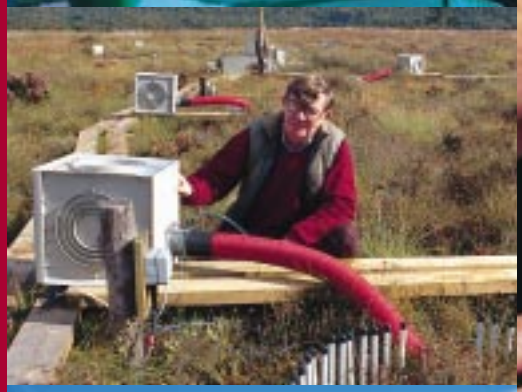
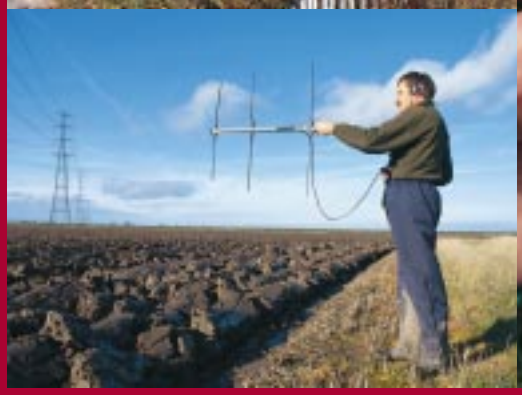
ENGLISH NATURE

Report Number
706

# *Apium repens* creeping marshwort Species Recovery Programme 1995-2005

English Nature Research Reports





working today
for nature tomorrow

English Nature Research Reports

**Number 706**

# *Apium repens* creeping marshwort Species Recovery Programme 1995-2005

A.W. McDonald and C.R. Lambrick

**Ashmolean Natural History Society of Oxfordshire**
**Rare Plants Group**

Funded by the English Nature Species Recovery Programme
and the Environment Agency

Recording *Apium repens* on Port Meadow, 2003. Photo A.W. McDonald.



ISSN 0967-876X

| | |
|---|---|
| **Project officer** | Dr Jill Sutcliffe, Terrestrial Wildlife Team<br>Jill.Sutcliffe@English-Nature.org.uk |
| **Contractor(s) (where appropriate)** | Alison McDonald<br>The Unviersity of Oxford<br>Department of Plant Sciences<br>South Parks Road<br>Oxford OX1 3RB<br>Alison.mcdonald@plants.ox.ac.uk<br><br>Camilla Lambrick<br>camilla@lambrick.fsnet.co.uk |



From October 2006, English Nature, the Landscape, Access and Recreation division of the Countryside Agency and the environmental land management functions of the Rural Development Service have been brought together to form a new independent body - Natural England. This research report was completed by English Nature, but has been published by Natural England to complete the English Nature Report series.

This report should be cited as:
McDONALD A.W., & LAMBRICK, C.R. 2006. *Apium repens* creeping marshwort. Species Recovery Programme 1995-2005. *English Nature Research Reports*, No 706

# Acknowledgements

**Oxford area**:

Ashmolean Natural History Society of Oxfordshire Rare Plants Group volunteers especially Susan Erskine and Frances Watkins
Botanical Society of the British Isles volunteers
Christ Church College, Oxford
Charles Gee, current tenant of Binsey Green
Freemen of Oxford
Oxford City Council, notably Anthony Roberts
Oxford Preservation Trust
Professor C R Leaver, University of Oxford Dept of Plant Sciences
Mr and Mrs N. Ryecroft, former tenant of Binsey Green
West Oxfordshire District Council
Wovercote Commoners Committee

**Walthamstow Marshes**

Dave Miller, Lee Valley Park Rangers
Brian Wurzell, Botanical Society of the British Isles

**Environment Agency**

EA staff: Rory Callan, Paul St Pierre
Andy Dixon, Groundwater Monitoring and Drilling Ltd
Dr David Gowing, Open University and the Institute of Water and the Environment Cranfield University

**Europe**

Mark Leten, Institute for Nature Conservation, Brussels, Belgium
Peter Maas, the Netherlands
Dr Anne Ronse, National Herbarium of Belgium, Meise
Professor Karel Sykora, Agricultural University, Wageningen, the Netherlands
Wim van Wijngaarden, Policy Development, Directorate of Environment, Landscape and Water, Province of Zeeland, the Netherlands

**Financial support**

Funding for this work has been provided by:

1995-2006: **English Nature** for survey, monitoring, European contacts and workshops. We have had immense help and support from the **Thames and Chilterns Area Team** – Keith Payne, Graham Steven, Heather Whetter, Helen Lancaster and Rebecca Tibbetts
**National Terrestrial Wildlife Team:** Dr Roger Mitchell, head of Species Recovery Programme until 2003; Ron Porley and Dr Jill Sutcliffe of the Botanical and Mycological Unit
2002-04: **Environment Agency** for Hydrological survey and report by Dr David Gowing
1994: **Joint Nature Conservation Committee** for preliminary work

# Summary


## 1. Status

*Apium repens* (Jacq.) Lag., Apiaceae, is listed under the Habitats Directive because of its scarcity and decline in Europe. The one site originally known in the UK in 1995 is now designated part of the Oxford Meadows Special Area for Conservation. A Species Action Plan was drawn up in 1995 and English Nature funded the Rare Plants Group of the Ashmolean Natural History Society of Oxfordshire to carry out field work under the Species Recovery Programme.

## 2. Distribution

*Apium repens* is widely distributed in western and southern Europe, in North Africa and the Canary Islands. A visit to Europe in 1997 enabled us to record it in seven sites in the Netherlands and Belgium growing in a range of conditions including mown lawns, saline alluvium and dune slacks. The swards where it was flourishing were all short, and all the sites were subject to flooding. Active work is also proceeding in France, Spain and Slovenia. In the UK its major location is on Port Meadow, Oxford. Restoration of the habitat at two Oxfordshire flood-plain sites resulted in the return of the species to one of them in 1998 (Binsey Green, Oxford). However at Langel Common, Witney, digging a scrape has restored species associated with *Apium repens* but not *A. repens* itself so far. Ditch management at Walthamstow Marshes SSSI, Essex, resulted in the appearance of the species in 2002. Introductions were made at two Oxfordshire sites; one was successful (North Hinksey, Oxford).

## 3. Nomenclature and hybridization

*Apium repens* has formerly been placed in two other genera (*Sium* and *Helosciadium*), and studies of relationships within *Apium* are ongoing by Ann Ronse in Belgium. Identification is not always easy, there being possible confusion with a prostrate meadow form (plastodeme) of *A. nodiflorum.* A number of infraspecific taxa have been proposed but are not in general use. A hybrid between *A. repens* and *A. nodiflorum* (A. x *longipedunculatum* (F. W. Schultz) Rothm.) has been put forward, but its existence is not supported by DNA studies.

## 4. Vegetation

Annual vegetation monitoring on Port Meadow, combined with earlier records, has shown substantial changes from domination by perennials characteristic of MG13 *Agrostis stolonifera – Alopecurus geniculatus* flood-plain grassland, to loss of these perennials and inclusion of ruderal species characteristic of various Open Vegetation Associations of the National Vegetation Classification. Comparisons of life-form and Ellenberg Indicator Values showed little resemblance between *Apium repens* and associated species. No companion species was identified. The water-table on Port Meadow was found by David Gowing to be freely connected to the gravel aquifer rather than to the river level.

## 5. Population studies

The population of *Apium repens* has varied widely from year to year in its numbers and its distribution. Summer fouling (soil anoxia) in some years caused loss of mature plants which were made up by vegetation spread and by seedling emergence in July and August. Germination during June- August was abundant in some years, often following soil anoxia events. For reasons which are unclear, flowering varied between sites and years.

## 6. Experimental studies

Simple experiments suggested that *Apium repens* has only a low level of self-fertility, but does set fertile seed when out-crossed. Experiments showed that *Apium repens* responds to submergence during the summer by losing its rooted attachment to the soil and floating to the surface, where it later succumbed.

## 7. Habitat requirements

*Apium repens* flourishes where there is plenty of light, including high levels of summer sunshine, and the soil is moist. It tolerates winter-flooding but it and its associated species are killed by early summer-flooding with soil anoxia. On these occasions there is an increase in the extent of bare ground and annual species as well as *A. repens* germinate. Grazing is essential to keep down the accompanying vegetation and does not inhibit *A. repens* which generally lies below the level of grazing teeth.

## 8. Threats and factors leading to loss or decline

Summer flooding causes loss of plants but is beneficial because it opens the sward created associated bare ground thus providing germination sites. However, too many of these events may deplete the seedbank. Grazing is essential to maintain a low sward with trampled areas and provide plenty of light. The invasive alien *Crassula helmsii* is a potential threat.

## 9. Conservation actions

Monitoring will need to be continued under present protocols at existing sites.

Further monitoring of the restoration site at Langel Common, to be followed, if *Apium repens* does not reappear, by a reintroduction at this or another site.

The eradication of *Crassula helmsii* from the Oxford Meadows SAC.

## 10. Future research

There is extensive experience and interest in *Apium repens* in other European countries. All would benefit from continuing to exchange information and ideas.

Clive Stace has offered to do chromosome counts and this should be taken up in conjunction with voucher specimens.

A repeat of the 2003 hydroecology survey methodology should be undertaken when appropriate.

*Apium repens* may be frost sensitive, but this has still to be tested experimentally and it would be informative to do so.

The longevity of seed in the soil under natural conditions has not been studied, but is important as the seed bank on Port Meadow is likely to be declining at present.

*Apium repens* appears to be sensitive to some grazing, possibly more so than *Apium nodiflorum* which is notoriously poisonous, but this has not been studied.

# Contents

Research Information Note

# 1 Introduction

## 1.1 General introduction

Creeping marshwort, *Apium repens*, Apiaceae, is a small perennial which grows in flood-prone pastures **(Photo 1.1)**. It has always been uncommon both in the UK and Europe where it is recorded from Denmark to the Czech Republic, south to Italy and west to the Canary Islands. *Apium repens* was listed in Appendix I of the Bern Convention 1982 by the Council of Europe. However, outside Europe it is not rare where it grows in the Atlas Mountains of Morocco (See Section 2.1.1).

