

over the site. There are equally poor prospects for *A. fluitans* at Boggy Pond. A decision taken in 1984 to direct water from nearby farmlands into Boggy Pond has not only reduced the period of each year in which the shores are exposed, but it will also have raised the fertility of the water. This, in turn, is likely to produce more vigorous growth of competitive, adventive grasses.

Similar fates have undoubtedly been met by other populations of *A. fluitans*. There have been no collections from lowland sites, other than at Boggy Pond and Paekakariki, for more than 20 years. Zotov's "pond at Church Street, Palmerston North" (Table 1) has been obliterated (R.M. Greenwood, pers. comm.), but the state of other lowland locations which once had *A. fluitans* is unknown.

The future for *Amphibromus fluitans* appears generally bleak, for not only have many habitats gone, but remaining ones are often heavily infested by adventive plants and grazing animals, and conservation management will be difficult and labour-intensive. *A. fluitans* is not alone in this. There are a number of once wide-spread native species of lowland, fertile wetlands which are now uncommon. In the previous issue of this bulletin Dr. Patrick Brownsey (1985) identified the precarious hold which *Ophioglossum petiolatum* has in New Zealand. *Myriophyllum robustum*, *Mazus pumilio*, *Crassula acutifolia*, *Thelypteris confluens*, and *Pterostylis micromega* are a few others which might be heading in the same direction.

#### ACKNOWLEDGEMENTS

My thanks to Miss B.H. Macmillan and Dr E. Edgar of Botany Division, DSIR, Christchurch and Dr P.J. Brownsey, National Museum, Wellington, for herbaria information on *Amphibromus fluitans*.

#### REFERENCES

- Brownsey, P.J. 1985. *Ophioglossum petiolatum* at Hokio Beach. *Wellington Botanical Society Bulletin* 42: 33-34.
- Jacobs, S.W.L. and Lapinuro, L. 1986. The Australasian species of *Amphibromus* (Poaceae). *Telopea* 2(6): 715-729.
- Kirk, T. 1884. Notice of the discovery of *Amphibromus* in New Zealand, with description of a new species. *Transactions of the New Zealand Institute* 16: 374-375.

## Native Forest Remnants in Wellington's Botanic Gardens

*Shona C Myers, Wellington*

### INTRODUCTION

Because of a lack of information on the remaining native forest areas in the Wellington Region (Fig 1) a regional study of the biological resources in Wellington was initiated by the Wellington Regional Council in 1981 (Anon. 1984).

This led to more detailed surveys of several areas in the Region (Clelland 1984; Myers 1985). In the latter report, five forest remnants within

Wellington City were surveyed, following the discovery that the Wellington Botanic Gardens contained remnants of original Pre-European forest (Cook & Shepherd, in prep.). This paper discusses one of these five sites, the Wellington Botanic Gardens.

Wellington is fortunate in having remnants of original and secondary native forest close to the city centre. Such remnants are so rare in urban areas, that where they occur they play extremely valuable scientific, historical, recreational and scenic roles. Their value will undoubtedly increase as urban New Zealanders develop a greater appreciation of their natural heritage. However, these remnants are usually small and isolated and are often threatened by intensive human use, introduced plant species, and by urban development.

## **SURVEY METHOD**

The survey method is adapted from the Biological Survey of Reserves methodology (Kelly 1972) which was also used by Clelland (1984). A major aspect of the methodology is an assessment of the uniqueness of the biological features, i.e. the extent to which particular features are found in other reserves in the district. The method was chosen for this study to provide a description and comparison of the type and condition of the plant communities in each of the five sites, and to be consistent with a national standard. This paper describes only one site, the Wellington Botanic Gardens.

The field survey included making a description of the plant communities and an assessment of the modifications, trends and threats to the site. The plant communities are described in Table 1. Estimates of their area (% area) and of their naturalness, i.e. whether the vegetation is primary (1°), secondary (2°) or induced (ind.), are given. Primary refers to vegetation which obviously predates European settlement (i.e. > 140 years), secondary refers to vegetation which has regenerated after destruction, while induced refers to vegetation which establishes after destruction or disturbance of the previous cover and which is essentially different from the original vegetation (Kelly 1972).

As well as the site description, a vegetation map (Fig 2) and species list (Appendix) were made. The map is based on an aerial photograph of the Botanic Gardens and the map supplied in a Wellington City Council bulletin of the Botanic Gardens (Parks and Recreation Department, Wellington City Council 1982). It shows vegetation boundaries and important geographical features. The common native and adventive plants are listed.

