Changes in Riparian Vegetation along the

Avon, Heathcote and Styx Rivers

1992/93-1996/97

March 1998
Kate McCombs
Christchurch City Council

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AIM

To monitor possible changes in the composition of riparian vegetation along the Avon, Heathcote and Styx Rivers, that may occur as a result of a reduction in the amount of riverbank vegetation control carried out by the Christchurch City Council.

ACKNOWLEDGEMENTS

Thank you to the following people who provided assistance with fieldwork and data entry: Jodie Burowes, Helen Greenep, Timothy Jordan and Bianca Sullivan.

Thank you also to Ken Couling who read a draft of this report and to Alistair Suren (NIWA) who provided assistance with the statistical analysis.

INTRODUCTION

The aim of the riverbank maintenance carried out by the Christchurch City Council is to

"(i) Ensure that the storm water capacity of the river is retained, (ii) Maintain the river environment in a state which meets acceptable aesthetic and environmental demands" (Drainage and Waste Management Unit, 1991).

To determine whether these aims are being met, various monitoring programs have been initiated and this one concentrates on the botanical component of the environment. The composition of the vegetation along the river bank is of particular interest as maintenance regimes have changed since this monitoring programme began.

The study includes sites on the Avon. Heathcote and Styx Rivers. There is a similar but more extensive study being run concurrently for the Styx River (McCombs 1997b).

METHODS

Sites

Sites were chosen to correspond to sites being monitored in a riverbank photographic survey[1] initiated by Dr Jim Robb and Andrew Nichols.

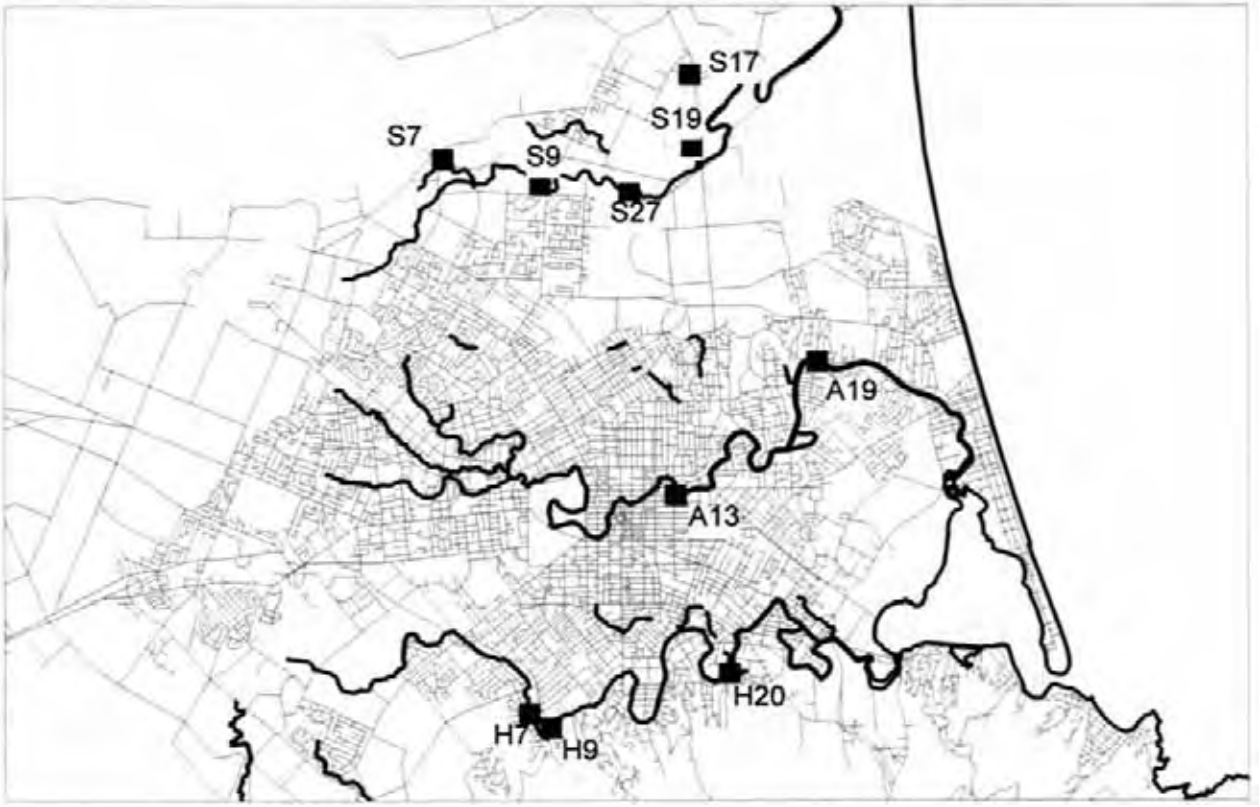
Nine sites were selected:

- Two along the Avon River (A 13, A19)
- Three along the Heathcote River (H7, H9, H20)
- Four along the Styx River (S9) and its tributaries (S7, S17, S19)

The location of each site is shown in Figure 1 and described in detail in Appendix 1.

