average first record	Average last record
3 (acidic soils)	2016	2016
4	1977	1998
5 (neutral soils)	1973	2014
6	1971	2016
7 (weakly basic)	1971	2015
8	1974	2006

Salt

The last of the Ellenberg Values, salt tolerance (S) (NB continentality and temperature are not used in Britain) is particularly intriguing. Some of the key features of Stodmarsh, as explained elsewhere in this report, are derived from former saltmarsh and coastal grazing marsh habitats. The majority of plants in Britain have an EV of 0 for salt tolerance, which means they do not really tolerate any salinity in their soil. Of the 359 species analysed here, 299 are S = 0 plants.

Only one has S = 5, which is *Spergularia marina*, which I believe was a casual on the Lampen Wall from 1978 to 1987. The only one with S = 4 is *Bolboschoenus maritimus*, which has been known here for decades and which is still widespread in the ditches. The S = 3 plants are the most interesting, because these are the ones derived from the coastal habitat. There are 7 species (*Eleocharis uniglumis*, *Oenanthe lachenalii*, *Carex distans*, *Juncus gerardii*, *Lepidium latifolium*, *Carex divisa* and *Schoenoplectus tabernaemontani*). The latter 5 are still present. Groups 1 & 2 contain 52 species that have some tolerance of salt. By and large they are all still present. What is most significant about this analysis is that there is no evidence of any transition towards a more freshwater habitat, which suggests that the sea still has a strong influence on the water quality, albeit through a mechanism that is not obvious.

Ellenberg Value for S	Average first record	Average last record
0 (absent from saline sites)	1976	2014
1 (tolerant of some salt)	1952	2016
2	1957	2019
3 (mostly coastal)	1955	1996
4 (brackish)	1963	2021
5 (upper saltmarsh)	1978	1987

Changes in the ditches

By the standards of site monitoring exercises, Stodmarsh has fairy thorough data on its ditches. Structured surveys have been taking place since 1989 using techniques that are reasonably comparable. The main ones are summarised. The variations between the ditches are due to the extent of the surveys (whether banks were included), which ditches were visited (dry, clogged or open ones), and the sampling technique (whole ditch or just a short section).

Summary data	1989	1996	1998	2019	2021
No. of ditches	27	136	67	27	33
No. of species	95	80	48	69	83
No. of records	793	1,362	516	240	571
No. of spp./ditch	29	10	8	9	17

The ditches are important for their aquatic plants and conserving or increasing the rarities is one of the main aims of the ditch maintenance and enhancement programme. Examining how this has worked for a number of key aquatics gives the results below. The data is not sufficiently rigorous to treat the numbers as anything other than a general indication of the status of a species across time, but it certainly seems to show that the aims of the dredging operations are being met. Most of the rarities are at least as abundant now as they were thirty years ago. Exceptions include *Stuckenia pectinata* (*Potamogeton pectinatus*), which has become rather rare, and *Hippuris vulgaris*, which is still abundant in some places, but not usually in ditches. The most important plant, *Potamogeton acutifolius*, is clearly thriving.

Key species	1989	1996	1998	2019	2021
Potamogeton acutifolius	3	6	0	2	14
Potamogeton friesii	6	7	13	1	7
Myriophyllum verticillatum	16	8	0	4	15
Bolboschoenus maritimus	6	20	0	2	5
Utricularia vulgaris	3	1	0	1	6
Alisma lanceolatum	0	5	5	0	10
Oenanthe fistulosa	12	46	4	3	16
Samolus valerandi	3	11	8	8	12
Stuckenia pectinata	1	7	7	0	0
Hippuris vulgaris	9	11	0	0	1
Equisetum fluviatile	11	15	0	0	7
Hydrocharis morsus-ranae	26	65	14	13	25
Ranunculus circinatus	0	3	2	1	3

The most troublesome plants in the ditches are the tall emergent species which of course clog up the watercourse and can eventually shade out all competition. However, it is difficult to assess whether the ditches are overgrown, from the surveys, because abundance data is largely lacking. Even where surveyors have recorded this information, 'abundant' could indicate a problem quantity or simply many plants, so the state of the ditch remains uncertain. On the other hand, there are a few non-native problem species, which are listed below. They don't seem to show any real trend, except perhaps that the waterweeds (Elodea spp.) are unevenly recorded and that *Crassula helmsii* appears to have spread in recent years. Although *Azolla* has not been recorded in these surveys, it is still present in a few ditches.

Negative indicators	1989	1996	1998	2019	2021
Azolla filiculoides	8	0	0	0	0
Crassula helmsii	0	0	0	0	6
Elodea canadensis	0	0	0	2	10
Elodea nuttallii	23	25	27	8	22
Lemna minuta	0	4	0	1	4

There have been some resurveys of individual ditches, but the variation in the results is very large. This is due in part because of the differing scope of the surveys. All surveyors have attempted to identify the fully aquatic plants, but emergents, marginal species and bankside plants have been inconsistently surveyed, which results in huge differences in the number of species listed. The analysis is better if restricted to the axiophytes, which are mostly wetland plants and which would be more likely to be included than commoner species. Nevertheless, there is still quite wide variation depending on the sample size (length of ditch surveyed), the ease of access and the state of the ditch. It is very difficult to adequately sample water plants in a ditch which is clogged with *Phragmites* or *Hydrocharis*. Some of this variation is of course what one would want to measure in a comparison across time, and it is likely that many species would return to a ditch following clearance. This appears to be what has happened in D55, for example, which was species-rich in 1989 but deteriorated in the 1990s (either dry or clogged, most likely), and which has been largely restored by 2021.

Number of axiophytes per ditch

(Showing only the most species-rich ditches from each survey)

Best ditches	1989	1996	1998	2019	2021
D55 (C17)	16	5	4	-	12
D28 (C15)	16	10	2	-	-
D65 (C17)	-	10	2	-	12
D51 (C16)	-	7	5	-	6
D157 (C52)	-	1	5	-	-
D99 (C22)	-	1	-	8	-
D58 (C16)	-	4	-	-	17
D17.3 (C17)	-	-	-	3	15

To get a better picture of how the ditches vary in time – whether particular species are consistently or repeatedly present, or how the management regime affects species-richness – we would need considerably more resurveys of the ditches than we have at present and, ideally, at more frequent intervals.

Species recorded by date class

Date classes: 1 = 1839-1969 (Hanbury & Marshall & Francis Rose)
2 = 1970-1979 (Philp's first Atlas & Forbes's Checklist)
3 = 1980-2009 (Philp's 2nd Atlas & Williams's ditch survey)
4 = 2010-2023 (KBRG records & the current survey)

Species	Common Name	Status	DC1	DC2	DC3	DC4
Acer campestre	Field Maple	-	-	1	-	1
Acer platanoides	Norway Maple	-	-	-	-	1
Acer pseudoplatanus	Sycamore	-	-	1	1	1
Achillea millefolium	Yarrow	-	-	1	1	1
Adoxa moschatellina	Moschatel	axiophyte	-	1	1	1
Agrimonia eupatoria	Agrimony	-	-	1	-	1
Agrostis capillaris	Common Bent	-	-	1	1	1
Agrostis stolonifera	Creeping Bent	-	-	1	1	1
Alisma lanceolatum	Narrow-leaved Water-plantain	axiophyte	1	1	1	1
Alisma plantago-aquatica	Water-plantain	-	1	1	1	1
Alliaria petiolata	Garlic Mustard	-	-	1	1	1
Allium vineale	Wild Onion	-	1	-	-	-
Alnus glutinosa	Alder	-	-	1	1	1
Alopecurus geniculatus	Marsh Foxtail	-	1	1	1	1
Alopecurus pratensis	Meadow Foxtail	-	-	1	1	1
Anacamptis morio	Green-winged Orchid	axiophyte	1	-	-	-
Anacamptis pyramidalis	Pyramidal Orchid	axiophyte	-	-	-	1
Angelica sylvestris	Wild Angelica	-	-	1	1	1
Anisantha sterilis	Barren Brome	-	-	1	1	1
Anthoxanthum odoratum	Sweet Vernal Grass	-	-	-	1	1
Anthriscus sylvestris	Cow Parsley	-	-	1	1	1
Arctium lappa	Greater Burdock	-	-	1	1	1
Arctium minus	Lesser Burdock	-	-	-	-	1
Armoracia rusticana	Horseradish	-	-	1	1	1
Arrhenatherum elatius	False Oat-grass	-	-	1	1	1
Artemisia vulgaris	Mugwort	-	-	1	1	1
Arum italicum	Italian Lords-and-ladies	-	-	-	-	1
Arum maculatum	Lords-and-ladies	-	-	1	1	1
Asparagus officinalis	Asparagus	-	1	-	1	1
Asplenium scolopendrium	Hart's-tongue	-	-	-	-	1
Atriplex prostrata	Spear-leaved Orache	-	-	1	1	1
Atropa belladonna	Deadly Nightshade	axiophyte	-	1	1	-
Avena fatua	Wild Oat	-	-	1	1	1
Azolla filiculoides	Water Fern	-	1	1	1	1
Baldellia ranunculoides	Lesser Water-plantain	axiophyte	1	1	1	1
Ballota nigra	Black Horehound	-	-	1	1	1
Barbarea vulgaris	Winter-cress	-	-	1	-	1
Bellis perennis	Daisy	-	-	1	1	1
Berula erecta	Lesser Water-parsnip	axiophyte	-	1	1	1
Betula pendula	Silver Birch	-	-	1	-	1
Bidens cernua	Nodding Bur-marigold	axiophyte	-	1	-	1
Bidens tripartita	Trifid Bur-marigold	axiophyte	-	1	1	1
Bolboschoenus maritimus	Sea Club-rush	axiophyte	1	1	1	1
Brachypodium sylvaticum	False-brome	-	-	1	-	1
Brassica nigra	Black Mustard	-	-	1	-	1
Brassica rapa	Wild Turnip	-	-	1	-	1
Bromus hordeaceus	Soft-brome	-	-	1	1	1
Bromus racemosus	Smooth Brome	-	-	-	-	1
Buddleja davidii	Butterfly-bush	-	-	1	1	1
Butomus umbellatus	Flowering Rush	axiophyte	1	1	1	1
Callitriche obtusangula	Blunt-fruited Water-starwort	-	1	1	1	1
Callitriche platycarpa	Various-leaved Water-starwort	-	-	-	-	1
Callitriche stagnalis	Common Water-starwort	-	1	-	1	1
Caltha palustris	Marsh Marigold	axiophyte	-	1	1	1
Calystegia sepium	Hedge Bindweed	-	-	1	1	1
Calystegia silvatica	Large Bindweed	-	-	-	-	1
Calystegia x lucana	Large x Hedge Bindweed	-	-	-	-	1
Capsella bursa-pastoris	Shepherd's-purse	-	-	1	1	1
Cardamine flexuosa	Wavy Bitter-cress	-	-	-	-	1
Cardamine hirsuta	Hairy Bitter-cress	-	-	-	-	1
Cardamine pratensis	Cuckooflower	-	-	1	1	1
Carex acuta	Slender Tufted-sedge	axiophyte	-	-	-	1
Carex acutiformis	Lesser Pond-sedge	-	1	1	1	1

