REPORT OF PROGRESS 2005-06

FOREST CHECK

Department of Environment and Conservation

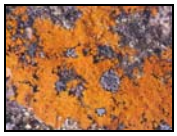
Science Division
October 2006

Forest structure, soils, litter and coarse woody debris


Reptiles


Fungi


Invertebrates


Lichens


Mammals


Birds


Flora

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This report highlights preliminary results, determined by basic analysis and observation, for the year 2005-06. This and previous FORESTCHECK Annual Reports should not be quoted or used as final results for the FORESTCHECK program. A 5-year analysis based on comprehensive statistical methods and detailing final results and management implications will be published in the future.

Department of
Environment and Conservation

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EXECUTIVE SUMMARY

This document reports the results of FORESTCHECK monitoring on eleven grids on the Blackwood Plateau in the Blackwood District in 2005-06. There are now 48 FORESTCHECK monitoring grids established throughout the jarrah forest in Donnelly, Wellington, Perth Hills and Blackwood Districts. This report, and previous reports, can be viewed on and downloaded from DEC's Naturebase website at http://www.naturebase.net/content/view/2388/482

All grids on the Blackwood Plateau are located within the Kingia vegetation complex, which is typified by an open forest of jarrah (*E. marginata* ssp. *marginata*), marri (*Corymbia calophylla*), sheoak (*Allocasuarina fraseriana*), bull banksia (*Banksia grandis*) and woody pear (*Xylomelum occidentale*) on lateritic uplands in perhumid and humid zones. The external control grids are situated in uncut forest located either in crown reserve, conservation park or national park. However, in two of the grids there is evidence to suggest that a small number of trees were selectively removed sometime in the past. The remaining grids are in forest that was harvested during the period of 1995 to 2002 and are established in stands with comparable management histories. In addition to the general silvicultural treatments of shelterwood and gap release, grids were also established in forest that was selectively cut. Selective cutting is a silvicultural practice that involves the removal of individual trees in stands where the proportion of sawlogs is low, and in the past has been widely practiced on the Blackwood Plateau.

The results in this report represent observations and preliminary findings from basic analyses. However, some interesting points which have emerged from the 2005-06 results, and from comparisons with data from other FORESTCHECK locations are:

- Jarrah contributed more than 40% of eucalypt regeneration and established trees on all Blackwood Plateau grids.
- Grids cut to gap release and shelterwood met the 65% stocking standard, but selectively cut areas with a high level of retained overwood were not as well stocked.
- Blackwood Plateau soils have lower concentrations of N, P (available and total) and K (extractable) than measured in the previous 4 years of sampling.
- On all FORESTCHECK grids so far monitored for soil bulk density (11 grids), timber harvesting increased bulk density of the surface soils across the harvested area by 18% on average.
- Caprock substantially reduced visual evidence of soil disturbance on several sites and several sandy sites showed little evidence of soil disturbance.
- Litter loads generally reflected the time since last burn.
- The volume of coarse woody debris was variable within and between the treatments.
- A total of 556 species of macrofungi have so far been recorded by FORESTCHECK.
- The majority of macrofungi recorded in the Blackwood Plateau grids fruited on soil.
- Cryptogam species richness was highest in the external controls.
- The most common lichens were crustose-types and the most common substrates utilised in all treatments were rocks and decaying logs.
- The Blackwood Plateau sites have the highest vascular plant species richness of all FORESTCHECK locations monitored so far, with 22% more species.
- Harvesting treatments on the Blackwood Plateau grids appeared not to have had a significant impact on vascular plant species richness and abundance, however in the shelterwood treatment, plant abundance in the shrub layer was low compared to other treatments.
- Adverse spring weather resulted in the spring invertebrate light trap capture being less diverse than the autumn capture (the reverse of other localities).
- Blackwood Plateau had the highest invertebrate species diversity of all FORESTCHECK locations monitored so far, with 1,489 morphospecies recorded.
- The number of birds per hectare was similar in each treatment, with an overall density of 8.9 birds per hectare.
- Barking owls (*Ninox connivens*) have not been recorded at any of the FORESTCHECK locations.

- The dominant mammal recorded was the brushtail possum (*Pseudocheirus occidentalis*) (49% and 90% of captures in spring and autumn respectively).
- A woylie (*Bettongia penicillata*) captured at Butler block was about 15 km from where the species was reintroduced in 1980.
- Feral cats were recorded on 5 of the 8 sandpad transects, and cats, dogs, foxes, pigs and rabbits were all recorded on Keene Rd.

After five years of monitoring FORESTCHECK has gathered data on about 2,890 species of plants, animals (vertebrate and invertebrate), fungi and cryptogams (Fig. 1).

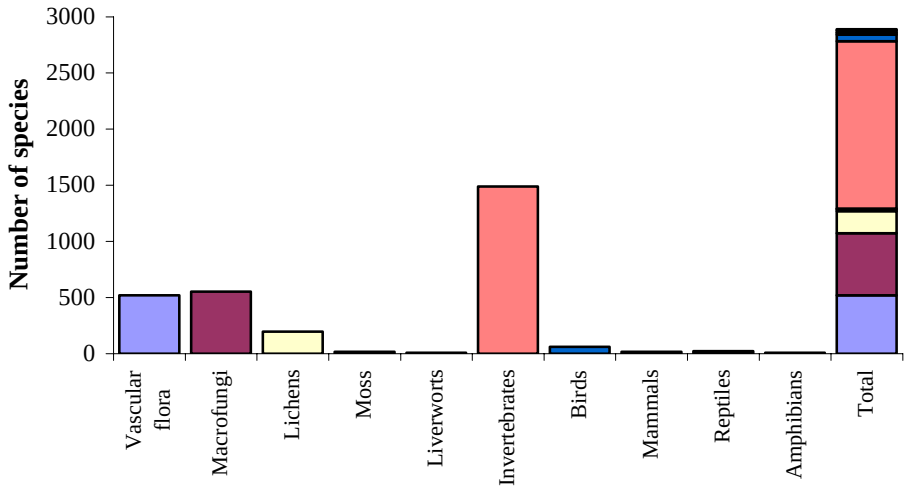

Figure 1. The number of species recorded for each element of the biota monitored by FORESTCHECK from 2002-2006.

Invertebrates account for about 50% of the total species diversity. Many species of invertebrates, fungi and cryptogams are new to science or are new records for WA. Monitoring on the Blackwood Plateau in 2005-06 marked the fifth year of FORESTCHECK monitoring. When the program was initiated in 2002, it was agreed that a major analysis and write-up would be undertaken every five years. In view of this, monitoring will be suspended for 2006-07 and emphasis will be placed on the 5-year analysis and write-up. The results will be important in supporting ecologically sustainable forest management in WA. Monitoring will continue in 2007-08.

A general trend to emerge from each year of monitoring was that timber harvesting and the various silvicultural treatments did not affect species richness and abundance, but species composition recorded in each treatment and at different locations within the jarrah forest differed. The extent and importance of this difference will be explored in the major analysis in 2006-07.

The commitment and professionalism of the FORESTCHECK team is to be commended and I look forward to examining the results of the 5-year analysis in 2007.

Dr Neil Burrows
Director Science Division
October 2006

INTRODUCTION

Scope

This report has been compiled from chapters prepared by scientists and technical staff involved in the FORESTCHECK monitoring program. It represents a summary of monitoring activities completed in jarrah forest on the Blackwood Plateau in the Blackwood District during the 2005-06 financial year.

FORESTCHECK is an integrated monitoring system that has been developed to provide information to forest managers in the southwest of 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 was 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[1] and is included as an operational program in the current Forest Management Plan 2004-2013[2]. 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 and adaptive management is recognized as an appropriate strategy for managing under conditions of uncertainty and change.

The Science Division of the Department of Environment and Conservation has primary responsibility for the implementation of FORESTCHECK. The development of the program took place over 2 years and included input from scientists and managers within the Department of Environment and Conservation, and from a number of external scientific agencies. The background to this process is described in the FORESTCHECK Concept Plan, and details of methods are provided in the FORESTCHECK Operations Plan. Annual Progress Reports, the Concept Plan and Operations Plan may be viewed on the Department's Naturebase website at http://www.naturebase.net/science/science.html.

Monitoring strategy

Between 1995 and 2004 timber harvesting in jarrah forests was undertaken according to Silvicultural Guideline 1/95, which recognizes three 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.

[1] Codd, M. 1999. Forest management Plans 1994-2003: Mid-Term EPA Report on Compliance
[2] Conservation Commission of Western Australia.2004. Forest management plan 2004-2013. Conservation Commission of Western Australia. 144p + maps.

Silvicultural guidelines were revised in conjunction with the preparation of the Forest Management Plan (2004-2013) and are now available as SFM Guideline No. 1 (CALM 2004[3]).

Gap creation 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.

FORESTCHECK sites have been established at a number of locations throughout the jarrah forest, stratified according to recognized ecological gradients of rainfall, evapo-transpiration and soil fertility. Forest ecosystem mapping (Mattiske and Havel 1998[4], 2000[5]) 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 have been established in forest subject to the following treatments:

(1) gap release,
(2) shelterwood and/or selective cut,
(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.

At each location, grids are 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 are always present in the one locality and occasionally external reference forest has been located some distance from their harvested counterparts. Also, 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

Monitoring of biodiversity is based on a sampling grid (see Fig. 1). The main grid is 200 m x 100 m, with a central area of 100 m x 100 m. Four 30 m x 30 m vegetation sample plots are located external to and adjacent each corner of the central area.

A range of ecosystem attributes are monitored on each grid 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

[3] CALM 2004. Silvicultural practice in the jarrah forest. Dept. CALM, SFM guideline No. 1.
[4] Mattiske, E.M. and Havel, J.J. 1998. Regional Forest Agreement Vegetation Complexes, Collie, Western Australia [cartographic material – scale 1:250,000]. WA Department of Conservation and Land Management.
[5] Mattiske, E.M. and Havel, J.J 2000. Vegetation Mapping in the South West of Western Australia. CALM, Perth.

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 on the Blackwood Plateau 2005-06.

Eleven FORESTCHECK monitoring grids were established and monitored in jarrah forest in the Blackwood District during 2005-06. Four grids (FC38, 43, 41 and 46) were established in Barrabup, three in Cambray (FC44, 42 and 47), two in Butler (FC 45 and48) and one each in St John (FC39) and Layman (FC40) forest blocks. All grids were located on the Blackwood Plateau in areas of forest adjacent the 1100 mm annual rainfall isohyet, and identified by alphanumeric codes FC88 to FC48 (Figs 2 and 3).

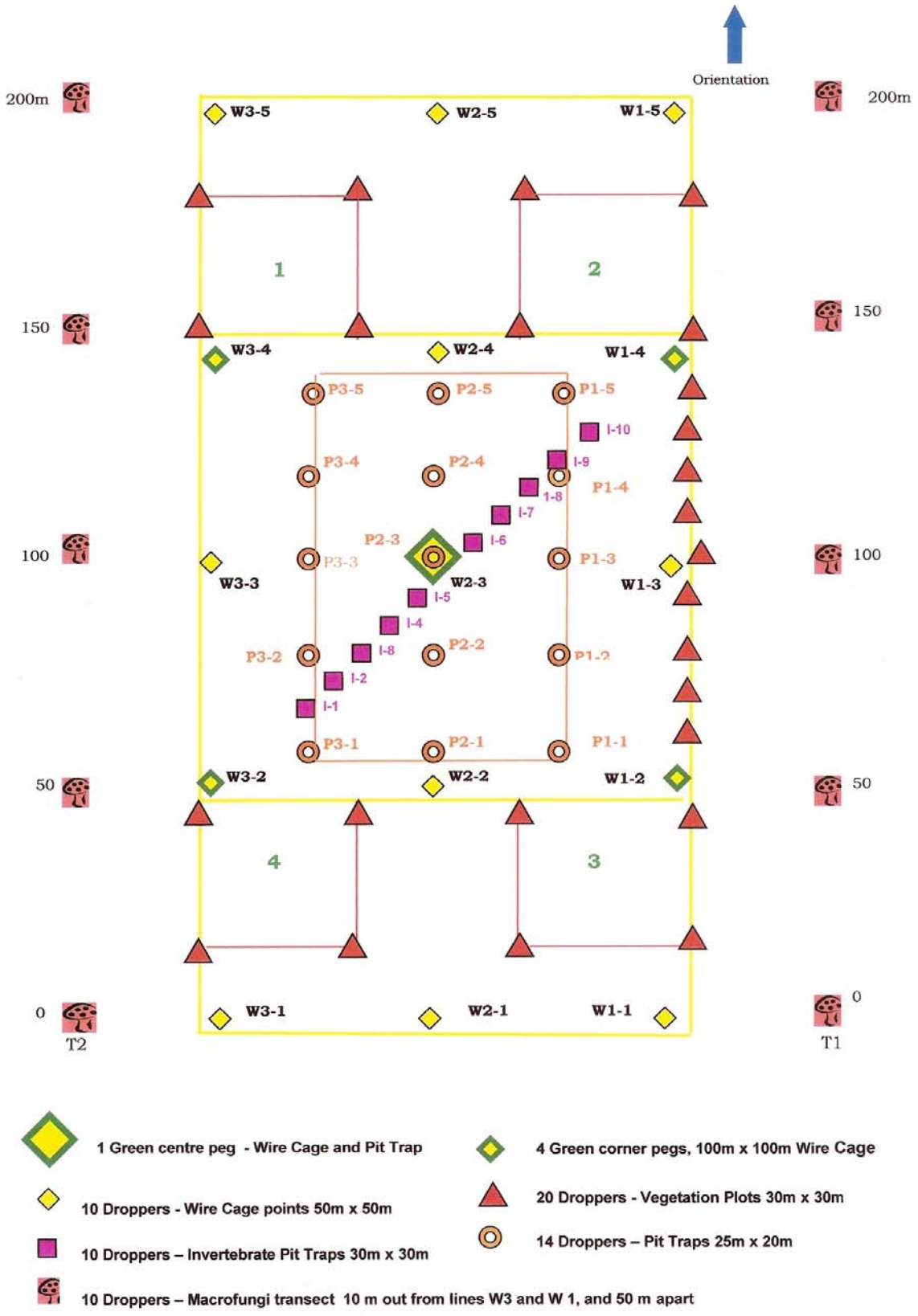

Figure 1. FORESTCHECK grid layout

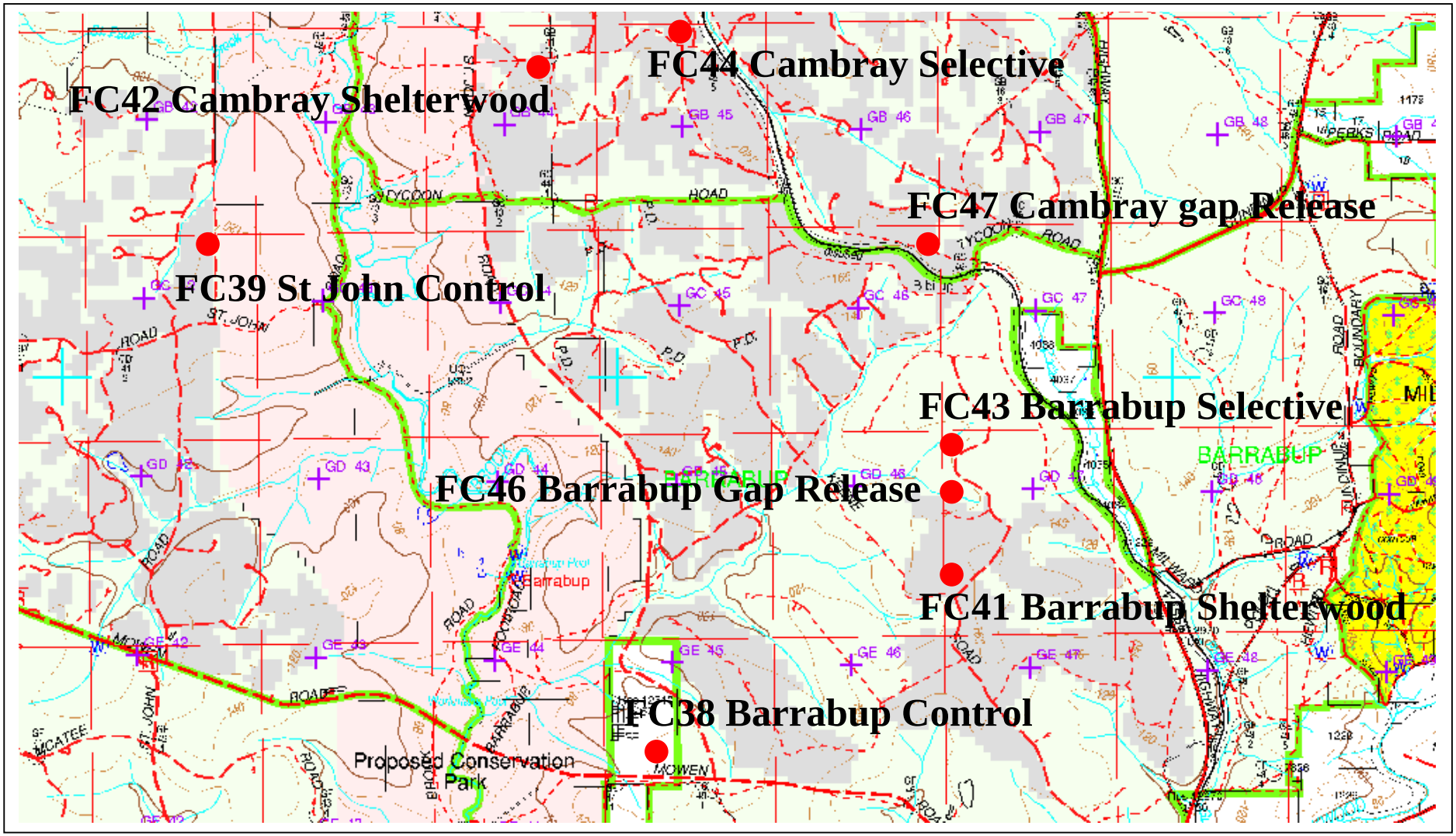

Figure 2. Location of FORESTCHECK sampling grids established in 2006 on the eastern Blackwood Plateau.

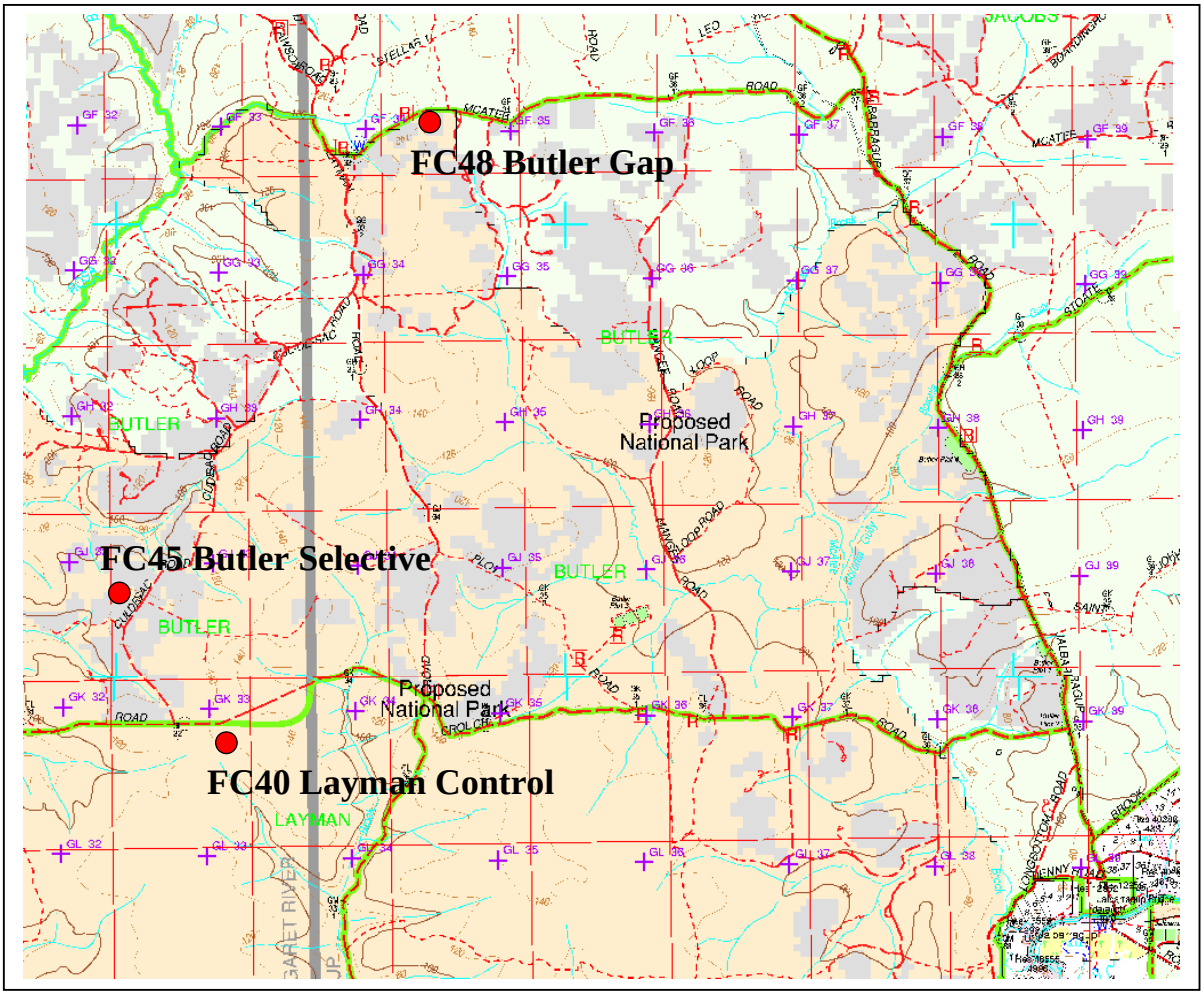

Figure 3. Location of FORESTCHECK sampling grids established in 2006 on the western Blackwood Plateau.

All grids are located within the Kingia vegetation complex of Mattiske and Havel (1998). This complex is found in open forests of jarrah (*E. marginata* ssp. *marginata*), marri (*Corymbia calophylla*), sheoak (*Allocasuarina fraseriana*), bull banksia (*Banksia grandis*) and woody pear (*Xylomelum occidentale*) on lateritic uplands in perhumid and humid zones (Table 1).

The external control grids are situated in uncut forest but there are a small number of stumps present in the Barrabup and St John grids suggesting a number of trees had been selectively removed in the past. The Barrabup grid is located in crown reserve, St John in conservation park and Layman in national park and the range of time since the last fire was 3-13 years (Table 1).

The remaining grids are in forest that was harvested during the period of 1995 to 2002 and were established at sites in stands with comparable management histories. On the Blackwood Plateau a common silvicultural treatment in the past was selective cutting. Selective cutting involves the removal of individual trees in stands where the proportion of sawlogs is low. Stands where the residual number of cull trees is too great to make follow-up silviculture achievable are also recorded as having been selectively cut. Selective cutting was recognised as a silvicultural option in Guideline 1/95, which applied from 1995 up until the adoption of SFM Guideline No.1 in

2004. Three selective cut grids were established, one each in Barrabup, Cambray and Butler forest blocks (Table 1).

Table 1. Forest block location, and management history of each FORESTCHECK grid on the Blackwood Plateau.

