REPORT OF PROGRESS
2002 – 2003

Science Division
November 2003

Natural tree-fall in oldgrowth forest in Surface forest block, adjacent to FORESTCHECK grid FC17. This large Jarrah tree has a diameter of about 1.8 m. Coarse woody debris is important as wildlife habitat, as a substrate for fungi, and in the carbon cycle of the forest.

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Cover photo: Mature Jarrah trees in oldgrowth forest at Tumlo forest block on FORESTCHECK grid FC19.

EXECUTIVE SUMMARY

This document is a report of the results of the second round of sampling (spring 2002, autumn 2003) under the FORESTCHECK initiative. Nine grids were established in Jarrah forests in six forest blocks in Wellington district, north of Collie and east of Harvey.

As was evident from the first round of sampling (spring 2001, autumn 2002) in Jarrah forests in Donnelly district near Manjimup, a large variety of forest species was recorded. Our strategy of not making an early 'best bet' selection of indicator species has proven to be well judged. For example, the invertebrate data show that of the 753 species collected in rounds 1 and 2, 22 % are found only at the Wellington sites and 48 % are found only at the Donnelly sites. I therefore remain confident that reliable lists of indicator species will be able to be assembled after FORESTCHECK has operated for another three rounds and data have been collected from a more comprehensive set of sites in Jarrah forest.

Several interesting points have emerged:

- Jarrah comprised 22–79% of eucalypt regeneration, therby satisfying the current silvicultural guideline.
- Shelterwood treatments were variable in their effectiveness at establishing regeneration, depending on the extent of overwood retention.
- The mean area of each faller's block disturbed by snig tracks and landings was 16%.
- The mean fine earth bulk density of the soil surface on sites with a history of logging was greater than on unlogged control sites.
- Litter weight differed little between the Control, Shelterwood and Gap Release treatments.
- Coarse woody debris was lowest in the Control sites.
- Macrofungal diversity differed little between the Control, Shelterwood and Gap Release treatments.
- Most fungal fruitbodies were consistently recorded on soil in the Gap Release treatment.
- Cryptogam diversity was consistently greater in the Control sites.
- The potential indicator cryptogam species approach is showing promise.
- Slime moulds (26 species detected) were well represented across the sites sampled.
- Vascular plant diversity differed little between the Control, Shelterwood and Gap Release treatments.
- The type of machinery used and the extent of soil disturbance can influence the abundance of understorey vegetation.
- Plants were on average more abundant in Gap Release treatments.
- 381 invertebrate morphspecies were collected, with no striking difference apparent between treatments.

- Bird diversity and abundance differed little between the Control, Shelterwood and Gap Release treatments.

- The Boobook owl was recorded at all sites, in both spring and autumn.

- Few mammals were captured or detected on any sites – the sites lie within a large area of forest that has been unbaited for a study of the impact of foxes on Woylies. This negative result reinforces the importance of fox control in allowing populations of native mammal species to increase.

I thank the FORESTCHECK team for their professionalism and commitment to this project Verna Tunsell of the Science Division office at Donnelly has provided extensive assistance to members of the team in the collation and management of data, and in the preparation of this report. Her enthusiasm and efforts towards the project are greatly appreciated.

Dr Neil Burrows

Director Science Division

November 2003

INTRODUCTION

Scope

This report presents a summary of activities completed as part of the FORESTCHECK monitoring project during the 2002/2003 financial year. It has been compiled from chapters prepared by a number of scientists and technical staff involved in the project.

FORESTCHECK is an integrated monitoring system that has been developed to provide information to forest managers in south-west Western Australia about changes and trends in key elements of forest biodiversity associated with a variety of forest management activities. Although the initial focus of FORESTCHECK will be on timber harvesting and silvicultural treatments in Jarrah (*Eucalyptus marginata*) forest, the intention is to extend the scale of monitoring over time to include other forest ecosystems, fire (prescribed and wildfire), mining, the effects of forest disturbance for utility corridors (e.g. roads, power transmission lines), and the impacts of recreation uses. (Note, however, that the Forest Products Commission will only fund the part of FORESTCHECK that is specific to its activities).

FORESTCHECK has been developed to meet a range of compliance conditions placed on the Forest Management Plan 1994-2003 through Ministerial Conditions and the Codd Report of 1999. Integrated monitoring is a fundamental component of Ecologically Sustainable Forest Management (ESFM), and is necessary for reporting against the Montreal Process criteria and indicators for ESFM. In addition, monitoring forms the basis for adaptive management, which is recognized as an appropriate strategy for managing under conditions of uncertainty and change.

The development of FORESTCHECK took place over 2 yrs and included input from scientists and managers within the Department of Conservation and Land Management, and from a number of external scientific agencies. Background to this process is described in the FORESTCHECK Concept Plan, and details of methods are provided in the FORESTCHECK Operations Plan (both document at URL: http://www.naturebase.net/science/science.html). The Science Division of the Department of Conservation and Land Management has primary responsibility for the implementation of FORESTCHECK.

Sampling strategy

Since 1995, timber harvesting in Jarrah forests has been undertaken according to Silvicultural Guideline 1/95, which recognizes 3 silvicultural objectives:

1. Thinning – to promote growth on retained trees,
2. Release of regeneration by gap creation, where existing advance growth is encouraged to develop unimpeded by the removal of competing overstorey,
3. Regeneration establishment by Shelterwood, where seedlings are encouraged to establish and develop into the lignotuberous ground coppice stage. This is achieved by reducing the competition from the overstorey, but retaining sufficient overstorey to provide a seed source and maintain other forest values until the ground coppice is developed and capable of responding to release.

Silvicultural guidelines have been revised in conjunction with the preparation of the new Forest Management Plan (2004-2013) and changes to the guidelines are detailed in Appendix 5 of the proposed plan.

Gap Release and Shelterwood treatments are being given priority in the initial stages of FORESTCHECK as these are the most widespread operations and involve the greatest extent of disturbance to the forest. Thinning will also be monitored where the structure of the forest dictates that this treatment is appropriate on a significant scale.

SITES AND GRID ESTABLISHMENT

FORESTCHECK sites are being established at a number of locations across the forest, stratified according to recognized ecological gradients of rainfall, evapo-transpiration and soil fertility. Forest ecosystem mapping (Mattiske and Havel 1998) provides a systematic basis for stratification of sampling. Allocation of sites also takes account of scheduled future harvesting within the Jarrah forest, with priority given to those ecosystems likely to be subject to harvesting on an extensive scale in the next decade.

Each FORESTCHECK site consists of up to 4 sampling grids. Grids will be established in forest subject to the following treatments:

1. Gap Release,
2. Shelterwood,
3. Coupe buffer or internal reference forest i.e. temporary exclusion areas (TEAS) between adjacent gaps or Shelterwood forest,
4. External reference or Control forest i.e. not recently harvested, or has had minimal harvesting, and will not be subject to harvesting in the foreseeable future.

The intention is that grids be closely matched in terms of site characteristics (climate, geomorphology, soils, topography, altitude, aspect), pre-harvest forest structure and vegetation attributes in order that differences between grids reflect the effects of harvesting, rather than inherent site differences. Not all treatment types will be found in the one locality and it is expected that external reference forest may have to be located some distance from their harvested counterparts. It may not always be possible to find Gap Release and Shelterwood treatments together, because underlying relationships between rainfall, soil fertility and jarrah lignotuber development influence the broad pattern of silvicultural treatment across the jarrah forest, as have previous silvicultural activities.

Methodology
A range of ecosystem attributes are monitored at each site including:

1. Forest structure and regeneration stocking
2. Foliar and soil nutrients
3. Soil disturbance
4. Coarse woody debris and leaf litter
5. Macrofungi
6. Cryptogams
7. Vascular flora
8. Invertebrate fauna
9. Vertebrate fauna (birds, herpetofauna, and mammals)

Sampling methodologies for each set of ecosystem attributes are described in the FORESTCHECK Operations Plan, together with examples of protocols for data collection and storage. Monitoring of biodiversity is based on a sample grid. The main grid is 100 m x 100 m, with 30 m x 30 m vegetation sample plots at each corner.

Sampling in Wellington District during 2002/03
Nine FORESTCHECK monitoring grids were established and sampled in the Wellington District during 2002/03. Grids were located north-east of Wellington in areas of State Forest and the Lane Poole Reserve between the 900 mm and 1000 mm annual rainfall isohyets. Grids were identified by alphanumeric codes FC11 to FC19, with the southern-most (FC16) and northern-most grids (FC19) being 25 km apart (Figure 1).

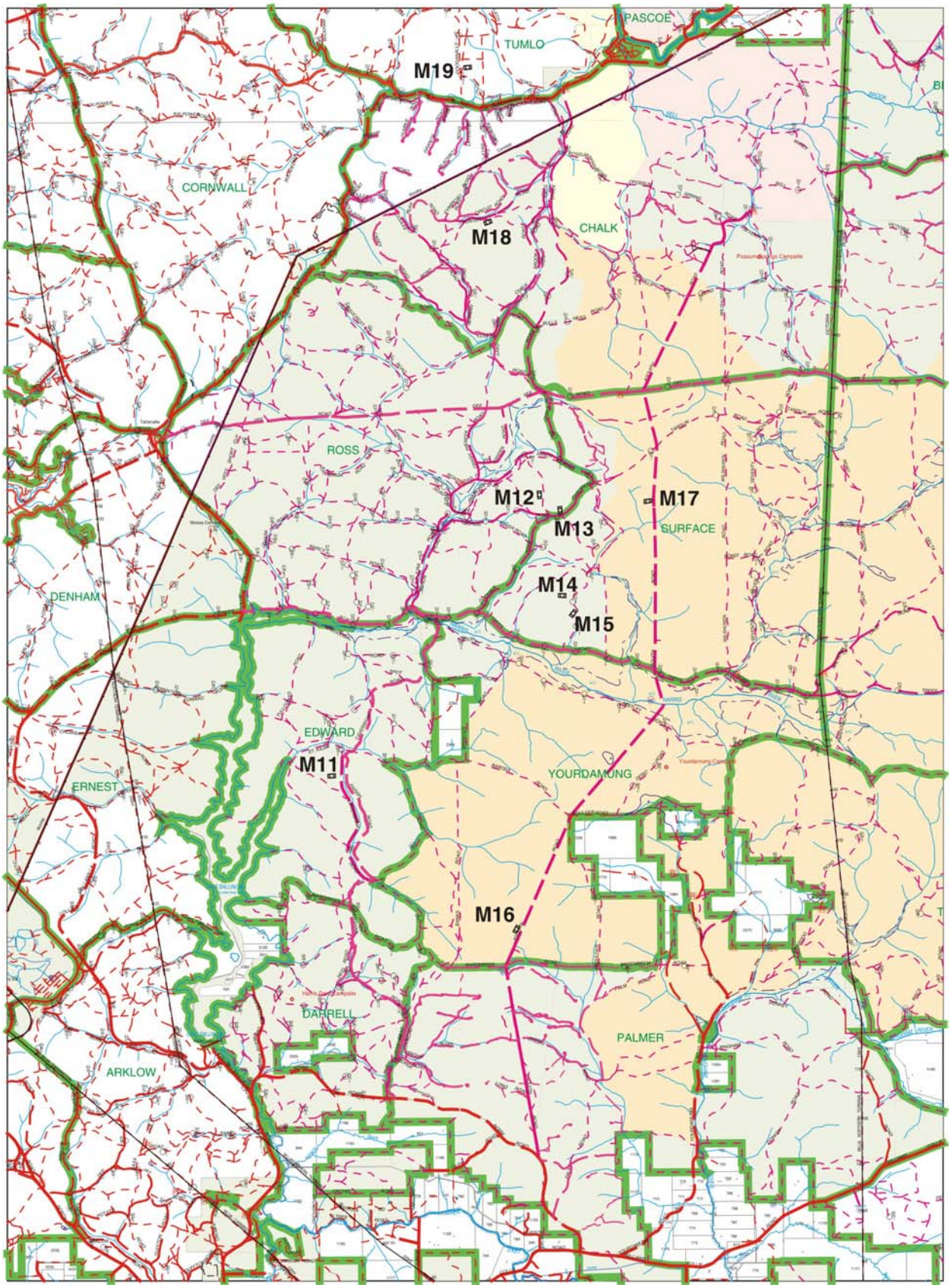


Figure 1. Location of 9 FORESTCHECK sampling grids established in Wellington District during 2002/03. The town of Wellington is situated just off the lower left hand corner of the map.

All grids are located in the Dwellingup1 vegetation complex of Mattiske and Havel (1998) that is characterized by open forests of Jarrah and Marri (*Corymbia calophylla*) on lateritic uplands in the humid and sub-humid zones. Upland sites have mild slopes (< 3°) and are at elevations between 248 and 320 m ASL (Table 1).

Table 1. Grid locations and attributes.

Grid ID	Block	Latitude (S)	Longitude (E)	Elevation (m)	Aspect	Slope (°)
FC11	Edward	33° 11' 20"	116° 10' 22"	248	E	2
FC12	Ross	33° 07' 33"	116° 13' 49"	316	S	2
FC13	Ross	33° 07' 34"	116° 14' 12"	320	S	2
FC14	Surface	33° 08' 49"	116° 14' 24"	310	SW	1
FC15	Surface	33° 08' 55"	116° 14' 28"	290	S	3
FC16	Yourdamung	33° 13' 38"	116° 13' 27"	285	W	0
FC17	Surface	33° 07' 22"	116° 15' 49"	305	W	1
FC18	Chalk	33° 03' 13"	116° 13' 01"	280	W	2
FC19	Tumlo	33° 01' 03"	116° 13' 03"	260	W	1

Three grids are in oldgrowth forest with no recorded history of timber harvesting, representing parts of Yourdamung (FC16), Surface (FC17) and Tumlo (FC19) forest blocks (Table 2). This part of the Wellington District is notable in having the most extensive tracts of oldgrowth forest north of the Blackwood River (for further information refer to Map 14 of the Comprehensive Regional Assessment, Commonwealth of Australia and Western Australian Government 1998).

The remaining 6 grids are in forest that was harvested during the decade of the 1990s, and also sometime in the period between 1920 and 1950 (Table 2). Details of the most recent silvicultural and prescribed burning treatment applied to these grids are shown in Table 2. The treatment applied to the Gap Release and Shelterwood treatments in Ross forest block (FC12 and FC13) varied from the guideline in that burning took place prior to timber harvesting, and the sites have remained unburnt since harvesting in 1992. The 3 grids in oldgrowth forest were last burnt between 5 and 8 yrs prior to sampling, therefore the understorey flora were in a mature seral stage with few post-fire ephemerals still evident.

Table 2. Logging & Fire History at each grid.

Grid ID	Forest block	Year of most recent cut	Silvicultural Treatment	Decades of previous cutting	Year of most recent burn	Burn Type
FC11	Edward	1994	Gap Release	40, 90	1995	Regeneration release
FC12	Ross	1992	Gap Release	20, 90	1991	Advance
FC13	Ross	1992	Shelterwood	30, 90	1991	Advance
FC14	Surface	1997	Gap Release	30, 90	1998	Regeneration release
FC15	Surface	1997	Shelterwood	20, 90	1998	Establishment
FC16	Yourdamung	n/a	Oldgrowth	n/a	1995	Fuel Reduction
FC17	Surface	n/a	Oldgrowth	n/a	1998	Fuel Reduction
FC18	Chalk	1992	Shelterwood	50, 90	1993	Establishment
FC19	Tumlo	n/a	Oldgrowth	n/a	1996	Fuel Reduction

Photographs taken in each of the 9 sampling grids are presented in Figures 2 - 10. Details of the date, location and direction in which the camera was facing are shown for each photograph to allow changes in vegetation structure and condition to be determined in subsequent photographs.

FC11 Edward forest block; Gap Release; 21/05/2003 from peg W1-2 towards centre of plot.

FC12 Ross forest block; Gap Release; 20/05/2003 from peg W1-2 towards centre of plot.

FC13 Ross forest block; Shelterwood; 20/05/2003 from peg W2-2 towards peg W3-2.

FC14 Surface forest block; Gap Release; 20/05/2003 from peg W2-2 towards centre of plot.

FC15 Surface forest block; Shelterwood; 21/05/2002 from peg W2-2 towards centre of plot

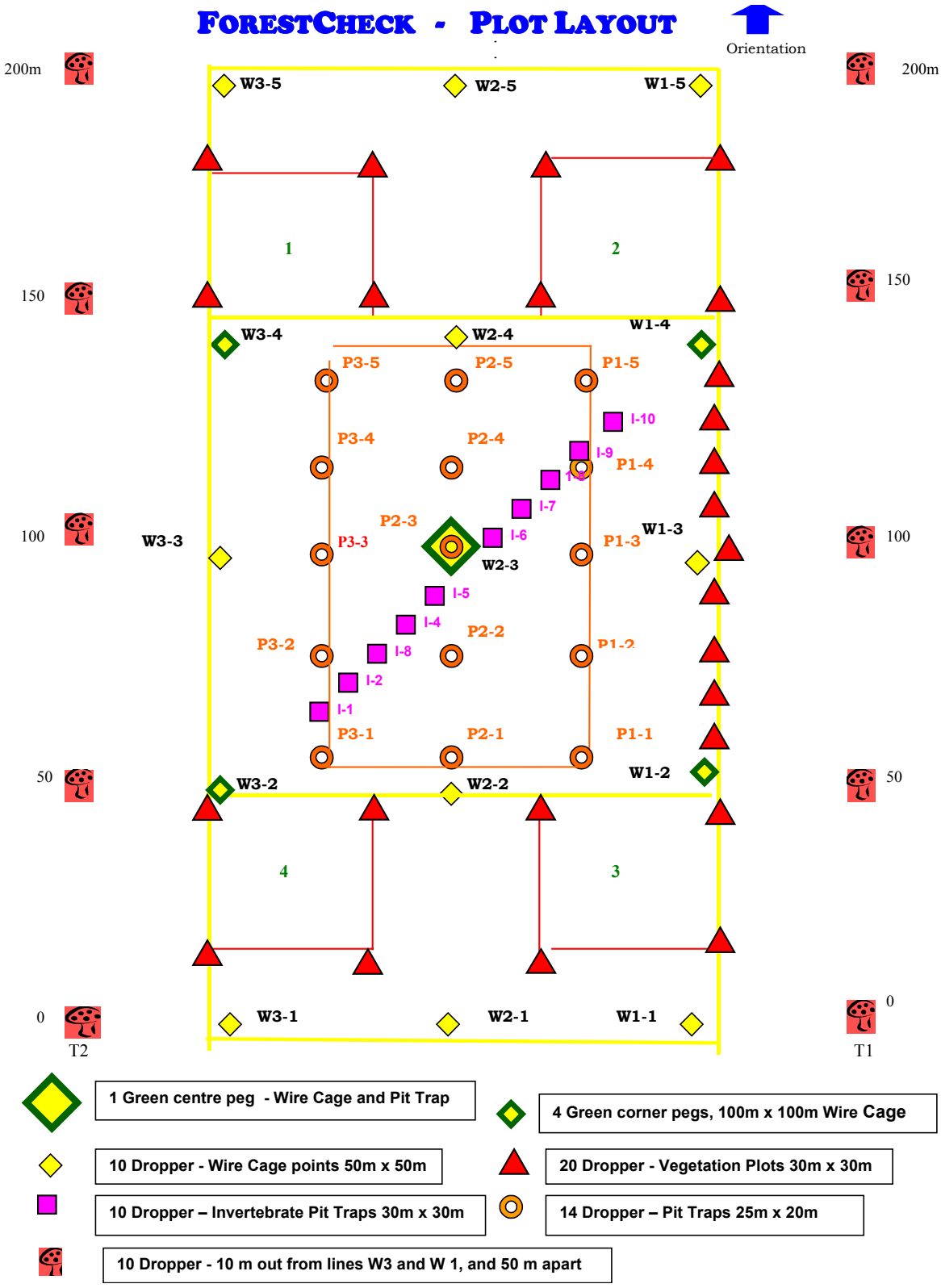
FC16 Yourdamung forest block; Control; 22/05/2003 from peg W3-3 towards centre of plot.

FC17 Surface forest block; Control; 21/05/2003 from peg on road verge towards plot.

FC18 Chalk forest block; Shelterwood; 19/05/2003 from peg W3-2 towards peg W3-3.

FC19 Tumlo forest block; Control; 19/05/2003 from W3-2 towards W3-3.

This diagram shows the layout of a sampling grid.



Budget for establishment and monitoring of FORESTCHECK sites in Wellington District in 2002/03

Task/Activity	OIC	Total Operating	[1]Salary + OH	TOTALS
Grid establishment	McCaw	10 000	30 000	40 000
Forest structure and regeneration	McCaw	12 000	6 500	18 500
Soil and foliar nutrients	McCaw	8 000	6 000	14 000
Soils disturbance	Whitford	12 500	14 000	26 500
Macrofungi / Litter & CWD	Robinson	10 600	6 000	16 600
Flora (vascular plants & cryptogams)	Ward	16 900	9 000	25 900
Invertebrates	Farr	12 000	9 500	21 500
Birds (diurnal)	Liddelow	6 000	12 000	18 000
Birds (nocturnal)	Liddelow	6 000		6 000
Fauna (grid trapping)	Liddelow	10 000	12 000	22 000
Spotlight Road surveys (vertebrate.)	Liddelow	4 000		4 000
TOTALS		**108 000**	**105 000**	**213 000**

GRAND TOTAL (incl. Division and Corporate OH) = 213 000 x 1.40 = $298 200

FOREST STRUCTURE AND REGENERATION STOCKING

Lachlan McCaw, Bob Smith and John Neal

Introduction

The adequacy of regeneration following harvesting and silvicultural treatment is one of the core indicators of Ecologically Sustainable Forest Management (ESFM). The current framework of regional level indicators provides for assessment of the area and percent of harvested area of native forest effectively regenerated (Indicator 2.1.g). This is recognized as a Category A indicator that can be reported upon immediately.

Regeneration outcomes have for a number of years been assessed as a matter of routine on at least a portion of the area of forest subject to harvesting. For uneven-aged forest stands, there is a need to consider the existing structure of the stand and whether sufficient sapling and advance growth is present to re-establish the stand following harvesting. Under the current silvicultural guidelines for Jarrah-Marri forest the decision as to whether the stand should be cut to Gap Release or to a Shelterwood is determined by the density of existing lignotuberous advance growth.

Forest managers also require information about the rate of growth and species composition of stands so that future stand conditions can be projected over time. These attributes can affect the potential of forest stands to produce wood and other products, and to achieve ecological outcomes.

The objectives of this component of FORESTCHECK monitoring are therefore:

- to describe the stand structure, species composition and developmental stage of tree species present at each sampling grid, and
- to measure the contribution of mid-storey species to stand structure, density and basal area.

Fieldwork in Wellington District during 2002/03

Nine sampling grids in Wellington District north of Wellington were assessed over 4 days in early March 2003.

Techniques were the same as used in Donnelly District during 2001/02. Regeneration stocking was assessed using the triangular tessellation method at 50 points around the outer perimeter of each grid. Triangular tessellation sampling is the standard technique employed for regeneration surveys undertaken before and after timber harvesting operations. Stand structure was assessed by measurement of all trees taller than 2 m in a transect 200 m long by 4 m wide. In stands cut to Gap Release and Shelterwood treatments, the height and species of regeneration was assessed at 4 locations on each grid to indicate the rate of regrowth.

Canopy cover was measured as part of the vascular plant assessment and is reported in that section.

Data management

Regeneration stocking data are summarized and entered into the FORESTCHECK database. Data are analysed to determine the following key information:

- whether the grid meets current stocking standards,
- species composition of overstorey trees and the regeneration cohort,
- proportion of the grid affected by retained overwood (Gap Release and Shelterwood grids only),
- average density of saplings and ground coppice at points that meet the stocking standard.

Stand structure and species composition

The 3 grids located in oldgrowth stands had eucalypt basal areas ranging from 33 to 43 m^2/ha, predominantly comprised of Jarrah (Table 1). Intermediate trees of *Banksia grandis* and *Allocasuarina fraseriana* contributed a further 5 m^2/ha at Tumlo (FC 19) but less than 2 m^2/ha at either FC16 or FC17. The basal area of Jarrah trees in the oldgrowth forest at Wellington was similar to that measured in the unharvested grids established in Donnelly District the year before. However, total basal areas were substantially greater for the Donnelly grids because Marri contributed an additional 30-40 m^2/ha.

Table 1. Analysis of eucalypt species composition determined according to basal area and stem density of live standing trees > 2 m tall, and the species mix determined in regeneration surveys of 9 FORESTCHECK sampling grids in Wellington District. (Figures in italics = % of total)

Grid	Basal Area (m^2/ha)			Stems/ha			Regeneration Species Composition	
	Jarrah	**Marri**	**Total**	**Jarrah**	**Marri**	**Total**	**Jarrah**	**Marri**
Control								
FC16	30.94	10.69	41.63	388	375	763	-	-
	74%	*26%*		*51%*	*49%*		*56%*	*44%*
FC17	31.14	2.13	33.27	588	488	1076	-	-
	94%	*6%*		*55%*	*45%*		*45%*	*55%*
FC19	42.45	0.15	42.60	325	38	363	-	-
	99%	*1%*		*90%*	*10%*		*74%*	*26%*
Shelterwood								
FC15	5.28	1.89	7.17	375	813	1188	-	-
	74%	*26%*		*32%*	*68%*		*45%*	*55%*
FC18	11.09	2.74	13.83	538	150	688	-	-
	80%	*20%*		*78%*	*22%*		*79%*	*21%*
FC13	7.38	8.28	15.66	150	288	438	-	-
	47%	*53%*		*34%*	*66%*		*37%*	*63%*
Gap Release								
FC14	44.98	7.13	52.11	450	1488	1938	-	-
	86%	*14%*		*23%*	*77%*		*27%*	*73%*
FC11	8.45	1.96	10.51	900	550	1450	-	-
	80%	*20%*		*62%*	*38%*		*57%*	*43%*
FC12	5.80	4.20	10.00	400	363	763	-	-
	58%	*42%*		*52%*	*48%*		*22%*	*78%*

Basal areas varied widely between the 3 grids established in areas cut to Gap Release. Grids in Edward (FC11) and Ross (FC12) forest blocks had eucalypt basal areas around 10 m^2/ha, with the latter grid also carrying 6 m^2/ha of *B. grandis*. The grid established in Gap Release treatment at Surface forest block (FC14) had a eucalypt basal area of 52 m^2/ha. This result was an artefact of the relatively small size of the gap, which was only just large enough to accommodate the grid. Consequently, some trees from adjacent unharvested forest were scored in the 4 m x 200 m transect used to sample basal area. The presence of these trees would have also affected light and moisture availability around the margins of the Gap Release in an influence zone of 30-50 m, which is equivalent to 1-2 times the average height of the overstorey.

The 3 grids in Shelterwood stands had eucalypt basal areas of 7-15 m^2/ha, but the Ross Shelterwood (FC13) also carried an additional 28 m^2/ha of *A. fraseriana*.

The proportion of Marri indicated by stem density was greater than reflected by basal area, indicating that Marri was more likely to be represented in the smaller size classes of saplings and poles. Jarrah tended to dominate the larger size classes. This was particularly evident in grids FC14 and FC15 in Surface forest block.

The eucalypt species composition of the regeneration cohort more closely resembled the proportions indicated by stem density than by basal area. Following harvesting and silvicultural treatment Marri often grows into the sapling stage more quickley than Jarrah. Marri is therefore chosen preferentially when using the current regeneration survey guideline which seeks to achieve the stocking standard with saplings before including Jarrah ground coppice or Marri advance growth. Using the current guideline to assess species composition in stands where more than 2 to 3 yrs have elapsed following treatment may result in a bias towards the inclusion of Marri. This bias could be addressed by the adoption of different sampling rules when regeneration surveys are delayed.

The current silvicultural guideline requires that on predominantly Jarrah sites the species mix of the eucalypt regeneration should contain at least 20 % Jarrah. This requirement was achieved in all silviculturally treated stands.

Regeneration stocking

Satisfactory stocking for regeneration in gaps is defined as 500 or more stems/ha of saplings or stool coppice from stumps < 30 cm diameter, or 1000 or more stems/ha of saplings, stool coppice and Jarrah ground coppice or Marri advance growth. Of the areas cut to Gap Release, 2 grids (FC12 and FC 14) were slightly understocked at 60-62 %, but both contained additional overwood trees that would contribute to the effective stocking on the site (Table 2). The other Gap Release grid (FC11) was 80 % stocked and had only 4 % of points affected by overwood.

Satisfactory stocking in stands cut to Shelterwood can include saplings, stool coppice, ground coppice and advance growth at the same densities as for Gap Release treatments, and can also include lignotuberous seedlings at 5000 or more stems/ha. Shelterwood stands in Ross (FC13) and Chalk (FC18) were poorly stocked with regeneration and had high levels of retained overwood. The Shelterwood in Surface forest block (FC15) was 60 % stocked and had only 14 % overwood. For the 3 Shelterwood sites in Wellington District there was an inverse relationship between overwood and effective stocking (Figure 1).

Table 2. Regeneration stocking and species composition for 9 FORESTCHECK grids in Wellington District assessed during March 2003. Values for percent stocking are based on 50 sample points per grid. Retained overwood is not assessed in uncut stands or TEAS.

Treatment	Grid	Height range of eucalypt regeneration (m)	Percent affected by overwood	Percent stocked with saplings	Percent stocked with saplings & ground coppice	Percent stocked including seedlings	Percent not stocked to standard
Control	FC16	Uncut	N/a	16	28	N/a	26
	FC17	Uncut	N/a	12	56	N/a	14
	FC19	Uncut	N/a	6	40	N/a	34
Shelterwood	FC15	5-6	14	22	38	N/a	26
	FC18	3-7	48	2	10	14	26
	FC13	2-5	42	4	18	10	26
Gap Release	FC14	5	22	38	34	N/a	6
	FC11	3-5	4	50	30	N/a	16
	FC12	6	18	28	34	N/a	20

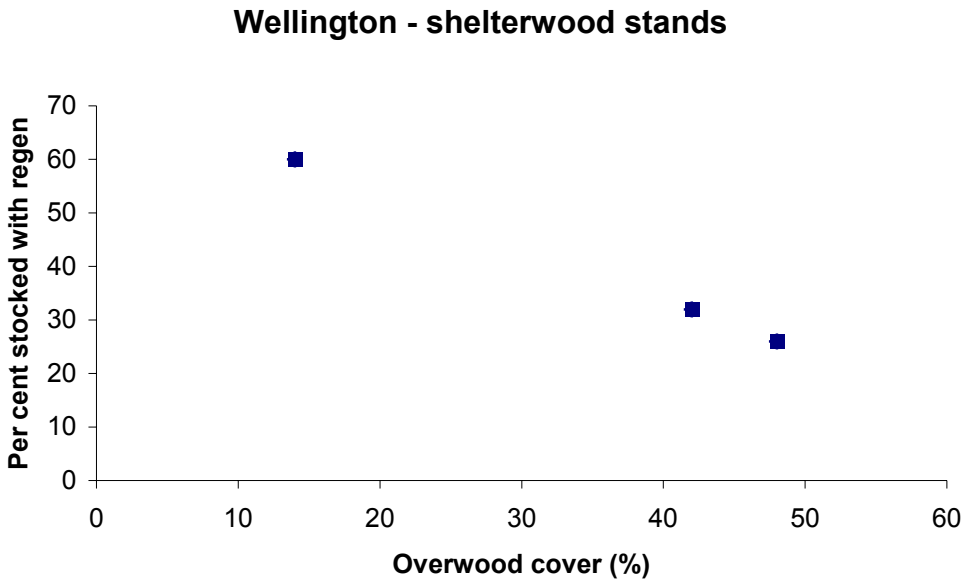


Figure 1. Relationship between the percentage of sample points having retained overwood and the percentage of points meeting the regeneration stocking standard for Wellington Shelterwood grids FC13, FC15 and FC18.

Grid FC18 had a high level of retained overwood (48 % of points) comprised primarily of Jarrah saplings and poles. There were 250 stems/ha of Jarrah and 113 stems/ha of Marri in the 20-50 cm diameter class, giving a stand basal area of 13.8 m^2/ha. This stand structure matches the specifications for a thinned stand where the silvicultural objective is to promote growth on selected future crop trees. Although the silvicultural treatment recorded by the SILREC system was Shelterwood, the situation in the field is that the treatment is more representative of thinning.

Regeneration originating from stool coppice on stems > 30 cm diameter and from stump coppice is not considered to contribute to the effective stocking at a point. This is because it is prone to wind-throw and is readily damaged by fire if the parent stump catches alight. However, on most sites there are a considerable number of additional stems originating from stump coppice that contribute to the initial re-establishment of crown cover and basal area.

The origin of all Jarrah and Marri stems > 2 m tall measured in the 4 m x 200 m transect on each grid is shown in Figure 2. All 3 grids in the Gap Release treatment had more than 500 stems of lignotuberous origin. Of the Shelterwood grids, only FC15 had more than 500 stems of lignotuberous origin. FC18 had a significant component (375 stems/ha) of Jarrah stump coppice, but FC13 had few coppice stems and failed to meet the stocking standard even if these were included in the tally for effective stocking.

Oldgrowth forest in grid FC16 also contained a small number of coppice stump stems resulting from natural windfall of large trees.

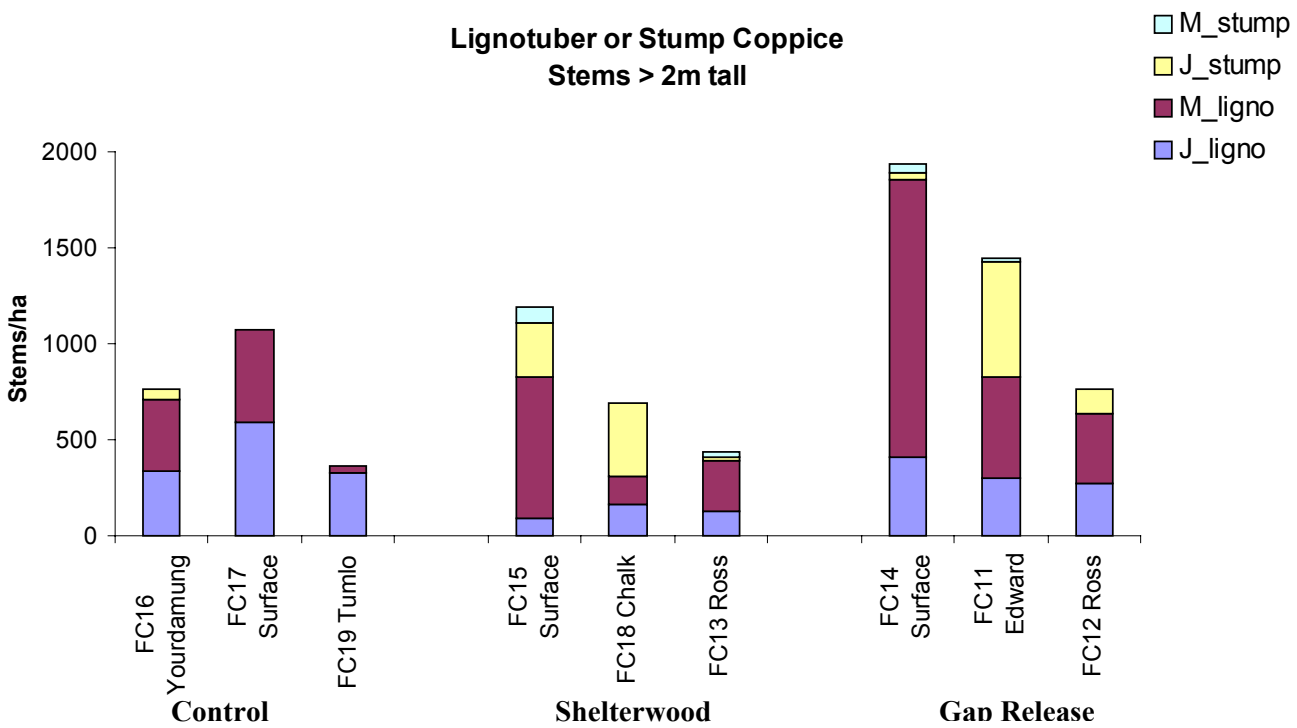


Figure 2. Origin of all Jarrah and Marri stems > 2 m tall measured in the 4 m x 200 m transect on 9 grids in Wellington District.

Discussion

The contribution of Marri in the FORESTCHECK grids at Wellington is notably lower than in those established in Donnelly, including those in the Kingston area where annual rainfall is comparable to the Wellington grids. This finding is consistent with previous studies of site vegetation mapping in south-west forests. The contribution of Marri would be expected to decline further as FORESTCHECK sampling is extended north and east of the Murray River.

Gap Release treatments have been reasonably effective in meeting the specified standards for regeneration stocking and species composition, although 2 of the grids (FC12 and FC14) were marginally below the stocking standard. Finding uniform gaps of sufficiently large size to accommodate the 1 ha sampling grids proved to be a challenge in the initial phase of site selection, and it is likely that this will become even more difficult in Perth Hills District due to the nature of past timber harvesting operations. Some modification of sampling protocols may need to be considered in order to achieve meaningful measures of stand structure.

Shelterwood treatments were found to be variable in their effectiveness in establishing regeneration, with only the Surface forest block Shelterwood (FC15) approaching the required standard for regeneration stocking. Factors that may have contributed to the lack of success in establishing seedling regeneration on Shelterwood grid FC13 include the high level of retained overwood, particularly *A. fraseriana*, and the fact that post-harvest burning was not undertaken. Grid FC18 also had a high level of retained overwood although this was comprised of saplings and poles. This grid met the requirements of a thinned stand where the establishment of additional regeneration would not be required. The relationship between the success of regeneration establishment and the level of retained overwood is an important silvicultural issue and will be examined further as data from more FORESTCHECK grids become available.

In future sampling, multi-stemmed trees of lignotuberous origin will be identified separately from single-stemmed trees to allow explicit consideration of longer-term form and growth potential.

FOLIAR AND SOIL NUTRIENTS

Lachlan McCaw, John Neal, Bob Smith, Shelley McArthur and Lin Wong

Introduction

Concentrations of nitrogen (N), phosphorus (P) and potassium (K) in the foliage of advance growth, saplings and overstorey trees, and in surface soils are measured at each FORESTCHECK monitoring grid to provide information about the nutritional status of the forest ecosystem. Data will be used to investigate correlations between macronutrient concentrations and measures of plant and animal abundance, and ecosystem health.

Field work in Donnelly and Wellington Districts during 2002/03

Samples of foliage and soil were collected from 19 grids in the Donnelly and Wellington Districts during February and March 2003. The methodology for collection and analysis of samples is described in the Operations Plan. Results from Donnelly grids (FC1-10) are presented here as they had not been measured in time for the 2001/02 progress report.

Foliar nutrients

Table 1. Concentrations of N, P and K in the foliage of Jarrah and Marri advance growth, saplings and mature trees for 10 grids in Donnelly District. Data are shown as minimum-mean-maximum.

Species	Foliage source	Nitrogen (total) Percent	Phosphorus Percent	Potassium Percent
Jarrah	Advance growth	0.54-**0.65**-0.71	0.010-**0.020**-0.050	0.18-**0.51**-0.76
	Sapling	0.61-**0.71**-0.81	0.010-**0.020**-0.030	0.19-**0.54**-0.79
	Mature	0.65-**0.78**-0.94	0.090-**0.030**-0.082	0.20-**0.55**-0.94
Marri	Advance growth	0.64-**0.74**-0.85	0.001-**0.015**-0.026	0.19-**0.44**-0.79
	Sapling	0.67-**0.77**-0.91	0.008-**0.014**-0.025	0.19-**0.33**-0.63
	Mature	0.85-**0.94**-1.06	0.014-**0.025**-0.045	0.30-**0.42**-0.94

Table 2. Concentrations of N, P and K in the foliage of Jarrah and Marri advance growth, saplings and mature trees for 9 grids in Wellington District. Data are shown as minimum-mean-maximum.

Species	Foliage source	Nitrogen (total) Percent	Phosphorus Percent	Potassium Percent
Jarrah	Advance growth	0.53-**0.69**-0.81	0.000-**0.004**-0.010	0.15-**0.27**-0.39
	Sapling	0.48-**0.68**-0.82	0.001-**0.005**-0.008	0.19-**0.27**-0.32
	Mature	0.73-**0.84**-0.98	0.013-**0.024**-0.082	0.27-**0.43**-0.88
Marri	Advance growth	0.64-**0.73**-0.83	0.003-**0.009**-0.013	0.46-**0.62**-0.84
	Sapling	0.63-**0.71**-0.81	0.003-**0.009**-0.014	0.49-**0.62**-0.86
	Mature	0.74-**0.84**-0.95	0.014-**0.024**-0.045	0.75-**0.84**-1.12

Foliage from mature trees tended to have higher concentrations of N, P and K than were evident in advance growth and saplings. This tendency was evident for both Donnelly and Wellington sites, but was particularly evident for P. Concentrations of P in advance growth and saplings at Wellington were only a quarter of those measured in the same growth stages at Donnelly, suggesting that the mature trees are more effective at capturing the P available at the Wellington sites.

Nitrogen concentrations in mature foliage were similar for Jarrah and Marri and showed little site influence. Jarrah and Marri had similar concentrations of K in the Donnelly grids, but at Wellington the K concentrations were higher in Marri than in Jarrah.

Soil nutrients

Overall mean concentrations of N, P and K in surface soils were similar for grids in Donnelly and Wellington, with a tendency for higher levels of total P and K at Wellington (Table 3).

Table 3. Mean concentrations of N, extractable and total P, and extractable and total K determined from 5 samples surface soil samples. Overall means (s.e.m.) for grids in Donnelly (n=10) and Wellington (n=9) are indicated.

District	Grid	N Percent	P_extract ppm	P_total ppm	K_extract ppm	K_total ppm
Donnelly						
Control						
	FC10	0.20	3.24	155.68	67.95	168.98
	FC05	0.08	1.61	31.10	25.89	82.95
	FC01	0.11	0.83	56.64	50.62	101.38
Shelterwood						
	FC03	0.14	4.04	114.66	50.04	128.13
Gap Release						
	FC06	0.10	0.75	47.54	37.94	76.71
	FC02	0.18	2.41	91.40	78.02	153.89
	FC08	0.14	1.73	30.99	24.42	49.03
Buffer						
	FC09	0.09	3.09	58.41	38.36	71.72
	FC07	0.11	0.59	26.15	34.96	69.28
	FC04	0.08	1.60	41.40	30.09	45.80
	MEAN	**0.12**	**1.99**	**65.40**	**43.83**	**94.81**
	(s.e.m)	**(0.01)**	**(0.37)**	**(13.41)**	**(5.64)**	**(13.45)**
Wellington						
Control						
	FC16	0.14	0.75	40.70	63.56	111.71
	FC17	0.19	4.49	113.70	60.37	127.00
	FC19	0.13	2.77	103.65	47.40	116.95
Shelterwood						
	FC15	0.17	1.06	35.85	69.49	106.47
	FC18	0.11	3.15	62.85	44.12	76.15
	FC13	0.13	2.06	59.00	39.11	88.61
Gap Release						
	FC14	0.20	1.06	41.56	86.84	108.51
	FC11	0.12	2.70	174.89	47.99	188.19
	FC12	0.09	2.93	134.39	33.40	147.69
	MEAN	0.14	2.32	85.17	54.69	119.02
	(s.e.m.)	(0.01)	(0.64)	(16.29)	(5.61)	(11.02)

Discussion

The markedly lower concentrations of P in the advance growth and saplings at Wellington were not reflected in the levels of available or total P measured in surface soil samples. This suggests that some factor other than P concentration in the soil is affecting the uptake of this element into the younger growth stages of Jarrah and Marri. Further investigation and literature review is required to determine what other factors may be affecting nutrient availability to trees in these growth stages.

SOIL DISTURBANCE

Kim Whitford

Introduction

This report covers the 2002/2003 assessments of the FORESTCHECK sites: Edward Gap Release (FC11) Ross Gap Release (FC12), Ross Shelterwood (FC13), Surface Gap Release (FC14), Surface Shelterwood (FC15), Chalk Shelterwood (FC18), and the external Control site at Tumlo forest forest block (FC19). Following the conclusions reached from the initial FORESTCHECK soil disturbance sampling in 2001/2002 (Whitford, 2002), the sampling regime was reduced this year. Soil strength and soil moisture were not measured, and bulk density was measured on only 2 sites: Chalk (Shelterwood), and Tumlo (external Control). As snig tracks are the source and location of most soil disturbance produced by logging, snig track layout and snig track order were mapped on all logged sites.