Carex distans	Distant Sedge	axiophyte	-	-	1	1
Carex disticha	Brown Sedge	axiophyte	1	1	1	1
Carex divisa	Divided Sedge	axiophyte	1	-	1	1
Carex divulsa	Grey Sedge	-	1	-	-	1
Carex flacca	Glaucous Sedge	-	-	-	-	1
Carex hirta	Hairy Sedge	-	-	1	1	1
Carex leporina	Oval Sedge	-	1	-	-	-
Carex otrubae	False Fox-sedge	-	1	1	1	1
Carex paniculata	Greater Tussock-sedge	axiophyte	1	-	-	-
Carex pendula	Pendulous Sedge	-	1	-	1	-
Carex remota	Remote Sedge	axiophyte	1	-	-	1
Carex riparia	Greater Pond-sedge	-	-	1	1	1
Carex rostrata	Bottle Sedge	axiophyte	1	-	-	-
Centaurea nigra	Common Knapweed	-	-	1	1	1
Cerastium fontanum	Common Mouse-ear	-	-	1	1	1
Cerastium glomeratum	Sticky Mouse-ear	-	-	-	-	1
Ceratophyllum demersum	Rigid Hornwort	-	1	1	1	1
Chamaenerion angustifolium	Rosebay Willowherb	-	-	1	-	1
Chara globularis	Fragile Stonewort	axiophyte	-	-	-	1
Chara hispida	Bristly Stonewort	axiophyte	-	-	-	1
Chara vulgaris	Common Stonewort	axiophyte	1	1	1	1
Chenopodium album	Fat-hen	-	-	1	1	1
Cichorium intybus	Chicory	-	-	-	-	1
Circaea lutetiana	Enchanter's-nightshade	-	-	-	-	1
Cirsium arvense	Creeping Thistle	-	-	1	1	1
Cirsium vulgare	Spear Thistle	-	-	1	1	1
Clematis vitalba	Traveller's Joy	-	-	1	1	1
Comarum palustre	Marsh Cinquefoil	-	1	1	-	-
Conium maculatum	Hemlock	-	-	1	1	1
Convolvulus arvensis	Field Bindweed	-	-	1	1	1
Cornus sanguinea	Dogwood	-	-	1	1	1
Corylus avellana	Hazel	-	-	1	-	1
Corylus maxima	Filbert	-	-	-	-	1
Crassula helmsii	New Zealand Pigmyweed	-	-	-	1	1
Crataegus laevigata	Midland Hawthorn	axiophyte	-	-	-	1
Crataegus monogyna	Hawthorn	-	-	1	1	1
Crataegus persimilis	Broad-leaved Cockspur-thorn	-	-	-	-	1
Crepis capillaris	Smooth Hawk's-beard	-	-	1	1	1
Crepis vesicaria	Beaked Hawk's-beard	-	-	1	-	1
Cynosurus cristatus	Crested Dog's-tail	-	-	1	1	1
Dactylis glomerata	Cock's-foot	-	-	1	1	1
Dactylorhiza fuchsii	Common Spotted-orchid	-	1	-	-	-
Dactylorhiza praetermissa	Southern Marsh-orchid	-	-	-	-	1
Daucus carota	Wild Carrot	-	-	-	-	1
Digitalis purpurea	Foxglove	-	-	-	-	1
Dipsacus fullonum	Wild Teasel	-	1	1	1	1
Dryopteris carthusiana	Narrow Buckler-fern	axiophyte	-	-	-	1
Dryopteris dilatata	Broad Buckler-fern	-	-	-	1	1
Dryopteris filix-mas	Common Male Fern	-	-	-	-	1
Eleocharis palustris	Common Spike-rush	axiophyte	1	1	1	1
Eleocharis uniglumis	Slender Spike-rush	axiophyte	1	-	-	-
Elodea canadensis	Canadian Waterweed	-	1	1	1	1
Elodea nuttallii	Nuttall's Water-weed	-	-	1	1	1
Elymus repens	Common Couch	-	1	1	1	1
Epilobium ciliatum	American Willowherb	-	-	-	-	1
Epilobium hirsutum	Great Willowherb	-	-	1	1	1
Epilobium parviflorum	Hoary Willowherb	-	-	-	-	1
Epilobium tetragonum	Square-stalked Willowherb	-	1	-	-	1
Epipactis helleborine	Broad-leaved Helleborine	-	-	-	-	1
Equisetum arvense	Field Horsetail	-	-	1	1	1
Equisetum fluviatile	Water Horsetail	axiophyte	-	1	1	1
Equisetum palustre	Marsh Horsetail	axiophyte	1	1	1	1
Erigeron floribundus	Bilbao's Fleabane	-	-	-	-	1
Erigeron sumatrensis	Guernsey Fleabane	-	-	-	-	1
Eriophorum angustifolium	Common Cottongrass	axiophyte	1	-	-	-
Ervum tetraspermum	Smooth Tare	-	-	-	1	1
Euonymus europaeus	Spindle	-	-	-	-	1
Eupatorium cannabinum	Hemp-agrimony	-	-	1	1	1
Fallopia convolvulus	Black Bindweed	-	-	1	1	1
Festuca ovina	Sheep's Fescue	-	-	-	-	1
Festuca rubra	Red Fescue	-	-	1	1	1

Ficaria verna	Lesser Celandine	-	-	1	1	1
Filipendula ulmaria	Meadowsweet	-	-	1	1	1
Fragaria ananassa	Garden Strawberry	-	-	-	-	1
Fraxinus excelsior	Ash	-	-	1	1	1
Galeopsis bifida	Bifid Hemp-nettle	-	-	-	-	1
Galium album	Hedge Bedstraw	-	-	1	-	1
Galium aparine	Cleavers	-	-	1	1	1
Galium palustre	Common Marsh-bedstraw	-	1	1	1	1
Geranium dissectum	Cut-leaved Crane's-bill	-	-	1	1	1
Geranium molle	Dove's-foot Crane's-bill	-	-	1	-	1
Geranium pusillum	Small-flowered Crane's-bill	-	-	-	1	1
Geranium robertianum	Herb-robert	-	-	-	-	1
Geum urbanum	Wood Avens	-	-	1	1	1
Glechoma hederacea	Ground-ivy	-	-	1	1	1
Glyceria declinata	Small Sweet-grass	axiophyte	-	-	-	1
Glyceria fluitans	Floating Sweet-grass	-	-	1	1	1
Glyceria maxima	Reed Sweet-grass	-	1	1	1	1
Glyceria notata	Plicate Sweet-grass	axiophyte	-	1	1	1
Gnaphalium uliginosum	Marsh Cudweed	-	-	-	-	1
Groenlandia densa	Opposite-leaved Pondweed	axiophyte	1	-	-	-
Hedera helix	Ivy	-	-	1	1	1
Helminthotheca echioides	Bristly Oxtongue	-	-	1	1	1
Helosciadium nodiflorum	Fool's Watercress	-	-	1	1	1
Heracleum sphondylium	Hogweed	-	-	1	1	1
Hippuris vulgaris	Mare's-tail	axiophyte	1	1	1	1
Hirschfeldia incana	Hoary Mustard	-	-	1	-	1
Holcus lanatus	Yorkshire-fog	-	-	1	1	1
Hordeum secalinum	Meadow Barley	-	-	1	1	1
Humulus lupulus	Hop	-	-	1	1	1
Hyacinthoides non-scripta	Bluebell	-	-	1	1	1
Hydrocharis morsus-ranae	Frogbit	axiophyte	1	1	1	1
Hydrocotyle vulgaris	Marsh Pennywort	axiophyte	1	-	1	1
Hypericum perforatum	Perforate St John's-wort	-	-	-	-	1
Hypericum tetrapterum	Square-stalked St John's-wort	-	1	-	1	1
Hypochaeris radicata	Cat's-ear	-	-	1	1	1
Iris foetidissima	Stinking Iris	-	-	-	-	1
Iris pseudacorus	Yellow Iris	-	1	1	1	1
Jacobaea erucifolia	Hoary Ragwort	-	-	1	1	1
Jacobaea vulgaris	Ragwort	-	-	1	1	1
Juglans regia	Walnut	-	-	-	-	1
Juncus acutiflorus	Sharp-flowered Rush	axiophyte	-	-	-	1
Juncus articulatus	Jointed Rush	-	1	1	1	1
Juncus bufonius	Toad Rush	-	1	1	1	1
Juncus conglomeratus	Compact Rush	-	-	1	-	1
Juncus effusus	Soft-rush	-	1	1	1	1
Juncus gerardii	Saltmarsh Rush	axiophyte	1	1	1	1
Juncus inflexus	Hard Rush	-	-	1	1	1
Juncus subnodulosus	Blunt-flowered Rush	axiophyte	1	1	-	-
Lactuca virosa	Greater Lettuce	-	-	1	-	1
Lamium album	White Dead-nettle	-	-	1	1	1
Lamium purpureum	Red Dead-nettle	-	-	1	1	1
Lapsana communis	Nipplewort	-	-	-	-	1
Lathyrus nissolia	Grass Vetchling	-	-	1	1	1
Lathyrus pratensis	Meadow Vetchling	-	-	1	1	1
Lemna gibba	Fat Duckweed	-	1	1	1	1
Lemna minor	Common Duckweed	-	1	1	1	1
Lemna minuta	Least Duckweed	-	-	-	1	1
Lemna trisulca	Ivy-leaved Duckweed	-	1	1	1	1
Leontodon saxatilis	Lesser Hawkbit	-	-	-	1	1
Lepidium coronopus	Swine-cress	-	-	1	1	1
Lepidium draba	Hoary Cress	-	-	1	1	1
Lepidium latifolium	Dittander	-	-	1	1	1
Leucanthemum vulgare	Oxeye Daisy	-	-	1	1	1
Ligustrum vulgare	Wild Privet	-	-	1	-	1
Lipandra polysperma	Many-seeded Goosefoot	-	-	-	-	1
Lolium perenne	Perennial Rye-grass	-	-	1	1	1
Lolium x boucheanum	Hybrid Rye-grass	-	-	-	-	1
Lonicera periclymenum	Honeysuckle	-	-	1	-	1
Lotus corniculatus	Common Bird's-foot-trefoil	-	-	1	1	1
Lotus corniculatus var. sativus	a bird's-foot-trefoil	-	-	-	-	1
Lotus pedunculatus	Greater Bird's-foot-trefoil	-	-	1	-	1