' The photographic study is ongoing and photographs are filed in an album which is currently held at the Parks Unit. Not all sites being photographed have been included in this study.

Figure 1. Location of sites.



Botanical Data

At each site a quadrat was located on both sides of the stream or river. Each quadrat is 2.5 m long and extends back 1 m from where the riverbank drops off noticeably. The position of these quadrats is marked with 2 pegs (or sometimes 1), in the two corners furthest from the waterway. The distance to landmarks was also noted.

Within each quadrat the other abundance of the species present was recorded, i.e. the percent of the quadrat occupied by that species.

Six classes were defined:

1.....<5%

2.....5- 10%

3.....11-25%

4.....26-50%

5.....51 -75%

6.....76- 100%

Species near to each quadrat were also recorded, but are not included in any of the analysis done for this report.

Survey Times

The initial fieldwork was carried out in September 1992. The same sites were resurveyed in subsequent summers.

Survey dates were as follows:

16/09/92 to 25/09/92	referred to as	1992/93
10/03/94 to 5/04/94	referred to as	1993/94
27/01/95 to 10/02/95	referred to as	1994/95
11 /02/97 to 20/02/97	referred to as	1996/97

Photographs

Photographs were taken of each site. These assist in locating sites again, especially when pegs may be difficult to find. They also give a visual impression and enable large changes in vegetation composition to be seen (Figure 2, Figure 3).

The photographs are in an album that is currently held at the Parks Unit but they will probably be shifted to the Water Services Unit in the near future.

Statistical Analysis

Some of the analysis was done on all of the sites and some was done using "pooled" sites, i.e. combining left and right banks for each site.

The data for pooled sites used the table in Appendix 3 to derive the pooled abundance for each species recorded.

Detrended correspondence analysis

The ordination technique known as "detrended correspondence analysis" (Decorana), which is described in detail by Hill & Gauch (1980), was used to further examine the data. Decorana groups sites with a similar composition together, and can be used to show gradients of sites and species, based on floristic similarities, that generally correspond to major controlling factors in the environment. Decorana was used to detect changes in overall floristics and species cover during the study period.

Decorana was done on the non-pooled site data. Other data was overlaid onto the ordination diagram to see if any patterns emerged that would aid in interpretation of the floristics.

RESULTS

The vascular plant species observed and their abundance, for each site and for each summer are recorded in Appendix 2.

Number of species

The number of species per plot decreased over the course of the study (see Table 1).

A total of 115 *different* species were recorded over the 4 surveys with 44 of these occurring only once[2].

Table 1. The number of vascular plant species recorded at each site, each year.

Site	1992/93	1993/94	1994/95	1996/97	Difference between 1992/93 and 1996/97
A13	19	16	17	16	-3
A19	17	9	16	18	+1
H7	14	16	19	13	-1
H9	19	8	11	10	-9
H20	19	-	21	18	-1
S7	22	17	23	18	-4
S9	15	14	13	11	-4
S17	19	6	11	8	-11
S19	19	24	17	8	-11
Sum	163	110	148	120	-43

Table 2. Paired t-test on the number of species in a quadrat, comparing 1992/93 with 1996/97.

	Mean 1992/93	Mean 1996/97	Std. Dev.	t value	D.F	Prob.	*
Number of species/quadrat	18.111	13.333	4.494	3.190	8	0.013	significant

* Significance at P = 0.05

[2]The exact number may vary because some plants were not able to be identified down to species level because they did not have sufficient flowers/fruit to enable full identification to be made.

Table 3. The number of native vascular plant species recorded at each site, each year.

Site	1992/93	1993/94	1994/95	1996/97	Difference between 1992/93 and 1996/97
A13	2	0	0	0	-2
A19	2	1	0	0	-2
H7	0	2	0	1	+1
H9	0	1	1	1	+1
H20	0	-	0	0	0
S7	3	3	3	1	-2
S9	1	0	0	0	-1
S17	1	0	0	0	-1
S19	1	0	0	1	0
Sum	10	7	4	4	-6

Table 4. Paired t-test on the number of vascular plant species in a quadrat, comparing 1992/93 with 1996/97.

	Mean 1992/93	Mean 1996/97	Std. Dev.	t value	D.F	Prob.	*
Number of species/quadrat	1.111	0.444	1.225	1.633	8	0.141	not significant

* Significance at P = 0.05

Figure 2. H20 true right, 25/9/92.

Figure 3. H20 true right, 1/3/95.