The objectives of this work were:

1. To record the extent of soil disturbance on FORESTCHECK monitoring sites where machine disturbance (snig tracks) could be readily identified.
2. To monitor the intensity of changes to soil physical properties induced by logging, on selected sites.
3. To provide base data that could be used to monitor any change in these soil physical properties over time.

Sampling

Bulk density was measured on 2 sites: Chalk Shelterwood, FC18 and Tumlo External Control, FC19. On the Chalk Shelterwood site, sampling of bulk density was stratified on the basis of operational categories (harvested area, unharvested area, log landing, old snig track, snig track order) (Whitford 2001). This stratification requires clear identification of the snig track location so that bulk density measurements can be collected from known strata. On the remaining 5 sites where bulk density was not measured, mapping of snig tracks provided a measure of the amount of disturbance. Incorrect or low quality mapping produces biased measurements of the amount of disturbance. The mapping of the snig track layout was satisfactory on all sites except the Surface forest block Gap Release (FC14) (see Table 1) where dense understorey made it very difficult to identify snig tracks. Consequently this site was not mapped. The quality of mapping of the Surface forest block Shelterwood (FC15) was degraded by relatively large GPS errors in the south east and south of the faller's block, and some difficulty in locating and identifying snig tracks due to the dense understorey. The mapping on this site was of a lower standard than on the other mapped sites. For all sites the aerial photography available did not clearly depict the snig track layout. None of the sites had been ripped after logging and most snig tracks could be identified on the ground.

Sample processing

No unforeseen problems occurred in sample processing. The costs of sample processing were correctly estimated.

Database establishment

There were no unforeseen problems in establishing the database.

Preliminary results

The sites and treatments assessed and measured are listed in Table 1. Table 2 gives the means and standard errors for total bulk density (TBD) and fine earth bulk density (FEBD), and gravel content of operational categories at 2 FORESTCHECK sites. Table 3 shows the area of the snig tracks and landings on each site. Figure 1, which makes use of FORESTCHECK data from both the 2001/2002 and 2002/2003 assessments, shows that the standard error of the mean for fine earth bulk density. The snig track maps (Figures 2 – 6) show the location and extent of snig tracks and landings on these sites. Similarly Figures 7 – 9 show the location and extent of snig tracks and landings on 3 FORESTCHECK sites from the 2001/02 assessment.

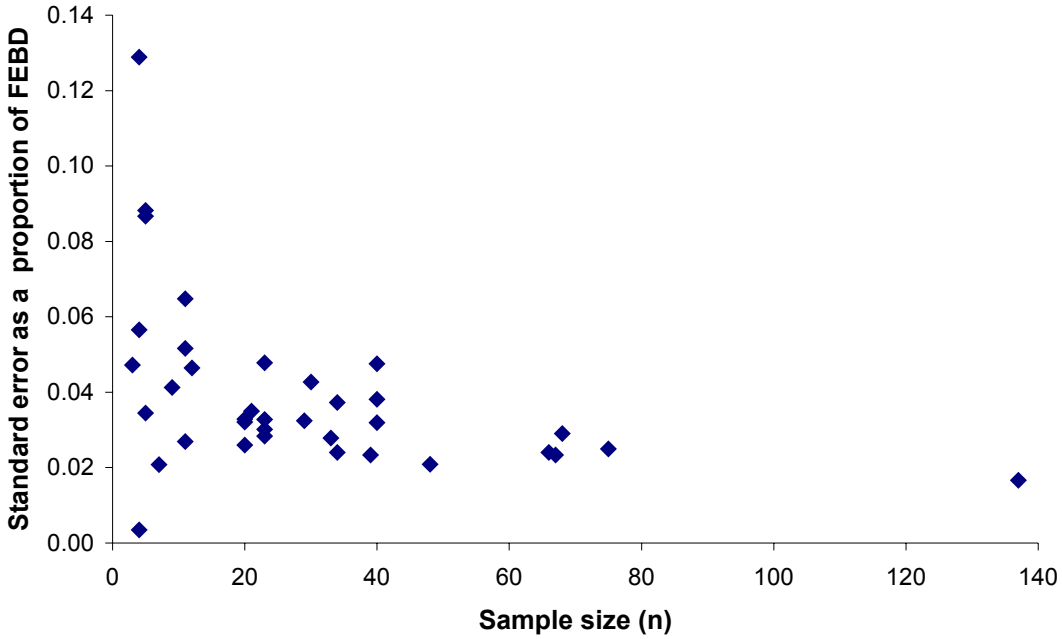


Figure 1. The effect of sample size on the standard error of fine earth bulk density (FEBD)

Sampling intensity

Some of the snig track operational categories had small sample sizes as few measurement points occurred in these operational categories. As would be expected, the bulk density measurements for operational categories with low numbers of samples have higher standard errors than those from operational categories with large numbers of samples. The bulk density of snig tracks is sampled where the transect lines of the FORESTCHECK grid cross the snig tracks. This method of sampling the operational categories is efficient and provides a secure means of relocating the sample points at some future time. However there is limited flexibility for increasing sample size as there is a set number of intersections between the transect lines and the snig tracks.

Figure 1 shows the standard error of the mean for fine earth bulk density measurements from the 2001/2002 and 2002/2003 assessments. Fine earth bulk density increases substantially once the sample size is less than about 20, indicating that the target sample size of 20 is satisfactory for monitoring work of this nature. The sample size for most operational categories was 20 or larger (Table 2). However, the sample size for the ST1 operational category was low (n = 11), and correspondingly the standard error for this operational class was high

Table 1. The type of assessment and the number of samples collected at each site.

Site		Snig track map	Operational category sample points	Bulk density sample points	Quality of snig track mapping
Control	FC19, Tumlo	No	40	40	No snig tracks
Shelterwood	FC15, Surface	Yes			OK
Shelterwood	FC18, Chalk	Yes	170	170	Good
Shelterwood	FC13, Ross	Yes			Good
Gap Release	FC14, Surface	No			Poor
Gap Release	FC11, Edward	Yes			Good
Gap Release	FC12, Ross	Yes			Good
TOTAL			**210**	**210**	

Table 2. Bulk density and gravel content for operational categories at 2 FORESTCHECK sites. Operational categories: Harvested Area (HA), Unharvested Area (UA), Major snig track into landing (ST0), Primary snig track (ST1), Secondary snig tracks (ST2), Tertiary snig track (ST3), Old Snig track from previous logging (OST), Log landing (LL).

FORESTCHECK Site		Operational category	n	Total bulk density	SE	Fine earth bulk density	SE	Gravel content %	SE
Control	FC19, Tumlo	UA	40	1.43	0.03	0.60	0.02	0.702	0.016
Shelterwood	FC18, Chalk	HA	67	1.60	0.03	0.80	0.02	0.65	0.01
		LL	29	1.84	0.04	0.90	0.03	0.70	0.01
		OST	20	1.73	0.05	0.89	0.03	0.66	0.02
		ST1	11	1.75	0.07	0.94	0.05	0.65	0.01
		ST2	23	1.82	0.03	1.02	0.03	0.63	0.02
		ST3	20	1.65	0.04	0.87	0.02	0.65	0.02

Table 3. The estimated area of the faller's block surrounding each FORESTCHECK site, the area of snig tracks and landings identified on each faller's block, and the areal proportion of the faller's block that has been disturbed by snig tracks and landings. Snig track classes are: primary (ST1), secondary (ST2), tertiary (ST3), and old snig track from a previous logging (OST). Snig track area calculations are based on measurements of snig track lengths and assumed widths of 4.67 m for ST1, 4.46 m for ST2, and 4.13 m for ST3.

Site	Site code	ST1 (m^2)	ST2 (m^2)	ST3 (m^2)	OST (m^2)	Total snig track area (m^2)	Landing area (m^2)	Estimated faller's block area (m^2)	Landing area as a percentage of faller's block	Snig track area as a percentage of faller's block	Percentage of faller's block disturbed
Surface Shelterwood	FC15	2351	1761	6908	0	11020	1590	65760	2.4	16.8	19.2
Chalk Shelterwood western faller's block	FC18	322	825	5995	2159	9301	2120	43820	4.8	21.2	26.1
Chalk Shelterwood eastern faller's block	FC18	444	1511	3596	2739	8290	680	46700	1.5	17.8	19.2
Chalk combined, both faller's blocks	FC18	766	2336	9591	4899	17592	2805	90520	3.1	19.4	22.5
Chalk Shelterwood west, excluding OST	FC18	322	825	5995	excluded	7142	2120	43820	4.8	16.3	21.1
Chalk Shelterwood east, excluding OST	FC18	444	1511	3596	excluded	5551	680	46700	1.5	11.9	13.3
Chalk combined, excluding OST	FC18	766	2336	9591	excluded	12693	2805	90520	3.1	14.0	17.1
Ross Shelterwood eastern faller's block	FC13	1112	1560	8262	0	10934	2248	77130	2.9	14.2	17.1
Edward Gap Release main landing and faller's block	FC11	1365	1346	5326	0	8037	1970	55220	3.6	14.6	18.1
Edwards Gap Release second landing	FC11	n/a	n/a	n/a	n/a	n/a	2240	n/a			
Edwards Gap Release third landing	FC11	n/a	n/a	n/a	n/a	n/a	600	n/a			
Ross Gap Release	FC12	1804	2331	5256	0	9391	4350	105300	4.1	8.9	13.0

Future tasks

This work is complete. The snig track widths used to calculate the area of the snig tracks were mean values determined from earlier work at other sites in the jarrah forest (Whitford 2001). The addition of measurements of snig track widths on the individual FORESTCHECK sites would increase the accuracy of the snig track areas presented here.

Discussion

- The boundaries of the faller's blocks about these 2002/03 FORESTCHECK sites in the northern jarrah forest were not as well delineated as the faller's blocks assessed in the southern jarrah forest in 2001/2002. The boundaries of the Shelterwood and Gap Release loggings of the 2001/02 FORESTCHECK sites were marked on the surrounding trees and the paint marks were clearly visible. This was not the case in 2002/03. Consequently the faller's block areas presented in Table 3 should be regarded only as estimates. These areas were estimated from the extent and distribution of the snig tracks on these sites. This reduces the accuracy of the last 2 columns in Table 3, i.e. the estimates of the area of the landing as a proportion of the faller's block area, and the estimates of the proportion of the faller's block disturbed by snig tracks and landings. This problem was greatest at the Ross Gap Release site (FC12), where the estimate of the area of the fallers' block was poor. The areas estimated for the remaining faller's blocks should be reasonable underestimates. These faller's block areas for 2002/03 are not as accurate as the values available for 2001/02.
- On 4 of the sites (FC11, FC12, FC13 and FC18) the FORESTCHECK sampling grid covered an area that included snig tracks that lead to more than one landing. Typically a faller's block includes a network of snig tracks that lead to a single landing. Hence the FORESTCHECK grids on these sites covered 2 faller's blocks. This was most notable on the Chalk forest block Shelterwood site (FC18), and the Ross forest block Gap Release site (FC12) where approximately half of each FORESTCHECK grid was in one faller's block and half was in a second faller's block (see Figures 3 and 6).
- All of the logged sites have been logged twice. From the evidence of stumps in the area the Chalk forest block Shelterwood site has been logged 3 times: Once by axe and crosscut saw, once by circular saw, and once by chainsaw. The felling by axe and crosscut saw may have only impacted part of this faller's block and probably only removed a relatively low number of trees.
- Old snig tracks from a previous logging event in the 1950's (circular saw cut stumps) were clearly visible on the Chalk forest block Shelterwood site (FC18). These old snig tracks were mapped and some can be readily identified in Figure 6, as they do not lead into either of the mapped landings. Table 3 gives the estimated area of snig tracks both with and without these old snig tracks included. The bulk density of these old snig tracks was also determined. The mean bulk density of these old snig tracks was only slightly higher than the mean for the harvest area and was similar to that of the ripped landing.
- Landing sizes ranged from a very small 600 m^2 landing in the north west corner of the Edwards Gap Release site (Figure 2) through to a large 4350 m^2 landing at the Ross Gap Release site (Figure 3). These are both extremes. The small landing on the Edwards Gap Release site was used for assembling stockpiles of logs before moving them to another larger landing, and so was not a landing in the usual sense of the word. The very large landing on the Ross Gap Release site served at least 2 faller's blocks. Ignoring the very small landing on the Edwards Gap Release site, the mean landing size was 2171 m^2. This compares with a mean landing size of 1513 m^2 observed across the 2001/02 FORESTCHECK sites and a mean landing size of 1897 m^2 if data from both years are combined.
- Landing size varied from 1.5% to 4.8% of the total area of the faller's block. The mean landing size was 3.2% of the total area of the faller's block. If data from last years FORESTCHECK assessments are also included, the mean landing size was 2.6% of the total area of the faller's block.

- Across this years FORESTCHECK sites the percentage of the faller's block covered by landings and new snig tracks ranged from 13% on the Ross Gap Release site through to 21% on the western faller's block of the Chalk Shelterwood site. The mean value was 17%. In the previous FORESTCHECK assessment (2001/02) the mean value was 11%, but only 2 sites (the gaps at the FC2 and FC6 sites) were suitable for this calculation, as mapping of snig tracks was poor on the other sites. Considering the data from both years, 16% of each faller's block was disturbed by snig tracks and landings.
- As previously noted, these calculations are dependant on the accuracy of the estimate of the area of the faller's block, and the boundaries of the faller's blocks were poorly defined on the sites assessed this year. This problem was greatest at the Ross Gap Release site (FC12), where the estimated area of the faller's block was poor. The estimated area of the other faller's blocks should be reasonable underestimates, which would tend to increase the estimate of the percentage of the faller's block covered by landings and snig tracks.
- The gravel content was high on the 2 sites where bulk density was measured (FC18, and FC19). At the Chalk forest block Shelterwood site (FC18) gravel content was 66%, while at the Tumlo forest block external Control site (FC19) gravel content was 70%. Although not adjacent to one another – the preferred arrangement for comparison of sites (the 2 sites are separated by a distance of 4 km) – these 2 sites have similar soils and should provide a sound basis for comparison of the impact of logging on bulk density. The Tumlo forest block external Control site (FC19) has never been logged, while the Chalk forest block Shelterwood site (FC18) has been logged on 3 previous occasions. The undisturbed surface soil on the FC19 site has a mean fine earth bulk density of 0.60 g cm^{-3} (n = 40). This compares with a mean fine earth bulk density of 0.81 g cm^{-3} from the 81 sample points systematically located about the FORESTCHECK sample grid on FC18. Alternatively the bulk density of the undisturbed surface soil on the FC19 site (0.60 g cm^{-3}) could be compared to the mean fine earth bulk density of the 67 sample points classified as from the HA operational category on FC18 (0.80 g cm^{-3}). These values indicate a general increase in bulk density across the Chalk forest block site that may be associated with the 3 logging events that have occurred on this site.
- As expected, the bulk density of the snig tracks is higher than that of the general harvested area. The ripped landing also has a bulk density that is higher than the general harvested area, but less than that of the most highly compacted snig tracks (ST1 and ST2).

Conclusions

- Considering all data available from the last 2 yrs of FORESTCHECK site assessments, the mean landing size was 1897 m^2. This is equivalent to 2.6% of the total area of the faller's block.
- Considering the data from both years, a mean of 13% of each faller's block was disturbed by snig tracks. The sum of the mean area of snig track disturbance and the mean area of landing disturbance gives a mean of 16% of each faller's block being disturbed by snig tracks and landings.
- The gravel content was high on the 2 sites where bulk density was measured (FC18 and FC19), at 66% and 70% respectively.
- The fine earth bulk density of the surface soil on the Tumlo forest block external Control site (FC19) was 0.60 ± 0.02 g cm^{-3} (n = 40). This site has never been logged. This compares with a mean fine earth bulk density of 0.81 g cm^{-3} (n = 81) from the 81 sample points systematically located on Shelterwood logged Chalk forest block site (FC18), and a mean fine earth bulk density of 0.80 g cm^{-3} for the 67 sample points classified as from the HA operational category on this site. The size of these differences may indicate that the 3 logging events that have occurred on the Chalk forest block site have produced a general increase in bulk density across this site. However the comparison of pre and post logging bulk density values between 2 separate sites can be misleading. Similar differences would need to be observed over a number of sites before any conclusion was reached regarding the size of any increase in bulk density that could be attributed to logging activities.

- Comparisons such as this are most meaningful when the sites have similar soil types. This is best achieved by selecting sites with the same Havel-Mattiske vegetation types.

Reference

Whitford, K. R., 2001. The impact of logging on soil physical properties at 3 sites in the northern jarrah forest. Final report - Part 2. Project PN 99.802 - Evaluation of key soil indicators of sustainability in Australian mediterranean forests (Indicators 4.1d, 4.1e). September 2001. Forest and Wood Products Research and Development Corporation and the Western Australian Department of Conservation and Land Management.

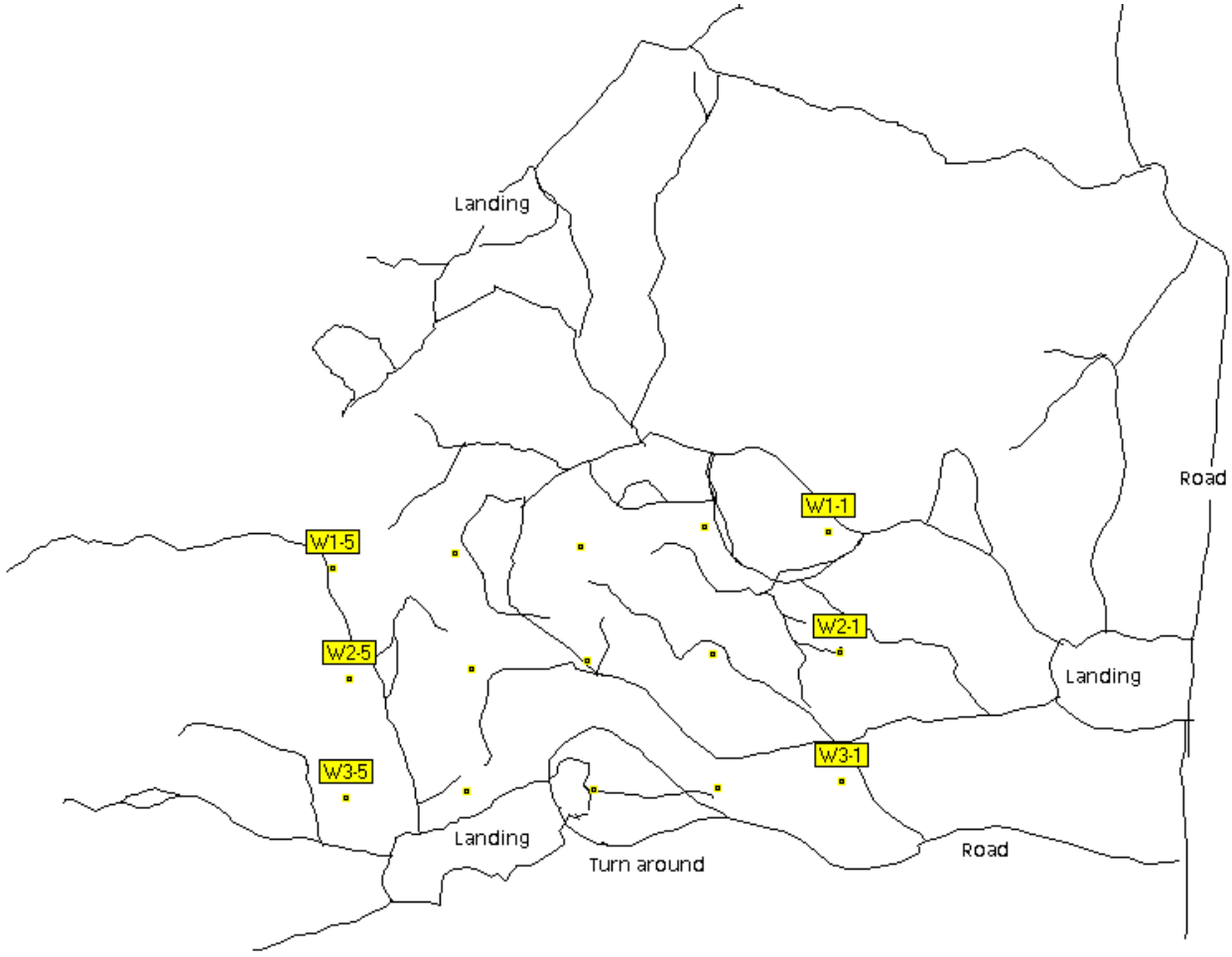


Figure 2. FORESTCHECK site 11, Edward forest block Gap Release treatment, west of Caversham Rd. Scale is given by the grid point spacing of 50 m.

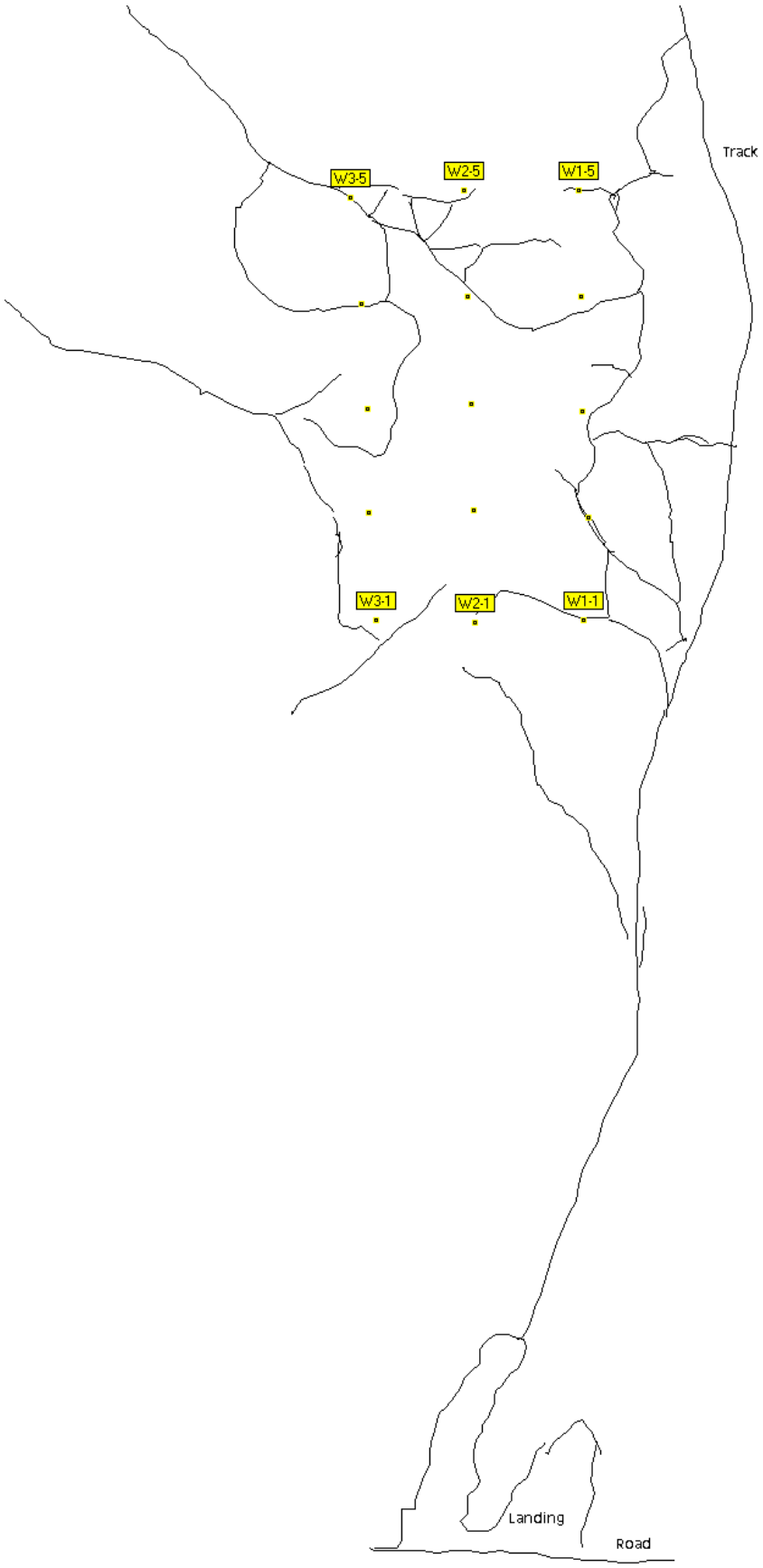


Figure 3. FORESTCHECK site 12, Ross forest block Gap Release treatment, north of Chalk Rd. Scale is given by the grid point spacing of 50 m.

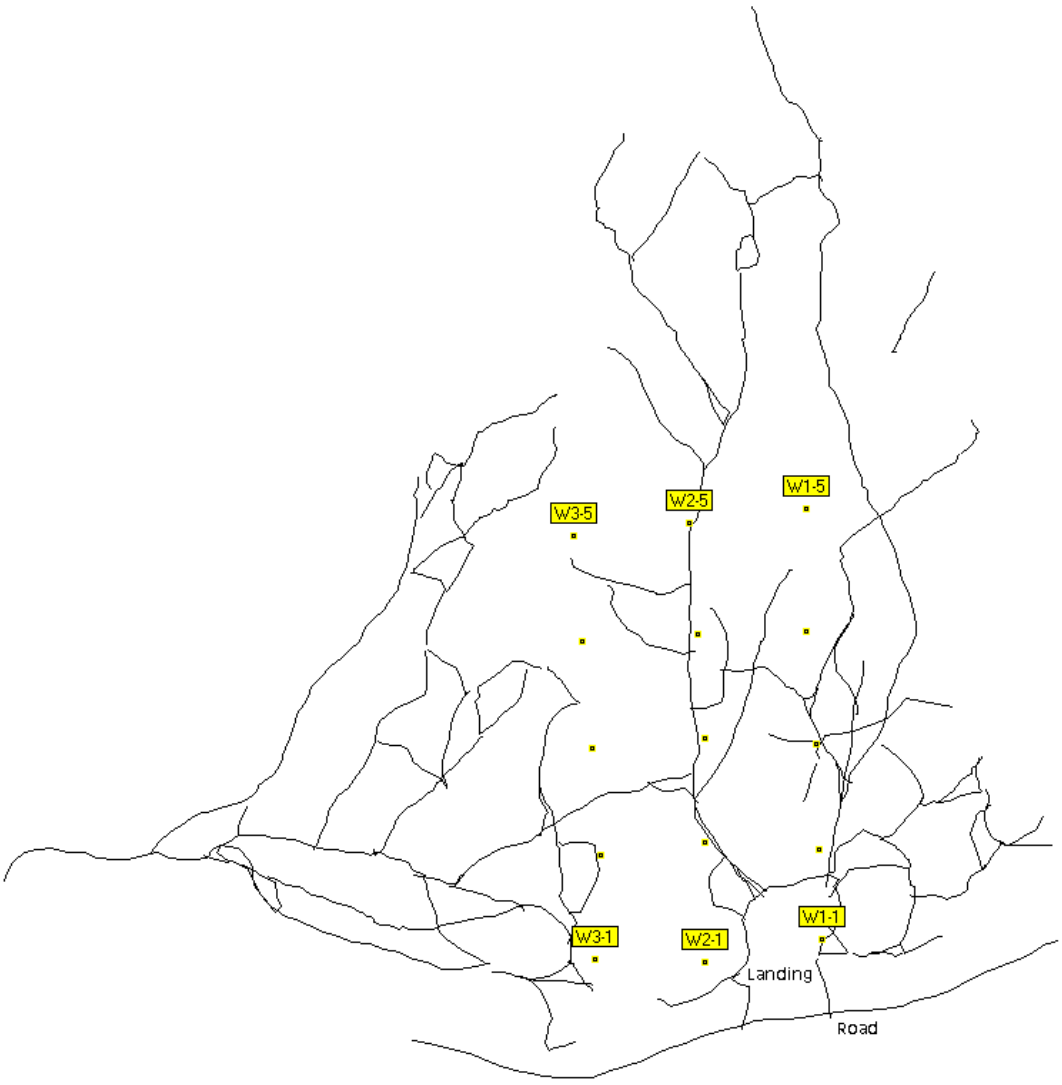


Figure 4. FORESTCHECK site 13, Ross forest block Shelterwood treatment, north of Chalk Rd. Scale is given by the grid point spacing of 50 m.

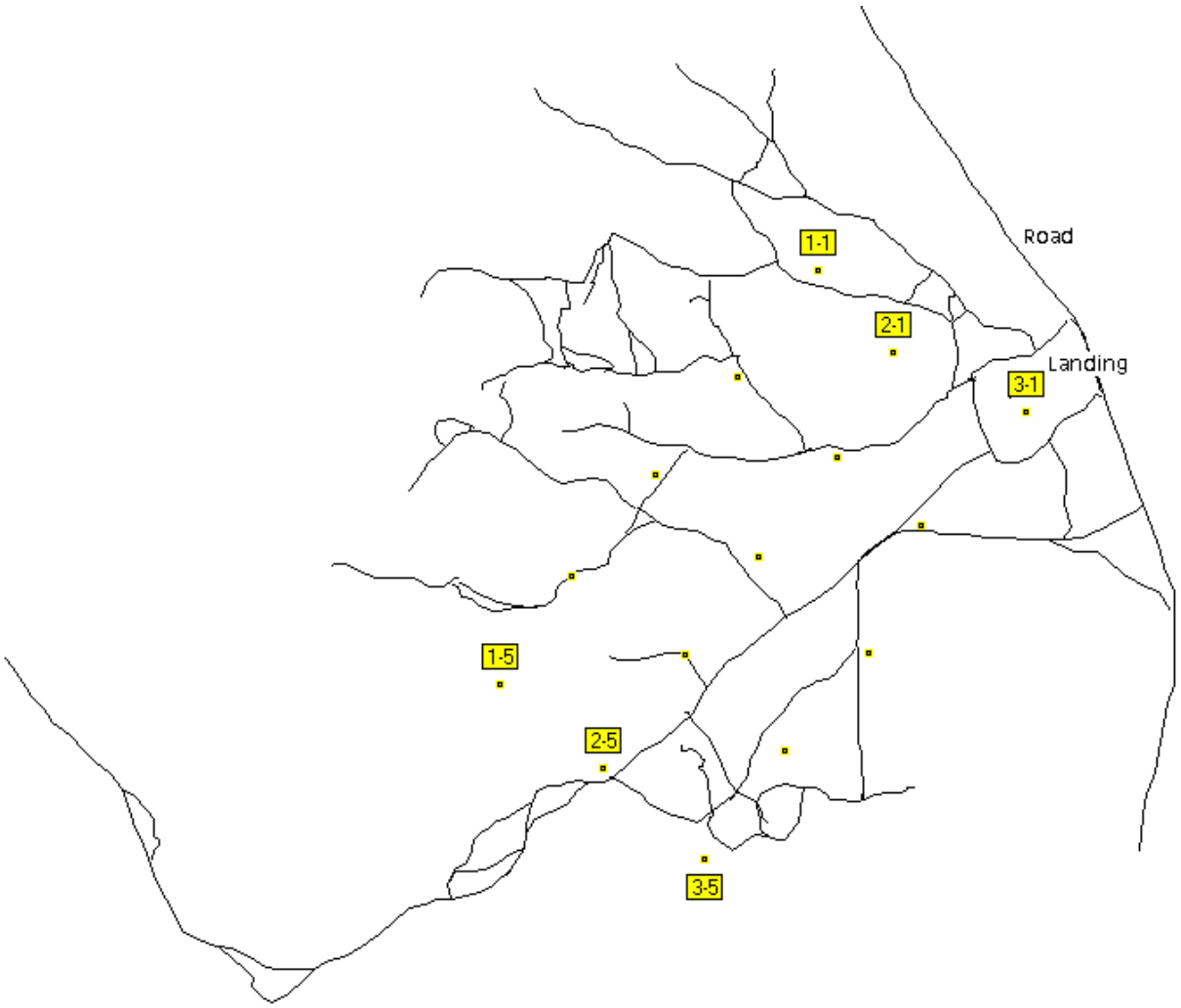


Figure 5. FORESTCHECK site 15, Surface forest block Shelterwood treatment. Scale is given by the grid point spacing of 50 m.

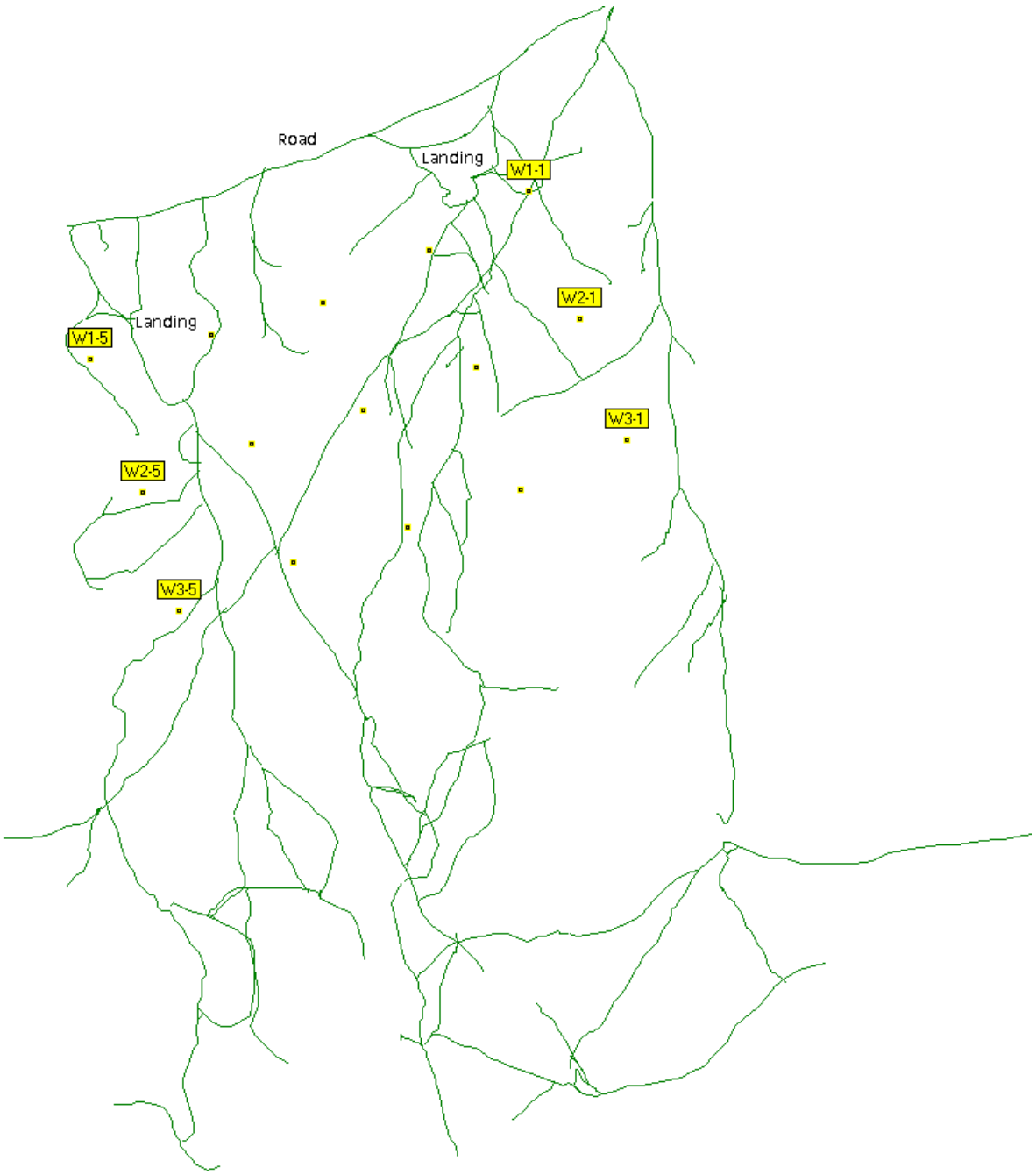


Figure 6. FORESTCHECK site 18, Chalk forest block Shelterwood treatment south of Hunter Rd. Scale is given by the grid point spacing of 50 m.

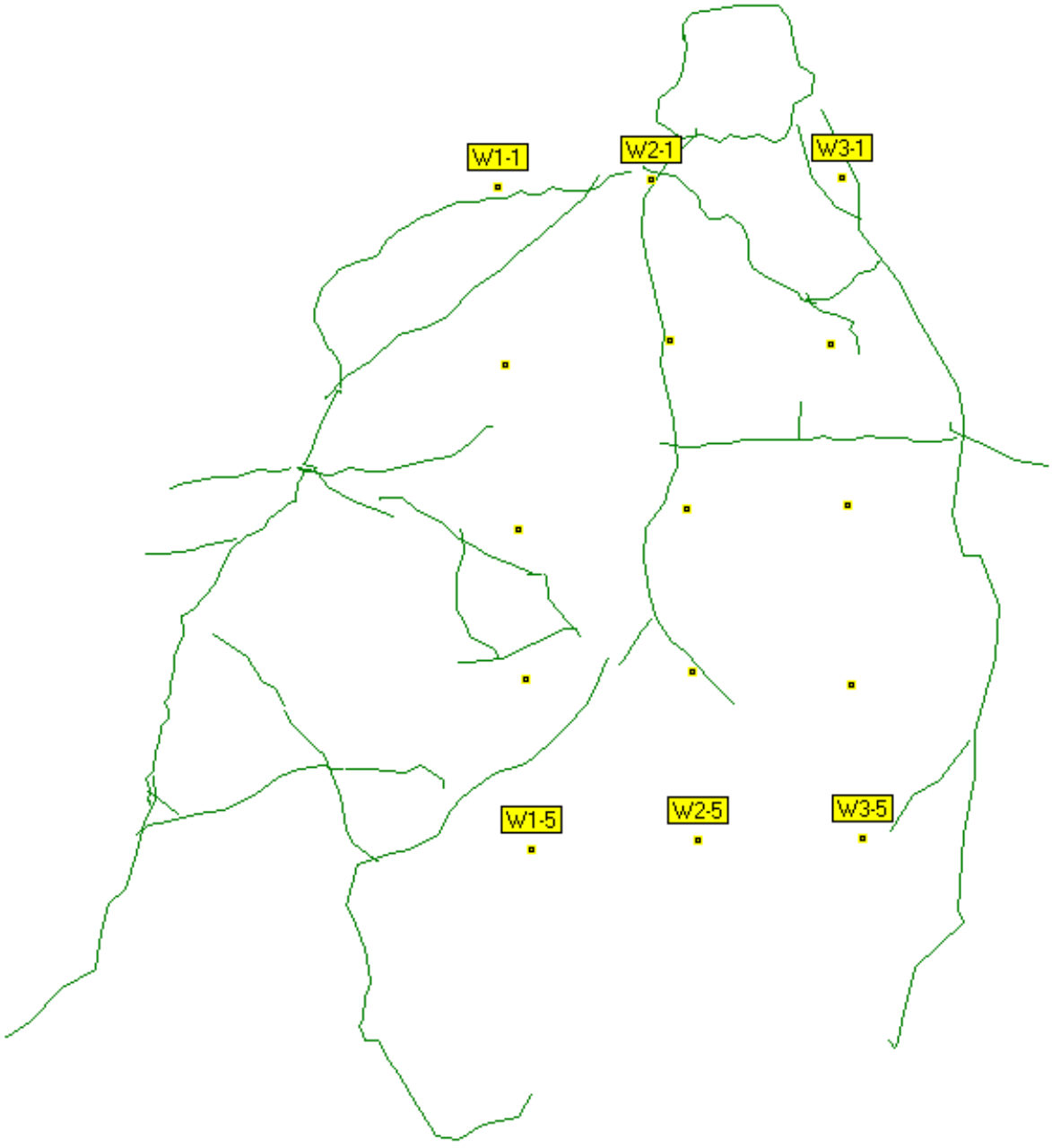


Figure 7. FORESTCHECK site 2, from the 2001/02 assessments, Kingston forest block Gap Release treatment south of Kingston Rd. Scale is given by grid point spacing of 50 m.

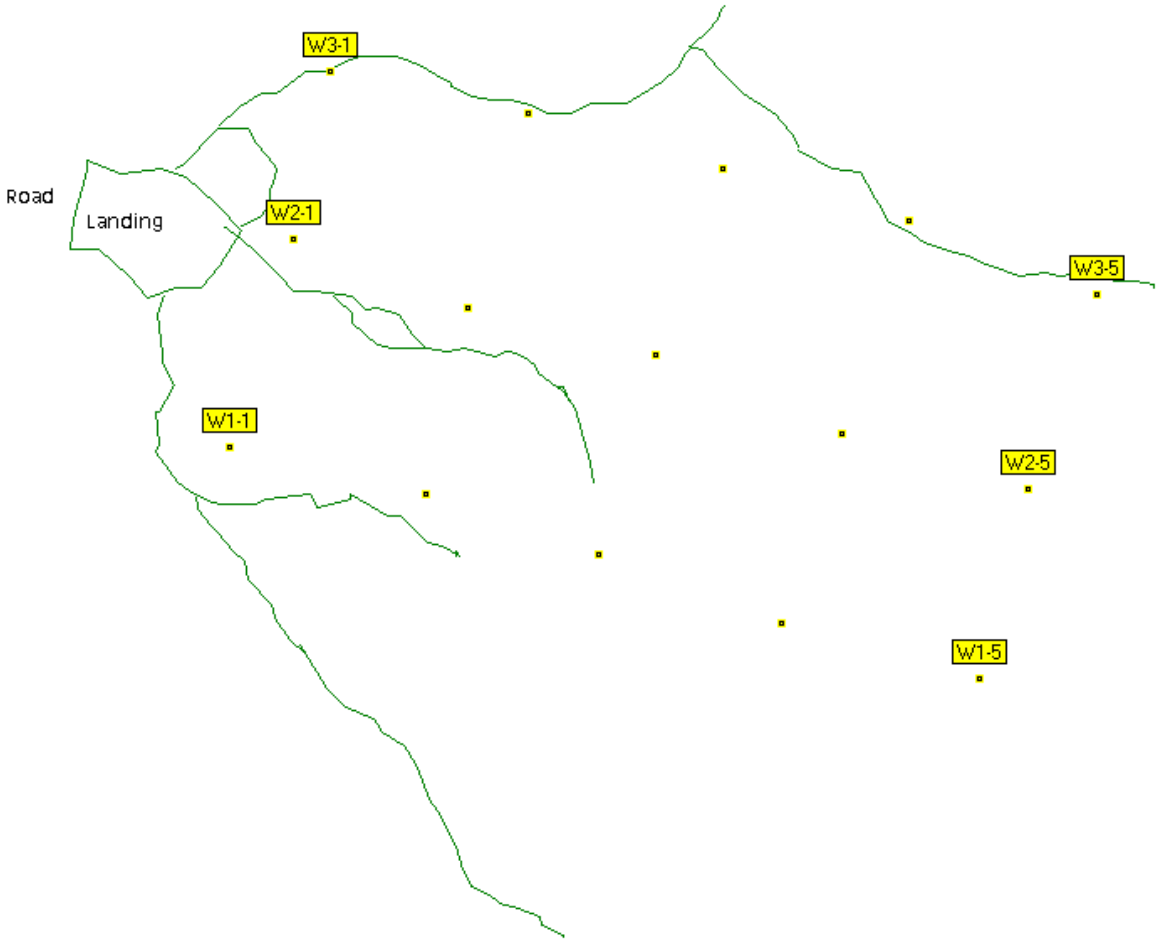


Figure 8. FORESTCHECK site 3, from the 2001/02 assessments, Kingston forest block Shelterwood treatment west of Tinkers Flat Rd. Scale is given by grid point spacing of 50 m.