Lotus tenuis	Narrow-leaved Bird's-foot-trefoil	axiophyte	1	1	1	1
Lycopus europaeus	Gipsywort	-	1	1	1	1
Lysimachia arvensis	Scarlet Pimpernel	-	-	-	1	1
Lysimachia nummularia	Creeping-Jenny	axiophyte	1	1	1	1
Lysimachia vulgaris	Yellow Loosestrife	axiophyte	-	1	1	1
Lythrum salicaria	Purple-loosestrife	-	-	1	1	1
Malus domestica	Apple	-	-	1	-	1
Malus x purpurea	Purple Crab	-	-	-	-	1
Malva sylvestris	Common Mallow	-	-	-	1	1
Matricaria chamomilla	Scented Mayweed	-	-	1	1	1
Matricaria discoidea	Pineapple Weed	-	-	1	1	1
Medicago arabica	Spotted Medick	-	-	1	1	1
Medicago lupulina	Black Medick	-	-	1	1	1
Mentha aquatica	Water Mint	-	-	1	1	1
Menyanthes trifoliata	Bogbean	axiophyte	1	-	-	-
Montia fontana	Blinks	axiophyte	1	-	-	-
Myosotis arvensis	Field Forget-me-not	-	-	-	-	1
Myosotis laxa	Tufted Forget-me-not	axiophyte	-	1	1	1
Myosotis scorpioides	Water Forget-me-not	-	-	1	1	1
Myosotis x suzae	Water x Tufted Forget-me-not	-	-	-	-	1
Myriophyllum spicatum	Spiked Water-milfoil	-	1	1	-	1
Myriophyllum verticillatum	Whorled Water-milfoil	axiophyte	1	1	1	1
Narcissus 'Tahiti'	Narcissus 'Tahiti'	-	-	-	-	1
Narcissus 'Telamonius Plenus'	Narcissus 'Telamonius Plenus'	-	-	-	-	1
Nasturtium officinale	Watercress	-	-	1	1	1
Nitella flexilis	Smooth Stonewort	-	-	-	-	1
Nuphar lutea	Yellow Water-lily	-	-	1	1	1
Nymphaea alba	White Water-lily	-	1	1	1	1
Oenanthe aquatica	Fine-leaved Water-dropwort	axiophyte	1	-	1	1
Oenanthe crocata	Hemlock Water-dropwort	-	-	1	1	1
Oenanthe fistulosa	Tubular Water-dropwort	axiophyte	1	1	1	1
Oenanthe fluviatilis	River Water-dropwort	axiophyte	1	-	-	-
Oenanthe lachenalii	Parsley Water-dropwort	axiophyte	1	-	-	-
Ophioglossum vulgatum	Adder's-tongue	axiophyte	-	-	-	1
Oxybasis rubra	Red Goosefoot	-	-	-	1	1
Pentaglottis sempervirens	Green Alkanet	-	-	-	-	1
Persicaria amphibia	Amphibious Bistort	-	-	1	1	1
Persicaria hydropiper	Water-pepper	-	-	1	-	1
Persicaria lapathifolia	Pale Persicaria	-	-	1	1	1
Persicaria maculosa	Redshank	-	-	1	1	1
Phalaris arundinacea	Reed Canary-grass	-	-	1	1	1
Phleum bertolonii	Smaller Cat's-tail	-	-	-	1	1
Phleum pratense	Timothy	-	-	1	1	1
Phragmites australis	Common Reed	-	1	1	1	1
Picris hieracioides	Hawkweed Oxtongue	-	-	-	-	1
Pilosella officinarum	Mouse-ear-hawkweed	-	-	1	1	1
Plantago coronopus	Buck's-horn Plantain	-	-	-	-	1
Plantago lanceolata	Ribwort Plantain	-	-	1	1	1
Plantago major	Greater Plantain	-	-	1	1	1
Poa annua	Annual Meadow-grass	-	-	1	1	1
Poa infirma	Early Meadow-grass	-	-	-	-	1
Poa nemoralis	Wood Meadow-grass	axiophyte	-	-	-	1
Poa pratensis	Smooth Meadow-grass	-	-	1	-	1
Poa trivialis	Rough Meadow-grass	-	-	1	1	1
Polygonum aviculare	Knotgrass	-	-	1	1	1
Polygonum depressum	Equal-leaved Knotgrass	-	-	1	1	1
Polystichum setiferum	Soft Shield-fern	axiophyte	-	-	-	1
Populus x canadensis	Hybrid Black Poplar	-	-	1	-	1
Potamogeton acutifolius	Sharp-leaved Pondweed	axiophyte	1	1	1	1
Potamogeton berchtoldii	Small Pondweed	-	-	1	1	1
Potamogeton coloratus	Fen Pondweed	axiophyte	-	-	-	1
Potamogeton crispus	Curled Pondweed	-	1	1	1	1
Potamogeton friesii	Flat-stalked Pondweed	axiophyte	1	1	1	1
Potamogeton lucens	Shining Pondweed	axiophyte	1	1	1	1
Potamogeton natans	Broad-leaved Pondweed	-	1	1	1	1
Potamogeton perfoliatus	Perfoliate Pondweed	axiophyte	1	-	-	-
Potamogeton pusillus	Lesser Pondweed	-	1	-	1	1
Potamogeton trichoides	Hairlike Pondweed	axiophyte	-	-	1	1
Potentilla anserina	Silverweed	-	-	1	1	1
Potentilla reptans	Creeping Cinquefoil	-	-	1	1	1
Prunella vulgaris	Selfheal	-	-	1	-	1

Prunus avium	Wild Cherry	-	-	-	-	1
Prunus cerasifera	Cherry Plum	-	-	-	-	1
Prunus domestica	Wild Plum	-	-	1	1	1
Prunus spinosa	Blackthorn	-	-	1	1	1
Pulicaria dysenterica	Fleabane	-	-	1	1	1
Pyrus communis	Pear	-	-	-	-	1
Quercus cerris	Turkey Oak	-	-	-	-	1
Quercus robur	Pedunculate Oak	-	-	1	1	1
Ranunculus acris	Meadow Buttercup	-	-	1	1	1
Ranunculus aquatilis	Common Water-crowfoot	axiophyte	-	-	-	1
Ranunculus circinatus	Fan-leaved Water-crowfoot	axiophyte	1	1	1	1
Ranunculus flammula	Lesser Spearwort	axiophyte	-	1	-	1
Ranunculus lingua	Greater Spearwort	-	1	1	1	-
Ranunculus peltatus	Pond Water-crowfoot	axiophyte	-	-	-	1
Ranunculus repens	Creeping Buttercup	-	-	1	1	1
Ranunculus sardous	Hairy Buttercup	-	1	1	1	1
Ranunculus sceleratus	Celery-leaved Buttercup	-	-	1	1	1
Ranunculus trichophyllus	Thread-leaved Water-crowfoot	axiophyte	-	-	-	1
Reseda luteola	Weld	-	-	1	-	1
Ribes nigrum	Black Currant	axiophyte	-	1	-	1
Ribes rubrum	Red Currant	-	-	1	-	1
Rorippa amphibia	Great Yellow-cress	axiophyte	-	-	-	1
Rorippa palustris	Marsh Yellow-cress	axiophyte	-	1	1	1
Rorippa sylvestris	Creeping Yellow-cress	-	1	-	-	-
Rosa arvensis	Field Rose	-	-	-	-	1
Rosa canina	Dog Rose	-	-	1	1	1
Rubus fruticosus	Bramble	-	-	1	1	1
Rumex acetosa	Common Sorrel	-	-	1	1	1
Rumex conglomeratus	Clustered Dock	-	-	1	1	1
Rumex crispus	Curled Dock	-	-	1	1	1
Rumex hydrolapathum	Water Dock	axiophyte	-	1	1	1
Rumex obtusifolius	Broad-leaved Dock	-	-	1	1	1
Rumex pulcher	Fiddle Dock	-	-	-	-	1
Rumex sanguineus	Wood Dock	-	-	1	1	1
Rumex x schreberi	Water x Curled Dock	-	-	-	-	1
Sagittaria sagittifolia	Arrowhead	axiophyte	-	-	1	1
Salix alba	White Willow	-	-	1	1	1
Salix atrocinerea	Grey Willow	-	-	1	1	1
Salix caprea	Goat Willow	-	-	-	-	1
Salix purpurea	Purple Willow	-	-	-	1	1
Salix triandra	Almond Willow	-	-	-	-	1
Salix viminalis	Osier	-	-	1	1	1
Salix x fragilis	Crack-willow	-	-	1	1	1
Salix x holosericea	Silky-leaved Osier	-	-	-	-	1
Salix x mollissima	Sharp-stipuled Willow	-	-	-	-	1
Salix x quercifolia	Goat x Grey Willow	-	-	-	-	1
Salix x smithiana	Broad-leaved Osier	-	-	-	-	1
Sambucus nigra	Elder	-	-	1	1	1
Samolus valerandi	Brookweed	axiophyte	-	1	1	1
Schedonorus arundinaceus	Tall Fescue	-	-	1	1	1
Schoenoplectus lacustris	Common Club-rush	axiophyte	-	-	-	1
Schoenoplectus tabernaemontani	Grey Club-rush	axiophyte	1	1	1	1
Scleranthus annuus	Annual Knawel	axiophyte	1	-	-	-
Scorzoneroides autumnalis	Autumnal Hawkbit	-	-	1	1	1
Scrophularia auriculata	Water Figwort	-	-	1	1	1
Scutellaria galericulata	Skullcap	-	1	1	1	1
Senecio inaequidens	Narrow-leaved Ragwort	-	-	-	-	1
Senecio squalidus	Oxford Ragwort	-	-	1	-	1
Senecio vulgaris	Groundsel	-	-	1	1	1
Silaum silaus	Pepper-saxifrage	axiophyte	-	-	-	1
Silene dioica	Red Campion	-	-	1	1	1
Silene flos-cuculi	Ragged Robin	axiophyte	-	1	1	1
Silene x hampeana	Hybrid Campion	-	-	-	-	1
Sinapis arvensis	Charlock	-	-	1	1	1
Sison amomum	Stone Parsley	-	-	1	1	1
Sison segetum	Corn Parsley	axiophyte	-	1	-	1
Sisymbrium officinale	Hedge Mustard	-	-	1	1	1
Smyrnium olusatrum	Alexanders	-	-	-	-	1
Solanum dulcamara	Bittersweet	-	-	1	1	1
Sonchus arvensis	Perennial Sow-thistle	-	-	1	1	1
Sonchus asper	Prickly Sow-thistle	-	-	1	1	1