**Photo 1.1** Creeping marshwort, *Apium repens*, at Binsey Green, Oxford, growing uncharacteristically among rather tall vegetation including *Carex riparia*. Photo by F.H. Watkins.

Following the Earth Summit on Biodiversity at Rio de Janiero in 1992, *Apium repens* was listed in Annexes II and IV of the European Union Directive on the Conservation of Habitats and Wild Fauna and Flora. In the UK, the Joint Nature Conservation Committee (JNCC) initiated a search in 1994 which revealed that *Apium repens* was known only at one UK site – Port Meadow in Oxford. The JNCC then funded and set in train both research and conservation action. **Table 1.1** shows a timeline of events. A workshop was held at the University of Oxford Department of Plant Sciences in 1994 which drew together what little knowledge was available, and a Species Action Plan was drafted by C.R. Lambrick in the spring of 1995. English Nature then put *Apium repens* into its Species Recovery Programme and contracted the Rare Plants Group (RPG) of the Ashmolean Natural History Society of Oxfordshire to undertake experimental, monitoring and introduction work. This report is an account of that work.

**Table 1.1 Timeline of events in the Species Recovery Programme for *Apium repens***

| | |
|---|---|
| 1982 | Listed in Appendix I of the Bern Convention by the Council of Europe |
| 1992 | The Convention on Biological Diversity adopted at the Earth Summit in Rio de Janiero. |
| 1992 | Listed in Annexes II and IV of the European Union Directive on the Conservation of Habitats and Wild Fauna and Flora. |
| 1994 | JNCC asked Q.C.B. Cronk of Plant Sciences Dept for information on *Apium repens*. |
| | Workshop held at the University of Oxford Department of Plant Sciences. |
| 1995 | Species Action Plan drafted. |
| | Rare Plants Group of the Ashmolean Natural History Society of Oxfordshire appointed to carry out survey, monitoring and introduction work. |
| | DNA study by N.C. Grassly, S.A. Harris and Q.C.B. Cronk. |
| | Annual monitoring of *Apium repens* on Port Meadow started. |
| | Search at Scottish and Yorkshire sites by Q.C.B. Cronk. |
| | Workshop held at the University of Oxford Field Station at Wytham. |
| 1996 | Population found at Burgess Field corner on Port Meadow. |
| | Pollination experiment carried out. |
| | Introduction of population at North Hinksey. |
| | Introduction of plants at New Marston. |
| 1997 | Visit to the Netherlands and Belgium by three members of the Rare Plants Group. |
| | Further introduction of plants at New Marston, Oxford. |
| 1998 | Water Management Plan for Port Meadow developed by the Environment Agency. |
| | Port Meadow included as part of the Oxford Meadows candidate Special Area of Conservation. |
| | Binsey Green population found. |
| | *Crassula helmsii* found at the north end of Port Meadow. |
| 2000 | Submergence experiment set up at the Botanic Gardens, University of Oxford. |
| | Scrape dug at Langel Common, Witney, by the Environment Agency. |
| 2002 | Population found at Walthamstow Marshes SSSI, Essex, by Brian Wurzell. |
| 2003 | Hydroecological study carried out by David Gowing for the Environment Agency. |
| 2004 | Binsey Green declared a CWS – County Wildlife Site. |
| 2005 | *Apium repens* International Workshop held at Wytham, Oxford, 17 September. |

Port Meadow, where the main UK populations of the plant grow (cover photo), was put forward under European legislation, as part of the Oxford Meadows Special Area of Conservation, and the Environment Agency (EA) became involved to develop a Water Management Plan and assess whether or not water abstraction licences were having significant impacts on *Apium repens*. The EA then funded a hydroecological study of Port Meadow by David Gowing, of Cranfield and the Open Universities. This work has greatly extended the understanding of the hydrology and vegetation types of the area, and is partially discussed here and in Gowing and Youngs (2005). The study also recommended further research on the effects of hydrology on *Apium repens*.

## 1.2 Morphology and nomenclature

The stems of *Apium repens* are prostrate and root at each node. The leaves are pinnately lobed with the lobes coarsely toothed. One of the indentations between the teeth, particularly in the third pair of leaves from the base, is much deeper than the others **(Figure 1.1).** This is the most useful field character distinguishing *Apium repens* from *A. nodiflorum*, the colour of the leaves is usually pale, rather yellowish green. The petiole is slightly inflated at the base, much less so than in *A. nodiflorum*. The peduncle is much longer than the pedicels, usually 1.5 – 4 (-6) cm, holding the inflorescence clear of the leaves. The bract number is also distinctive with 2-6 bracts in *Apium repens* and 0-1 (-2) in *A. nodiflorum*. The flowers are small with equal, white petals. The two species also differ in fruit proportions, the fruit is

wider in *A. repens* **(Figure 1.1)** and the ridges are narrower. These differences are tabulated in Rich and Jermy (1998).

The nomenclatural and morphological distinctions between *Apium repens* (Jacq.) Lag. and *A. nodiflorum* (L.) Lag. have not always been clear. *Apium repens* has changed its name several times while *A. nodiflorum* has had many varieties named, and there is the possibility of the hybrid (*A. x longipedunculatum*), described in Stace (1997) (see Chapter 3). *Apium nodiflorum* has a high phenotypic plasticity with a small, prostrate form growing in grazed pastures. Typical *A. repens* is illustrated in **Figure 1.1**.

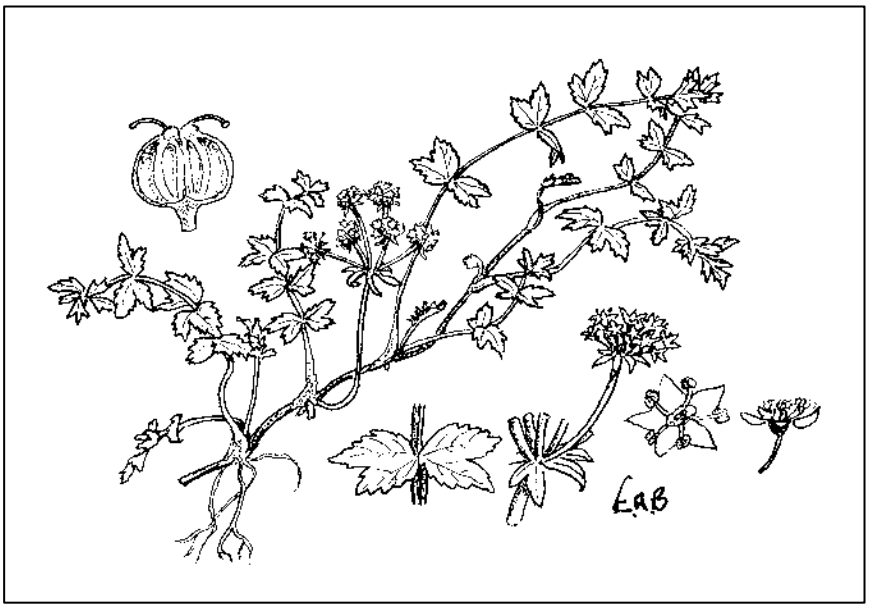



**Figure 1.1** Typical *Apium repens* from Port Meadow. Drawn by Elspeth Beckett 1997.

## 1.3 Aims of the Species Action Plan

The full Species Action Plan is given in Appendix 1; progress towards the Action Plan objectives and targets is briefly summarised below:

**Objectives and targets**

**1. Maintain the population at the Oxfordshire site. Revised**

This objective has largely been realized. The population at the south end of Port Meadow in 2004 was higher than in 1995, though numbers fluctuate considerably from year to year, with mature plants having been lost in four years. The population recovered, however, aided by germination of seeds in the seed-bank. In addition, a small population was found in 1996 midway along Port Meadow, at Burgess Field corner.

**2. Restore two Thames Valley sites by 2005. Revised from five sites**

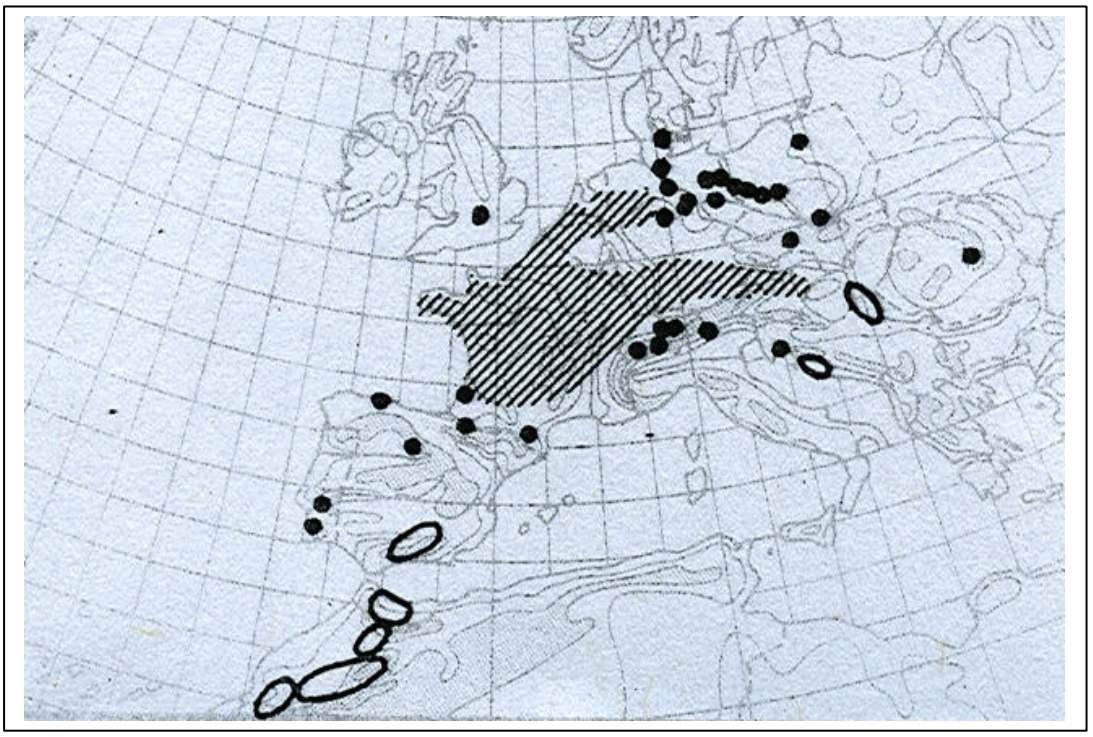
In 1996 *Apium repens* was introduced to two sites on the Thames flood-plain close to Oxford and is maintaining itself at one (North Hinksey). Work is still underway at another potential restoration site (Langel Common, West Oxfordshire). Searches for suitable sites for further re-introduction have been undertaken but not produced any obvious candidates. *Apium repens*

has reappeared at one site in Oxford (Binsey Green County Wildlife Site) following restoration of the habitat, and ditch maintenance led to its reappearance in Essex, at Walthamstow Marshes SSSI. The revised target has therefore been met.