Treatment/ Plot	Forest Block	Burnt		Logged		Site Type	Site Description
		Year	Years since	Current cutting cycle	Years since		
External Control							
FC38	Barrabup	2002 Sp[1]	3	Uncut[2]		Kingia	Uplands - perhumid
FC39	St John	1992 Sp	13	Uncut[2]		Kingia	Uplands - perhumid
FC40	Layman	1997 Sp	8	Uncut		Kingia	Uplands - perhumid
Shelterwood							
FC41	Barrabup	2002 Sp	3	2002	3	Kingia	Uplands - perhumid
FC42	Cambray	1996 Sp	9	1995	10	Kingia	Uplands - perhumid
Selective Cut							
FC43	Barrabup	2002 Sp	3	2002	3	Kingia	Uplands - perhumid
FC44	Cambray	1996 Sp	9	1995	10	Kingia	Uplands - perhumid
FC45	Butler	1995 Sp	10	1998	7	Kingia	Uplands - perhumid
Gap Release							
FC46	Barrabup	2002 Sp	3	2002	3	Kingia	Uplands - perhumid
FC47	Cambray	1996 Sp	9	1996	9	Kingia	Uplands - perhumid
FC48	Butler	2001 Sp	4	1998	7	Kingia	Uplands - perhumid

[1] Sp refers to the silvicultural burn being carried out in the spring.
[2] Removal of a small number of trees had occurred in the past.

Reference photographs taken of each sampling grid are presented in Figs. 4-15. All photos were taken from peg W2.1 looking towards the centre peg (W2.3) (see Fig. 1), and allow changes in vegetation structure and condition to be observed in each subsequent photograph. All photographs were taken during plot establishment in October 2005.

Barrabup Grids

Figure 4. FC38 Barrabup forest block, External Control

Figure 5. FC41 Barrabup forest block, Shelterwood

Figure 6. FC43 Barrabup forest block, Selective Cut

Figure 7. FC46 Barrabup forest block, Gap Release.

St John and Cambray grids:

Figure 8. FC39 St John forest block, External Control;

Figure 9. FC42 Cambray forest block, Shelterwood.

Figure 10. FC44 Cambray forest block, Selective cut.

Figure 11. FC47 Cambray forest block, Gap Release.

Layman and Butler grids:

Figure 12. FC40 Layman forest block, External Control.

Figure 13. FC45 Butler forest block, Selective Cut.

Figure 14. FC45 stumps and coppice in Butler forest block Selective Cut grid illustrating 3 past cutting events. The photo on the far right shows coppice resulting from the 1998 cut

Figure 15. FC48 Butler forest block, Gap Release.

The budget and expenditure for the 2005-06 FORESTCHECK program is detailed in Table 2. Funding for the program is provided by the Sustainable Forest Management Division of DEC and the Forest Products Commission, of which FPC contributed $200, 000.

Table 2. Budget for establishment and monitoring of FORESTCHECK sites on the Blackwood Plateau for 2005-06

Task/Activity	OIC	Total Operating
OPERATIONAL		
Grid establishment	McCaw	13 000
Forest structure and regeneration	McCaw	6 000
Soil and foliar nutrients	McCaw	5 000
Soils disturbance	Whitford	10 000
Macrofungi / Litter & CWD	Robinson	7 000
Vascular flora	Ward	5 000
Cryptogams	Cranfield	5 000
Invertebrates	Farr	13 000
Birds (diurnal)	Liddelow	4 000
Birds (nocturnal)	Liddelow	5 000
Fauna (grid trapping)	Liddelow	4 000
Spotlight Road surveys (vertebrate)	Liddelow	4 000
OTHER		
Administration and overheads	McCaw	57 060
Data base management	McCaw	46 619
Directorate		15 321
SUB TOTAL		**200 000**
SALARY		173 437
TOTAL		**373 437**

2006-07 Activities

In 2006-07 a major analysis will be undertaken on the 5 years of data collected by the FORESTCHECK program. Results of the analysis will be published in a reputable scientific journal and will include recommendations for future jarrah forest management.

FOREST STRUCTURE AND REGENERATION STOCKING

Lachlan McCaw, Bob Smith (retired 2006) and John Neal (retired 2006)

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 per cent of harvested area of native forest effectively regenerated (Indicator 2.1.g). This is recognised 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 stands, there is a need to consider existing stand structure and whether there is sufficient sapling and advance growth present for re-establishment 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 shelterwood is determined by the density of existing lignotuberous advance growth.

Forest managers also require information about growth rate and species composition 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.

Following discussion at the 2004 annual project meeting the sampling methodology for stand structure was extended to include assessment of cut stumps and trees that have been either pushed over or blown down. Collection of this data makes possible a quantification of the basal area removed in each previous cutting cycle, and the effect of stand improvement silvicultural practices on forest structure. All 48 sampling grids established for the project have now been assessed for stumps and pushed trees.

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.
- Quantify the basal area removed in past harvesting events, and
- Measure the contribution of mid-storey species to stand structure, density and basal area.

Monitoring

Stand structure was assessed at sampling grids between November 2005 and Jan 2006. In addition to the silvicultural treatments of gap release and shelterwood, jarrah forest on the Blackwood Plateau is also subject to selective cut treatment. Selective cutting involves the removal of individual trees in stands where the proportion of sawlogs is low and has in the past been common practice in Blackwood Plateau forests. Stands where the residual number of cull trees is too great to make follow-up silviculture achievable are also recorded as having been selectively cut. Selective cutting was recognised as a silvicultural option in Guideline 1/95, which applied from 1995 up until the adoption of SFM Guideline No.1 in 2004.

Sampling techniques were the same as in previous years and included the assessment of cut stumps and pushed trees to quantify basal area reduction. The diameter, height and species of

stumps >10 cm diameter on the cut face were recorded in the 800 m^2 transect used to assess stand structure. The age of cutting event that resulted in the stump was noted (1 = most recent harvest event, 2 = harvested prior to the most recent event and so on for earlier harvests). Trees that had been pushed or blown down were measured for diameter at 1.3 m about nominal ground level, and a judgement was made as to whether they had fallen as a result of disturbance during harvesting or at an earlier time. 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 measuring all trees taller than 2 m in a transect 200 m long by 4 m wide. In stands cut to gap release, shelterwood and selective cut 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.

Data Management

Regeneration stocking data were summarised and entered into the FORESTCHECK database. Data were 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 and shelterwood grids only).
- Average density of saplings and ground coppice at points that meet the stocking standard.

Preliminary Results

Stand structure and species composition

Eucalypt basal areas in the three external control grids ranged from 34 to 62 m^2, with jarrah comprising at least half of the basal area (Fig. 1, Table 1). Occasional large jarrah cut stumps were recorded at Barrabup (FC 38) and St Johns (FC 39) indicating that 10-15 m^2 ha-1 of basal area had been removed during earlier harvesting operations. Parts of the north-western corner of the Layman grid (FC 40) adjoined a graveyard dieback site and there were several large dead trees included in the transect assessment of stand structure. Intermediate trees of *Allocasuarina fraseriana*, *Banksia grandis* and *Xylomelum occidentale* were present but contributed less than 1 m^2 ha^{-1} to basal area.

Shelterwood stands had retained basal area of jarrah and marri ranging from 21 to 43 m^2 ha^{-1}. The recent harvesting operations had removed 11-13 m^2 ha^{-1} of jarrah basal area from the shelterwood grids at Barrabup (FC 41) and Cambray (FC 42), together with 6 m^2 ha^{-1} of marri at FC 41.

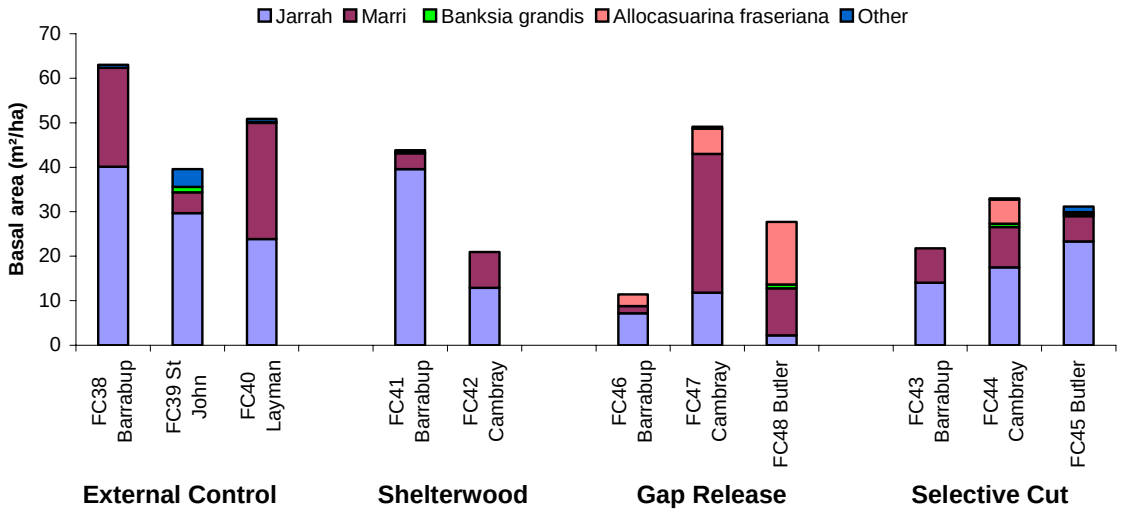

Figure 1. Basal area of jarrah, marri and intermediate trees.

Table 1. Analysis of eucalypt species composition determined according to basal area and stem density of live standing trees >2 m tall, and species mix assessed in regeneration surveys of eleven FORESTCHECK grids in Blackwood Plateau District.

Treatment	Grid	Basal area (m^2 ha^{-1})			Stems/ha			Regeneration species composition	
		jarrah	marri	total	jarrah	marri	total	jarrah	marri
External control	FC38	40.13	22.25	62.38	1413	663	2076	-	-
		64%	*36%*		*79%*	*21%*		*60%*	*40%*
	FC39	29.70	4.68	34.38	425	163	588	-	-
		86%	*49%*		*72%*	*28%*		*48%*	*52%*
	FC40	23.86	26.10	49.96	900	838	1738	-	-
		48%	*52%*		*52%*	*48%*		*56%*	*44%*
Shelterwood	FC41	39.56	3.58	43.14	938	488	1426	-	-
		91%	*9%*		*66%*	*34%*		*48%*	*52%*
	FC42	12.93	8.03	20.96	1025	500	1525	-	-
		62%	*38%*		*67%*	*33%*		*39%*	*61%*
Gap release	FC46	7.18	1.63	8.81	900	488	1388	-	-
		81%	*19%*		*65%*	*35%*		*40%*	*60%*
	FC47	11.85	31.19	43.04	625	400	1025	-	-
		27%	*73%*		*61%*	*39%*		*41%*	*59%*
	FC48	2.24	10.56	12.80	850	225	1075	-	-
		18%	*82%*		*79%*	*21%*		*66%*	*34%*
Selective cut	FC43	14.05	7.74	21.79	1138	788	1926	-	-
		64%	*36%*		*59%*	*41%*		*51%*	*49%*
	FC44	17.50	9.06	26.56	1075	975	2050	-	-
		66%	*34%*		*52%*	*48%*		*44%*	*56%*
	FC45	23.35	5.64	28.99	913	388	1301	-	-
		81%	*19%*		*70%*	*30%*		*77%*	*23%*

Retained basal areas in gap release treatments at Barrabup (FC 46) and Cambray (FC 47) ranged from 9-13 m^2 ha^{-1}, with Butler (FC 48) having a high basal area of marri contributed by several very large retained trees, as well as a substantial intermediate storey of *A. fraseriana*. Basal area reduction in gap release treatments ranged from 19-37 m^2 ha^{-1}, predominantly of jarrah, and were greater than for selective cut or shelterwood treatments (Table 2).

Table 2. Basal area of cut stumps and trees pushed down or blown over as a result of harvesting in eleven FORESTCHECK grids in Blackwood Plateau District. Other trees and shrubs were predominantly *A. fraseriana* and *B. grandis*.

Treatment	Grid	Basal area reduction from most recent harvesting (m^2 ha^{-1})			Basal area reduction from earlier harvesting or disturbance (m^2 ha^{-1})		
		jarrah	marri	other	jarrah	marri	other
External control	FC38	-	-	-	1.76	-	-
	FC39	-	-	-	30.73	-	-
	FC40	-	-	-	11.88	-	-
Shelterwood	FC41	13.36	6.05	-	8.56	6.05	-
	FC42	11.23	-	-	4.07	-	-
Gap release	FC46	18.46	-	2.15	14.85	-	-
	FC47	23.84	1.42	-	9.82	-	-
	FC48	37.41	0.88	-	4.02	-	-
Selective cut	FC43	17.62	-	-	2.45	-	-
	FC44	20.61	-	-	9.10	8.0	-
	FC45	8.24	-	-	14.43		

Retained basal areas in selective cut stands ranged from 22-29 m^2 ha^{-1}, comprised mostly of jarrah (Fig. 1).

The current silvicultural guideline requires that on predominantly jarrah sites the species mix of the eucalypt regeneration should contain at least 20 per cent jarrah. Jarrah comprised 39-77% of eucalypt regeneration measured by the triangular tessellation method, and 52-79% of stems measured on transects. Jarrah also contributed more than 50% of the retained basal area on 8 of the sampling grids, with only the Butler gap release (FC 48) having <20% contributed by jarrah (Table 1).

Regeneration stocking

Satisfactory stocking following harvesting is defined as 65 per cent of sample points with 500 or more stems per hectare of saplings or stool coppice from stumps <30 cm diameter, or 1000 or more stems per hectare of saplings, stool coppice and jarrah ground coppice or marri advance growth. Lignotuberous seedlings can also contribute to effective stocking in shelterwood stands provided that density exceeds 5000 seedlings per hectare.

The three external control grids contained moderate stocking levels of ground coppice and advance growth (Table 3). The Barrabup grid (FC 38) was also well stocked with saplings.

Table 3. Regeneration stocking and species composition for FORESTCHECK grids in Blackwood Plateau District. Retained over-wood is not assessed in uncut stands.

Treatment	Grid	Height range of eucalypt regen. (m)	Percent affected by overwood	Percent stocked with saplings	Percent stocked with saplings & ground coppice	Per cent stocked incl. seedlings	Per cent not stocked to standard
External control	FC38	Uncut	N/a	46	36	N/a	14
	FC39	Uncut	N/a	14	26	N/a	30
	FC40	Uncut	N/a	8	48	N/a	16
Shelterwood	FC41	3-4	12	22	40	8	18
	FC42	3-6	12	46	22	2	18
Gap release	FC46	2-4	6	24	56	N/a	14
	FC47	3-5	12	30	40	N/a	18
	FC48	4-5	16	28	36	N/a	20
Selective cut	FC43	3-4	6	56	24	N/a	14
	FC44	3-6	28	30	28	N/a	14
	FC45	2-5	28	28	14	N/a	30

The two shelterwood stands had low levels of overwood cover and met the 65% stocking standard although the contribution of points including lignotuberous seedlings was low (<10%). Gap release treatments were adequately stocked with saplings and ground coppice and had overwood cover of 6-16%.

Selective cut grids at Cambray (FC 44) and Butler (FC 45) had substantial levels of retained overwood, and stocking of saplings and advance growth did not meet the 65% standard. The selective cut grid at Barrabup (FC 43) had only 6% cover of overwood and was very well stocked with saplings and advance growth.

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, most sites have 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 Fig. 2. Saplings on the external control grids were predominantly of lignotuberous origin, reflecting the lack of stumps resulting from previous harvesting. Trees of lignotuberous origin and stool coppice from small stumps contributed the majority of stems on the remaining grids, with at least 475 stems per hectare of lignotuberous jarrah and marri present on each grid.

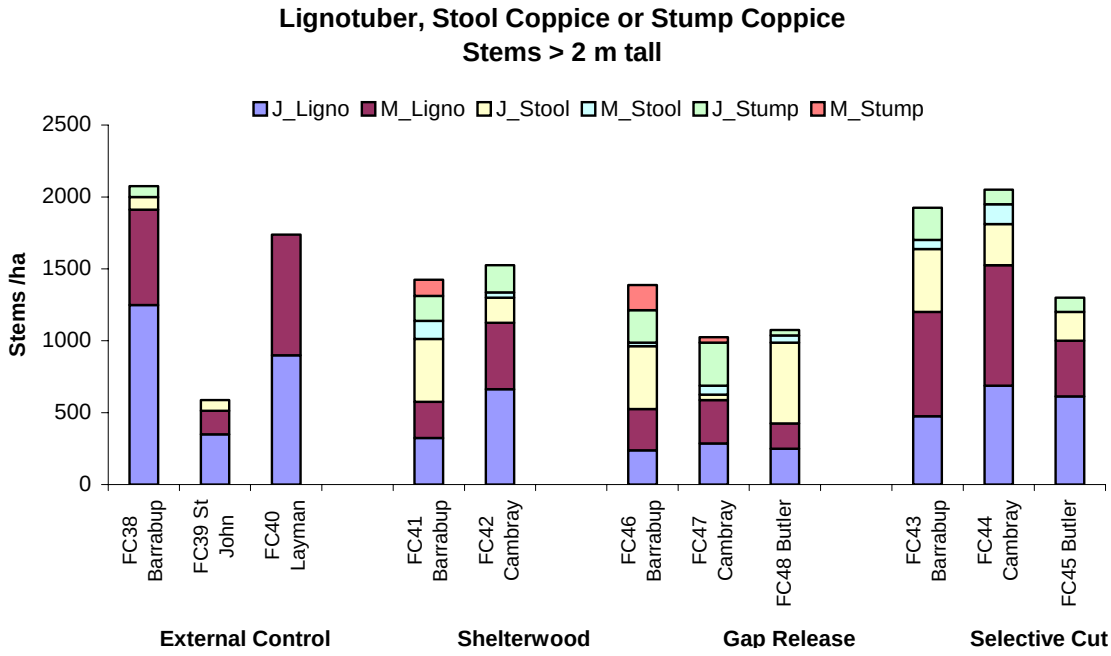

Figure 2. Origin of all jarrah and marri stems >2 m tall measured in the 4 m x 200 m transect on eleven grids in Blackwood Plateau.

Canopy cover

Canopy cover ranged from 50-65% in external controls. Similar cover values were recorded for the selectively cut grids at Cambray (FC 44) and Butler (FC 45), corresponding with the relatively high levels of overwood determined by the regeneration survey procedure. Canopy cover values in shelterwood and gap release treatments were 23-54% (Fig. 3).

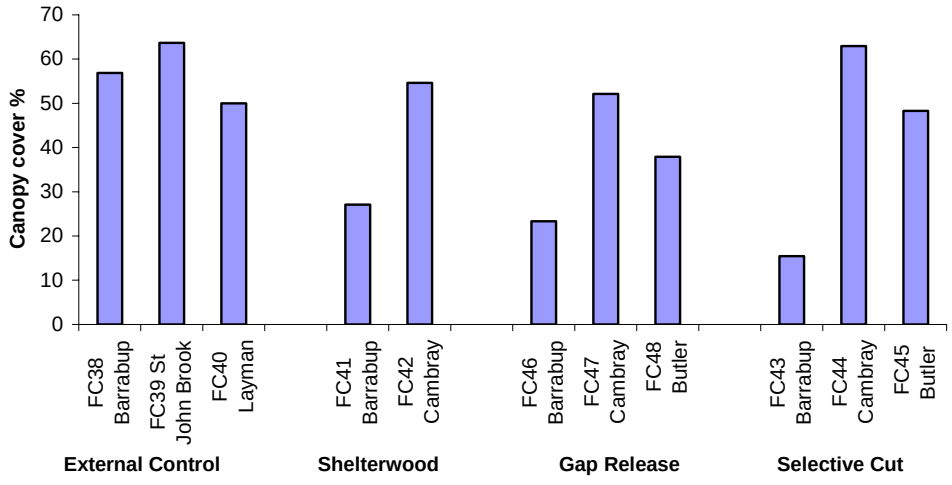

Figure 3. Canopy cover estimated using point intercept sampling.

Discussion

The forests of the Blackwood Plateau have a long history of utilisation for timber production, with a mill established on the St Johns Brook at Barrabup in the first decade of the 20th century (Heberle 1997). This history is reflected in the fact that stumps from past cutting operations were recorded at most sampling grids, with up to 31 m^2 ha^{-1} of basal area removed from one grid. Basal area removed by past cutting was almost exclusively jarrah as the demand for marri sawlogs has been low until recent times. Taking into account removals by past cutting, basal areas of 60-70 m^2 ha^{-1} appear typical of mature forests on the Blackwood plateau. Comparable basal areas were recorded for mature forest in Donnelly District, while stands in the intermediate rainfall zone in Wellington District were more typically 40-50 m^2 ha^{-1}. Mature stands on the Blackwood Plateau also tended to have more stems per hectare across a range of size classes than was the case for Wellington.

Stands subject to shelterwood and selective cutting treatments had retained basal areas of 20-43 m^2 ha^{-1}, corresponding to basal area reductions of 22-45%. These reductions include trees pushed over or that had fallen over after catching alight at the base of the stem. Two of the gap release treated grids had retained basal areas less than 13 m^2 ha^{-1} corresponding to basal area reductions of 70-75%, while the third had a high basal area of large diameter marri, probably retained as habitat trees.

In calculating the reduction in basal area we included cut stumps resulting from harvesting, trees pushed down during silvicultural operations, and trees that had burnt down following post-harvest burning. We reasoned that the impact of treatment on stand structure should be quantified regardless of the intent of treatment.

Recommended change to sampling procedure

The only change to field sampling procedure that should be considered at this stage relates to how established trees of pole size (15-45 cm dbh) are recorded during regeneration stocking assessment in areas cut to gap release. Currently the sampling protocol specifies that saplings may be included in regeneration assessment, and that sampling points with a tree of >50 cm dbh within 4 m should be recorded as stocked. However, pole sized trees are not directly accounted for in this protocol even though they may often be the preferred form of regeneration and should be retained where possible. From a silvicultural perspective the logical approach would be to consider a point as stocked if it included a pole sized tree of acceptable form within 4 m radius of the sample point. Cull trees having poor form or high levels of stem defect would not be counted as acceptable stocking.

Conclusions

The main observations made following measurement of stand structure at Blackwood Plateau were:

- Most grids showed evidence of cutting prior to the current cycle of timber harvesting operations,
- Basal areas of 60-70 m^2 ha^{-1} are typical of mature forests on the Blackwood plateau,
- Jarrah contributed more than 40% of eucalypt regeneration and established trees at all grids,
- Grids cut to gap release and shelterwood met the 65% stocking standard, but selectively cut areas with a high level of retained overwood were not as well stocked.

