

**THE ECOLOGY AND MANAGEMENT OF RIVERINE TREES**

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Interim Report

NRA Anglian Region

Operational Investigation

01/526/11A

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## SUMMARY

This report documents the progress of the NRA Anglian Region Operational Investigation, Project 526, between 1 April and 31 October 1991. During this period the objectives, choice of sites and initial survey of the selected river sections, have been accomplished.

For the purpose of sampling, the tributaries of the River Great Ouse have been grouped into four broad categories depending upon the dominant underlying geology of each stream. In addition to this the main channel of the Great Ouse has been sub-divided into four sections. For each tributary or river section chosen, a single 500 m sample site has been selected for detailed survey.

A field methodology and data collection sheet has been devised and information regarding the tree, shrub and herb community at each site has been collated. Any apparent management of the channel or banks, or use of the site for particular activities is recorded and a general description of the site is provided. An annotated section map will be provided for each 500m stretch of river in the Project Report.

## 1. INTRODUCTION

This report documents the progress of the NRA Anglian Region Operational Investigation, Project 526, between 1 April and 31 October 1991. The project forms a precursor to a proposed National R&D project. The targets for this period have been -

- Selection of survey sites.
- Initial survey of the selected river sections.

## **2. OBJECTIVES**

### **2.1 Overall objective**

To investigate the management practices with regard to existing trees within the river corridor of the Great Ouse catchment, their current health and density, and their relationship with the channel form and riparian herbs and grasses.

### **2.2 Specific objectives**

#### **2.2.1 Information**

- To review, from literature and staff experience, both positive and negative aspects of vegetation use in flood prevention operations.
- To review the influence of riparian vegetation on channel form.
- To review the relationship between woodland canopy and herbage understory.
- To review literature on alternative techniques to channelisation.

#### **2.2.2 Survey**

- To establish the distribution and density of tree species along selected representative sites within the river corridor of the Great Ouse.
- To investigate the relationship between existing trees and herb understory.
- To investigate the relationship between channel form and bankside vegetation.
- To classify the existing riparian tree communities within the Great Ouse catchment.

### **3. PROGRESS TO DATE**

#### **3.1 Site selection**

For the purpose of sampling, the tributaries of the River Great Ouse have been grouped into four broad categories depending upon the dominant underlying geology of each stream. The categories chosen are: Mid-Jurassic Limestone of the Great Oolite Series; Clay (including Kimmeridge Clay, Corallian, and Oxford Clay with Kellaway Beds); Lower and Upper Greensand; and Cretaceous Chalk.

In addition to the above groupings the main channel of the Great Ouse has been subdivided into four sections under the following headings:

Section i: Brackley to Buckingham; equivalent in size to other tributaries.

Section ii: Buckingham to Bedford; non-navigable.

Section iii: Bedford to Earith; navigable.

Section iv: Earith to river mouth; fenland.

For each tributary or river section chosen, a single 500 m sample site has been selected for detailed survey (using a random number table to select grid references). Because of the limited surveying period, the final choice of site was influenced by accessibility. Having selected the stretches of river to be surveyed, Ordnance Survey maps (1: 2500 scale) were obtained from the NRA map library at Brampton. Table 1 gives details of the eighteen sites – including geology, map reference number, and date surveyed.

#### **3.2 Survey methods**

A field methodology and data collection sheet has been devised which records data of tree and shrub species; tree density and distance between like species; distance between tree and channel bank; girth; height; species and the abundance of grasses/herbs growing both beneath canopy and elsewhere along the river (An example for the River Granta/Cam is appended). Any apparent management of the channel (channelisation; widening), of the bank (clearance; dumping of silt and/or aquatic macrophytes), or of the adjacent vegetation (tree planting; pollarding; coppicing; grazing) or use of the site for particular activities (angling; bridleway; footpath etc.) is recorded and a general description of the site provided. An annotated section