# 2 Distribution

## 2.1 World distribution

*Apium repens* is found in Europe and North Africa where it has been recorded from the High Atlas in Morocco **(Map. 2.1).**



**Map 2.1.** World distribution of *Apium repens* after Hulten and Fries (1986). Dots, hatching and loops all show *A. repens* distribution. It also occurs in the Canary Islands.

### 2.1.1 African distribution

Dr. Heike Culmsee (Dept. of Vegetation and Phytodiversity Analysis, Albrecht-von-Haller-Institute for Plant Sciences, University of Goettingen, Untere Karspuele 2, D-37073 Goettingen, Germany) works in the High Atlas Mountains of Morocco. She found the following note in the Catalogue des Plantes du Maroc "*Helosciadium repens* (Jacq.) Koch – Bords des ruisseau et des lacs, prairies tourbeuses des montagnes, jusque vers 2,300 m – Juin-août. R.S. – MA. GA. Aire géogr. – Europe occident, et centr." Valdés and others (2002) give the following distribution: "Rif, Tarquist, Tazzeka". See also Valdés (1996).

## 2.2 European distribution

### 2.2.1 European except Belgium and the Netherlands

In Europe, *Apium repens* is found in Denmark, Belgium, Holland, France, Germany, Czech Republic, Poland, Hungary, Austria, Switzerland, Italy, Slovenia, Spain, Portugal and the Canary Islands. Details have been investigated in the Netherlands and Belgium, otherwise only the following information has been obtained:

**Germany:** Seed from the Dresden Botanical Garden was obtained from the Garden at Halle which had obtained it from the wild (1983, no. 153) at Müritz-See, Waren, Mecklenburg. More information is available from Lederbogen and others (2004).

**France:** *Apium repens* is listed as occurring in five Departements: Centre, Bourgogne, Nord-pas-de-Calais and Picardie (Danton and Baffray 1995). Hendoux (2001) reported that *Apium repens* is present in several valleys in the Nord-Pas-de-Calais and also in several dune systems.

**Spain:** Dr. Emilio Laguna, Lot Wildlife Services, Service of Biodiversity Conservation, Government of the Valencian Community (Generalitat Valenciana) is working on *A. repens.*

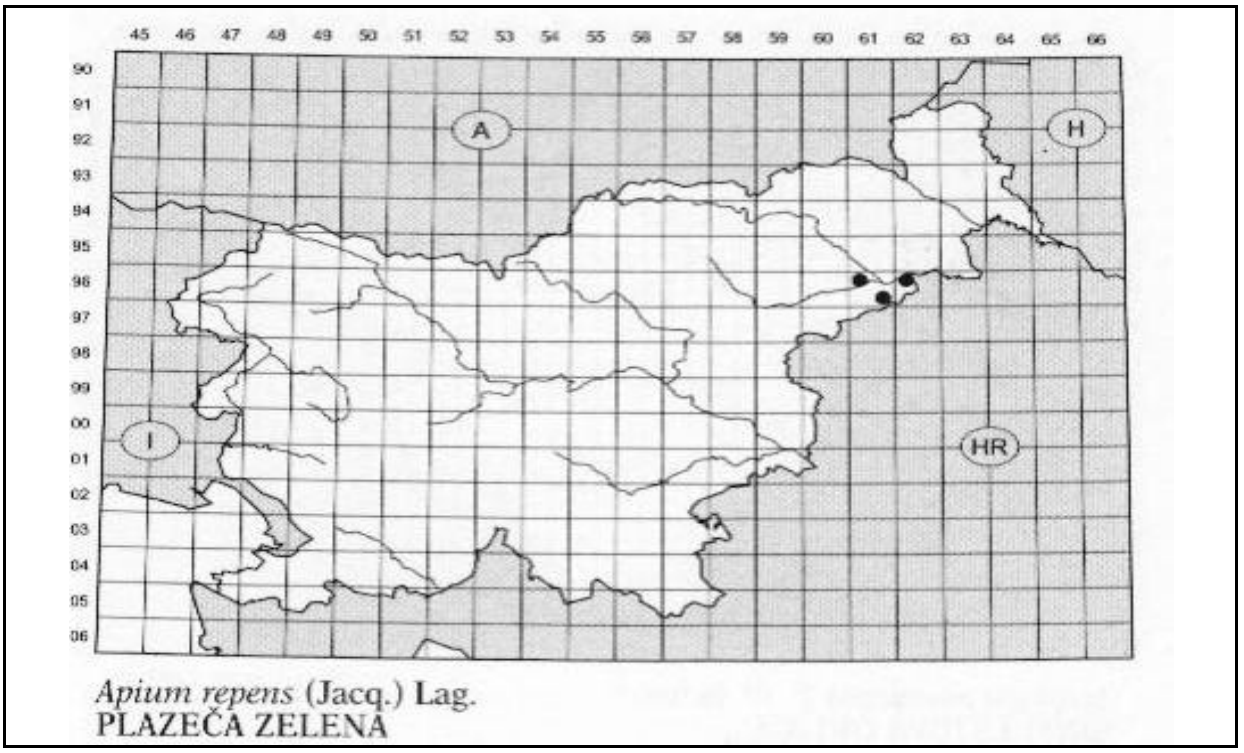
**Portugal:** Alison McDonald viewed the specimens in the Herbarium of the University of Lisbon but found no new records.

**Slovenia:** Dr. Mitja Kaligaric, University of Maribor, is preparing a LIFE Nature funds application for a project which includes, amongst other topics, the reinforcement of the Slovenian population of *A. repens.*

*Apium repens* was found along the Drava river at Središce ob Dravi, in the north-east of Slovenia **(Map 2.2)**. In 1924 the *Apium repens* found at Labacensi is thought to have been growing in alluvial grassland; a herbarium specimen of it is preserved in the Herbarium of the University of Ljubljiana **(Figure 2.1)**. Cušin and others (2004) contains a section on *Apium repens* by Nejk Jogan with the following:

> *"Apium repens* is a tiny umbellifera of open wet places. It can be easily recognized by its rooting stem nodes, although it is sometimes hard to distinguish it from the narrowly related *A. nodiflorum*, which has not yet been found in the territory of Slovenia. In Slovenia, the occurrence of *A. repens* has been recently confirmed on only one locality on well preserved gravel deposits along the Drava River at Središce ob Dravi. Before that, it was recorded only in the second half of 19$^{th}$ century on three localities, also along the Drava river.
>
> Its habitat strongly depends on the preserved natural river dynamics, which regularly forms open wet habitats on sand and gravel, where pioneer vegetation can develop. Human activities which have the highest negative impact on the population of *A. repens* are changing of the river dynamics, large-scale extraction of gravel, eutrophication, and to certain extent also sport fishing (frequent trampling of habitats); but on the other hand, the population is threatened also by natural processes of vegetation succession. The temporal and spatial patchy vegetation dynamics on sand and gravel deposits along the big rivers can be preserved only if human interference into the natural riverbed area is minimized." (see **Photo 2.1**)

The Slovenian text of this summary has been translated into English by Dr. Gerry Stone of the University of Oxford .




**Map 2.2.** Distribution of *Apium repens* in Slovenia. Dots represent locations along the Drava River. In Cušin and others (2004).

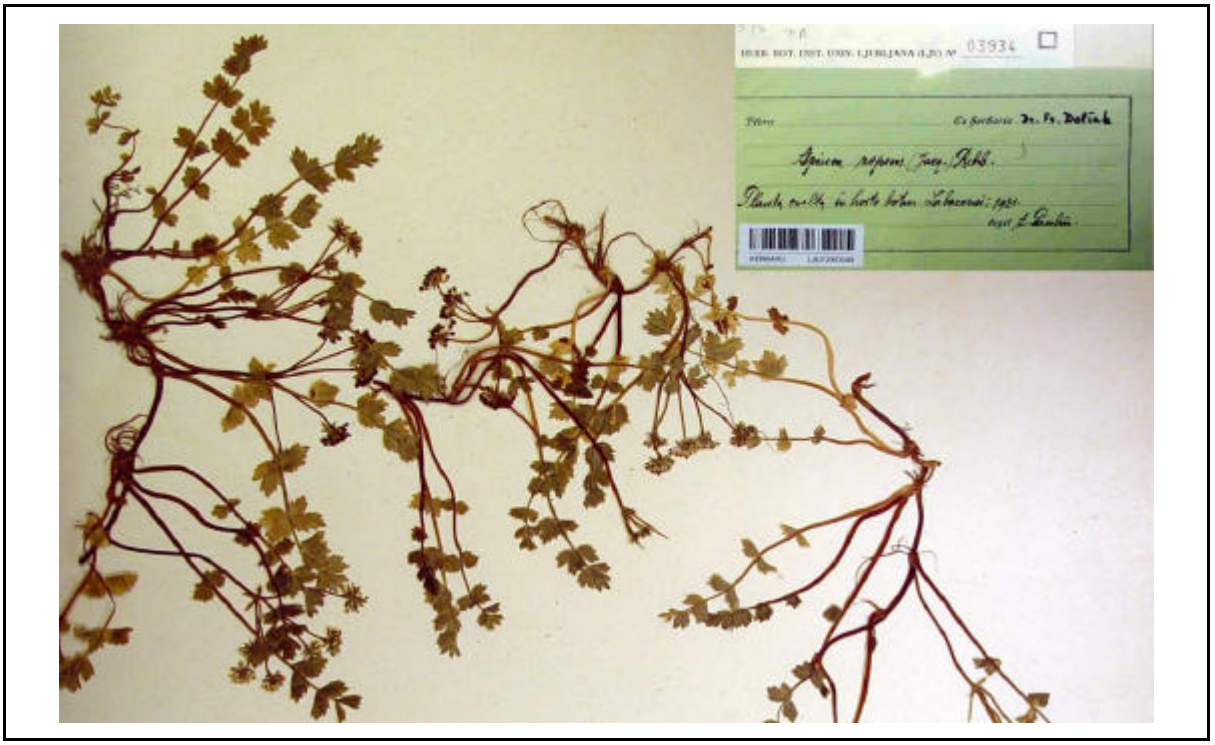


**Figure 2.1** Herbarium specimen of *Apium repens* found at Labacensi in 1924 in the herbarium of the University of Lljubljani. In Cušin and others (2004). Photo by L.N. Jogan.