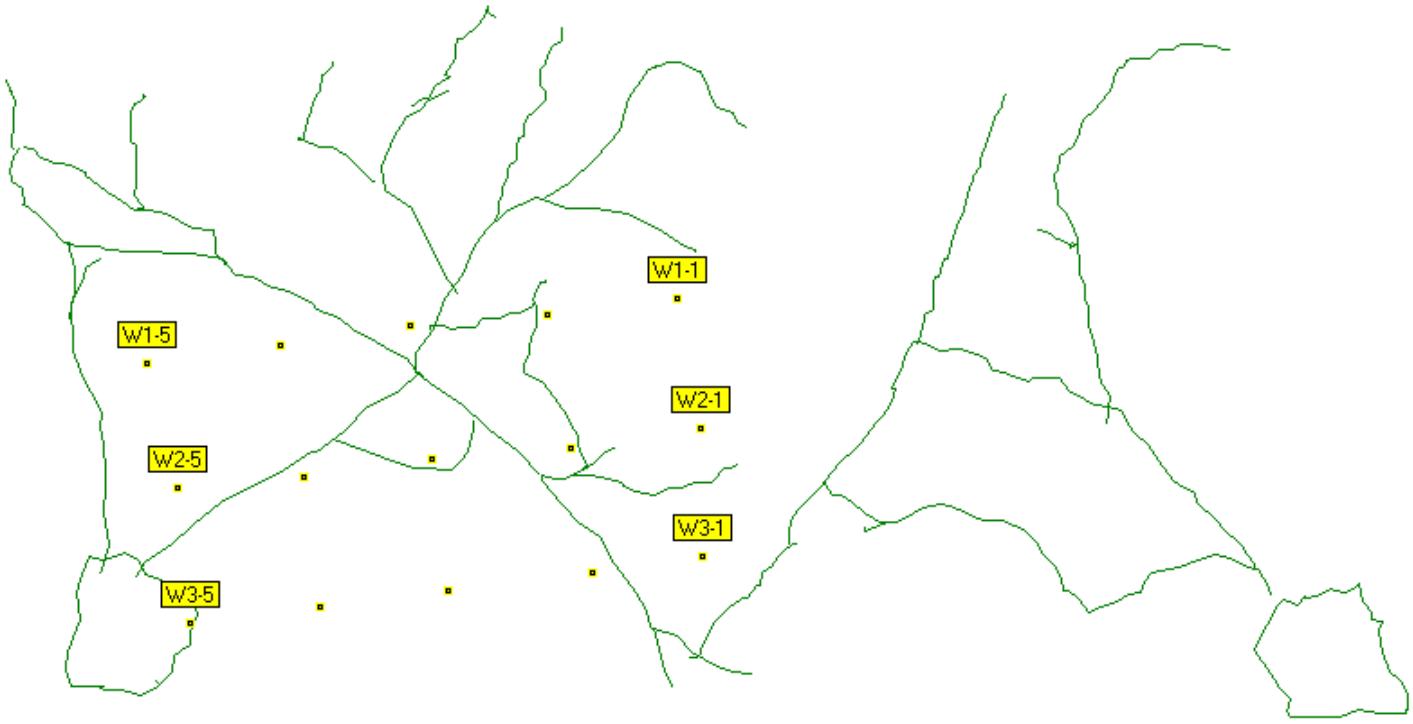


Figure 9. FORESTCHECK site 6, from the 2001/02 assessment, Thornton forest block Gap Release treatment north of Wagelup Rd. Scale is given by grid point spacing of 50 m.

COARSE AND SMALL WOODY DEBRIS AND LITTER

Bob Smith, Richard Robinson and Kirsten Pearce

Introduction

For a number of groups of organisms, species richness and abundance has a close relationship with habitat structure. Coarse woody debris and litter are not only vital as substrates for fungi and many invertebrates but also as refugia for larger invertebrates, reptiles and mammals. Many organisms rely on a habitat mosaic for development and persistence when confronted with disturbance and for recolonization following disturbance. Litter cover and the recovery of this cover following disturbance such as logging and regeneration burning is also important in the maintenance of soil moisture regimes.

The maintenance and/or recovery of a diverse habitat for both ground dwelling organisms and as substrates for nutrient enhancing organisms is of vital importance to forest managers making decisions on Sustainable Forest Management.

The objective of this component of the FORESTCHECK program is to:

- Measure and record the amount of litter, small wood and twigs (SWT) and Coarse woody debris (CWD) on the ground in the various treatments of managed Jarrah forest (Gap Release, Shelterwood) and in uncut (Control) forest.
- Analyse trends within and between the treatments over time.
- Make the data available for analysis of distribution patterns of other organisms such as Invertebrates and Fungi.

Field and Lab work

Litter, SWT and CWD assessment was carried out from 27 May to 3 June 2003.

Data management

All data have been entered onto a Microsoft Excel worksheet. Litter and SWT loads (t ha^{-1}) and CWD volumes (m^3 ha^{-1}) have been calculated for each site.

Key Findings

Litter

The average litter loads were similar in all treatments and within treatments they generally reflected the age of the sites since logging and burning. FC13 in Ross forest block had a heavy load of litter in relation to the other sites and FC18 in Chalk forest block had a very low litter load (Figure 1). FC13 was logged in 1990 and not burnt post-harvest and may explain the reason for the heavy litter measured on that site. FC18 was logged and burnt in 1999 and is a very open site with large areas having no canopy cover, which likely accounts for the low litter load measured there. Note also that FC12 at Ross forest block was not burnt post harvest and also has a slightly higher litter load than the other Gap Release sites. The average load measured within each treatment ranged from 10-12.3 t ha^{-1} on the Control sites, 6.7-14.7 t ha^{-1} on the Shelterwood sites, and 8.4-11.2 t ha^{-1} on the Gap Release sites.

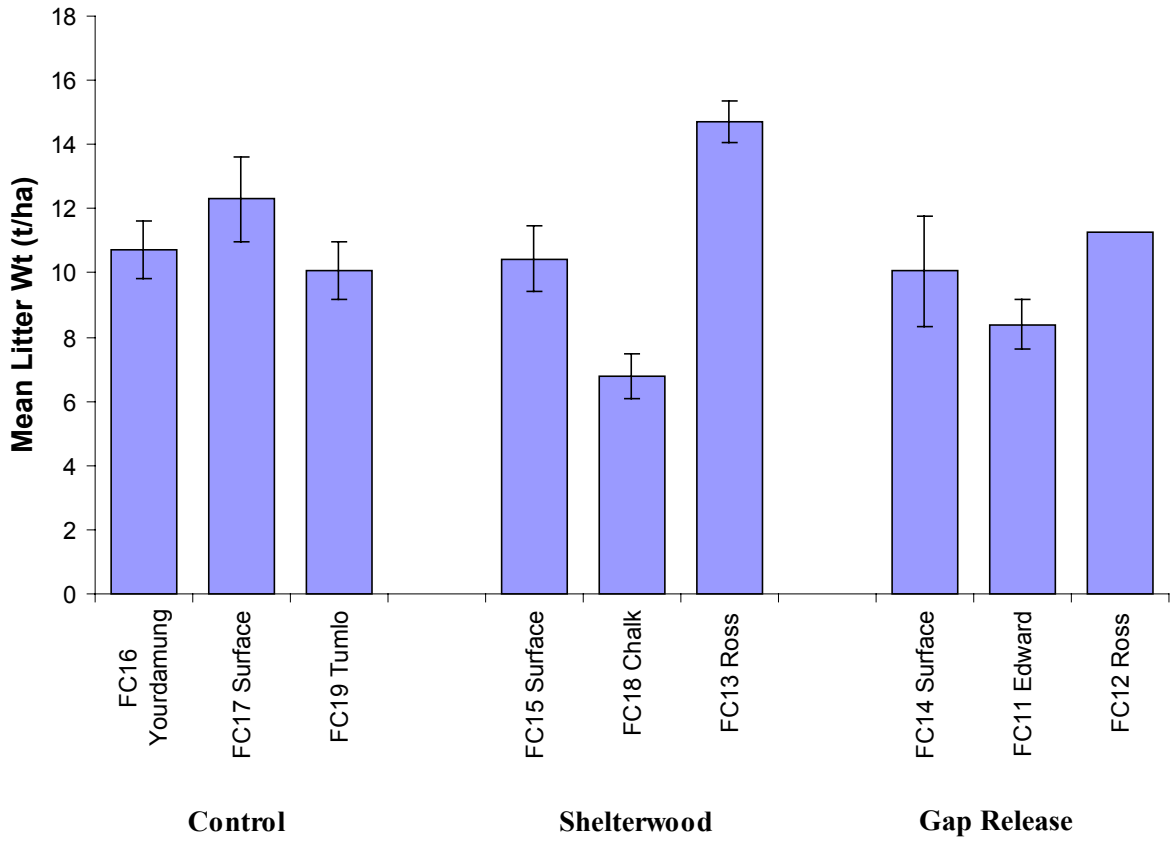


Figure 1. Mean litter load (t ha^{-1}) calculated for each FORESTCHECK grid in Wellington District in May 2003.

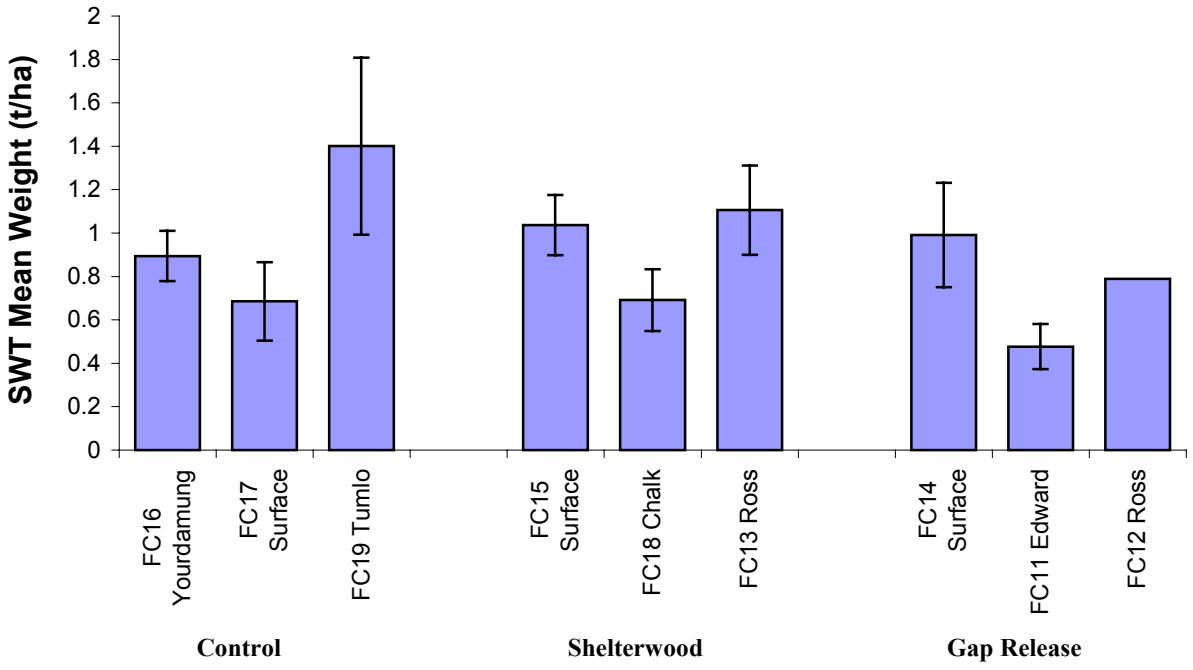


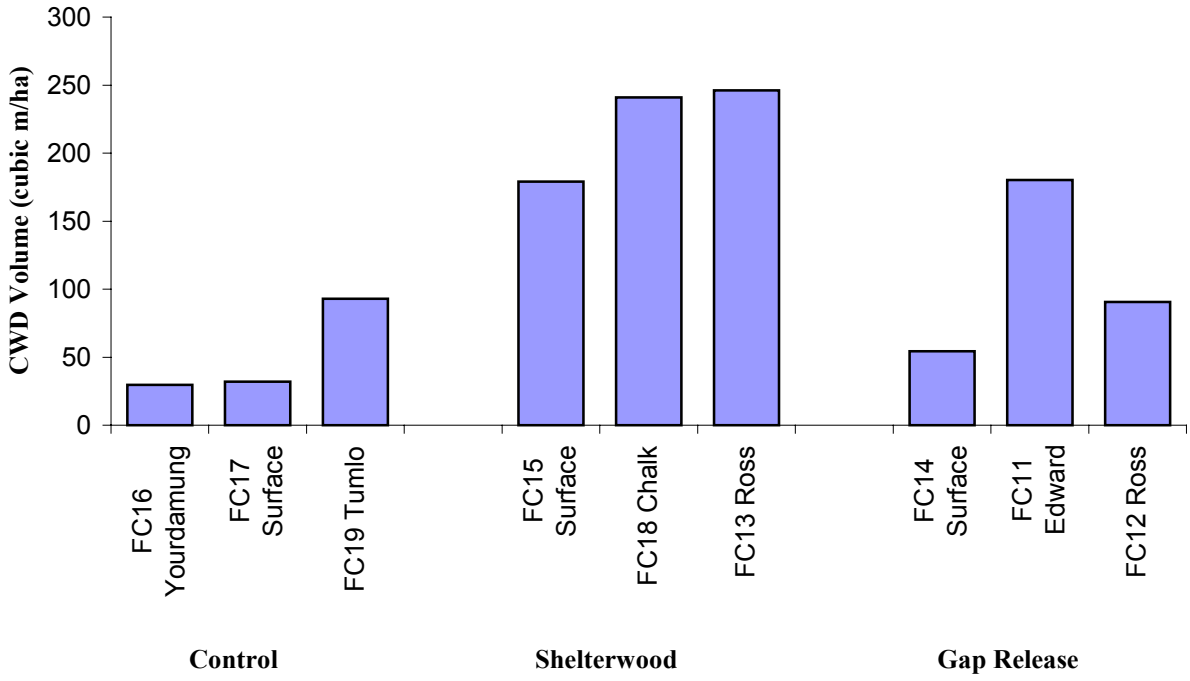
Figure 2. The average weight (t ha^{-1}) of small wood and twigs measured at each FORESTCHECK site in Wellington District in May 2003.

Small Wood and Twigs

Small wood and twig (SWT) measurements varied within each treatment, but were similar between treatments (Figure 2). The variation was greatest on FC19 at Tumlo forest block. Within the Gap Release treatments, the low measurement at FC11 at Edward forest block is likely the result of it being logged and burnt recently (1998 and 1999 respectively), but the amount measured at FC14 is surprisingly high since it was also burnt in 1998 and FC12 was not burnt following harvesting in 1990.

Coarse Woody Debris

The amount of coarse woody debris recorded on the Control and Gap Release sites was much lower than that recorded on the Shelterwood sites. An exception was the 180 t ha^{-1} measured on FC11 at Edward forest block.



Modification to Methods, Difficulties

No modification was necessary for the methods. No difficulties were encountered; however, the presence of stumps and calculating their contribution to volume ha^{-1} still needs to be refined and standardized.

MACROFUNGI

Richard Robinson, Kirsten Pearce and Bob Smith

Introduction

Fungi are considered one of the most important forest organisms in terms of both biodiversity and forest function. Soil, litter and wood inhabiting fungi play major roles in decomposition and nutrient cycling. Mycorrhizal fungi enhance nutrient uptake of plants and may enhance plant resistance to some pathogens. In addition, underground truffle-like fungi are an important food source for small mammals, especially following disturbance such as fire.

Research on fungi in Western Australia's southern forests is in its infancy. Knowledge of fungal diversity and the ecological roles that fungi play is of vital importance to forest managers making decisions on Sustainable Forest Management.

The objective of this component of the FORESTCHECK program is to:

1. Monitor and record the species of macrofungi in the various treatments of managed jarrah forest (Gap Release, Shelterwood) and in uncut forest.
2. Analyse trends in species composition, richness and abundance and substrate utilization over time.
3. Generate detailed descriptions of unknown or unnamed species.

Field and Lab work

Macrofungi transects were installed at the Wellington sites during March and April 2003. Assessment of all the Wellington sites was carried out in May and again in July 2003. The Donnelly sites initially established and monitored in 2002 were also monitored in June 2003.

The emphasis of this report is on monitoring undertaken at Wellington; however, a brief report on results obtained at the Donnelly sites in 2003 is also included.

Wellington

1. Monitoring

Monitoring dates were selected on the basis of rainfall and soil dryness index (SDI) statistics provided by the Wellington Work Centre and the Bureau of Meteorology online SDI statistics for Harvey. Following 6 days of steady rain, delivering about 60 mm, from 11-16 May and a further 22.5 mm on 21-22 May, all sites were monitored from 27-29 May. Despite this rain the SDI remained above 1000 (mm x 10 needed to fully saturate soil). Previous monitoring suggests that to ensure maximum fungal fruiting the SDI should be below 1000 and declining rapidly following autumn rains. Steady rain for a week resulted in the SDI steadily declining at the end of June dropping from 1093 on 24 June to be zero by the 28 June. The second monitoring was undertaken from 30 June to 8 July (Figure 1).

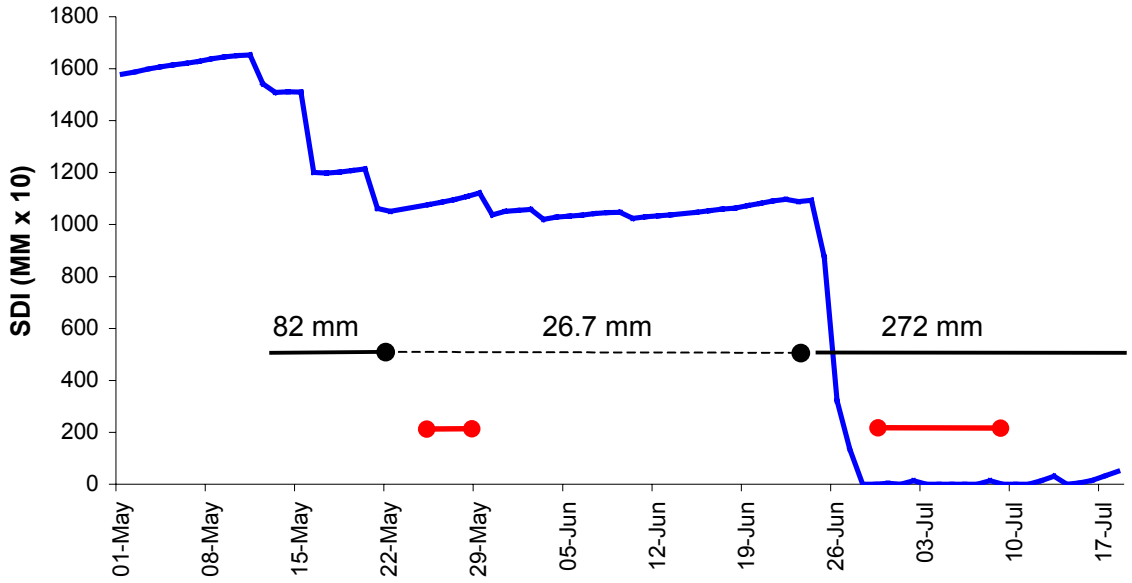


Figure 1. Soil Dryness index calculated for Wellington for the period 1 May to 18 July 2003. The FORESTCHECK sampling period is indicated in red and periods of significant rainfall indicated by the solid black line.

2. Voucher Specimens

Voucher specimens have been processed and where possible identified. An overall species list and one for each individual site has been determined. In total, 271 voucher collections were made. These collections represented 103 species. As fungal specimens deteriorate rapidly, processing was completed on the same day or the next day. This included photographing in the field, and preparing morphological descriptions of fresh collections. A large number of species had not been encountered previously and detailed descriptions were necessary to validate their identity. All collections were then dried and microscopic descriptions were later completed on the dried specimens in the Laboratory at Donnelly Research Centre. All vouchers will be databased at PERTH and housed at the Tony Annels Herbarium, Donnelly.

3. Key Findings

There were significantly more species recorded during the July assessment than in the earlier May assessment (Figure 2). Only 1,270 fruitbodies were recorded in May compared to 17,119 in July. This clearly illustrates the importance of timing for fungal monitoring if maximum species richness and abundance is to be recorded.

In total, 202 species of fungi were recorded on the Wellington sites. Of these, only 56% (114) were recorded during FORESTCHECK monitoring on the Donnelly sites in 2002. A total of 18,389 fruitbodies were recorded (Table 1). This equates to 51,080 fruitbodies ha^{-1} and demonstrates the important contribution that macrofungi provide to jarrah forest biodiversity.

Table 1. The complete species list of fungi recorded in FORESTCHECK 2002 and 2003 and the species and number of fruitbodies recorded on the Wellington sites in 2003.

Sp #	Species	Life Mode[1]	Substrate[2]	Control	Shelterwood	Gap Release	Total
46	Agaric "creamy white"	S	S				
82	Agaric "Lepiota-like, cream-grey"	S	S				
156	Agaric "light brown - red scales on stem"	S	S				
18	Agaric "light brown-olive"	S	S	2			2
97	Agaric "pure white"	?	S				
174	Agaric "red/yellow/red"	S	?				
170	Agaric "yellow brown-moist"	S	S/L	5		8	13
23	Agaric ?Clitocybe	S	S				
240	*Agaricus* sp. "small with red brown fibrils"	S	S		3		3
38	*Agaricus* sp. "small"	S	S				
71	*Agaricus* sp. "small, flat- red stain"	S	S		1		1
33	*Agaricus* sp. ″yellow stainer"	S	S				
39	*Agaricus* sp. "large cap, purplish scales"	S	S			1	1
120	Aleuria rhenana	S	S		42		42
126	Aleurina ferruginea	S	S/Moss	14	44	55	113
206	Amanita ananiceps	M	S		3	3	6
186	Amanita brunnea "grey-brown"	M	S	5	2		7
283	Amanita eucalypti	M	S			1	1
269	Amanita ochrophylloides	M	S				
114	*Amanita* sp. "apricot-pink margin"	M	S				
45	*Amanita* sp. "white, deeply rooted"	M	S		3		3
28	*Amanita* sp. "white, stout"	M	S				
218	*Amanita* sp. "powdery - long tapering base"	M	S	4		1	5
196	Amanita umbrinella	M	S	1	7	9	17
6	Amanita xanthocephala	M	S	7	59	32	98
35	Amanita xanthocephala forma macalpiniana	M	S				
180	Armillaria luteobubalina	P/S	W	13	67		80
188	Austroboletus laccunosa	S	S	1	2	1	4
200	Austroboletus occidentale	S	S		1	3	4
93	Boletellus ananiceps	S	S	1	1		2
103	Boletellus obscurecoccineus	S	S	4	5	3	12
225	*Boletus* sp. "creamy pale yellow	M	S	1			1
29	*Boletus* sp. "dull maroon"	M	S		1		1
49	*Boletus* sp. ″red pores and stem"	M	S				
253	*Boletus* sp. "red-brown/golden yellow – intense blue stain"	M	S		4	2	6
95	*Boletus* sp. "small yellow/cream pores"	M	S				
99	*Boletus* sp. "yellow-red, stains blue"	M	S		14	3	17
216	*Boletus* sp. "brown/yellow pores which stain blue"	M	S		1	1	2
210	*Boletus* sp. "maroon/orange pores"	M	S		1		1
195	*Boletus* sp. "mustard brown-brown stain"	M	S		1		1
193	*Boletus* sp. "purple brown"	M	S		2		2
284	*Boletus* sp. "under Allocasuarina"	M	S				
305	*Boletus* sp. "yellow"	M	S	1			1
208	*Boletus* sp. "yellow-brown, cracked/white pores"	M	S	3			3
9	*Calocera* sp. "yellow"	S	W	265	949	544	1758
265	*Cheilymenia* sp. "eyelash on roo poo"	C	Dung				
243	*Cheilymenia* sp. "orange disks on marri nuts"	S	Capsule				
316	Clavaria (Clavulinopsis) aff. aurantiaca "orange"	S	S/L				
319	*Clavaria* (*Clavulinopsis*) sp. "grey-brown with black tips"	S	S/L				
81	Clavulina cf. cinerea "grey-brown"	S	S	29	52	100	181
140	*Clavulina* sp. "pink-buff coral"	S	S	94	104	87	285
261	Clavulinopsis sp. "cream"	S	S				
262	*Clavulinopsis* sp. "tiny white candles"	S	S				
14	Clitocybe sp.	*S*	S				
197	*Clitocybe* sp. "semi occulta"	S	S		57		57
301	*Clitocybe* sp. "dark grey with dimple"	S	S	11		2	13
181	Collybia aff. butracea	S	W		5		5
143	*Collybia* sp. "buff funnel"	S	S				
249	*Collybia* sp. "grey"	S	S				
233	*Collybia* sp. "grey/dimple"	S	S	3		1	4
151	*Collybia* sp. "large"	S	S				

Sp #	Species	Life Mode[1]	Substrate[2]	Control	Shelterwood	Gap Release	Total
46	Agaric "creamy white"	S	S				
15	Coltricia oblectans	S	S	20	82	80	182
32	Coprinus sp.	S	S/L			6	6
128	*Coprinus* sp. "basal hairs"	S	S				
224	*Coprinus* sp. "micacus"	S	S				
282	*Corinarius* sp."honey-brown dome /long stem"	M	S	10		13	23
303	*Cortinaius* sp. "stubby domes"	M	S	4			4
146	Cortinarius (Myxacium) sp. "orange-brown"	M	S		1		1
125	Cortinarius (Phlegmacium) sp. "purple-grey"	M	S		6		6
171b	Cortinarius ?vinaceolamellatus "purple"	M	S	1	9		10
158	Cortinarius aff. micro archerii	M	S	5	2		7
314	Cortinarius archerii	M	S				
207	Cortinarius australiensis	M	S		5	5	10
173	Cortinarius basirubescens (red cap)	M	S	4	14	15	33
173b	Cortinarius basirubescens (brown cap)	M	S	2	6	20	28
115	*Cortinarius fibrillosus*	M	S	18	8		26
7	Cortinarius radicatus	M	S	10	1		11
293	Cortinarius rotundisporus	M	S	5	1	5	11
234	Cortinarius sp.	M	S				
73	*Cortinarius* sp. "brown with purplish tints"	M	S	10	12	9	31
68	*Cortinarius* sp. "brown" (?34)	M	S				
232	*Cortinarius* sp. "cf sinapicolor"	M	S		1		1
154	*Cortinarius* sp. "chestnut"	M	S				
252	*Cortinarius* sp. "glutinous cap/rooting stem"	M	S	11			11
257	*Cortinarius* sp. "honey-brown"	M	S	2			2
251	*Cortinarius* sp. "orange-brown 2"	M	S				
121	*Cortinarius* sp. "slender brown"	M	S				
131	*Cortinarius* sp. "slender lilac"	M	S			5	5
259/96	*Cortinarius* sp. "viscid - pink"	M	S		23	9	32
237	*Cortinarius* sp. "yellow with orange brown fibrils"	M	S	4			4
231	*Cortinarius* sp. "yellow-brown/tan margin"	M	S			4	4
124	Cortinarius sp. "yellow-olive"	M	S				
255	*Cortinarius* sp. "yellow-orange"	M	S				
279	*Cortinarius* sp. "brown fibrillose"	M	S		30	7	37
244	*Cortinarius* sp. "brown umbonate"	M					
299	*Cortinarius* sp. "chocolate brown with mustard gills"	M	S	10	4		14
201	*Cortinarius* sp. "cream with orange gills"	M	S	16			16
212	*Cortinarius* sp. "orange brown"	M	S	13			13
230	*Cortinarius* sp. "orange viscid"	M	S				
223	Cortinarius sp. "orange"	M	S				
205	*Cortinarius* sp. "orange/yellow flesh/yellow gills"	M	S	7	1	1	9
267	*Cortinarius* sp. "showy chestnut"	M	S	44	24	39	107
270	*Cortinarius* sp. "viscid, yellow-red-brown, white	stem"	M	S			
273	*Cortinarius* sp. "white with deep rooting stem"	M	S			4	4
199	*Cortinarius* sp. "yellow orange"	M	S			12	12
184	*Cortinarius* spp. (unidentified)	M		36	18	15	69
171	Cortinarius vinaceolamellatus	M	S				
290	Cortinarius violaceous	M	S	1	4		5
118	*Crepidotus* sp. "large creamy-tan"	S	W		46	23	69
61	Crepidotus sp. "small brown"	S	W/Bk				
83	*Crepidotus* sp. "small creamy tan"	S	Bk/W				
21	*Crepidotus* sp. "small white"	S	W				
241	Crepidotus variabilis	S	T/W				
148	Crucibulum laeve	S	T/L		21	28	49
296	*Cyathus* sp. "on roo poo"	S/C	Dung	6			6
307	Cyathus sp.	S	L	19			19
138	Daldina concentrica	S	W				
110	Dermocybe aff. sanguinea	M	S				
147	Dermocybe austroveneta	M	S				
57/34	Dermocybe clelandii (white mycelium)	M	S	5	5	15	25
172b	*Dermocybe clelandii* (yellow mycelium -	glutinous cap)	M				
172	Dermocybe clelandii (yellow mycelium)	M	S	14	5	14	33
168	*Dermocybe* sp. (*D. clelandii* ?) "brown with mustard yellow gills"	M	S				
40	*Dermocybe* sp. "chestnut"	M	S				

Sp #	Species	Life Mode[1]	Substrate[2]	Control	Shelterwood	Gap Release	Total
46	Agaric "creamy white"	S	S				
310	Dermocybe splendida	M	S			2	2
294	Discomycete "small yellow on *Banksia grandis* leaf"	S	L	150		20	170
123	Discomycete "yellow stalked"	S	S	86	41	545	672
31	Entoloma (Leptonia) sp. "blue-black"	S	S		2	2	4
78	*Entoloma* (*Leptonia*) sp. "grey/decurrent gills"	S	S			3	3
153	*Entoloma* (*Leptonia*) sp. "small dark grey-brown"	S	S				
222	*Entoloma* sp. "black with grey-white gills	S	S				
227	*Entoloma* sp. "brown-black with tan gills"	S	S				
30	*Entoloma* sp. "creamy white"	S	S	47	30	60	137
167	*Entoloma* sp. "dark grey/blue gill edge"	S	S	1	12	1	14
25	*Entoloma* sp. "grey-brown/blue stem"	S	S				
77	*Entoloma* sp. "grey-brown/brown stem"	S	S				
235	*Entoloma* sp. "grey-brown/grey stem"	S	S	7	37	11	55
135	*Entoloma* sp. "tall, grey-brown"	S	S	8	9		17
198	*Entoloma* sp. "brown black/tan/blue"	S	S		4		4
194	*Entoloma* sp. "brown"	S	S	2	47	34	83
272	*Entoloma* sp. "grey-brown with dimple"	S	S	5	18	6	29
278	*Entoloma* sp. "suede grey-brown"	S	S		3		3
274	Entoloma viridomarginatum	S	S		2	1	3
159	Exidia glandulosus	S	W	4	16		20
41	Fistulina hepatica	S	W	2	3	4	9
91	Fistulinella mollis	S	W				
11	*Galerina* sp. "hanging gills" and "conic"	S	S/L	380	308	165	853
111	Galerina sp. "large"	S	S		11		11
42	*Galerina* sp. "small on bark"	S	Bk				
228	Geastrum sp.	S	S/L				
8	Gymnopilus austrosapineus	S	W	279	443	343	1065
43	Gymnopilus sp.	S	W				
105	*Gymnopilus* sp. "chestnut scales, forked gills"	S	W				
26	*Gymnopilus* sp. "reddish cap, orange gills"	S	W				
85	*Gymnopilus* sp. "slender"	S	W	123	240	204	567
58	*Gymnopilus* sp. "small cap, eccentric stipe - on wood"	S	W	126	118	124	368
217	*Gyroporus* aff. *cyanescens* "yellow suede - intense blue stain"	M	S		1		1
292	*Gyroporus* sp. "beige-yellow, blue stain"	M	S			1	1
56	Heterotexus peziziformis	S	W/T	32	66	26	124
275	Hydnoid "fleshy funnel"	?	S/L	11			11
297	Hydnum repandum	S?	S	13			13
317	Hygrocybe conica	S	S				
281	*Hygrocybe* sp. "pallid yellow"	S	S			2	2
100	Hypholoma australe	S	W	7	59	100	166
59	Hypholoma brunneum	S	W				
108	Hypomyces chrysospermus	P	Bolete	5	6	11	22
204	Innonotus sp.	S	W	1			1
1	Inocybe australiensis	M	S				
203	Inocybe geophylla	M	S	1			1
137	*Inocybe* sp. "creamy-brown"	M	S				
48	*Inocybe* sp. "grey"	M	S		3	8	11
65	*Inocybe* sp. "large scaly cap"	M	S	1	2	4	7
226	*Inocybe sp.* "orange brown"	M	S				
113	*Inocybe* sp. "radially fibrillose, pink stem"	M	S			10	10
20	*Inocybe* sp. "scaly cap" see sp. 277 Fire Fungi	M	S	46	114	107	267
169	*Inocybe* sp. "shaggy stem"	M	S				
162	*Inocybe* sp. "small light brown, fibrillose"	M	S	3			3
53	*Inocybe* sp. "tan skirt"	M	S	48	233	203	484
286	*Inocybe* sp. "umbonate, shaggy"	M	S	7	13	8	28
74	Laccaria aff. masonii	M	S	234	786	1861	2881
36	Laccaria lateritia	M	S	41	5	10	56
221	Lactarius clarkii	M	S	8	2		10
142	Lactarius eucalypti	M	S	6			6
245	*Lactarius* sp. "cream yellow"	M	S	114	13	13	140
215/220	*Lactarius* sp. "cream custard"	M	S	23	9	4	36
271	Lepiota aff. haemorrhagica "red stainer"	S	S	1		6	7
185	Lepiota cristata	S	S				
264	*Lepiota* sp. "cream-grey"	S	S	11	7	4	22
246	*Lepiota* sp. "purple-grey"	S	S	1	5		6

Sp #	Species	Life Mode[1]	Substrate[2]	Control	Shelterwood	Gap Release	Total
46	Agaric "creamy white"	S	S				
166	*Lepiota* sp. "creamy-brown"	S	S	24	11	4	39
76	*Lepiota* sp. "orange with brick red scales/white gills"	S	S	1	1		2
117	Lepista sp.	M?	S				
214	Leucapaxillus lilacinus	M	S	1	5		6
24	Lycoperdon sp.	S	S		42	25	67
190	Macrolepiota konradii	S	S				
318	*Marasmellis* sp."small white, on twigs & leaves"	S	L				
191	*Marasmiellis* sp. "white umbrella"	S	T/W				
239	*Marasmiellus* sp. "on zamia"	S	T				
55	Marasmius crinis-equi	S	L		29	139	168
183	Marasmius elegans	S	S				
309	*Marasmius* sp. (see 223 Fire fungi)	S	S/L		1	55	56
75	*Marasmius* sp. "large brown, on Zamia stems"	S	T				
22	Melanotus hepatocrois	S	W			6	6
304	Meruliopsis sp.	S	W/T	7			7
101	Merulius sp."pink-buff"	S	W/Bk				
238	Mycana yuulongicola	S	W	74	27	37	138
134	Mycena aff. subcapillaris	S	L	234	61	128	423
44	Mycena aff. subgallericulata	S	W		12		12
80	Mycena carmeliana	S	W	2	19	91	112
50	Mycena mijoii	S	L	82	118	84	284
66	Mycena pura	S	S/L		3	12	15
144	Mycena sanguinolenta	S	S	44	28	23	95
163/260	*Mycena* sp. "brown-grey, on wood"	S	W				
51	*Mycena* sp. "buff umbrella"	S	L/T	1011	280	166	1457
285	*Mycena* sp. "light brown striate/white stems, on wood"	S	W			60	60
27	*Mycena* sp. "long stem"	S	W				
165	*Mycena* sp. "small grey - bleach"	S	S/L	9	7	27	43
88	*Mycena* sp. "tiny white with decurrent gills"	S	S				
64	*Mycena* sp. "tiny white, on twigs"	S	T				
308	*Mycena* sp. "grey-brown,/no bleach"	S	S	14			14
302	*Mycena* sp. "nipple umbrellas"	S	W	12			12
312	*Mycena* sp. "pink, bleach"	S	S/L			10	10
295	*Mycena* sp. "small buff"	S	L	247			247
182	*Mycena* spp. (unidentified)	S		30	6	8	44
164	Nidula candida	S	L/T				
127	Omphalina aff. umbellifera	S	S	3	92	98	193
112	Omphalina chromacea	S	S/Lichen				
122	*Omphalina* sp. "orange in moss - on log"	S	Moss				
213	Omphalotus nidiformis	S	W			2	2
130	Orange parasite on white resupinate polypore	(sp.116)	P				
104	Panellus ligulatus	S	W				
311	Panus fasciatus	S	W		12		12
179	*Paxillus* sp. "yellow, brown scales"	M	S	6		4	10
291	*Paxillus* sp. "orange-brown"	M	S	6	17	12	35
256	*Peziza* sp. "white cup"	?					
300	Peziza whitei	M	S	3			3
136	Phellinus gilvus	S	W	1	4	4	9
37	Phellinus sp.	S	W				
70	Phellodon niger	S	L/S	16			16
87	*Phellodon* sp."brown, white margin"	S	L/S		8	11	19
160	Pholiota highlandensis	S	L	163	508	220	891
119	Pholiota multicingulata	S	W	20	40	52	112
192	Plectania sp. "black"	S	L				
133	Pluteus attromarginata	S	W		2	1	3
248	Pluteus cervinus	S	W				
47	Pluteus lutescens	S	W		4	4	8
4	*Pluteus* sp. "brown velvet"	S	S				
157	Podoserpula pusio	S/M?	L/S				
277	Polypore "beige"	S	W	1		1	2
13	Polypore "brown with white margin"	S	W				
236/219	Polypore "chocolate brown, hirsute"	S	W	2			2
3	Polypore "long white shelf"	S	W				
116	Polypore "white resupinate"	S	T/W			1	1
313	Polyporus citreus	S	T/W				
109	*Poria* sp. "purple splash"	S	W		1		1

Sp #	Species	Life Mode[1]	Substrate[2]	Control	Shelterwood	Gap Release	Total
46	Agaric "creamy white"	S	S				
145	Poronia ericii	C	Dung		2		2
155	Protubera canescens	M?	S				
17	Psathyrella sp.	S	S/L				
229	Psathyrella sp.	S	L	3			3
250	Psathyrella sp.	S	L				
98	*Psathyrella* sp. "very tall, slender"	S	L	6	1	1	8
177	Psilocybe coprophila	C	Dung	12	99	16	127
129	Pulvinula sp.	S	S				
280	Pulvinula sp.	S	S		12	30	42
176	Pycnoporus coccineus	S	W	10	62	67	139
52	*Ramaria* aff. *Aurea* "yellow, flat tops"	M	S	2			2
72	*Ramaria holorubella* "purple-pink with pink tips"	M	S	3			3
102	Ramaria ochroceosalmonicolor	M	S	16	73	122	211
139	*Ramaria* sp. "bright-yellow"	M	S				
242	*Ramaria* sp. "cream/flat"	M	S				
247	*Ramaria* sp. "lemon yellow"	M	S	5	22	5	32
86	*Ramaria* sp. "orange-red, yellow stem"	M	S	5	4	1	10
254	Ramaria vesatilis "purple"	M	S	4			4
79	Resupinatus cineroscens	S	T/Bk			2	2
187	*Resupinatus* sp. "veined underside"	S	W	30	20	55	105
209	Rickinella fibula	S	Moss			1	1
69	Russula adusta	M	S	1	3	7	11
90	Russula aff. cyanoxantha	M	S	2		3	5
89	Russula clelandii group	M	S	47	24	6	77
202	Russula flocktoniae	M	S	164	12	16	192
92	Russula neerimea	M	S	24	9	18	51
178	Russula persanguinea (white stem)	M	W				
107	*Russula* sp. "grey-white"	M	S	1			1
10	*Russula* sp. "white/white/white"	S	S	19	14	22	55
276	*Russula* sp. "purple-mottled"	M	S	3			3
263	*Sarcodon* sp. "brown"	S	S				
315	*Scleroderma* sp. "yellow/yellow mycelium"	M	S				
150	Scutellina aff. margaritacea	S	W/T				
12	*Simocybe* sp. "olive"	S	W		5	2	7
106	Slime Mould Stemonitis herbatica		Capsule				
306	Sphaerobolus stellatus	S	L	17			17
132	*Steccherinum* sp. "creamy yellow crust"	S	W		1		1
94	*Steccherinum* sp."tiered white shelves"	S	W				
62	Stereum hirsutum	S	W	8	61	5	74
149/141/152	Stereum illudens	S	W	1	24	11	36
5&84	*Stereum* sp. "grey-brown white hirsute, purple fertile layer"	S	W				
67	Stropharia semiglobata	C	Dung		1	4	5
266	*Thelephora* sp. "terrestris"	M	S/Host	3			3
268	*Thelephora* sp. “brown/yellow-orange”	M	S				
16	Thelephore "translucent funnels"	S	S/Moss			4	4
19	Trametes lilacino-gilva	S	W		1		1
63	Trametes versicolor (brown or grey)	S	W		45	21	66
60	Tremella mesentericia	S	W		4		4
287	*Tremella* sp. "cloudy yellowish white"	S	W		15		15
289	*Tremella* sp. "tiny yellow knobs"	S	W		144		144
288	*Tremella* sp. "yellow buttons"	S	W	50	100		150
211	Tricholoma sp.	M	S			1	1
161	*Tricholoma* sp. "grey-white"	M	S			1	1
54	Tricoloma eucalypticum	M	S	11	16	18	45
258	Truffle "sticky"	M	S				
189	Tubaria rufofulva	S	W				
2	Xerula australis	S	S			1	1
175	Xylaria hypoxylon	S	W				
	Number of fruitbodies			**5035**	**6540**	**6814**	**18389**
	Number of species			**129**	**136**	**127**	**202**

[1] S = saprotrophic, M = mycorrhizal, P = parasitic, C = coprophilous

[2] S = soil, L = litter, T = twigs, Bk = bark, W = wood

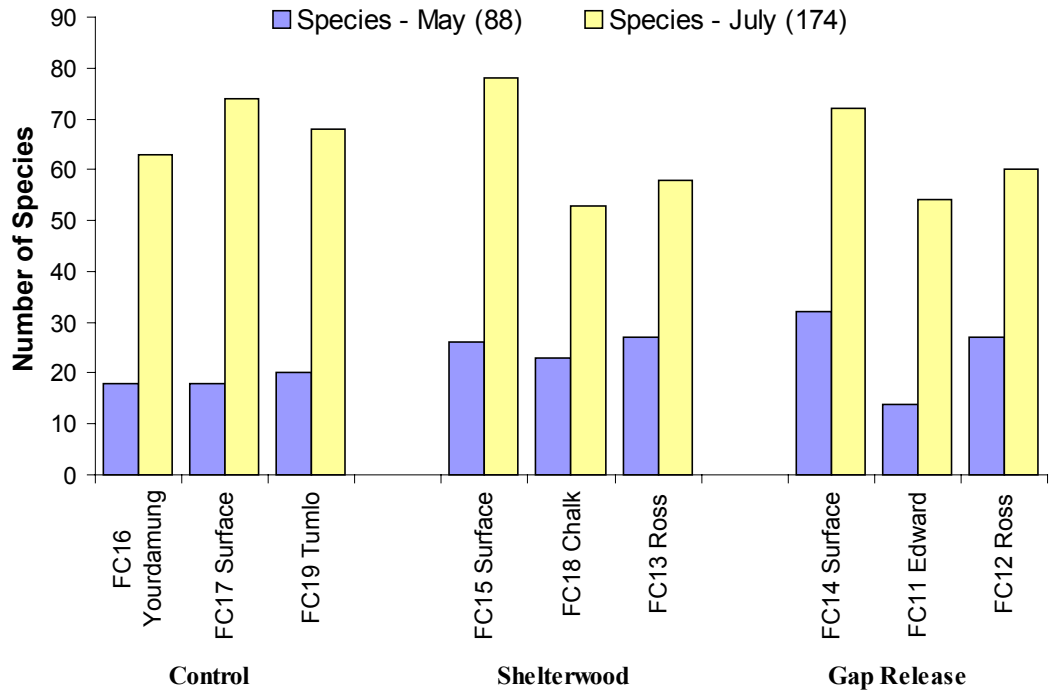


Figure 2. The number of species recorded in May and July at the Wellington FORESTCHECK sites.

Preliminary analysis suggests that there were no obvious differences in species richness between treatments or within grids in each treatment (Figure 4). Species composition within the treatments has not yet been investigated, but will have some influence on the abundance, as a number of wood decay species, such as *Calocera* and *Gymnopilus*, can produce large numbers of fruitbodies on a single piece of wood. The abundance on the Shelterwood and Gap Release treatments was generally higher than on the Controls (Figure 3).