Table 1 : Survey sites

NAME OF RIVER	SOLID GEOLOGY (dominant)	O.S. MAP NO.	O.S. MAP NUMBERS	DATE(S) SURVEYED
		1:50 000	1:2 500	
Little Ouse	Chalk	144	TL 82/87	31st July/1st August 1991
Kennett	Chalk	154	TL 70/63	19th August 1991
Granta	Chalk	154	TL 50/49; TL 50/50	20th August 1991
Granta/Cam	Chalk	154	TL 48/47	28th August 1991
Wissey	Greensand	143	TL 68/97	7th June/12th June 1991
Hencham	Greensand	132	TF 70/36	5th August 1991
Cam	Greensand	154	TL 36/48	27th August 1991
Bourne Brook	Greensand	154	TL 36/55	10th September 1991
Hundred Foot Dr.	Clay	143	TL 54/95	5th June 1991
Kym	Clay	153	TL 14/63	9th September 1991
Ouzel	Clay	165	SP 90/23	9th October 1991
Tove	Clay	152	SP 66/48; SP 66/49	11th October 1991
Nar	Mixed	132	TF 80/14; TF 80/15	8th June/25th July 1991
Padbury Brook	Mixed	165	SP 72/32	10th October 1991
i-ii: Great Ouse	Oolite Series	152	SP 64/34	10th October 1991
ii-iii: Great Ouse		152	SP 86/45	9th October 1991
iii-iv: Great Ouse		153	TL 14/53	8th October 1991
Forty Foot Drain		142	TL 42/87	8th October 1991

map will be provided for each 500m stretch of river in the Project Report.

The position of the recorder with respect to bank top has been recorded to enable viable comparisons between site specific data. This is necessary as an instream viewpoint tends to lead to bias towards the influence of trees upon aquatic vegetation whilst disregarding the canopy effects on the riparian community.

### 3.3 Survey results

All of the 18 summer surveys have been completed. The random nature of the site sampling method has located river sections with a varied riparian community ranging from managed parkland to alder woodland/scrub with no apparent management.

In parallel to the field-based survey, aerial photographs of the river sections (scale 1:10000) have been obtained from County Council Planning Departments and their potential value to a project of this nature is currently being assessed.

A third study is currently underway comparing the tree and herb communities of urban and rural sites in an attempt to assess their relative 'naturalness'. This assessment will be based upon statistical analysis and observation since historical information regarding past management of these sites is not available. The definition of 'naturalness' is derived from several papers outlining public perception of what constitutes a 'natural' river.

## **4. FUTURE WORK**

### **4.1 Fieldwork**

These have been arranged for the 26th-29th November and the 10th-13th December in order to collect the following information:-

1. Details of channel morphology, previously obscured by vegetation during the earlier sample period (channel width, bank slope and height). Such information is required to assess whether an association exists between channel form and the presence/absence of trees.
2. Aging stands of riverine trees by the manipulation of girth and height measurements viable for plantation trees, the environmental conditions of which are known. In natural conditions, tree morphology is influenced by a number of variables (e.g. air currents, density of trees/scrub, soil type, flooding frequency, climate/aspect etc.). For this reason all of the sites will need to be re-visited in order to collect sample cores from representative trees, and a table drawn relating girth/height data to the truthed ages. A cross-comparison of tree size between sites is not a viable proposition given that the environmental factors will differ from site-to-site.

### **4.2 Statistical analysis**

Sørensen's Similarity Coefficient will be used for investigating simple associations between sites; as a binary coefficient this will only incorporate presence-absence data in its calculation. A second measure (ie. Bray-Curtis Measure), incorporating the relative abundance of a particular species, is required to establish whether distinct communities of tree/shrub and herbs exist and to investigate how (if at all) the presence of trees influences the herb layer. These will be combined with cluster analysis to ascertain the distinctness or otherwise of tree, shrub and herb communities.