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FOLIAR AND SOIL NUTRIENTS

Lachlan McCaw, John Neal (retired 2006) and Bob Smith (retired 2006)

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 Monitoring and Laboratory Analysis

Samples of foliage and soil were collected from all Blackwood Plateau grids during March 2006. Three sites at Bell block (Wellington District) burnt during an unplanned fire in December 2004 were also sampled in autumn 2006; tree canopies having recovered sufficiently to allow collection of one year old foliage. The methodology for collection and analysis of samples is described in the Operations Plan. Samples were analysed at the WA Chemistry Centre.

Preliminary Results

Foliar nutrients

Foliage from mature marri trees tended to have slightly higher concentrations of N and K than measured in advance growth or saplings, while P concentrations were similar. Growth stage appeared to have little or no effect on concentrations of N, P or K in jarrah foliage (Table 1). Mature marri foliage had higher concentrations of N, P and K than mature jarrah foliage, with this difference being almost threefold in the case of K. These patterns of foliar nutrient concentration are generally consistent with those observed in the previous 4 years of sampling.

Table 1. Concentrations of N, P and K in the foliage of jarrah and marri advance growth, saplings and mature trees for FORESTCHECK grids on Blackwood Plateau. Data are shown as minimum-**mean**-maximum.

Species	Foliage source	Nitrogen (total) %	Phosphorus %	Potassium %
Jarrah	Advance growth	0.36-**0.65**-0.72	0.020-**0.020**-0.020	0.26-**0.32**-0.39
	Sapling	0.55-**0.70**-0.85	0.010-**0.019**-0.020	0.25-**0.34**-0.44
	Mature	0.73-**0.81**-0.91	0.020-**0.026**-0.032	0.25-**0.35**-0.38
Marri	Advance growth	0.63-**0.74**-0.81	0.010-**0.030**-0.030	0.56-**0.67**-0.77
	Sapling	0.58-**0.79**-0.92	0.020-**0.042**-0.170	0.54-**0.77**-1.00
	Mature	0.84-**0.96**-1.08	0.030-**0.042**-0.060	0.73-**0.92**-1.04

Soil nutrients

Soil N and P concentrations for the external control grid at Barrabup (FC 38) were substantially higher than at the remaining grids (Table 2). Extractable K concentrations at FC 38 were also higher than for most other grids.

Table 2. Mean concentrations of N, extractable and total P, and extractable and total K determined from 5 surface soil samples. The overall mean (s.e.m.) for FORESTCHECK grids on Blackwood Plateau is indicated.

Grid	N	P_extract	P_total	K_extract	K_total
	Per cent	ppm	ppm	ppm	ppm
FC 38	0.16	1	96.2	66	245
FC 39	0.06	1	31	27	240
FC 40	0.05	1	37	20	200
FC 41	0.07	1	40	79	220
FC 42	0.06	1	32	39	180
FC 43	0.10	1	53	55	280
FC 44	0.05	1	26	30	240
FC 45	0.04	1	32	17	200
FC 46	0.06	1	29	25	200
FC 47	0.05	1	24	18	160
FC 48	0.06	1	24	25	200
MEAN	**0.07**	**1.0**	**38.6**	**36.5**	**215**
(s.e.m)	**(0.01)**	**(0.01)**	**(6.3)**	**(6.3)**	**(10.3)**

Discussion

In comparison with FORESTCHECK grids in Donnelly, Perth Hills and Wellington District the soils at Blackwood have:

- Lower mean N concentrations,
- Lower mean concentrations of total P and available P,
- Lower mean concentrations of extractable K (Table 3).

Table 3. Mean (s.e.m) soil nutrient concentrations for FORESTCHECK grids in Donnelly, Wellington, Perth Hills and Blackwood Plateau Districts.

District	N	P_extract	P_total	K_extract	K_total
	Per cent	ppm	ppm	ppm	ppm
Donnelly	0.12 (0.01)	2.0 (0.4)	65.4 (13.4)	43.8 (5.6)	94.8 (13.5)
Wellington	0.14 (0.01)	2.3 (0.6)	85.2 (16.3)	54.7 (5.6)	119.0 (11.0)
Perth Hills	0.13 (0.03)	1.4 (0.4)	32.3 (16.7)	53.6 (17.1)	135.7 (49.4)
Wellington East	0.18 (0.02)	2.8 (0.3)	122.3 (13.4)	86.7 (14.1)	112.1 (14.0)
Blackwood Plateau	0.07 (0.01)	1.0 (0.01)	38.6 (6.3)	36.5 (6.3)	215 (10.3)

Foliar nutrient concentrations were generally comparable with those measured in Donnelly and Wellington in previous years.

Recommended changes to operating procedure

The WA Chemistry Centre provided good service for analysis of soil and foliar samples this year, and at similar cost to previous years. Analyses performed for total K by the Chemistry Centre employ an X-ray Fluorescence technique and discussions are being held with the

Chemistry Centre to establish the extent to which these data are comparable with earlier data from the Kensington soils laboratory measured using flame photometry.

Conclusions

The main observations made following monitoring of soil and foliar nutrient levels at Blackwood Plateau were:

- Patterns of foliar nutrient concentration are generally consistent with those observed in the previous 4 years of sampling,
- Blackwood Plateau soils have lower concentrations of N, P (available and total) and K (extractable) than measured in the previous 4 years of sampling.

SOIL DISTURBANCE

Kim Whitford and Marnie Swinburn

Introduction

Monitoring changes in soil physical properties caused by soil disturbance provides information on the extent of disturbance, and the intensity of disturbance on selected representative treatments. This information is relevant to interpreting data collected in other FORESTCHECK monitoring exercises. Snig tracks are the source and location of most soil disturbance produced by logging, and mapping of snig track layout and snig track order was carried out on all of the harvested sites on the Blackwood Plateau.

In previous years soil bulk density was measured on only one harvested FORESTCHECK grid per year and on one grid that had never been harvested or had not recently been harvested. This year soil bulk density was measured on five reference sites that had never been harvested. These reference sites are not part of the standard set of FORESTCHECK sampling grids but they have soils that are similar to those on harvested FORESTCHECK grids where bulk density has previously been measured. The measurements of soil bulk density from reference sites were compared with the bulk densities measured on the harvested FORESTCHECK grids to determine the amount of soil compaction caused by timber harvesting.

The objectives of this work were to:

- Record the extent of soil disturbance on FORESTCHECK monitoring sites where machine disturbance (snig tracks) could be readily identified.
- Monitor the intensity of changes to soil physical properties induced by logging, on selected sites.
- Provide base data that could be used to monitor any change in these soil physical properties over time.
- Contribute data that can be used to relate the intensity of disturbance to the operational categories, where intensity of disturbance is measured as the fine earth bulk density of the soil.

Monitoring

This year soil bulk density was measured across five reference sites of similar dimensions to a FORESTCHECK grid (Thornton Reference 1, Thornton Reference 2, Alco Reference, Yackelup Reference and Bombala Reference) (Table 1). The sites are not part of the standard set of FORESTCHECK grids, but provide soil bulk density data for undisturbed soil from sites that have never been harvested. The reference sites were selected for measurement of bulk density because:

- They had never been harvested, or there had only been minor handfalling of trees.
- The reference site was the same Mattiske-Havel vegetation complex as a previously sampled FORESTCHECK grid that had been harvested.
- Hand-texturing of the surface soil indicated this soil was similar to a previously sampled FORESTCHECK grid that had been harvested, and
- The surface soils were relatively free of large boulders or sheet caprock.

The bulk density measurements from undisturbed soil were then compared with measurements from 2001 and 2003 FORESTCHECK sites that had similar soils and had previously been harvested.

Mapping of snig tracks on and around all the Blackwood Plateau FORESTCHECK grids provided an assessment of the amount and the location of the disturbance. Incorrect or low quality mapping gives a poor indication of soil disturbance. Mapping of the snig tracks on the Butler selective cut (FC45) was good, with an extensive network of snig tracks identified. Mapping of the snig track layout on the Barrabup shelterwood (FC41) was satisfactory - most or all of the primary, secondary and tertiary snig tracks would have been identified. Mapping of the snig tracks on the Cambray selective cut (FC44) and on the Cambray shelterwood (FC42) was poor due to the length of time that had passed since the harvesting finished and the relatively light harvest that presumably occurred on these sites. Logs harvested from the FORESTCHECK grid on the Cambray shelterwood were hauled to two separate landings. Mapping of the snig tracks on the Barrabup selective cut (FC43) was poor due to the presence of caprock, which obscured evidence of the snig tracks. The mapping of the Barrabup gap release (FC46) was variable – few snig tracks were mapped in the southern one third of the FORESTCHECK grid. The absence of snig tracks in this area may be due to the presence of caprock. In some areas many snig tracks were found while in others few or no snig tracks were evident. The mapping of the Butler gap release (FC48) and the Cambray gap release (FC47) were poor, particularly about the FORESTCHECK grid, due to the presence of caprock. It appears that a formal snig track structure was not followed during harvesting on the Cambray gap release, and much of this area has probably been trafficked by machinery. Two of the FORESTCHECK grid points on this site were outside the harvested area (see Fig. 7).

Table 1. Forest block, Mattiske-Havel vegetation complex and UTM co-ordinates of the five reference sites measured for soil bulk density. These sites, which have never been harvested, were selected to provide an undisturbed comparison for the listed 2001 and 2003 FORESTCHECK sites.

Site name	Forest Block	Mattiske-Havel vegetation complex	Easting	Northing	Possible reference soil for Forestcheck sites
Thornton Reference 1	Thornton	Corbalup 1	414350	6224029	FC6, FC7
Thornton Reference 2	Thornton	Corbalup 1	410844	6224453	FC6, FC7
Alco Reference	Alco	Collis 1	417523	6220248	FC8, FC9
Yackelup Reference	Yackelup	Corbalup 2	463566	6218237	FC2, FC3, FC4
Bombala Reference	Bombala	Dwellingup 1	430196	6371489	FC23, FC24

Preliminary Results

The locations and Mattiske-Havel vegetation complexes of the five reference sites are provided in Table 1, which also lists the 2001 and 2003 FORESTCHECK grids with similar soils. The sites, treatment, assessments and sampling are listed in Table 2. Table 3 gives the means and standard errors for total bulk density (TBD) and fine earth bulk density (FEBD), and gravel content for the various unharvested reference sites.

Table 2. The type of assessment and the number of samples collected at each site.

Site	Treatment	Site label	Snig track map	Bulk density sample points	Quality of snig track mapping
Barrabup	External control	FC38	No		Not mapped
St John	External control	FC39	No		Not mapped
Layman	External control	FC40	No		Not mapped
Barrabup	Shelterwood	FC41	Yes		Satisfactory
Cambray	Shelterwood	FC42	Yes		Poor
Barrabup	Selective	FC43	Yes		Poor
Cambray	Selective	FC44	Yes		Poor
Butler	Selective	FC45	Yes		Good
Barrabup	Gap release	FC46	Yes		Variable
Cambray	Gap release	FC47	Yes		Poor
Butler	Gap release	FC48	Yes		Poor
Thornton Reference 1	Not harvested		No	40	No snig tracks
Thornton Reference 2	Not harvested		No	40	No snig tracks
Alco Reference	Not harvested		No	40	No snig tracks
Yackelup Reference	Not harvested		No	50	No snig tracks
Bombala Reference	Not harvested		No	40	No snig tracks
TOTAL				**210**	

Table 3. Mean measurements collected this year for reference sites that have never been harvested. Values are total and fine earth bulk density and gravel content with standard errors of the mean.

Site	Operational category	n	Total bulk density	SE	Fine earth bulk density	SE	Gravel content (%)	SE
Thornton Reference 1	Uncut	40	1.279	0.032	0.734	0.018	53.9	2.2
Thornton Reference 2	Uncut	40	0.915	0.022	0.737	0.022	20.4	3.3
Alco Reference	Uncut	40	1.066	0.046	0.688	0.020	41.1	2.6
Yackelup Reference	Uncut	50	1.380	0.036	0.823	0.021	51.4	3.6
Bombala Reference	Uncut	40	1.576	0.029	0.727	0.025	69.9	1.0
Stockyard reference	Uncut	40	1.396	0.032	0.664	0.018	65.6	1.6
Tumlo control FC19	Uncut	40	1.433	0.033	0.602	0.023	70.2	1.6
Mean	**Uncut**	**290**	**1.292**	**0.033**	**0.711**	**0.021**	**53.2**	**2.3**

Table 4 shows the area of the snig tracks and landings for eight FORESTCHECK sites from 2005-06 monitoring and ten sites from previous years monitoring. The snig track maps (Figs. 1 to 8) show the location and extent of snig tracks and landings mapped on this years eight harvested FORESTCHECK sites. Table 5 provides a summary of soil classifications from hand-texturing of surface soil samples from each of the sites where bulk density was measured. This table lists the percentage of all samples that fell into each soil texture class. Sites with similar distributions of soil types were grouped together to provide a preliminary grouping for comparison of soil bulk densities between sites with similar soils.

Table 6 provides a summary of preliminary comparisons of soil bulk density that can be made between the harvested sites and reference, control, or undisturbed sites. Comparisons are made for eleven sites. Three different comparisons are shown. The three comparisons are between the mean from the systematically sampled grid points, and either:

- The mean from the relevant "not harvested" control site.
- The mean from a nominated reference site that has never been harvested, or
- The mean for all of the sites that have never been harvested.

The change in bulk density as a result of the harvesting is best estimated by the third comparison between the mean bulk density from the all of the sites that have never been harvested, and the systematic grid point samples from the recently harvested sites.

Table 7 lists actual and percentage increases in total bulk density observed at other harvested forest sites in Australia and overseas.

Table 4. The estimated area of the fallers block surrounding each FORESTCHECK site, the area of snig tracks and landings identified on each fallers block, and the areal proportion of the fallers 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)	Fallers block Area (m^2)	Landing area (percentage of fallers block)	Snig track area (percentage of fallers block)	Percentage of fallers block disturbed
Edward gap main landing and fallers block	FC11	1,365	1,346	5,326	0	8,037	1,970	55,220	3.6	14.6	18.1
Edwards gap second landing	FC11	n/a	n/a	n/a	n/a	n/a	2,240	n/a			
Edwards gap third landing	FC11	n/a	n/a	n/a	n/a	n/a	600	n/a			
Ross gap release	FC12	1,804	2,331	5,256	0	9,391	4,350	105,300	4.1	8.9	13.0
Ross shelterwood eastern fallers block	FC13	1,112	1,560	8,262	0	10,934	2,248	77,130	2.9	14.2	17.1
Surface shelterwood	FC15	2,351	1,761	6,908	0	11,020	1,590	65,760	2.4	16.8	19.2
Chalk shelterwood western fallers block	FC18	322	825	5,995	2,159	9,301	2,120	43,820	4.8	21.2	26.1
Chalk shelterwood eastern fallers block	FC18	444	1,511	3,596	2,739	8,290	680	46,700	1.5	17.8	19.2
Chalk combined, both fallers blocks	FC18	766	2,336	9,591	4,899	17,592	2,805	90,520	3.1	19.4	22.5
Chalk shelterwood west, excluding OST	FC18	322	825	5,995	excluded	7,142	2,120	43,820	4.8	16.3	21.1
Chalk shelterwood east, excluding OST	FC18	444	1,511	3,596	excluded	5,551	680	46,700	1.5	11.9	13.3
Chalk combined, excluding OST	FC18	766	2,336	9,591	excluded	12,693	2,805	90,520	3.1	14.0	17.1
Lesley gap release	FC25					9,666	418	120,179	0.4	8.4	8.8
Godfrey shelterwood Landing 1 (East)	FC30	1,453	1,141	1,817	963	5,374	2,677	74,043	3.6	7.3	10.9
Godfrey shelterwood Landing 2 (West)	FC30						2,970				
Godfrey gap release Landing 1 (East)	FC31	790	2,679	1,590	1,664	6,722	2,366	101,400	2.3	6.6	9.0
Godfrey gap release Landing 2 (West)	FC31	220	2,536	1,420	173	4,349	2,044	77,406	2.6	5.6	8.3
Stockyard shelterwood	FC33	2,491	3,664	10,434	9,233	25,822	1,802	200,990	0.9	12.8	13.7
Stockyard gap release Landing 1 (South)	FC34	1,467	1,110	1,197	1,444	5,219	1,358	80,959	1.7	6.4	8.1
Stockyard gap release Landing 2 (North)	FC34	3,094	1,810	801		5,704	2,568	181,224	1.4	3.1	4.6

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)	Fallers block Area (m^2)	Landing area (percentage of fallers block)	Snig track area (percentage of fallers block)	Percentage of fallers block disturbed
Barrabup shelterwood	FC41	528	1,872	2,667	0	5,067	1,063	n/a			
Cambray shelterwood Landing 1 (South)	FC42	98	352	1,726	0	2,176	835	n/a			
Cambray shelterwood Landing 2 (North)	FC42	402	1,132	1,164	0	2,698	850	n/a			
Barrabup selective cut	FC43	598	1,516	582	0	2,696	733	n/a			
Cambray selective cut Landing 1 (South)	FC44	416	223	91	0	730	600	n/a			
Cambray selective cut Landing 2 (North)	FC44	963	620	983	0	2565	706	n/a			
Butler selective cut	FC45	701	3,677	15,392	202	19,973	1,325	166,200	0.8	12.0	12.8
Butler selective cut, excluding OST	FC45	701	3,677	15,392	excluded	19,771	1,325	166,200	0.8	11.9	12.7
Barrabup gap release	FC46	1,065	1,975	6,499	0	9,539	1,225	n/a			
Cambray gap release Landing 1 (South)	FC47	327	816	1,449	0	2,592	550	n/a			
Cambray gap release Landing 2 (East)	FC47	159	308	318	0	784	1,084	n/a			
Cambray gap release Landing 3 (West)	FC47						681	n/a			
Butler gap release	FC48	1,322	1,582	2,225		5,130	871	n/a			
Mean	**All**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**12.1**	**14.5**

Table 5. Summary of soil classifications from hand-texturing of surface soil samples from each of the sites where bulk density has been measured. Values are the percentage samples in each soil texture class. Sites with similar distributions of soils types are grouped together.

Site	FC code	Mattiske-Havel vegetation complex	n	Gravel content	Silty clay loam	Sandy clay loam	Clay loam	Clay	Sandy loam (medium)	Sandy loam (coarse)	Loam	Silt loam	Loamy sand Fine	Loamy sand Medium	Loamy sand Coarse
Chalk shelterwood	FC18	Dwellingup 1	42	65%					100%						
Bombala reference		Dwellingup 1	36	70%					90%		5%				5%
Stockyard shelterwood	FC33	Dwellingup 4	1	65%		10%			85%		2%				2%
Thornton TEAS	FC7	Corbalup 2	22	47%			7%		81%		7%			4%	
Yackelup reference		Corbalup 2	1	51%					78%		2%		18%	2%	
Kingston shelterwood	FC3	Warren	15	10%			32%		60%		8%				
Carter TEAS	FC 9	Corbalup 1	8	55%				32%	60%		8%				
Thornton gap release	FC6	Collis 1	12	17%			35%		46%		12%			4%	4%
Thornton reference 2		Corbalup 1	13	20%	33%	8%	10%		43%	8%					
Carter gap release	FC 8	Corbalup 2	18	35%			67%		33%						
Kingston gap release	FC2	Mattaband 1	8	33%		9%	59%		25%		6%				
Thornton reference 1		Corbelup 1	26	54%			65%		23%		8%		3%	3%	
Alco reference		Collis 1	28	41%			70%					30%			
Stockyard reference		Dwellingup 4	6	66%		75%	10%		15%						
Tumlo control	FC19	Dwellingup 1	35	70%					8%		88%				3%
Kennedy control	FC24	Dwellingup 1	24	67%					3%					77%	19%
Cameron shelterwood	FC23	Dwellingup 1	40	53%					2%				5%	93%	
Relative percentages of all sites					**2%**	**6%**	**21%**	**2%**	**44%**	**0%**	**9%**	**2%**	**1%**	**11%**	**2%**

Table 6. A summary of the mean change in surface soil (0-10cm) bulk density attributed to timber harvesting operations across eleven FORESTCHECK sites.

Site	Site Code	Operational category or grid points	Number of times harvested	Year of last harvest	Years since harvest	Mattiske-Havel vegetation complex	Fine earth bulk density (g/cm^3)	% Change (grid vs. not harvested site)	% Change (grid vs. reference site)	% Change (grid vs. mean)	n	Gravel content %
Chalk shelterwood	FC18	Grid points	3	1992	11	Dwellingup 1	0.81 ± 0.02		11.4%	12.2%	81	65
Stockyard shelterwood	FC33	Grid points	3	1998	7	Dwellingup 4	0.71 ± 0.02		-2.7%	-0.5%	75	65
Thornton TEAS	FC7	Not recently harvested	1	1940's	52-62	Corbalup 1	0.76 ± 0.04		-8.2%	6.0%	40	47
Bombala reference		Uncut	0	virgin	n/a	Dwellingup 1	0.73 ± 0.03				40	70
Yackelup reference		Uncut	0	virgin	n/a	Corbalup 2	0.82 ± 0.02				50	51
Kingston shelterwood	FC3	Grid points	3	1995/96	7	Warren	1.01 ± 0.02		46.5%	34.2%	100	10
Carter TEAS	FC9	Not recently harvested	1	1940's	52-62	Corbalup 1	0.78 ± 0.02		5.4%	8.5%	40	55
Thornton gap release	FC6	Grid points	2	1991	11	Corbalup 1	1.00 ± 0.02	32	35.3%	28.7%	77	17
Thornton reference 2		Uncut	0	virgin	n/a	Corbalup 1	0.74 ± 0.02				40	20
Carter gap release	FC8	Grid points	2	1999	3	Corbalup 2	0.81 ± 0.01	3	9.4%	11.5%	147	35
Kingston gap release	FC2	Grid points	3	1995/96	7	Mattaband 1	0.82 ± 0.03	-11	11.4%	13.1%	77	33
Thornton reference 1		Uncut	0	virgin	n/a	Corbalup 1	0.73 ± 0.02				40	54
Alco reference		Uncut	0	virgin	n/a	Collis 1	0.69 ± 0.02				40	41
Stockyard reference		Uncut	0	virgin	n/a	Dwellingup 4	0.66 ± 0.02				40	66
Tumlo control	FC19	Uncut	0	virgin	n/a	Dwellingup 1	0.60 ± 0.02				40	70
Kennedy control	FC24	Not recently harvested	2	1930-34	74-70	Dwellingup 1	0.83 ± 0.02		13.5%	13.9%	40	67
Cameron shelterwood	FC23	Grid points	3	1989	15	Dwellingup 1	0.92 ± 0.01	11	25.9%	22.4%	74	53
Kingston TEAS	FC4	Not recently harvested	2	1970's	22-32	Corbalup 2	0.92 ± 0.02		12.3%	23.2%	39	10
Mean recent harvest									19.6%	17.4%		
Mean old harvest									5.8%	12.9%		
Mean All								**15.3**	**14.6%**	**15.7%**		

Table 7. Comparison of soil bulk densities (g/cm^3) for the surface soil (0-10cm) following tractor logging as reported in Australia and overseas (from Rab, 1992).