Sonchus oleraceus	Smooth Sow-thistle	-	-	1	1	1
Sonchus palustris	Marsh Sow-thistle	-	-	-	1	1
Sorbus aucuparia	Rowan	-	-	-	-	1
Sparganium emersum	Unbranched Bur-reed	axiophyte	-	-	1	1
Sparganium erectum	Branched Bur-reed	-	1	1	1	1
Spergularia marina	Lesser Sea-spurrey	-	-	1	1	-
Spergularia rubra	Sand Spurrey	axiophyte	-	-	-	1
Spirodela polyrhiza	Greater Duckweed	axiophyte	1	1	1	1
Stachys palustris	Marsh Woundwort	axiophyte	-	1	-	1
Stachys sylvatica	Hedge Woundwort	-	-	1	-	1
Stellaria aquatica	Water Chickweed	axiophyte	-	-	1	1
Stellaria holostea	Greater Stitchwort	-	-	1	1	1
Stellaria media	Chickweed	-	-	1	1	1
Stellaria palustris	Marsh Stitchwort	axiophyte	1	1	1	-
Stuckenia pectinata	Fennel Pondweed	-	1	1	1	1
Symphyotrichum laeve var. concinnum	Delicate Michaelmas-daisy	-	-	-	-	1
Symphytum officinale	Common Comfrey	-	1	-	-	-
Symphytum orientale	White Comfrey	-	-	-	-	1
Symphytum x uplandicum	Russian Comfrey	-	-	-	1	1
Taraxacum officinale	Dandelion	-	-	1	1	1
Taxus baccata	Yew	-	-	-	-	1
Thalictrum flavum	Meadow-rue	axiophyte	-	1	-	1
Torilis japonica	Upright Hedge-parsley	-	-	1	1	1
Tragopogon pratensis	Goat's-beard	-	-	1	1	1
Trifolium campestre	Hop Trefoil	-	-	-	-	1
Trifolium dubium	Lesser Trefoil	-	1	1	1	1
Trifolium fragiferum	Strawberry Clover	axiophyte	1	1	1	1
Trifolium micranthum	Slender Trefoil	-	-	1	1	1
Trifolium pratense	Red Clover	-	-	1	1	1
Trifolium repens	White Clover	-	-	1	1	1
Triglochin palustris	Marsh Arrowgrass	axiophyte	1	1	-	1
Tripleurospermum inodorum	Scentless Mayweed	-	-	1	1	1
Trisetum flavescens	Yellow Oat-grass	-	-	1	1	1
Tussilago farfara	Colt's-foot	-	-	1	1	1
Typha angustifolia	Lesser Reedmace	axiophyte	-	1	1	1
Typha latifolia	Great Reedmace	-	-	1	1	1
Typha x glauca	Hybrid Reedmace	-	-	-	-	1
Ulmus glabra	Wych Elm	-	-	-	-	1
Ulmus minor	Small-leaved Elm	-	-	1	1	1
Ulmus procera	English Elm	-	-	-	-	1
Urtica dioica	Stinging Nettle	-	-	1	1	1
Urtica galeopsifolia	Fen Nettle	-	-	-	-	1
Utricularia vulgaris	Greater Bladderwort	axiophyte	1	1	1	1
Valeriana officinalis	Common Valerian	axiophyte	1	1	-	1
Veronica anagallis-aquatica	Blue Water-speedwell	axiophyte	-	-	1	1
Veronica arvensis	Wall Speedwell	-	-	-	-	1
Veronica beccabunga	Brooklime	-	-	1	-	1
Veronica catenata	Pink Water-speedwell	axiophyte	-	1	1	1
Veronica chamaedrys	Germander Speedwell	-	-	1	-	1
Veronica persica	Common Field-speedwell	-	-	1	1	1
Veronica scutellata	Marsh Speedwell	axiophyte	-	-	1	1
Viburnum opulus	Guelder-rose	-	-	1	-	1
Vicia cracca	Tufted Vetch	-	-	1	1	1
Vicia sativa	Common Vetch	-	-	1	1	1
Vinca minor	Lesser Periwinkle	-	-	-	-	1
Vulpia bromoides	Squirrel-tail Fescue	-	-	1	1	1
Vulpia myuros	Rat's-tail Fescue	-	-	1	-	1
Wolffia arrhiza	Rootless Duckweed	axiophyte	1	-	-	-
Zannichellia palustris	Horned Pondweed	axiophyte	1	-	1	1
Total		92	89	261	249	381
Axiophytes			45	48	50	76

Conservation status

There are various ways of assessing the conservation status of a site, but there is no one method that is widely accepted or particularly convincing. The Ratcliffe Criteria (Ratcliffe, 1977) provide a philosophical basis for site selection but not a practical process. The key elements of the Criteria are rarity, diversity, naturalness and age, and these concepts are widely accepted as fundamental parts of any conservation assessment, although they can be difficult to evaluate empirically.

Rarity

In general rarity is the most widely used criterion for the selection of important sites. This is obviously useful if a species or habitat is globally restricted, but that does not often apply in Britain. Being rare within the British Isles often means simply that the species is on the edge of its range, and so it might be common elsewhere and of no real consequence. Because of this, one needs to take a wider view than simply counting rare species.

Stodmarsh has one plant that is Nationally Rare, *Potamogeton acutifolius*, and this is undoubtedly a species which deserves its status. Pondweeds are well represented in the British flora, and they are of considerable ecological importance. Six more species are Nationally Scarce: *Carex divisa*, *Lepidium latifolium*, *Myriophyllum verticillatum*, *Potamogeton coloratus*, *P. trichoides* and *Sonchus palustris*, and one more that has apparently been lost: *Wolffia arrhiza*. These are all wetland plants, typical of ditches, swamps, reedbeds and saltmarsh.

The vegetation at Stodmarsh also has a claim to rarity. There is no information on the distribution of the *Hordeum secalinum-Agrostis stolonifera* community, but it seems reasonable to assume that it is not widespread. The S19 *Eleocharis palustris* vegetation and A3 *Hydrocharis morsus-ranae* ditches are also uncommon, but again difficult to quantify, owing to the lack of a national register.

Diversity

Diversity alone can clearly be a pointless measure of conservation value: however good a site is, one could always increase its diversity by planting something inappropriate in it, and this shows that diversity itself is not the important issue. However, the diversity of a natural community can be important, and the best way of measuring that is by counting axiophytes. These are the species that tend to be restricted to habitats that have been deemed valuable for conservation purposes. Assuming that the habitats and species have been chosen well, a reasonable approximation of the value of site can be obtained simply by counting the number of axiophytes present. Losses and gains can then be used to assess change.

A total of 92 species of axiophyte has been recorded at Stodmarsh, which is well over the recommended minimum of 30 for a SSSI. This large total would make it one of the top sites in any county. Nearly all of them (62) are wetland or open water plants which occur in the ditches. Ten are woodland plants, although some of those (e.g. *Caltha palustris*, *Lysimachia vulgaris*) are from distinctly wet woodland and can also occur in ditches. Thirteen are grassland plants although only two of those are at all common in the site: *Lotus tenuis* and *Trifolium fragiferum* are fairly frequent in the best-preserved fields. The most curious group is the mire or fen plants, of which there are six: *Carex rostrata*, *Eriophorum angustifolium*, *Hydrocotyle vulgaris*, *Juncus subnodulosus*, *Menyanthes trifoliata* & *Triglochin palustris*. Only *Hydrocotyle* and *Triglochin* are still there, as far as we know.

Of the 92 axiophytes, 16 have not been recorded in the current date class. However, there have been gains as well as losses. The current score is 76, whereas in the previous three date classes the totals were from 45 to 50. On the face of it, this suggests that the reserve is improving, in conservation terms. Of the 19 apparent gains in the current date class, only one (*Potamogeton coloratus*) is particularly interesting. Others are woodland plants or species that are difficult to identify and may have been missed before.

The axiophyte analysis therefore supports the view that the ditches are the feature of most interest at Stodmarsh and that, on the whole, they are being quite effectively conserved under the current management.