## **SITE DESCRIPTION**

### **Location**

The Wellington Botanic Gardens are bordered by the suburbs of Kelburn, Thorndon and Northland.

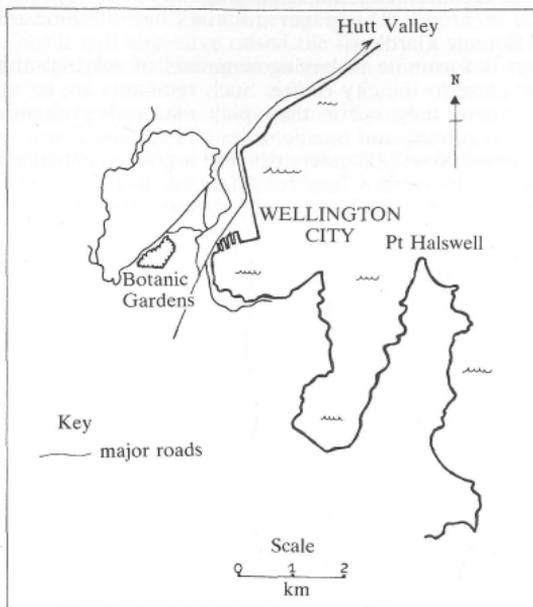
### **Area**

Eight hectares of native forest within the 26ha Botanic Gardens.

### **Classification**

The land was set aside in 1869 to create a Botanic Gardens and to save the remaining areas of original forest (Cook & Shepherd, in prep.). The land

FIG. 1. Location of the Wellington Botanic Gardens withing Wellington City



was vested in the Wellington City Council in 1891. The management plan for the Gardens (Parks & Recreation Department, Wellington City Council, 1981) does not provide protection for the native forest remnants, although a review of the management plan is currently being carried out and this should provide protection for these remnants (I Galloway, pers. comm.).

#### **Area Description**

The Wellington Botanic Gardens contain areas of exotic plantings, mixed native and exotic plantings, lawn and ornamental bedding and several areas of native forest. The native forest occupies three main valleys within the gardens (Fig 2 and Table 1):

1. The western slope of Fern Glen Stream, extending also on to the eastern side through two valleys;
2. Stable Gully;
3. The hillside south of the Rose Gardens.

Prior to the 1840's, the land was covered in dense broadleaved-podocarp and coastal broadleaved forest. Most was cleared during the late 19th century and early 20th century, during pioneer settlement in Wellington. With the establishment of the Botanic Gardens in 1869 further destruction was prevented in this area (Cook & Shepherd, in prep.). Most of the forest remaining in the gardens at the time of establishment still exists today (ibid.).

Fig. 2. Vegetaion Map of Wellington Botanic Gardens

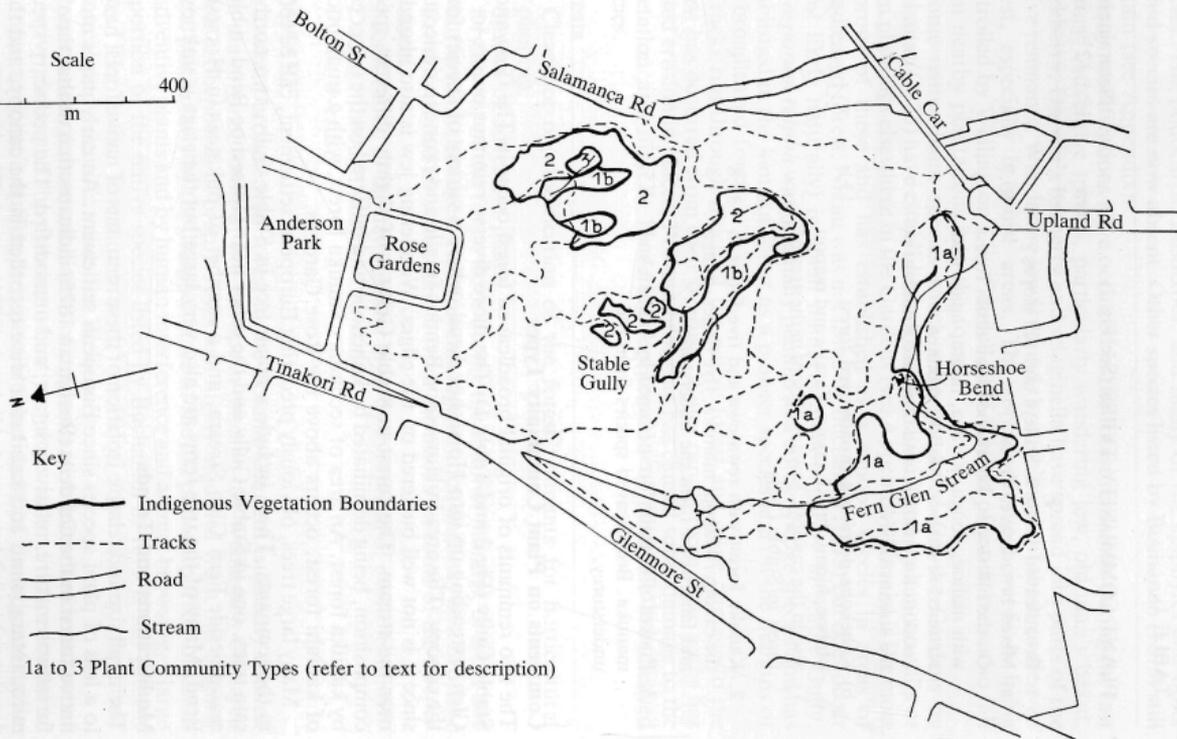
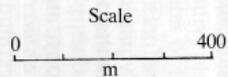