Source	Total bulk density (g/cm^3)				Percentage change from undisturbed		
	Undisturbed areas	Harvested areas	Snig tracks	Log landings	Harvested areas	Snig tracks	Log landings
Dickerson (1976)	1.29	1.42	1.55		10.1	18.3	
Froehlich (1979)	0.97		1.14				
Jakobsen (1983)	0.9		1.07				
Gent et al. (1984)	1.14	1.36	1.52		19.3	27.9	
Incerti et al. (1987)	0.96	0.99	1.22	1.33	3.1	26.3	30.3
Rab et al. (1992)	0.94	1.02	1.12	1.19	8.5	17.6	22.3
Anderson et al. (1992)	0.71	0.86	1.1	1.22	21.1	45.3	46.4

Future tasks

The planned work for 2005-05 monitoring 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 grids would increase the value of the snig track areas presented here. In the final analysis of this and other FORESTCHECK data we will provide particle size analysis, and soil descriptions for all of the FORESTCHECK grids listed in Table 4 where soil bulk density has been measured. The final report will include more detailed analysis of the amounts of soil compaction on the various operational categories at each site where soil bulk density was measured.

Discussion

- Bulk density was measured on the Thornton Reference 1, Thornton Reference 2, Alco Reference, Yackelup Reference and Bombala Reference sites. Considering these five sites, and two other sites that have never been harvested (n = 7) the mean fine earth bulk density ranged from 0.60 ± 0.02 to 0.82 ± 0.02 g/cm^3. The fine earth bulk density of the soil on these sites that have never been harvested will vary with changes in the soil texture, organic matter content and soil structure. The mean value for all sites was 0.71 g/cm^3.
- The bulk density measurements from reference sites were compared with measurements from FORESTCHECK harvested grids where the soils had similar soil textures.
- Soil texture was used as a basis for identifying sites that had similar soils. The change in soil bulk density was subsequently determined by comparing these sites with similar soils. This is one of several comparisons that will be used to determine the impact of timber harvesting on soil bulk density. Internal comparisons of disturbed and undisturbed soil on individual sites will also be used to determine this impact.

- The majority of the soils measured for bulk density in this study were sandy loams (44%), followed by clay loams (21%), loamy sands (14%), loams (9%) and sandy clay loams (6% of all soils measured).
- Table 6 summarizes the mean change in surface soil bulk density attributed to timber harvesting operations across the eleven FORESTCHECK grids where bulk density has been measured. The change in bulk density as a result of timber harvesting is best estimated from this preliminary data by comparing the mean bulk densities from the grid point samples for the recently harvested treatments, with the mean for all sites that have never been harvested. This comparison yields an estimate of the mean change in soil bulk density across the harvested sites. This mean increase in soil bulk density is 16%. Three of these sites were harvested more than 20 years ago. For those sites that were measured less than 15 years after the harvesting the mean increase in soil bulk density was 17%. This is a substantial increase in the mean bulk density of the surface soils, and can be identified as an impact of timber harvesting.
- Table 7 lists actual and percentage increases in total bulk density observed at other harvested forest sites in Australia and overseas. These percentage increases give some indication of the change in total bulk density observed in other forest harvesting operations. These values indicate that the increase in soil bulk density that we observe in the surface soils of the jarrah forest (~17%) is within the upper range observed in other forest types (3% to 20%).
- As with the 2003-04 and 2004-05 FORESTCHECK sites, the boundaries of the faller's blocks about the 2005-06 FORESTCHECK grids in the Blackwood Plateau were not as well delineated as the 2001-02 FORESTCHECK sites in the southern jarrah forest. Consequently the areas of the snig tracks and landings cannot be calculated as a proportion of the faller's block area.
- Across all the FORESTCHECK sites, landing size varied from 0.4% to 4.8% of the total area of the faller's block. The mean landing size was 2.6% of the total area of the faller's block.

Conclusions

The main observations made following monitoring of soil disturbance at all FORESTCHECK locations are:

- The mean fine earth bulk density for undisturbed jarrah loams is approximately 0.7 g/cm^3.
- Considering the eleven FORESTCHECK sites so far monitored for soil bulk density, harvesting typically increases bulk density of the surface soils across the harvested area by 18%.
- This increase in bulk density of the surface soils varies widely across sites depending on the type and degree of disturbance. It also varies greatly between sites due to differences in the soils, soil moisture, harvesting intensity, harvesting method, and machinery used. For example a 34% increase was measured on the Kingston shelterwood (FC3) and Thornton gap release (FC6), but a mean increase of only 12% was measured on the Stockyard shelterwood (FC33).
- The change in soil bulk density attributed to timber harvesting also depends on which site or reference value is used as representing the undisturbed state of the soil. Both internal, within site, and external, between sites, comparisons can be made.
- Particle size analysis may help match sites and subsets better and reduce this variation in the estimated change in soil bulk density
- Reuse snig tracks and landings and focus compaction onto a smaller area.
- Across all of the FORESTCHECK sites, landing size has varied from 0.4% to 4.8% of the total area of the faller's block and the mean landing size was 2.4% of the total area of the faller's block.
- Typically snig tracks cover 12% of the faller's block.

- On the Blackwood Plateau, caprock substantially reduced visual evidence of soil disturbance on the Barrabup selective cut, the Cambray gap release and parts of Barrabup and Butler gap release.
- The sandy sites on the Blackwood Plateau, Cambray shelterwood and selective cut, showed little evidences of soil disturbance.

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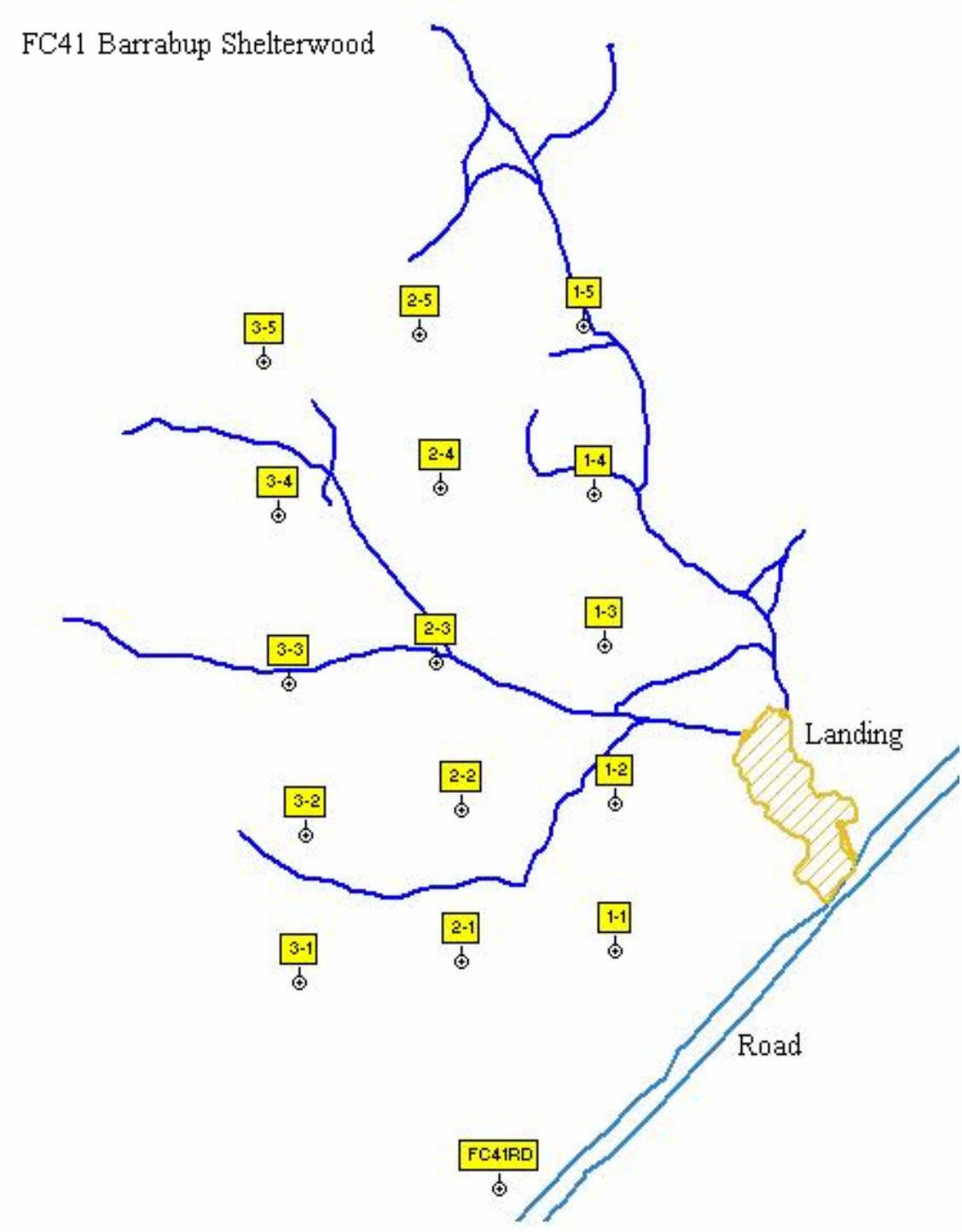


Figure 1. FORESTCHECK grid FC41, Barrabup block shelterwood showing the layout of the snig tracks, the landing and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

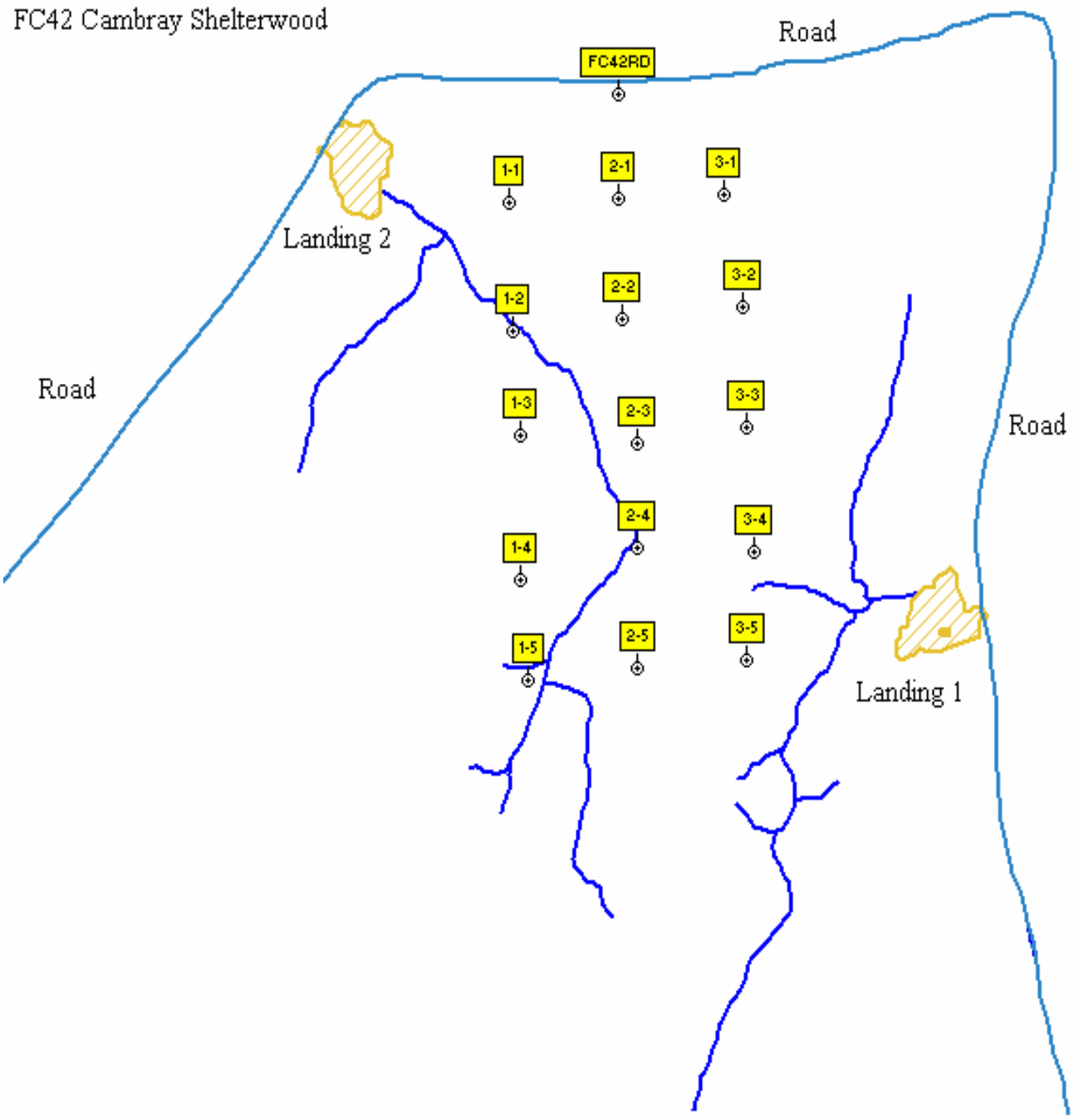


Figure 2. FORESTCHECK grid FC42, Cambray block shelterwood showing the layout of the snig tracks, the landings and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

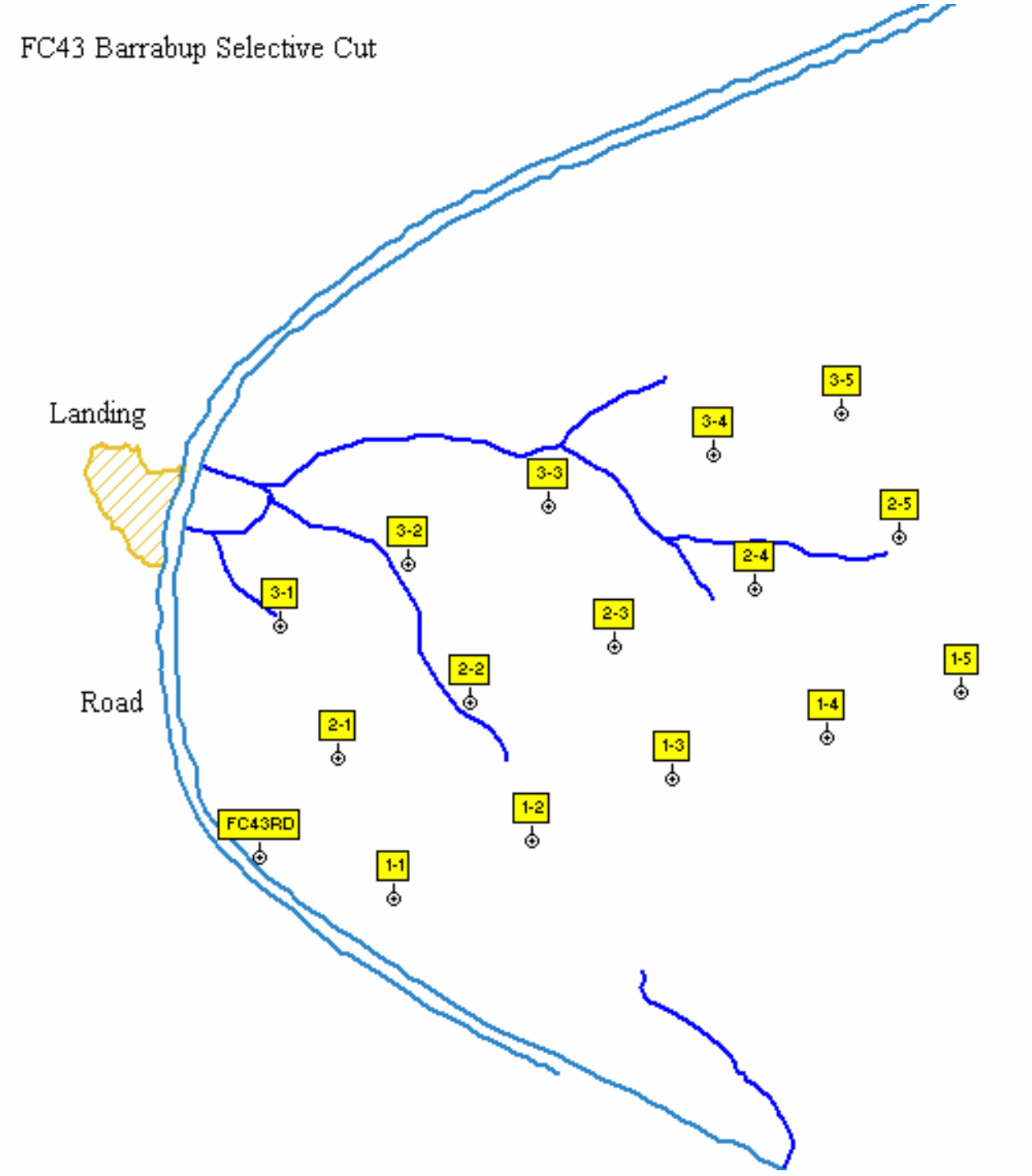


Figure 3. FORESTCHECK grid FC43, Barrabup selective cut showing the layout of the snig tracks, the landing and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

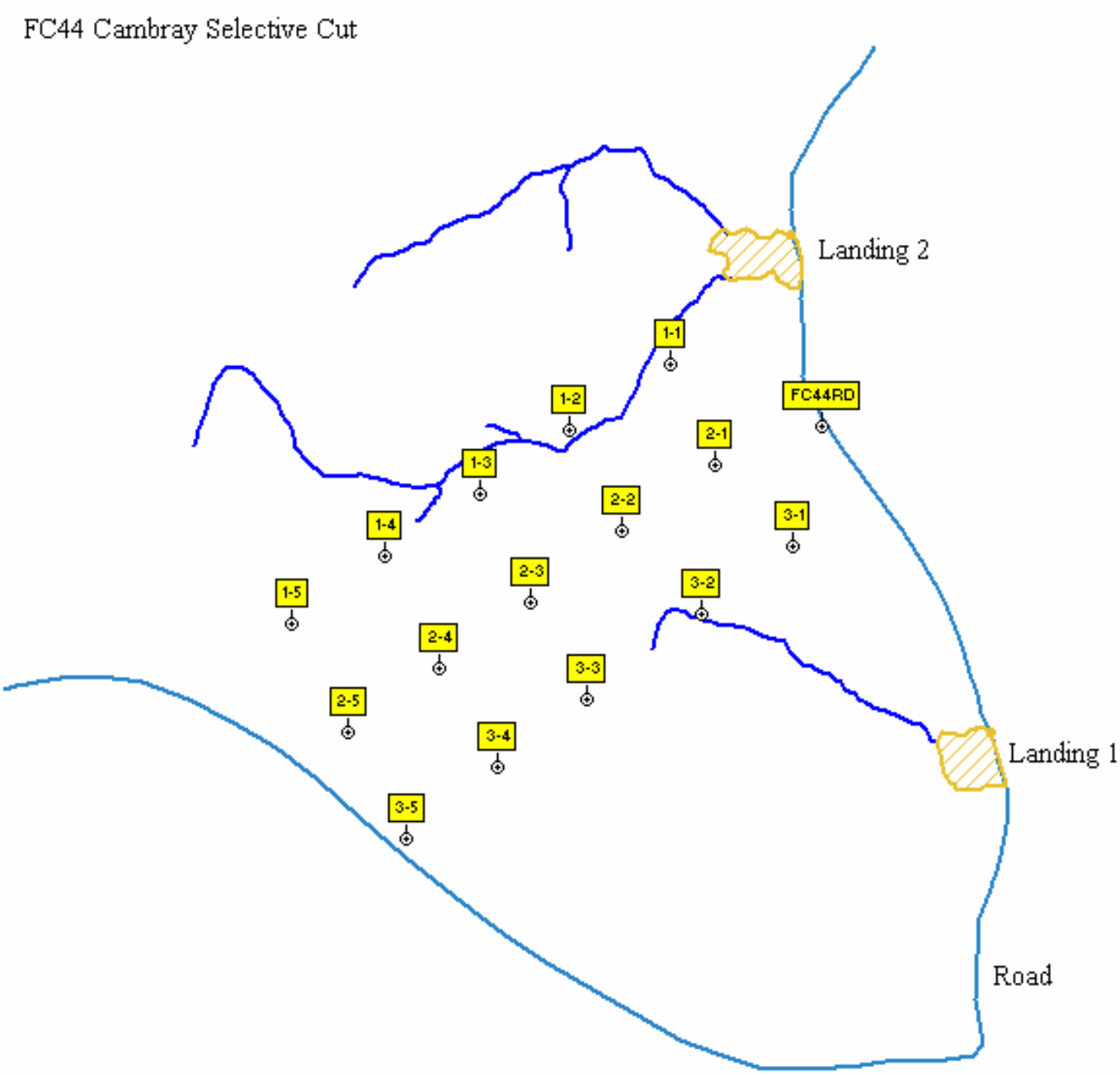


Figure 4. FORESTCHECK grid FC44, Cambray selective cut showing the layout of the snig tracks, the landings and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

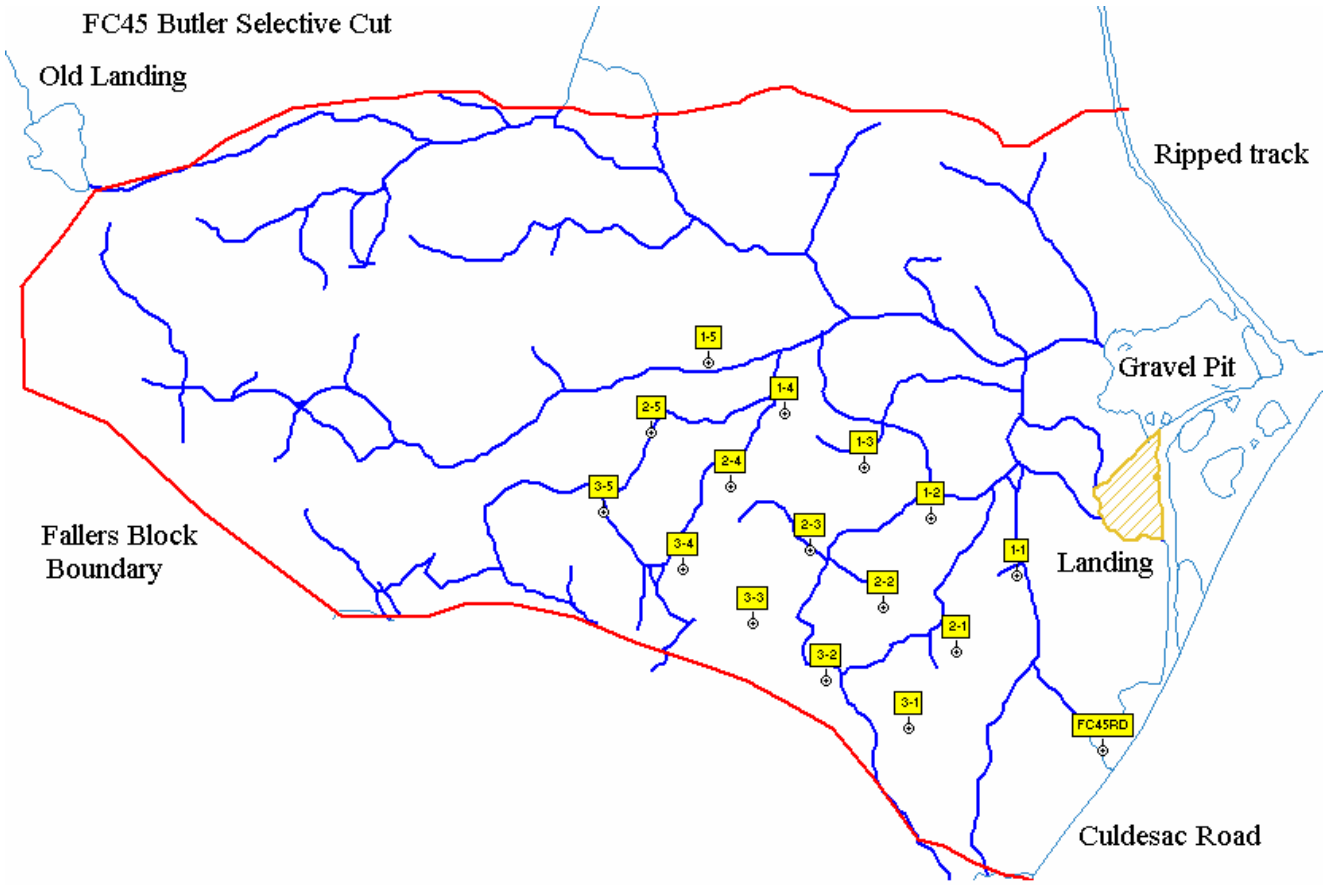


Figure 5. FORESTCHECK grid FC45, Butler selective cut showing the layout of the snig tracks, the landing, the fallers block and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