Naturalness

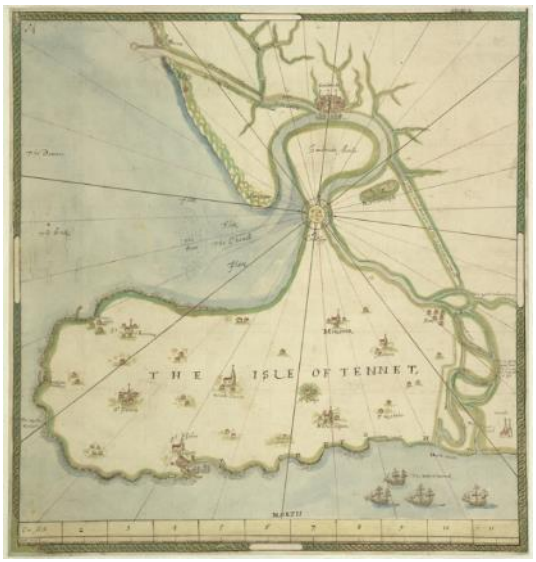
If Stodmarsh were a completely natural site, it would probably be a flat area of salty floodplain marshes and wet woodland, periodically inundated by the sea and regularly submerged by the river. But flood protection works, particularly the river embankment, keep the meadows dry almost all year round by an elaborate network of drains and sluices. It is thus an entirely artificial habitat, maintained only by large scale engineering projects and continuous ongoing management. On the other hand, the species present are to a large extent the same ones that would likely be found in this area if it were truly wild. Whether Stodmarsh could or should be managed in a

more natural way is a question that may become more pertinent as climate change and sea level rise affect the area over the coming decades.

Age

The origin of the vegetation at Stodmarsh can only be inferred from the records, which date back no more than 200 years, and from its current appearance. In many parts of England, for example, an ancient meadow might be characterised by a ridge-and-furrow pattern, which indicates that it was ploughed in the Middle Ages and is therefore no more than 500 or so years old.

At Stodmarsh, the best clue to the age of the habitat is the coastal nature of the vegetation. Stodmarsh was once on the shore, and the vegetation must have been saltmarsh. At some point it was transformed into grazing marsh. The most likely time for this is about when the Wantsum Channel silted up. In Roman times, this was a deep channel of the sea, and ships would use it in preference to sailing around the Isle of Thanet. In places it was over a mile wide.



- The silting up of the Wantsum Channel. The top map shows what the coastline is thought to have been like at the end of the Roman era (c. 400 AD). The lower map, from the British Library, dates from about 1548 and shows the Stour as a river rather than an estuary (note that on this map north is down). Stodmarsh would have changed from a coastal site to an inland one at some time between these dates.

Despite a small amount of sea level rise since that time, the silt brought down by the rivers filled the channel and raised the level to the point where it could be protected from flooding. This apparently happened around 1,000 years ago. Stodmarsh, at the highest point of the channel, would have been one of the first areas that could have been protected from the sea. This dates the vegetation to about 1,000 CE, which is interesting because that would make these fields some of the oldest in the country, as they have not been ploughed or significantly changed in the interim.

This points to what is possibly the most ecologically interesting feature of Stodmarsh. It has not been significantly altered by the changes that have affected the British countryside since the industrial revolution. The agricultural practices have remained the same for a millennium. It was never ploughed or used for military purposes during wartime. It was never abandoned to scrub, or subject to enclosure. The only significant change that has happened is the coal mining in the 20th century – and this has only affected the western portion of the site. Everywhere else seems to have remained as slightly brackish grazing pasture, with ditches for field boundaries, since Saxon times. This history is quite remarkable, and it is surely the most important feature of the site.

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Dowker, Mr G.	1	Millward, Miss M.E.	1	Williams, Mr P.	2566
Dyson, Mr C.	36	Mobarak, Miss J.	1596	Williams, Mr R.G.	3
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Appendix 1: phytosociological data

Hordeum secalinum grassland

Table 1 lists the quadrats recorded in *Hordeum secalinum* vegetation.

- Q1053 compartment 23 TR23266214, 9th August 2014: typical but rather species-poor grassland.
- Q1054 compartment 22 TR23216234, 9th August 2014: very fine, wet *Hordeum* grassland.
- Q1071 compartment 22 TR23206231, 28th July 2016: typical grassland.
- Q1074 compartment 15D TR22686209, 4th August 2016: this is close to MG6 *Cynosurus cristatus* grassland but retaining some features of *H. secalinum* grassland.
- Q1075 compartment 49 TR24066267, 13th August 2016: this is an example of a sward that is turning into MG5a *Festuca rubra* grassland, although it is still intermediate.
- Q1077 compartment 23 TR23336224, 31st July 2015: species-poor but typical grassland.

Table 1: *Hordeum secalinum-Agrostis stolonifera* grassland quadrats

	Q1053	Q1054	Q1071	Q1074	Q1075	Q1077
Hordeum secalinum	7	4	9	5	6	5
Agrostis stolonifera	5	8	6	7	8	8
Lotus corniculatus	8	-	-	-	2	-
Cynosurus cristatus	-	-	-	6	3	-
Lolium perenne	6	-	-	2	6	3
Ranunculus acris	6	1	1	-	2	-
Juncus inflexus	-	4	4	1	5	4
Lotus tenuis	-	2	5	5	5	4
Medicago lupulina	5	-	-	-	3	-
Potentilla anserina	-	5	-	4	-	-
Ranunculus sardous	-	5	-	-	-	4
Trifolium fragiferum	5	4	5	5	3	5
Alopecurus geniculatus	-	4	-	-	-	-
Alopecurus pratensis	-	4	4	-	-	-
Carex disticha	-	4	-	-	-	-
Juncus effusus	-	1	4	-	-	-
Leontodon saxatilis	-	-	1	-	3	4
Phragmites australis	-	4	-	-	-	-
Trifolium pratense	4	-	-	2	4	-
Trifolium repens	4	1	4	-	-	2
Cerastium fontanum	-	-	-	-	3	-
Dactylis glomerata	-	-	-	3	-	-
Eleocharis palustris	-	3	-	-	-	-
Elytrigia repens	-	3	2	1	-	3
Festuca rubra	-	-	2	-	3	-
Holcus lanatus	-	-	-	-	3	-
Phleum bertolonii	-	-	-	-	3	-
Phleum pratense	-	-	-	3	-	-
Poa pratensis	-	-	3	-	-	-
Carex flacca	-	-	-	-	2	-
Cirsium arvense	2	-	-	1	2	-
Crataegus monogyna	-	-	-	-	2	-
Helminthotheca echioides	-	-	-	-	2	-
Juncus articulatus	-	2	-	-	-	-
Persicaria amphibia	2	-	-	-	-	-
Plantago lanceolata	-	-	-	1	2	-
Poa trivialis	2	-	-	-	-	-
Prunella vulgaris	1	-	-	2	2	-
Pulicaria dysenterica	-	2	2	1	1	-
Ranunculus repens	-	-	-	-	2	-
Rumex crispus	-	2	-	-	-	-
Senecio erucifolius	-	-	-	-	2	-
Agrimonia eupatoria	-	-	-	-	1	-
Bellis perennis	1	-	-	-	-	-
Carex otrubae	-	1	-	1	1	-
Plantago major	-	-	-	1	-	-
Rumex acetosa	-	-	-	1	-	-
Rumex conglomeratus	-	-	-	1	-	-
Taraxacum officinale agg.	-	-	-	-	1	-

S19 *Eleocharis palustris* swamps

Table 2 lists the quadrats in the S19 *Eleocharis palustris* vegetation:

- Q1055 compartment 18a, TR22876235, 12th August 2014: a wet hollow with a typical, rather species-poor *Eleocharis* swamp.
- Q1072 compartment 15a, TR22386209, 5th August 2016: on the edge of a shallow depression of hard, dry mud at the time of survey. This area looked like grassland rather than swamp but, although some people think there should be an *Agrostis-Eleocharis* grassland, to me it seems to fit well within the S19c *Agrostis stolonifera* subcommunity.
- Q1073, compartment 59, TR24026260, 13th August 2016: a wet hollow in a wet field of sedge swamp and marshy grassland. This is a fine example of the community with rare plants like *Baldellia* and *Alisma lanceolatum*.
- Q1076, compartment 57, TR23956242, 13th August 2016: the best example I have found of this community. Note the presence of brackish plants such as *Carex divisa* and the rarity *Potamogeton coloratus*.
- Q1078, compartment 45, TR23476278, 4th September 2016: a rather plain example of this community in the heavily goose-grazed margin of a shallow lake.
- Q1079, compartment 15E, TR22606196, 4th September 2016: a swamp filled with flowering-rush in a muddy hollow in a drying field. This quadrat hints at a relationship between the *Eleocharis* swamps and the *Butomus* swamp if it counts as distinctive.