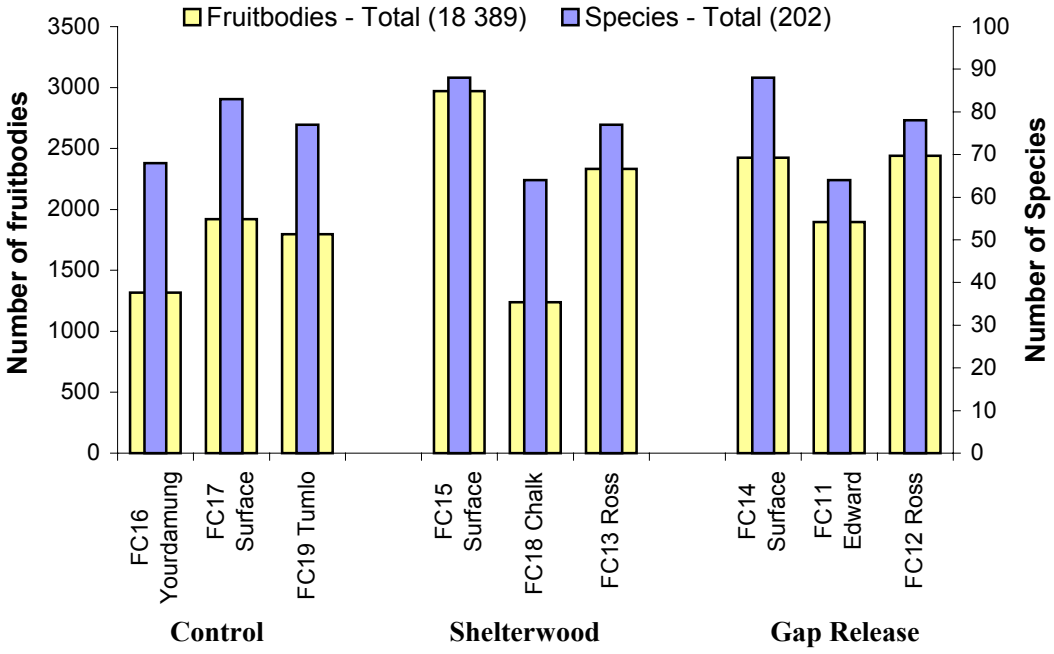


Figure 3. The total number of species and abundance recorded at the Wellington FORESTCHECK sites in 2003.

The variation in the number of species fruiting on soil, litter and wood was similar within and between treatments (Figure 4). However, there were several examples of significant variation in the number of fruitbodies recorded on each of these substrates within and between the treatments (Figure 5). The Shelterwood treatments contained large amounts of coarse woody debris (see CWD section Figure 3) compared to the gaps and Control treatments, but fruiting abundance of wood decay species was only reflected on site FC13 in Ross forest block.

On the Ross forest block Gap Release treatment, FC12 also had a larger number of fruitbodies recorded on wood than the other sites within the Gap Release treatment. This may be due to the fact that both FC12 and FC13 are the "older" sites within each treatment and that neither was burnt following harvest. In the Shelterwood treatment, Surface forest block FC15 also had a significantly higher amount of species fruiting on the soil than did FC13 and FC18. Future analysis of the species composition on the various sites and within the treatments is needed to explain why this occurred. In the Gap Release treatment FC11 and FC14 both had a large number of fruitbodies recorded on the soil, with FC12 having a lower number. This may reflect the type of site and the age and treatment of the sites since harvest, but again, analysis of the species composition on the sites needs to be undertaken before attempting to explain why.

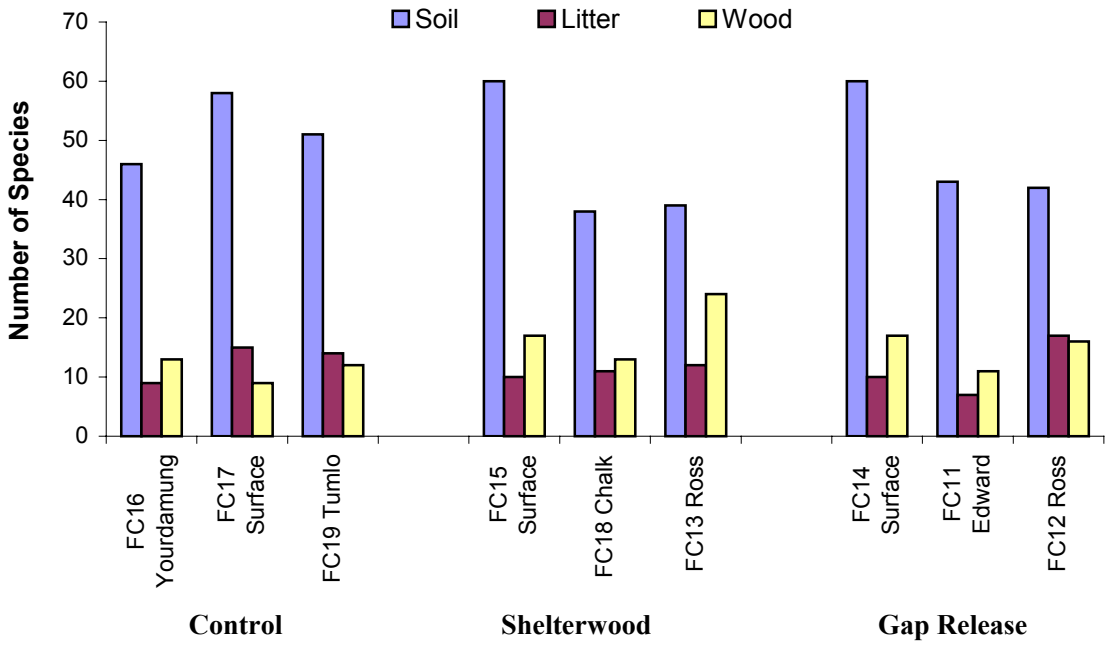


Figure 4. The number of species recorded fruiting on litter, soil and wood on the Wellington FORESTCHECK sites in 2003.

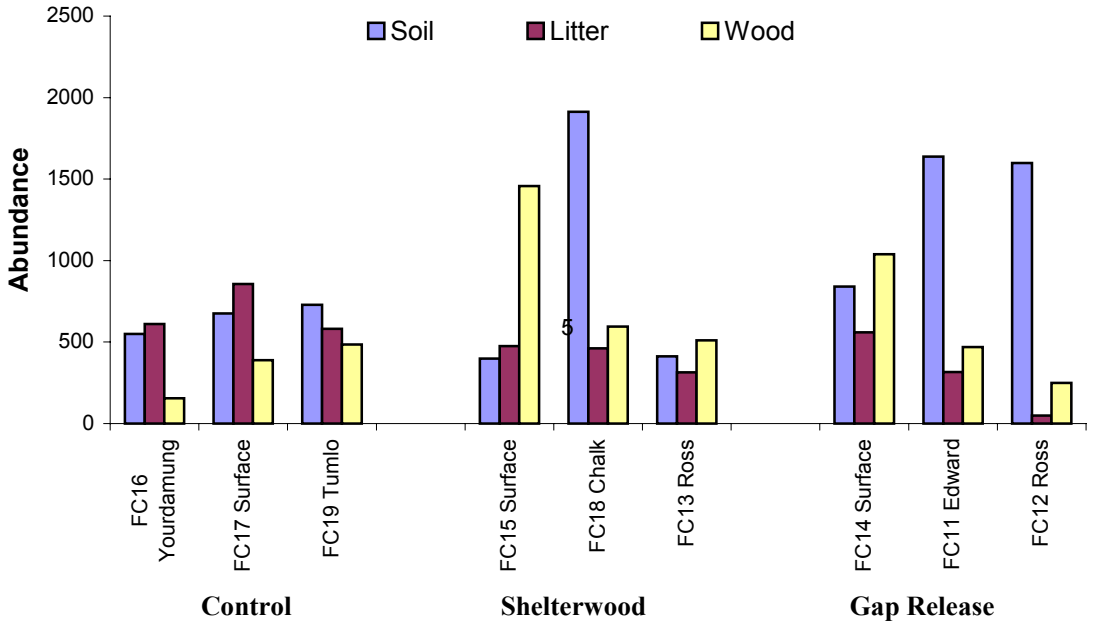


Figure 5. The number of fruitbodies recorded on litter, soil and wood on the Wellington FORESTCHECK sites in 2003.

Donnelly

1. Monitoring

Monitoring at the Donnelly sites (installed and monitored in 2002) was carried out from 9-18 June 2003.

2. Voucher Specimens

The 118 voucher collections made included 88 species.

3. Key Findings

A total of 200 species, and 14, 536 fruitbodies were recorded across all the sites. Of these species, 131 occurred in 2002. Therefore, on the Donnelly sites, 69 new species were recorded in 2003 and 61 species that were recorded in 2002 were not recorded in 2003. When the species are compared to those recorded on the Wellington sites, only 114 species were common to both the Donnelly and Wellington sites in 2003. In 2003, a higher number of species was recorded on most sites within treatments and many more fruitbodies were recorded on both the Easter and Kingston Control sites and on the Carter Buffer site (compare Figures 6 and 7).

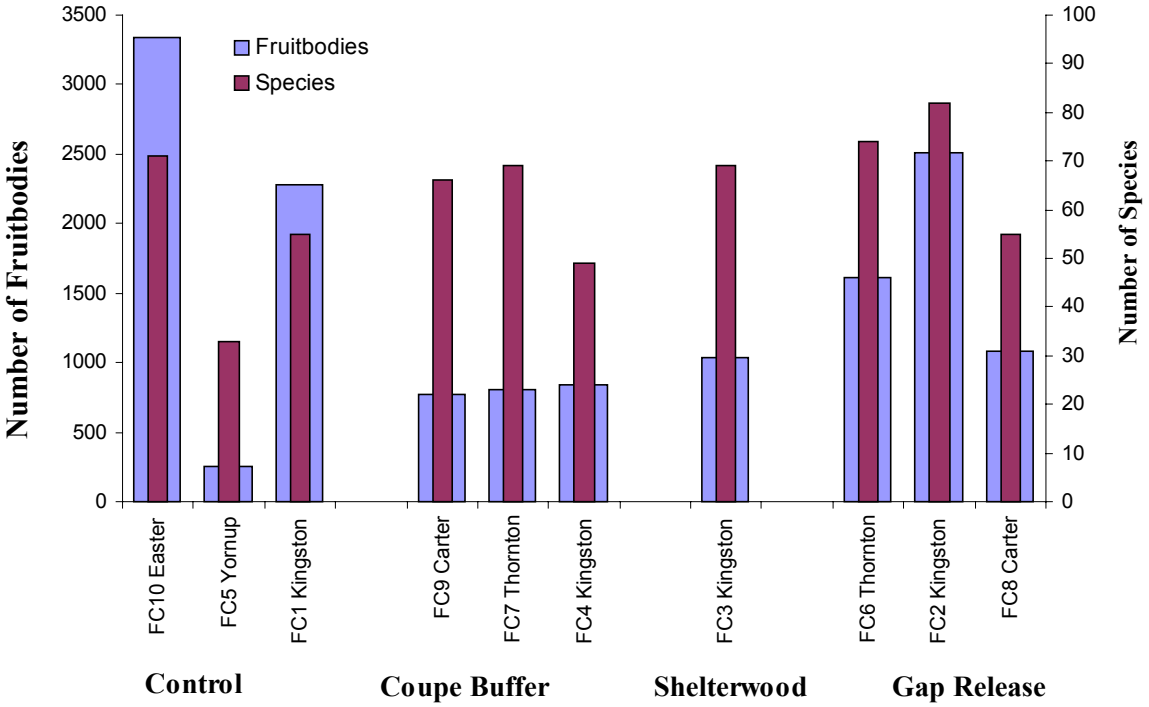


Figure 6. The total number of species and abundance recorded at the Donnelly FORESTCHECK sites in 2003.

The importance of long-term monitoring of macrofungi is clearly illustrated by the differences found between the number of species, their abundance and the species composition at the Donnelly sites in 2002 and 2003 (Figures 6 and 7). Differences between the Wellington and the Donnelly sites may be due to environmental factors associated with location, and may reflect real distribution preferences for some species. However, year-to-year differences at the same location(s) reflect the variation in fruiting patterns associated with annual fluctuations of local climate regimes and requires regular and long-term monitoring to ensure that all species are reliably and adequately recorded.

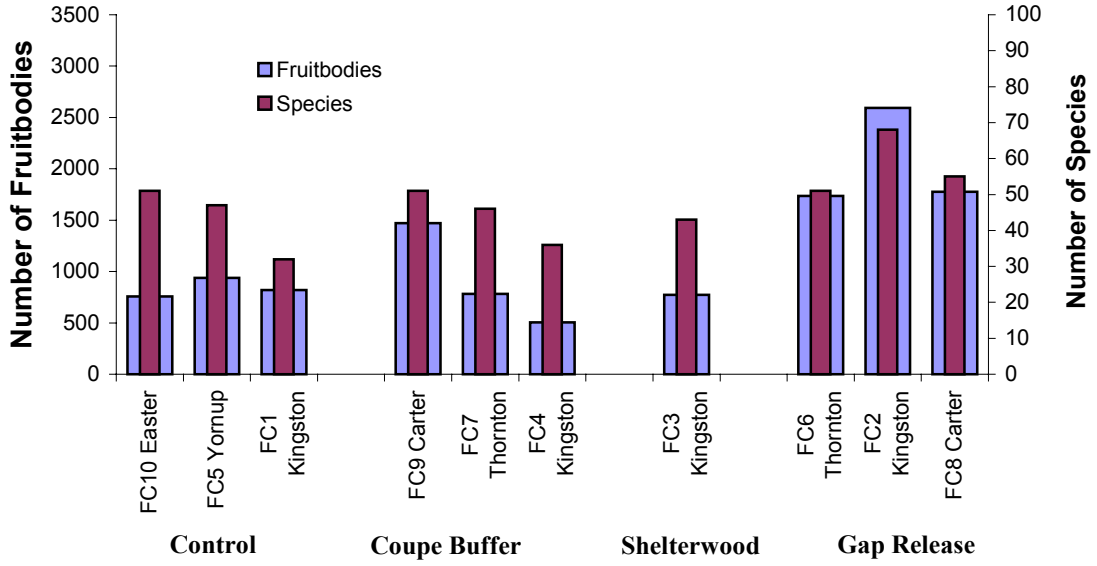


Figure 7. The total number of species and abundance recorded at the Donnelly FORESTCHECK sites in 2002.

Data Management

All data have been entered onto a Microsoft Excel worksheet. Species diversity and abundance at each site and a frequency rating of 1 (rare) to 8 (very common) for each species at each site has been determined. The data include a complete list of species recorded across all the sites, their life modes (mycorrhizal, saprotrophic, parasitic) and the substrate on which they were fruiting. Analysis is ongoing.

Modification to Methods, Difficulties

No further modifications to the methods were necessary. Monitoring rainfall proved to be successful in maximizing the chance of encountering the peak in the fruiting of species. The addition of a third person to the team was extremely beneficial and economical in that field time was maximized and not disrupted by voucher specimen preparation and species descriptions.

CRYPTOGAMS

Ray Cranfield and Karina Knight, with assistance from Kirsten Pearce

Introduction

Nine FORESTCHECK grids were visited over 5 days during May 2003 and cryptogams (lichens, mosses and liverworts [LBH]) were sampled. Macro and microhabitats, species occurrence and frequency were recorded at each grid. Potential indicator species were investigated and a further 3 species included in the draft listing.

Sampling

The same sampling methods were employed as for May 2002 (Report of Progress 2001-02). As in 2002, two collectors conducted most of the sampling, with the additional assistance of a third collector later in the week.

Specimen Processing

All specimens for this year's sampling have been identified as far as possible. Problem species have once again been phrase-named and a working draft of these species illustrated. Moss and liverwort identification and sample processing has been completed. Several samples of terrestrial algae and microscopic fungi were collected and retained for the Herbarium but only identified as genus sp.

All samples have been presented for database entry and label generation prior to submitting these vouchers to the Herbarium.

Number of samples collected including repeats for all grids = 490
Number of lichen samples = 394
Number of moss samples = 46
Number of liverwort samples = 19

Excluding repeat samples, 337 individual cryptogam collections have been recognized from 9 grids. A further 31 samples of algae and fungi were collected.

Preliminary Results

Table 1. FORESTCHECK Cryptogam site data.

		Control			Shelterwood			Gap Release		
Grids		**FC16**	**FC17**	**FC19**	**FC15**	**FC18**	**FC13**	**FC14**	**FC11**	**FC12**
Number of Samples		56	62	40	29	29	44	8	18	51
Groups					**Number of Species**					
L	Lichen	51	59	33	24	25	38	3	13	46
B	Moss	4	2	6	3	3	4	3	4	3
H	Liverwort	1	1	1	2	1	2	2	1	2
Habitats					**Number of species recorded for each microhabitat**					
1	Wood	44	38	28	13	15	29	0	6	43
2	Bark	16	10	14	11	8	10	0	7	21
3	Ant Hill	0	1	0	0	1	0	0	0	0
4	Soil	9	4	3	3	3	6	3	1	7
5	Stone	15	15	6	8	2	6	5	4	9
6	Organic Material	13	9	3	3	13	9	2	3	11
7	Charcoal	3	4	4	3	2	1	1	2	2
Stratal Position										
1	0 -30 cm	33	36	30	21	21	26	10	15	40
2	31 cm – 3 m	51	46	27	15	20	33	0	8	49
3	3.1 m +	3	5	1	7	1	2	0	1	3
Habitat Frequency										
1	71%	0	1	0	0	0	0	0	0	0
2	50 – 70%	36	40	22	10	14	25	3	4	32
3	10 – 49%	41	28	30	16	18	31	7	11	31
4	0 – 9%	10	16	7	12	11	4	0	8	27
Site Frequency										
1	50%+	0	0	0	0	0	0	0	0	0
2	15-49%	16	15	0	6	1	1	0	1	2
3	3-14%	30	30	23	5	14	23	3	2	25
4	1-2%	43	34	30	27	25	30	7	16	56
Indicators species present (20 for Wellington sites)		17	13	14	12	13	5	6	14	10

Table 2. Combined number of Cryptogam groups located on different substrates and strata

	Microhabitats (Substrates)							Strata levels		
Grids	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Ground**	**Shrub**	**Tree**
Control										
FC16	44	16	0	9	15	13	3	33	51	3
FC17	38	10	1	4	15	9	4	36	46	5
FC19	28	14	0	3	6	3	4	30	27	1
Shelterwood										
FC15	13	11	0	3	8	3	3	21	15	7
FC18	15	8	1	3	2	13	2	21	20	1
FC13	29	10	0	6	6	9	1	26	33	2
Gap Release										
FC14	0	0	0	3	5	2	1	10	0	0
FC11	6	7	0	1	4	3	2	15	8	1
FC12	43	21	0	7	9	11	2	40	49	3

Note that in several instances individual species may be located in several habitats and strata.

Table 3. FORESTCHECK Cryptogam habitat and Stratal Usage [showing Number of Species in all 3 groups: Lichens (L), Mosses (B) and Liverworts (H)].

		Habitats							Strata Levels		
Grids	**Groups**	Wood	Bark	Ant Hill	Soil	Stone	Organic	Charcoal	0-30cm	31cm-3m	3m+
Control											
FC16	L	28	17	0	3	8	6	3	19	37	2
	B	0	0	0	2	1	3	0	4	0	0
	H	1	0	0	0	0	0	0	1	0	0
FC17	L	30	12	1	3	11	7	3	27	34	7
	B	0	0	0	2	1	2	0	3	0	0
	H	1	0	0	0	0	0	1	0	1	0
FC19	L	21	12	0	2	5	2	0	18	23	2
	B	2	0	0	3	1	2	1	7	2	0
	H	1	0	0	0	0	0	1	1	0	0
Shelterwood											
FC15	L	10	7	0	0	7	2	4	15	12	3
	B	0	0	0	2	1	2	0	3	0	0
	H	1	1	0	1	0	0	1	2	1	0
FC18	L	11	7	1	0	3	2	2	12	15	2
	B	0	0	0	2	0	3	0	3	1	0
	H	0	0	0	0	0	1	0	1	0	0
FC13	L	20	10	0	3	4	6	1	17	27	1
	B	0	0	0	2	1	2	0	4	0	0
	H	1	0	0	4	0	1	0	2	0	0
Gap Release											
FC14	L	0	0	0	0	4	0	0	4	0	0
	B	1	0	0	1	1	1	0	3	0	0
	H	0	0	0	1	0	1	1	2	0	0
FC11	L	4	6	0	0	2	1	0	7	7	0
	B	0	1	0	1	0	2	0	3	0	0
	H	1	0	0	0	0	0	1	1	0	0
FC12	L	29	14	0	4	5	6	1	21	32	4
	B	0	0	0	2	1	2	0	3	0	0
	H	1	0	0	0	0	1	0	1	1	0

Table 4. Interim Listing of Proposed FORESTCHECK Indicator Species

Code No.	Groups	Taxa	Habitats
1	L	Cladia aggregata	organic litter or decayed wood
2	L	Cladonia cervicornis var. verticellata	organic matter
3A	**l**	**Cladonia krempelhuberi**	**organic matter and soil**
3	L	Paraporpidia glauca	soil or rock
4	L	Diploschistes ocellatus	soil
5	L	Xanthoparmelia notata	rock
5a	**L**	**Xanthoparmelia isidiigera**	**rock**
6	L	Cladia schizopora	bark or decayed wood
7	L	Cladonia rigida	wood
8	L	Neuropogon sp.	shrubs or rocks
9	L	Flavoparmelia rutidota	charred & uncharred wood
10	*L*	*Parmotrema cooperi*	*bark or wood*
11	L	Thysanothecium scutellatum	charred & uncharred wood
11a	**L**	**Thysanothecium hookeri**	**termite mounds**
12	L	Usnea inermis	epiphyte in branches
13	L	Menegazzia platytrema	upper branches and bark
14	L	Hypogymnia subphysodes	upper branches and bark
15	L	Candelariella sp	mature bark
16	B	Funaria hygrometrica	ash beds and soil
17	B	Racopilum cuspidigerum var. convolutaceum	rock
18	B	Sematophyllum contiguum	rock
19	B	Barbula calycina	litter, soil, decayed wood
20	B	Campylopus introflexus	soil, organic material
21	B	Ceratodon purpureus	ash beds and soil
22	H	Cephaloziella exiliflora	charcoal and wood
23	*H*	*Fossombronia sp.(leafy & lettuce)*	*soil and organic litter*
24	H	Chiloscyphus semiteres	organic material
25	H	Frullania probosciphora	organic material
26	**L**	**Pannoparmelia wilsonii**	**bark and wood**
27	**L**	**Tephromela atra**	**wood and upper branches**

Bold text indicates new additions

Italics indicate taxonomic changes

Note: Additions and correction were made after the 2003 survey.

Table 5. Presence/Absence of Cryptogam taxa located on each site.
(Names in **bold text** are the nominated indicator species).

Taxa Grids	11	12	13	14	15	16	17	18	19
Mosses (B)									
Barbula calycina	*		*	*		*		*	*
Campylopus introflexus	*	*	*	*	*	*	*	*	*
Ceratodon purpureus		*			*	*	*		*
Fissidens tenellus			*						
Racopilum cuspidigerum var. convolutaceus				*					
Rosulabryum ?albolimbata	*				*				*
Sematophyllum contiguum		*	*			*	*		*
Thuidium sparsam var. hastatum								*	*
Genus sp.			*						*
Liverworts (H)									
Cephaloziella exiliflora	*	*	*	*	*	*	*		*
Fossombronia sp. (leafy)								*	
Fossombronia sp. (lettuce)		*	*	*	*				
Fossombronia sp. (purple lipped clam)									
Lichens (L)									
Buellia stellulata		*				*	*		*
Buellia sp.	*		*			*	*	*	
Buellia sp. (Brown apo's)						*			
Candelariella sp.							*		
Calicium abietinum		*	*						
Calicium glaucellum		*	*			*		*	
Calicium tricolor		*	*			*			
Calicium victorianum subsp. victorianum		*				*		*	*
Caloplaca sp.					*	*	*		
Cannoparmelia owariensis			*				*	*	
Cladia aggregata	*	*	*		*	*	*	*	*
Cladia schizopora	*	*	*		*	*	*	*	*
Cladonia cervicornis var. verticellata	*					*	*		
Cladonia calyciformis		*	*				*		*
Cladonia fimbriata			*						
Cladonia humilis var. humilis							*		
Cladonia krempelhuberi		*			*	*	*		
Cladonia merochlorphaea						*	*	*	
Cladonia ramulosa		*	*			*	*	*	*
Cladonia rigida	*	*	*		*	*	*	*	*
Cladonia ?scabriuscula			*			*		*	*
Cladonia southlandica			*			*			*
Cladonia subdigitata		*							
Cladonia sulcata var. sulcata		*	*		*	*	*		
Cladonia sulcata var. wilsonii		*							
Cladonia ustulata		*	*						
Cladonia sp.							*		*
?Cyphelium trachylioides							*		
Graphis sp. (black beans)		*				*	*		
Graphis sp. (black rays)		*	*				*	*	
Graphis sp. (black lips)		*							*

Taxa Grids	11	12	13	14	15	16	17	18	19
Graphis sp. (black tram lines)			*			*			
Graphis sp. (conglomerate)			*						*
Graphis sp. (writhing mass)		*							
Hafellia disciformis		*	*		*	*	*		
Hypocenomyce australis		*					*	*	*
Hypocenomyce foveata		*	*			*	*		*
Hypocenomyce scalaris		*				*	*	*	
Hypogymnia subphysodes var. subphysodes	*	*	*		*	*	*	*	*
Menegazzia platytrema			*		*	*	*		*
Neuropogon sp.						*	*		
Normandina sp. (yellow)		*							
Ochrolechia sp. GS (Kantavilis 306/92)		*					*		*
Ochrolechia sp. (cream doughnuts)		*				*			*
Ochrolechia sp.		*	*			*	*		
Pannaria elixii							*		*
Pannaria sphinctrina			*						
Pannaria sp.									*
Pannoparmelia wilsonii		*	*		*	*	*	*	*
Paraporpidia glauca	*	*	*	*	*	*	*	*	*
Parmotrema tinctorum						*	*		*
Pertusaria trachyspora							*		
Pertusaria sp.		*				*			
?Placopsis sp.			*		*				
?Pyrenopsis					*				
Ramboldia stuartii		*	*			*	*		*
Rhizocarpon sp. (grey white)							*		*
Tephromela atra		*	*		*	*	*		
Thelotrema lepadinum							*		
Thysanothecium hookeri							*		
Thysanothecium scutellatum	*	*	*		*	*	*	*	*
?Trapelia sp.						*			
?Toninia sp.									*
Usnea confusa	*					*		*	
Usnea inermis	*	*	*		*	*	*	*	*
Usnea ?pulvinata							*		
Usnea ?rubicunda	*								
Usnea sp.							*		
Xanthoparmelia australasica						*			
Xanthoparmelia elixii					*				
Xanthoparmelia exillima				*					
Xanthoparmelia isidiigera		*	*	*	*	*		*	*
Xanthoparmelia mougeotina		*					*		
Xanthoparmelia sp.							*		
Genus sp. (algae pancakes)							*		
Genus sp. (black domes)		*				*			
Genus sp. (black hairy stepping stones)							*		
Genus sp. (black lily pads)		*				*			
Genus sp. (black micro nuts)		*			*		*		
Genus sp. (blue green edge)							*		

Taxa	**Grids**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Genus sp. (brown buns)										*
Genus sp. (brown cactus)			*							
Genus sp. (brown dirt)										*
Genus sp. (brown discs)						*				
Genus sp. (brown domes)							*	*		
Taxa	Grids	11	12	13	14	15	16	17	18	19
Genus sp. (brown glossy apo's)							*			
Genus sp. (brown slime trail)									*	
Genus sp. (brown wax)							*			*
Genus sp. (coral)										*
Genus sp. (green balls)										*
Genus sp. (green cotton balls)								*		
Genus sp. (green crust)			*	*						
Genus sp. (green doughnuts)								*		
Genus sp. (green flecks)								*		
Genus sp. (green grey)			*	*		*	*	*		*
Genus sp. (green specks)		*				*				
Genus sp. (grey corn cob)			*	*			*	*	*	
Genus sp. (grey crazey path)					*					
Genus sp. (grey crumbs)		*	*	*					*	
Genus sp. (grey frosting)								*		
Genus sp. (grey lumps)						*	*			
Genus sp. (grey squamules)			*			*				
Genus sp. (necklace apo's)								*		
Genus sp. (rust blobs)							*			
Genus sp. (?sarcopyrenia sp.)			*					*		*
Genus sp. (sultana's)							*		*	
Genus sp. (soot)								*		
Genus sp. (spotty)									*	
Genus sp. (tan/yellow)							*	*		
Genus sp. (warty heads)				*						
Genus sp. (yellow crust)			*	*			*			
Genus sp. RJC19040								*		
Genus sp. RJC19041								*		

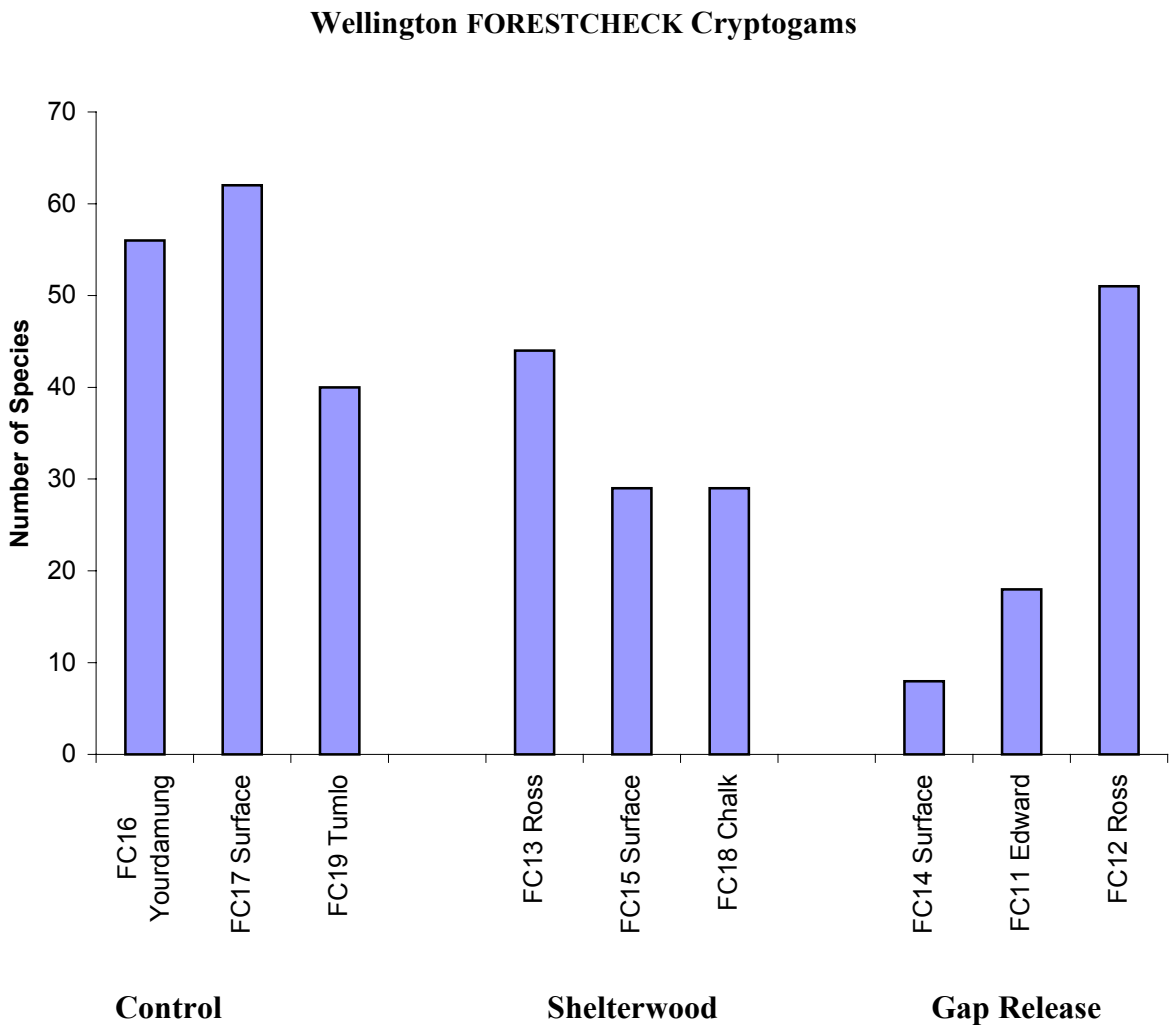


Figure 1. Combined Cryptogam Groups, Occurrences per grid.

Variations are shown between the Control grids (FC16, 17 & 19) that may be a reflection of the degree of aridity between each of these grids. The reduced number of taxa detected of taxa in 2 of the Gap Release grids (FC11 & 14) appears to be a direct relationship to the high degree of disturbance occurring on these sites. As these site mature and regrowth instability slows, the number of cryptogams appears to increase. In the Shelterwood grids the degree of disturbance is less than that of the Gap Release and the cryptogam number is higher. The different ages of these sites is reflected in the graph FC 13(1992), 15(1998) & 18(1994). The later 2 grids appear have the same number of species although there is a 4 year difference between these treatments.

The diversity and occurrence of the cryptogam species for all of these treatments appears to vary although other factors may be exerting influences.

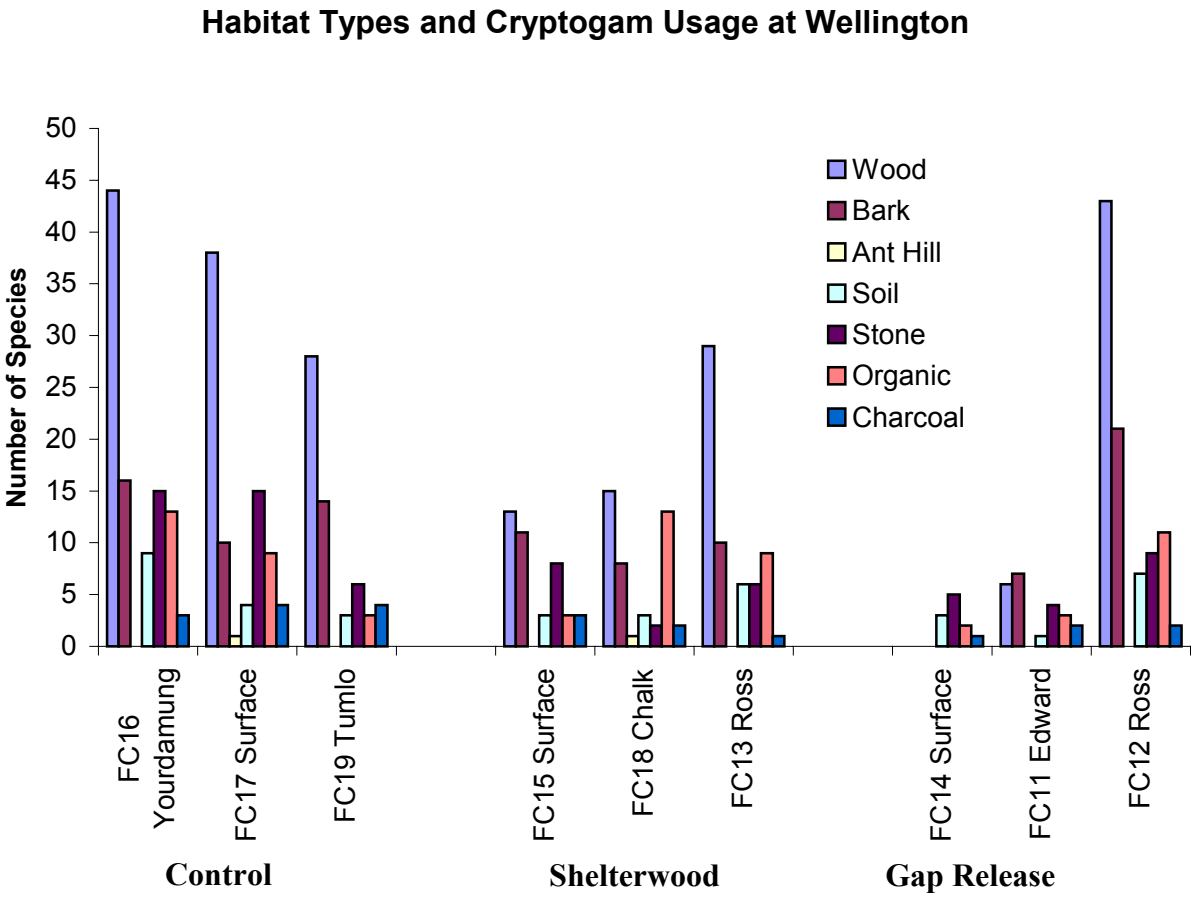


Figure 2. Available microhabitats (substrates) and the number of cryptogams colonizing these substrates.

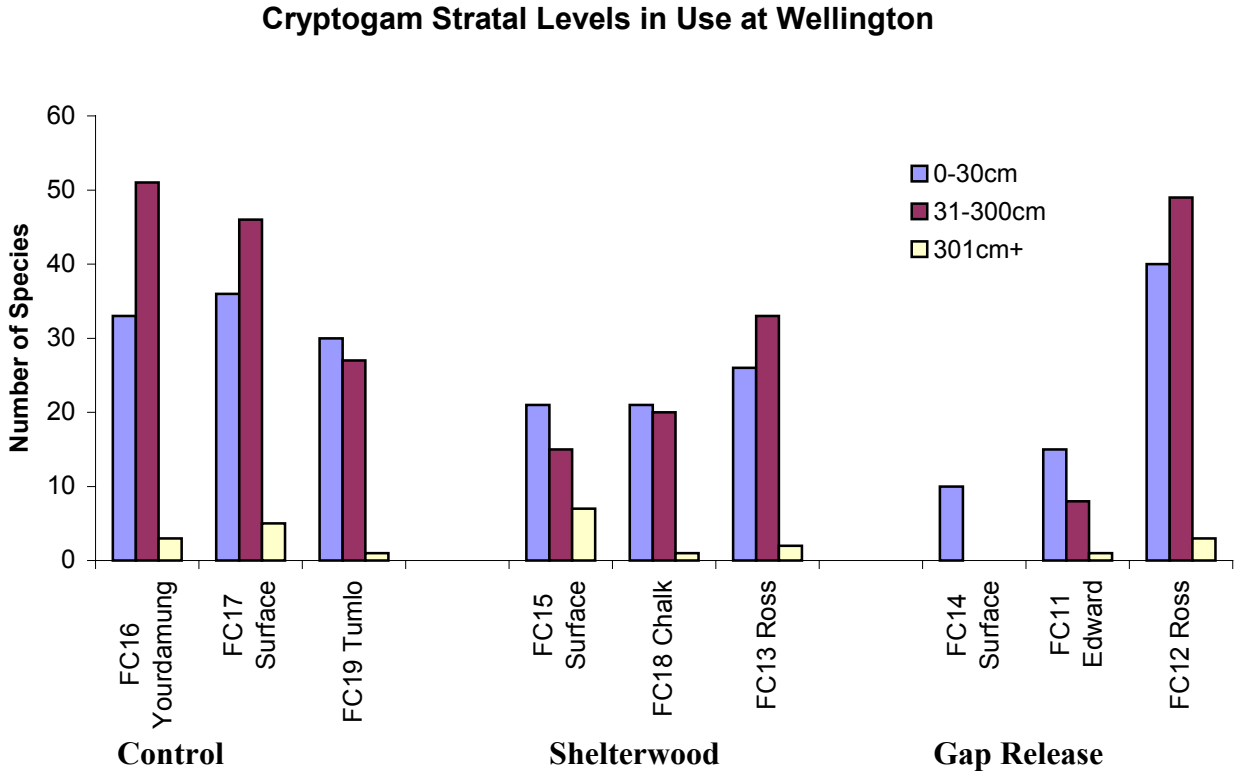


Figure 3. The occurrence of cryptogams and the number of species found at each stratal level.

Preferred habitats used on all grids are 1 wood, 2 bark and 4 organic materials. Wellington sites indicate that rock substrates (5) are frequently used while termite mounds (3) are either absent or virtually unused.

A significant change appears to have occurred when looking at the data from both the Donnelly and the Wellington sites. The Wellington sites appear to have a greater number of cryptogams occurring within the shrub layer (31-300 cm), where as the Donnelly sites are dominated at ground level (0-30 cm).

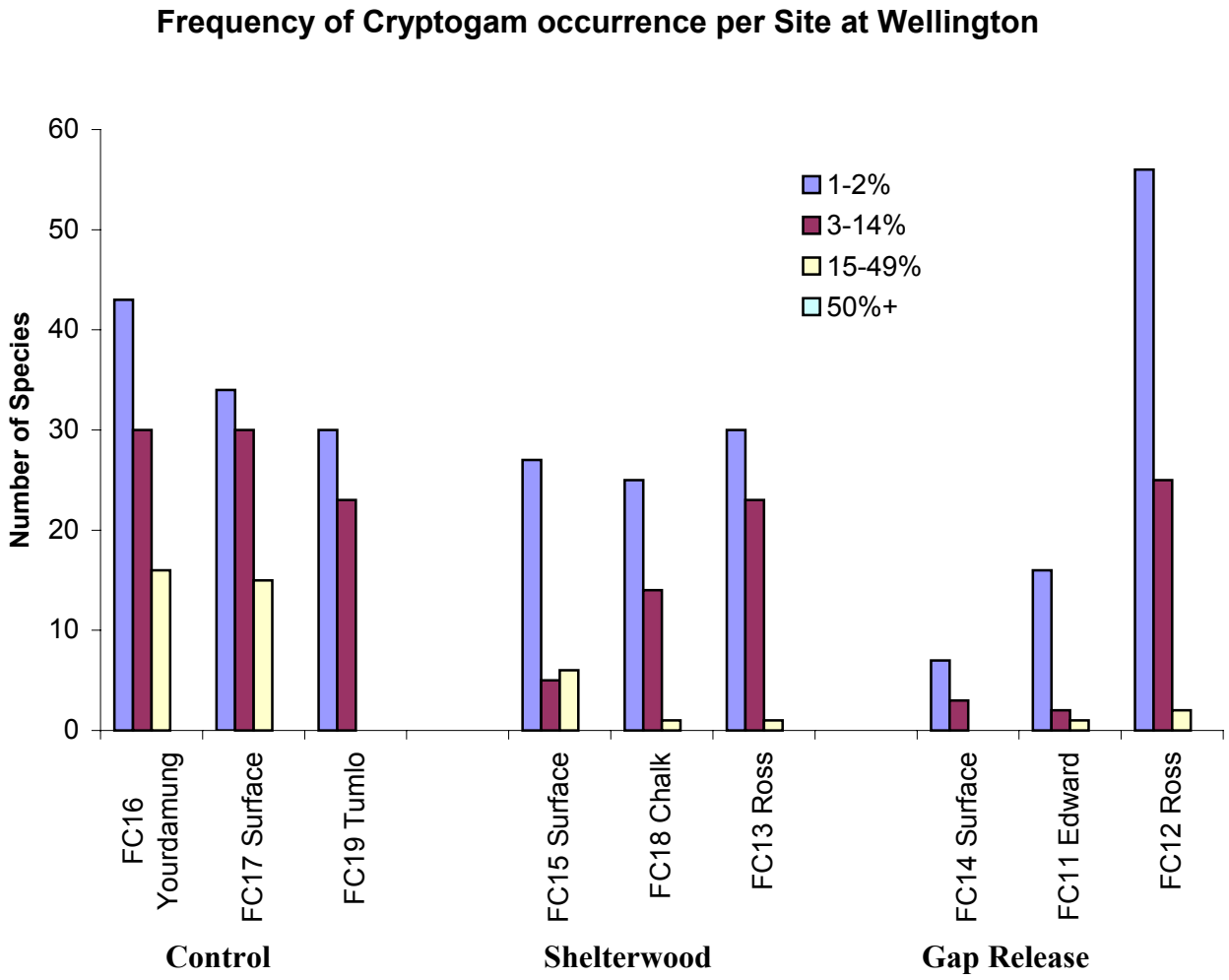


Figure 4. Frequency and number of species of cryptogams occurring at each grid.

As expected the frequency of cryptogams occurring on each site is rated at 1-2% of the total area or less.