Prodišča Drave pri Ormožu – predlog pSCI za plazečo zeleno. Obstoj nekaterim rastlinam omogoča le naravna rečna dinamika. V nasprotnem bi človek moral vzdrževati rečne bregove v inicialnem stanju. Foto M. Govedič.

**Photo 2.1.** The Drava river in the north-east of Slovenia when *Apium repens* was observed recently. Photo by M. Goredie. In Cušin and others (2004).

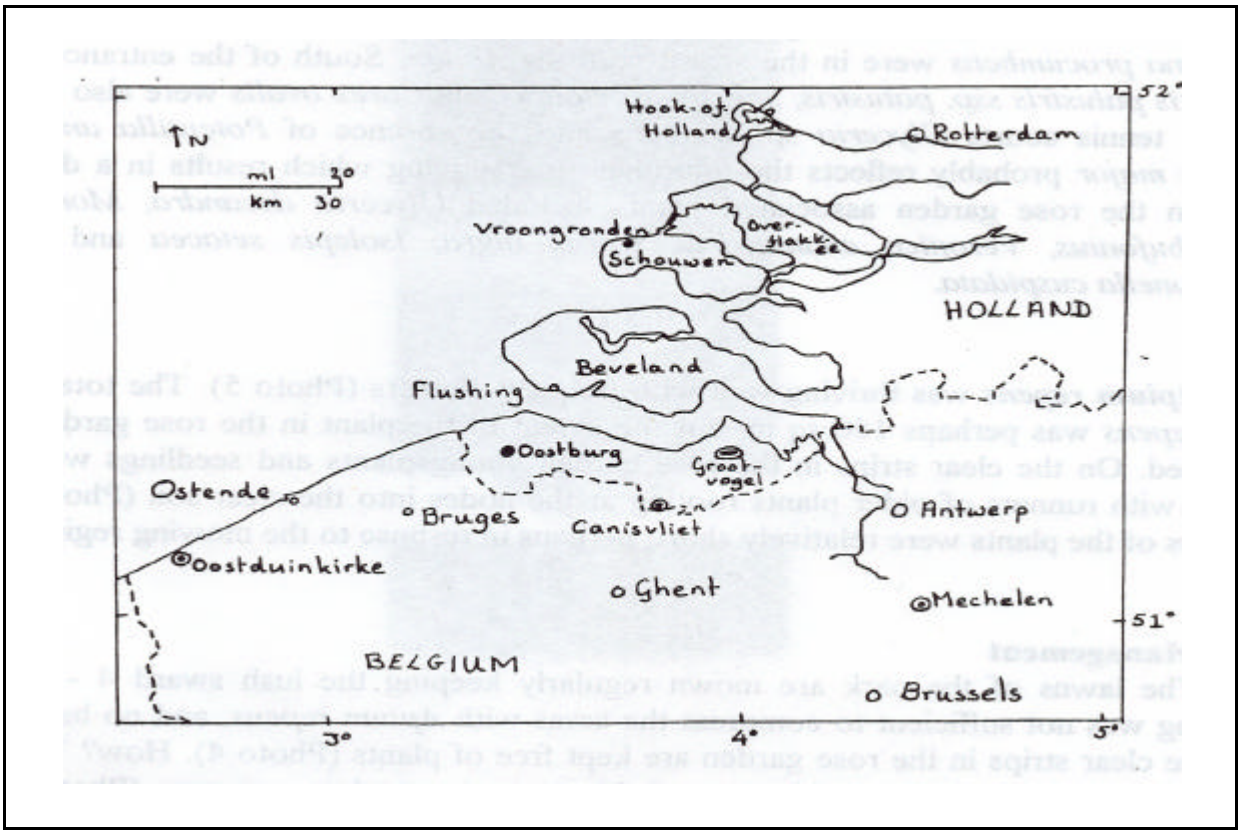
### 2.2.2 Belgium and the Netherlands

#### 2.2.2.1 Introduction

Contact with workers in Belgium and the Netherlands was started in 1997 and in 2005 Wim van Wijngaarden, Peter Maas and Dr. Anne Ronse contributed to a Workshop held at Wytham near Oxford (Lambrick and McDonald in prep.). Dr. Ronse of the National Herbarium of Belgium is undertaking an extensive study of the conservation biology of *A. repens* (Ronse and Vanhecke 2004).

#### 2.2.2.2 Distribution and habitats

In early August 1997, English Nature funded a visit to seven *Apium repens* sites in Holland and Belgium. Alison McDonald, Kathy Warden and Camilla Lambrick were taken to the sites by Prof. Karlé Sykora, Wim van Wijngaarden and Marc Leten from Belgian Government Agency **(Map 2.3.).** *Apium repens* was found at five sites but not at the other two, though it had been seen recently (Appendix 2). A list of Latin names and their English equivalents mentioned in the text is given in Appendix 7. Morphological information was recorded as shown in **Table 2.1**, and all the material found was confidently identified as *Apium repens*.




**Map 2.3.** Sites in Belgium and the Netherlands, shown by black dots, visited by the Rare Plants Group in 1997. Map drawn by C.R. Lambrick.

**Table 2.1. Morphological characters of *Apium repens* on Port Meadow and Belgium and the Netherlands. The site is shown in column 1; peduncle length (minimum, mean of 10 values, and maximum) in columns 2 - 4; bract number (minimum, mean of 10 values, and maximum) in columns 5 – 7, and leaf indentation range in column 8.**

| Site | Peduncle length (cm) | | | Number of bracts | | | Leaf indentation |
|---|---|---|---|---|---|---|---|
| Port Meadow, N. pop. 1995 | 1 | 1.9 | 3 | 2 | 4.1 | 6 | ¼-½ |
| Vrijbroekpark | 2 | 2.5 | 3 | 3 | 4.2 | 6 | |
| Grootvogel north | 4 | 8.1 | 12 | 0 | 3.1 | 5 | ¼-½ |
| Grootvogel south | 1 | 2.3 | 5 | 2 | 4.3 | 5 | ¼-½ |
| Canisvliet north | 4 | 5.4 | 7 | 5 | 5.2 | 6 | |
| Canisvliet south | 2 | 4.1 | 9 | 5 | 5.4 | 6 | ¼-½ |
| Oostvoorduinen pond A | 2.5 | 4 | 7 | 4 | 5 | 5 | ¼-½ |
| Oostvoorduinen pond B | 1.5 | 3.1 | 7 | 3 | 4.6 | 6 | ¼-½ |

The conditions in which *Apium repens* was growing were surprisingly different from those found in England in that it was growing in mown lawns between rose beds in a Municipal garden and in seasonal ponds among stabilised sand dunes within half a mile of the sea. *Apium repens* was found associated with a range of plants, mostly the same species as at Port Meadow, but also with others including brackish-water species (Appendix 2). *Apium repens* thrived in short turf with a fluctuating water table similar to that which it enjoys on Port Meadow. There was clear evidence that leaving the vegetation to grow tall is fatal to this species. A suggestion that absence of flooding could lead to frost damage was made by

Wim van Wijngaarden. Full details of the findings are given in the Report to English Nature (Lambrick, McDonald and Warden 1997).

In order to compare the European and UK material various morphological variables were recorded during the1997 visit (see section 2.3). The characters chosen were those which distinguish *Apium repens* from *A. nodiflorum* and in which the UK population might differ if the population had been hybridizing. For each of ten plants at each site we recorded peduncle length, bract number and lobing of third leaflet from the base **(Table 2.1)**. The plants varied in peduncle length, having short peduncles in the mown areas in Vrijbroekpark similar to the British material; while the population at Grootvogel north had become very etiolated in the surrounding tall herb vegetation with correspondingly long peduncles **(Photo 2.3.)**. In one case bract number was as low as none; on Port Meadow such low numbers of bracts are thought to be associated with *A. nodiflorum*. Leaflet indentation was consistently similar in both the Low Countries and the UK. The degree of lobing is illustrated on the proforma used to record *Apium repens* on Port Meadow (Appendix 5).

#### 2.2.2.3 Vrijbroekpark, Mechelen, Belgium

This is a municipal park, formerly common grazing marsh, now including a rose garden in which raised beds are set between damp lawns with ornamental sunken paths kept almost free of plants. **(Photo 2.2)**. The soil is sandy with a little organic and silty material. The water-table here fluctuates, probably covering the *Apium repens* areas in several centimetres of water during wet periods in the winter. At the time of our visit it was in a "wet knees" condition and it was thought that there might be locally impeded drainage.