TABLE 1.

PLANT COMMUNITY TYPES (See Fig 2)	% area	Naturalness		
		1°	2°	ind.
1. Broadleaved forest in valleys and hill slopes				
a) Mixed broadleaved forest. On the hill slopes, kohekohe-hinau-titoki forest with mahoe, ponga, karaka, tarata, ngaio and scattered rewarewa. Mahoe, pukatea, kotukutuku, mamaku and titoki are abundant in the stream valleys.	50.7	x		
b) Kohekohe dominant broadleaved forest. Mahoe, hinau, titoki, tarata, karaka and mapou also in the canopy. Tawa is present in the area of forest in Stable Gully.	13.0	x		
2. Kanuka forest with rewarewa and five finger in the canopy. Mapou, manuka, five finger, ponga and lancewood form the understorey.	34.8		x	x
3. Pocket of kamahi forest fringed by kanuka and manuka. Broadleaved species form the understorey.	1.5		x	

### Comments on Plant Community Types

The two remnants of original broadleaved forest occur in The Glen and in Stable Gully (Fig 2 and Table 1). The more diverse remnant occurs in The Glen, extending up into Horseshoe Bend, where a variety of species forms the canopy. The area in Horseshoe Bend is fragile and prone to desiccation since it is not well buffered on the edges. Wandering jew is also abundant near the stream. The forest in Stable Gully is of slightly different species composition, being dominated by kohekohe and buffered on the upper edge by kanuka forest. An area of secondary kanuka forest, with a small pocket of kamahi forest, occurs above the Rose Gardens.

Many large trees, obviously predating European settlement, can be found in the remnants. These include a hinau tree in Stable Gully, two northern rata trees, one in Stable Gully and the other near Horseshoe Bend, a black maire beside Fern Glen Stream, and a number of pukateas in Horseshoe Bend. Many of the tree ferns are also very large but their age is unknown.

### Modifications and Trends

The small size and relative isolation of these remnants of native forest has led to a loss of plant species since European settlement. An early paper on the native forest in the Gardens (Buchanan 1875) indicates that at that time the forest was mature, relatively intact, and unmodified. The podocarp species miro, totara, rimu and kahikatea were recorded in the canopy, and there were native mistletoe species (*Ileostylus micranthus*, *Tupeia antarctica* and *Korthalsella salicornioides*), many epiphytes (*Astelia* species) and orchid

species. The podocarps, mistletoes, and many of the epiphytes and other orchid species are now absent. Other species listed by Buchanan (1875) still remain (see Appendix).

Many modifications have occurred in the forest remnants during the last century. Adventive species, particularly wandering jew, old man's beard, blackberry, Darwin's barberry and selaginella have spread into parts of the native remnants. Wandering jew is found through much of the broadleaved forest, especially in moist areas. The spread of these weeds is being controlled by Wellington City Council staff. Leaves of exotic trees also fall from nearby plantations into the forest.

Some native plant species which were not listed for the Gardens by Buchanan (1875) have established within the native forest, either naturally or from plantings elsewhere in the Gardens (see Appendix). Karaka is the most vigorous of these and has established as a canopy species in areas of broadleaved forest. Nikau was not listed by Buchanan (1875) but does occur (most likely naturally) in small numbers predominantly in Stable Gully. *Pittosporum ralphii* was originally planted as a border-hedge species and has established in the kanuka forest as a pioneer species and on the margins of the broadleaved forest.

Tracks run through much of the native forest and some damage to the forest has occurred from their overuse. Water runoff from these paths has caused erosion in places. Possum browsing has caused some damage to the vegetation and may be hindering regeneration of palatable broadleaved species.