### **4.3 Literature Review**

Following the initial project review carried out in 1990, further papers collected have been on aspects of vegetation use in flood prevention operations; the influence of riparian vegetation on channel form; the relationship between woodland canopy and herbage understory; and alternative biological ('soft') techniques to channelisation. These will be reviewed in the first two months of the new year, together with available literature on the ecology and structure of floodplain woodland.

### **4.4 Liaison**

No further liaison has been carried out with operational staff of Anglian region, except over site access, due to the emphasis upon fieldwork. The next step of liaison is to develop the idea, originally discussed in each District, of demonstration river sites (chosen from within those sampled for this project), where different management options would be planned, evaluated and written up, for different objectives ranging from maximum conservation to maximum drainage efficiency.

No further liaison has been carried out with other NRA contractors (such as Silsoe College), but we are aware of the overlap of their OI with several other national and regional projects, and will need to link our objectives into theirs before the final report is produced in March 1992.

## APPENDIX A. EXAMPLE SURVEY – RIVER GRANTA/CAM

The River Granta (or Cam) flows north-north-west, across an underlying geology of Cretaceous chalk and Quaternary cover of alluvium, joining the River Cam (or Rhee) south of Grantchester. The upstream end of the 500m section is recognised by a bridge (A505) crossing the river. Further details of the site are outlined on the riparian vegetation survey sheet (pp. \*\*-\*). It has been necessary to delay the recording of bank morphology (including Sections 14-17 and section 19 of the survey sheet) until site visits planned for November and December, following the seasonal dieback of vegetation which obscured these features during the summer.

**RIPARIAN VEGETATION SURVEY**

SHEET 1:

1. Name of river : <b>River Granta/Cam</b>	2. OS 1:2500 map no. : <b>4847</b>	3. Subsections : <b>i &amp; ii</b>
4. Location of section : <b>A505 (nr. Duxford)</b>	upstream : <b>4868 4727</b>	downstream :
5. Info. (if any) related to site: <b>None</b>		contact name:
6. Recorder : <b>D.K.M. &amp; L.P.</b>		7. Date : <b>28th August, 1991</b>
8. Photographic point grid ref( <b>None</b> )		photo number(s):
9. Sample point/cross section grid ref(s) :		<b>4876 4736</b>
10. Stream order : <b>2</b>		
11. Geology : solid : <b>Cretaceous Chalk</b>		drift : <b>Alluvium</b>
12. Adjacent land use :	woodland	parkland
arable <b>Right bank : Section ii</b>	heath	scrub <b>Left bank : Section i</b>
imp. grass <b>Left bank : Section ii</b>	unimp. grass	marsh
urban	edge habitats	standing water
bare/open communities	quarries	other <b>Fruit/nut trees : L.B./Section i.</b>
13. River corridor width* : <b>see section map</b>		
14. Channel width range*: (estimate and %)		
	$\leq 1m$	$1 \leq 5m$
$5 \leq 10m$	$10 \leq 20m$	$> 20m$
15. Depth of channel*: (estimate/position in channel)		
	$\leq 0.25m$	$0.25 \leq 0.5m$
	$0.5 \leq 1.0m$	$> 1.0m$
16. Bank slope range*: (estimate and %)		
L	$\leq 30^\circ$	R L $30^\circ \leq 60^\circ$ R
L	$60^\circ \leq 90^\circ$	R L $> 90^\circ$ R
17. Bank height range*: (estimate and %)		
L	$\leq 0.5m$	R L $0.5 \leq 1m$ R
L	$1 \leq 3m$	R L $3 \leq 5m$ R L $> 5m$ R
18. Bank shading (by trees): (√ and %)		
L	absent	R L light R
L	moderate	R L heavy R
	40	60
19. Bank materials*: (√ and %)		
L	bedrock	R L stones R
L	gravel	R L clay R
L	silt	R L artificial R L other R

\* if parameter is variable along channel see accompanying section map.