*Apium repens* was growing in four areas mown to 4-5 cm tall. The sward was dominated by *Trifolium repens, Agrostis stolonifera, Poa trivialis, Lolium perenne* and *Cardamine pratensis,* with some *Anthoxanthum odoratum* and *Bellis perennis* and occasional *Trifolium fragiferum* and *Galium palustre*. Near the entrance to the gardens *Anthoxanthum odoratum, Holcus lanatus* and *Sagina procumbens* were in the sward with *Apium repens.* South of the entrance *Eleocharis palustris ssp. palustris, Juncus articulatus* and *Carex ovalis* were also associated. Near the tennis courts *Glyceria* sp. was present. The absence of *Potentilla anserina* and *Plantago major,* which are companion species on Port Meadow, probably reflects the low level of trampling which results in a dense, thick sward. In the Rose Garden associated plants included *Glyceria decandra, Montia verna, Juncus bufonius, Veronica chamaedrys, Carex nigra, Isolepis setacea* and *Calligeronella cuspidata. Apium repens* was thriving with frequent flowers. The total area with *Apium repens* was perhaps 150 $m^2$. On the clear paths in the Rose Garden many young plants and seedlings were present together with runners of older plants rooting at the nodes into the open gravely soil**.** The peduncles of the freely flowering plants were relatively short thus allowing survival under the current mowing regime.

**Photo 2.2.** Vrijbroekpark, Mechelen, Belgium. The Rose Garden showing the damp lawns and gravel paths which were colonized by *Apium repens.* Photo by A.W. McDonald

#### 2.2.2.4 Grootvogel north, Hengstdijk, Zeeuws-Vlaanderen, Zeeland, the Netherlands

*Apium repens* was found in a strip of grassland some 20 m wide lying between a bed of *Phragmites australis* fringing the lake (Grootvogel or de Vogel Kreek) and a belt of *Alnus glutinosa, Salix* spp. and *Crataegus monogyna.* The soil was very dark indicating high organic content but with some sand. The water in the adjacent lake is slightly brackish but the salt is mostly held back from the meadow by the *Phragmites.* The water-table fluctuates considerably and the area with *Apium repens* was saturated at the time of the visit. When seen 20 years ago by Karlé Sykora the area was a dark green, grazed pasture.

In 1997 grassland had just been cut leaving islands of vegetation 1 m tall which consisted of abundant *Phragmites australis, Juncus articulatus, Oenanthe lachenalii, Poa trivialis, Samolus valerandi* and *Carex disticha.* Some of the cut hay had been removed and heaped at the wooded side of the site. *Apium repens* was first found at this site in 1983 by Peter Maas. Fewer than 100 plants were seen in 1997 mostly in a strip 60 m long, 1-4 m from the uncut *Phragmites*. It was flowering freely but the stems were very etiolated and with peduncles averaging 8 cm long **(Photo 2.3)**.

**Photo 2.3.** Grootvogel north, The Netherlands: etiolated plants of *Apium repens* among *Phragmites* stems. Photo by A. W. McDonald.

#### 2.2.2.5 Grootvogel south, Hengstdijk, Zeeuws-Vlaanderen, Prov. Zeeland, the Netherlands

This small field lies on a gentle slope between an arable field and Grootvogel (the De Vogel lake) **(Photo 2.4)**. The bank of the lake has been reinforced with blocks reducing the area of marginal vegetation and improving access for fishing and recreation. The field is generally species-poor and had a strong dark green colour with quite tall lush *Lolium perenne* suggesting nutrient enrichment. Twelve flowering plants of *Apium repens* were growing in an area some 2 x 3 m. The sward was short (2-15 cm) and poached. *Cardamine pratensis, Triglochin palustre, Ranunculus sardous* and *Trifolium fragiferum* were present. The adjacent field eastwards contained some species suggesting brackish influence *Scirpus cariciformis, Glaux maritima* and *Juncus gerardii.* The field contained no stock when visited but was evidently grazed by cattle and geese.

**Photo 2.4.** Grootvogel south, The Netherlands, the area with *Apium repens.* Brackish indicator plants occur just beyond fence on right. Camilla Lambrick left, with Wim van Wijngaarden, Marc Leten standing and Karlé Sykora to right. Photo by A. W. McDonald.

### 2.2.2.6 Canisvliet Reserve, Westdorpe, Sas-van-Gent, Zeeuws-Vlaanderen, the Netherlands

The vegetation is a mosaic of tall clumps of *Juncus inflexus* interspaced with short tightly cattle grazed sward with abundant *Agrostis stolonifera, Juncus articulatus, Ranunculus repens, Trifolium repens* and *T. fragiferum* with some *Glyceria declinata, Eleocharis palustris* and *Cardamine pratensis. Apium repens* was frequent in the short sward **(Photo 2.5)** parts of the northern field particularly towards the waterside. It was found in at least 10 patches and was flowering well. Maas (1999) reported that the plant is still there. Grazing was discontinued in c.1987, and when the site was visited by Peter Maas in 1993 no plants were seen. P. Maas then arranged with the owner for annual cutting *Apium repens* reappeared and increased but decreased again in 1997. In 1998 it was present in two patches (Maas 2004) but the vegetation had lost unusual species such as *Blysmus compressus* and *Oenanthe aquatica*.

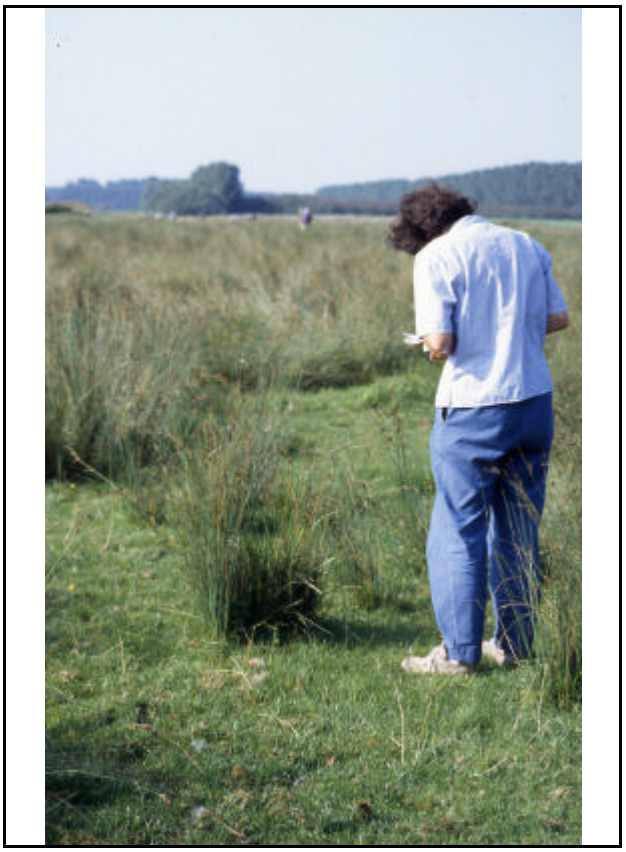


**Photo 2.5.** Canisvliet, the Netherlands, showing tall *Juncus inflexus* among which are patches of closely grazed sward in which *Apium repens* was growing. Camilla Lambrick recording associated species. Photo by A.W. McDonald.

### 2.2.2.7 Oostvoorduinen, near Oostduinkerke, Belgium

This is an area of well-vegetated low calcareous dunes about 1.5 km from the sea. The area is surrounded by housing and is used extensively for recreation. Grazing is sporadic though it was heavily grazed in 1996. The margins of three ponds were inspected. The origin of the ponds may have been First World War bomb craters and they have probably been kept dug out to provide water for cattle. The soil at the base of the drying ponds was quite dark with organic matter. At one pond trampling had created a mosaic of tall and very short vegetation **(Photo 2.6)**. *Apium repens* was formerly been abundant but had been searched for in vain during the early summer 1997. In August the grass had become dense and a few *A. repens*

were flowering and there were also numerous (50 – 100) seedlings on bare soil in the very short areas. One possibility is that a major part of the population had been killed by frost and seeds had germinated during the summer. An *Arrhenatheretum elatioris* Association grew on the upper slopes and *Lolio-Potentillion* below, with a zone of dense *Eleocharis palustris* and *Agrostis stolonifera* below that. The centre of the pond contained *Alisma plantago-aquatica, Lemna major* and *Glyceria declinata.* The maximum water-table fluctuation in the pond is probably c. 1.4 m. The *Apium repens* was mostly in the *Lolio-Potentillion* but with some plants above and below.

**Photo 2.6.**
Oostvoorduinen Oostduinkerke, the Netherlands, west pond A: showing zonation of vegetation with *Arrhenatheretum* inside the string quadrat and *Eleocharis* in the wettest part (lower right hand corner). Photo by A.W. McDonald.

At pond B the water had all dried up and *Chenopodium rubrum, Bidens tripartita, Veronica catenata* and *Ranunculus batrachium* were growing on the exposed mud which was dark with organic matter and probably also nutrient enriched. Around the sides there were *Rumex crispus, Juncus inflexus* and *Potentilla reptans.* There was a small (5 – 10) population of mature flowering *Apium repens.* A third pond had *Apium nodiflorum* but no *A. repens.*

### 2.2.2.8 De Plate, Oostburg, west Zeeuws-Vlaanderen, the Netherlands

This site was a hay field traversed by damp ditches. The soil was sandy (with marine shells). The ditches contained a dense uncut sward of *Eleocharis palustris* and *Agrostis stolonifera* about 30 – 40 cm high. Also present were *Juncus articulatus, J. bufonius, J. compressus, Schoenoplectus tabernaemontani, Bolboschoenus maritimus* and *Rorippa islandica.* At one margin some annuals survived including *Centaurium pulchellum* and *Filago uliginosus***.** *Apium repens* was recorded in 1991 but not in 1997 or subsequently (Maas 1999).