Table 2: S19 *Eleocharis palustris* quadrats

	Q1055	Q1072	Q1073	Q1076	Q1078	Q1079
Eleocharis palustris	9	6	10	10	9	8
Agrostis stolonifera	3	10	2	3	-	3
Crassula helmsii	4	3	4	-	8	-
Juncus articulatus	-	5	3	7	4	-
Chara vulgaris	-	-	-	4	5	-
Mentha aquatica	5	4	-	-	-	-
Veronica catenata	-	-	4	-	-	5
Juncus inflexus	-	4	-	4	-	-
Butomus umbellatus	-	-	-	-	-	7
Galium palustre	3	-	1	3	-	-
Hippuris vulgaris	1	3	-	-	3	-
Baldellia ranunculoides	-	-	2	4	-	-
Carex divisa	-	-	-	6	-	-
Oxybasis rubra	-	-	-	-	-	6
Alisma plantago-aquatica	-	-	-	-	4	1
Hydrocharis morsus-ranae	-	-	-	-	5	-
Elodea nuttallii	-	-	-	-	4	-
Glyceria maxima	4	-	-	-	-	-
Persicaria amphibia	4	-	-	-	-	-
Phragmites australis	-	-	-	-	4	-
Potamogeton coloratus	-	-	-	4	-	-
Ranunculus sardous	-	-	1	2	-	-
Rumex conglomeratus	-	2	-	1	-	-
Alisma lanceolatum	-	-	2	-	-	-
Atriplex patula	-	-	-	-	-	2
Bolboschoenus maritimus	-	-	-	-	-	2
Carex hirta	-	-	-	2	-	-
Carex otrubae	-	1	-	1	-	-
Persicaria maculosa	-	-	-	-	-	2
Potentilla anserina	2	-	-	-	-	-
Typha angustifolia	-	-	-	-	-	2
Epilobium hirsutum	-	1	-	-	-	-
Epilobium parviflorum	-	1	-	-	-	-
Juncus bufonius	-	-	-	-	-	1
Persicaria lapathifolia	-	-	-	-	-	1
Ranunculus sceleratus	-	-	-	-	-	1
Rumex crispus	1	-	-	-	-	-
Veronica scutellata	-	-	1	-	-	-

W5 *Alnus glutinosa* and W6 *Salix x fragilis* woodland

- Q1033 compartment 2, TR22216088, 25th July 2013. This is an example of where the woodland is closer to W6 than to W5. The willows, nettles and willowherbs particularly point to this, although the yellow loosestrife in particular is more a W5 plant.
- Q1044, riverbank by compartment 32, TR23056279, 23rd May 2014. Typical W6 woodland by the river, with only *Lepidium latifolium* to give it a regional difference.
- Q1062, close to Q1044, TR23026289, 11th August 2015. The abundance of nettle tends to increase in the summer, and this is an extreme example of eutrophic woodland.
- Q1064, compartment 2, TR22246102, 20th May 2016. Alder and willow carr with an understorey of sedges. Closer to W5 than to W6, but hardly typical.
- Q1065, similar to Q1064, TR22246102, 20th May 2016. Similar to the above, but with white willow in the canopy.
- Q1066, compartment 14G, TR22356117, 20th May 2016. This is grey willow woodland with an understorey of reed sweetgrass. Rather like W1 woodland, but arguably within the range of variability of the W5/W6 continuum.
- Q1067, compartment 14G, TR22346113, 20th May 2016. This is the closest stand to good W5, with characteristic species such as fen nettle.
- Q1080, riverbank by compartment 32, TR23026283, 20th April 2016. W6 woodland by the river.

Table 3: woodland quadrats

	Q1033	Q1044	Q1062	Q1064	Q1065	Q1066	Q1067	Q1080
Salix x fragilis	7	7	9	5	4	-	4	5
Urtica dioica	4	4	10	2	3	-	2	6
Alnus glutinosa	6	-	-	5	6	1	9	-
Carex riparia	7	-	-	4	2	-	9	-
Iris pseudacorus	4	-	-	4	4	3	5	2
Salix atrocinerea	4	-	-	4	4	9	-	-
Crataegus monogyna	-	4	1	4	5	-	1	4
Glyceria maxima	-	4	-	-	-	8	4	-
Solanum dulcamara	3	3	-	3	1	3	3	-
Oenanthe crocata	-	5	4	-	-	-	1	5
Filipendula ulmaria	5	-	-	2	5	-	-	2
Epilobium hirsutum	4	4	-	2	-	-	2	-
Salix alba	5	-	-	-	7	-	-	-
Phalaris arundinacea	7	-	-	-	3	-	-	-
Phragmites australis	-	7	3	-	-	-	-	-
Lemna minuta	-	-	-	-	-	6	3	-
Populus x canadensis	-	-	-	4	5	-	-	-
Buddleja davidii	-	-	4	-	-	-	-	4
Carex acutiformis	-	-	-	8	-	-	-	-
Fraxinus excelsior	-	1	-	1	4	-	1	1
Hedera helix	-	-	5	-	-	-	-	3
Ribes nigrum	-	-	-	4	4	-	-	-
Viburnum opulus	-	-	-	4	4	-	-	-
Galium palustre	3	-	-	1	3	-	-	-
Angelica sylvestris	1	-	2	-	-	-	-	2
Equisetum fluviatile	-	-	-	-	-	5	-	-
Lysimachia vulgaris	4	-	-	-	1	-	-	-
Lythrum salicaria	-	-	2	2	-	-	1	-
Poa trivialis	2	-	-	2	1	-	-	-
Quercus robur	-	-	-	-	5	-	-	-
Rosa arvensis	-	-	-	-	4	-	-	1
Acer pseudoplatanus	-	-	4	-	-	-	-	-
Calystegia sepium	-	2	-	-	-	-	2	-
Corylus avellana	-	-	-	-	4	-	-	-
Ficaria verna	-	-	-	-	-	-	-	4
Humulus lupulus	-	-	-	2	1	-	-	1
Lepidium latifolium	-	4	-	-	-	-	-	-
Lysimachia nummularia	-	-	-	-	4	-	-	-
Ribes rubrum	-	-	-	-	2	-	-	2
Sambucus nigra	-	-	4	-	-	-	-	-
Scutellaria galericulata	1	-	-	-	1	-	2	-
Urtica galeopsifolia	-	-	-	-	2	-	2	-
Cardamine pratensis	-	-	-	1	-	-	-	2
Galium aparine	-	-	-	-	-	-	3	-
Juncus effusus	-	-	-	2	-	-	1	-
Ranunculus sceleratus	-	-	-	2	-	-	1	-

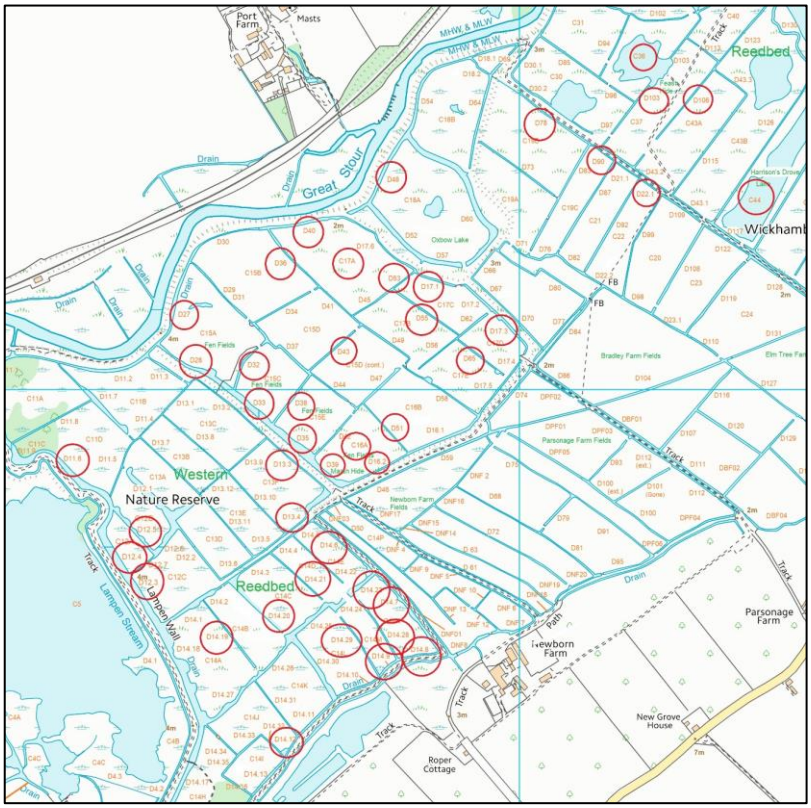
Cardamine flexuosa	-	-	-	-	-	-	2	-
Carex remota	-	-	-	-	2	-	-	-
Dipsacus fullonum	-	2	-	-	-	-	-	-
Epilobium parviflorum	-	-	-	-	-	-	2	-
Lycopus europaeus	-	-	-	2	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	2	-
Myosotis scorpioides	1	-	-	1	-	-	-	-
Rumex conglomeratus	-	-	-	2	-	-	-	-
Rumex hydrolapathum	-	-	-	-	-	2	-	-
Stachys palustris	-	-	2	-	-	-	-	-
Berula erecta	1	-	-	-	-	-	-	-
Caltha palustris	-	-	-	-	1	-	-	-
Dryopteris dilatata	-	-	-	-	-	-	1	-
Myosotis laxa	1	-	-	-	-	-	-	-
Ranunculus repens	-	-	-	1	-	-	-	-
Rosa canina agg.	-	-	-	-	-	-	-	1

Appendix 2: evidence & experiments

1: Distribution of *Utricularia vulgaris*

In the 1996 ditch survey, Williams commented that '*Utricularia vulgaris* was recorded in only a few ditches but is much more abundant in the wide fleets within the reedbeds.' This creates a hypothesis that can be tested. The idea would presumably be that the reeds affect the water quality and, as reedbeds are often used for water purification, this seems entirely reasonable. As a carnivorous plant, Bladderwort would be expected to occur in mesotrophic to oligotrophic conditions, perhaps with low N, P and/or K, although as a calcicole it prefers high Ca. If this species does indeed occur preferentially in the reedbeds, then there may also be other plants associated with these conditions.

The best way to test this is to see if it is indeed mainly found within the reedbeds, and whether it has spread to the new reedbeds since they were created in the late 1990s. The various ditch surveys provide systematic data on its distribution, so this is a straightforward operation. The map below shows the results.



Distribution of *Utricularia* at Stodmarsh (presence shown by red circles)

The answer is yes, it has spread to the eastern reedbed since the 1990s. Overall there has been a considerable increase in the amount of *Utricularia* at Stodmarsh, which could perhaps be attributed to a variety of causes, but seems quite likely to be associated with the expansion of the reedbeds. It appears to be about as frequent in the meadows as in the reedbeds, but abundance is not documented in these surveys. My opinion, for what it is worth, is that Williams was right, that it is more abundant in the fleets than elsewhere.