SHEET 2: River: Recorder: Date:  
 River Granta/Cam D.K.M. & L.P. 28th August, 1991

20. Management :	weed control	bank clearance
channel deepening	channel widening	channelisation
tree planting small orchard (section i)	pollarding	coppicing. hazels (section i)
sludge dumping	grazing	other/none
21. Present use :	angling	boating
bridleway	shooting	footpath
abstraction	education	other/none none

22. General description:

**Channel morphology:**

Uniform channel width, but water flow is occasionally impeded by shallow berms. Fast-flowing shallow riffle sections are interspersed by deeper (>1m) pools with sandy beds.

Downstream (section ii) has undergone channelisation leaving the batter of the banks very steep ( $\approx 70^\circ$ ) and the channel straightened.

**Vegetation:**

Many of the trees growing alongside the upstream section of the site (section i) provide evidence of the introduction of non-native species (Italian alders) and past orchard management (plum, apple trees and coppiced hazels).

Entering the second section, the trees (predominantly white-willows) have been planted single-file at the boundary of an open field of improved grass, edging the river. There is approximately 10m between each mature tree and only two continuous stands occur (through natural regeneration, whereupon a mixture of juveniles and adult trees are observed; or as regrowth from the main trunk of a collapsed, over-mature tree).

Marginal vegetation includes Nasturtium officinale (water-cress) Epilobium hirsutum (Great willowherb), Impatiens glandulifera (Indian balsam) and Myosoton aquaticum (Water chickweed). Elsewhere, Phalaris arundinacea (Reed canary-grass) and Sparganium erectum (Branched bur-reed) extend into the channel. The water-level of the river is as low as 10-20cm in places (section i) and the shallow berms that protrude into the channel, and that are not shaded by the overhanging tree/shrub canopy of the left bank, are colonised by Urtica dioica (Common nettle) and Solanum dulcamara (Bittersweet) together with the more common marginal species. Beneath the shade of the left-bank of section i the emergent aquatics, seen frequently elsewhere, are replaced by a submerged growth of Ranunculus penicillatus (Stream water-crowfoot). Alongside the right-bank of section ii frequent marginal beds of N. officinale are evident.

N.B. Although emergent marginals are seen growing from the right-bank of section i, they are not associated with the shade provided by the overhanging vegetation of this section and as such have been included under the species list for section ii (relatively open bank, alongside field).

SHEET 3: River:

Recorder:

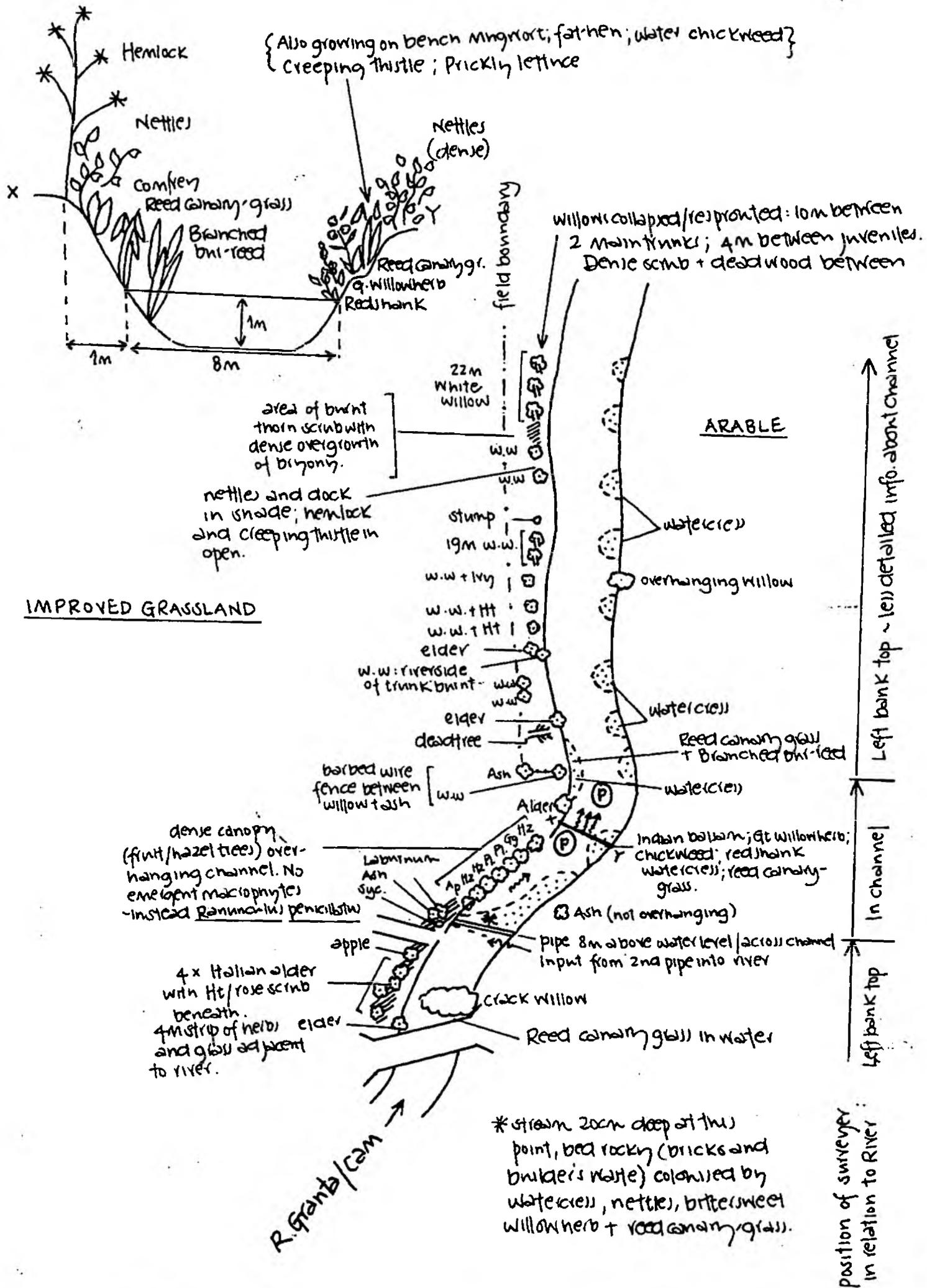
23. Species list (trees and scrub):

Generic name	
Sambucus nigre L.	Elder
Alnus chordata Desf.	Italian
Cretagaeus monogyna Jacq.	Comm
Sambucus nigre L.	Italian
Sambucus nigre L.	Italian
Cretagaeus monogyna Jacq.	Comm
Sambucus nigre L.	Italian
Malus sp.	Apple
Acer pseudoplatanus L.	Sycam
Laburnum sp.	Laburn
---	uniden
	uniden
Fraxinus excelsior L.	Comm
Malus sp.	Apple
---	uniden
Corylus avellana L.	Comm
---	uniden
Corylus avellana L.	Comm
Prunus sp.	Plum
Prunus sp.	Plum
Prunus domestica	Green
Corylus avellana L.	Comm
Alnus glutinosa (L.) Geartn.	Comm
Salix alba L.	White
Fraxinus excelsior L.	Ash (&
Sambucus nigre L.	Elder
Salix alba L.	White
Salix alba L.	White
Salix alba L.	White
Sambucus nigre L.	Elder
Salix alba L.	W. will
Salix alba L.	White
Salix alba L.	W. will
Salix alba L.	W. will
Salix alba L.	Stump
Salix alba L.	White
Salix alba L.	White
Salix alba L.	White