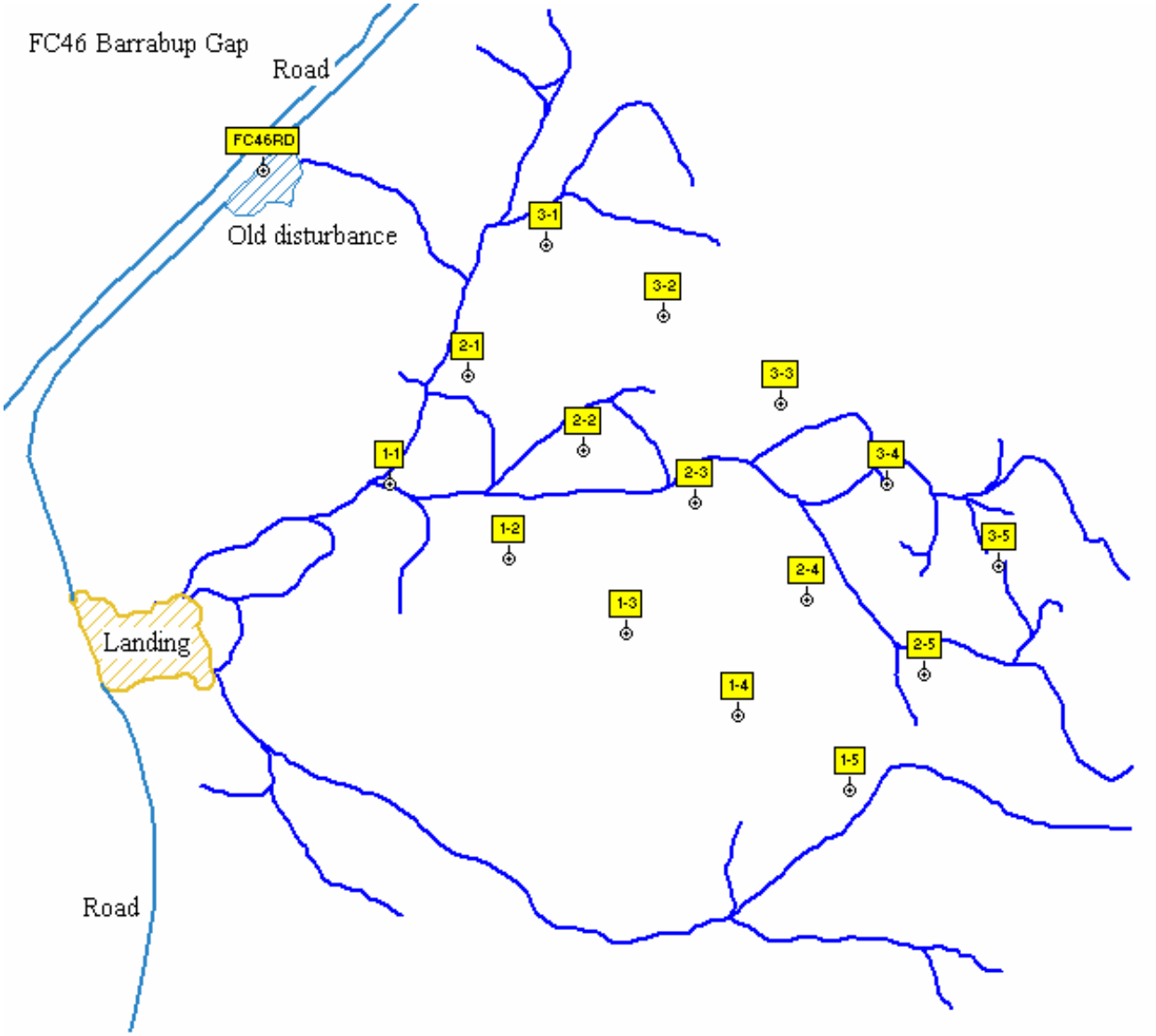


Figure 6. FORESTCHECK grid FC46, Barrabup block gap release showing the layout of the snig tracks, the landing and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

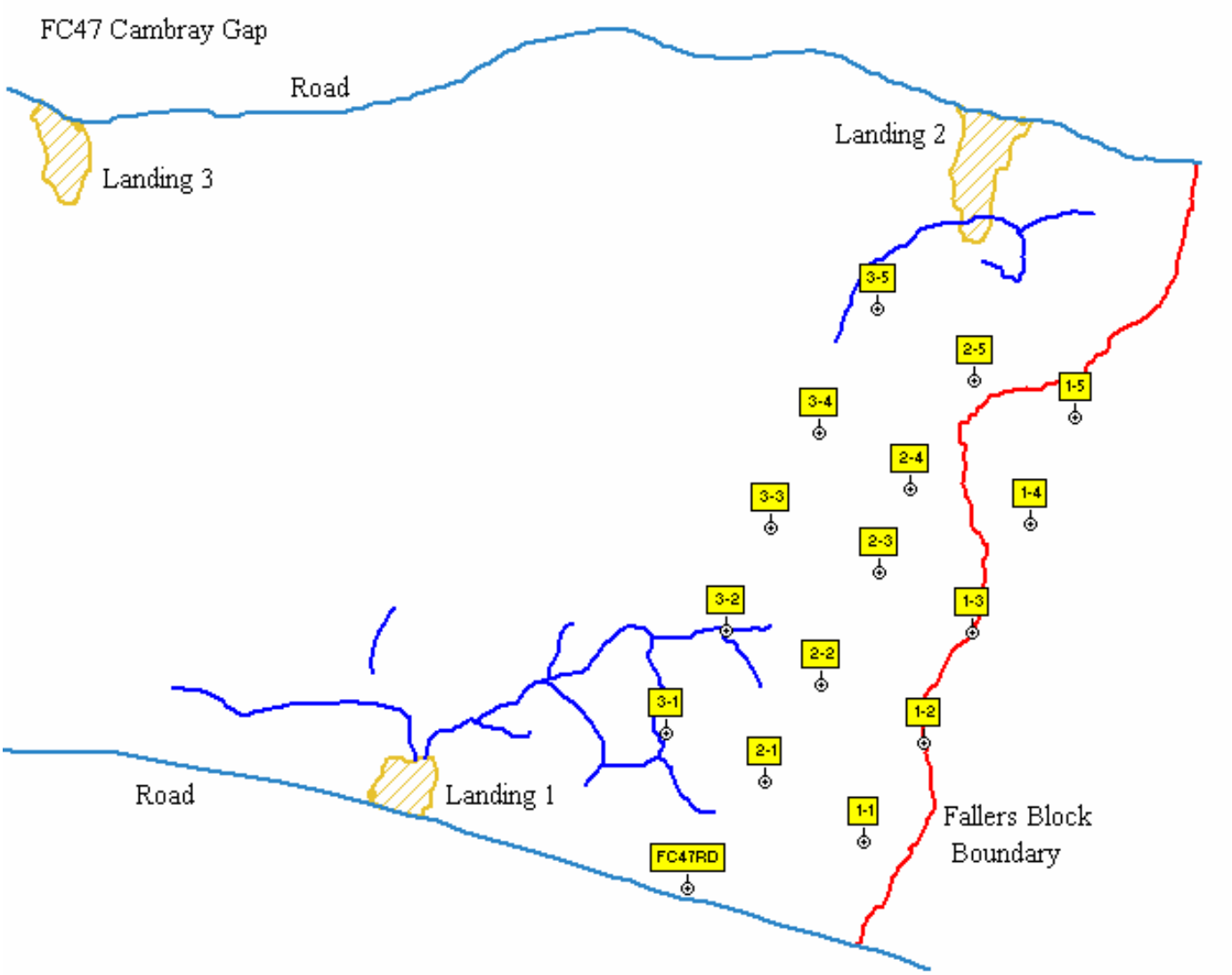


Figure 7. FORESTCHECK grid FC47, Cambray block gap release showing the layout of the snig tracks, the landings and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

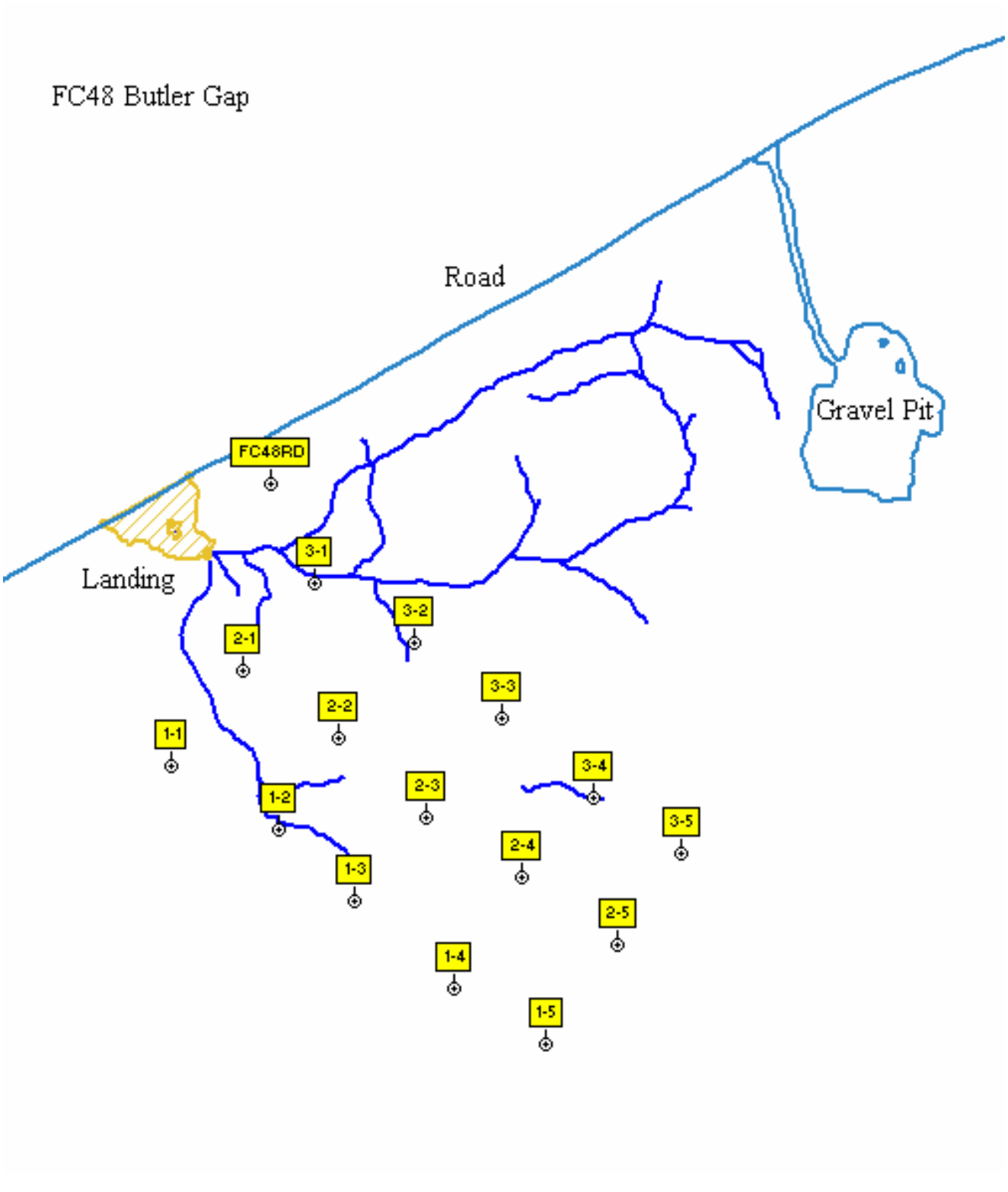


Figure 8. FORESTCHECK grid FC48, Butler block gap release showing the layout of the snig tracks, the landing and the FORESTCHECK sampling grid. Scale is given by the grid point spacing of 50 metres.

COARSE WOODY DEBRIS, SMALL WOOD AND TWIGS, AND LITTER

Richard Robinson and Bob Smith (retired 2006)

Introduction

The quantity of wood and leaf debris on the forest floor has a great influence on the habitat for the fungi, small reptiles, mammals and invertebrates. It is therefore of some importance to ascertain the amount of debris in each area before and after disturbance such as logging and burning. The amount of litter also affects the soil moisture, which in conjunction with micro-organisms affects the soil texture.

This component of FORESTCHECK is intended to:

- Measure and record the amount of litter, small wood and twigs (SWT) and coarse woody debris (CWD) on the ground in the various managed jarrah forest treatments (i.e. Gap Release and Shelterwood) and in uncut 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, small mammals, fungi and cryptogams.

Field and Laboratory Monitoring

Sampling in 2005-06 was carried out from 30 March – 6 April 2006. The litter and small wood and twigs (SWT) samples were oven dried, weighed in grams and then converted to tonnes ha^{-1}. The volume of coarse woody debris (CWD) was determined using the line intersect method[6] and calculated to cubic metres ha^{-1}.

Results and Discussion

Litter weights

Litter weights on the treatment grids generally reflected the time since the last burn (Fig. 1). However, the Barrabup external control (FC38) appears to be carrying a heavy litter load despite being burnt only 3 years previously and the load on the Layman external control (FC40) may be low considering it was burnt 8 years previously. The heaviest litter weights were measured on the Barabup and St John (FC39) external control grids. Within the selective cut treatment, the Butler (FC45) grid had a lighter litter load than the Cambray grid (FC44) despite being unburnt for one year longer.

[6] Van Wagner, C.E. 1968. The line intersect method in forest fuel sampling. Forest Science 17: 20-26

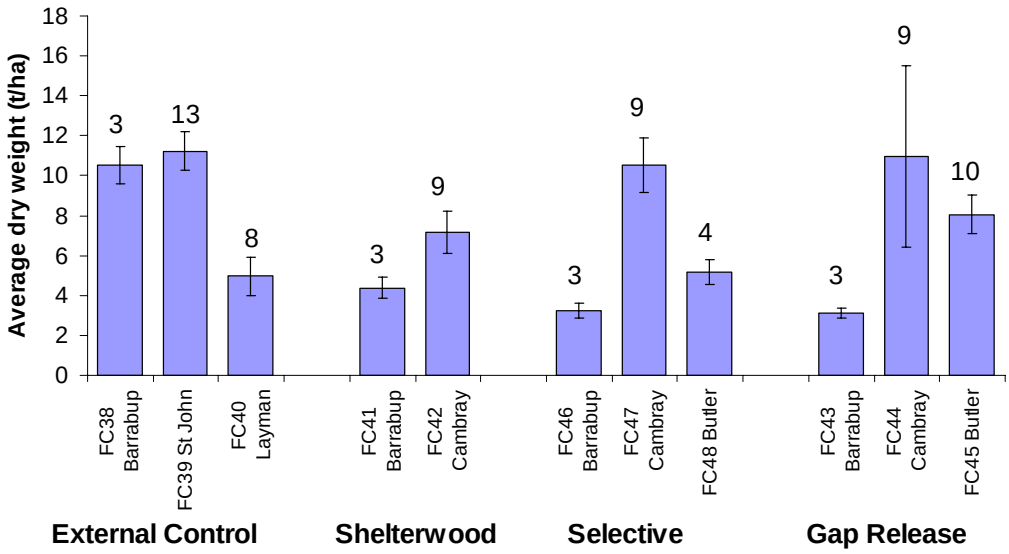


Figure 1: Mean litter loads (t ha^{-1} ± se) calculated at each FORESTCHECK site on the Blackwood Plateau in April 2006. Numbers above columns indicate years since burnt.

Small wood and twigs

The amount of small wood and twigs carried on all sites was light (Fig. 2) compared to that of the litter (Fig. 1), The heaviest load was measured on the Barrabup external control (FC38) and the Butler gap release treatment (FC48), 0.81 t ha^{-1} and 0.82 t ha^{-1} respectively. There appears to be no relationship with time since fire in any of the treatments.

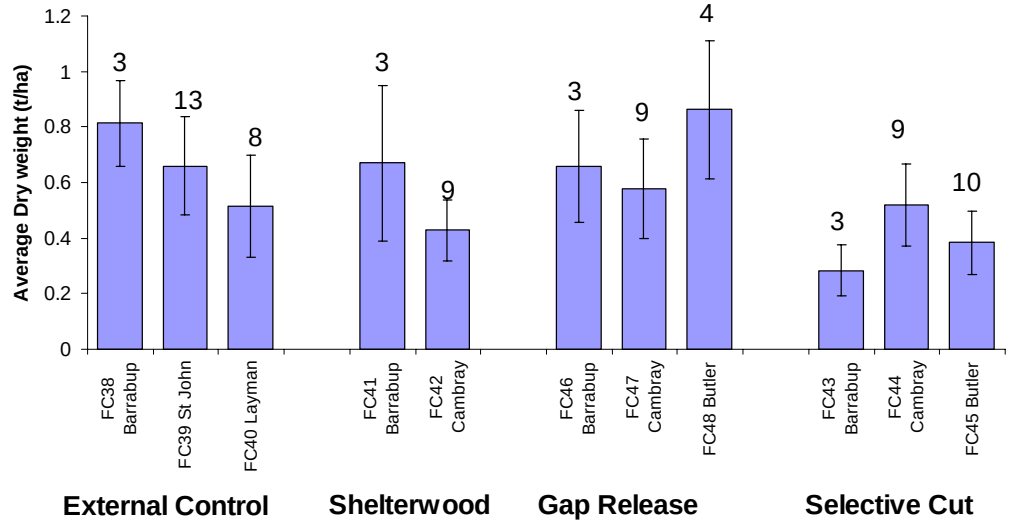


Figure 2: The average weights (t ha^{-1}) of small wood and twigs measured at each FORESTCHECK site on the Blackwood Plateau in 2006. The numbers above the columns indicate years since burnt.

Coarse woody debris

The largest volume of CWD was found on the Butler gap release (FC48) treatment (Fig.3). The external control grids and the Cambray selective cut (FC44) carried the lowest amounts of CWD.

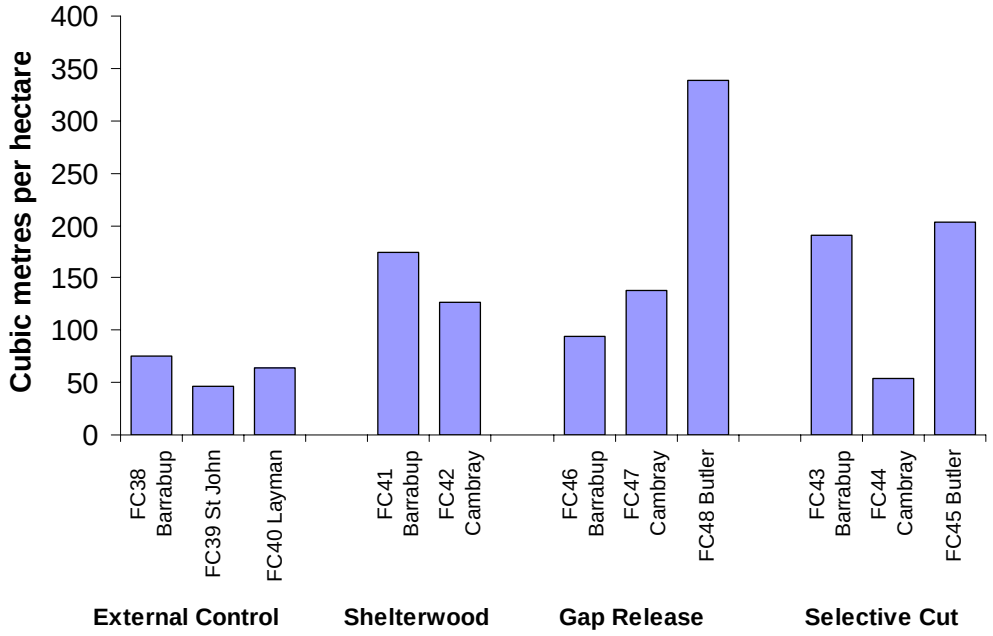


Figure 3: The volume (m^3 ha^{-1}) of coarse woody debris measured at each FORESTCHECK site in Wellington East in March 2005. NB. Bell block grids burnt in wildfire in December 2004

Conclusions

The main observations made following measurement of litter, small wood and twigs and coarse woody debris at Blackwood Plateau were:

- Litter loads generally reflected the time since last burn
- Barabup external control grid had a high litter load despite recently being burnt
- Compared to litter, all grids had low weights of SWT
- The volume of CWD was variable within and between the treatments
- Butler gap release grid had a high amount of CWD compared to other harvested grids.

MACROFUNGI

Richard Robinson and Julie Fielder

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 on 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:

- Monitor and record the species of macrofungi in the various treatments of managed jarrah forest (shelterwood, Selective cut and gap release) and in uncut forest.
- Analyse trends in species composition, richness and abundance and substrate utilization over time.
- To generate detailed descriptions of unknown or unnamed species.

Field and Laboratory Monitoring

Transects to monitor macrofungi were installed at the Blackwood Plateau sites during grid establishment in September-October 2005. The sites were monitored in June and again in July 2006. Donnelly FORESTCHECK sites (initially established and monitored in 2002) were also monitored in June 2006.

This report deals primarily with the results of monitoring undertaken on the Blackwood Plateau sites, however, a brief report on results obtained at the Donnelly sites in 2006 and details on the overall species diversity recorded from 2002-06 are also included.