#### 2.2.2.9 Vroongronden Common Reserve, Schouwen Island, Zeeland

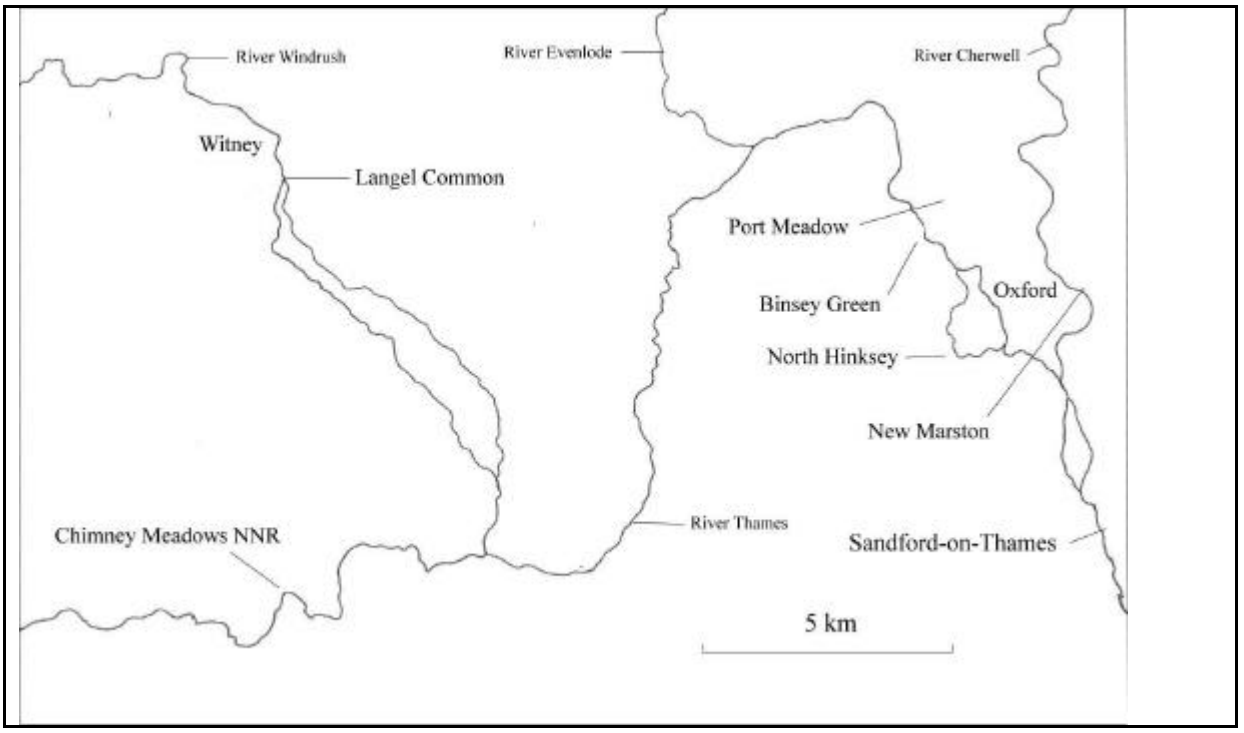
This nature reserve comprises former common land which was grazed by cattle with perhaps a few horses. The site is within 2 km of the sea and the soil is sand with almost no organic matter. *Apium repens* had been growing in 1994 around a pond containing *Chara* sp. which has a water-level fluctuating by *c.* 1 m **(Photo 2.7)**. The vegetation was very short (*c.* 2 cm) and open. *Potentilla anserina* and *Agrostis stolonifera* were an abundant component of this area which also contained many of the Port Meadow associates of *Apium repens* such as *Oenanthe fistulosa, Galium palustre, Eleocharis* sp., *Juncus articulatus, Trifolium repens, T. fragiferum, Ranunculus flammula* and *Mentha aquatica* as well as *Juncus ambiguus, Hydrocotyle* sp., *Carex oederi* and *Plantago intermedia*. The latter was present on Sanda Island, a Scottish site where *Apium repens* is now extinct.

**Photo 2.7.** Vroongronden, the Netherlands, pond with fluctuating water-table close to the sea. Kathy Warden searching for *Apium repens* which had been found recently but was not refound in 1997. Photo by A.W. McDonald.

A number of annuals were also present such as *Linum catharticum, Cerastium fontanum, Anagalis minima, Radiola minima* and *Juncus bufonius*. It is possible that the combination of low water-table and frost had caused damage here as seemed likely at Oostduinkerke. Subsequent searches have been unsuccessful (Maas 1996).

## 2.3 British sites

*Apium repens* has always been rare in the UK, with scattered sites as far north as southern Scotland. There has been no systematic search of herbaria or floras, but the main concentration appears to have been in the Thames basin with three sites close to Oxford **(Map 2.4)**.



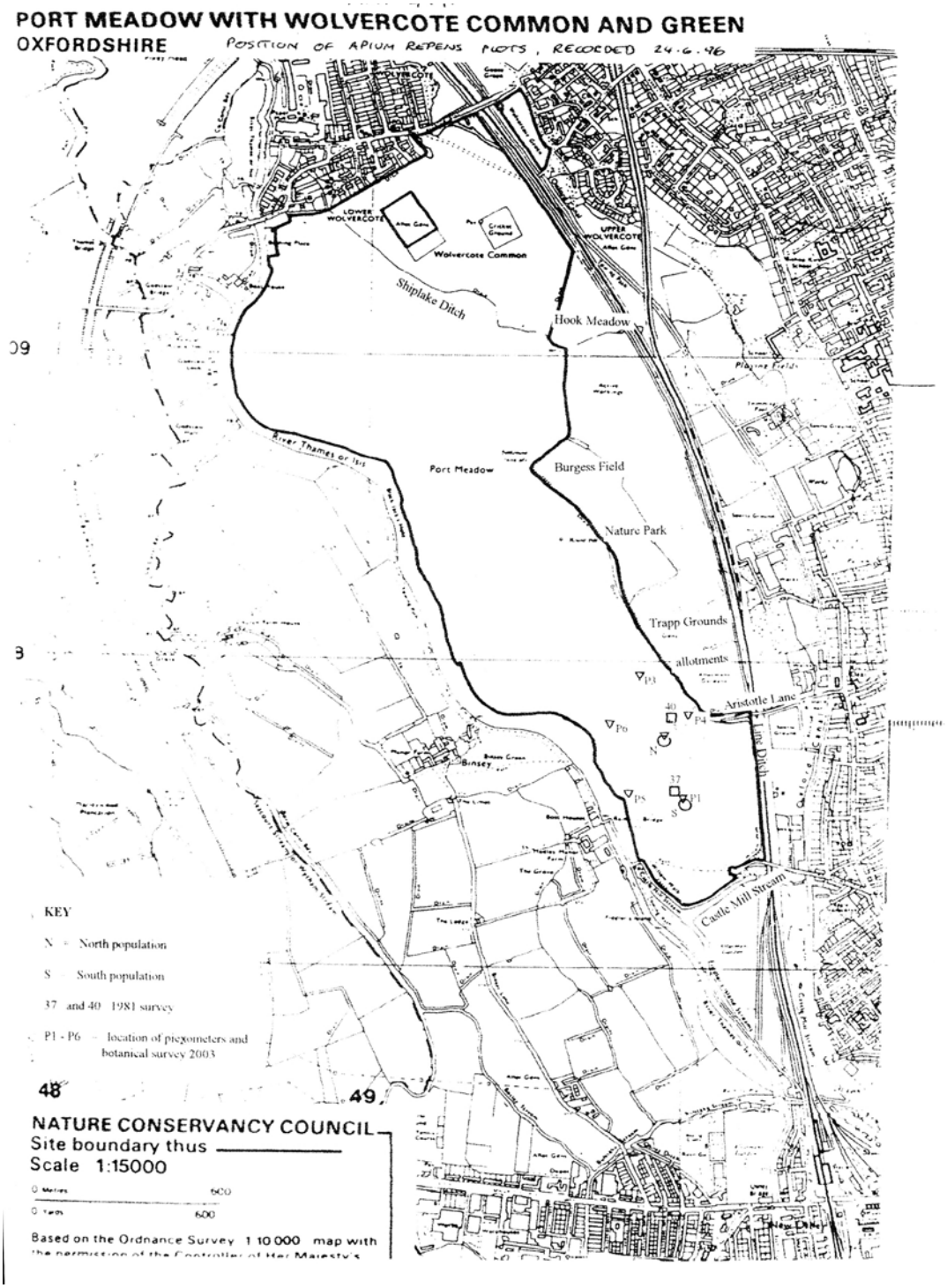

**Map 2.4.** The Oxford area showing: four historic sites including Port Meadow (main population), Binsey Green (now restored), Langel Common (restoration in progress), Sandford-on-Thames (not re-found); two introduction sites, North Hinksey (successful) and New Marston (unsuccessful); and one proposed experimental site, Chimney Meadows.

### 2.3.1 Original site - Port Meadow SAC

Port Meadow is an extensive area of common land on the flood-plain of the River Thames which is now part of the Oxford Meadows Special Area of Conservation under European Union (EU) legislation (**photo on front cover and Photo 2.8)**. Its history and vegetation are described in Chapter 4.

**Photo 2.8.** Port Meadow in July 2004 looking north across the South and (in the far right) North population areas of *Apium repens.* Photo by C.R. Lambrick.

*Apium repens* is found in three main areas **(Map 2.5).** The North and South population areas at the south end of Port Meadow were known to various botanists prior to 1995, while the Aristotle Lane population was found by A.W. McDonald in 1981 (McDonald forthcoming) and the Burgess Field population by Joyce Thomas in 1996 **(Photo 2.9).** See Appendix 2 for species list.




**Map 2.5.** Map of Port Meadow and Wolvercote Common showing names of the surrounding areas and research plots. ▼= 2003 six survey plots and location of peizometers, ● = North (N) and South (S) populations, ■ = 1981 survey plots 37 and 40.

*Apium repens* was recorded from the north end of Wolvercote Common and Shiplake Ditch (**Map 2.5**) by H.J.M. Bowen in 1969, and searches have been made in these areas without success.

**Photo 2.9**. Burgess Field Corner, Port Meadow. Susan Erskine and Alison McDonald finding that the original single patch had increased to two in 2004. Photo by C.R. Lambrick.

### 2.3.2 Restored sites

#### 2.3.2.1 Binsey Green County Wildlife Site, Oxford

Binsey Green is on the right bank of the River Thames opposite Port Meadow **(Map 2.4).** It was common land which was enclosed in the 20th century. It is slightly higher than Port Meadow so is less affected by flooding. *Apium repens* was recorded on the northern side by H.J.M. Bowen in 1969. The land was ploughed and cropped for some years during the 1970s. At the start of this study the field had been in "set aside". Restoration measures commissioned and funded by English Nature were begun in 1998 by the tenants Nick and Carolyne Ryecroft. Nettles and thistles were topped and there was rotational grazing by horses and cattle, and thistle topping. In September of that year 15 *Apium repens* plants were found in one patch on the eastern edge of the field **(Photo 2.10)**. In the summer of 1999 there were five patches. The return was reported in the *Oxford Times*.