Ordination of Sites

Ordination is a matrix technique that organises data, using species abundance, so that "similar entities are close by and dissimilar entities [are] far apart" (Gauch 1982, p 109). Decorana is one of the more robust ordination techniques as it is less likely to be distorted by samples that have very different species compositions (Hill and Gauch, 1980). The ordination of sites, using Decorana, is shown in Figure 4.

Eigenvalues represent the variance accounted for by a particular axis. The eigenvalue for Axis 1=0.4576 and for Axis 2=0.3554.

The ordination diagram produced is then overlaid with “summer” in Figure 5, but the grouping of sites shows no clear difference between summers.

Figure 6 shows another overlay of "summer" but only for the Avon River sites. The sites in 1992/93 are mostly further along both Axis 1 and Axis 2 than they are in 1996/97.

Figure 4. Ordination of sites using Decorana.

The first two or three numbers comprise the site number.

TL = true left quadrat TR = true right quadrat

1 = 1992/93 3 = 1994/95

2 = 1993/94 4 = 1996/97

e.g. H(TL1 refers to site H9, the quadrat on the true left, 1992/93 summer.

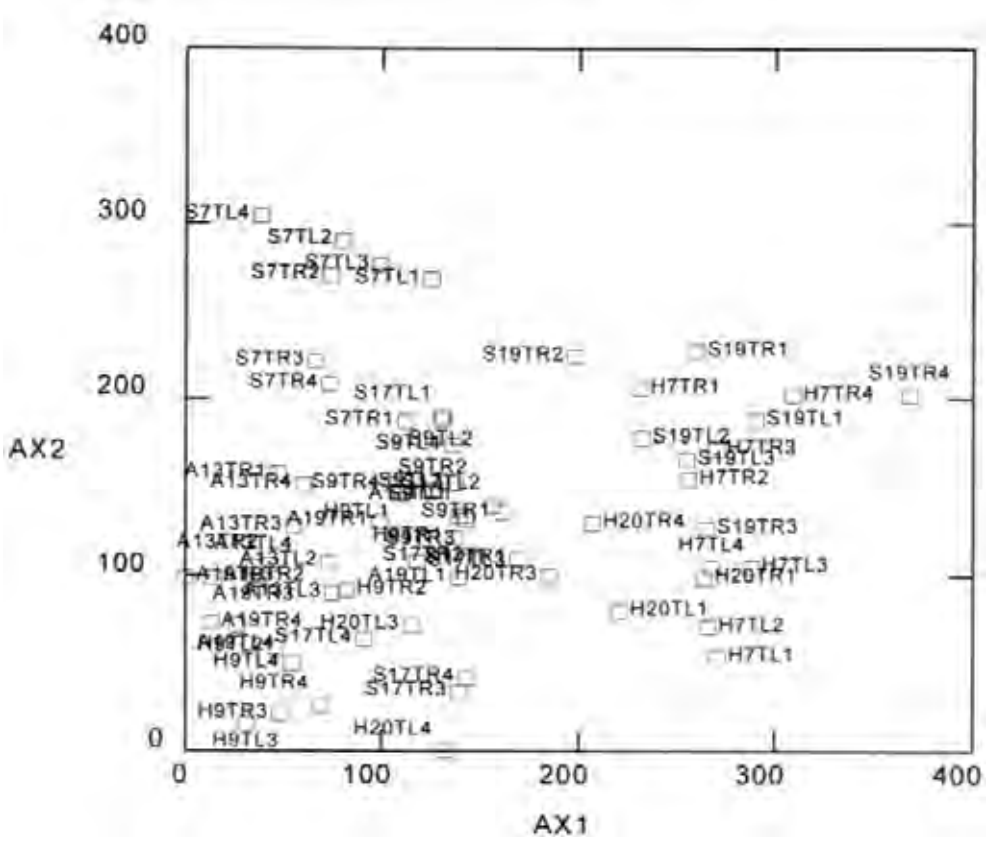


Figure 5. Overlay of summer onto ordination of sites.