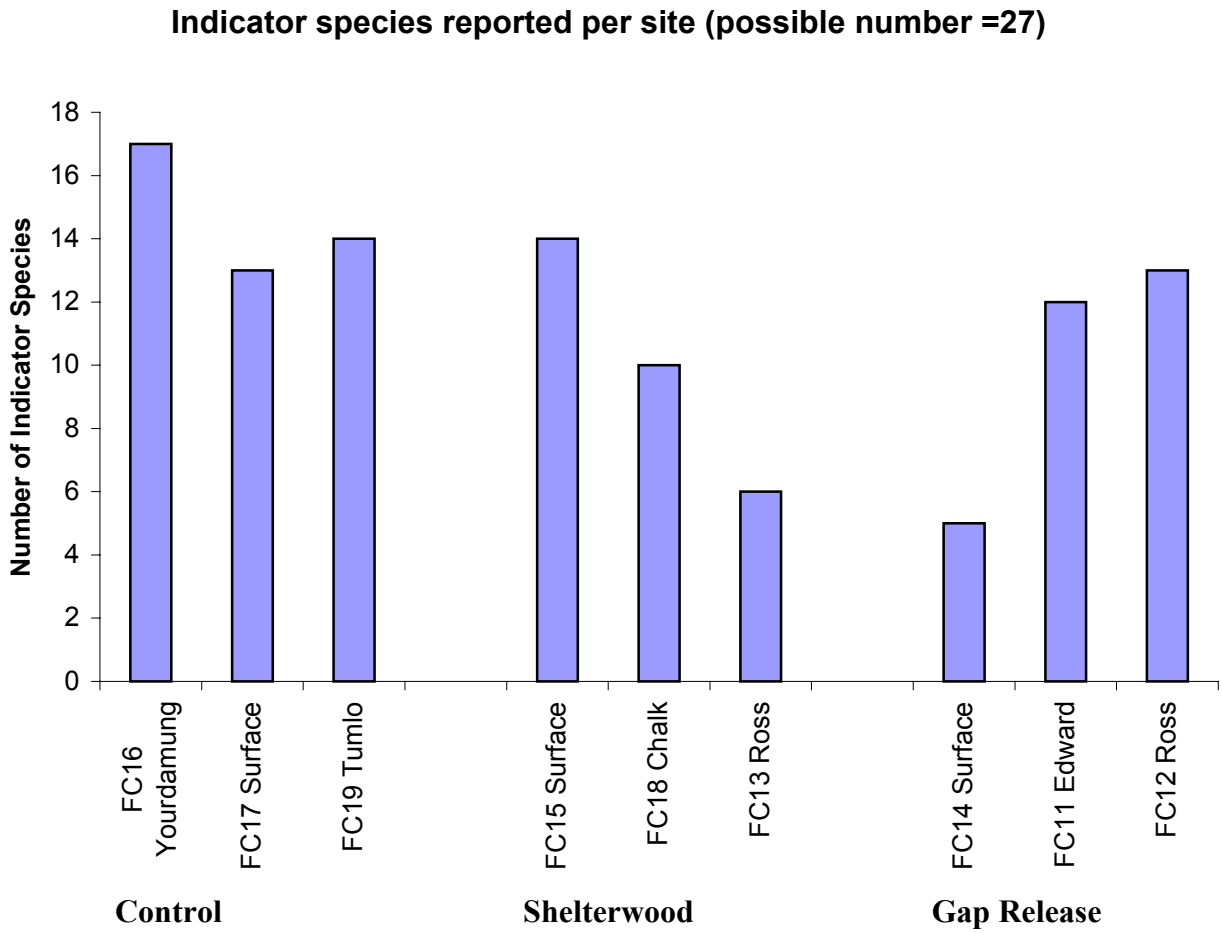


Figure 5. The number of Indicator species located on each grid.

Indicator Species

The listing of potential indicator species was reviewed during this survey and a further 5 species were included. At present 2 species may require removal due to associated taxonomic problems or may not be suitable for the survey work undertaken. It is hoped that within the next 2 rounds of sites a stable indicator species listing will be finalized and ready for more focused monitoring.

Conclusion

Superficial differences between the Donnelly and Wellington areas can be noticed when comparing the data from each survey but data analysis may indicate that there are no major differences between areas. As mentioned there appears to be a greater usage of the shrub layer in the Wellington area while in the Donnelly area the ground level appears to be the preferred stratal layer. Wellington grids appear to be more arid and this is reflected in the noticeable increase in the number of crustose lichens and reduced numbers of mosses and liverwort species. There appears to be an increased use of rock surfaces and a reduced reliance upon the soil substrate.

The aspect of the various age of individual sites after analysis may require further studies as these are likely to be the key to the time required for recolonization of cryptogams in disturbed forest sites.

Future Tasks

The preparation of a series of field guides and keys to lichen species is underway and draft/working copies are in use. Unknown and phrase named species presently sampled have been photographically and digitally captured in preparation for the development of a field guide. As mentioned a draft listing of Indicator Species is being prepared and should be finalized by the mid-term review of FORESTCHECK.

The updating of species names is an ongoing program that will change as we gain a higher understanding of cryptogam taxonomy.

The training of other cryptogam workers is desirable and needs to be considered.

MYXOMYCETES

Margaret and Alex Brims

Introduction

An opportunity to encourage and involve Margaret Brims to participate in a collection of slime moulds (Myxomycetes) for the Wellington FORESTCHECK sites has been taken. Although all sites were not covered in the time available for this trial collection, the resulting information is of exceptional interest.

Slime moulds are a group of cryptogams that are not well collected in Western Australia.
Seven of the 9 sites were searched and samples gathered on the fringes of these sites from which 35 taxa were recorded.

Sample processing

To identify many of these slime moulds the collected material required culturing using a form of moist growth chamber to encourage fruiting body development.

Preliminary Results

Table 1. Number of taxa located on each site surveyed.

Site Number	Treatment	Number of Taxa
FC16	Control	5
FC17	Control	4
FC19	Control	7
FC13	Shelterwood	7
FC14	Gap Release	1
FC11	Gap Release	6
FC12	Gap Release	5

FC15 (Shelterwood) and FC18 (Shelterwood) were not surveyed at this time.

Table2. Taxa present and site occurrence.

Taxa	**Sites**
Arcyria ferruginea	11, 13
Arcyria insignis	11, 16
Arcyria obvelata	16
Ceratiomyxa fruticulosa	19
Comatricha ellae	12, 17
Comatricha sp.	17
Cribraria microcarp	12, 19
Cribraria sp.	13
Echinosrelium minutum	17
Enerthenema sp.	12
Lamproderma aff. Scintillans	19
Lycogola epidendrum	19
Metatrichia floriformis	13
Physarum nutans	12
Physarum sp.	13
Physarum viride	16, 19
Semonitis fusca	19
Taxa	Sites
Stemonitis lignicola	11
Stemonitis sp.	14
Stemonitis virginiensis	11,16
Stemonitopsis gracilis	13
Stemonitopsis sp.	13, 19
Trichia affinis	11, 16
Trichia botrytis var. botrytis	13
Trichia varia	17

26 species of slime moulds were recognized from the 7 indicated Wellington FORESTCHECK sites.

VASCULAR PLANTS

Bruce Ward

Introduction

The selection of monitoring plots for the second round of FORESTCHECK resulted in 9 grids being established in the Wellington District. These grids were numbered FC11 – FC19, with 3 grids established in Gap Release treatments, 3 in Shelterwood and 3 Control grids. These grids were all established in the Mattiske and Havel D2 soil/vegetation complex and were located on mid to upper slopes. Establishment of plots was completed in spring and measurement of vegetation was done in mid October. The flowering of most species was completed at the time of measurement and resulted in only 21 species being vouchered (11%). The objective of this report highlights the outcomes from the second round of monitoring sites for FORESTCHECK.

Aim

To monitor vascular plant species richness and abundance for each of the FORESTCHECK sites.

Sampling

Species richness was assessed using four 30 m x 30 m plots in each grid (36 in total) with frequency distribution and abundance categories added. 1 x 1 m plots were used to analyse species abundance with 20 per plot (720 in total). 116 species were identified for the 1 m x 1 m quadrats and 181 for the 30 m x 30 m quadrats and a complete species list is attached (Appendix 1).

Sampling is now routine and follows established protocols. No real issues have emerged for this sampling period. Delays in site selection plot establishment pushed the sampling into late spring. This resulted in missing the main flowering time of vegetation during our sampling.

Specimen Processing

The area around each grid was used to search for and voucher flowering plant specimens. In total 21 vouchers were collected which represents about 11% of the species and to achieve a complete set of voucher specimens for this site further vouchering will be needed during the next monitoring session.

Database Establishment

Three database files have been established to record vegetation data and are called vegbook1, which contains data from the 30 m x 30 m plots, vegbook2 has the 1 m x 1 m plot data and vegbook3 has Levy structural measurements. The databasing of the voucher specimens is contained in the Herbarium system under MAX system program. These data are unique and can be retrieved for each site.

Preliminary Results

Species Richness

A total of 181 species were noted from the 30 m x 30 m plots and 116 species in total from the 1 m x 1 m plots (see Table 1 for comparison of species numbers).

Table 1. Showing species diversity comparisons for FORESTCHECK sites at Donnelly and Wellington.

	30 m x 30 m Plots species numbers	1 m x 1 m Plots species numbers	% Difference	Number of weed species
Donnelly Plots 2002	203	158	78%	24
Wellington Plots 2003	181	116	64%	10

The difference in species numbers between Donnelly and Wellington is due mainly to higher annual weeds at the Donnelly sites and if these are removed the 2 sites show similar levels of richness. For this year 16.4% of species are annuals, of which 5.2% are weeds and the remaining 83.6% of species are perennials.

Species richness graphs show similar trends across the range of treatments, with no apparent impact from logging treatments evident (Figure 1).

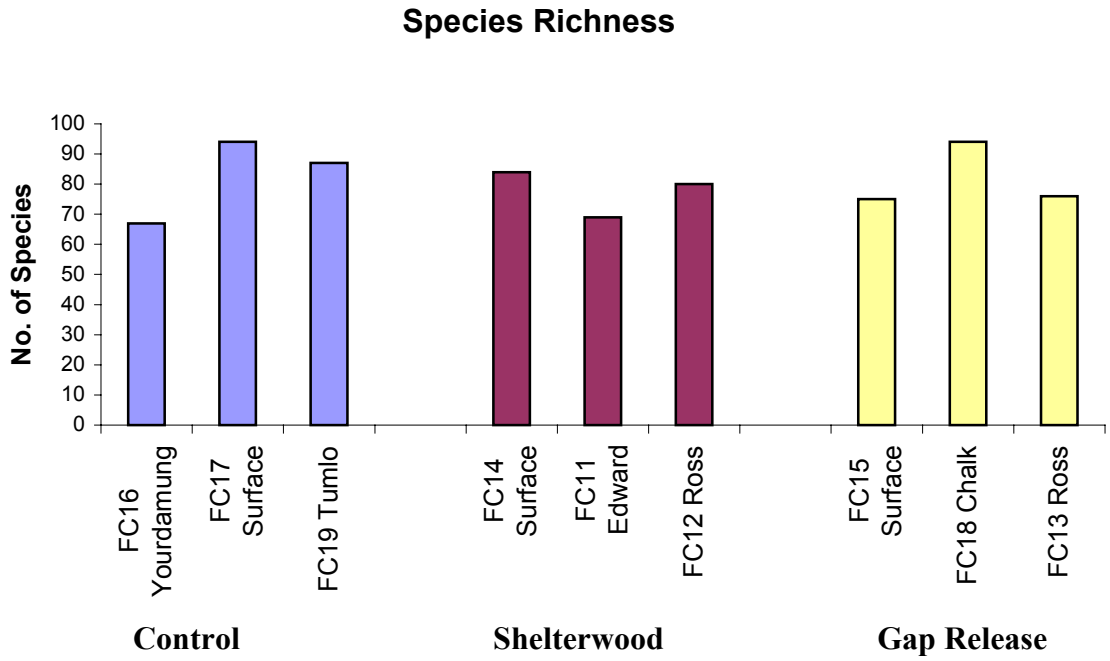
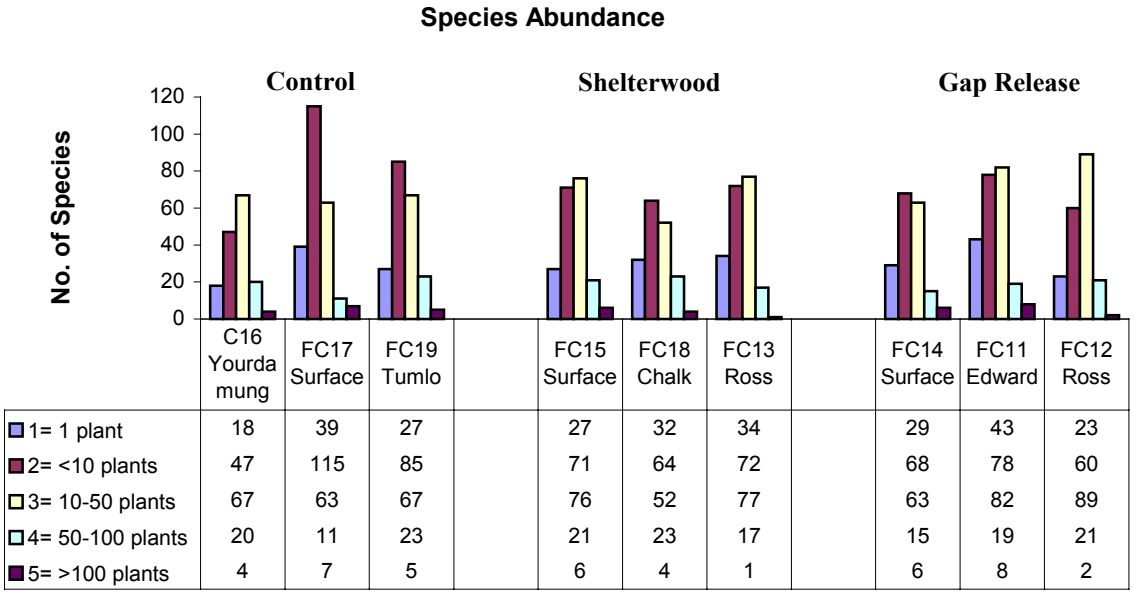


Figure 1. Plant species diversity recorded at the 2003 FORESTCHECK grids.

Species Abundance

Species abundance show similar trends across all treatments and there appears to be no apparent impact with logging treatments (Figures 2a and 2b).



	C16 Yourdamung	FC17 Surface	FC19 Tumlo	FC15 Surface	FC18 Chalk	FC13 Ross	FC14 Surface	FC11 Edward	FC12 Ross
1= 1 plant	18	39	27	27	32	34	29	43	23
2= <10 plants	47	115	85	71	64	72	68	78	60
3= 10-50 plants	67	63	67	76	52	77	63	82	89
4= 50-100 plants	20	11	23	21	23	17	15	19	21
5= >100 plants	4	7	5	6	4	1	6	8	2

Figure 2a. Number of plants per frequency group for each of the 2003 FORESTCHECK grids (30 m x 30 m plots).

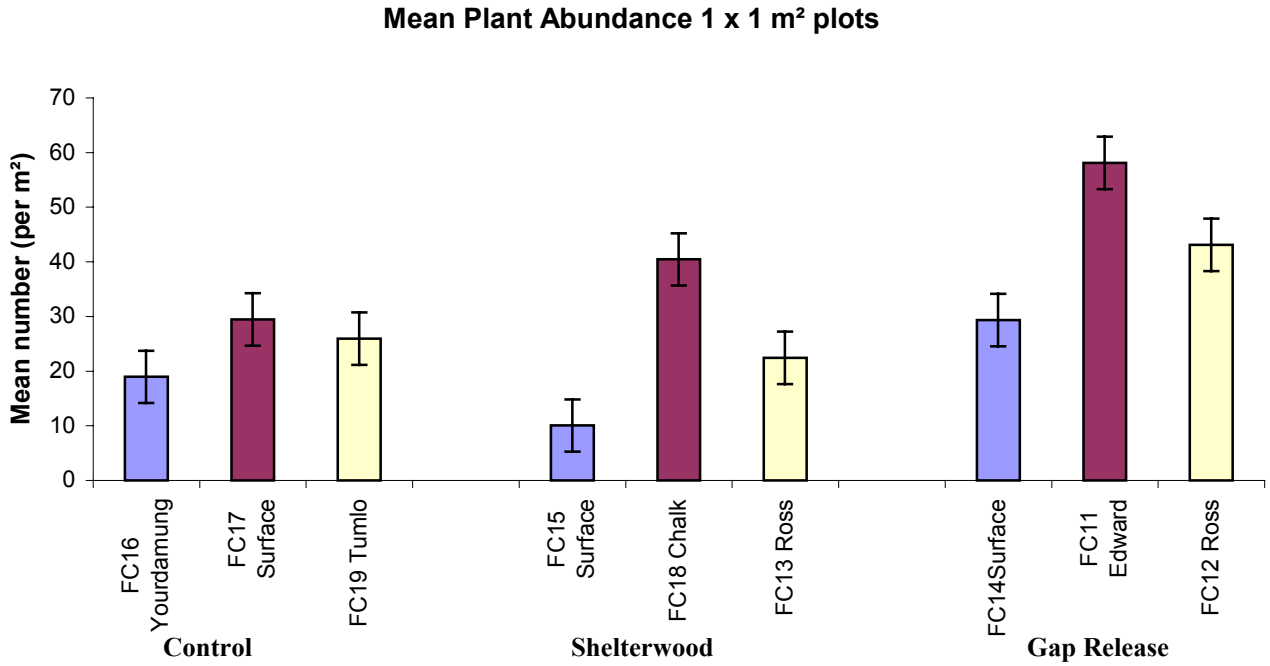


Figure 2b. Mean abundance for each grid in the 2003 FORESTCHECK grids.

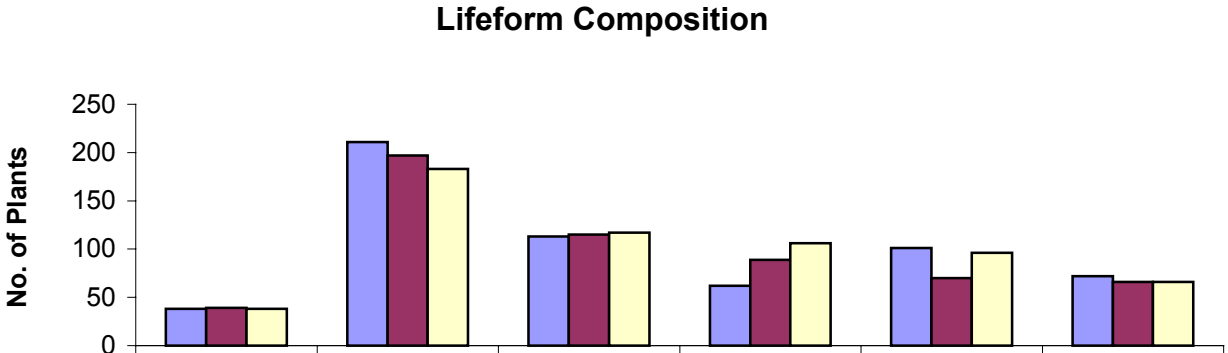
There were 86 species common to all grids in the 2003 FORESTCHECK sites and another 23 species were unique to the Controls and not found in either Shelterwood or Gap Release treatments. 12 were unique to Shelterwood and 22 to Gap Release. There were a further:

13 species found in Control and Gap Release and not in Shelterwood.
11 in Control and Shelterwood but not in Gap Release.
14 in Shelterwood and Gap Release but not Controls.

Combined, these make up the 181 species recorded for the FORESTCHECK sites for 2003.

Lifeform Fire Response
40% of species seeders
60% rootstock

Lifeform composition is generally consistent within each treatment and suggests that there have not been any serious impacts due to logging (Figure 3).



	Tree	Shrub > 30 cm	Shrub < 30 cm	Herb	Geophyte	Other Lifeform
Control	38	211	113	62	101	72
Shelter	39	197	115	89	70	66
Gap	38	183	117	106	96	66

Figure 3. Lifeform composition for each of the logging treatments in 2003 FORESTCHECK sites.

Vegetation heights appear to be affected by time since fire and dominant species type. In Control plots for example, the middle plot is 5 yrs since fire while the other 2 are 7 and 8 yrs (Figure 4).

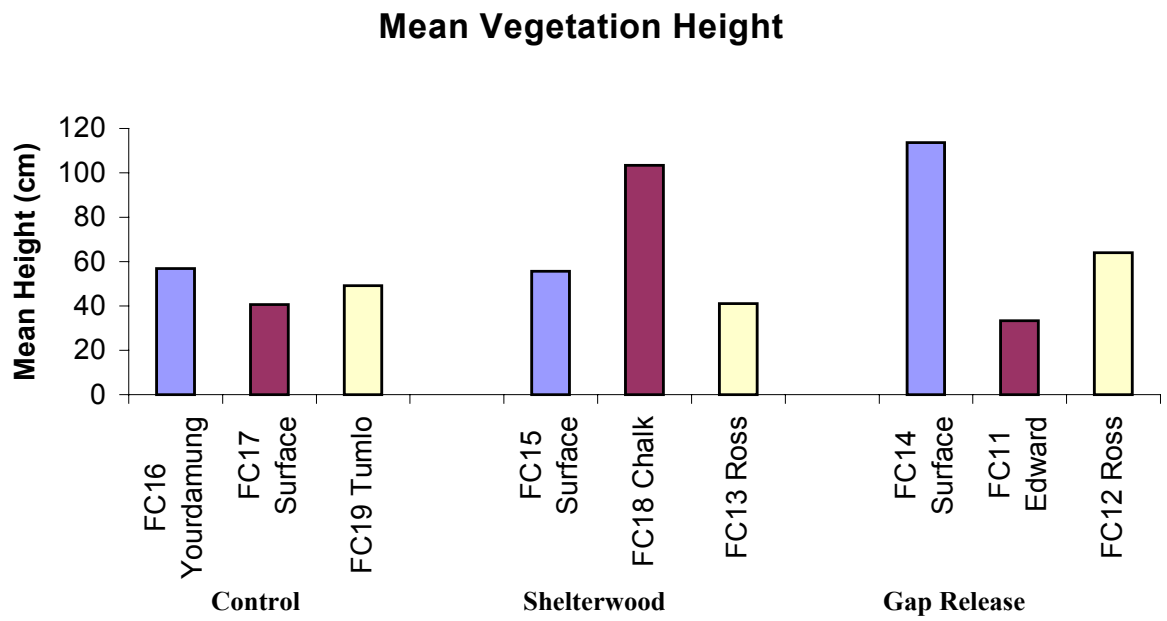


Figure 4. Comparison of vegetation height for logging treatments in the Wellington plots.

The Control plots have separated into two tiers of vegetation, with one layer at 30 cm and another layer at 70 cm. Treatment plots have one layer < 0.5 m height (Figure 5).

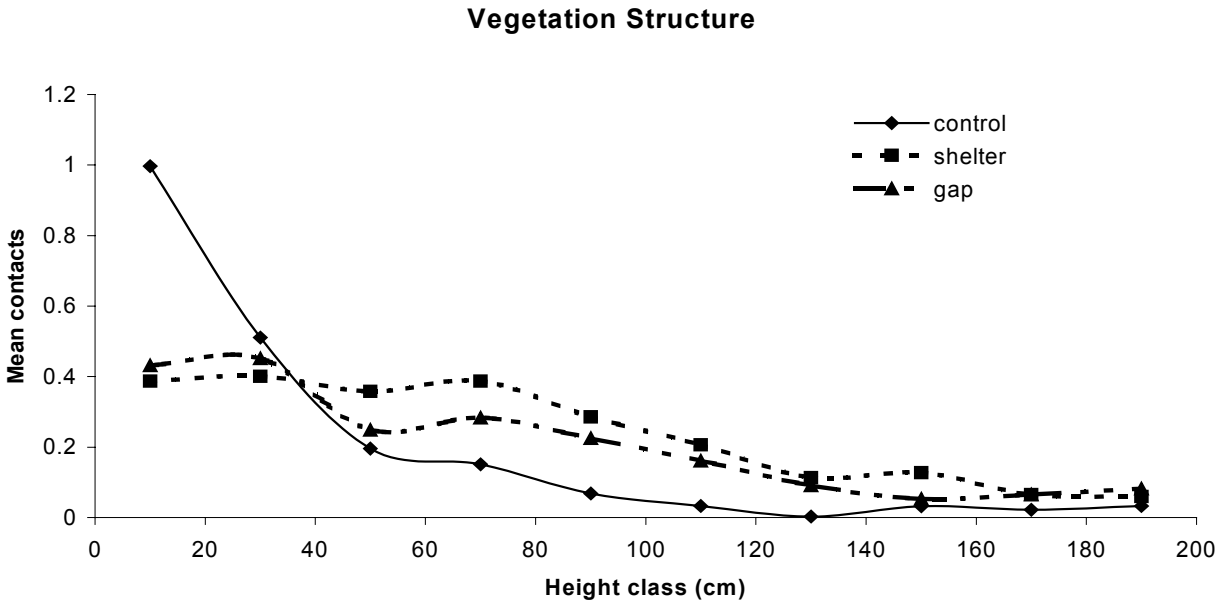


Figure 5. Vegetation structure determined from mean numbers of Levy contacts for height classes up to 2 m.

The recovery of the overstorey canopy has been rapid with treated plots having two thirds of the cover of unlogged sites. The exception is the 1992 gap, which appears to be affected by site (Figure 6).

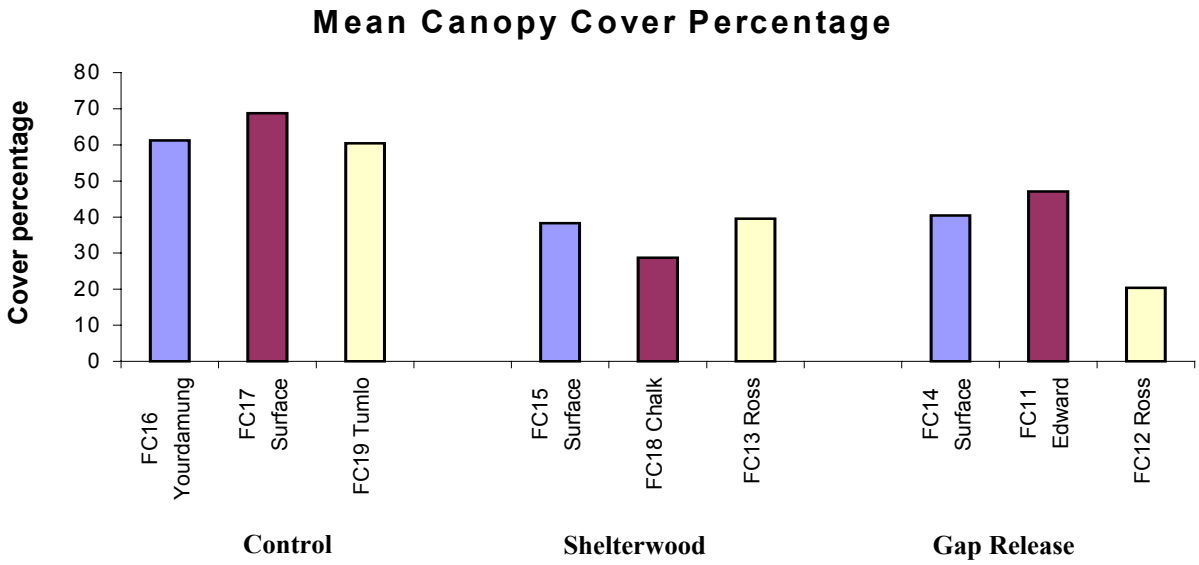


Figure 6. Mean canopy heights for all plots.

Outcomes

1. There is no significant difference in species richness and plant abundance between treatments for the 2003 measurements.
2. A major difference between the 2002 measurements at the Donnelly sites and the 2003 measurements at the Wellington sites is that plant abundance has been affected at the Donnelly sites and is most likely the result of the type of logging machinery used.

Future Tasks

- Prepare and measure the next site for FORESTCHECK monitoring.
- Track any occurrence of priority species that may be present on monitoring sites (none located in current plots).
- Collect voucher specimens.

Operating Plan Revision

There is no need for any major revision to the Operating Plan.

Appendix 1. Total species list 2003 sampling.

Alien	Taxon Name	Taxon ID	SpCode	Life Form	Fire Response	Lifestyle
	Acacia browniana	3247	ACABRO	S	A1	P
	Acacia celastrifolia	3254	ACACEL	S	A1	P
	Acacia drummondii	3311	ACADRU	S	A1	P
	Acacia drummondii subsp. drummondii	11661	ACADRU	S	A1	P
	Acacia extensa	3331	ACAEXT	S	A1	P
	Acacia preissiana	3496	ACAPRE	DS	A1	P
	Acacia pulchella	3502	ACAPUL	S	A1	P
	Acacia pulchella var. pulchella	15483	ACAPUL	S	A1	P
	Acacia urophylla	3591	ACAURO	S	A1	P
	Agrostocrinum scabrum	1261	AGRSCA	G	B3	P
*	Aira cupaniana	185	AIRCUP	GR	A1	A
	Allocasuarina fraseriana	1728	ALLFRA	T	B2	P
	Amphipogon amphipogonoides	194	AMPAMP	DS	B2	P
*	Anagallis arvensis var. caerulea	19405	ANAARV	H	A1	A
	Astroloma ciliatum	6323	ASTCIL	DS	B2	P
	Astroloma drummondii	6325	ASTDRU	DS	B2	P
	Astroloma pallidum	6334	ASTPAL	DS	B2	P
	Austrodanthonia caespitose	17950	AUSCAE	GR	B3	P
	Austrostipa campylachne	17233	AUSCAM	GR	B3	P
	Banksia grandis	1819	BANGRA	T	A2	P
	Billardiera floribunda	3157	BILFLO	V	A1	P
	Billardiera variifolia	3165	BILVAR	V	A1	P
	Boronia crenulata	4413	BORCRE	DS	B2	P
	Bossiaea aquifolium subsp. aquifolium	14396	BOSAQU	S	A1	P
	Bossiaea ornata	3714	BOSORN	S	B2	P
	Brachyscome iberidifolia	7878	BRAIBE	H	A1	A
*	Briza minor	245	BRIMIN	GR	A1	A
	Burchardia umbellate	1387	BURUMB	G	B3	P
	Caesia micrantha	1276	CAEMIC	G	B3	P
	Caladenia flava	1592	CALFLA	G	B3	P
	Caladenia flava subsp. flava	15348	CALFLAF	G	B3	P
	Caladenia reptans	1613	CALREP	G	B3	P
	Caladenia reptans subsp. reptans	15377	CALREP	G	B3	P
	Caladenia sp.	-2	CALSP.	G	B3	P
	Cassytha racemosa	2957	CASRAC	P	A1	P
*	Centaurium erythraea	6539	CENERY	H	A1	A
	Centrolepis polygyna	1134	CENPOL	H	A1	A
	Chamaescilla corymbose	1280	CHACOR	G	B3	P
	Chorizema rhombeum	3761	CHORHO	DS	A1	P
	Clematis pubescens	2929	CLEPUB	V	A1	P
	Comesperma calymega	4550	COMCAL	DS	B2	P
	Comesperma confertum	4552	COMCON	S	A1	P
	Conospermum capitatum	1863	CONCAP	S	B2	P
	Conostylis serrulata	1453	CONSER	DS	B3	P
	Conostylis setigera	1454	CONSET	DS	B3	P
	Conostylis sp.		CONSP.	DS	B3	P
	Corymbia calophylla	17104	CORCAL	T	A2	P
	Crassula decumbens	3138	CRADEC	H	A1	A
	Craspedia variabilis	13354	CRAVAR	G	B3	P
	Cyanicula deformis	15405	CYADEF	G	B3	P
	Cyrtostylis huegelii	10916	CYRHUE	G	B2	P
	Cyrtostylis tenuissima	10942	CYRTEN	G	B3	P
	Dampiera linearis	7454	DAMLIN	DS	A1	P
	Daucus glochidiatus	6218	DAUGLO	H	A1	A
	Daviesia preissii	3835	DAVPRE	S	A1	P
	Desmocladus fasciculatus	17691	DESFAS	Z	B3	P

Alien	Taxon Name	Taxon ID	SpCode	Life Form	Fire Response	Lifestyle
	Dianella revolute	1259	DIAREV	H	B3	P
	Diuris laxiflora	1634	DIULAX	G	B3	P
	Diuris magnifica	12939	DIUMAG	G	B3	P
	Diuris sp.Arrowsmith(K.W.Dixon 924)	17815	DIUSP.	G	B3	P
	Drosera erythrorhiza	3095	DROERY	G	B3	P
	Drosera glanduligera	3098	DROGLA	H	A1	A
	Drosera menziesii subsp. menziesii	11853	DROMEN	G	B3	P
	Drosera pallida	3118	DROPAL	G	B3	P
	Drosera sp.		DROSP.	G	B3	P
	Drosera stolonifera	3131	DROSTO	G	B3	P
	Dryandra bipinnatifida	1891	DRYBIP	DS	B2	P
	Dryandra lindleyana	16672	DRYLIN	S	B2	P
	Dryandra sessilis	1932	DRYSES	S	A1	P
	Elythranthera brunonis	1643	ELYBRU	G	B3	P
	Eriochilus scaber	1647	ERISCA	G	B3	P
	Euchiton collinus	19088	EUCCOL	H	A1	A
	Eucalyptus marginata	5708	EUCMAR	T	A2	P
	Gompholobium ovatum	3953	GOMOVA	DS	A1	P
	Gompholobium tomentosum	3957	GOMTOM	DS	A1	P
	Haemodorum paniculatum	1470	HAEPAN	H	B3	P
	Hakea lissocarpha	2175	HAKLIS	S	B2	P
	Hemigenia rigida	6868	HEMRIG	DS	A1	P
	Hibbertia amplexicaulis	5109	HIBAMP	S	B2	P
	Hibbertia commutata	5114	HIBCOM	S	B2	P
	Hibbertia hypericoides	5135	HIBHYP	S	B2	P
	Hibbertia spicata	5171	HIBSPI	S	B2	P
	Hovea chorizemifolia	3964	HOVCHO	DS	B2	P
	Hyalosperma cotula	12741	HYACOT	H	A1	A
	Hyalosperma demissum	12742	HYADEM	H	A1	A
	Hibbertia hypericoides	5135	HIBHYP	S	B2	P
	Hydrocotyle callicarpa	6226	HYDCAL	H	A1	A
	Hydrocotyle sp.		HYDSP.	H	A1	A
	Hypocalymma angustifolium	5817	HYPANG	S	B2	P
*	Hypochaeris glabra	8086	HYPGLA	H	A1	A
	Hypoxis occidentalis	1503	HYPOCC	DS	B3	P
	Isopogon cuneatus	2226	ISOCUN	S	A1	P
	Isotoma hypocrateriformis	7396	ISOHYP	H	A1	A
	Kennedia coccinea	4037	KENCOC	V	A1	P
	Kennedia prostrata	4044	KENPRO	V	A1	P
	Kunzea glabrescens	15498	KUNGLA	S	A1	P
	Labichea punctata	3669	LABPUN	DS	B2	P
	Lagenophora huegelii	18585	LAGHUE	G	B3	P
	Lasiopetalum floribundum	5033	LASFLO	S	A1	P
	Lechenaultia biloba	7568	LECBIL	S	A1	P
	Leptomeria cunninghamii	2342	LEPCUN	S	A1	P
	Lepidosperma leptostachyum	936	LEPLEP	Z	B3	P
	Lepidosperma squamatum	945	LEPSQU	Z	B3	P
	Leucopogon australis	6360	LEUAUS	S	B2	P
	Leucopogon capitellatus	6367	LEUCAP	S	B2	P
	Leucopogon propinquus	6436	LEUPRO	S	B2	P
	Leucopogon verticillatus	6454	LEUVER	S	B2	P
	Levenhookia pusilla	7676	LEVPUS	H	A1	A
	Logania serpyllifolia	6511	LOGSER	DS	B2	P
	Lomandra caespitosa	1223	LOMCAE	DS	B3	P
	Lomandra drummondii	1225	LOMDRU	DS	B3	P
	Lomandra integra	1229	LOMINT	DS	B3	P
	Lomandra purpurea	1240	LOMPUR	DS	B3	P
	Lomandra suaveolens	1246	LOMSUA	DS	B2	P

Alien	Taxon Name	Taxon ID	SpCode	Life Form	Fire Response	Lifestyle
	Lomandra sericea	1243	LOMSER	DS	B3	P
	Lomandra sp.		LOMSP.	DS	B2	P
	Luzula meridionalis	1198	LUZMER	R	B2	P
	Macrozamia riedlei	85	MACRIE	C	B2	P
	Melaleuca thymoides	5980	MELTHY	S	B2	P
	Millotia tenuifolia	8106	MILTEN	H	A1	A
	Monotaxis occidentalis	4666	MONOCC	DS	A1	P
	Neurachne alopecuroidea	492	NEUALO	GR	B3	P
	Olax benthamiana	2365	OLABEN	DS	A1	P
	Oligochaetochilus vittatus	19804	OLIVIT	G	B3	P
	Opercularia hispidula	7348	OPEHIS	S	B2	P
*	Oxalis corniculata	4349	OXACOR	G	B3	P
	Patersonia babianoides	1542	PATBAB	G	B3	P
	Patersonia occidentalis	1550	PATOCC	DS	B3	P
	Patersonia pygmaea	1551	PATPYG	DS	B3	P
	Pelargonium littorale	4346	PELLIT	DS	A1	P
	Pentapeltis peltigera	6245	PENPEL	DS	B2	P
	Pentapeltis silvatica	6246	PENSIL	S	B2	P
	Persoonia longifolia	2267	PERLON	S	B2	P
	Phyllanthus calycinus	4675	PHYCAL	DS	B2	P
	Phyllangium paradoxum	16177	PHYPAR	H	A1	A
	Pimelea rosea	5261	PIMROS	S	A1	P
	Pimelea spectabilis	5264	PIMSPE	S	A1	P
	Pimelea suaveolens	5266	PIMSUA	S	B2	P
	Pimelea sylvestris	5269	PIMSYL	S	A1	P
	Podolepis canescens	8172	PODCAN	H	A1	A
	Podotheca gnaphalioides	8184	PODGNA	H	A1	A
	Poranthera microphylla	4691	PORMIC	DS	A1	A
*	Pseudognaphalium luteoalbum	8189	PSELUT	H	A1	A
	Pteridium esculentum	57	PTEESC	F	B2	P
	Pterostylis pyramidalis	11118	PTEPYR	G	B3	P
	Pterostylis recurva	1693	PTEREC	G	B3	P
	Ptilotus drummondii	2718	PTIDRU	G	A1	P
	Ptilotus manglesii	2742	PTIMAN	DS	B3	P
	Ptilotus stipitatus	2762	PTISTI	G	B3	P
	Pyrorchis nigricans	16367	PYRNIG	DS	B3	P
	Rhodanthe citrina	13300	RHOCIT	G	A1	P
	Scaevola calliptera	7602	SCACAL	H	A1	P
	Scaevola striata	7646	SCASTR	DS	A1	A
	Senecio hispidulus	8208	SENHIS	DS	A1	P
	Senecio lautus	8211	SENLAU	S	A1	A
	Senecio leucoglossus	8212	SENLEU	S	A1	A
*	Silene gallica	2909	SILGAL	H	A1	A
*	Sonchus asper	8230	SONASP	H	A1	A
*	Sonchus oleraceus	8231	SONOLE	H	A1	A
	Lomandra sonderi	1244	LOMSON	S	B2	P
	Sowerbaea laxiflora	1312	SOWLAX	G	B3	P
	Sphaerollobium sp.	-33	SPHSP.	S	B2	P
	Stackhousia monogyna	4733	STAMON	S	B2	P
	Stylidium amoenum	7684	STYAMO	DS	A1	P
	Stylidium calcaratum	7696	STYCAL	H	A1	A
	Stylidium ciliatum	7702	STYCIL	DS	A1	P

Alien	Taxon Name	Taxon ID	SpCode	Life Form	Fire Response	Lifestyle
	Stylidium schoenoides	7798	STYSCH	DS	A1	P
	Styphelia tenuiflora	6476	STYTEN	S	A1	P
	Synaphea petiolaris	2324	SYNPET	DS	B2	P
	Tetraria capillaris	1034	TETCAP	S	B3	P
	Tetratheca hirsuta	4535	TETHIR	S	A1	P
	Tetratheca hispidissima	4536	TETHIS	S	A1	P
	Tetrarrhena laevis	667	TETLAE	GR	B3	P
	Tetraria octandra	1036	TETOCT	Z	A1	P
	Thelymitra crinita	1705	THECRI	G	B3	P
	Thelymitra sp.		THESP.	G	B3	P
	Thysanotus manglesianus	1338	THYMAN	G	B3	P
	Thysanotus multiflorus	1339	THYMUL	G	B3	P
	Thysanotus patersonii	1343	THYPAT	G	B3	P
	Thysanotus sp.		THYSP.	G	B3	P
	Thysanotus tenellus	1354	THYTEN	H	B3	P
	Trachymene pilosa	6280	TRAPIL	H	A1	A
	Tricoryne elatior	1361	TRIELA	H	B3	P
	Trichocline spathulata	8251	TRISPA	G	B3	P
	Trymalium ledifolium	4842	TRYLED	S	A1	P
	Xanthosia atkinsoniana	6283	XANATK	S	B2	P
	Xanthosia candida	6284	XANCAN	DS	B2	P
	Xanthorrhoea gracilis	1253	XANGRA	X	B2	P
	Xanthosia huegelii	6289	XANHUE	DS	A1	P
	Xanthorrhoea preissii	1256	XANPRE	X	B2	P

INVERTEBRATES

Janet Farr, Allan Wills and Tom Burbidge

Introduction

Sampling at Wellington District was performed using the protocol previously established for Donnelly District. To briefly summarize: active capture samples, involving sweeping, beating, and habitat searches of coarse woody debris (CWD) and litter were conducted once at each site for a total time of 1 person hour per capture/habitat method. Light traps were run for 3 nights simultaneously at each site, achieving one trap night per week for 3 weeks; pitfall traps were opened for 10 days simultaneously at each site. Captures were bagged and labelled according to site and other capture details in the field, then transported in an insulated container to a base camp were they were stored in a portable freezer. At the conclusion of a sampling period, specimens were then transported to the laboratory in Donnelly where they were sorted and morphospecies assigned. This report examines invertebrate captures made in Wellington District and includes some comparison with the Donnelly samples collected in the first round of FORESTCHECK.

Results

The Wellington samples increased the number of morphospecies to 795 (Appendix 1). In total 381 morphospecies were collected from Wellington, compared to 587 from Donnelly District (Appendix II). Of those collected in Wellington, 20 species had Gondwanan affinities and 10 were considered Gondwanan relicts, compared to 32 and 25 respectively for Donnelly. The numbers of morphospecies for orders where 10 or more morphospecies have been assigned are compared for Donnelly and Wellington Districts in Figure 1.

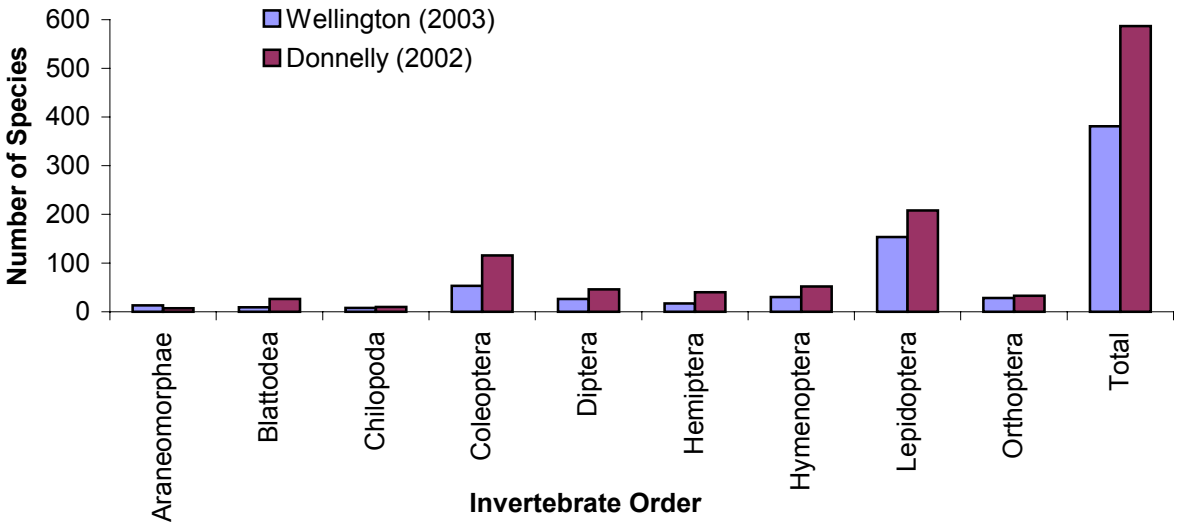


Figure 1. Comparison of Wellington and Donnelly District morphospecies numbers for orders where 10 or more morphospecies have been assigned.