**Photo 2.10**. Binsey Green, Oxford, area on east side where *Apium repens* was first found, with Susan Erskine. Photo by C.R. Lambrick.

In 2000 Charles Gee took over the lease for Binsey Green. Quadrats were recorded to follow the floristic progression from "set aside" to grassland under cattle-grazing. In 2000, the Binsey population flowered extremely well; whereas the population in 2003 was similar in size to 2002 but only four inflorescences were seen; suggesting this drier site does less well in dry years (discussed in section 5). In 2004, two patches were refound, their sizes were much as in 2003, three of the patches were not refound, these were in areas of longer vegetation, two with dense *Carex riparia.* One new patch was located.

The vegetation on Binsey Green has increased in diversity with 101 species recorded over the seven years (Appendix 3). The damp areas are dominated by *Agrostis stolonifera* with many of the species typical of MG13, such as *Eleocharis palustris*, *Mentha aquatica, Oenanthe fistulosa, Myosotis scorpioides, Veronica scutellata* and *Potentilla anserina* present at low frequencies. There is no bare ground, almost no poaching, and relatively few ruderals. Some rarer species include *Isolepis setacea, Juncus compressus* and *Persicaria mitis*. Binsey Green was designated a SLINC **(**Site of Local Importance for Nature Conservation) no. 42, in 2004 and a County Wildlife Site (CWS) in 2005.

#### 2.3.2.2 Walthamstow Marshes SSSI, Essex

In 2002, Brian Wurzell, checking the ditches on Walthamstow Marsh, in Lea Valley Regional Park, found young plants of *Apium repens* **(Photo 2.11).** This ditch had originally been dug in 1996 to benefit dragonflies, but had become filled with *Typha latifolia*. It was re-profiled in 2001 with a shelf, referred to as a conservation berm, just below winter water level. It is here that the *A. repens* was growing **(Photo 2.12**). Associated plants included *Agrostis stolonifera, Alisma plantago-aquatica, Apium nodiflorum, Bidens tripartita, Equisetum arvense, Glyceria declinata, Iris pseudacorus, Juncus inflexus, J. articulatus, J. effusus, Lycopus europaeus, Lythrum salicaria* and *Scrophularia nodosa*.

**Photo 2.11**. David Miller and Camilla Lambrick looking for *Apium repens* in a 'dragonfly' ditch made in 1996 and re-profiled in 2001. Photo by A.W. McDonald.

**Photo 2.12**. Young plants of *Apium repens* found by Brian Wurzell in a new ditch in Walthamstow Marshes SSSI, Essex, in 2002. Photo by A.W. McDonald.

The plants flowered with the characteristic long peduncle and many bracts of *Apium repens*. Alison McDonald and Camilla Lambrick confirmed that the plants were very similar to the forms on Port Meadow. The *Apium repens* almost certainly came up from buried seed, and it was found that there is a mention of the species at Walthamstow in the 19th century *Flora of Essex*. David Miller of the Lea Valley Park Rangers and English Nature were already keen to re-introduce cattle onto the marsh to control the dense vegetation. This was done in 2003, and there were five cattle in 2004. If cattle are brought in in early May in sufficient numbers they should be able to maintain the open conditions the plant requires. In the summer of 2004 *A. repens* had hundreds of inflorescences.

### 2.3.3 Introduction sites

#### 2.3.3.1 North Hinksey, Oxford

This is a flood-plain site adjacent to the Hinksey Stream on the west side of Oxford **(Map 2.4)**. It was ploughed in the 1970s but almost immediately the field was found to be unsuitable for arable cropping and it reverted to pasture. It is now owned by the Oxford Preservation Trust and grazed by ponies all the year round creating a suitably short sward **(Photo 2.13)**. There is no statutory protection. On 1 May 1996, 20 *A. repens* plants propagated by Kathy Warden at the University of Oxford Botanic Garden from the North and South areas of Port Meadow were planted out in two grids of 1 m spacing. The plants were monitored and watered during the summer. In November, 14 plants had survived, two had spread well but only six survived to October 1997, of which four were flowering and fruiting and two had formed large patches.

**Photo 2.13.** North Hinksey Meadows, Oxford. Horse grazed area where *Apium repens* was successfully introduced in 1996. Photo by C.R. Lambrick.

By 1998, the reintroduced plants were spreading and flowering, and in 1999 there were 25 patches with one filling about three square meters. They continued to spread during 2000 and coalesced into one large patch which measured 9 x 8 m in 2002, 9.2 x 6.7 m in 2003 and 9.5 x 5.5 m in 2004. In 2003 the area flowering was again prolific with 74 inflorescences counted, but in 2004 only 13 inflorescences were counted **(Figure 5.15)**.

The field has many species found on Port Meadow such as *Agrostis stolonifera* and *Mentha aquatica*, but lacks the wetter elements such as *Eleocharis palustris* and *Ranunculus flammula*. It also lacks the more unusual species such as *Oenanthe fistulosa* and *Veronica scutellata* (see list in Appendix 3).

### 2.3.3.2 New Marston Meadows SSSI, Oxford – unsuccessful introduction

This site lies alongside the River Cherwell to the northeast of Oxford and is flood-plain grassland **(Map 2.4)**. The field chosen was grazed by ponies in summer, but the vegetation became quite dense during the winter. The sward contained a suitable range of species including *Agrostis stolonifera, Alopecurus geniculatus, Ranunculus flammula, Eleocharis palustris, Oenanthe fistulosa, Glyceria fluitans, Mentha aquatica, Veronica scutellata, V.*

*catenata, Juncus articulatus, Cardamine pratensis, Myosotis scorpioides* and *Trifolium fragiferum*.

In December 1996, 48 *Apium repens* plants from Port Meadow stock were introduced by Kathy Warden of the University of Oxford Botanic Garden **(Photo 2.14).** Only two survived the winter, so replanting was done in May 1997. About half of these were seen in January 1998, but none survived the winter. This may have been due to the high water table, as on Port Meadow, or to competition from other plants, or being eaten by Canada geese, as some evidence was seen of leaves of *A. repens* which had been pulled off and there was much evidence of Canada geese. The site was deemed unsuitable and no further action taken.

**Photo 2.14.** New Marston Meadows SSSI, Oxford. Unsuccessful introduction site. Kathy Warden planting *Apium repens* in 1996. Photo. by C.R. Lambrick.

### 2.3.4 Restoration site

#### 2.3.4.1 Langel Common, Witney, West Oxfordshire

Richard Palmer found *Apium repens* at Langel Common on the flood-plain of the River Windrush in the 1960s. However by the early 1970s the plant could not be found; the site was much drier and covered by a dense mass of thistles. By the 1990s, a dense improved sward of *Festuca rubra* and *F. pratensis* covered the site; it is cut for hay once a year. Soil samples were taken and grown on in the University of Oxford Botanic Garden by Kathy Warden in 1999 but no *A. repens* germinated. It was supposed that conditions had become too dry to suit the plant.

In order to enable any buried seed to germinate a plan was drawn up with the Environment Agency (as part of their responsibilities under the EU Habitats Directive) to construct a scrape in a low-lying area. The scrape was made in the autumn 2000, it was broadly elliptical, about 20 m long and 10 wide. First the turf was scraped off and removed, then a 10 cm depth

of topsoil was scraped off and piled to one side, then 30 cm of subsoil with sloping sides was removed, and finally the 10 cm of topsoil was re-spread over the scrape so that any buried seed could germinate. **(Photo 2.15)**

**Photo 2.15**. Langel Common, Witney, restoration site. Constructing the scrape, subsoil and turf at right to be removed; topsoil heaped at left to be re-spread. Photo by C.R. Lambrick.

During the winter the scrape filled with water thus creating suitable flooded conditions **(Photo 2.16).** In summer it dried out creating ideal conditions for *A. repens* germination. The scrape was soon colonised by species such as *Veronica catenata* and *V. scutellata* which accompany *A. repens* on Port Meadow, and *Juncus compressus* which does not otherwise occur on Langel Common. (List in Appendix 3).

**Photo 2.16**. The scrape at Langel Common, Witney, Alison McDonald with Tibbie Shields looking at the water during the first winter after construction in the autumn of 2000. Photo. by C.R. Lambrick.

By 2004 a dense vegetation of grasses and *Rumex* species, with young *Salix cinerea* had out-competed the more delicate herbs **(Photo 2.17).** It was agreed to rotavate the scrape to give *A. repens* another chance to germinate. It has also been suggested that the Common should be grazed to restore suitable conditions, and this will be considered by West Oxford District Council.

**Photo 2.17.** The scrape at Langel Common, Witney, in 2004. Frances Watkins examining the dense sward. Photo by C. R. Lambrick.

### 2.3.5 Historic sites

Searches in the herbaria at Oxford and Edinburgh revealed a number of localities. Unusual plants also have been reported from the New Forest, Norfolk and Chippenham Fen, Cambridgeshire, and are not considered to be *Apium repens*, see section 3. Other herbaria and old floras have not been searched.

#### 2.3.5.1 Searched sites

**Sandford-on-Thames, Oxfordshire.** This site was searched in June 2000 by Camilla Lambrick and Alison McDonald. It had possibly suitable short *Agrostis stolonifera* sward, but no *Apium repens* plants could be found.

**Henley-on-Thames, Oxfordshire.** This site is reported to be highly improved and not suitable (S. Rankin pers. comm.).

**The Line Ponds, Skipwith Common, Yorkshire.** *Apium repens* was reported here by F.A. Lees in the 19$^{th}$ century (Cheetham and Sledge 1941 p. 52). Quentin Cronk visited the Common, now a reserve, on 5th September 1995, assisted by Dr F.E. Crackles, Tim Dixon (English Nature) and Caroline Fitzgerald of the Yorkshire Wildlife Trust. The majority of the area is acid heathland with regeneration of pine and birch; grazing has been restarted with Hebridean sheep, Exmoor ponies and Highland cattle. The Line Ponds are a complex series of rectangular depressions, dug, probably in medieval times for retting flax, hence the name Line = lin, linum and linen. Cattle on the heath used the ponds for drinking and the eutrophic conditions with heavy cattle poaching, would have been ideal for *A. repens*. However, the

ponds are now overgrown with *Salix* and birch scrub and silted up with a depth of 1 m of dark silt. There was no immediate prospect of restoration of suitable conditions for *A. repens*.