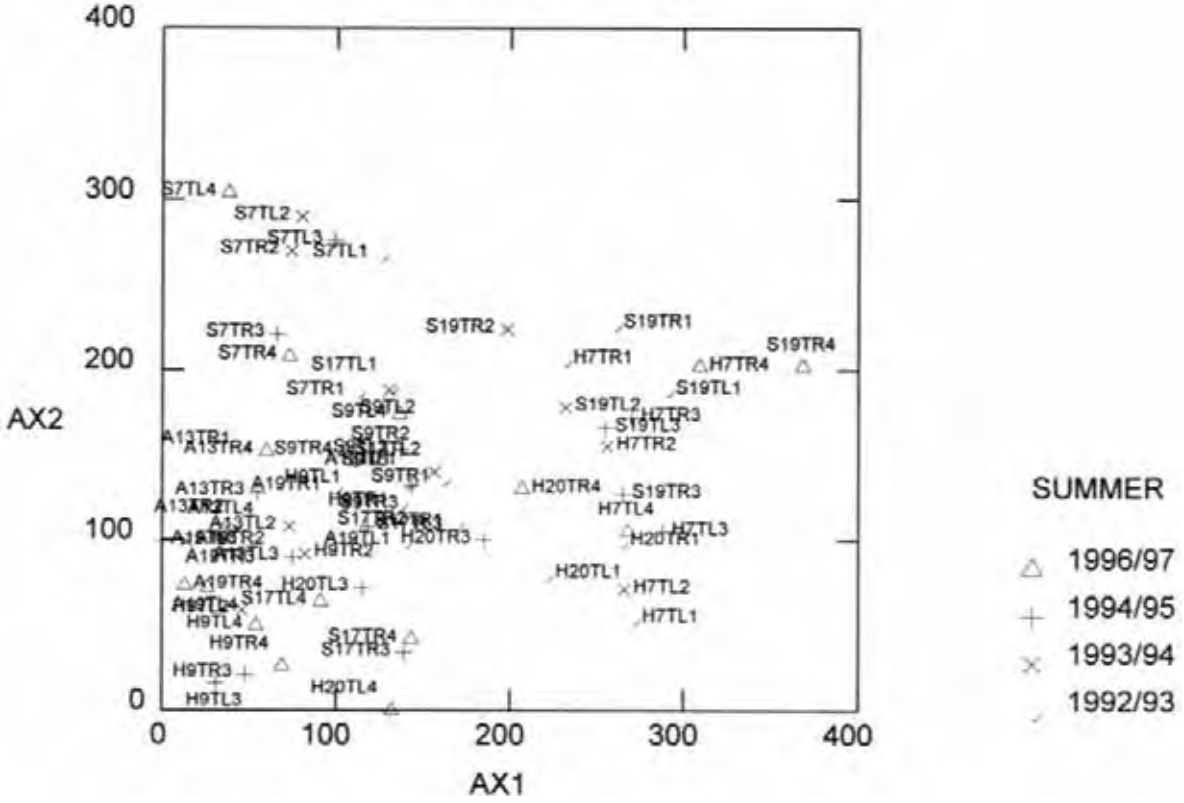
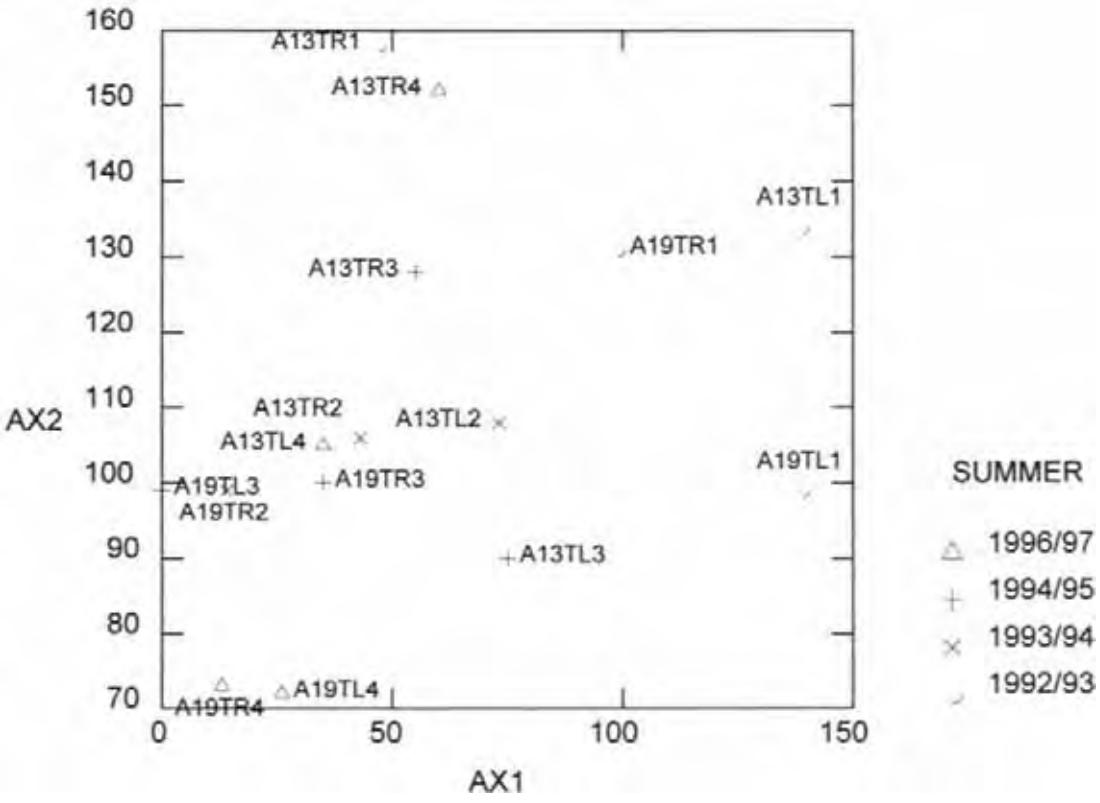


Figure 6. Overlay of summer onto ordination, showing Avon River sites only.