Comparing capture methods

Light trapping resulted in the most abundant and diverse captures (Table 1) with a spring capture of 116 morphospecies comprising 1075 individuals. Autumn captures for Wellington are comparable to spring in the light trap captures and indicate a higher level of abundance. Spring and autumn litter captures are also comparable. For the other capture methods, spring is the most diverse season.

Table 1. Number of morphospecies and specimen abundance for Wellington District in spring and autumn for each capture method (CWD = coarse woody debris search).

	No. Morphospecies		Abundance	
Capture Method	**Spring**	**Autumn**	**Spring**	**Autumn**
Light	116	106	1075	1239
Pitfall	69	32	272	120
Sweep	44	12	77	20
Beat	36	14	86	38
CWD	15	8	53	16
Litter	21	24	45	31

Figures 2 and 3 show morphospecies comparisons for capture methods for both Wellington and Donnelly Districts. Abundance comparisons are shown in Appendix III (discrepancies in Donnelly data from the FORESTCHECK 2002 report are due to missing data now being included). With the exception of autumn litter and beat captures where morphospecies numbers are comparable, Donnelly sites were the most species diverse (Figures 2 and 3). For abundance (Appendix III), again the number of individuals captured was greater in Donnelly, with the exception of coarse woody debris in spring, and litter captures in autumn. Light trap captures (abundance) are also similar for Wellington and Donnelly Districts in autumn.

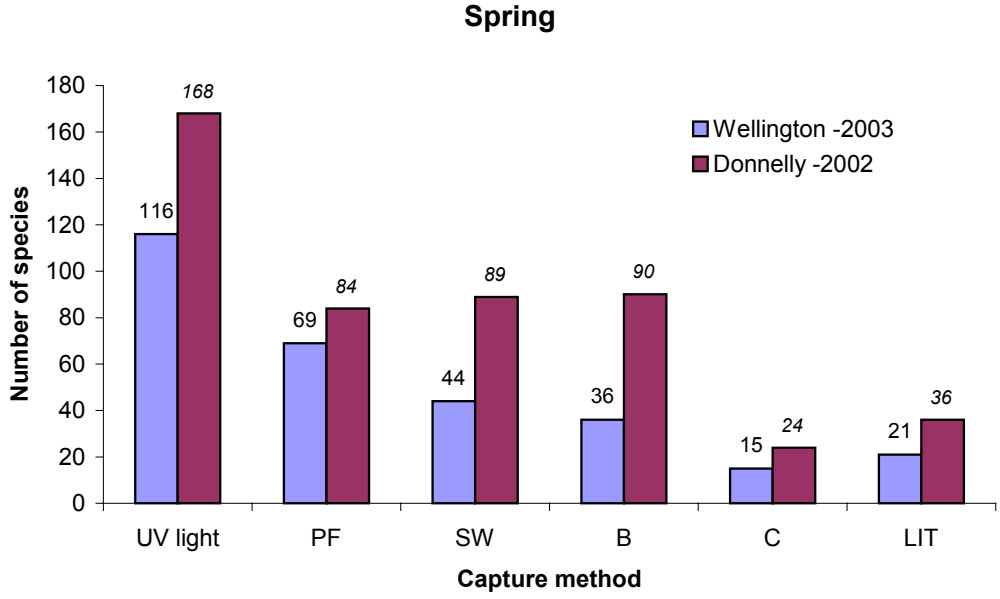


Figure 2. The number of morphospecies in spring for each capture method, Wellington and Donnelly Districts compared. (PF= pitfall trap; SW = sweep net; B = beating tray; C = coarse woody debris search; LIT = litter search)

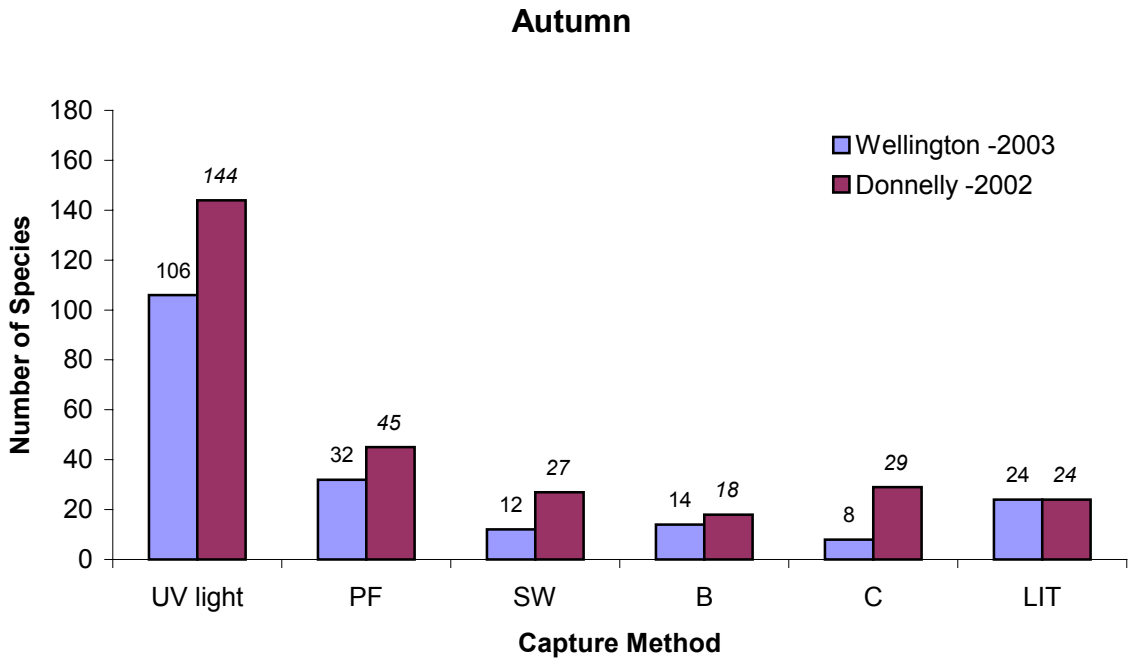


Figure 3. The number of morphospecies in autumn for each capture method, Wellington and Donnelly Districts compared. (PF= pitfall trap; SW = sweep net; B = beating tray; C = coarse woody debris search; LIT = litter search)

Comparing silvicultural treatments

Figure 4 shows Wellington grid comparisons for silvicultural treatments expressed as the total morphospecies and abundance for all capture methods and summed for spring and summer seasons. The Gap Release treatment site of Ross (FC12) had the greatest number of species (130). The Control treatment at Surface (FC17) also contained a similar species diversity (129), but the most species poor site was also a Control treatment, Yourdamung (FC16) where only 85 species were captured. The greatest number of individuals (463) were captured at the Edward Gap Release site (FC11), whilst the least abundance (276) was found at the Control treatment Yourdamung. Appendix IV shows the number of morphospecies and abundance (number of individuals captured at each grid) for active (beat, sweep, coarse woody debris and litter searches), light and pitfall trap capture techniques in spring and autumn.

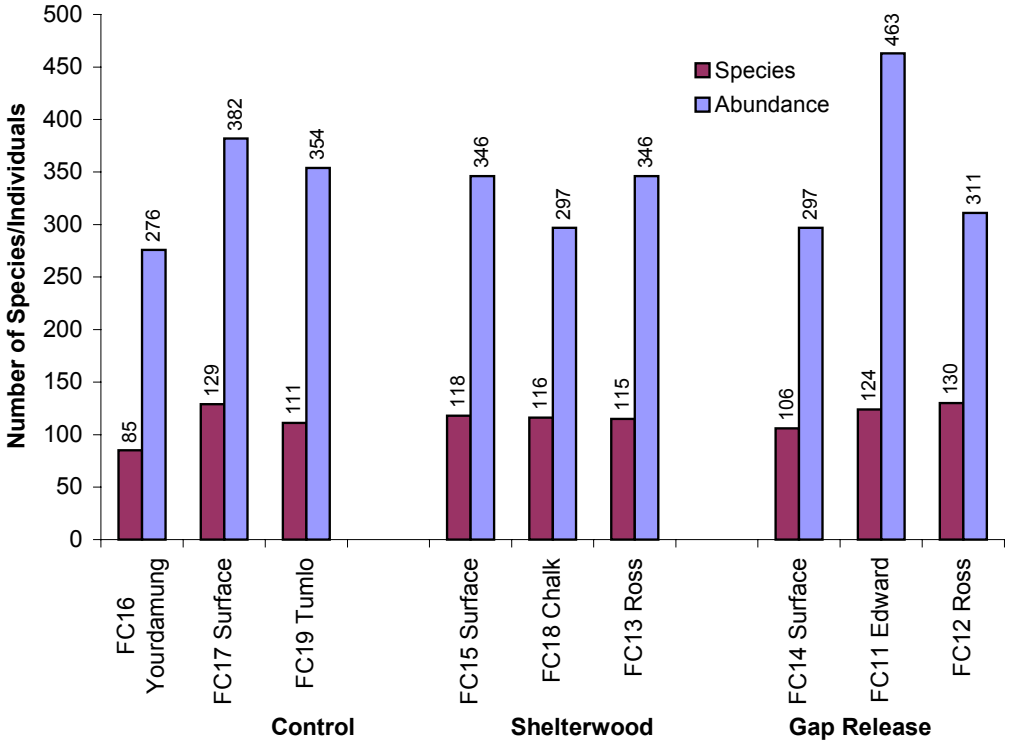
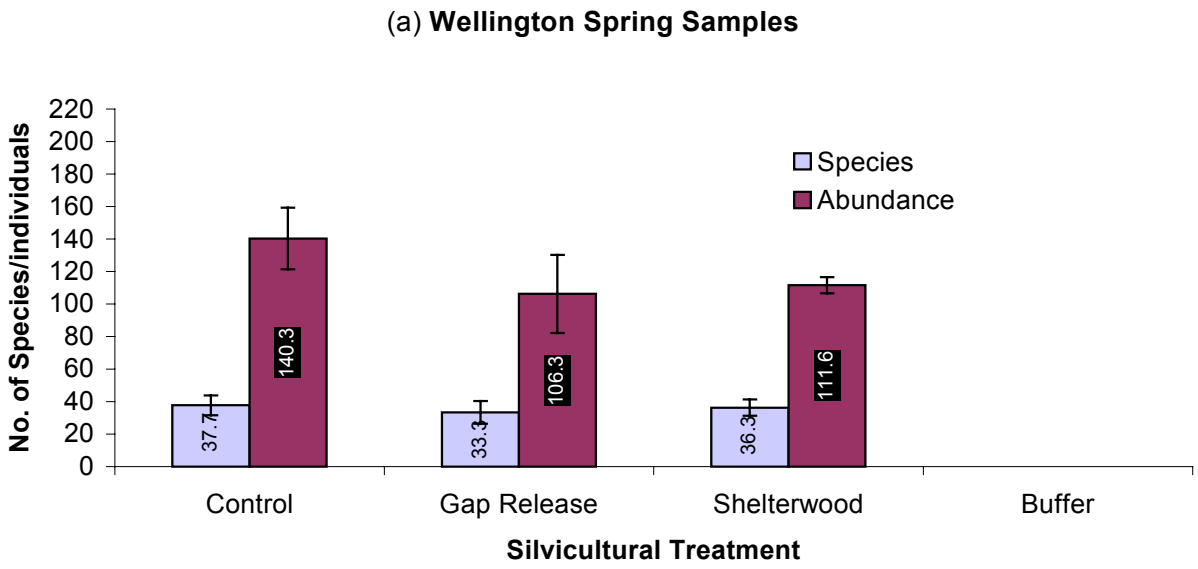


Figure 4. Comparison of individual Wellington treatment grids for total morphospecies and abundance, for all capture methods, summed for both seasons.

Figure 5 shows comparisons for silvicultural treatments for light trap captures between Wellington and Donnelly in spring (graphs for autumn are available in Appendix V). For Wellington morphospecies numbers vary little between grid treatments, while capture abundances are slightly higher in the Control treatment. For Donnelly, again there is little variation between treatments for morphospecies (the Shelterwood site is one value only, therefore comparisons with this value are unreliable).



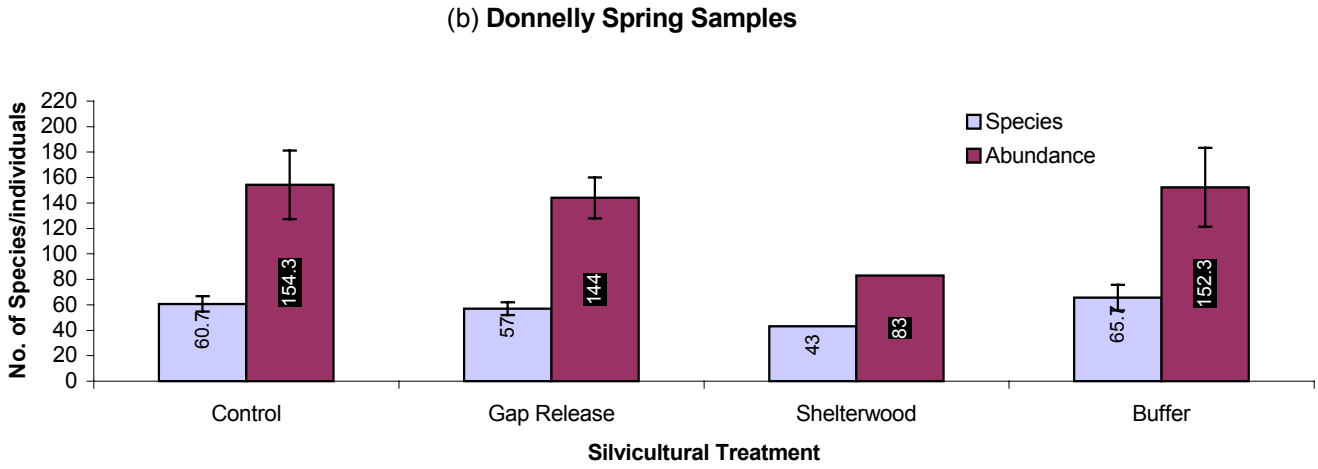


Figure 5. Mean (n = 3, ± SE) spring light trap captures against treatment grids for Wellington (a) and Donnelly (b). (number of morphospecies = number of species, number of individuals = abundance).

Figure 6 shows combined coarse woody debris and litter captures only against silvicultural treatment and indicates there may be an association with the amount of coarse woody debris measured for each site (see R Robinson *et al.* for graph for coarse woody debris volume for each site. p. 40). This is particularly apparent in the Gap Release sites (FC11, FC14, FC12) and Shelterwood sites (FC13, FC15, FC18)

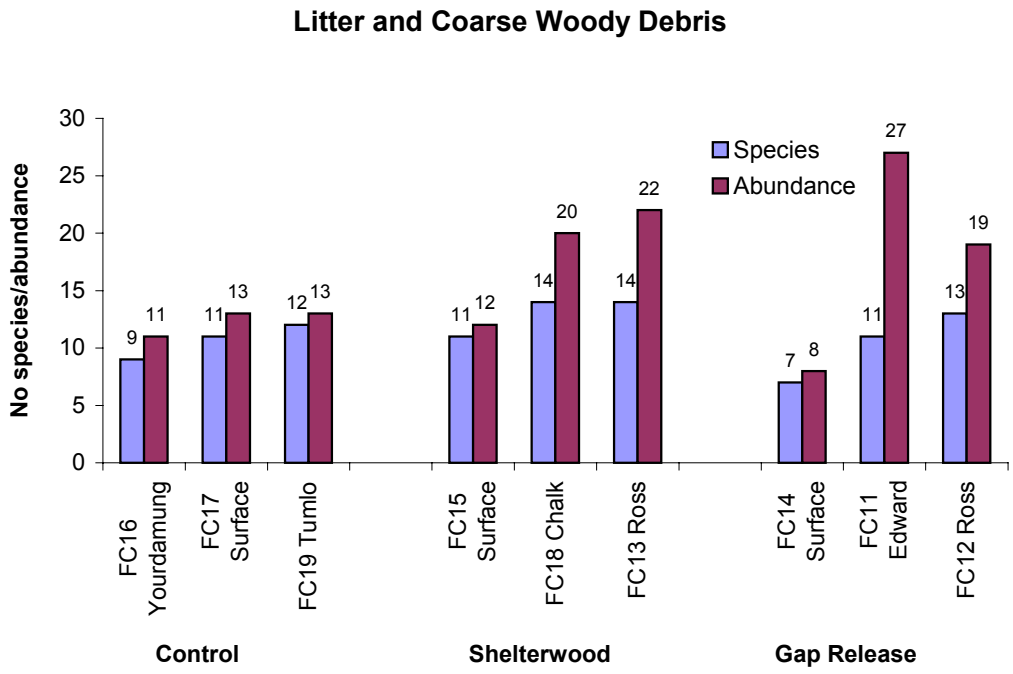


Figure 6. Number of species and abundance for coarse woody debris and litter captures.

Species differences

Table 2 shows the 10 most frequent species captured for Wellington and Donnelly. Trichopteran 145 was the most common species collected in Wellington and also features in the 10 most common species captured in Donnelly.

Table 2. Ten most frequent species captured for Wellington and Donnelly (Cap freq is the number of times a specimen is collected and is not to be confused with abundance levels which refer to the total number of specimens collected; Wellington capture frequency ranks > 19 indicates single specimen only found in Wellington; frequency rank = 0 indicates no specimen captured in Wellington. Well = Wellington).

Sample Site	Species no	Cap Freq	Well Capture freq rank	Order	Family	Genus
Wellington	145	26	1	Trichoptera		
	11	20	2	Lepidoptera	Thaumetopoeidae	Ochrogaster
	1	19	3	Lepidoptera	Carthaeidae	Carthaea
	16	19	3	Diptera	Tipulidae	
	423	19	3	Hymenoptera	Formicidae	Iridomyrex
	39	18	4	Lepidoptera	Noctuidae	
	52	18	4	Hymenoptera	Apidae	Apis (honey bee)
	374	18	4	Lepidoptera	Notodontidae	
	326	18	4	Lepidoptera	Geometridae	
	630	17	5	Lepidoptera	Geometridae	
Donnelly	52	64	4	Hymenoptera	Apidae	Apis (honey bee)
	6	54	0	Lepidoptera	Arctiidae	
	235	45	15	Orthoptera	Acrididae	
	373	28	> 19	Lepidoptera	Hepialidae	Abantiades
	39	28	4	Lepidoptera	Noctuidae	
	145	26	1	Trichoptera		
	18	26	8	Lepidoptera	Noctuidae	Agrotis
	376	26	> 19	Lepidoptera		
	423	24	3	Hymenoptera	Formicidae	Iridomyrex
	16	23	3	Diptera	Tipulidae	

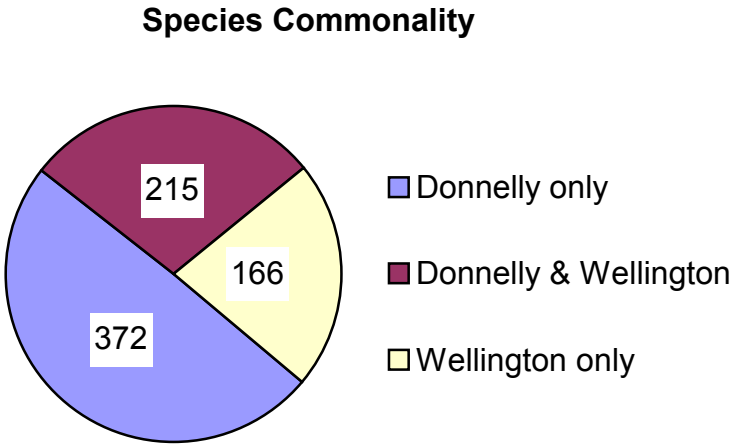


Figure 7. Number of species common and exclusive to Wellington and Donnelly.

There were 372 morphospecies common to both Wellington and Donnelly (Figure 7). For each study site there were 166 morphospecies exclusive to Wellington and 215 exclusive to Donnelly.

Pest presence

The forest pest Jarrah leafminer was present and abundant at all grid locations (Table 3). Gumleaf skeletonizer was observed at Ross Gap Release (FC12) and Chalk Shelterwood (FC18). Bullseye borer was present at all sites except Edward Gap Release (FC11) and Surface Control (FC17).

Table 3. Pest presence and abundance assessment at each site (JLM = Jarrah leafminer; GLS = Gumleaf skeletonizer; BEB = Bullseye borer; 0 = absent, 1 = present, 2 = abundant).

Site No	Location	Treatment	JLM	GLS	BEB
FC16	Yourdamung	Control	2	0	1
FC17	Surface	Control	2	0	0
FC19	Tumlo	Control	2	0	1
FC15	Surface	Shelterwood	2	0	1
FC18	Chalk	Shelterwood	2	1	1
FC13	Ross	Shelterwood	2	0	1
FC14	Surface	Gap Release	2	0	1
FC11	Edward	Gap Release	2	0	0
FC12	Ross	Gap Release	2	1	1

Appendix I. Morphospecies list for FORESTCHECK invertebrates.

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
1	Lepidoptera	Carthaeidae		Carthaea	saturnioides	K
2	Lepidoptera	Geometridae	Oenochrominae	Arhodia	sp	K
3	Lepidoptera	Thaumetopoeidae		Epicoma	melanosticta	K
4	Lepidoptera	Notodontidae		Destolmia	lineata	K
5	Lepidoptera					
6	Lepidoptera	Arctiidae				K
7	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 1	K
8	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 2	K
9	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 3	K
10	Lepidoptera	Thaumetopoeidae		Ochrogaster	lunifer	K
11	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 4	K
12	Lepidoptera	Geometridae				K
13	Coleoptera	Dytiscidae				
14	Coleoptera	Hydrophilidae				
15	Coleoptera	Elateridae				
16	Diptera	Tipulidae				K
17	Coleoptera	Scarabeidae		Onthophagus	ferox	K
18	Lepidoptera	Noctuidae		Agrotis	munda	K
19	Lepidoptera	Geometridae		Chlorocoma	dicloraria	K
20	Lepidoptera					
21	Lepidoptera					
22	Lepidoptera	Geometridae		Chlorocoma	sp	K
23	Lepidoptera	Geometridae				K
24	Lepidoptera	Geometridae				K
25	Lepidoptera					
26	Coleoptera	Elateridae				
27	Blattodea	Blaberidae		Cololampra	sp	K
28	Coleoptera	Melolonthinae		Heteronyx	sp 1	
29	Coleoptera	Melolonthinae		Heteronyx	sp 2	
30	Lepidoptera	Noctuidae		Dasypodia	selenophora	
31	Lepidoptera	Geometridae		Parepisparis	excusata	K
32	Lepidoptera	Thaumetopoeidae				K
33	Lepidoptera					
34	Lepidoptera	Lymantriidae		Teia	athlophora	K
35	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 5	K
36	Lepidoptera	Thaumetopoeidae		Ochrogaster	sp 6	K
37	Lepidoptera					K
38	Lepidoptera					
39	Lepidoptera	Noctuidae				K
40	Lepidoptera	Noctuidae		Persectania	sp	K
41	Lepidoptera	Geometridae				K
42	Lepidoptera	Geometridae		Gastrina	cristaria	K
43	Lepidoptera	Pyralidae ?				K
45	Lepidoptera	Zygaenidae		Pollanisus	viridipulverulenta	K
46	Lepidoptera	Geometridae				
47	Lepidoptera	Geometridae				
48	Lepidoptera					
49	Hemiptera	Cicadidae		Cicadetta	sp	
50	Lepidoptera	Geometridae				K
51	Diptera	Muscoidea				
52	Hymenoptera	Apidae		Apis	melifera	K
53	Diptera	Calliphoridae		Calliphora		
54	Diptera	Syrphidae				
55	Coleoptera	Dytiscidae				
56	Coleoptera	Chrysomelidae				

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
57	Lepidoptera	Notodontidae		Danima	banksiae	K
58	Lepidoptera	Notodontidae				K
59	Lepidoptera	Geometridae				K
60	Lepidoptera					
61	Lepidoptera					
62	Lepidoptera					K
63	Lepidoptera					
64	Lepidoptera	Oecophoridae				K
65	Lepidoptera					
66	Lepidoptera	Geometridae				
67	Lepidoptera					
68	Diptera	?				
69	Trichoptera					GR
70	Coleoptera	Melolonthinae		Heteronyx	sp 3	
71	Lepidoptera					
72	Lepidoptera	Geometridae				
73	Lepidoptera					
74	Lepidoptera	Noctuidae				
75	Lepidoptera	Noctuidae				
76	Lepidoptera					
77	Lepidoptera					
78	Lepidoptera	Zygaenidae		Pollanisus	viridipulverulenta	K
79	Lepidoptera	Geometridae	Oenochrominae	Arhodia	sp	K
80	Lepidoptera					K
81	Lepidoptera	Limacodidae		Doratifera	sp	K
82	Lepidoptera	Geometridae				
83	Lepidoptera	Geometridae				
84	Lepidoptera	Pyralidae		Uresiphita	ornithopteralis	K
85	Lepidoptera	Geometridae				
86	Lepidoptera	Geometridae				
87	Hymenoptera	Ichneumonidae		Ophion	sp	GA
88	Diptera	Pyrgotidae				K
89	Mecoptera	Meropeidae		Austromerope	poultoni	GR
90	Lepidoptera	Limacodidae				K
91	Lepidoptera	Anthelidae		Chenuala	sp	K
92	Lepidoptera	Tortricidae ?				
93	Coleoptera	Carabidae				
94	Coleoptera	Melolonthinae		Heteronyx	sp 4	
95	Lepidoptera	Geometridae				
96	Lepidoptera	Geometridae				
97	Lepidoptera	Geometridae				
98	Coleoptera	Curculionidae	Gonipterinae	Oxyops	sp	
99	Coleoptera	Lycidae		Metriorrhynchus	sp	K
100	Coleoptera	Curculionoidea	Belidae			GR
101	Coleoptera	Chrysomelidae				
102	Coleoptera	Curculionidae				
103	Coleoptera	Curculionidae				
104	Lepidoptera					
105	Hemiptera	Pentatomidae				K
106	Orthoptera	Tettigoniidae				K
107	Hemiptera					
108	Hemiptera	Membracidae				K
109	Hemiptera					
110	Hemiptera					
111	Lepidoptera					
112	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
113	Coleoptera	Curculionidae				

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
114	Coleoptera	Curculionidae				
115	Coleoptera	Chrysomelidae				
116	Coleoptera	?				
117	Hemiptera	Pentatomidae				
118	Orthoptera	Tettigoniidae				
119	Blattodea	Blaberidae		Calolampra	sp 1	K
120	Blattodea	Blatellidae		Neotemnopteryx	sp	K
121	Blattodea	Blatellidae		Platyzosteria	sp 1	K
122	Blattodea	Blatellidae		Platyzosteria	sp 2	K
123	Dermaptera					K
124	Coleoptera	Curculionidae	Gonipterinae			
125	Diptera	Drosophilidae				
126	Diptera	Tabanidae				
127	Diptera	?				
128	Diptera	Muscoidea				
129	Diptera	Syrphidae				
130	Diptera	Syrphidae				
131	Neuroptera	Hemerobeidae				GR
132	Mantodea					
133	Lepidoptera	Noctuidae				
134	Diptera	Muscoidea				
135	Coleoptera	Elateridae				
136	Diptera	Tachinidae				K
137	Lepidoptera	Noctuidae				
138	Lepidoptera					
139	Lepidoptera	Noctuidae				
140	Lepidoptera	Noctuidae				
141	Lepidoptera	Tineidae		Moerarchis	australasiella	K
142	Diptera	Therevidae				K
143	Diptera	Syrphidae				
144	Trichoptera					GR
145	Trichoptera					GR
145	Trichoptera					GR
147	Blattodea	Blaberidae		Calolampra	sp 2	
148	Blattodea	Blaberidae				
149	Orthoptera	Tettigoniidae				K
150	Hemiptera	Reduvidae				K
151	Trichoptera					GR
153	Hemiptera	Pentatomidae				
154	Coleoptera	Melolonthinae		Liparetrus	sp	
155	Coleoptera	Chrysomelidae				
156	Coleoptera	Curculionidae				
157	Coleoptera	Curculionidae	Rhadinosominae	Rhadinosomus	sp	K
158	Coleoptera	?				
159	Coleoptera	?				
160	Coleoptera	Curculionidae	Gonipterinae	Gonipterus	sp	
161	Coleoptera	Curculionidae	Gonipterinae	Oxyops	fasciata	K
162	Coleoptera	Scarabaeidae	Melolonthinae	Liparetrus	jenkinsi	
163	Hemiptera	Reduviidae				
164	Hemiptera					
165	Diptera	Asilidae				GA
166	Hemiptera					
167	Orthoptera	Tettigoniidae				
168	Coleoptera	Belidae		Belus	suturalis	GR
169	Coleoptera	Curculionidae				
170	Hemiptera					
171	Coleoptera	Scarabaeidae	Melolonthinae	Liparetrus	sp	

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
172	Coleoptera	Scarabaeidae	Melolonthinae	Heteronyx	sp	
173	Coleoptera	?				
174	Orthoptera					
175	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta		
176	Hemiptera	Pentatomidae				
177	Hemiptera					
178	Diptera	Tabanidae				GA
179	Diptera	Drosophilidae				
180	Orthoptera	Grillidae				K
181	Coleoptera	Curculionidae	Gonipterinae	Oxyops	sp	
182	Coleoptera	Chrysomelidae				
183	Hymenoptera	Colletidae				K
184	Hymenoptera	Doryctinae				
185	Lepidoptera	Noctuidae		Periscepta	polystieta	K
186	Hymenoptera	Colletidae				K
187	Hemiptera					
188	Hemiptera					
189	Coleoptera	Scarabeidae	Dynastinae	Cryptodus	sp	K
190	Blattodea	Blatidae				K
191	Coleoptera	Phycosecidae	Phycosecis			
192	Coleoptera	Tenebrionidae	Lagriinae	Lagria	aneouiobcea	GA
193	Coleoptera	Coccinellidae		Coccinella	repanda	
194	Coleoptera	?				
195	Diptera	?				
196	Hemiptera	Reduviidae				
197	Lepidoptera					
198	Coleoptera	Lycidae				
199	Coleoptera	Curculionidae				
200	Hemiptera					
201	Coleoptera	Belidae				GR
202	Orthoptera	Tettigoniidae				
203	Hymenoptera	Colletidae				
204	Diptera	Asilidae				GA
205	Diptera	Muscoidea				
206	Diptera	Syrphidae				
207	Hemiptera	Cicadidae		Cicadetta	sp	K
208	Coleoptera	Lycidae		Metriorrhynchus	sp	K
209	Coleoptera	Curculionidae				K
210	Coleoptera	Curculionidae				
212	Coleoptera	Scarabeidae	Melolonthinae	Liparetrus	sp	
214	Coleoptera	Curculionidae				
215	Coleoptera	?				
216	Orthoptera	Gryllidae				
217	Diptera	Asilidae				GA
218	Orthoptera	Tetigoniidae				K
219	Blattodea	Blattidae		Platyzosteria		K
220	Coleoptera	Elateridae				
221	Hemiptera	Pentatomidae				
222	Hymenoptera	Formicidae		Myrmecia	sp 2	
223	Chilopoda					
224	Chilopoda					
225	Chilopoda					
226	Chilopoda					
227	Chilopoda					
228	Chilopoda					
229	Chilopoda					
230	Hemiptera	Pseudococcidae				

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
231	Orthoptera	Acrididae				K
232	Orthoptera	Acrididae				K
233	Orthoptera	Acrididae		Goniaea	sp	K
235	Orthoptera	Acrididae				K
236	Lepidoptera					
237	Odonata	Zygoptera				GR
238	Lepidoptera					
239	Hemiptera					
240	Hemiptera	Pentatomidae				K
241	Hemiptera					
242	Diptera	Syrphidae				
243	Hymenoptera	Evaniidae				
244	Coleoptera	Curculionidae				K
245	Diptera	Bombyliidae				K
246	Orthoptera	Tetigoniidae				K
247	Coleoptera	Curculionidae				
248	Coleoptera	Chrysomelidae	Chrysomelinae			
249	Hemiptera					
250	Mecoptera	Bittacidae		Harpobittacus	sp	GR
251	Hemiptera	Pentatomidae				
252	Hymenoptera	Formicidae		Myrmecia	sp 1	
253	Coleoptera	Carabidae				
254	Blattodea	Blattidae		Platyzosteria	sp	
232	Orthoptera	Acrididae		Goniaea	sp	K
235	Orthoptera	Acrididae				K
257	Dermaptera					K
258	Dermaptera					K
259	Diplopoda					
260	Diplopoda					K
261	Amphipoda					GR
262	Isopoda					GR
264	Coleoptera	Carabidae	Harpalinae	?Cenogmus	sp	GA
265	Coleoptera	Carabidae	Esydrinae			GA
266	Blattodea	Blattidae		Platyzosteria		K
267	Chilopoda					
268	Orthoptera	Tettigoniidae				
269	Blattodea					
270	Hemiptera	Reduviidae				
271	Araneae					
275	Hymenoptera	Formicidae		Iridomyrmex	sp 3	
276	Orthoptera					
277	Chilopoda					
278	Orthoptera					
279	Hymenoptera	Formicidae		Myrmecia	sp 4	
280	Coleoptera	Carabidae		Carenum	sp	GA
281	Hymenoptera	Formicidae		Myrmecia	sp 3	
282	Blattodea	Blattidae		Platyzosteria	sp	K
283	Mygalomorphae					GR
284	Hemiptera	Reduviidae				K
285	Araneae					
286	Araneae	Araneomorphae	Sparassidae			
287	Coleoptera	Scarabeidae				
288	Coleoptera	Carabidae		Chlaenius		GA
289	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx	sp	
290	Coleoptera	Curculionidae				K
291	Coleoptera	Curculionidae	Molytinae	Tranes	sp	K
292	Blattodea	Blaberidae		Laxta		K

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
293	Orthoptera	Acrididae		Phaulacridium	vitatum	K
294	Orthoptera	?				
295	Hymenoptera	Pompilidae				
296	Lepidoptera	Lycinidae				K
297	Lepidoptera	Nymphalidae	Heteronympha	Merope	duboulayi	K
299	Coleoptera	Buprestidae				K
300	Coleoptera	Curculionidae	Amycterinae			K
301	Hemiptera	Membracidae				K
302	Hemiptera	Membracidae				K
303	Phasmatodea					
304	Orthoptera	Acrididae		Goniae		K
305	Neuroptera	Mermelontidae				GR
306	Lepidoptera	Nymphalidae		Geitoneura	klugit	K
307	Coleoptera	Chrysomelidae	Chrysomelinae	Paropsis	sp	K
308	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	K
309	Mantodea					
310	Orthoptera					
311	Hemiptera	Reduviidae				K
312	Diptera	Asilidae				GA
312	Diptera	Asilidae				GA
314	Orthoptera					
315	Lepidoptera					
316	Lepidoptera					
317	Lepidoptera	Geometridae				
318	Lepidoptera	Geometridae				
319	Lepidoptera	Tineidae		Moerarchis	clathrella	K
320	Lepidoptera	Geometridae		Arhodia	sp	K
321	Lepidoptera	Geometridae				K
322	Lepidoptera	Limacodidae		Doratifera	quadirguttata	K
323	Lepidoptera	Geometridae				
324	Lepidoptera	Tineidae		Moerarchis	sp	K
325	Lepidoptera	Psychidae		Iphierga	euphragma	K
326	Lepidoptera	Geometridae				
327	Lepidoptera	Geometridae				
328	Lepidoptera	Saturnidae		Opodiphthera	helena	K
329	Lepidoptera	Noctuidae				K
330	Lepidoptera	Geometridae		Crypsiphora	ocultaria	K
331	Lepidoptera	Oecophoridae		Wingia	aurata	K
332	Lepidoptera	Lymacodidae		Doratifera	sp	K
333	Lepidoptera	Pyralidae				
334	Lepidoptera	Geometridae		Gastrina	cristarina	K
336	Lepidoptera	Noctuidae		Chrysodeixis	argentifera	K
337	Lepidoptera					
338	Lepidoptera	Geometridae				
339	Lepidoptera	Geometridae				
340	Coleoptera	Carabidae	Chlaeniiae			
341	Lepidoptera	Pyralidae				
342	Lepidoptera	Pyralidae				
343	Hymenoptera	Formicidae		Myrmecia	sp 5	
344	Lepidoptera	Noctuidae				K
345	Lepidoptera					K
346	Lepidoptera	Noctuidae				K
347	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx		
340	Coleoptera	Carabidae	Chlaeniiae			
349	Coleoptera	Curculionidae				K
350	Lepidoptera					
351	Coleoptera	Cerambycidae		Uracantha	triangularis	K

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
352	Lepidoptera	Anthelidae		Anthela	sp	K
353	Coleoptera	Scarabeidae		Colpochila	sp	K
354	Coleoptera	Scarabeidae		Cryptodus	dynastinae	K
355	Lepidoptera	Geometridae				
356	Lepidoptera	Pyralidae				
357	Lepidoptera	Geometridae		Eucyclodes	buprestaria	K
358	Lepidoptera	Geometridae				
359	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx		
360	Neuroptera	Hemerobiidae				GR
361	Neuroptera	Chrysopidae		Chrysopa		GR
362	Lepidoptera					
363	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx		
364	Lepidoptera	Noctuidae				
365	Lepidoptera	Pyralidae				
366	Lepidoptera					
367	Lepidoptera					
368	Coleoptera	Curculionidae	Amycterinae			K
369	Lepidoptera					
370	Lepidoptera	Notodontidae		Hylaeora	dilucida	K
371	Lepidoptera	Lasiocampidae		Entometa	fervens	K
372	Lepidoptera	Hepialidae		Abantiades	hydrographis	GA
373	Lepidoptera	Hepialidae		Abantiades	ocellatus	GA
374	Lepidoptera	Notodontidae				K
375	Lepidoptera	Geometridae				K
376	Lepidoptera					
377	Lepidoptera	Geometridae		Phallaria	ophiusaria	K
373	Lepidoptera	Hepialidae		Abantiades	ocellatus	GA
379	Lepidoptera	Noctuidae		Peripyra	sanguinipucta	K
380	Lepidoptera					
381	Lepidoptera	Anthelidae				K
382	Lepidoptera					
383	Lepidoptera					
384	Lepidoptera	Geometridae		Pholodes	sp 1	K
385	Lepidoptera	Geometridae		Pholodes	sp 2	K
386	Lepidoptera	Noctuidae				
387	Lepidoptera					
388	Lepidoptera	Noctuidae		Pantydia	sp	
389	Lepidoptera	Geometridae				K
390	Lepidoptera	Notodontidae				K
391	Lepidoptera	Noctuidae				
392	Lepidoptera	Geometridae				K
393	Lepidoptera	Geometridae				K
394	Lepidoptera					
395	Lepidoptera	Geometridae				
396	Lepidoptera	Oecophoridae				
397	Lepidoptera	Pyralidae				
398	Lepidoptera	Limacodidae		Doratifera	sp	K
399	Lepidoptera					
400	Neuroptera	Myremeleontidae				GR
401	Lepidoptera	Pyralidae				
402	Lepidoptera	Geometridae				
403	Lepidoptera	Geometridae				K
404	Lepidoptera	Thaumetopoeidae		Oenosandra	sp	K
405	Lepidoptera	Noctuidae				
406	Lepidoptera					
407	Lepidoptera					
408	Hymenoptera					

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
409	Hymenoptera	Formicidae				
410	Blattodea	Blaberidae				K
411	Lepidoptera					
412	Lepidoptera	Noctuidae				K
413	Lepidoptera					
414	Lepidoptera					
415	Lepidoptera	Geometridae				K
416	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx	sp	
417	Lepidoptera	Geometridae		Gastrina	sp	K
418	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx	sp	
419	Lepidoptera					
420	Lepidoptera					
421	Lepidoptera					
422	Lepidoptera					
423	Hymenoptera	Formicidae	Dolichoderinae	Iridomyrex	sp 2	K
424	Lepidoptera	Geometridae				K
425	Lepidoptera	Geometridae				K
426	Lepidoptera	Lasiocampidae		Entometa	sp	K
427	Coleoptera	Scarabeidae	Melolonthinae	Heteronyx		
428	Lepidoptera					
429	Lepidoptera					
430	Lepidoptera					
431	Lepidoptera					
432	Lepidoptera	Pyralidae				K
433	Mantodea	Mantidae		Archimantis	sp	K
434	Lepidoptera					
435	Lepidoptera	Noctuidae				K
436	Lepidoptera	Geometridae				K
437	Coleoptera	Lucanidae		Syndesus	sp	K
438	Lepidoptera					
439	Coleoptera	Carabidae	Carabinae			GA
440	Coleoptera	Dytiscidae				
441	Lepidoptera					
442	Lepidoptera					
443	Lepidoptera					
444	Coleoptera	Elateridae				
445	Lepidoptera	Artctiidae	Arctiinae	Spilosoma	sp	K
446	Lepidoptera					K
449	Lepidoptera	Noctuidae				K
450	Lepidoptera	Geometridae		Thalaina	clara	K
451	Lepidoptera	Geometridae				K
452	Lepidoptera					K
453	Lepidoptera					
454	Lepidoptera					
455	Lepidoptera	Geometridae		Gastrina	cristaria	
456	Lepidoptera					
457	Lepidoptera	Anthelidae				K
458	Phasmatodea					
459	Lepidoptera					
460	Lepidoptera					
437	Coleoptera	Lucanidae		Syndesus	sp	K
462	Coleoptera	Curculionidae	Gonipterinae	Oxyops		
463	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	K
464	Diptera	Tachinidae				K
465	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	K
466	Diptera	Tabanidae				
467	Diptera	Tabanidae				GA

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
468	Araneae					K
469	Scorpionida				Scorpion sp2	K
470	Coleoptera	Curculionidae	Gonipterinae	Oxyops		
471	Coleoptera	Chrysomelidae	Paropsinae	Chrysophtharta		
472	Araneae					
473	Diptera	Tabanidae				
475	Hemiptera	Pentatomidae				K
476	Coleoptera	Cerambycidae	Laminae			
477	Hymenoptera	Formicidae		Myrmecia	callima	K
478	Hymenoptera	Formicidae		Myrmecia	sp 7	K
479	Blattodea	Blaberidae				
480	Diptera	Calliphoridae		Calliphora		
481	Hymenoptera	Pompilidae				GA
482	Hemiptera	Reduviidae				K
483	Blattodea	Blaberidae				
484	Dermaptera					K
485	Orthoptera					
486	Hymenoptera	Formicidae		Myrmecia	sp1	
487	Hymenoptera	Formicidae		Myrmecia	sp 6	
488	Coleoptera	Curculionidae	Gonipterinae	Gonipterus		
489	Hemiptera					K
490	Blattodea					
491	Dermaptera					
492	Dermaptera					
493	Hymenoptera	Braconinae				K
494	Hymenoptera	Pompilidae				
495	Diptera	Tabanidae				
496	Coleoptera	Curculionidae	Amycterinae			K
497	Araneae					
498	Diptera	Muscoidea				
500	Hymenoptera	Evaniidae				K
501	Orthoptera	Acrididae				K
502	Araneae					
503	Hemiptera	Eurymelidae		Pogonoscopus	sp	K
504	Hymenoptera					
505	Hymenoptera	Sphecidae				K
506	Diptera	Bombylidae				K
507	Blattodea					
508	Blattodea					K
509	Blattodea					
510	Hymenoptera	Formicidae				
511	Coleoptera	Scarabeidae		Onthophagus		
512	Hemiptera	Reduviidae				K
513	Hemiptera	Pentatomidae				K
514	Coleoptera	Curculionidae				
515	Hymenoptera	Ichneumonidae				GA
516	Hymenoptera	Pompilidae				
517	Lepidoptera	Geometridae				
518	Lepidoptera	Noctuidae				
519	Isopoda	collective sp				
520	Annelida	collective sp				
521	Platyhelminthes					
522	Dermaptera					
525	Blattodea	Blattidae				K
526	Orthoptera	Stenopelmatidae		Onosandrus	sp	K
527	Hemiptera	Gelastocoridae		Nerthra	sp	
528	Coleoptera	Carabidae				K