Voucher Specimens

Voucher specimens were processed and where possible identified. An overall species list and one for each individual site has been compiled. In total, 206 voucher collections were made representing 114 species. Processing of each voucher was completed on the day of collection or the next day. This included photographing in the field, and preparing morphological descriptions of fresh collections. A total of 61 species had not been encountered previously (39 recorded at Blackwood Plateau and 31 recorded at Donnelly). Detailed descriptions were compiled in order to validate their identity. All collections were air dried at 35º C. Microscopic descriptions were carried out to verify the identity of a number of species and to confirm a number of unnamed species. All vouchers have been entered onto the PERTH database and are housed at the Tony Annells Herbarium at the Manjimup Research Centre.

1. BLACKWOOD PLATEAU

Monitoring

Monitoring dates are generally selected on the basis of rainfall and soil dryness index (SDI). In previous years, monitoring was conducted when the SDI was below 100 and falling steadily following autumn rains. For the Blackwood Plateau, statistics from the Bureau of Meteorology on-line data from the Jarrahwood automatic weather station were used. The data for Jarrahwood showed that this would normally happen between May10-20 (Fig. 1). This year (2006) the SDI was above 100 and did not begin to fall steadily until July 20. In June, however, a decision was made to begin monitoring. The first monitoring was conducted from June 15-26, and the second monitoring from July 10-17 (Fig. 1).

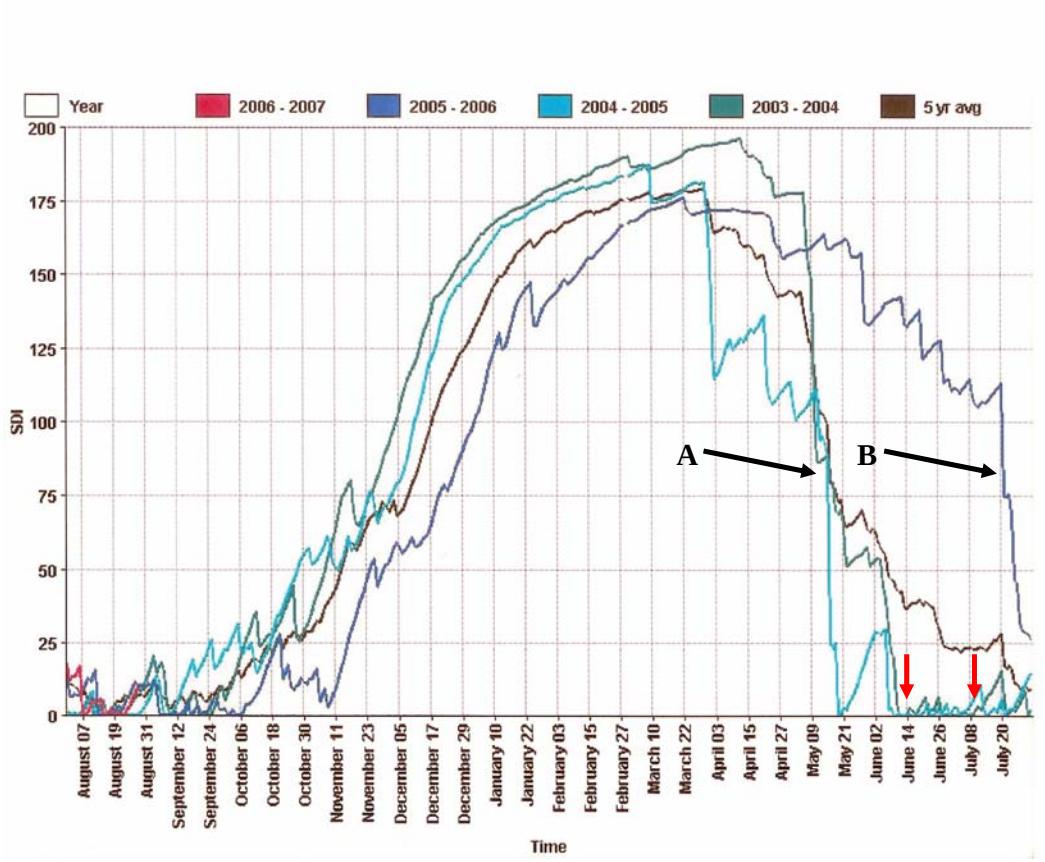


Figure 1. Daily soil dryness index (SDI) at Jarrahwood automatic weather station from August 2003 to August 2006 (Australian Bureau of Meteorology). The arrow (a) shows the ideal time for monitoring in the previous 3 years and the arrow (b) shows the time for similar conditions in 2006. The beginning of each FORESTCHECK macrofungi monitoring period is indicated by the red arrows.

Preliminary Results and Discussion

June was very dry (35.3 mm rain recorded at FPC Office in Nannup) as was July prior to the 20th (46.4 mm rain). However, a total of 195 species were recorded in June and 182 in July. The abundance of fruitbodies was lower in June (6,443 compared to 7,145 in July). The weather and soil condition improved slightly in July, and is likely reflected in the higher abundance despite the slightly lower species richness. Immediately following the monitoring period heavy rain resulted in the SDI falling to zero on August 7th (Fig. 1)

In all, 252species of fungi were recorded on the Blackwood Plateau sites (Appendix 1). Of these, 39 species (15.5%) were recorded for the first time in FORESTCHECK. A total of 13,588 fruitbodies were recorded. The highest numbers of fruitbodies were recorded in the Barrabup treatment grids (FC41, FC43, FC46), while the most number of species were recorded in the gap release treatments (FC46, FC47, FC48). The highest fungal diversity and abundance was recorded on treatment grids burnt only 3 years previously (FC41 Barrabup shelterwood, FC43 Barrabup selective cut and FC46 Barrabup gap release). The butler selective cut (FC45), harvested and burnt 10 years previously, had the lowest species diversity and second lowest abundance recorded for all the grids, while the highest diversity was recorded on the Cambray gap release treatment (FC47).

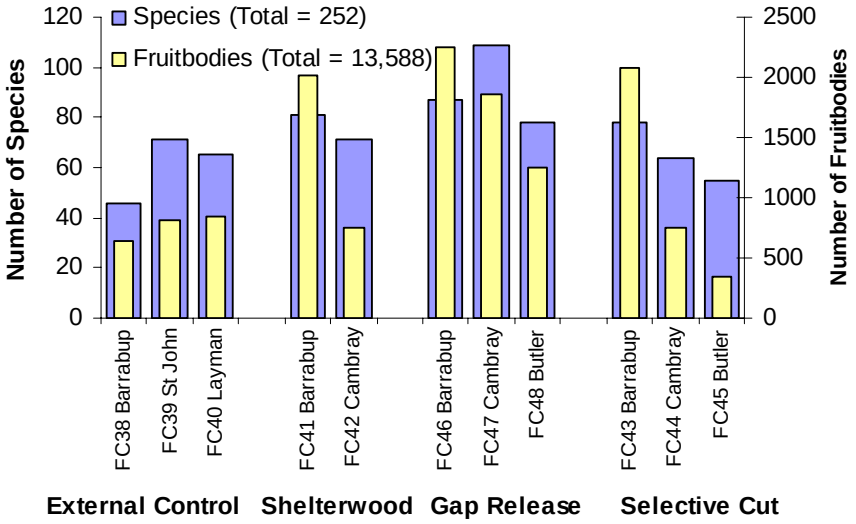


Figure 2. The total number of species and abundance recorded on the Blackwood Plateau FORESTCHECK grids in 2006.

Generally, in each treatment the majority of species were recorded fruiting on the soil (Fig. 3), but in several treatments more fruitbodies were recorded on wood (Fig. 4). Few species were recorded on litter and on the majority of grids, except the external controls, low numbers of fruitbodies were also recorded on the litter. This may be the result of dry conditions encountered during monitoring combined with the more open forest on the harvested grids.

In general, there appears to be no obvious effect of logging on the species richness of macrofungi, but more species of wood inhabiting fungi were recorded on logged treatments and they were more abundant. Also fruitbodies were more abundant on recently burnt soil on logged grids than on those grids logged and burnt 9 or10 years previously.

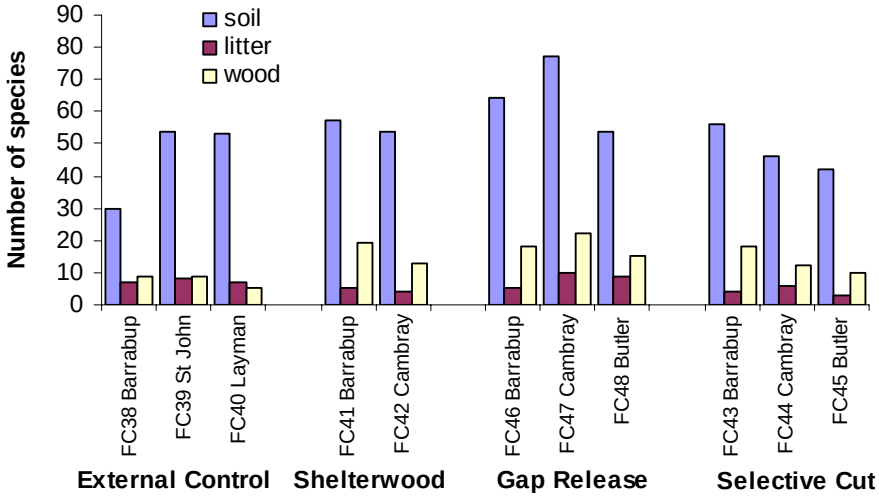


Figure 3. The number of species recorded fruiting on soil, litter and wood on the Blackwood Plateau FORESTCHECK grids in 2006.

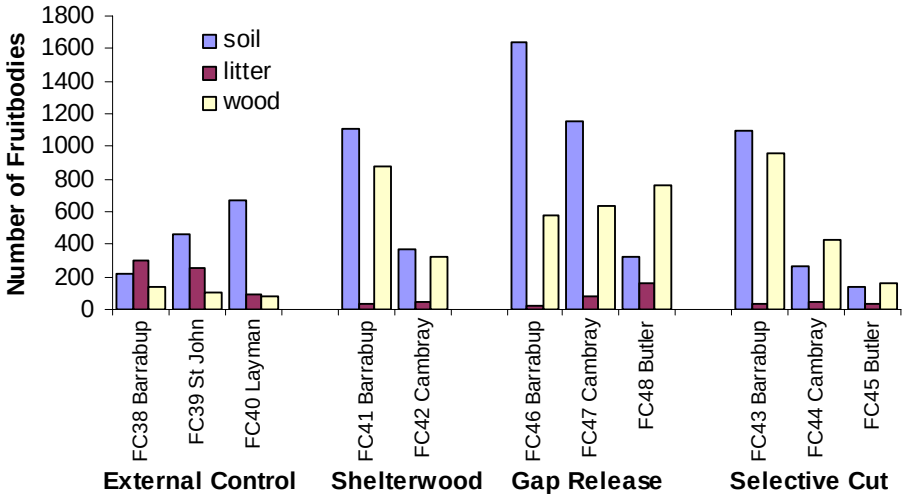


Figure 4. The number of fruitbodies recorded on litter, soil and wood in each grid on the Blackwood Plateau FORESTCHECK grids in 2006.

2. DONNELLY

Monitoring

The Donnelly sites were established in 2002. They have been monitored annually and in 2006 this was carried out from 28 June – 6 July. The SDI was still at about 600 at the time of monitoring and did not fall below 100 until July 27.

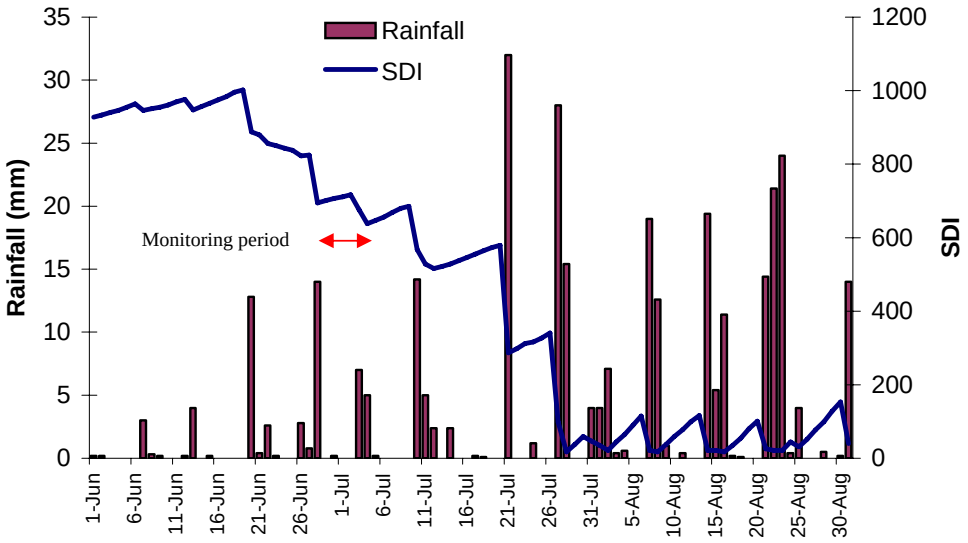


Figure 5. Rainfall and SDI for Manjimup during June, July and August 2006 (monitoring period indicated by red arrow).

Preliminary Results and Discussion

Despite the drier than usual conditions, a total of 241 species and 11,304 fruitbodies were recorded across all the sites. Thirty-one species were recorded for the first time on the Donnelly sites, illustrating that long term monitoring is necessary in order to document the full diversity of species actually present. There appeared to be no major differences in species richness on grids, either between or within treatments (Fig 5), except that both species richness and abundance was very high on the Easter external control grid (FC10).

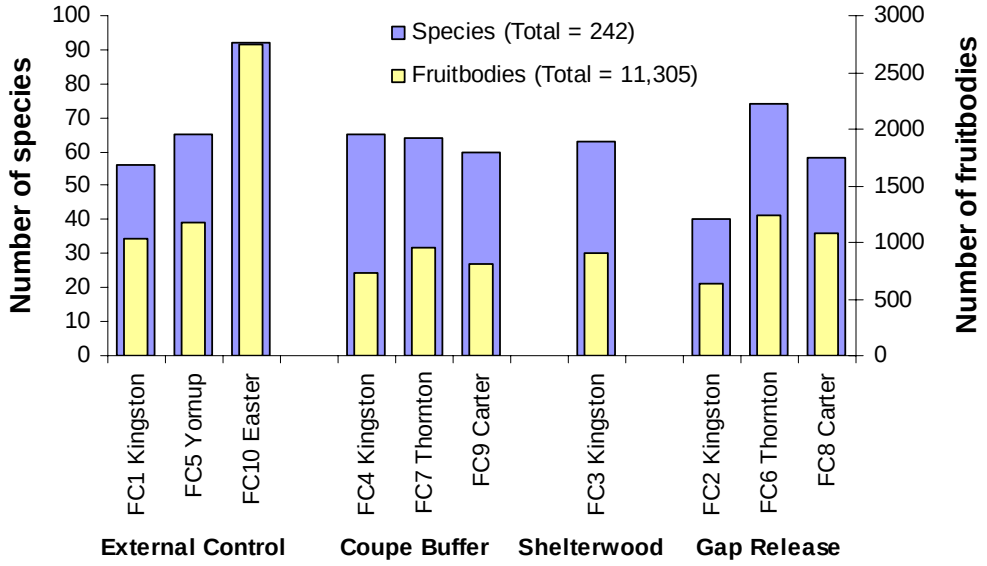


Figure 5. The total number of species and abundance recorded at the Donnelly FORESTCHECK grids in 2006.

Variation in species richness and abundance from year-to-year is shown in Figure 6. In previous years the species richness and abundance recorded in the gap release treatment was consistently high, but in 2006 it was much lower despite levels on the other treatments being consistent with other years. Gap release grids are more open than other treatments and the low abundance may be due to the dry conditions experienced in 2006, but further analysis is required to confirm that observation.

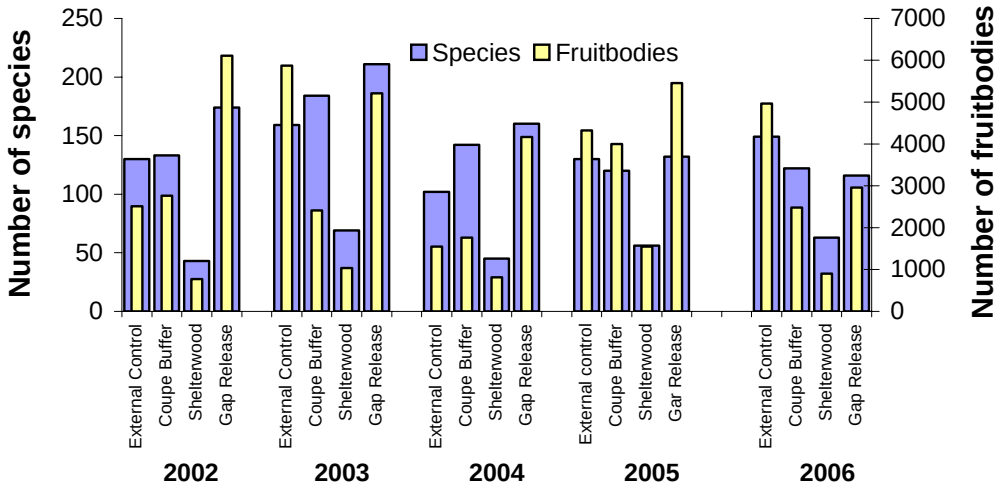


Figure 6. The total number of species and abundance recorded in each treatment in the Donnelly FORESTCHECK locations from 2002-06 (NB. Only one shelterwood grid at Donnelly, FC3 at Kingston).

FORESTCHECK Total Macrofungal Species Diversity 2002-2006

Since 2002, a total of 556 species of macrofungi have been recorded during FORESTCHECK monitoring and 1216 vouchers collected. 456 species have been recorded during the annual monitoring surveys, and 100 additional species recorded on the Donnelly grids from 2003-06.

Conclusions

The main observations made following monitoring of macrofungi at Blackwood Plateau were:

- A total of 556 species of macrofungi have so far been recorded in FORESTCHECK.
- 336 species were recorded in 2006, 252 on the Blackwood Plateau and 241 at Donnelly. Of these 160 species were recorded at both locations, 93 restricted to the Blackwood Plateau and 83 restricted to Donnelly.
- The majority of macrofungi recorded in the Blackwood Plateau grids fruited on soil.
- Fruitbody abundance was highest on recently burnt soil on harvested grids in Barrabup forest block.
- Macrofungal species richness and abundance was consistently high in the gap release treatments on the Blackwood Plateau.

Data Management

All data has been entered onto a Microsoft Excel worksheet. Species diversity and abundance on each grid and a frequency rating of 1 (rare) to 8 (very common) for each species on each grid has been determined. The data includes 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.

Appendix 1. List of macrofungi recorded in FORESTCHECK 2002-06, and the species and abundance recorded in each treatment on the Blackwood Plateau in 2006 and the species and abundance recorded in Donnelly in 2006

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
0	Agaric unidentified					3	8	11	3
1	*Inocybe australiensis*	M	S	91	34	71	70	266	237
2	*Xerula australis*	S	S		1	1	1	3	1
3	Polypore "long white shelf"	S	W						1
4	*Pluteus* sp. "brown velvet"	S	S				1	1	3
5&84	*Stereum* sp. "grey-brown white hirsute, purple fertile layer"	S	W						
6	*Amanita xanthocephala*	M	S		24	44	39	107	42
7	*Cortinarius radicatus*	M	S	1				1	
8	*Gymnopilus allantopus*	S	W	54	211	152	241	658	237
9	*Calocera guepinioides*	S	W		50	135	372	557	892
10	*Russula* sp. "white/white/white"	M	S	1	4	2	7	14	30
10a	*Russula* sp. "small white-white-white"	M							1
11	*Galerina* sp. "hanging gills" and "conic"	S	S/L	61	31	38	161	291	326
12	Simocybe sp."olive"	S	W	2	1	3		6	1
13	Polypore "brown with white margin"	S	W						
14	*Tephrocybe* sp.	S	S						
15	*Coltricia oblectans*	S	S	4	92	126	27	249	20
16	*Stereum* sp. "translucent funnels"	S	S/Moss		25	1	24	50	18
17	*Psathyrella* sp.	S	S/L		1	1	1	3	1
18	Agaric "light brown-olive"	S	S						
19	*Formitopsis lilacino-gilva*	S	W			1	11	12	3
20	*Inocybe* sp. "scaly cap" see sp. 277 Fire Fungi	M	S	6	19	6	30	61	17
21	*Crepidotus* sp. "small white"	S	W			11	12	23	1
22	*Melanotus hepatocrous (Crepidotus subhaustellaris)*	S	W			1	7	8	2
23	*Clitocybe* sp.	S	S						1
24	*Lycoperdon* sp.	S	S	3	31	3	35	72	2
25	*Entoloma* sp. "grey-brown/blue stem"	S	S		1		1	2	1
26	*Gymnopilus* sp. "reddish cap, orange gills"	S	W						2
27	*Mycena* sp. "long stem"	S	W						
28	*Amanita* sp. "white, stout"	M	S						
29	*Boletus* sp. "dull maroon"	M	S				1	1	2
30	*Entoloma* sp. "creamy white"	S	S	3	1	5	15	24	10
31	*Entoloma* (*Leptonia*) *moongum* "blue-black"	S	S		6	2	2	10	12
32	*Coprinus* sp.	S	S/L						3
33	*Agaricus* sp. "yellow stainer"	S	S						
35	*Amanita xanthocephala* forma *macalpiniana*	M	S						
36	*Laccaria lateritia*	M	S		1	18	127	146	52
37	*Phellinus* sp. "yellow rim"	S	W			5	1	6	1
38	*Agaricus* sp. "small"	S	S						
39	*Agaricus* sp."large cap, purplish scales"	S	S						4
40	*Dermocybe* sp."chestnut"	M	S						
41	*Fistulina hepatica*	S	W		3	3	2	8	4
42	*Galerina* sp. "small on bark"	S	Bark						
43	*Gymnopilus* sp.	S	W						
44	*Mycena* aff. *atrata*	S	W						1
45	*Amanita* sp. "white, deeply rooted"	M	S	1		3		4	
46	Agaric "creamy white"	S	S						
47	*Pluteus lutescens* "orange"	S	W						2
47b	*Pluteus lutescens* "yellow-green"				2	1	1	4	
48	*Inocybe* sp. "grey"	M	S		2	32	14	48	49
49	*Boletus* sp. "red pores and stem"	M	S						
50	*Mycena mijoii*	S	L	6		3	1	10	226