Weed species

The number of times that weeds were recorded within the quadrats is not high, but it is increasing. The greatest increase has been for great bindweed.

Table 5. Number of sites with weeds species, each year.

Species	Common Name(s)	1992/93	1993/94	1994/95	1996/97
Calystegia silvatica	great bindweed			3	5
Clematis vitalba	old man's beard			1	
Cytisus scoparius	broom		1		
Iris pseudacorus	yellow flag			1	

Figure 8. H9 true right, 23/9/92.

Figure 7. H9 true right, 1/2/95. Note the spread of great bindweed.

DISCUSSION

Large stretches of all three river banks have been modified by activities such as bankworks and road construction (resulting in soil compaction). These provide a "waste places" type of environment, i.e. modified soils, supporting short lived, weedy species.

This is reflected in the species list (approx. 3/4 exotic species) and also in the large number of species recorded that occur quite infrequently (Appendix2). "Infrequent" species include those that occur in a particular quadrat only once, those that only ever have an abundance of one and those that are only recorded once altogether.

Number of Species

Over the course of the study the number of vascular plant species occurring at each site has decreased significantly (Table 1, Table 2). Almost all of the sites have less species in 1996/97 than in 1992/93 with an overall decrease in number of species per plot of 26%. The largest drop for an individual site was from 19 species to 10, recorded for site H9.

The number of native vascular species recorded at the sites has also decreased, although the difference was not significant (Table3, Table 4). With time however, the natural processes of succession should reverse this trend, as discussed for the recent study on the Styx River (McCombs 1997b).

Additional planting of native plant species to improve seed sources, as is already occurring in many places, will facilitate this process. Planting species that provide food and habitat for birds and insects would further enhance the natural regeneration capability of the river banks by facilitating pollination and because the animals would also disperse seed.

Species Composition over Time

The overlay of "summer" onto the ordination of sites shows no clear pattern (Figure 5), except for the Avon River sites (Figure 6).

The highly variable species composition of sites may help to explain the lack of clear quadrat groupings over all of the sites with respect to time. The sites have changed composition, but not in any consistent way.

Weed Species

Over the period of the study there has been an increase in the occurrences of great bindweed (Table 5). This was also found in the recent study along the Styx River (McCombs 1997b). Targeted control of great bindweed (also known as convolvulus) needs to be included (or perhaps just increased) in the councils maintenance programs.

CONCLUSION

The vascular plant species composition of the riverbanks has changed over the course of this study. However the only consistent change detectable so far is the number of species recorded at each site, which has decreased.

With enough time the number of species should increase, but the process could be accelerated by the planting of native species, especially species providing habitat for native birds and insects.

RECOMMENDATIONS

1. Landscape Architects be specifically asked to include plant species that provide birds with food in their planting designs to improve seed dispersal.

2. Control of great bindweed be included (or increased) for maintenance contracts along all three river banks.

3. The same sites be reassessed in 5 years time, perhaps including a larger number of sites for the Heathcote and Avon Rivers.

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Appendix 1. Description of plot location