### Threats

1. Clearance or modification of the forest remnants for horticultural planting.
2. Spread of adventive plants.
3. Drying out of the forest floor during the summer months, in areas not buffered on the edges. This prevents regeneration and may be a fire risk.
4. Erosion caused by water runoff from the tracks on some of the steeper slopes.
5. Modification of the natural litter layer by the spread of exotic leaf litter.
6. Damage through possum browsing.
7. Public overuse.

### SUMMARY

The lowland broadleaved forest in the Botanic Gardens is directly derived from the original forest of pre-European times in the Wellington City area (Cook & Shepherd, in prep.). Although highly modified from this original forest, particularly by the disappearance of the old podocarp trees, invasion by adventive plants and by human interference and animal browsing, a large proportion of the native species listed by Buchanan in 1875 is still present today. The native forest remnants, therefore, have a very important historical and scientific value for Wellington.

Preservation of these small areas of original native forest needs control of adventive plants and the planting of native species around the perimeter of the forest to form a buffer. It is possible that some of the original native species recorded by Buchanan (1875) could also be re-established from local seed sources.

Total protection needs to be given to these remnants so as to preserve the area as a remnant of Wellington's original, lowland, broadleaved forest.

## REFERENCES

- Anon. 1984. Biological resources of the Wellington Region. A report jointly prepared by the Wellington Regional Council, the Queen Elizabeth II National Trust and the NZ Biological Resources Centre.
- Buchanan, J. 1875. Notes on the Colonial Botanic Gardens Wellington and its Flora. Unpublished paper, National Museum.
- Clelland, D. 1984. Unprotected Natural Areas of the Wellington Region (Unpublished). Department of Lands & Survey, Wellington.
- Cook, W. and Shepherd, R.W. (In prep.) History of the Wellington Botanic Gardens.
- Kelly, G.C. 1972. Scenic Reserves of Canterbury. *Biological Survey of Reserves, Report 2*. Department of Lands and Survey, Wellington.
- Myers, S.C. 1985. Native forest remnants of Wellington City — a survey of five sites. *Biological Resources Centre Unpublished Report No. 10*.
- Parks & Recreation Department, Wellington City Council 1981. Botanic Gardens Management Plan.
- Parks & Recreation Department, Wellington City Council 1982. Botanic Gardens. Wellington City Council Bulletin.
- Parrish, G.R. 1984. Wildlife and wildlife sites of the Wellington Region. *Fauna Survey Unit Report No 38*. New Zealand Wildlife Service, Wellington.

## ACKNOWLEDGEMENTS

The idea for this study was initiated by Winsome Shepherd and Walter Cook, who are both preparing a history of the Botanic Gardens. They contributed valuable information and continual enthusiasm for the preservation of the remnants in the Botanic Gardens.

## APPENDIX

### Higher Plants of Native Forest Remnants, Wellington Botanic Gardens

#### a) Indigenous Species

(\*Planted native species or natives outside their natural range)

SCIENTIFIC NAME	COMMON NAME
<b>Trees and Shrubs</b>	
<i>Alectryon excelsus</i>	titoki
<i>Aristotelia serrata</i>	wineberry
<i>Beilschmiedia tawa</i>	tawa
<i>Brachyglottis repanda</i> var. <i>repanda</i>	rangiora
<i>Carpodetus serratus</i>	putaputaweta
<i>Coprosma grandifolia</i>	raureka
<i>C. lucida</i>	karamu
<i>C. rhamnoides</i>	
<i>C. robusta</i>	karamu
* <i>Corynocarpus laevigatus</i>	karaka
<i>Dodonaea viscosa</i>	akeake
<i>Dysoxylum spectabile</i>	kohekohe
<i>Elaeocarpus dentatus</i>	hinau
<i>Fuchsia excorticata</i>	kotukutuku
<i>Geniostoma rupestre</i> var.	hangehange
<i>Griselinia lucida</i>	puka
<i>Hebe stricta</i> var. <i>atkinsonii</i>	koromiko
<i>Hedycarya arborea</i>	pigeonwood
* <i>Hoheria populnea</i> var. <i>populnea</i>	houhere, lacebark
<i>Knightsia excelsa</i>	rewarewa