2. Effect of *Crassula helmsii* on native vegetation

There have long been reports that *Crassula helmsii*, New Zealand Pigmyweed, has a negative impact on rare native plants. These arose in the 1980s and 1990s when *Crassula* appeared in several ponds in southern England that were famous for particular rarities. In some sites it became very abundant, and it has been known to form a dense sward up to about 1 foot thick over mud and shallow water. People speculated that this would harm small and aquatic plants by smothering them in its shade. This fear has never really been proven despite many studies, and there is an alternative explanation that any declines in certain rare species may be due to habitat degradation, climate change or eutrophication which just happen to coincide with the arrival of *Crassula* and other exotic species. One study recently has even suggested that *Crassula* can help rare species, although that one does not mention any specific candidates.

In summer 2020 I recorded 33 quadrats of vegetation throughout the reserve where *Crassula* occurred, and 33 more quadrats in the closes stand of similar vegetation without *Crassula*. It is too small a data set to be able to produce a convincing statistical analysis, but the following observations were made:

- *Crassula* seems to be largely restricted to shallow scrapes and reed swamps
- For some unknown reason, it occurs in just one ditch
- Vegetation stands with *Crassula* tend to be slightly wetter than stands without, and they are slightly more species-rich overall
- The only species which showed a marked aversion to *Crassula* is *Galium palustre* (which was in 7 +Crassula plots and only 1 -Crassula plot)
- *Crassula* does not appear to be spreading at Stodmarsh and in fact seems to have declined somewhat in recent years, due to summer droughts.

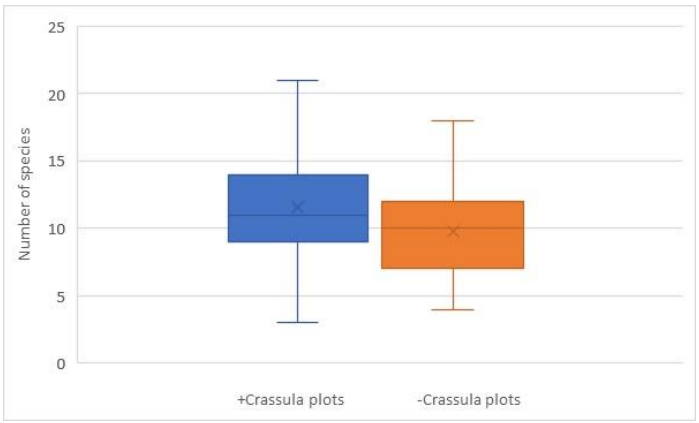


Fig. 1 Number of species per quadrat with and without *Crassula* present (omitting the *Crassula* itself)

These are only preliminary results, and the survey needs to be followed up in future years, but so far there is little evidence of any negative effect on rare plants or even on any other plants at all.

3: Is Stodmarsh a peatland?

There are numerous statements about Stodmarsh being a peatland, from Ratcliffe's (1977) inclusion of the NNR withing the peatland group of nationally important sites, to a recent Natural England report (Cousins, 2021) which classifies many of the beetles as peatland specialists. Francis Rose certainly considered Stodmarsh a peatland site and, in his manuscript Flora (written, perhaps, in the 1950s), listed it as one of the five relict fenlands of East Kent. He presented some records of distinctly peatland plants such as *Comarum palustre* and *Eriophorum angustifolium*, in support of this.

So where is the peat?

Whenever a ditch is dug out at Stodmarsh, I have examined the soil profile that is exposed. The photograph below is typical: ditch 84, cleared in the winter of 2020-21 and probably dug out wider and deeper than it had ever been dug before. A very clean cross-section is exposed, revealing a mineral substrate from the surface to a depth of at least 1 m. There is no sign of peat. This situation is repeated across the site, in all the ditches I have seen.

The UK Soil Observatory (ukso.org) shows some 'peat layers buried with subsoil' (shaded green on the map below) in the vicinity of Canterbury, but these do not extend as far as Stodmarsh, petering out just beyond Fordwich.

Left: soil profile in ditch 84 in April 2021; right: UK soil observatory map of peatlands in Kent.

Peat is formed when plant material breaks down in wet, anaerobic, conditions. Essentially all that is needed is for it to be permanently submerged in water. This suggests that the reedbeds are the most likely place where peat would form. However, the reedbeds at Stodmarsh are no more than a century old, which would make this a very new peatland (even more so in Francis Rose's time). Moreover, most of the reedbeds dry out regularly in summer, which suggests that much of the dead plant matter is likely to oxidise. It is only really in the subsidence lakes and the carr woodland where there is much opportunity for reed- and sedge-peat to form.

Further information is therefore needed on the presence and distribution of any peat in the NNR, and its effect on the flora and fauna.

4. Restoration of Stodmarsh Lake

Stodmarsh Lake is the main subsidence lake within the NNR, although there are several others to the west of the reserve. Some of these lakes connect to the river, others appear to be isolated. Stodmarsh Lake was largely separate from the river, but there was an inflow of water when the river was in spate. In about 2018-9, a large dam and sluice system was installed to prevent this happening, on the grounds that nitrogen (N) and phosphorus (P) concentrations in the river water were too high, because of outflow from the Canterbury sewage works.

The reasoning behind this was that the high levels of N and P were causing algal blooms within the lake and these led to fish kills and the virtual absence of aquatic macrophytes from the lake. The reduction in the quantities of fish and plants was said to threaten the survival of Bittern and Gadwall respectively. As these species are protected by law, action needed to be taken to reverse this decline. In addition to the construction of the sluice, the issue has held up major planning developments in Canterbury and may require expensive modifications to the nearby sewage treatment works.

Given that this is probably the largest investment that society in general has made in the reserve, it would seem sensible to attempt to evaluate the consequences. Some options are:

- Monitor Gadwall and Bittern populations. If either species increased dramatically in the period immediately following the installation of the sluice, it might be possible to trace a link, but that seems unlikely. A small increase in these species over a prolonged period of time would be consistent with a favourable outcome, but other activities such as the recent expansion of the reedbed would make it difficult to draw any firm conclusions.
- Survey for aquatic macrophytes. Numerous surveys have revealed barely any trace of macrophytes in Stodmarsh lake. The cause could be as simple as P and N levels, but it is rare to find such a simple link. Certainly, the appearance of sizeable populations of aquatic plants, especially if combined with reduced levels of N and/or P, would be a useful indication of success.
- Record the frequency of algal blooms.
- Survey for aquatic invertebrates such as snails and beetles. At present there appears to be very little data on the rare species in the lake, as most surveys have focused on the ditches.

5. Benefits of Ditch Restoration

Since about the 1970s, Natural England has had a programme of ditch maintenance at Stodmarsh aimed not only at regulating water levels, but also to benefit the aquatic flora and fauna.

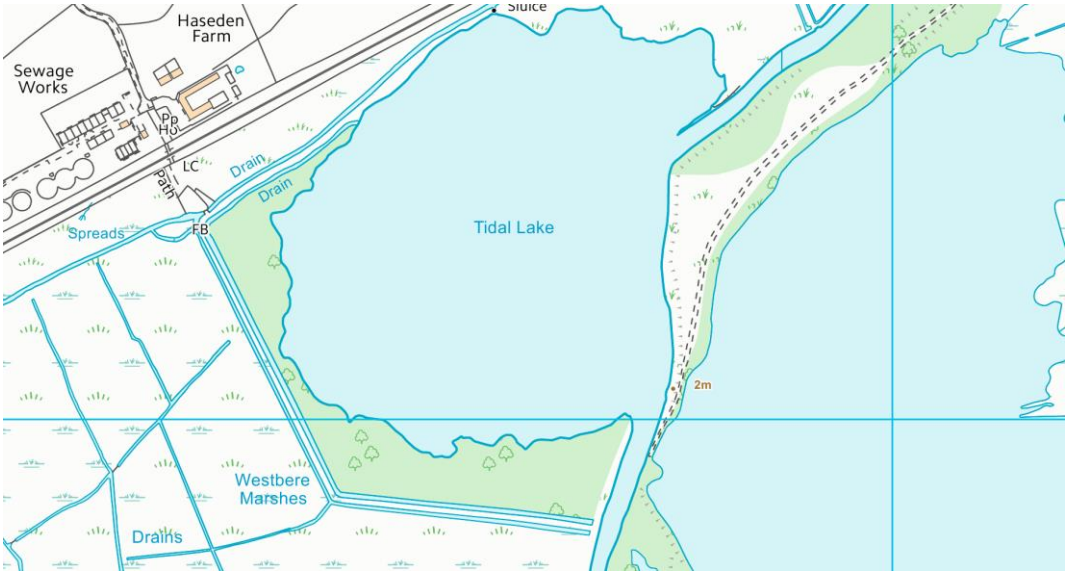
How to measure the success of this?

1. Some ditches were dry and without any interest at all. These have obviously improved. Seems too trivial to test.
2. Others were wet and species-rich in the past. Those seem to still be species-rich. Differences are subtle and could be partly due to recording effort/scope and choosing which species to include. The only real way to compare these would be to restrict analysis to the species which no-one should have overlooked (submerged aquatics in particular) but even they would be affected by sample size. Some people have only surveyed short sections of a ditch.
3. Some ditches would have been choked with reeds then or now. When reeds become very dense, most other species disappear. But on the whole we don't have abundance measures, so you can only tell this from the species list, which makes it a circular argument.
4. Could take all the ditches in a compartment or section and compare, say, axiophyte lists then and now. For example, D136, 149 and 152 surround one of the eastern fields. They were very species-poor in the 1990s and now have plenty of species. The ditches were dry and now are wet. Simple enough, but same problem as in 1.
5. Use mapping to show the spread of aquatic axiophytes? But how to account for differences in recording effort?
6. Use statistical methods to compare entire surveys. Would need to standardise them as much as possible, which would mean restricting species lists to certain plants that must be recorded if present (how to back-date that?), ensuring on standard sampling method (Williams uses 20 m sections, which increases random factors) and one would need to survey all the same ditches.

Conclusions… there doesn't seem to be much point in comparing the life cycle of ditches from newly-cleared to choked. The best way to demonstrate the state of the site would be by mapping key aquatics. This would probably show a spread of axiophytes into areas previously dry, and disappearance of certain axiophytes from the reedbeds. A problem is going to be how to survey in reedbeds.