SHEET 4: River:		Recorder:	Date:	
Granta/Cam		D.K.M. & L.P.	28th August, 1991.	
24. Species list (grasses and forbs)				
FAMILY:	Generic Name:	Common Name:	Granta/Cam (i) 28 Aug '91	G./C. (ii)
BALSAMINACEAE	<i>Impatiens glandulifera</i> Royle.	Indian balsam		O
BORAGINACEAE	<i>Symphytum officinale</i> L.	Common comfrey		O
CANNABACEAE	<i>Humulus lupulus</i> L.	Hop		R
CARYOPHYLLACEAE	<i>Myosoton aquaticum</i> (L.) Moench	Water chickweed		O
CHENOPODIACEAE	<i>Chenopodium album</i> L.	Fat-hen		R
COMPOSITAE	<i>Achillea millefolium</i> L.	Yarrow	R	
COMPOSITAE	<i>Artemisia vulgaris</i> L.	Mugwort		R
COMPOSITAE	<i>Cirsium arvense</i> (L.) Scop.	Creeping thistle		F
COMPOSITAE	<i>Cirsium palustre</i> (L.) Scop.	Marsh thistle		R
COMPOSITAE	<i>Cirsium vulgare</i> (Savi) Ten.	Spear thistle		O
COMPOSITAE	<i>Lactuca serriola</i> L.	Prickly lettuce		R
COMPOSITAE	<i>Matricaria perforata</i> Mérat.	Scentless mayweed		R
CRUCIFERAE	<i>Nasturtium officinale</i> R. Br.	Water cress		F
CUCURBITACEAE	<i>Bryonia dioica</i> Jacq.	White bryony		F
DIPSACACEAE	<i>Dipsacus fullonum</i> L.	Teasel		R
GRAMINEAE	<i>Phalaris arundinacea</i> L.	Reed canary-grass		F
LABIATAE	<i>Glechoma hederacea</i> L.	Ground ivy	F	O
LABIATAE	<i>Lamium album</i> L.	White deadnettle	O	
LABIATAE	<i>Lamium purpureum</i> L.	Red dead-nettle		R
LYTHRACEAE	<i>Lythrum salicaria</i> L.	Purple-loosestrife		
MALVACEAE	<i>Malva sylvestris</i> L.	Common mallow		O
ONAGRACEAE	<i>Epilobium hirsutum</i> L.	Great willowherb		F
POLYGONACEAE	<i>Polygonum persicaria</i> L.	Redshank		O
POLYGONACEAE	<i>Rumex obtusifolius</i> L.	Broad-leaved dock	O	F
POLYGONACEAE	<i>Rumex sanguineus</i> L. var. <i>viridis</i> Sibth.	Wood dock		
RANUNCULACEAE	<i>Clematis vitalba</i> L.	Traveller's-joy	F	O
RANUNCULACEAE	<i>Ranunculus penicillatus</i> (Dumort.) Bab.	Stream water-crowfoot	F	
ROSEACEAE	<i>Rubus fruticosus</i> agg.*	Bramble	R	R
RUBIACEAE	<i>Galium aparine</i> L.	Common cleaver	O	F
SCROPHULARIACEAE	<i>Veronica beccabunga</i> L.	Brooklime		R
SOLANACEAE	<i>Solanum dulcamara</i> L.	Bittersweet		O
SPARGANIACEAE	<i>Sparganium erectum</i> L.	Branched bur-reed		O
UMBELLIFERAE	<i>Aegopodium podagraria</i> L.	Ground elder		
UMBELLIFERAE	<i>Angelica archangelica</i> L.	Garden angelica	R	
UMBELLIFERAE	<i>Apium nodiflorum</i> (L.) Lag.	Fool's watercress		O
UMBELLIFERAE	<i>Conium maculatum</i> L.	Hemlock		F
UMBELLIFERAE	<i>Heracleum sphondylium</i> L.	Hogweed		R
URTICACEAE	<i>Urtica dioica</i> L.	Common nettle	O	F

\* from Fitter, Fitter & Blamey ('78)

\*\*Gaertn., Mey. & Scherb.



IMPROVED GRASSLAND

ARABLE

position of surveyor in relation to river