Site	Location
A13	*Avon River. River Rd from pump station at end of Templar St.*
A13 TL	Between 2nd and 3rd tree downstream from pump station. Opposite boundary of #33 & #35 and 9.97 m from edge of closest driveway. Downstream peg 4.65 m from 3rd tree from pump station. No peg upstream.
A13 TR	About opposite TL plot. Opposite #40. Upstream peg 2.75 m down from top of fence. Downstream peg 8.85 m upstream of large poplar and just below small poplar. Cabbage tree just behind plot.
A19	*Avon River. In front of #335 New Brighton Rd.*
A19 TL	Upstream corner is directly down from 2nd white pillar. Downstream corner 2 m along from Pittosporum stem. Plot is upstream of plantings.
A19 TR	Upstream peg 10.4 m from pole on water's edge. Downstream peg opposite dividing fence of #177 & #179 Avonside Drv.
H20	*Heathcote River. 20 m downstream of Aynsley Tce footbridge.*
H20 TL	Slightly downstream of TR plot. Upstream end of plot 4.2 m to far side of path, and 5.4 m to upstream ribbonwood.
H20 TR	Upstream peg is 10 m down from footbridge, down from first gap in low wall at roadside. 4.95m to downstream corner of st wooden part and 4.2 m to downstream leg of seat. No downstream peg.
H7	*Heathcote River. 40 m above Rose St.*
H7 TL	Bottom peg is 18 m upstream from flax bush on corner.
H7 TR	Between myrtle & pine(?).
H9	*Heathcote River. Downstream of Ferniehurst St bridge, near staff gauge.*
H9 TL	Upstream peg 24 m from lower-most concrete part of bridge and just slightly upstream of gingko; 2.42 m below, 0.1 m across. Lower peg is 20 m upstream from culvert and opposite tree (opposite station).
H9 TR	Opposite TL plot. Plot on ledge below main bank. Upstream peg 11.8 m from kerb, next to the bus stop sign.
S17	*Kaputone Stm. End of McDonalds Rd. 20 m upstream of bridge (plank).*
S17 TL	Slightly upstream of TR plot. The upstream peg is about opposite wooden fence on TR.
S17 TR	5m from upstream brown fence to upstream peg.
S19	*Kaputone Stm. Belfast Rd (Marshland Rd end) - culvert. (Can't cross river - ask owners for access).*
S19 TL	Upstream peg is 20 m down from bridge (just past stump).
S19 TR	Upstream peg is close to a main fence post. No peg downstream - plot ends at downstrem edge of stump. 20 m downstream to gate. Stump 23.5m from bridge, and in the middle of the plot.
S27	*Styx River. Selkirk Plc, near staff gauge out from dumping area. Can't cross river, both plots on TR.*
S27TRd	Upstream peg is 9.9 m downstream of wooden fence standing alone on river bank edge. Downstream peg is 21.5 m from neighbours fence and downstream of warratah.
S27TRu	Upstream of TR plot, on the same side of the river. Upstream peg is 20 m down from fence with wodden section.
S7	*Smacks Creek. Gardiners Rd.*
S7 TL	Peg on downstream side, 1m in from bank. Plot 9 m in from the road.
S7 TR	Peg on upstream side. 1m in from where bank drops off, ground is uneven. Opposite TL plot.
S9	*Styx River. Styx Mill Rd, near Main North Rd.*
S9 TL	Downstream peg is 16 m from culvert and main post.
S9 TR	Upstream peg 8-10 m downstream from outflow. Directly opposite TL plot. Downstream 15.9 m to fence post by entrance to culvert.

Appendix 1. Species at each site each year.

Six classes are used to describe the percentage cover of each species: 1 = <5%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 = 76-100%

	Species	Common Name(s)	Native	Summer	A13	A19	H7	H9	H20	S7	S9	S17	S19
	Bare ground / Leaf litter			1992/93			2						
				1993/94		2	4						4
				1994/95	2	4	3		1	4		3	3
				1996/97	1	1	1			1			
FERNS	*Athyrium felix-femina*	lady fern		1992/93	1								
				1993/94	3								
				1994/95	2								
				1996/97	1								
	Blechnum minus	swamp kiokio	*	1992/93						2			
				1993/94						3			
				1994/95						1			
				1996/97						3			
	Blechnum penna-marina	little hard-fern	*	1993/94						1			
				1994/95						1			
	Dryopteris filix-mas	male fern		1992/93				1					
				1993/94						1			
				1994/95					1				
GRASSES	*Agrostis capillaris*	browntop		1992/93			3		1				3
				1994/95			2						
	Agrostis stolonifera	creeping bent		1992/93	1			1		1	1		2
				1993/94			2				1	1	3
				1994/95		1	2				3		1
				1996/97			4		1	1	2		4
	Alopecurus pratensis	meadow foxtail		1992/93				1					
	Anthoxanthum odoratum	sweet vernal		1992/93							1		
	Arrhenantherum elatius	tall oat grass		1993/94	4	1		3			2		
				1994/95	2	2		4	1	1	1		
				1996/97	3	2		3		1	3		
	Bromus diandrus			1992/93				1					
				1994/95						1			
	Bromus mollis			1994/95					1			1	1
	Bromus wildenowii	prairie grass		1992/93						1		1	
				1994/95	1							1	

	Dactylis glomerata	cocksfoot		1992/93	1	1		4		1	2	3		
				1993/94	1	2				3	3			
				1994/95	1	1		1		1	1	1		
				1996/97	3	1		2		3	4			
	Elytrigia repens	couch		1992/93			1							
				1993/94		2				1		4		
				1994/95		1		1	3			4		
				1996/97		1			1			2		
	Festuca arundinacea	tall fescue		1992/93	4	3								
				1993/94						2				
				1994/95	2	2			1	1				
				1996/97	4	1				1				
	Festuca rubra	chewings fescue		1994/95			1							
				1996/97			1							
							1							
	Glyceria maxima	reed sweet grass		1992/93			3	1						1
	Holcus lanatus	Yorkshire fog		1992/93	3	5	1	3	1	4	5	5	2	
				1993/94	3	1	1	3		2	4	5	3	
				1994/95	5	1	1	2	3	2	3	3		
				1996/97	4	1	2	4	2	2	4	5		
	Hordeum murinum	barley grass		1994/95			1		1					
				1996/97					2					
	Lolium multiflorum	Italian ryegrass		1992/93					2			1		
				1994/95				1	2			2	2	
				1996/97			4	1	2			3		
	Lolium perenne	ryegrass		1992/93	2	3	4	2	4	1	3	1		
				1993/94	1		4	1						
				1994/95	1		4	1	2					
				1996/97	1	1		3	2					
	Phalaris aquatica			1992/93	1									
	Phalaris arundinacea	reed canary grass		1996/97					1					
	Phleum pratense	Timothy grass		1992/93				1						
				1994/95							1			