6. Turbidity of the river

From Canterbury down to Fordwich, the River Great Stour has clear water and from a boat it is easy to see the bottom. The aquatic vegetation is rich and seems to show no sign of pollution or eutrophication. Just at the point where the river reaches the Tidal Lake, at about TR207610, it turns highly turbid, and it becomes impossible to see more than a centimetre or so into the water. The flora seems to deteriorate somewhat in quality and becomes dominated by floating and emergent plants such as *Sagittaria sagittifolia*, *Schoenoplectus lacustris* and *Potamogeton lucens*. There is some evidence that submerged species such as *Myriophyllum spicatum*, *Nuphar lutea* and *Oenanthe fluviatilis* have declined or disappeared from this part of the river. Although it is normal for rivers to have a transition from their clear, fast-flowing middle range to a turbid, slow-flowing lowland stage at some point, it is curious that this is so abrupt and that this point may have moved upstream at in the past.



One possible explanation for this sudden change is that this could be where the Westbere wastewater treatment works at Haseden Farm discharges into the river. However, it seems like a small facility to have such a big effect, when the much larger Canterbury sewage works at Sturry does not seem to make much difference to the turbidity.

An alternative hypothesis is that the tidal lake could be responsible for the transition. It can be observed that, alongside Stodmarsh, the river is tidal and often flows in an upstream direction around the high tide. It seems likely that there could be a point where this tidal reversal tends to peter out, and at this point there might be a period of several hours each day when the water is still. Effectively, this becomes the lowest point in the river basin, as water flows towards it from the hills on the one side, and from the raised sea on the other. At this point, one might expect silt to sediment out during the periods when the water is still. Elsewhere in the river system, the constant current would tend to wash away any suspended particles.

If the turning point in the river channel happens to be about where the Tidal Lake occurs, then it is possible that huge quantities of silt have been deposited in the lake over the hundred or so years. This fine silt could be sufficient to make the river permanently turbid. It is possible to imagine that without the lake, the quantity of silt deposited on the riverbed would be much smaller, and it would be more easily washed downstream during periods of flood.

This suggests a mechanism which explains how the transition point to a lowland-type river could be moved upstream by the creation of a subsidence lake, and how the river could turn turbid so rapidly. Intriguingly, it does not depend on the location of Canterbury sewage works just a short distance upstream, and it does not necessarily involve pollution or eutrophication.

It is, however, purely speculative. How would one test such a hypothesis? It would be interesting to determine how far upstream the flow-reversal tends to occur. It would also be useful to know if there is any detectable change in the quality of the river water between Fordwich and Grove Ferry, other than suspended solids. To confirm the existence of such a process, it would be valuable to search for similar circumstances elsewhere, although perhaps the combination of a recently-created subsidence lake in such a precise location is an unlikely circumstance.

7. Repeat of the 1989 ditch survey

In 1989 Agnes van Dongen and David Painter carried out a ditch survey in the western reedbed and the central fields. The survey was quite thorough and very fully documented. There have been subsequent surveys of some of the same ditches over the years, but the most complete resurvey so far was in 2022: 20 of the 27 ditches were looked at. The more recent survey was simpler, but the essential element of a list of vascular plants for each ditch is common to both, and this is what it is most useful to analyse. Table 1 lists the total number of species and the number of axiophytes recorded in each ditch during each survey (I have used axiophytes both for simplicity and because it is independent of any biases that I might introduce).

- T1: summary results of the 1989 and 2022 surveys of selected ditches

	1989 survey		2022 survey	
Ditch No.	spp.	axios	spp.	axios
Meadow ditches				
D027	29	10	12	5
D028	41	16	9	4
D030	33	9	11	3
D032	28	8	24	10
D033	33	10	12	4
D035	24	8	26	9
D037	25	7	30	13
D038	33	13	28	12
D039	30	12	30	10
D041	39	13	30	16
D042	31	10	27	12
D043	33	8	31	15
D044	36	8	16	6
D047	16	3	28	12
D055	46	16	26	10
Reedbed ditches				
D11.6	22	3	14	4
D12.3	20	3	16	5
D12.4	19	2	16	4
D14.18	40	6	16	3
D16.2	33	13	21	7
Mean of all ditches	31	9	21	8
Mean of meadows	32	10	23	9
Mean of reedbeds	27	5	17	5

The results show a considerable decline in the number of species in the ditches: overall, from 31 to 21 on average. This is partly due to the methodology, as the 1989 survey included bankside plants that were ignored in the later one. This can be compensated for by examining just the axiophytes, which should have been fully recorded during both surveys. The axiophytes show no decline: the difference between 9 and 8 is not statistically significant in this data set (and may be due to an identification error in the earlier survey). This lack of change persists when the meadow and reedbed ditches are examined separately, although the lower species-richness of the reedbed ditches remains in all analyses.

Table 2 shows the species recorded during each survey. There appears to be quite a lot of 'churn' in the sense of plants found in these ditches during one survey but not the other, without any obvious significance to the change. For example, *Ranunculus sceleratus* happened not to be in those ditches in 2022, but it was present elsewhere and this was probably just a matter of chance. The wider scope of the 1989 survey is reflected in records of *Dactylis glomerata*, *Dipsacus fullonum* and *Salix atrocinerea*, which would have been omitted from the later survey.

One change which might have been expected would be the addition of some non-native species, but that does not seem to have happened to any great extent. *Crassula helmsii* has arrived, but *Azolla filiculoides* and *Elodea nuttallii* have declined significantly.

A slightly surprising result, given that there is a general trend of fewer species being recorded in the later survey, is that the total number of axiophytes has gone up slightly. Again, there is quite a lot of churn masking the changes but, overall, there are 2 more axiophytes in the second survey than in the first one. Unfortunately, this is

almost certainly due to identification issues: I suspect that charophytes were omitted from the first survey, and fine-leaved pondweeds like *Potamogeton trichoides* and *Stuckenia pectinata* may have been overlooked. Even the apparent rise in the number of ditches for *P. acutifolius* is probably not significant, given the difficulty in separating it from *P. friesii*, especially late in the season (when the 1989 survey took place). There are 8 records for these two species in each of the 2 surveys, which suggests that no real change has occurred.

In ecological terms, the only differences that looks significant to me are (1) the loss of *Hydrocotyle vulgaris* and (2) the gain of *Utricularia vulgaris*. The former prefers more acidic waters and the latter more base-rich. They both require low nutrient levels.

- T2: species recorded during the 1989 and 2022 surveys

Species	1989	2022
Agrostis stolonifera	9	-
Alisma lanceolatum	-	2
Alisma plantago-aquatica	2	10
Azolla filiculoides	7	1
Berula erecta	15	14
Bidens cernua	-	1
Bidens tripartita	4	-
Bolboschoenus maritimus	6	6
Butomus umbellatus	2	3
Calystegia sepium	7	-
Carex acuta	-	1
Carex disticha	1	3
Carex divisa	-	1
Carex otrubae	4	5
Carex riparia	18	19
Ceratophyllum demersum	9	5
Chara vulgaris	-	5
Chenopodium album	2	-
Cirsium arvense	18	-
Crassula helmsii	-	7
Crataegus monogyna	1	-
Cynosurus cristatus	2	-
Dactylis glomerata	7	-
Dipsacus fullonum	3	-
Eleocharis palustris	12	8
Elodea canadensis	1	2
Elodea nuttallii	18	7
Elymus repens	2	-
Epilobium hirsutum	15	2
Equisetum arvense	-	1
Equisetum fluviatile	11	5
Eupatorium cannabinum	2	9
Festuca rubra	1	-
Galium palustre	1	6
Glyceria declinata	-	1
Glyceria maxima	9	1
Helminthotheca echioides	3	-
Helosciadium nodiflorum	4	4
Heracleum sphondylium	3	-
Hippuris vulgaris	7	2
Holcus lanatus	8	-
Humulus lupulus	1	-
Hydrocharis morsus-ranae	20	20
Hydrocotyle vulgaris	2	-
Iris pseudacorus	3	3
Juncus articulatus	9	10
Juncus bufonius	-	2
Juncus effusus	5	5
Juncus inflexus	12	13
Lathyrus pratensis	2	1
Lemna gibba	3	-
Lemna minor	17	15
Lemna minuta	1	5
Lemna trisulca	18	18
Leontodon saxatilis	1	-
Lotus tenuis	1	4
Lycopus europaeus	7	3
Lysimachia nummularia	3	2
Lythrum salicaria	9	1
Mentha aquatica	16	13
Myosotis laxa	1	6
Myosotis scorpioides	4	1
Myriophyllum verticillatum	10	6
Nuphar lutea	5	3
Nymphaea alba	11	14
Oenanthe aquatica	9	-
Oenanthe fistulosa	12	4
Oxybasis rubra	5	1
Persicaria amphibia	5	6
Persicaria maculosa	8	-
Phalaris arundinacea	2	-
Phleum pratense	1	-
Phragmites australis	20	20
Plantago lanceolata	1	-
Plantago major	7	-
Potamogeton acutifolius	3	7
Potamogeton crispus	1	3
Potamogeton friesii	5	1
Potamogeton lucens	2	-
Potamogeton natans	10	6
Potamogeton trichoides	-	1
Potentilla anserina	1	-
Pulicaria dysenterica	10	5
Ranunculus repens	3	-
Ranunculus sardous	6	-
Ranunculus sceleratus	6	-
Rorippa palustris	3	-
Rubus fruticosus	7	-
Rumex hydrolapathum	20	13
Salix atrocinerea	2	-
Samolus valerandi	3	9
Schoenoplectus tabernaemontani	5	5
Scrophularia auriculata	-	1
Solanum dulcamara	7	1
Sonchus palustris	-	1
Sparganium emersum	5	2
Sparganium erectum	20	19
Spirodela polyrhiza	-	4
Stellaria media	1	-
Stuckenia pectinata	-	1
Trifolium fragiferum	6	1
Trifolium repens	9	-
Typha angustifolia	7	14
Typha latifolia	15	9
Urtica dioica	6	-
Utricularia vulgaris	-	12
Veronica anagallis-aquatica	2	-
Zannichellia palustris	1	1
No. species	93	72
No. axiophytes	28	31