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
529	Coleoptera	Carabidae				K
530	Diptera	Anthomyiidae				
531	Diptera	Tabanidae				GA
532	Diptera	Asilidae				GA
533	Hymenoptera	Ichneumonidae	Branchinae	Australoglypta	sp	
534	Hymenoptera	Mutilidae				
535	Hymenoptera	Formicidae	Dolichoderinae	Iridomyrmex	sp1	
536	Araneomorphae	Corinnidae		Supunna	albopunctata	K
537	Araneomorphae	Corinnidae		Supunna	picta sp1	K
538	Mygalomorphae	Nemesiidae			juvenile	GR
539	Isopoda					
540	Isopoda					
541	Diptera	Asilidae				GA
542	Hymenoptera	Formicidae	Ponerinae	Prionopella	sp	
543	Hymenoptera	Formicidae	Poneri	Rhytidoponera	sp	
545	Hymenoptera	Colletidae				
546	Hymenoptera	Colletidae				
547	Blattodea	Blaberidae		Laxta	sp2	K
548	Orthoptera	Acrididae				
550	Coleoptera	Scarabaeidae	Melolonthinae			
552	Hymenoptera	Formicidae	Myrmeciinae	Myrmecia	sp1	
553	Araneomorphae	Ctenidae				
554	Araneomorphae	Lycosidae				
555	Orthoptera	Gryllidae				
557	Coleoptera	Carabidae				K
558	Coleoptera	Carabidae	Pentagonicinae	Scapodes	boops	
560	Araneomorphae	Gnaphosidae				
562	Coleoptera	Scarabaeidae	Melololonthinae	Heteronyx	sp	
564	Diptera	Asilidae				GA
565	Diptera	Syrphidae				
567	Mygalomorphae	Nemesiidae		Chenistonia	sp1	GR
568	Scorpionida				Scorpion sp1	K
570	Blattodea	Blaberidae			sp4	K
571	Coleoptera	Elateridae				
573	Hemiptera	Reduviidae				
576	Orthoptera	Acrididae		Cedarinia	sp2	
577	Diptera	Tipulidae				
579	Diptera	Sarcophagidae				
580	Hymenoptera	Mutilidae				
581	Mygalomorphae	Nemesiidae		Chenistonia	sp2	GR
584	Hymenoptera	Tiphiidae				GA
585	Mygalomorphae	Nemesiidae			juvenile	GR
587	Coleoptera	Carabidae				K
588	Diptera	Tipulidae				
589	Lepidoptera	Noctuidae				
590	Mygalomorphae			Nemesiidae	juvenile	GR
591	Blattodea	Blatellidae		Neotemnopteryx	sp	
592	Blattodea	Blattidae		Polyzosteria	sp	
593	Lepidoptera	Hesperiidae		Hesperilla	chrysotricha	K
594	Lepidoptera	Nymphalidae		Vanessa	kershawi	K
596	Hymenoptera	Colletidae				
597	Araneomorphae	Miturgidae		genus2	sp1	
598	Lepidoptera	Noctuidae				
603	Diptera	Tabanidae				GA
604	Hymenoptera	Tiphiidae				GA
607	Hymenoptera	Pompilidae				GA
608	Orthoptera	Gryllidae				

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
609	Orthoptera	Gryllidae				
611	Hymenoptera	Pompilidae				GA
612	Hymenoptera	Pompilidae				GA
613	Orthoptera	Acrididae				
614	Hymenoptera	Tiphiidae				GA
616	Hymenoptera	Pompilidae				GA
617	Hymenoptera	Pompilidae				GA
618	Orthoptera	Gryllidae				
619	Hymenoptera	Pompilidae				GA
620	Araneomorphae	Trochanteridae		Rebilus	sp	
621	Coleoptera	Elateridae				
622	Hymenoptera	Pompilidae		Cryptocheilus	fabricolor	GA
623	Chilopoda					
628	Coleoptera	Staphylinidae				K
629	Scorpionida				Scorpion sp3	K
630	Lepidoptera	Geometridae				
631	Lepidoptera	Pyralidae				K
632	Lepidoptera	Geometridae				
633	Lepidoptera	Geometridae				
634	Lepidoptera	Geometridae				
635	Lepidoptera	Pyralidae				
636	Coleoptera	Elateridae				
637	Lepidoptera	Geometridae				
638	Lepidoptera	Geometridae				
639	Lepidoptera	Geometridae				
640	Lepidoptera	Noctuidae				
641	Lepidoptera	Pyralidae				
642	Lepidoptera	Noctuidae				
643	Lepidoptera	Noctuidae (?)				
644	Lepidoptera	Geometridae				
645	Lepidoptera	Pyralidae				
646	Lepidoptera	Pyralidae				
647	Lepidoptera					
648	Lepidoptera	Noctuidae				
649	Lepidoptera	Noctuidae				
650	Lepidoptera	Noctuidae				
651	Coleoptera	Dytiscidae		Lancetes	sp	
652	Lepidoptera	Pyralidae (?)				
653	Neuroptera	Hemerobiidae				
654	Coleoptera	Cerambycidae		Coptocercus	rubripes	
655	Lepidoptera	Geometridae				
656	Lepidoptera	Noctuidae				
657	Lepidoptera					K
658	Lepidoptera	Gelechiodea				
659	Lepidoptera	Noctuidae		Chrysodeixis	sp	
660	Lepidoptera					
661	Lepidoptera					
662	Lepidoptera					
663	Lepidoptera	Geometridae		Heliomystis	sp	
664	Hymenoptera	Formicidae		Myrmecia		
665	Coleoptera	Chrysomelidae	Chrysomelinae	Paropsis	sp	K
666	Coleoptera	Curculionidae		Gonipterus	sp	
667	Coleoptera	Chrysomelidae	Chrysomelinae	Paropsis	sp	K
669	Hemiptera	Pentatomidae				
670	Hemiptera	Pentatomidae				
671	Isopoda					
672	Orthoptera	Gryllidae				

Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
673	Coleoptera	Cerambycidae		Stenoderus	suturalis	
674	Mantodea					
675	Diptera	Muscidae				
676	Diptera	Conopoidea	Conopidae			
677	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
678	Hemiptera	Pentatomidae	(green)			
679	Hemiptera	Lygaeidae				
680	Hemiptera	Pentatomidae				
681	Orthoptera	Acrididae	Acridinae			
682	Dermaptera	Anisolabididae	Isolabellinae			
683	Diptera	Bombylidae				K
684	Coleoptera	Cleridae				
685	Hymenoptera	Thyninae				G
686	Lepidoptera	Noctuidae		Uraba	lugens	K
687	Neuroptera	Mantispidae				
688	Orthoptera					
689	Lepidoptera	Noctuidae				
690	Orthoptera	Acrididae	Catantopinae	Cedarinia	sp	
691	Lepidoptera	Geometridae				
692	Lepidoptera	Thaumetopoeidae				K
693	Lepidoptera	Lasiocampidae				
694	Lepidoptera	Geometridae				
695	Coleoptera	Cleridae		Eleale	sp	
696	Hymenoptera	Colletidae				
697	Hymenoptera	Gasteruptiidae				
698	Hymenoptera	Ichneumonidae				
699	Hymenoptera	Pompiilidae				
700	Hemiptera	Coreidae		Amorbus	bispinus	
701	Coleoptera	Buprestidae		Melobasis	sp	
702	Coleoptera	Curculionidae		Gonipterus		
703	Orthoptera	Acrididae	Acridinae			
704	Hymenoptera	Colletidae				
705	Orthoptera					
706	Blattodea	Blattidae				
707	Coleoptera	Chrysomelidae	Chrysomelinae	Paropsis	sp	
708	Orthoptera					
709	Coleoptera	Curculionidae				
710	Coleoptera	Curculionidae				
711	Coleoptera	Tenebrionidae		Oectosis	sp	K
712	Hymenoptera	Formicidae		Myrmecia	sp	
713	Orthoptera	Tetrigidae				
714	Hemiptera	Reduvidae				
715	Orthoptera					
716	Chilopoda					
717	Diplopoda					
718	Mantodea					
719	Diptera	Bombyliidae				
720	Hymenoptera	Sphecidae				
721	Mygalomorphae	Idiopidae		?Eucytops	sp	GR
722	Orthoptera	Acrididae		Cedarinia	sp3	
723	Hymenoptera	Sphecidae				
724	Araneomorphae	Miturgidae				
725	Araneomorphae	Stiphidiidae		?Balami	volucripes	
726	Orthoptera	Acrididae		Cedarinia	sp2?	
727	Coleoptera	Carabidae				GA
728	Hymenoptera	Formicidae				
729	Orthoptera	Acrididae				

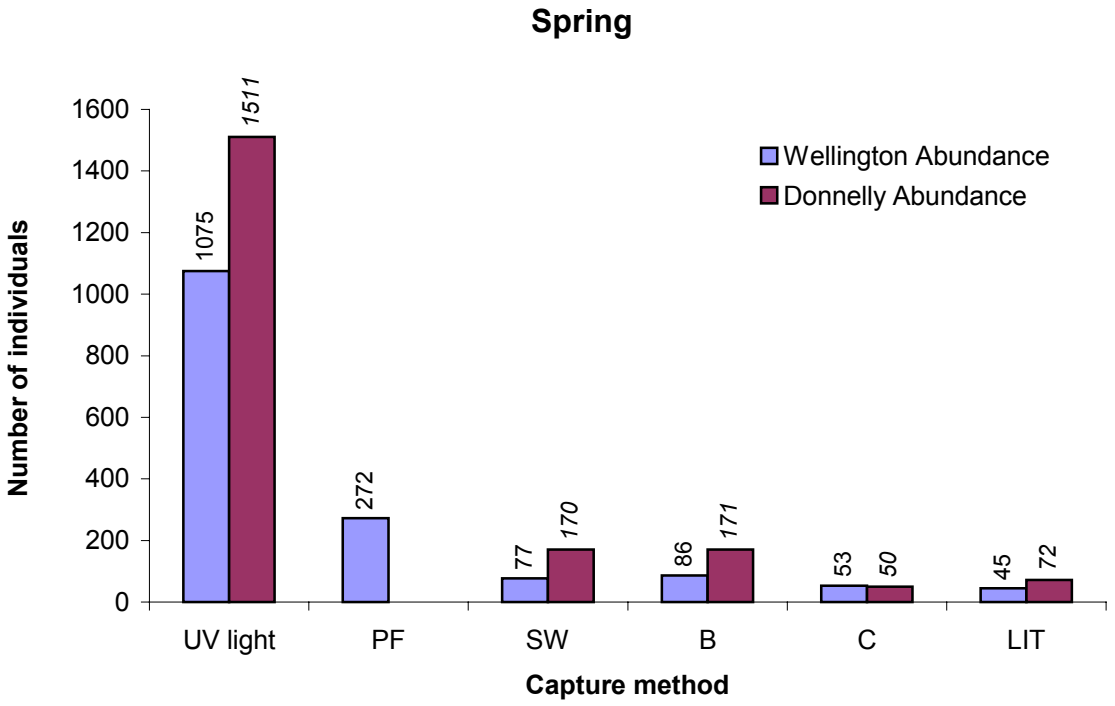
Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
730	Hymenoptera	Colletidae				
731	Araneomorphae	Zoridae				
732	Araneomorphae	Stiphidiidae		Balami	sp	
733	Araneomorphae	Lycosidae				
734	Dermaptera					K
735	Araneomorphae	Stiphidiidae		Balami	volucripes	
736	Coleoptera	Curculionidae				
737	Hymenoptera	Formicidae		Pachycondyla	sp	
738	Orthoptera	Eumasticidae				
739	Mantodea	Amorphoscelidae		Paroxypilus	?tasmaniensis	
740	Araneomorphae					
741	Araneomorphae	Lycosidae				
742	Araneomorphae	Gnaphosidae				
743	Araneomorphae	Lycosidae				
744	Coleoptera	Curculionidae	Amycterinae			K
745	Diptera	Bombyliidae				
746	Coleoptera	Carabidae				GA
747	Coleoptera	Carabidae		?Notonomus	sp	GA
748	Coleoptera	Curculionidae	Amycterinae			K
749	Lepidoptera	Bombycidae				
750	Lepidoptera					
751	Diptera	Asilidae				
752	Neuroptera	Hemerobiidae				GA
753	Lepidoptera	Geometridae (?)				
754	Lepidoptera					
755	Lepidoptera	Lasiocampidae				
756	Lepidoptera	Geometridae				
757	Lepidoptera	Geometridae				
758	Lepidoptera	Geometridae				
759	Lepidoptera	Geometridae				
760	Lepidoptera					
761	Lepidoptera	Hepialidae		Abantiades		K
762	Coleoptera	Cerambycidae		Phoracantha	semipunctata	
763	Lepidoptera	Pyralidae	Epipaschinae			
764	Hemiptera	Fulgoridae				
765	Lepidoptera	Geometridae				
766	Lepidoptera	Noctuidae (?)				
767	Mantodea	Mantidae				
768	Lepidoptera	Pyralidae (?)				
769	Lepidoptera	Noctuidae				
770	Lepidoptera	Noctuidae				
771	Lepidoptera	Noctuidae				
772	Lepidoptera	Geometridae (?)				
773	Lepidoptera					
774	Coleoptera	Dytiscidae		Eretes		
775	Diptera	Asilidae				
776	Lepidoptera	Geometridae				
777	Blattodea	Blattidae	Michells cocky	Polyzosteria	mitchelli	K
778	Coleoptera	Tenebrionidae		Oectosis	sp 2	
779	Hemiptera	Pentatomidae	(nymph)			
781	Blattodea	Blaberidae		Laxta	sp 2	K
782	Orthoptera	Pyrgomorphidae				
783	Araneae					
784	Mantodea					
785	Phasmatodea	(grey stick insect)				
786	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
787	Hemiptera	Cicadellidae				

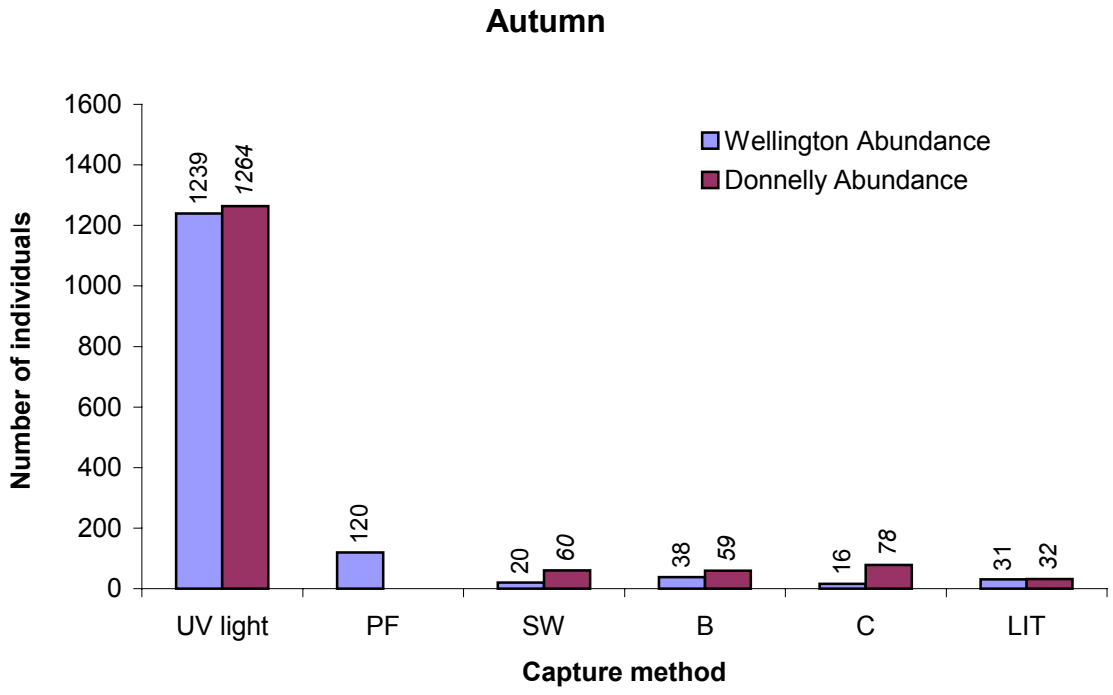
Spec No	Order	Family	Taxonomic affinity 3	Genus	Species	Status
788	Araneae					
789	Mantodea					
790	Hymenoptera					
791	Orthoptera					
792	Diptera	Tipulidae				K
793	Araneae					
794	Araneae					
795	Coleoptera	Lycidae				
796	Hymenptera	Tiphiidae				
797	Lepidoptera					
798	Lepidoptera					
799	Lepidoptera	Noctuidae				
800	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
801	Hymenoptera	Tiphiidae				GR
802	Coleoptera	Lycidae		Metriorrhynchus	sp	K
803	Coleoptera	Chrysomelidae	Chrysomelinae	Paropsis	sp	
804	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
805	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
806	Hymenoptera	Tiphiidae				GR
807	Coleoptera	Chrysomelidae	Chrysomelinae	Chalcolampra	sp	K
808	Coleoptera	Chrysomelidae	Chrysomelinae	Chrysophtharta	sp	
809	Orthoptera	Gryllidae				
810	Diptera	Asilidae				
811	Orthoptera	Gryllidae		Apterogryllus	sp2	
812	Araneomorphae	Miturgidae				
813	Hymenoptera	Pompilidae				
814	Coleoptera	Curculionidae				
815	Chilopoda					
816	Orthoptera	Eumasticidae				
817	Curculionidae					
818	Diptera	Muscidae				

Appendix II. Number of morphospecies collected using active and passive techniques in spring and autumn 2001-2003 from Donnelly and Wellington. (Note discrepancies in Donnelly data from FORESTCHECK 2002 report are due to missing data now being included).

Order	WELLINGTON				DONNELLY			
	No of Species	GR	GA	K	No of Species	GR	GA	K
Amphipoda	0				1	1		
Annelida	1				1			
Araneae	5			1	7			1
Araneomorphae	13				7			1
Blattodea	9			5	26			15
Chilopoda	8				10			
Coleoptera	53	1	6	12	116	3	6	30
Dermaptera	7			5	7			4
Diplopoda	3			1	2			1
Diptera	26		8	4	46		11	7
Hemiptera	17			2	40			15
Hymenoptera	30		5	2	52	2	13	12
Isopoda	2				4	1		
Lepidoptera	153		1	62	208		2	98
Mantodea	8			1	3			1
Mecoptera	2	2			2	2		
Mygalomorphae	5			5	6	6		
Neuroptera	5	5			5	5		
Odonata	0				1	1		
Orthoptera	28			9	33			14
Phasmatodea	1				2			
Platyhelminthes	1				1			
Scorpionida	2			2	3			3
Trichoptera	2	2			5	5		
Total	381	10	20	111	587	25	32	203

Appendix III. Abundance (measured as the number of individuals) in spring and autumn for each capture method, Wellington (signified as Wellington) and Donnelly (signified as Donnelly) compared. (PF= pitfall trap; SW = sweep net; B = beating tray; C = coarse woody debris search; LIT = litter search).

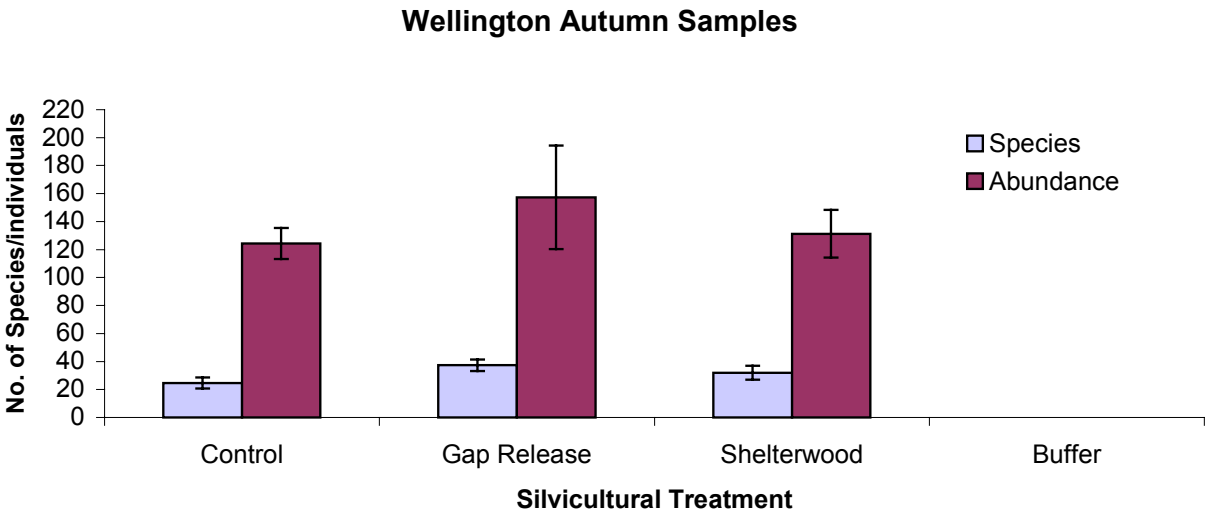


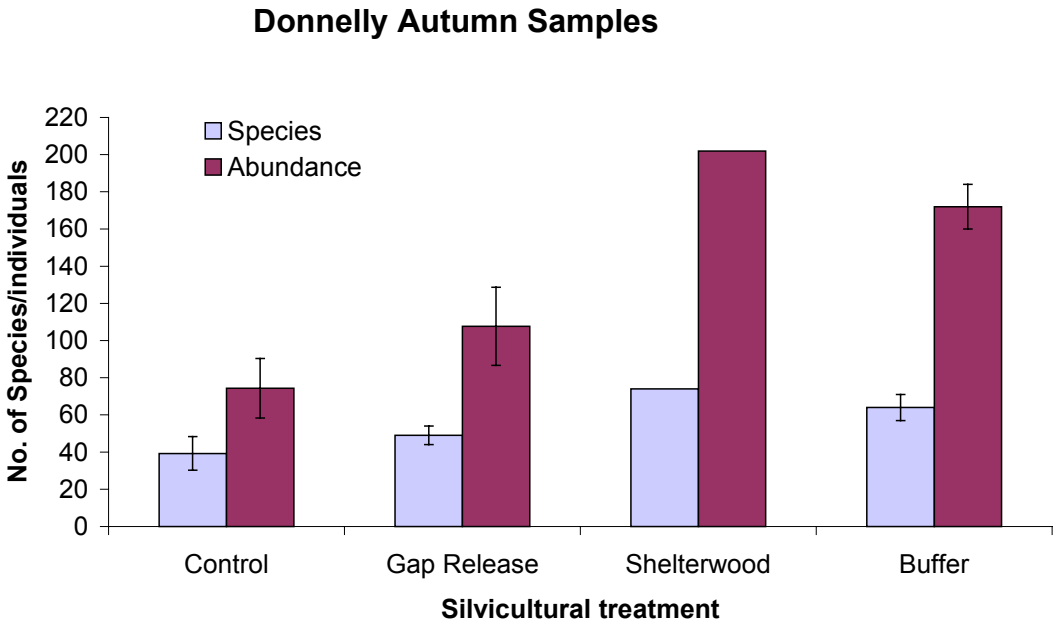


Appendix IV. Number of morphospecies and abundance (number of individuals captured at each grid) for active (beat, sweep, coarse woody debris, litter), light and pitfall trap capture techniques in spring and autumn for Wellington District.

				Active		Light trap		Pitfall trap		All Capture methods	
Treatment	**Site**	**Location**	**Season**	**No Spec**	**Abund**	**No Spec**	**Abund**	**No Spec**	**Abund**	**No Spec**	**Abund**
Control	FC16	Yourdamung	AU	8	11	17	103	7	10	32	124
Control	FC16	Yourdamung	SP	13	22	26	107	15	23	53	152
Control	FC17	Surface	AU	5	6	30	134	10	21	45	161
Control	FC17	Surface	SP	22	26	46	172	17	23	84	221
Control	FC19	Tumlo	AU	8	15	27	136	10	16	45	167
Control	FC19	Tumlo	SP	13	16	41	142	12	29	66	187
Shelter	FC15	Surface	AU	7	8	36	144	7	21	50	173
Shelter	FC15	Surface	SP	26	34	29	103	17	36	68	173
Shelter	FC18	Chalk	AU	11	12	23	97	5	6	38	115
Shelter	FC18	Chalk	SP	17	31	45	120	17	31	78	182
Shelter	FC13	Ross	AU	8	12	37	153	7	14	52	179
Shelter	FC13	Ross	SP	18	34	35	112	12	21	63	167
Gap	FC14	Surface	AU	5	6	32	137	7	18	43	161
Gap	FC14	Surface	SP	19	27	22	58	24	51	63	136
Gap	FC11	Edward	AU	15	19	46	229	3	5	62	253
Gap	FC11	Edward	SP	20	43	31	124	15	43	62	210
Gap	FC12	Ross	AU	11	16	34	106	7	9	51	131
Gap	FC12	Ross	SP	20	28	47	137	14	15	79	180

Appendix V. Mean (n = 3, ± SE) autumn light trap captures against treatment grids for Wellington and Donnelly (Note: Donnelly Shelterwood is for n = 1). (Number of morphospecies = number of species; number of individuals = abundance).





BIRDS

Graeme Liddelow

Introduction

Nine FORESTCHECK sites were selected in 2002 and during spring 2002 were sampled for diurnal birds in order to monitor the impacts of logging and associated burning on avifaunal composition and abundance.

Sampling

The sampling strategy selected by the consultative group has worked well in this study and no problems have been encountered, apart from the availability of suitably skilled people to do the counts.

The program was not too ambitious and is flexible enough to overcome any inclement weather that occurred.

Specimen Processing

No specimens are collected in this program. Any species identification that poses a problem is followed up immediately.

Database

The database system, developed for the Gray and Kingston bird studies, and used last year, has been refined over a number of years and works well. This year the database developed by Amanda Mellican was used. This was to keep all FORESTCHECK databases in the same format. There do not appear to be any problems to date.

Preliminary Results

35 species of bird with 697 individuals were recorded during the counts. There were 27 species and 226 individuals in the Control, 28 species and 220 individuals in the Shelterwood and 30 species and 251 individuals in the Gap Release treatments (Table 1).

2 species were recorded only in the Control (Horsefield's Bronze Cuckoo, Brown Honeyeater), 2 species were recorded only in the Shelterwood (Boobook owl, Dusky Woodswallow), and 2 species were recorded only in the Gap Release treatments (Fan-tailed Cuckoo, Welcome Swallow).

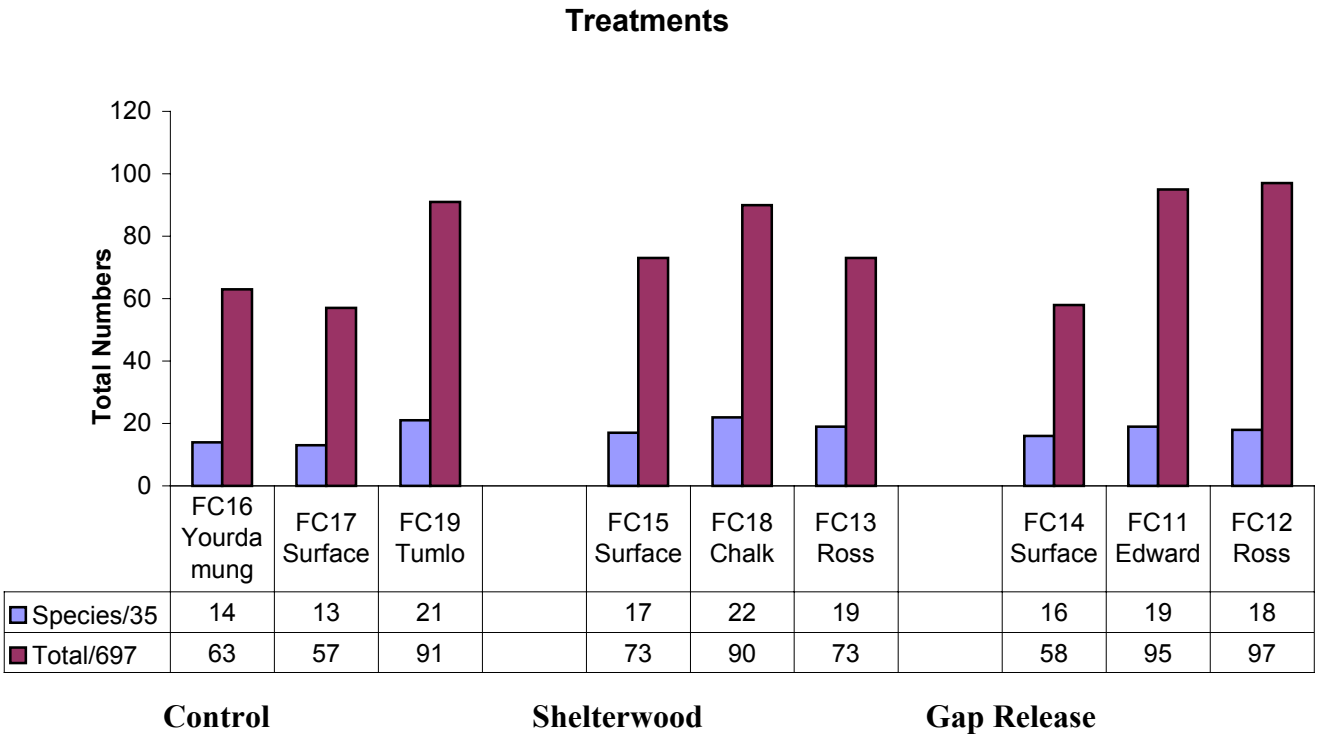
The density of birds recorded in these sites is similar to the Kingston Study in an average year, namely Wellington 15.5 birds/ha, and Kingston 16.6 birds/ha.

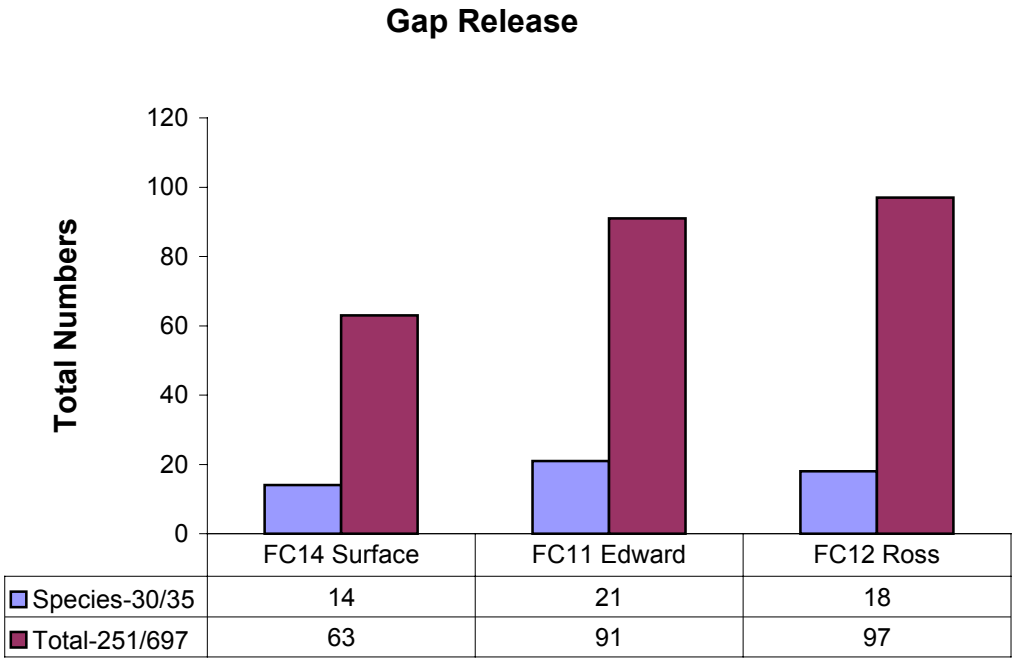
From previous studies at Gray and Kingston forest blocks, the changes in bird species composition and numbers of individuals changes as the understorey density and fuel age varies. These changes will continue for some considerable time and may not stabilize until crown separation occurs. Changes will continue even after this time as areas are subjected to fuel reduction or protection burns.

It is important that the Gray and Kingston studies continue to be monitored in order to document the changes that occur up to and beyond crown separation.

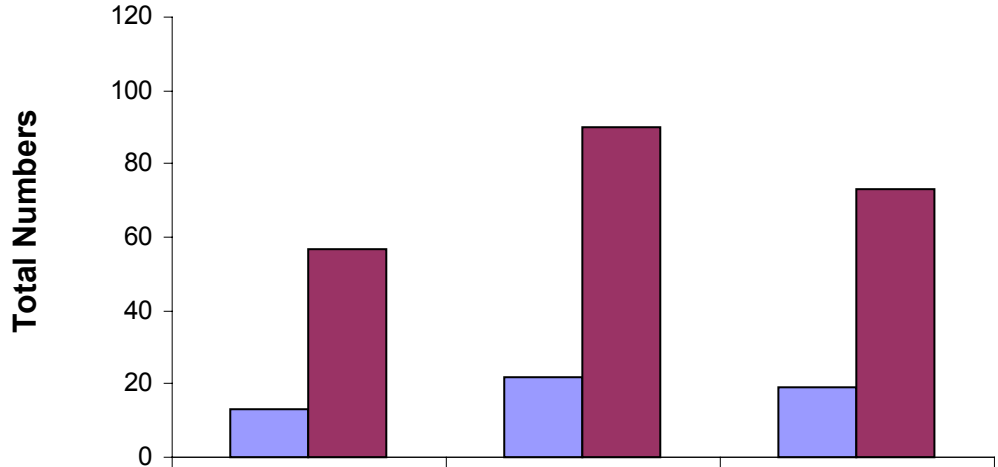
Table 1. Bird Species and Number of Individuals.

RAOU	Common Name	Scientific Name	Total	Control	Shelterwood	Gap Release
221	Brown Goshawk	Accipiter fasciatus	4	1	2	1
242	Boobook owl	Ninox novaeseelandiae	1		1	
264	Red-tailed Black Cockatoo	Calyptorhynchus banksii	6		3	3
289	Western Rosella	Platycercus icterotis	2	1	1	
290	Red-capped Parrot	Purpureicephalus spurius	12	4	5	3
294	Australian Ringneck	Platycercus zonarius	19	7	9	3
322	Laughing Kookaburra	Dacelo novaeguineae	2		1	1
338	Fan-tailed Cuckoo	Cuculus flabelliformis	2			2
342	Horsefield's Bronze Cuckoo	Chrysococcyx basalis	1	1		
344	Shining Bronze Cuckoo	Chrysococcyx lucidus	9	5	2	2
357	Welcome Swallow	Hirundo neoxena	5			5
359	Tree Martin	Hirundo nigricans	44	5	12	27
361	Grey Fantail	Rhipidura fuliginosa	35	9	15	11
380	Scarlet Robin	Petroica multicolor	15	5	6	4
387	White-breasted Robin	Eopsaltria georgiana	3		2	1
394	Yellow Robin	Eopsaltria australis	3	1		2
398	Golden Whistler	Pachycephala pectoralis	32	10	12	10
408	Grey Shrike-thrush	Colluricincla harmonica	7	2	4	1
424	Black-faced Cuckoo Shrike	Coracina novaehollandiae	8	4	3	1
463	Western Gerygone	Greygone fusca	63	25	24	14
472	Western Thornbill	Acanthiza inornata	58	21	10	27
476	Broad-tailed Thornbill	Acanthiza apicalis	103	30	35	38
488	White-browed Scrubwren	Sericornis frontalis	12	2	4	6
532	Spendid Fairy-wren	Malurus splendens	31	16	6	9
547	Dusky Woodswallow	Artamus cyanopterus	6		6	
549	Varied Sittella	Daphoenositta chrysoptera	19	10		9
556	Rufous Treecreeper	Climacteris rufa	10	2	5	3
565	Spotted Paradalote	Pardalotus punctatus	3		2	1
574	Grey-breasted White-eye	Zosterops lateralis	37	4	9	24
578	Western White-naped Honeyeater	Melithreptus chloropsis	23	9	8	6
592	Western Spinebill	Acanthorhynchus superciliosus	28	16	5	7
597	Brown Honeyeater	Lichmera indistincta	2	2		
637	Western Little Wattlebird	Anthochaera lunulata	11	4		7
638	Red Wattlebird	Anthochaera carunculata	12	8	1	3
976	Striated Paradalote	Pardalotus striatus	69	22	27	20
		Total Species	35	27	28	30
		Total Individuals	**697**	**226**	**220**	**251**


Treatments
Total Numbers
120
100
80
60
40
20
0
FC16 Yourdamung
FC17 Surface
FC19 Tumlo
FC15 Surface
FC18 Chalk
FC13 Ross
FC14 Surface
FC11 Edward
FC12 Ross
Species/35
14
13
21
17
22
19
16
19
18
Total/697
63
57
91
73
90
73
58
95
97
Control
Shelterwood
Gap Release

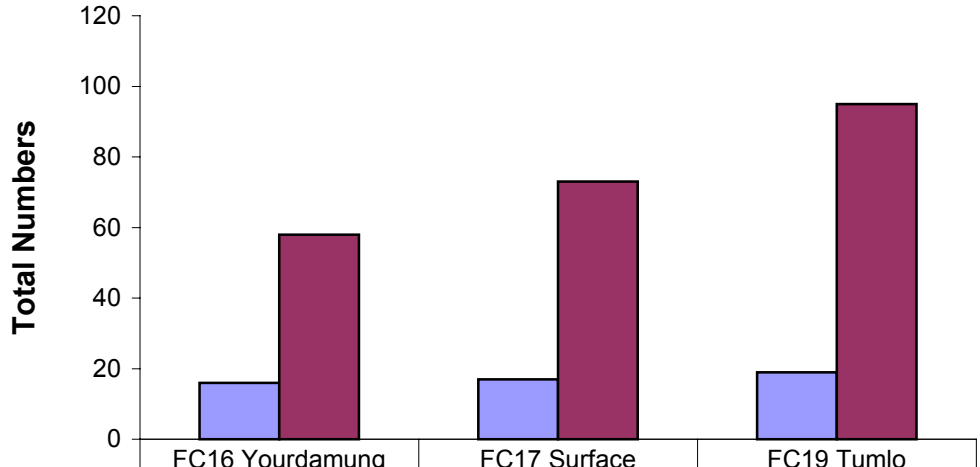

Gap Release
Total Numbers
120
100
80
60
40
20
0
FC14 Surface
FC11 Edward
FC12 Ross
Species-30/35
14
21
18
Total-251/697
63
91
97

Shelterwood



	FC15 Surface	FC18 Chalk	FC13 Ross
Species-28/35	13	22	19
Total-220/697	57	90	73

Control



	FC16 Yourdamung	FC17 Surface	FC19 Tumlo
Species-27/35	16	17	19
Total-226/697	58	73	95

Future Tasks
Select and prepare sites for this years round of monitoring.

Operating Plan
No revision required.

NOCTURNAL BIRDS

Graeme Liddelow

Introduction

The aim is to monitor the impact of logging and associated burning on the abundance of nocturnal birds at sites selected for the FORESTCHECK study in the Wellington District.

Sampling

It is not possible to monitor the nocturnal birds on an individual site basis. Of the 9 FORESTCHECK sites it was possible to include 7 from which to sample these birds.
The sampling procedure is described in Liddelow *et al.* chapter 21 of "Ecology and Conservation of Owls", Ian Newton (Editor); CSIRO 2002.

The two 1992 sites were combined, as were the two 1998 sites as the sampling system requires site separation by 3 km and it was not possible to achieve this for all sites.

The program was realistic and flexible and no problems were encountered.

Specimens

None required.

Database

The database was established in 2002 and all data has been entered.

Preliminary Results

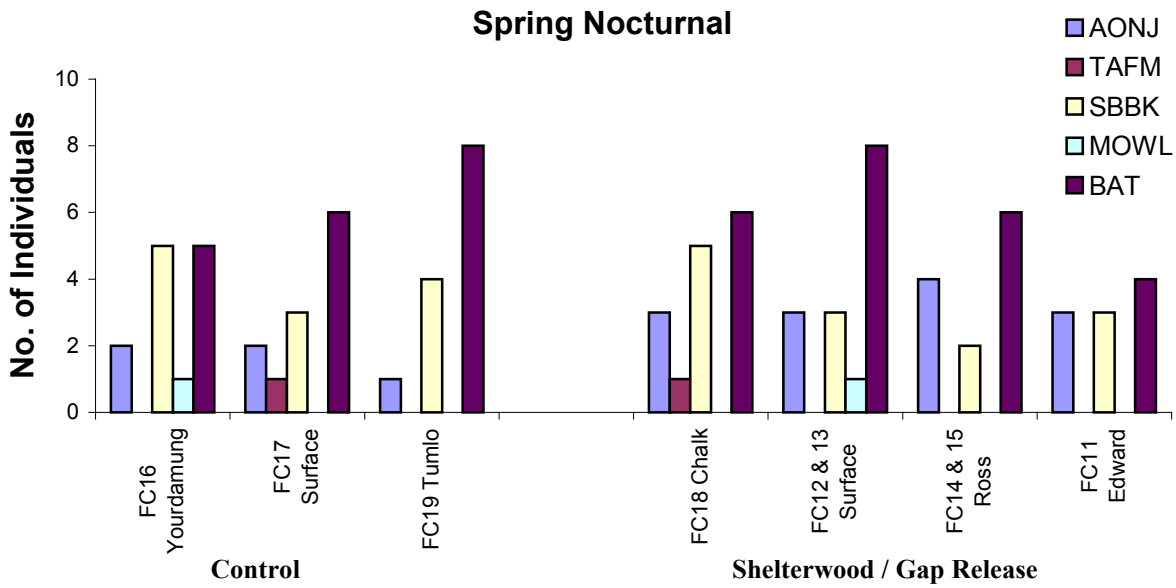
The Southern Boobook owl was recorded at all sites in both spring and autumn as was expected. This is the only forest owl present in south-west Western Australia. The Masked owl was recorded twice in spring, once in the 1995 Gap Release and in the southern Control and was also recorded twice in autumn but both of these were in the southern Control. This site is only 2.5 km from private property and the edge of private property is a favourite hunting area for the Masked owl. Masked owls are recorded occasionally in forest areas, but are more typically seen in open forest/woodland country.

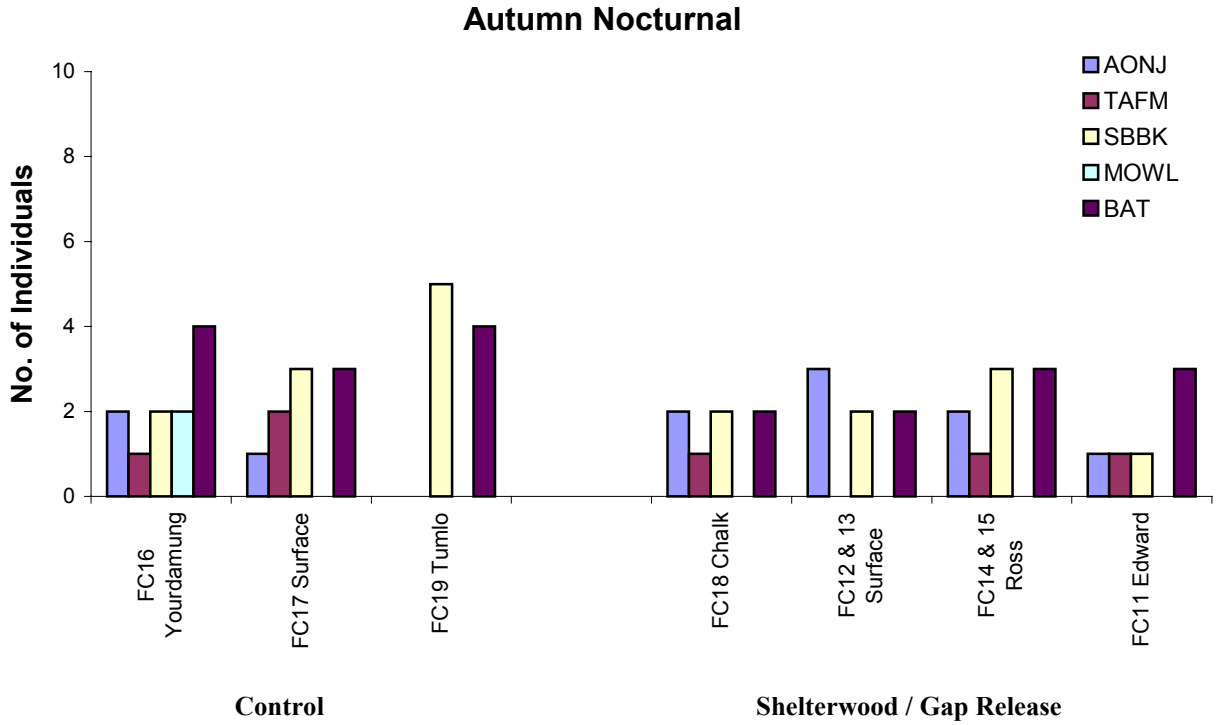
The spotlighting from this sampling system has intended to reveal the extent of occurrence of medium sized arboreal or ground dwelling mammals such as possums, phascogales, woylies, quenda etc. (which constitute the natural food of the larger Masked and Barking owl species. No small mammals were seen which would be taken by both the large owls or the smaller owls (Boobook, Barn). The Boobook owl is presumably preying on either bats or flying insects.