	Species	Common Name(s)	Native	Summer	A13	A19	H7	H9	H20	S7	S9	S17	S19
	Poa annua	annual poa		1992/93					1				1
				1993/94									1
				1994/95						1			1
				1996/97			3						
	Poa pratensis	meadow grass		1992/93			2						4
				1994/95			3						
				1996/97			2						3
	Poa trivialis			1992/93					1				
				1994/95					1				
				1996/97									2
HERBS	*Achillea millefolium*	yarrow		1992/93		1		1					
				1993/94	1	2		1					
				1994/95	1	3		1					
				1996/97	1	4		1					
	Angelica pachycarpa	angelica		1994/95			1						
	Anthemis cotula	stinking mayweed		1994/95									1
	Apium prostratum	shore parsley	*	1993/94			1						
	Bellis perennis	lawn daisy		1992/93			1		1				
				1993/94			1						
				1994/95			1						
				1996/97			1						
	Callitriche stagnalis	mudwort		1992/93	1				2		1		
				1993/94			1			1			
				1994/95			1						
	Capsella bursa-pastoris	shepherd's purse		1992/93					1			1	
	Cardamine hirsuta	bitter cress		1992/93		1							1
	Carduus sp.	winged thistle		1992/93						1			
				1996/97		1					3	2	
	Cerastium glomeratum	mouse ear chickweed		1992/93	1	1						1	
				1994/95									1
	Cirsium sp.	thistle		1992/93		1					1	1	1
				1993/94							1	1	
				1994/95						1	2	1	
	Cirsium vulgare	scotch thistle		1992/93								1	
	Conyza bonariensis	Canadian fleabane		1993/94	1								1
	Conyza sp.	fleabane		1992/93						1			
	Cotula australis			1994/95									1
	Cotula sp.			1994/95			1						

	Crepis capillaris	hawksbeard		1994/95	1	1					1		
				1996/97	1	1			1				
	Epilobium brunnescens		*	1992/93	1								
	Epilobium ciliatum			1996/97									1
	Epilobium sp.	willowherb	?	1992/93						1		1	
				1993/94									1
				1994/95									1
	Foeniculum vulgare	fennel		1992/93									1
	Galium aparine	cleavers		1992/93						3		1	
				1993/94						1			
				1994/95						1			
	Geranium sp.		?	1992/93								1	
	Hydrocotyle heteromeria		*	1996/97									1
	Hydrocotyle sp.	waxweed	?	1992/93						1			
				1993/94	1					1			
				1994/95									2
	Hypochoeris radicata	catsear		1992/93	1	1				1			
				1993/94	2	2					1		
				1994/95	1	2							
				1996/97	1	2							
	Lamium amplexicaule	henbit		1992/93									1
	Leptinella dioica		*	1996/97			1						
	Leptinella maniototo		*	1993/94			1						
	Lotus pedunculatus	lotus major		1994/95							1		
				1996/97							2		
	Matricaria inodora	scentless mayweed		1993/94									1
	Mentha sp.	mint		1992/93							1	1	
	Mentha x piperita	peppermint		1992/93	1					1			
				1993/94	1					1			
				1994/95	1					1			
				1996/97						1			
	Mimulus guttatus	monkey musk		1992/93	1		2	1	1	3	1		1
				1993/94	2		1	2		2	2		1
				1994/95	1	1	1	1	1	1	1		
				1996/97	1	1			1	1	2		