<i>Kunzea ericoides</i> var. <i>ericoides</i>	kanuka
<i>Laurelia novae-zelandiae</i>	pukatea
<i>Leptospermum scoparium</i>	manuka
<i>Leucopogon fasciculatus</i>	mingimingi
<i>Lophomyrtus bullata</i>	ramarama
<i>Macropiper excelsum</i> var. <i>excelsum</i>	kawakawa
<i>Melicope ternata</i>	wharangi
<i>Melicytus ramiflorus</i> var. <i>ramiflorus</i>	mahoe
<i>Metrosideros robusta</i>	northern rata
<i>Myoporum laetum</i>	ngaio
<i>Myrsine australis</i>	mapou
<i>M. salicina</i>	toro
<i>Nestegis cunninghamii</i>	black maire
<i>Olearia paniculata</i>	akiraho
<i>O. rani</i>	heketara
<i>Pennantia corymbosa</i>	kaikomako
* <i>Pittosporum crassifolium</i>	karo
<i>P. eugenioides</i>	lemonwood, tarata
* <i>P. ralphii</i>	
<i>P. tenuifolium</i>	kohuhu
* <i>Pomaderris apetala</i>	tainui
<i>Pseudopanax arboreus</i>	five-finger
<i>P. crassifolius</i>	lancewood
<i>P. edgerleyi</i>	raukawa
<i>Pseudowintera axillaris</i>	pepper tree
<i>Rhopalostylis sapida</i>	nikau
<i>Schefflera digitata</i>	pate
* <i>Vitex lucens</i>	puriri
<i>Weinmannia racemosa</i> var. <i>racemosa</i>	kamahi

## Lianes

<i>Clematis forsteri</i> var. ( <i>C. hookeriana</i> )	
<i>C. paniculata</i>	puawananga
<i>Freycinetia baueriana</i> subsp. <i>banksii</i>	kiekie
<i>Metrosideros diffusa</i>	white climbing rata, akatea
<i>M. fulgens</i>	
<i>M. perforata</i>	aka
<i>Muehlenbeckia australis</i>	pohuehue
<i>M. complexa</i>	scrub pohuehue
<i>Parsonia heterophylla</i>	kaiwhiria
<i>Passiflora tetrandra</i>	kohia, native passionfruit
<i>Ripogonum scandens</i>	supplejack
<i>Rubus cissoides</i> var. <i>cissoides</i>	bush lawyer, tataramoa

## Grasses and like plants

<i>Microlaena avenacea</i>	bush rice grass
<i>Uncinia banksii</i>	a hooked sedge
<i>U. uncinata</i>	a hooked sedge

## Herbs

<i>Dianella nigra</i>	blueberry grass
<i>Haloragis erecta</i>	toatoa
<i>Microtis unifolia</i>	onion orchid
<i>Phormium tenax</i>	flax
<i>Pterostylis banksii</i>	a greenhood orchid
<i>P. alobula</i>	a greenhood orchid
<i>Thelymitra longifolia</i>	white sun orchid

## Ferns

<i>Adiantum cunninghamii</i>	maidenhair fern
<i>A. viridescens</i>	
<i>Asplenium bulbiferum</i> subsp. <i>bulbiferum</i>	hen and chicken fern
<i>A. flaccidum</i> subsp. <i>flaccidum</i>	hanging spleenwort
<i>A. oblongifolium</i>	shining spleenwort
<i>A. polyodon</i>	sickle spleenwort
<i>Blechnum</i> sp. (unnamed <i>B. capense</i> agg.)	kiokio
<i>B. chambersii</i>	
<i>B. filiforme</i>	
<i>B. membranaceum</i>	
<i>Cyathea dealbata</i>	ponga
<i>C. medullaris</i>	mamaku
<i>Histiopteris incisa</i>	water-fern
<i>Hymenophyllum demissum</i>	a filmy fern
<i>Lastreopsis glabella</i>	
<i>L. hispida</i>	
<i>L. velutina</i>	
<i>Leptopteris hymenophylloides</i>	heruheru
<i>Phymatosorus diversifolius</i>	hound's tongue fern
<i>P. scandens</i>	fragrant fern
<i>Pneumatopteris pennigera</i>	
<i>Polystichum richardii</i>	shield fern
<i>Pteridium esculentum</i>	bracken
<i>Pyrrosia serpens</i>	leather-leaf fern

## b) Common Adventive Species

<i>Allium triquetrum</i>	three-cornered garlic
<i>Berberis darwinii</i>	Darwin's barberry
<i>Clematis vitalba</i>	Old Man's Beard
<i>Cytisus scoparius</i>	yellow flowered broom
<i>Lonicera periclymenum</i>	honeysuckle
<i>Rubus fruticosus</i> agg.	blackberry
<i>Selaginella kraussiana</i>	selaginella
<i>Tradescantia fluminensis</i>	wandering jew
<i>Ulex europaeus</i>	gorse