**Talmire SSSI, Yorkshire.** Flood-plain site recorded as having *Apium repens* in the 19th Century, but none of the specimens are good. The site was visited by Q.C.B. Cronk in 1995, who found the habitat was not suitable.

**Sanda Island, Mull of Kintyre, Argyll**. There is a herbarium specimen at the Royal Botanic Garden, Edinburgh from Sanda Island that was collected in 1932 by Mrs E.M. MacAlister Hall. Q.C.B. Cronk and Mark Watson visited the island on 23 August 1995 with the kind help of the owners (Mr and Mrs Gannon) and David Batty and Erica Knott of Scottish Natural Heritage. The most likely area for *Apium repens* was near Lag nan Gael (GR 729046), where there is a level area of short turf on sand over rock, which is flooded in winter. The area has probably been intermittently cultivated and is presently grazed by sheep with small blowouts. The sward includes several species also found on Port Meadow, namely *Alopecurus geniculatus, Eleocharis palustris, Potentilla anserina* and *Plantago major* (a small hairy form, probably ssp. *intermedia* also found in Belgium, see section 2.2.2.9). A number of agricultural weed species were also present, but no *A. repens* was found.

There are a number of purported records of *Apium repens* from Fife (Kinghorn) and East Lothian (Guillane), but examination of the specimens by Q.C.B. Cronk revealed that they were all the creeping form of *A. nodiflorum*.

#### 2.3.5.2 Sites that have not been searched

In a ditch at Early, Berks (F.Tufnail). *Flora of Berkshire* (Druce 1927).

Hughendon Manor, West Wycombe, grid ref SP 865955, Mervyn Southam pers. comm. reported that the plants here are probably a prostrate form of *A. nodiflorum*.

# 3 Nomenclature and hybridization

## 3.1 Taxonomy

Linnaeus used an existing Latin name *Apium* for celery and parsley, and an old Greek name *Sium* for a group of other large aquatic Apiaceae in 1754. However he did not know *Apium repens* which was first named as *Sium repens* by Nicolaus Joseph von Jacquin in 1775 in his Flora of Austria, where there is a beautiful illustration by Franz von Scheidel **(Photo 3.1)** (see www.digitalis.mobot.org). (According to Index Kewensis this *Sium repens* name "= *A. nodiflorum*", but it is clear from the illustration with its long peduncle, numerous bracts and notched leaves and description that it is indeed *Apium repens* which is intended.) This name was also used by Linnaeus' son in 1781. However Mariano Lagasca y Segura (1821) transferred the species into *Apium*, where it appeared more fitted being closely related to *Apium graveolens* L.. In 1824 Koch described a new genus *Helosciadium* into which he transferred *Apium repens* and *A. nodiflorum*, which was maintained by Syme (in a paper by Schultz in 1854). *Apium repens* has also briefly been regarded as a subspecies of *Helosciadium repens* (by Rouy and Camus) and placed in the genera *Helodium* Dumort. and *Selinum* E.H.L. Krause. In 1867 Reichenbach sank *Helosciadium* back into *Apium* leaving the current formula *Apium repens* (Jacq.) Lag..

**Photo 3.1.** Illustration of *Apium repens* by Franz von Scheidel published in N.J. Jacquin's Flora of Austria in 1775. Reproduced with kind permission of the Missouri Botanic Garden.

It has been suggested that the continuity of forms reflects hybridization between the two species. Riddelsdell (1917) noted the occurrence of a hybrid, and plants from Binsey Common and Port Meadow were named by G.C. Druce as a hybrid between *A. nodiflorum* and *A. repens* (but *Apium* x *riddelsdellii* Druce, is a *nomen nudum*). T.G. Tutin examined the specimens and considered them all variants of *A. nodiflorum* (Stace 1975). Stace (1997) gives the hybrid as = x longipedunculatum (F.W. Schultz) Rothm.

Herbarium specimens identified as *Apium repens* were found in the Norwich Museum by Gillian Beckett. The plant was collected in 1850 at Hempton Green, Norfolk TF9128. These specimens have been loaned to Oxford. Close inspection suggests that they resemble *A. repens* in having a quite long peduncle, but there are no bracts (what looks like bracts is, in

fact, a piece of grass) and the leaves are toothed and elongated, without the single larger tooth of *A. repens* **(Photo 3.2**). Mervyn Southam has confirmed that they appear to be *A. nodiflorum*.

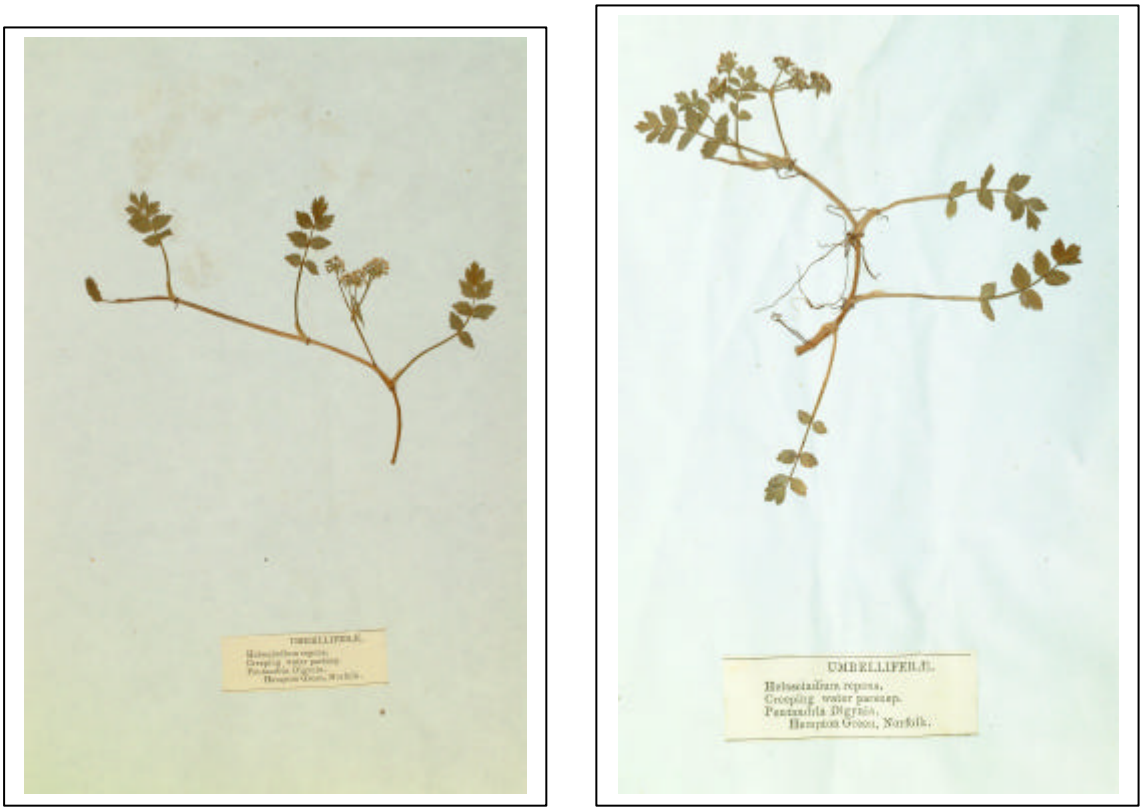


**Photo 3.2**. Herbarium specimens labeled as *Helosciadium repens* = *Apium repens* from the Herbarium in Norwich.

Plants from Chippenham Fen SSSI, Cambridgeshire, have roused interest for many years (S. M. Walters pers. comm.) and Camilla Lambrick visited the site in May 1995 but found only *Berula erecta* and *Apium nodiflorum*. Specimens collected by Chris Preston retained short peduncles in cultivation suggesting a form of *A. nodiflorum* rather than *A. repens* (Rich and Jermy 1998). Specimens were also collected by Brian Wurzell in 2004 which Mervyn Southam concluded were *A. nodiflorum.*

## 3.2 Chromosome numbers

Cytological evidence is mixed, *Apium nodiflorum* has 2n=22 (Stace 1997) with two satellites, one large and one small (Q.C.B. Cronk pers. com.). This number was confirmed by Cronk for material from the north and south population areas of Port Meadow, and the material from Frankfurt and Morocco. *Apium repens* has been recorded with 2n = 22 and 2n = 18 by A. Richards. This would agree with putative hybrid material from Chippenham Fen having 2n = 20 (Grassly and others 1996) but this number is not certain as = 22 was also reported. Clive Stace has offered to do chromosome counts and this should be taken up in conjunction with voucher specimens.

## 3.3 DNA studies and hybridization

In 1995 a study, lead by Quentin Cronk of the University of Oxford Department of Plant Sciences, was initiated and funded by the Joint Nature Conservation Committee (JNCC) to use random amplified polymorphic DNA analysis (RAPDS) to compare German, Swiss and Moroccan material with British *Apium repens* and *A. nodiforum* (Grassly and others 1996). Thirteen Operational Taxonomic units (O.T.U.s) including morphologically intermediate forms from Port Meadow were compared. The O.T.U.s fell into two well-defined groups (containing the *A. repens* on one hand and *A. nodiflorum* and the small-leaved low-growing forms on the other). The Moroccan material was well separated from either, but slightly closer to *A. repens*. It was thus established that both true *A. repens* (genetically resembling Swiss material) and a low-growing, small-leaved form of *A. nodiflorum* are present on Port Meadow. This form was called the meadow plastodeme of *A. nodiflorum* by Quentin Cronk.

No plants had a mixture of the markers associated with each species, indicating that there was no evidence of hybridization between the two species. There have been criticisms of the RAPDS methods, but they appear unlikely to undermine conclusions from the results. This suggests that if there has been genetic exchange, it is not recent and does not appear to present a threat to *Apium repens* by introgression.