Species	Common Name(s)	Native	Summer	A13	A19	H7	H9	H20	S7	S9	S17	S19
Myosotis laxa subsp. *caespitosa*	water forget-me-not		1996/97						1			
Myosotis sp.	forget-me-not		1992/93									1
Picris echioides	oxtongue		1992/93				1					
			1993/94				2					
			1994/95					1				
Plantago lanceolata	narrow plantain		1992/93	1	1		1					
			1993/94	2								
			1994/95	1	1							
			1996/97	1	1							
Plantago major	broad plantain		1992/93	1				1				
			1993/94			1						1
			1994/95			1		1				1
			1996/97			1		1				
Polygonum aviculare	wireweed		1993/94							1		
Polygonum hydropiper	water pepper		1993/94									1
Polygonum sp.	willowherb		1993/94									1
Ranunculus acris	giant buttercup		1992/93			1						
			1993/94			1						
Ranunculus repens			1992/93	1			1			2		1
			1993/94	1			2		1	2	1	2
			1994/95	3		1	2	1	1	3	1	1
			1996/97	2		1	2	3	1	3	3	
Ranunculus sceleratus	celery leaved buttercup		1992/93			1						1
			1993/94			1						
Ranunculus sp.	buttercup		1992/93								1	
Rorippa microphylla	water cress		1992/93									2
			1993/94						1	4		4
			1994/95						1	1		1
			1996/97						1	2		
Rorippa sylvestris			1993/94			1						
Rumex acetosella	sheep sorrel		1996/97		1							
Rumex crispus	curled dock		1993/94							1		1
Rumex flexuosus		*	1992/93							1	1	
Rumex obtusifolius	broad dock		1992/93		1	1	1	1	1		2	1
			1993/94			3					2	2
			1994/95			2		1	1	1	2	1
			1996/97			2		1		1	1	

	Rumex pulcher	fiddle dock		1992/93					1				
	Sagina procumbens	pearlwort		1994/95			1						
	Senecio sp.	groundsel		1994/95						1			
				1996/97									1
	Silene gallica	catchfly		1996/97		1							
	Solanum dulcamara	bittersweet		1993/94									1
	Sonchus asper	prickly sow thistle		1996/97						1			
	Sonchus oleraceus	sow thistle		1993/94							1		1
				1994/95						1			
				1996/97					1	1			
	Stellaria graminea	stitchwort		1994/95						1			1
	Stellaria media	chickweed		1992/93		1			1				1
				1993/94			1						
				1996/97									1
	Taraxacum officinale	dandelion		1992/93	1	1	1	1	1	1	1	1	
				1993/94	2								1
				1994/95			1		1				
				1996/97	1				1	1			
	Trifolium repens	white clover		1992/93	1	2	1	1	1	1	1	1	1
				1993/94	3		1				2		1
				1994/95	3	1	1		2		4		1
				1996/97	3	4	1		1		1	1	
	Urtica sp.	nettle		1993/94									1
	Veronica anagallis-aquatica			1992/93				1					
	Veronica arvensis	field speedwell		1992/93								1	
MISC. MONOCOTS	*Iris pseudacorus*	yellow flag		1994/95		1							
	Phormium tenax	harakeke, NZ flax	*	1992/93		1							
	Zantedeschia aethiopica	aram lily		1993/94									1
RUSHES & SEDGES	*Carex coriacea*		*	1994/95				3					
				1996/97				3					
	Carex geminata	toe toe rautahi	*	1993/94				4					
	Carex maorica	maori sedge	*	1992/93	1								
	Carex sp.			1992/93				1	1				
				1996/97	1								

	Species	Common Name(s)	Native	Summer	A13	A19	H7	H9	H20	S7	S9	S17	S19
	Cyperus eragrostis	umbrella sedge		1993/94	1								
				1994/95	1				1				
				1996/97					1				
	Juncus articulatus	jointed rush		1992/93		1			1		1		
				1994/95					1				
	Juncus bufonius	toad rush		1992/93					1	1	1		
	Juncus effusus	soft rush		1993/94						1	1		2
				1994/95									1
	Juncus gregiflorus	wi	*	1992/93						1			
				1993/94						2			
	Juncus pallidus	wi	*	1992/93		1				1			2
				1993/94		1							
				1994/95					1				
	Juncus sp.		?	1996/97					2				
TREES & SHRUBS	*Alnus glutinosa*	alder		1993/94									1
	Cytisus scoparius	broom		1993/94		1							
	Ribes sanguineum	flowering currant		1996/97									1
	Sambucus nigra	elder		1992/93						1			
				1993/94									1
				1994/95						2			
				1996/97						1			
VINES & CLIMBERS	*Calystegia silvatica*	great bindweed		1994/95		1		4				1	
		great bindweed		1996/97		1		4	1	1		2	
	Clematis vitalba	old man's beard		1994/95						1			
	Muehlenbeckia australis	pohuehue	*	1994/95						1			
	Rubus fruticosus	blackberry		1992/93						1			
				1993/94						2			
				1994/95						2			
				1996/97						4			

Appendix 3. Matrix used to convert data into pooled sites.

Abundance Class	0	1	2	3	4	5	6
0	0	-	-	-	-	-	-
1	1	1	-	-	-	-	-
2	1	2	2	-	-	-	-
3	2	3	3	3	-	-	-
4	3	3	3	4	4	-	-
5	4	4	4	4	5	5	-
6	4	4	4	5	5	6	6