Owlet nightjars and Tawny frogmouths have a similar recording rate to that found by Liddelow *et al.* (2002) and is typical of the forest region of WA.

Due to the large home ranges of owls sites, sites need to be separated by larger distances and as this is not always possible, nocturnal birds should be monitored on a landscape basis where the treatments have taken place.

In the figures below, AONJ = Australian Owlet nightjar, TAFM = Tawny frogmouth, SBBK = Southern boobook owl, MOWL = Masked owl, and BAT = bat.





Future Tasks
Select and monitor sites for 2003-4 in the Dwellingup/Mundaring area.

Operating Plan
No changes are required.

MAMMALS AND HERPETOFAUNA

Graeme Liddelow

Introduction

To monitor the impacts of logging and associated burning practices on species composition and abundance of mammals and herpetofauna.

Sampling Issues

The program was flexible enough to allow for any inclement weather that occurred during the sampling period.

All went according to plan except for the last day of the autumn period when the pitfall traps were closed due to heavy rainfall. The Sheffield traps were used this year in both spring and autumn sampling sessions and did not impose any undue stress on the handlers or species caught.

The program was within budget.

Specimen Processing

47 individual specimens were lodged with the WA Museum and these included 1 mammal, 1 amphibian, 1 snake, 1 pygopod, 2 species of geckoes, and 7 species of skink.

A new recording form was developed for these specimens and the Museum was pleased with this (Table 1)

Database

There were no problems with the database.

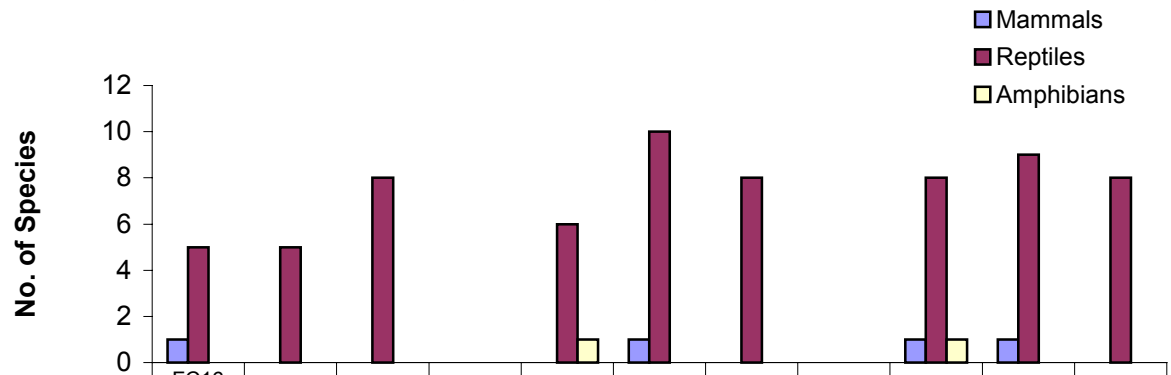
Preliminary Results

All sites returned very poor mammal captures. This is probably because the The area sampled is within the area that was used as an unbaited Control as part of a study by Paul de Tores; if the area is baited there may be different results when sampling of Woylies is repeated after baiting.

Table 1. Museum Specimen List

Field #	Museum #	Museum Name
FC11-1	R112905	*Lerista distinguenda*
FC11-2	R112915	*Morethia obscura*
FC11-3	R112926	*Menetia greyii*
FC11-4	R112917	*Morethia obscura*
FC11-5	R112904	*Lerista distinguenda*
FC12-6	R112903	*Lerista distinguenda*
FC12-7	R112925	*Hemiergis initialis*
FC12-8	R112914	*Morethia obscura*
FC12-9	R112898	*Ctenotus labillardieri*
FC14-10	R112913	*Morethia obscura*
FC14-11	R112924	*Menetia greyii*
FC14-12	R112897	*Ctenotus labillardieri*
FC15-13	R112923	*Menetia greyii*
FC15-14	R112912	*Morethia obscura*
FC19-15	R112900	*Ctenotus labillardieri*
FC11-16	R112889	*Diplodactylus polyophthalmus*
FC12-17	R112908	*Acritoscincus trilineatum*
FC12-18	R112922	*Menetia greyii*
FC12-19	R112895	*Christinus marmoratus*
FC12-20	R112887	*Ramphotyphlops australis*
FC13-21	R112899	*Ctenotus labillardieri*
FC13-22	R112916	*Morethia obscura*
FC13-23	R112927	*Menetia greyii*
FC13-24	R112902	*Hemiergis initialis*
FC13-25	R112894	*Aprasia pulchella*
FC14-26	R112928	*Menetia greyii*
FC14-27	R112896	*Christinus marmoratus*
FC15-28	R112901	*Ctenotus labillardieri*
FC15-29	R112886	*Crinia georgiana*
FC15-30	R112890	*Egernia napoleonis*
FC16-31	R112918	*Morethia obscura*
FC17-32	R112893	*Aprasia pulchella*
FC17-33	R112931	*Menetia greyii*
FC17-34	R112910	*Acritoscincus trilineatum*
FC17-35	R112919	*Morethia obscura*
FC18-36	R112907	*Lerista distinguenda*
FC18-37	R112929	*Menetia greyii*
FC18-38	R112930	*?*
FC18-39	R112906	*Lerista distinguenda*
FC18-40	R112920	*Morethia obscura*
FC18-41	R`112892	*Aprasia pulchella*
FC19-42	R112911	*Acritoscincus trilineatum*
FC19-43	R112909	*Morethia obscura*
FC19-44	R112891	*Egernia napoleonis*
FC19-45	R112921	*Hemiergis initialis*
FC19-46	R112888	*Diplodactylus polyophthalmus*
FC11-47	M53719	*Sminthopsis gilberti*

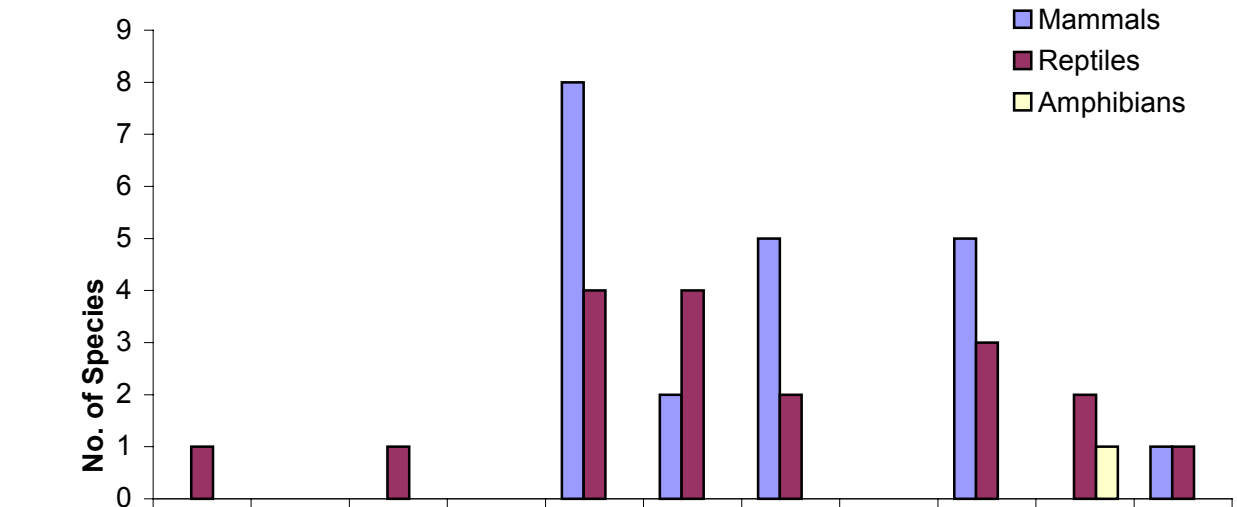
Spring Trapping By Species



	FC16 Yourdamung	FC17 Surface	FC19 Tumlo		FC15 Surface	FC18 Chalk	FC13 Ross		FC14 Surface	FC11 Edward	FC12 Ross
Mammals	1					1			1	1	
Reptiles	5	5	8		6	10	8		8	9	8
Amphibians					1				1		

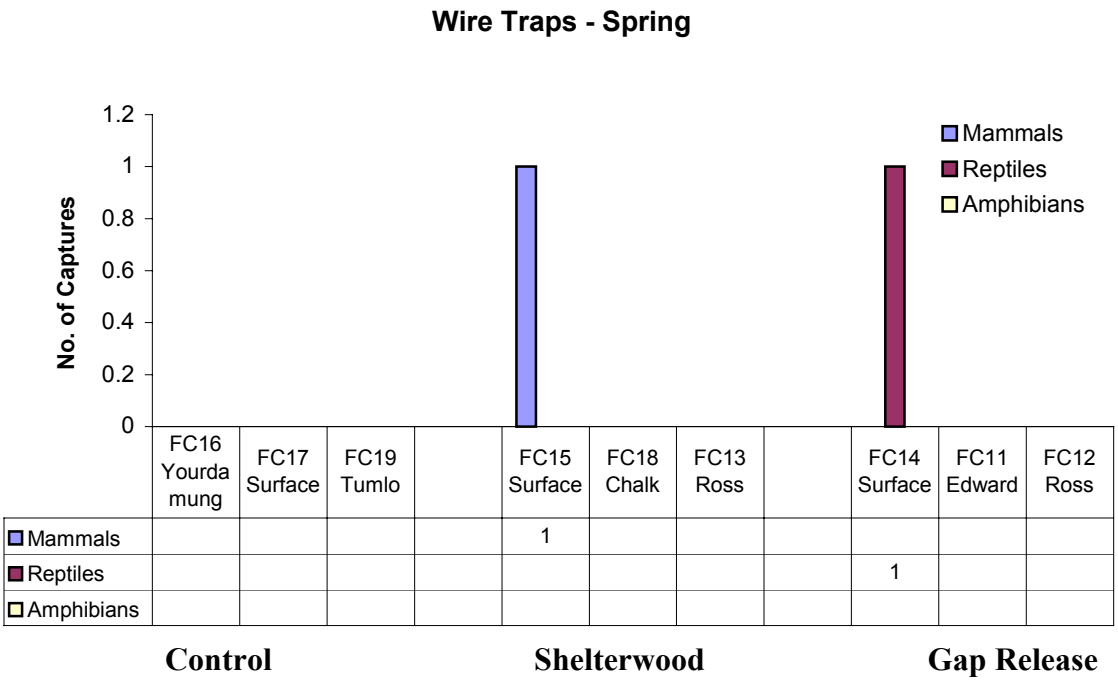
Control **Shelterwood** **Gap Release**

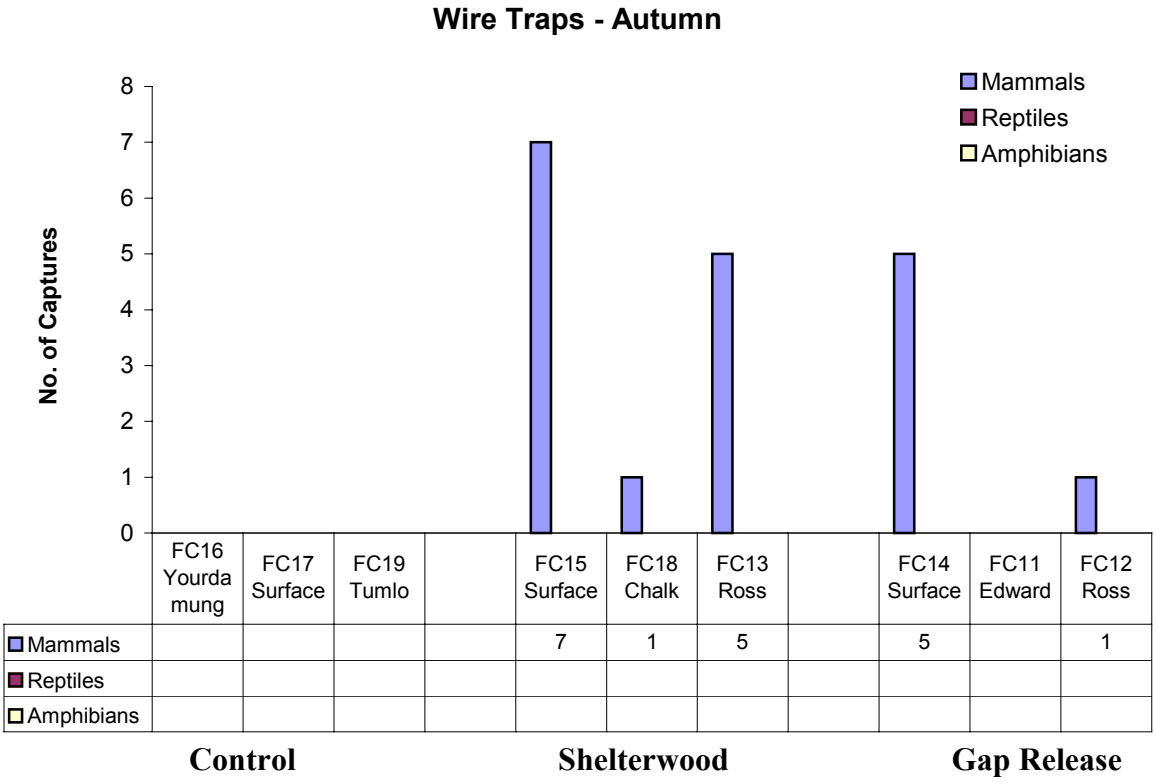
Autumn Trapping By Species



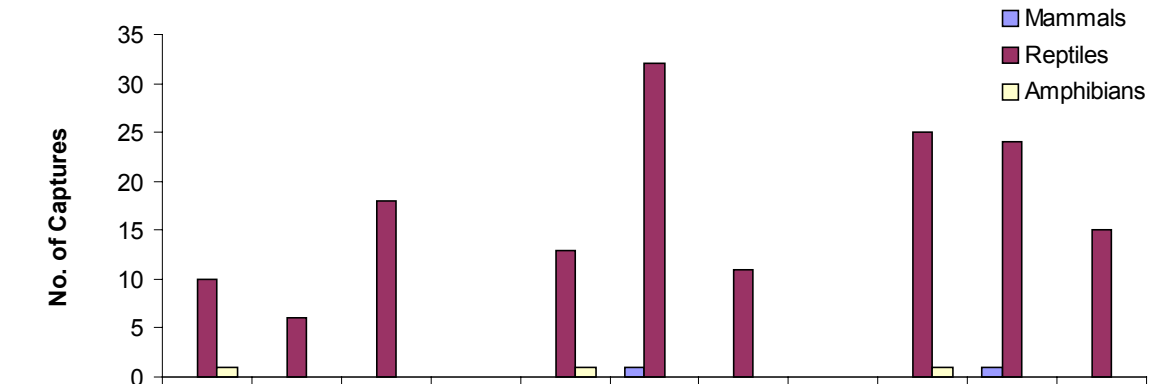
	FC16 Yourdamung	FC17 Surface	FC19 Tumlo		FC15 Surface	FC18 Chalk	FC13 Ross		FC14 Surface	FC11 Edward	FC12 Ross
Mammals					8	2	5		5		1
Reptiles	1		1		4	4	2		3	2	1
Amphibians										1	

Control **Shelterwood** **Gap Release**


Wire Traps - Spring
No. of Captures
1.2
1
0.8
0.6
0.4
0.2
0
Mammals
Reptiles
Amphibians
FC16 Yourdamung
FC17 Surface
FC19 Tumlo
FC15 Surface
FC18 Chalk
FC13 Ross
FC14 Surface
FC11 Edward
FC12 Ross
Mammals 1
Reptiles 1
Amphibians
Control
Shelterwood
Gap Release


Wire Traps - Autumn
No. of Captures
8
7
6
5
4
3
2
1
0
Mammals
Reptiles
Amphibians
FC16 Yourdamung
FC17 Surface
FC19 Tumlo
FC15 Surface
FC18 Chalk
FC13 Ross
FC14 Surface
FC11 Edward
FC12 Ross
Mammals 7 1 5 5 1
Reptiles
Amphibians
Control
Shelterwood
Gap Release

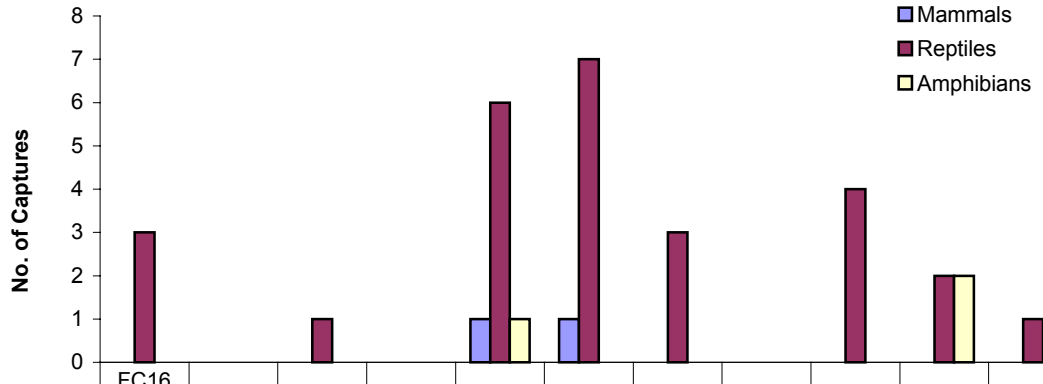
Pitfall Traps - Spring



	FC16 Yourdamung	FC17 Surface	FC19 Tumlo		FC15 Surface	FC18 Chalk	FC13 Ross		FC14 Surface	FC11 Edward	FC12 Ross
Mammals						1				1	
Reptiles	10	6	18		13	32	11		25	24	15
Amphibians	1				1				1		

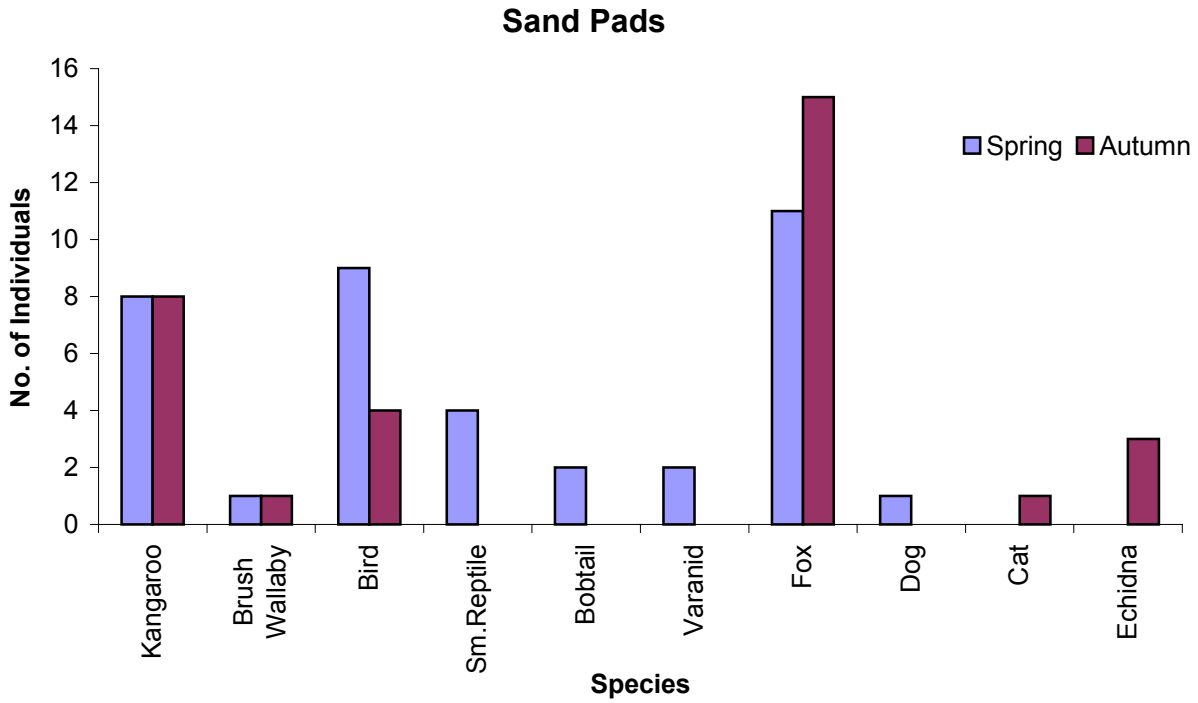
Control **Shelterwood** **Gap Release**

Pitfall Traps - Autumn



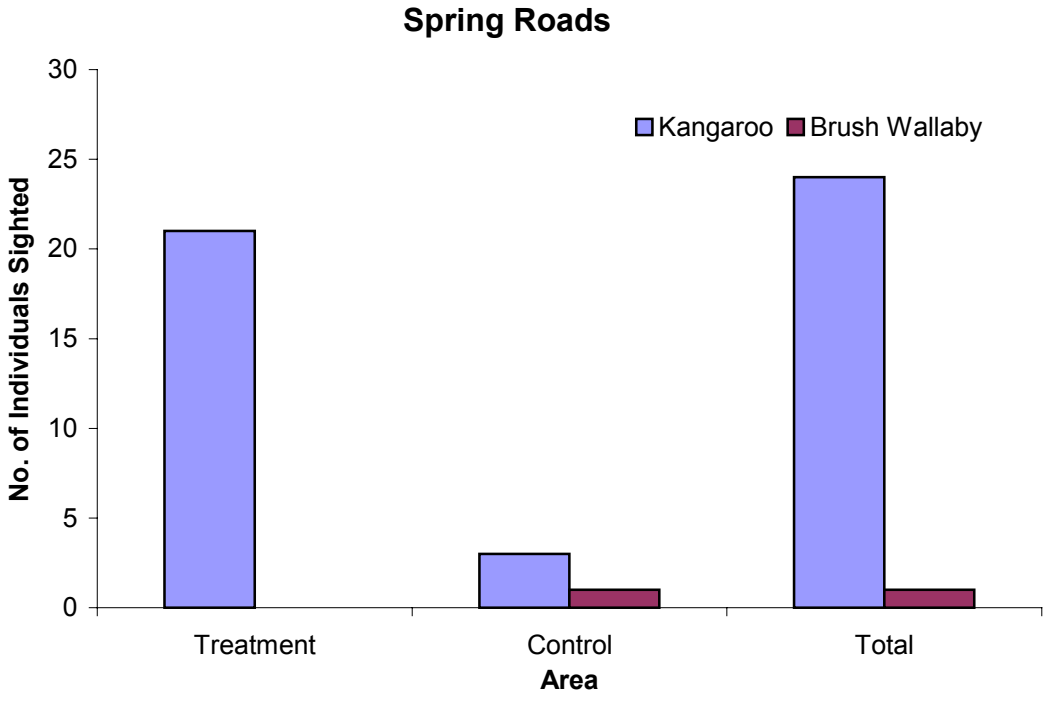
	FC16 Yourdamung	FC17 Surface	FC19 Tumlo		FC15 Surface	FC18 Chalk	FC13 Ross		FC14 Surface	FC11 Edward	FC12 Ross
Mammals			0		1	1	0		0		0
Reptiles	3		1		6	7	3		4	2	1
Amphibians					1					2	

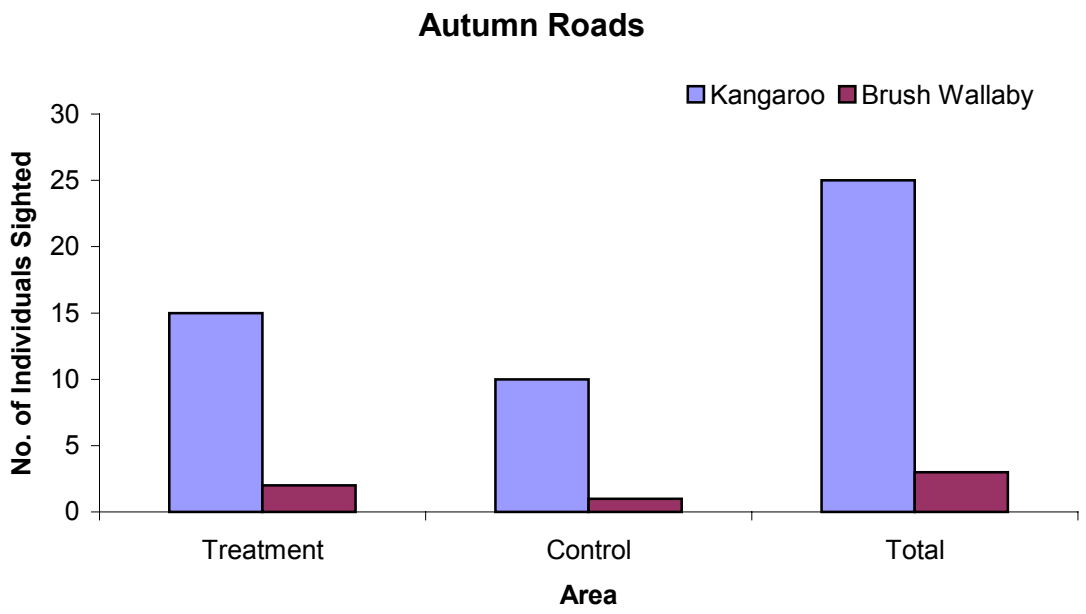
Control **Shelterwood** **Gap Release**



The 2002 results for sandpads were applied only to trap sites and though we did see an array of species recorded on the pads, the results for this year (2003) are based on sand pads at 1 km intervals over 52 km. The main species looked for on the pads are the feral mammals. The high numbers of foxes recorded (11 for spring and 15 for autumn) do present a concern. If the area is included in the Western Shield baiting it will be of great benefit to the native species.

The Brush Wallaby was recorded in very low numbers from the road surveys, with one seen in spring and 3 seen in autumn. These numbers are similar to the results found west of the SW Hwy in Donnelly last year, which was also unbaited.





Sampling Methods
The major issues of sampling from last year (2002) were the inclusion of the wire cage traps in the spring session . This was done and no problems were encountered. It is unlikely that wire cage traps will present problems even if capture rates are high.

The other major sampling issue from 2002 was the inadequacy of the sand pads as a sampling technique. The focus of this was changed in the Operating Plan to landscape monitoring, with pleasing results. The only problem is the availability of clean sand for this technique.

Future Tasks
Finalize the sites and set up for the next (third) round of monitoring.

Revision of Operating Plan
None required.

DATA MANAGEMENT AND STORAGE

Amanda Mellican and Verna Tunsell

Introduction

We are responsible for entering the data collected into electronic format for macro vertebrates, birds, nocturnal birds, mammals and herpetofauna, vascular plants and cryptogams, and the collected voucher specimens (flora, cryptogams and fungi), and obtaining the electronic data from the remaining groups.

Data Entry

An excel program applying Visual Basic was developed for each of the survey sheets. There are 2 parts in the program; Data entry and Data correction. The aim is to save time and to reduce typing errors during the data entry process.

As an example, in the Trapping Field Data Sheet, there are 12 fields for the data entry (Location, Treatment, Personnel, Date, Trap point, Species, Weight, Tag #1, Tag #2, Sex, Breeding Condition and Comments). Places of location, names of treatment, names of personnel and gender are known and they are created as drop-down lists. As for the species, common species name was pre-listed in the program. Date as in Day, Month and Year (from 2001 to 2010) was also created as drop down lists. Thus, location, treatment and personnel are only entered once for all the records for a particular data sheet. If there was nothing to comment on, then the program will automatically record in the Comments section as "No comment". If any one of the fields is missing or left it as blank, an error message is given and the data would not be inserted into data file until all the fields are selected or filled. Species code, scientific name and common name are also automatically recorded into the data file depending upon the selected common species. Record number is automatically written into the data file.

To date, all the survey sheets were completed by Verna Tunsell. A Metadata form as shown in Appendix A is also completed.

Data Validation

Amanda validates the data for all the groups that we are responsible for. The validation date will be recorded in the metadata form. Then a DESCRIPTIONS file (which indicates the lists of an individual field, and codes and descriptions of an individual field), and the validated DATA file will be sent to the leader of the individual group.

Data Storage

All the individual sampling data will be saved and backed up as individual files on the network drive. The data are saved and secured since the network drive is backed up at COB everyday. The final version of the validated data will be printed and kept in a filing cabinet and eventually archived with the library at the completion of the project.

Collected Specimens

Of the 241 Flora and 489 Cryptogam specimens collected during the period, all of the specimens have been identified, prepared and are lodged at the WA Herbarium. Identification and processing of fungi is still progressing as these are later collections.

The specimens that have been lodged at the Herbarium have been databased on the "MAX" system and submitted electronically. Max is used as the primary means of submitting specimen information to the Herbarium. There are many facets to Max but the main ones relevant to

FORESTCHECK are the collection book, specimen tables and reporting facilities. (Examples are illustrated in Appendices B, C and D).

Mosses are washed prior to drying to remove debris, Cryptogams are dried. All friable specimens are stabilized with emulsion. Specimens are placed on a card with adhesive to keep the specimen together. The specimens are then secured in cardboard boxes to prevent damage. Fungi specimens are also dried wrapped in paper and placed into zip lock bags. Those small enough then go into similar boxes to cryptogams. Very large specimens remain unboxed. Flora specimens are pressed and dried, then mounted, with specialized herbarium tape, on card, and placed in separate folders.

All these specimens then have labels and barcodes attached. Each specimen is allocated its own barcode so that each is unique and is readily located by electronic means or by physical means as required.

Appendix A. Example of Metadata Form.

Group Name →

Leader →

Contact Officer →

No	File Name	File Size (KB)	File Type	Date (completed)	Name of Data Entry Person	Validated Date

Appendix B. Example of Flora Labels generated by MAX.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Senecio leucoglossus F.Muell.

Asteraceae

Identified by:

Erect open perennial shrub, height to 50 cm, width to 35 cm; floral rays white. Population flowering: 100%. State forest; ridge; brown laterite clayey sand; not recently burnt. Locally occasional Forest with associated Eucalyptus marginata, Banksia grandis, Allocasuarina fraseriana.

Loc.: Plot FC17, Asquith Road, Surface Forest Block, N of Collie,

Lat. 33° 7' 22"S **Long.** 116° 15' 49"E (WGS84)

Coll. B.G. Ward and R.J. Cranfield FC241 **Date:** 07/10/2002

Voucher: Forestcheck Monitoring Program.

PERTH 5651018

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Persoonia longifolia R.Br.

Proteaceae

Identified by:

Erect compact perennial shrub, height to 2 m, width to 1.6 m; past fruiting. State forest; ridge; brown laterite clayey sand; not recently burnt. Frequent. Forest with associated Eucalyptus marginata, Banksia grandis, Allocasuarina fraseriana.

Loc.: Plot FC17, Asquith Road, Surface Forest Block, N of Collie,

Lat. 33° 7' 22"S **Long.** 116° 15' 49"E (WGS84)

Coll. B.G. Ward and R.J. Cranfield FC243 **Date:** 07/10/2002

Voucher: Forestcheck Monitoring Program.

PERTH 5650984

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia extensa Lindl.

Mimosaceae

Identified by:

Erect open perennial shrub, height to 1.1 m, width to 70 cm; flowers yellow. Population flowering: 10%. State forest; ridge; brown laterite clayey sand; not recently burnt. Occasional Forest with associated Eucalyptus marginata, Banksia grandis, Allocasuarina fraseriana.

Loc.: Plot FC17, Asquith Road, Surface Forest Block, N of Collie,

Lat. 33° 7' 22"S **Long.** 116° 15' 49"E (WGS84)

Coll. B.G. Ward and R.J. Cranfield FC242 **Date:** 07/10/2002

Voucher: Forestcheck Monitoring Program.

PERTH 5650992

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Thysanotus sp. (FC244)

Anthericaceae

Identified by:

Erect perennial dwarf shrub, height to 15 cm, width to 11 cm; flowers purple. Population flowering: 100%. State forest; ridge; brown laterite clayey sand; not recently burnt. Locally occasional. Forest with associated Eucalyptus marginata, Banksia grandis, Allocasuarina fraseriana.

Loc.: Plot FC17, Asquith Road, Surface Forest Block, N of Collie,

Lat. 33° 7' 22"S **Long.** 116° 15' 49"E (WGS84)

Coll. B.G. Ward and R.J. Cranfield FC244 **Date:** 07/10/2002

Voucher: Forestcheck Monitoring Program.

PERTH 5650976

Appendix C. Example of Cryptogam Label generated by MAX.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Cladonia ramulosa

Cladoniaceae

Identified by: R.J. Cranfield 17/06/2003

Lichen: active growth phase; growing in sheltered wet positions on organic material in ground layer. Chemistry: Cortex K-. Hill; bare to littered gravelly, stony, brown clay; soil pH 7; disturbance from logging present; last burnt 1994. Occasional on isolated sites. Forest with 3-4 life denisty classes associated with Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia, Banksia grandis, Bossiaea aquifolium subsp. aquifolium.

Loc.: FC18, Hunter Road, Chalk Forest Block, 34.5 km at 21.8° from Collie,

Lat. 33° 3' 12"S **Long.** 116° 13' 1"E (WGS84)

Coll. R.J. Cranfield & K. Knight. 18900 **Date:** 20/05/2003

Voucher: Forestcheck Monitoring Program

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Cladonia sulcata var. ***sulcata***

Cladoniaceae

Identified by: R.J. Cranfield 17/06/2003

Lichen: active growth phase; fruiting bodies present; growing in sheltered wet positions on soil and organic material in ground layer. Chemistry: Cortex K+ yellow. Hill; bare to littered gravelly, stony, brown clay; soil pH 7; disturbance from logging present; last burnt 1994. Frequent on isolated sites. Forest with 3-4 life denisty classes associated with Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia, Banksia grandis, Bossiaea aquifolium subsp. aquifolium.

Loc.: FC18, Hunter Road, Chalk Forest Block, 34.5 km at 21.8° from Collie,

Lat. 33° 3' 12"S **Long.** 116° 13' 1"E (WGS84)

Coll. R.J. Cranfield & K. Knight. 18901 **Date:** 20/05/2003

Voucher: Forestcheck Monitoring Program

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Cladonia sulcata var. ***wilsonii***

Cladoniaceae

Identified by: R.J. Cranfield 17/06/2003

Lichen: active growth phase; fruiting bodies present, podetia erect, apo's brown; growing in sheltered wet positions on soil and organic material in ground layer. Chemistry: Cortex K+ yellow. Hill; bare to littered gravelly, stony, brown clay; soil pH 7; disturbance from logging present; last burnt 1994. Frequent on occasional sites. Forest with 3-4 life denisty classes associated with Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia, Banksia grandis, Bossiaea aquifolium subsp. aquifolium.

Loc.: FC18, Hunter Road, Chalk Forest Block, 34.5 km at 21.8° from Collie,

Lat. 33° 3' 12"S **Long.** 116° 13' 1"E (WGS84)

Coll. R.J. Cranfield & K. Knight. 18902 **Date:** 20/05/2003

Voucher: Forestcheck Monitoring Program

Dups. to: MJP.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Cladonia sulcata var. ***wilsonii***

Cladoniaceae

Identified by: R.J. Cranfield 17/06/2003

Lichen: active growth phase; fruiting bodies present, podetia erect, apo's brown; growing in sheltered wet positions on soil and organic material in ground layer. Hill; bare to littered gravelly, stony, brown clay; soil pH 7; disturbance from logging present; last burnt 1994. Frequent on occasional sites. Forest with 3-4 life denisty classes associated with Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia, Banksia grandis, Bossiaea aquifolium subsp. aquifolium.

Loc.: FC18, Hunter Road, Chalk Forest Block, 34.5 km at 21.8° from Collie,

Lat. 33° 3' 12"S **Long.** 116° 13' 1"E (WGS84)

Coll. R.J. Cranfield & K. Knight. 18902A **Date:** 20/05/2003

Voucher: Forestcheck Monitoring Program

Appendix D. Example of Specimen Table generated in MAX.

		2003 VEG			
	Taxon Name	TaxonID	SpCode	LifefornFire Resp	LifeStyle
	Leptomeria cunninghamii	2342	LEPCUN	S A1	P
	Leucopogon australis	6360	LEUAUS	S B2	P
	Leucopogon capitellatus	6367	LEUCAP	S B2	P
	Leucopogon propinquus	6436	LEUPRO	S B2	P
	Leucopogon verticillatus	6454	LEUVER	S B2	P
	Levenhookia pusilla	7676	LEVPUS	H A1	A
	Logania serpyllifolia	6511	LOGSER	DS B2	P
	Lomandra caespitosa	1223	LOMCAE	DS B3	P
	Lomandra drummondii	1225	LOMDRU	DS B3	P
	Lomandra integra	1229	LOMINT	DS B3	P
	Lomandra purpurea	1240	LOMPUR	DS B3	P
	Lomandra sericea	1243	LOMSER	DS B3	P
	Lomandra sonderi	1244	LOMSON	S B2	P
	Lomandra suaveolens	1246	LOMSUA	DS B2	P
	Luzula meridionalis	1198	LUZMER	R B2	P
	Macrozamia riedlei	85	MACRIE	C B32	P
	Melaleuca thymoides	5980	MELTHY	S B2	P
	Millotia tenuifolia	8106	MILTEN	H A1	A
	Monotaxis occidentalis	4666	MONOCC	DS A1	P
	Neurachne alopecuroidea	492	NEUALO	GR B3	P
	Olax benthamiana	2365	OLABEN	DS A1	P
	Oligochaetochilus vittatus	19804	OLIVIT	G B3	P
	Opercularia hispidula	7348	OPEHIS	S B2	P
*	*Oxalis corniculata*	4349	OXACOR	G B3	P
	Patersonia babianoides	1542	PATBAB	G B3	P
	Patersonia occidentalis	1550	PATOCC	DS B3	P
	Patersonia pygmaea	1551	PATPYG	DS B3	P
	Pelargonium littorale	4346	PELLIT	DS A1	P
	Pentapeltis peltigera	6245	PENPEL	DS B2	P
	Pentapeltis silvatica	6246	PENSIL	S B2	P
	Persoonia longifolia	2267	PERLON	S B2	P
	Phyllangium paradoxum	16177	PHYPAR	H A1	A
	Phyllanthus calycinus	4675	PHYCAL	DS B2	P
	Pimelea rosea	5261	PIMROS	S A1	P
	Pimelea spectabilis	5264	PIMSPE	S A1	P
	Pimelea suaveolens	5266	PIMSUA	S B2	P
	Pimelea sylvestris	5269	PIMSYL	S A1	P
	Podolepis canescens	8172	PODCAN	H A1	A
	Podotheca gnaphalioides	8184	PODGNA	H A1	A
	Poranthera microphylla	4691	PORMIC	DS A1	A
*	*Pseudognaphalium luteoalbum*	8189	PSELUT	H A1	A
	Pteridium esculentum	57	PTEESC	F B2	P
	Pterostylis pyramidalis	11118	PTEPYR	G B3	P
	Pterostylis recurva	1693	PTEREC	G B3	P
	Ptilotus drummondii	2718	PTIDRU	G A1	P
	Ptilotus manglesii	2742	PTIMAN	DS B3	P
	Ptilotus stipitatus	2762	PTISTI	G B3	P
	Pyrorchis nigricans	16367	PYRNIG	DS B3	P
	Rhodanthe citrina	13300	RHOCIT	G A1	P
	Scaevola calliptera	7602	SCACAL	H A1	P
	Scaevola striata	7646	SCASTR	DS A1	A
	Senecio hispidulus	8208	SENHIS	DS A1	P
	Senecio lautus	8211	SENLAU	S A1	A

* = Alien species

Appendix E. Example of Flora File Report generated in MAX.

23/10/2003 FC Spring 2002 - 1 1

COLLECT_NO	FAMILY	GENUS	SPECIES	INFSP_TYPE	INFSP_NAME	SHEETNO
FC241	Asteraceae	Senecio	leucoglossus			5651018
FC242	Mimosaceae	Acacia	extensa			5650992
FC243	Proteaceae	Persoonia	longifolia			5650984
FC244	Anthericaceae	Thysanotus	sp. (FC244)			5650976
FC245	Apiaceae	Xanthosia	candida			5650968
FC249	Epacridaceae	Leucopogon	verticillatus			5650941
FC250	Santalaceae	Leptomeria	cunninghamii			5650933
FC253	Zamiaceae	Macrozamia	riedlei			56650925
FC259	Dilleniaceae	Hibbertia	commutata			5651093
FC267	Rubiaceae	Opercularia	hispidula			5651085
FC268	Droseraceae	Drosera	glanduligera			5651077
FC269	Asteraceae	Senecio	hispidulus			5651069
FC270	Apiaceae	Hydrocotyle	callicarpa			5651050
FC271	Stylidiaceae	Levenhookia	pusilla			5651042
FC273A	Mimosaceae	Acacia	preissiana			5651034
FC279	Zamiaceae	Macrozamia	riedlei			5651026
FC280	Goodeniaceae	Lechenaultia	biloba			5651182
FC282	Olacaceae	Olax	benthamiana			5651174
FC283	Lamiaceae	Hemigenia	rigida			5651166
FC284	Papilionaceae	Kennedia	prostrata			5651158
FC285	Rubiaceae	Opercularia	hispidula			5651131
FC286	Papilionaceae	Kennedia	coccinea			5651123
FC287	Dasypogonaceae	Lomandra	caespitosa			5651115
FC288	Euphorbiaceae	Phyllanthus	calycinus			5651107
FC291	Proteaceae	Hakea	lissocarpha			5651263
FC292	Dilleniaceae	Hibbertia	amplexicaulis			5651255
FC294	Caesalpiniaceae	Labichea	punctata			5651247
FC296	Droseraceae	Drosera	menziesii	subsp.	menziesii	5651239
FC300	Goodeniaceae	Dampiera	linearis			5651220
FC301	Orchidaceae	Caladenia	flava	subsp.	flava	5651212
FC302	Euphorbiaceae	Monotaxis	occidentalis			5651204
FC304	Orchidaceae	Diuris	magnifica			5651190
FC305	Asteraceae	Lagenophora	huegelii			5651360
FC306	Apiaceae	Hydrocotyle	callicarpa			5651352
FC307	Orchidaceae	Pterostylis	pyramidalis			5651344
FC308	Proteaceae	Persoonia	longifolia			5651336
FC309	Epacridaceae	Leucopogon	capitellatus			5651328
FC311	Mimosaceae	Acacia	pulchella	var.	pulchella	5651301
FC312	Myrtaceae	Hypocalymma	angustifolium			5651298
FC313	Epacridaceae	Astroloma	pallidum			5651271
FC314	Euphorbiaceae	Phyllanthus	calycinus			5651441
FC316	Papilionaceae	Gompholobium	preissii			5651433
FC318	Santalaceae	Leptomeria	cunninghamii			5651425
FC319	Dilleniaceae	Hibbertia	hypericoides			5651417
FC320	Mimosaceae	Acacia	browniana	var.	browniana	5651409
FC321	Papilionaceae	Bossiaea	ornata			5651395
FC323	Haemodoraceae	Conostylis	serrulata			5651387
FC325	Papilionaceae	Daviesia	incrassata			5651379
FC327	Dilleniaceae	Hibbertia	amplexicaulis			5651530
FC328	Goodeniaceae	Dampiera	linearis			5651522
FC330	Dasypogonaceae	Lomandra	caespitosa			5651514

* = Alien species