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
51	*Mycena* sp. "buff umbrella"	S	L/T	348	46	61	50	505	347
52	*Ramaria capitata* "yellow, flat tops"	M	S		1			1	3
53	*Inocybe* sp. "tan skirt"	M	S	3	11	27	75	116	60
54	*Tricoloma eucalypticum*	M	S	11	3	9	3	26	6
55	*Marasmius crinis-equi*	S	L						149
55b	*Marasmius crinisequi* "garlic"						6	6	
56	*Heterotexus peziziformis*	S	W/T		10	5	12	27	155
57/34	*Dermocybe clelandii* (white mycelium)	M	S	17	1	4	43	65	18
57b	*Dermocybe clelandii* "olive brown"								9
58	*Galerina* sp. "small cap, eccentric stipe - on wood"	S	W		10	16	105	131	59
59	*Hypholoma brunneum*	S	W		59			59	13
60	*Tremella mesentericia*	S	W						1
61	*Crepidotus sp.* "small brown"	S	W/Bark						
62	*Stereum hirsutum*	S	W		4		176	180	204
63	*Trametes versicolor* (brown or grey)	S	W				20	20	48
64	*Mycena* sp. "tiny white, on twigs"	S	T		1		6	7	6
65	*Inocybe* sp. "large scaly cap"	M	S						1
66	*Mycena pura*	S	S/L						25
67	*Stropharia semiglobata*	C	Dung	13		5	2	20	14
68	*Cortinarius* sp. "brown" ?(34)	M	S	67		2		69	9
69	*Russula adusta*	M	S		1			1	2
70	*Phellodon* aff. *niger*	S	L/S	16			1	17	111
70b	*Phelledon niger* 'slender'				8	135	6	149	57
71	*Agaricus* sp. "small, flat- red stain"	S	S						
72	*Ramaria australiana* "purple-pink with pink tips"	M	S						6
73	*Cortinarius* sp. "brown with purplish tints"	M	S				4	4	
74	*Laccaria* aff. *masonii*	M	S		466	286	1092	1844	822
75	*Marasmius* sp."large brown, on Zamia stems"	S	T						
76	*Lepiota* sp."orange with brick red scales/white gills"	S	S						
77	*Entoloma* sp. "grey-brown/brown stem"	S	S			1		1	
78	Entoloma (*Leptonia*) sp. "grey/decurrent gills"	S	S				2	2	
79	*Resupinatus cineroscens*	S	T/Bark		20	5		25	13
80	*Mycena carmeliana*	S	W	1	126	6	32	165	52
81	*Clavulina* cf. *cinerea* "grey-brown"	S	S			1		1	24
82	Agaric "Lepiota-like, cream-grey"	S	S						
83	*Crepidotus* sp. "small creamy tan"	S	Bark/W						
85	*Gymnopilus* sp. "slender"	S	W	109	247	300	456	1112	666
86	*Ramaria* sp. "orange-red, yellow stem"	M	S		3	2		5	4
87	*Hydnellum* sp."red brown"	S	L/S	30			2	32	9
88	*Mycena* sp. "tiny white with decurrent gills"	S	S		3	1	13	17	
89	*Russula clelandii* group	M	S	8	4	2	3	17	20
90	*Russula* aff. *cyanoxantha*	M	S				1	1	2
91	*Fistulinella mollis*	S	W						1
92	*Russula neerimea*	M	S	1	2	8	3	14	2
93	*Boletellus ananiceps*	S	S						
94	*Steccherinum* sp."tiered white shelves"	S	W		17		8	25	154
95	*Boletus* sp. "small yellow/cream pores"	M	S						1
96/259	*Cortinarius* sp. "viscid - pink"	M	S	3				3	8
97	Agaric "pure white"	?	S						
98	*Cortinarius* sp. "pointy cap"	S	S	13		5	22	40	44
99	*Boletus* sp. "yellow-red, stains blue"	M	S	2	1	6	4	13	2
100	*Hypholoma australe*	S	W		11	50	125	186	47
101	*Phlebia rufra*	S	W/Bark						
102	*Ramaria ochroceosalmonicolor*	M	S	6	6	41	15	68	31

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
103	*Boletellus obscurecoccineus*	S	S	6	3	1	4	14	1
104	*Panellus ligulatus*	S	W	5		15	3	23	29
105	*Gymnopilus* sp. "chestnut scales, forked gills"	S	W						
106	*Stemonitis herbatica*	Bacteria	Fruit						
107	*Russula* sp. "grey-white"	M	S						
108	*Hypomyces chrysospermus*	P	Bolete	1	1	4	10	16	1
109	*Trichopatum byssogenum.*"purple splash"	S	W			1		1	
110	*Dermocybe* aff. *sanguinea*	M	S			1		1	66
111	*Galerina* sp. "large"	S	S						
112	*Omphalina chromacea*	S	S/Lichen	21	7	10	64	102	6
113	*Inocybe* sp. "radially fibrillose, pink stem"	M	S						4
114	*Amanita* sp. "apricot-pink margin"	M	S						
115	*Cortinarius fibrillosus*	M	S	24	8	2	6	40	26
116	Polypore "white resupinate"	S	T/W						
117	*Lepista* sp.	M?	S						
118	*Crepidotus* sp. "large creamy-tan"	S	W	6	1		4	11	273
119	*Pholiota multicingulata*	S	W	7	6	11	45	69	102
120	*Aleuria rhenana*	S	S		9			9	25
121	*Cortinarius* sp. "slender brown"	M	S						
122	*Hygrocybe* sp. "yellow-orange"	S	Moss	1	3		1	5	6
123	Discomycete "yellow stalked"	S	S	116	17	28	197	358	394
124	*Dermocybe sp.* "yellow-olive"	M	S			1	2	3	49
125	*Cortinarius (Phlegmacium)* sp. "purple-grey"	M	S						
126	*Aleurina ferruginea*	S	S/Moss				4	4	7
127	*Omphalina* aff. *umbellifera*	S	S	6	11		55	72	151
128	*Coprinus* sp. "basal hairs"	S	S						
129	*Pulvinula* sp. (*P. tetraspora?)*	S	S				54	54	
130	Orange parasite on white resupinate polypore (sp.116)	P							
131	*Cortinarius* sp. "slender lilac"	M	S						
132	*Steccherinum* sp. "creamy yellow crust"	S	W			2		2	2
133	*Pluteus attromarginata*	S	W		3		2	5	2
134	*Mycena albidocapillaris (*aff. *subcapillaris)*	S	L	2	1	1	21	25	30
135	*Entoloma* sp. "tall, grey-brown"	S	S	6		6	5	17	5
136	*Phellinus gilvus*	S	W			1		1	9
137	*Inocybe* sp. "creamy-brown"	M	S						
138	*Daldina concentrica* (*D. childiea*?)	S	W						
140	*Clavulina* sp. "pink-buff coral"	S	S						
142	*Lactarius eucalypti*	M	S	6	9	10	9	34	12
143	*Collybia* sp. "buff funnel"	S	S						33
144	*Mycena sanguinolenta*	S	S		43	59	49	151	15
145	*Poronia ericii*	C	Dung						
146	*Cortinarius* (*Myxacium*) sp. "orange-brown viscid cap"	M	S	10	2		2	14	19
147	*Dermocybe austroveneta*	M	S			2		2	1
148	*Crucibulum laeve*	S	T/L		10		9	19	30
149/141/ 152	*Stereum illudens*	S	W		5	3	37	45	18
150	*Scutellina* aff. *margaritacea*	S	W/T			35		35	
151	*Collybia* sp. "large"	S	S						
153	Tephrocybe sp. "small dark grey-brown"	S	S						
154	*Cortinarius* sp. "chestnut"	M	S	89	22	23	27	161	69
155	*Protubera canescens*	M?	S						
156	Agaric "light brown - red scales on stem"	S	S						
157	*Podoserpula pusio*	S/M?	L/S						5
158	*Cortinarius* aff. *micro archerii*	M	S						

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
159	*Exidia glandulosus*	S	W		100			100	
160	*Pholiota highlandensis*	S	S	5	248	188	259	700	283
160b	*Pholiota communis*			39	2	7	19	67	
161	*Tricholoma* aff. *virgatum*	M	S		1	1		2	14
162	*Inocybe* sp. "small light brown, fibrillose"	M	S						
163/260	*Mycena subgallericulata*	S	W	15	220	695	135	1065	146
164	*Nidula niveotomentosa*	S	L/T						7
165	*Mycena* sp. "small grey - bleach"	S	S/L		2		1	3	30
166	*Lepiota* sp."creamy-brown"	S	S	3	3	10	17	33	18
167	*Entoloma* sp. "dark grey/blue gill edge"	S	S				3	3	
168	*Dermocybe* sp. (*D. clelandii* ?) "brown with mustard yellow gills"	M	S	60	26	25	32	143	7
169	*Inocybe* sp. "shaggy stem"	M	S						
170	Agaric "yellow brown-moist"	S	S/L						
171	*Cortinarius vinaceolamellatus*	M	S						
171b	*Cortinarius* sp. "vinaceus lilac"	M	S	38	1	1	14	54	25
172	*Dermocybe clelandii* (yellow mycelium)	M	S		3	6	3	12	26
172b	*Dermocybe clelandii* (yellow mycelium - glutinous cap)	M	S	7		2		9	7
173	*Cortinarius basirubescens* (red cap)	M	S	2		5	11	18	
173b	*Cortinarius basirubescens*(brown cap)	M	S	1	51	10	30	92	11
173c	*Cortinarius basirubescens* " brown large"	M	S						
174	Agaric "red/yellow/red"	S	??						1
175	*Xylaria hypoxylon*	S	W						
176	*Pycnoporus coccineus*	S	W	2	16	28	79	125	1
177	*Psilocybe coprophila*	C	Dung	6	11	27	5	49	11
178	*Russula persanguinea* (white stem)	M	W						8
179	*Paxillus* sp. "yellow, brown scales"	M	S	1	6	3	4	14	24
180	*Armillaria luteobubalina*	P/S	W	12			17	29	
181	*Collybia* aff. *butracea*	S	S		2			2	4
182	*Mycena* spp. (unidentified)	S		3			6	9	10
183	*Marasmius elegans*	S	S						
184	*Cortinarius* spp. (unidentified)	M	S	27	4	9	22	62	42
185	*Lepiota cristata*	S	S	3			1	4	5
186	*Amanita brunneibulbosa* "grey-brown"	M	S	2	1	2	6	11	2
187	*Campanella gragaria*	S	W	32		40		72	
188	*Austroboletus laccunosa*	S	S	2				2	
189	*Tubaria rufofulva*	S	W						
190	*Macrolepiota konradii*	S	S						1
191	*Marasmiellis* sp. "white umbrella"	S	T/W						
192	*Plectania* sp. "black"	S	L						
193	*Boletus* sp."purple brown"	M	S						
194	*Entoloma* sp."brown"	S	S						
195	*Boletus* sp."mustard brown-brown stain"	M	S						
196	*Amanita umbrinella*	M	S	1	1			2	
197	*Clitocybe semi oculta*	S	W						1
197b	*Clitocybe semi-occulta* "large"								
198	*Entoloma* sp."brown black/tan/blue"	S	S		1	1	2	4	11
199	*Cortinarius* sp."yellow orange"	M	S						
200	*Austroboletus occidentale*	S	S	2	3		2	7	1
201	*Cortinarius* sp."cream with orange gills"	M	S						
202	*Russula flocktoniae*	M	S		2		5	7	3
203	*Inocybe geophylla*	M	S						
204	*Innonotus* sp.	S	W						
205	*Cortinarius* sp."orange/yellow flesh/yellow gills"	M	S	1		1		2	

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
206	*Amanita ananiceps*	M	S				1	1	
207	*Cortinarius australiensis*	M	S						
208	*Boletus* sp."yellow-brown, cracked/white pores"	M	S						
209	*Rickenella fibula*	S	Moss				8	8	12
210	*Boletus* sp."maroon/orange pores"	M	S						
211	*Tricholoma* sp.	M	S						
212	*Cortinarius* sp."orange brown"	M	S	12		2		14	2
213	*Omphalotus nidiformis*	S	W						
214	*Leucapaxillus lilacinus*	M	S						
215/220	*Lactarius* sp."cream custard"	M	S						
216	*Boletus* sp."brown/yellow pores which stain blue"	M	S						
217	*Gyroporus* aff. *cyanescens* "yellow suede - intense blue stain"	M	S						
218	*Amanita* sp."powdery - long tapering base"	M	S						
221	*Lactarius clarkeae*	M	S			1	2	3	1
222	*Entoloma* sp. "black with grey-white gills	S	S	2				2	
223	*Cortinarius* sp."orange"	M	S	29		2		31	2
223b	*Cortinarius* sp."orange"	M	S	3				3	
224	*Coprinus* sp. "micacus"	S	S						
225	*Boletus* sp. "creamy pale yellow	M	S						
226	*Inocybe sp.* "orange brown"	M	S						
227	*Entoloma* sp. "brown-black with tan gills"	S	S						
228	*Geastrum* sp.	S	S/L						1
229	*Psathyrella* sp.	S	L						
230	*Cortinarius* sp."orange viscid"	M	S						6
231	*Cortinarius* sp. "yellow-brown/tan margin"	M	S						
232	*Cortinarius* sp. "cf sinapicolor"	M	S						
233	*Tephrocybe* sp. "grey/dimple"	S	S						6
234	*Cortinarius* sp.	M	S						1
235	*Entoloma* sp. "grey-brown/grey stem"	S	S				1	1	14
236/219	*Postia* (*Tyromyces*) *peliculosa*	S	W		1		1	2	1
237	*Cortinarius* sp. "yellow with orange brown fibrils"	M	S						1
238	*Mycena yuulongicola*	S	W			8		8	
239	*Marasmiellus* sp. "on zamia"	S	T						
240	*Agaricus* sp. "small with red brown fibrils"	S	S				1	1	3
241	*Crepidotus variabilis*	S	T/W	8				8	2028
242	*Ramaria* sp. "cream/flat"	M	S						
243	*Cheilymenia* sp. "orange disks on marri nuts"	S	Fruits				13	13	12
244	*Cortinarius* sp."brown umbonate"	M	S	56		19	25	100	
245	*Lactarius* sp. "cream yellow"	M	S		3		1	4	1
246	*Lepiota* sp. "purple-grey"	S	S		1		1	2	
247	*Ramaria* sp. "lemon yellow"	M	S		3	2	1	6	1
248	*Pluteus cervinus*	S	W						
249	*Tephrocybe* sp. "grey"	S	S						
250	*Psathyrella* sp.	S	L						8
251	*Cortinarius* sp. "orange-brown 2"	M	S						
252	*Cortinarius* sp. "glutinous cap/rooting stem"	M	S						
253	*Boletus* sp. "red-brown/golden yellow - intense blue stain"	M	S						
254	*Ramaria vesatilis* "purple"	M	S						
255	*Cortinarius* sp. "yellow-orange"	M	S						
256	*Peziza* sp. "white cup"	?							
257	*Cortinarius* sp. "honey-brown"	M	S						
258	Truffle "sticky"	M	S						
261	*Clavulinopsis* sp. "cream"	S	S						6
262	*Multiclavula* sp. "tiny white candles"	S	S						

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
263	*Sarcodon* sp. "brown"	S	S						1
264	*Lepiota* sp. "cream-grey"	S	S				5	5	2
265	*Cheilymenia* sp. "eyelash on roo poo"	C	Dung						
266	*Thelephora* sp. "white with orange margin"	M	S/Host		17	6	28	51	11
267	*Cortinarius* sp."snowy chestnut"	M	S	9	1	7	7	24	26
268	*Hyphomyces* sp."brown/yellow-orange"	M	S						1
269	*Amanita ochrophylloides*	M	S						
270	*Cortinarius* sp."viscid, yellow-red-brown, white stem"	M	S	1				1	1
271	*Lepiota* aff. *haemorrhagica* "red stainer"	S	S						2
272	*Entoloma* sp."grey-brown with dimple"	S	S		2		1	3	
273	*Cortinarius* sp."white with deep rooting stem"	M	S						
274	*Entoloma viridomarginatum*	S	S			1		1	1
275	Hydnoid "fleshy funnel"	?	S/L						
276	*Russula* sp."purple-mottled"	M	S	1				1	1
277	Polypore "beige"	S	W						1
278	*Entoloma* sp."suede grey-brown with dimple"	S	S						
279	*Cortinarius* sp."brown fibrillose"	M	S				6	6	
280	*Pulvinula* sp.	S	S						
281	*Hygrocybe* sp."pallid yellow"	S	S						9
282	*Corinarius* sp."honey-brown dome /long stem"	M	S						
283	*Amanita eucalypti*	M	S						
284	*Boletus* sp."under Allocasuarina"	M	S						
285	*Mycena* sp. "light brown striate/white stems, on wood"	S	W						
286	*Inocybe* sp."umbonate, shaggy"	M	S			4		4	2
287	*Tremella globispora*	S	W		85		20	105	
288	*Tremella* sp."yellow buttons"	S	W						60
289	*Tremella* sp."tiny yellow knobs"	S	W						
290	*Cortinarius violaceous*	M	S						
291	*Austropaxillus* sp."orange-brown"	M	S			10	33	43	1
292	*Gyroporus* sp."beige-yellow, blue stain"	M	S				2	2	
293	*Cortinarius rotundisporus*	M	S						7
294	Discomycete "small yellow on *Banksia grandis* leaf"	S	L						
295	*Mycena* sp."small buff"	S	L						
296	*Cyathus* sp."on roo poo"	S/C	Dung						
297	*Hydnum repandum*	S?	S		30	1		31	49
299	*Cortinarius* sp."chocolate brown with mustard gills"	M	S	6				6	1
300	*Peziza whitei*	M	S						
301	*Tephrocybe* sp."dark grey with dimple"	S	S				1	1	
302	*Mycena* sp."nipple umbrellas"	S	W						
303	*Cortinaius* sp."stubby domes"	M	S						7
304	*Byssomerulius corium*.	S	W/T						
305	*Tylopilus* sp."yellow"	M	S	26		5	1	32	
306	*Sphaerobolus stellatus*	S	L						
307	*Cyathus*sp.	S	L	5				5	
308	*Mycena* sp."grey-brown,/no bleach"	S	S	3	15	14	23	55	4
309	*Marasmius* sp. (see 223 Fire fungi)	S	S/L		16	2	23	41	
310	*Dermocybe splendida*	M	S						5
311	*Panus fasciatus*	S	W		1		2	3	6
312	*Mycena* sp."pink,bleach"	S	S/L				1	1	
313	*Antrodiella citrea*	S	W/T						5
314	*Cortinarius archerii*	M	S	7	3	2	1	13	
315	*Scleroderma* sp."yellow/yellow mycelium"	M	S						
316	*Clavaria* (*Clavulinopsis*) aff. *aurantiaca* "orange"	M?	S						22
317	*Hygrocybe conica*	S	S	2				2	

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
318	*Marasmellis* sp."small white, on twigs & leaves"	S	L/T	20			9	29	13
319	*Clavaria* (*Clavulinopsis*) sp. "grey-brown with black tips"	M?	S				7	7	24
320	*Amanita* sp. "small robust, yellow-buff, bulbous base	M	S				2	2	
321	Truffle "pink gleba"	M	S						
322	Truffle "black gleba"	M	S						
323	*Crepidotus* sp. "rusty brown suede"	S	W	1				1	4
324	*Clitocybe* sp. "grey robust"	S	S						
325	*Stereum* sp. "purple margin - algae"	S	W						
326	*Mycena* sp. "small buff on wood - bleach"	S	W						
327	*Mycena maldea* (austrocapillaris (bleach))	S	L		1		4	5	1
328	*Dermocybe* sp. "small olive"	M	S						
329	*Lyophyllum* sp. "viscid buff, long stem"	M?	S						
330	*Peziza tenacella*	S	S						
331	*Pulvinula archerii*	S	S						
332	*Peziza "praetervisa"*	S	S						
333	Polypore "on dead waterbush"	S	W						
334	*Cortinarius* sp. "fawn brown"	M	S						
335	*Lentinellus* sp. "brown cap, saw-toothed gills"	S	W						
336	*Mycena* sp. "dk brown on burnt ground"	S	S						
337	*Psathyrella* sp.	S	S						
338	*Anthrocobia muelleri*	S	S						
338b	*Anthrocobia muelleri "*small yellow"	S	S						
339	*Hohenbuehelia carbonaria* - on ground	S	S						
340	*Dermocybe clelandii* "mini"	M	S	2	13	4	1	20	1
341	*Marasmius* sp. "tiny red on twigs"	S	L/T						2
342	*Ryvardinia campyla*	S	W						
343	*Hohenbuehelia* sp. "soft brown"	S	W						
344	*Clavulina* sp. "cream, fluffy tips"	M?	S						
345	*Boletus* sp. "light yellow"	M	S	1		3		4	
346	*Cortinarius* sp. "brown, grey-lavender gills"	M	S						
347	*Entoloma* sp. "brown striate cap"	S	S						10
348	*Cortinarius* sp. "golden tan, long stem"	M	S		1	3	1	5	
349	Agaric "brown, brown decurrent gills"	S?	S		1			1	
350	Boletus sp. "pink maroon cap, yellow/red stem"	M	S						
351	*Ramaria* / *Clavulina* "creamy white"	M	S						
352	Mycena sp. "small creamy yellow-white"	S	L/Bark						
353	*Pisolithus* sp. 'small, stalked"	M	S						
354	*Cortinarius* sp. "yellow-brown cap, lavender gills and stem"	M	S	3				3	
355	*Cortinarius* sp. "brown with lavender margin and stem"	M	S				1	1	
356	*Paxillus* sp. "robust with bulbous base"	M	S						
357	*Cortinarius sinapicolor*	M	S	16		4	3	23	7
358	*Boletus* sp. "viscid brown cap, yellow marshmallow pores"	M	S	1				1	
359	*Psathyrella* sp. "brown with white skirt"	S	S						2
360	*Amanita* sp. "large grey-white, robust"	M	S						
361	Polypore "white resuipinate on twig"	S	W/T						1
362	*Clavulinopsis* "grey brown, black tips"	M?	S						
363	*Piptoporus australiensis*	S	W						1
364	*Chlorociboria aeruginascens*	S	W						3
365	*Gymnopilus junionus*	S	W						
366	*Pyronema*sp.	S	S						
368	*Amanita* sp. "white with mealy stem"	M	S						
369	*Cortinarius* sp. "large red-brown"	M	S						
370	*Clitocybe* sp. "creamy beige"	S	S/L						
371	*Amanita* sp. "white with saccate volva"	M	S						

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
372	*Mycena* aff. *fumosa*	S	W						
373	*Merulius* sp "creamy yellow, on jarrah stick'	S	W						
374	*Cortinarius* sp. "golden-tan"	M	S	2	2			4	5
375	*Cortinarius* sp. "yellow with brown fibrils and orange ring"	M	S	3		4	3	10	1
376	*Mycena* sp. "small brown with decurrent gills"	S	W						
377	*Ramaria lorithamnus*	S	S	2	2	2	4	10	31
378	*Inocybe* sp. "chocolate umbonate"	M	S						
379	*Cortinarius* sp. "lilac-brown with yellow gills"	M	S						
380	*Hydnum* sp. "chestnut"	S?	S						15
381	*Hygrocybe cantharellus*	M	S						4
382	*Cortinarius* sp. "chestnut with yellow margin and yellow flesh"	M	S		1			1	
383	*Laccocephalum tumulosum*	S	W						
384	*Laccocephalum basilapiloides*	S	W						
386	*Mycena* sp. "tiny white sticky cap"	S	T	7				7	
	Banksiamyces sp. *"*sphaerocarpa"	S	Fruit	37				37	
395	*Amanita basirubra*	M	S			1	1	2	
397	*Rhodocybe* ? sp. "grey agaric"	S	S						1
398	*Inocybe* sp. "large scaly umbonate cap"	M	S						1
401	*Pisolothus mamoratus*					1	1	2	
403	*Pisolithus* aff. *arhizus* "black-yellow"	M	S						
404	*Cortinarius* sp. "orange cap, white floccose stem"	M	S						
409	*Entoloma* aff. incana	S	S						
410	*Entoloma* sp. "blue-black, marginate gills"	S	S			4	2	6	2
413	*Nidularia* aff. *farcta* "white dots on roo poo"	S	Dung			8		8	
416	*Hymenochaete* sp.	W			1		2	3	4
421	*Cortinarius* sp. "brown cap, lilac white stem"	M	S	4	14	28	26	72	44
422	*Hohenbuehelia* aff. *atracaerulea* "grey brown"	S	W	6	2			8	4
432	*Cortinarius* sp. "tan cap with chocolate gills"	M	S		1		12	13	
433	*Hebeloma* aff. *westraliensis*	S	S						
435	*Phelledon* sp. "brown"	S	L				2	2	5
436	*Beauvaria bassiana*	P	Insect						
440	White mycelium on roo poo	S	Dung						
443	*Marasmius* sp. “small tan”	S	T		5	12	4	21	4
445	*Hygrocybe polychroma*	S	S	1	11			12	
446	*Tricholoma* sp. "orange with ring"	S	S						
447	*Phelledon* sp. "silver-blue"	S	S	S	S				2
451	*Stropharia* sp. "shaggy stem, on roo poo"	S	Dung						
452	*Rhizopogon* sp.	M	S						
453	*Cortinarius* sp. "decurrent gills, deep stem with double ring"	M	S						
454	Thelephore "creamy jagged-ridged crust"	S	S						22
455	*Peziza* sp. "brown"	S	S	1				1	
456	*Mycena* sp. "brown-grey, viscid conic"	S	L						
457	*Lentinellus* sp. "brown fan, white saw-gills"	S	W						
458	*Clavulina* sp. "pinkish brown, red-brown tips"	S	S						1
459	*Xylaria* sp. "black and white spears"	S	W/S						
460	*Cordyceps* sp. "brown club"	P	Insect						
461	*Omphalina* sp.	S	S				1	1	
462	Discomycete "tiny white on marri nut"	S	Fruit						
463	*Cantharellus concinnus*	M	S						
464	Truffle "pale yellow"	M	S						
465	*Calostoma fuscum*	S	S						
466	*Cortinarius* sp. "brown with white margin"	M	S	1				1	4
467	*Cordyceps* sp. "orange-brown club"	P	Insect						

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
468	*Lentinellus* sp. "brown lobed, hirsute, brown gills"	S	W						
469	*Crepidotus* sp. "chestnut with fringed margin"	S	W						5
470	*Ceratiomyxa fruiticulosa*	Bacteria	W			10		10	
471	*Entoloma* sp. "buff with dimple"	S	S						
472	*Clavulinopsis* sp. "coral pink"	S	S						
473	Agaric "orange"	S?	S						
474	Polypore "soft pored bracket"	S	W						
475	Agaric "creamy brown scaly cap, white bifurcate gills"	S?	S						
476	*Hygrocybe* aff. *astatogala*	S	S						
477	*Mycena* sp. "tiny rosy pink"	S	S				3	3	14
478	*Laetiporus potentosus*	S	W						1
479	*Phelledon* sp. "niger brown"	S	L	103			15	118	377
480	*Hydnellum* sp. "orange tipped spines"	S	L						19
481	*Phylloporus* sp.	M	S						
482	*Torrendia* sp.	M	S						
483	*Tricholoma* sp	S	S						
484	*Inocybe* sp. "large firillose, umbonate, yellow-tan gills"	M	S	1	5			6	1
485	*Cortinarius* sp.	M	S						
486	*Dermocybe* sp. "yellow stipe, yellow mycelium"	M	S						
487	*Inocybe* sp. "brown fibrillose, yellow gills"	M	S			2		2	
488	*Phaeocollybia ratticauda*	S	W/S						
489	*Collybia* sp. "large brown, tan gills"	S	S						
490	*Ramaria* sp. "tan, Allocasuarina litter"	S	S						
491	*Mycena* sp. "brown pointy cap"	S	L						
492	*Cortinarius* sp. "yellow with yellow stem"	M	S						
493	*Amanita* sp. "grey brown robust"	M	S						
494	*Polyporus* sp. "brown stalked"	S	W						
495	*Tricholoma* sp. "orange with white stem"	S	S						
496	*Amanita* sp. "grey veil"	M	S						
497	*Amanita* sp. "grey brown with orange yellow veil"	M	S						
498	*Hebeloma* sp. "small"	S	S						
499	*Peziza* sp. "dark brown-burgandy, tan underside"	S	S						
500	*Cortinarius* sp. "chestnut large"	M	S			15	4	19	
501	*Peziza* sp. "black, flat"	S	S						
502	*Mycena* sp. "striate cap, decurrent gills, on burnt ground"	S	S						
503	*Botryobasidium* sp. "creamy-grey crust on charcoal and leaves"	S	L/W						
504	*Botryohypochus* sp. "creamy-orange mycelium under well rotted litter"	S	L/W						
505	*Tyromyces caesius*	S	W						
506	*Pholiota* sp. "water soaked gills"	S	S						
507	*Tapinella curtisii*	S	W						
508	*Discomycete "tiny cream disks on leaves"*	S	L						
509	*Anthracophyllum archeri*	S	T						
510	*Mycoacia subceracea*	S	T/W				1	1	
511	*Cortinarius* sp. "multi red"	M	S						
512	*Tephrocybe* sp. "small grey-brown"	S	S			1		1	
513	*Tephrocybe* sp. "dark grey-brown convex"	S	S		2			2	
514	*Entoloma* sp. "very large brown-grey"	S	S						
515	*Cortinarius* sp. "red brown cap, slender lavender stem"	M	S						
516	*Ileodictyon gracile*	S	S						
517	*Gymnopilus* sp. "red cap, yellow gills, yellow stem"	S	W						
518	*Amanita* sp. "beige with saccate base"	M	S						
519	*Amanita* sp. "yellow brown, long stem, constricted bulb"	M	S	3				3	
520	*Amanita* sp. "creamy yellow, sticky cap"	M	S						

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
521	*Mycena* sp. "brown pura"	S	L						
522	*Paxillus* sp. "yellow" (*P. infundibuliformis*?)	M	S		2		3	5	
523	*Mycena* sp. "brown striate with dark umbo"	S	L						
524	*Peziza* aff. *thozetii*	S	S				1	1	
525	*Amanita* sp. "white, grey scales, silvery stem"	M	S						
526	*Amanita* sp. "small creamy white, membranous ring"	M	S						
527	*Peziza* sp. "dark brown, smooth"	S	S						
528	Yellow discs on Emu poo	S	Dung						100
529	*Melanoleuca* sp. "grey-brown/white/white"	S	S						
530	*Entoloma* sp. "brown-black, marginate gills, bluish-grey stem"	S	S						
531	Amanita spp. unidentified	M	S	2		2	2	6	1
532	*Coltriciella dependens*	S	W	66	6			72	
533	*Geoglossum* sp.	S	S						
534	*Clavulina amethystina*	S	S						
535	*Nothojafnea thaxterii*	S	S		35			35	
536	*Aleurodiscus* sp. 'apricot on B. grandis cone'	S	Fruits						
539	Hydnoid resupinate	S	W				1	1	
549	*Thelephora* sp. 'small rosette'	S/M	S				1	1	
558	*Paecilomyces tenuipes* 'fluffy antlers'	P	Insect			1		1	
559	*Russula* sp. 'peaches and cream'	M	S				1	1	
565	*Mycena* sp. 'red gills'	S	T	1				1	
582	Resupinate 'white parchment'	S	T			2	1	3	
583	*Entoloma* sp. 'khaki brown cap, white stem'	S	S				6	6	4
584	*Cortinarius* sp. 'hygrophanous orange-brown cap, membranous ring'	M	S	3			6	9	
585	Resupinate polypore 'white floccose, pored'	S	W	1		5	4	10	16
586	Thelephore 'brown feathers'	S/M	S				1	1	
587	*Tephrocybe* sp. 'dark brown with grey brown gills'	S	S		5		25	30	
588	*Amanita* sp. 'salmon pink margin and stem'	M	S		2			2	
589	*Entoloma* sp. 'tall grey conical'	S	S		2	6		8	
590	*Mycena* sp. 'grey brown with creamy brown margin'	S	S		1		1	2	
591	*Gymnopilus* sp. 'purple maroon'	S	W				2	2	
592	*Hysterangium* sp. 'olive gleba'	M	S				18	18	
593	Resupinate 'pinkish beige skin'	S	W				40	40	
594	*Tricholoma* sp.	S	S	1				1	
595	*Hyphaloma* sp.	S	S/L	59	1	1		61	52
596	*Cortinarius* sp. 'pink brown, apressed fibrillose cap'	M	S	3				3	
597	*Cortinarius* sp. 'chestnut with banded stem'	M	S						
598	*Phaeocollybia tasmanica*	S	S	2		4	1	7	
599	*Hygrocybe* sp. 'olive yellow'	S	S	5				5	
600	*Hebeloma aminophylum*	S	S	1		31		32	3
601	*Zelleromyces* sp. 'orange'	M	S		4			4	
602	*Tubifera fuliginosa* 'strawberry myxo'	S	W				1	1	
603	*Lepiota* sp. 'creamy pink'	S	S						1
604	*Entoloma* sp. 'dark cap, grey white scales'	S	S						2
605	*Cortinarius* sp. 'viscid orange cap, yellow stem'	M	S						25
606	*Entoloma* sp. 'tall velvet grey brown cap'	S	S						2
607	*Boletus* sp. 'yellow brown, stains blue'	M	S						2
608	*Cortinarius* sp. 'sticky creamy beige'	M	S						58
609	*Cortinarius* sp. 'small purple umbonate'	M	S		2			2	90
610	*Macowanites* sp.	M	S						1
611	*Cortinarius* sp. 'dry, purple grey'	M	S						9
612	*Melanophyllum echinatum*	S	S						1
613	*Hygrocybe* sp. 'dry, orange brown'	S	S						8

Sp#	Species	Life Mode[1]	Sub-strate[2]	Treatments[3]				Black-wood	Donn-elly
				E.C.	SW.	S.C.	G.R.	Total	Total
614	*Phlebia* sp. 'orange'	S	W						10
615	*Resupinate* ‘creamy grey maze'	S	W						1
616	*Hygrocybe* sp. 'viscid, red, purple stem'	S	S						3
617	Agaric "red brown, scurfy cap"	S?	L						108
618	*Marasmius sp.*	S	T						20
619	*Crepidotus* sp. "ginger with white margin and gills"	S	W						150
620	*Clavaria* sp. "yellow orange forks"	S	S						3
621	*Phellodon* sp. "black, silver/brown grey spines"	S	L	36			100	136	60
622	Discomycete "creamy white discs on soil"	S	S				1	1	23
623	Resupinate thelephore "creamy pimpled with orange margin and stem"	S	Charcoal				1	1	25
624	*Ramaria* sp. "golden orange"	S	S						1
625	Discomycete "tiny white cups - on marri nut"	S	Fruits						12
626	*Cortinarius* sp. "red-brown pointy cap"	M	S	250				250	
627	*Cortinarius* sp. 'purple brown with glutinous stem"	M	S	26		1	3	30	
628	*Boletus* sp. "slippery dark brown - stains pinkish brown"	M	S	2				2	
629	*Zelleromyces* sp. "yellow, olive gleba"	M	S				2	2	
630	*Marasmiellis* sp. "tiny tan"	S	Bark				30	30	
631	*Hygrocybe* sp. "yellow with orange stem"	S	S		1		5	6	
632	*Thelephore "purple splash"*	S	W		1			1	
633	*Collybia dryophila*	S	S		1			1	
634	*Phellodon* sp. "flimsy, silver grey"	S	S			1		1	
556	**Number of species**			**115**	**124**	**130**	**173**	**252**	**241**
	Abundance			**2294**	**2769**	**3168**	**5357**	**13588**	**11304**

[1] S = saprotrophic, M = mycorrhizal, P = parasitic, C = coprophilous
[2] S = soil, L = litter, T = twigs, W = wood
[3] E.C. = external control, S.W. = shelterwood, S.C. = selective cut, G.R. = gap release

The yellow shaded species represent those recorded at Donnelly from 2003-2006, but not at any of the other FORESTCHECK locations

CRYPTOGAMS

Ray Cranfield

Introduction

Cryptogam is the collective name for the Lichen, Moss and Liverwort flora. Some species of lichens are important indicators of ecosystem health being sensitive to changes and disturbance in the environment in which they grow. Many colonise primary substrates such as rocks and bare organic matter and are active in the initial breakdown of these materials. Mosses also play an important role in the stabilization of bare soil. Cryptogams are a major component of the biodiversity of forest ecosystems, and most species in Western Australia have unknown distributions and many are yet to be determined.

The object of this component of FORESTCHECK is to:

- Record species richness and abundance in each FORESTCHECK grid and treatment
- Record species habitat and substrate preference, and
- Monitor the effect of disturbance on cryptogam communities

Monitoring

The cryptogam flora was monitored in September 2005. At each of the 11 FORESTCHECK grids, the presence and frequency of each species along with the macro and microhabitat that each species occurred on was recorded. Although the monitoring was conducted much later than previous years it appears that the flora was well represented. This is due partly to the durable nature of the cryptogams and the extended period of rain during this time frame.

Voucher Specimen Processing

All specimens collected this year have been identified or phrase named for ease of redetermination. Information gained from several ongoing cryptogam studies has become available and several names used in this report reflect these changes. Once again several samples of terrestrial algae were collected and prepared for incorporation in the state collection held at the WA Herbarium.

All collections have been prepared for database entry and label generation prior to submitting these vouchers to the Herbarium. A total of 460 collections (366 lichens, 74 mosses and 20 liverworts) were made from the 11 grids in the Blackwood Plateau area. These collections represent 83 species of lichens, 12 species of moss and 5 species of liverworts, making a total of 100 species of cryptogams. A further 30 collections of terrestrial algae were collected and 17 fungal and slime mould collections. It should be noted that, like in 2004-05 when monitoring was also conducted in the spring, there was a reduction in the number of microfungi collections made, but no real impact on the number of other cryptogams was observed.

Preliminary Results and Discussion

Species and habitats

A total of 100 species of cryptogams were recorded on the grids in the Blackwood Plateau area (Appendix 1). The number of liverwort species recorded was relatively low. This may be a reflection of the more open and exposed sites with free draining soils or they may have a naturally low occurrence in this area. These factors may affect all species of cryptogams

associated with the Blackwood Plateau grids. However, how increased exposure due to logging impacts liverwort and other sensitive cryptogam species in jarrah forest is still unknown and more detailed analysis is needed in order to estimate a time frame for them to re-establish and return to pre-logging levels.

In general, a decline in species numbers occurred from external control to selective cut, shelterwood and gap release treatments (Fig. 1). The long unburnt St John external control (FC39 - burnt in 1992) appears to have a reduced species composition compared to the recent burnt Barrabup external control (FC38 – burnt in 2002). The Layman external control (FC40) was burnt in 1997 and appears to be richer in species than the St John external control but not as species rich as the Barrabup grid. In the treatment grids (selective cut, shelterwood and gap release) there appeared to be no pattern or relationship associated with time since logging or burning. For example the Cambray grids had higher numbers and the Barrabup grids had lower number of species than would be expected from having respectively been burnt 4 and 7 years previously (compared to the external controls). Species composition on the respective sites and the relationship to treatments and time since fire will be investigated and analysed in detail during 2006-07.

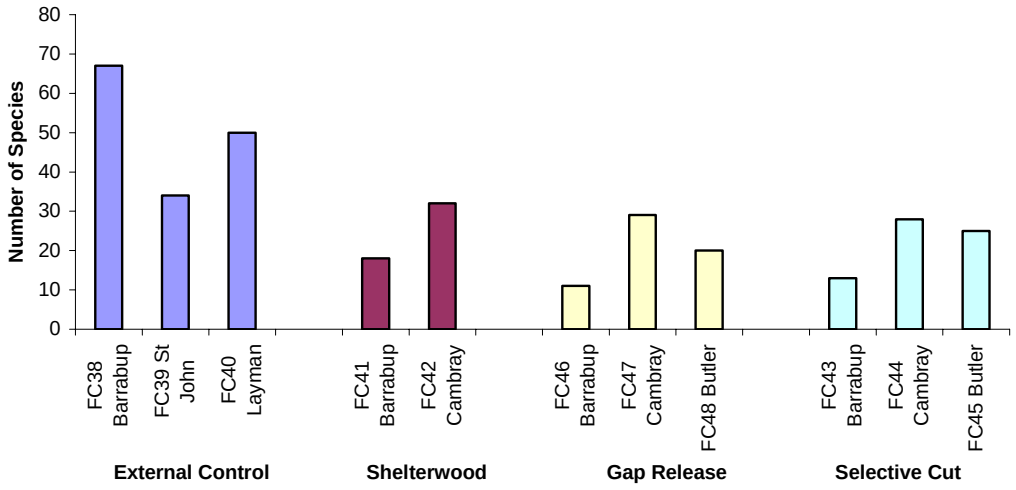


Figure 1. The number of species of cryptogams on each FORESTCHECK grid on the Blackwood Plateau.

Wood (old logs), the bark of older trees and to a lesser degree soil and stone were the most utilised substrates in the control grids (Fig. 2). All 7 specified substrate types were present in each of the treatment grids but differences in colonisation of the substrates were related to the age and condition of the substrate. Time after fire is important for cryptogams and species substitution can be observed. Several substrates, although present on treatment sites, were not utilised or were under utilised, as they were not sufficiently mature or developed to be readily colonised.

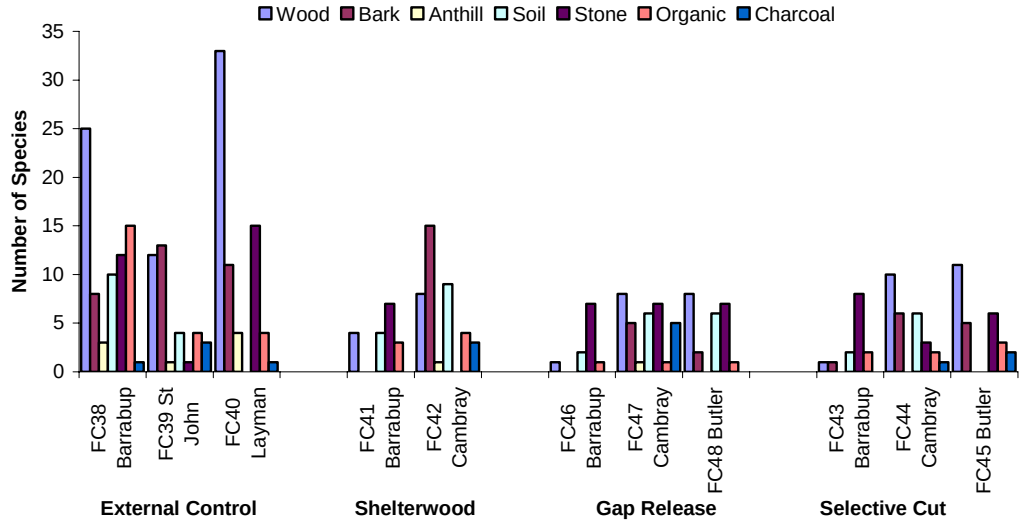


Figure 2. The number of cryptogam species colonizing available microhabitats (substrates) on FORESTCHECK grids on the Blackwood Plateau.

The position of each species within the 3 strata layers was recorded (Fig. 3). The number of species recorded at ground level (0-30 cm) was relatively high across all treatments and grids. The number of species recorded in the shrub level (31 cm-3 m) varied within the treatments, with the gap release treatment recording the lowest numbers. As expected, treatments where older trees have been disturbed or removed species normally recorded at the tree level (< 3.1 m) were absent or greatly reduced in numbers.

An understanding of the growth requirements of individual cryptogam species and the effects of modified external influences is required to ensure the long term viability and diversity of these taxa. The number of species of lichens, mosses and liverworts occurring on each substrate and in each level of strata is included in the summary in Appendix 1.

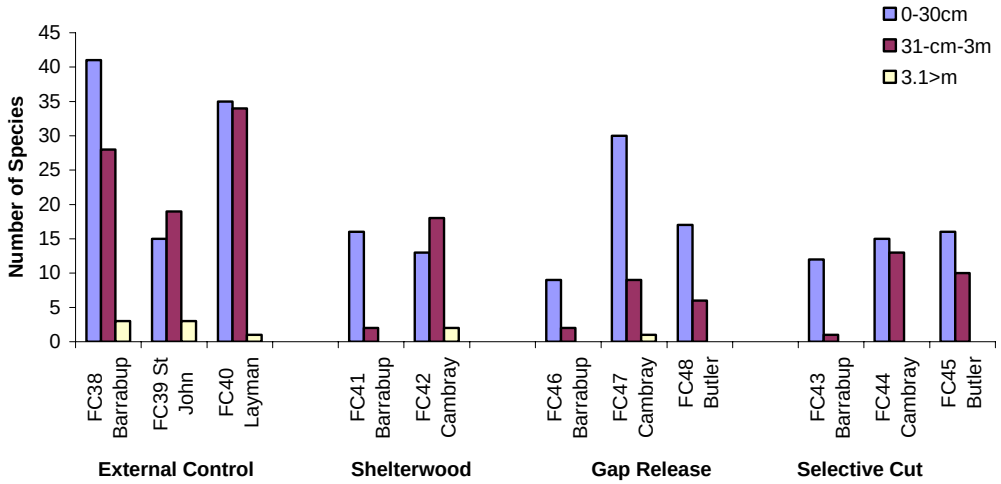


Figure 3. The number of cryptogam species recorded at each stratum on FORESTCHECK grids of Blackwood Plateau.

Cryptogam life forms

The classification of the cryptogam species into artificial sub-groupings, that reflect life forms associated with recognised groupings, may assist in the understanding the survival and growth requirements of individual species and has been investigated for this set of grids. The lichens were divided into artificial groups, based on morphology (foliose, crustose including squamulose, fruticose and filamentose), that are well established in the literature. Likewise the liverworts were divided into the established classifications thallose and leafy types. Mosses were placed into 2 basic types, tufted and creeping, although there may be considerable overlapping and recognition may be difficult.

Analysing the presence of these groups for the Blackwood Plateau (Fig. 4.) showed that moss groups were consistent across all the grids and the crustose lichens were widely represented. The liverwort groups were not common on the grids or absent in many instances and were restricted to the leafy type.

These broad groupings may be closely linked to the perceived fragility and survival strategies of the species within them, and will be further investigated in 2006-07 to encompass all of the areas involved in the FORESTCHECK project.

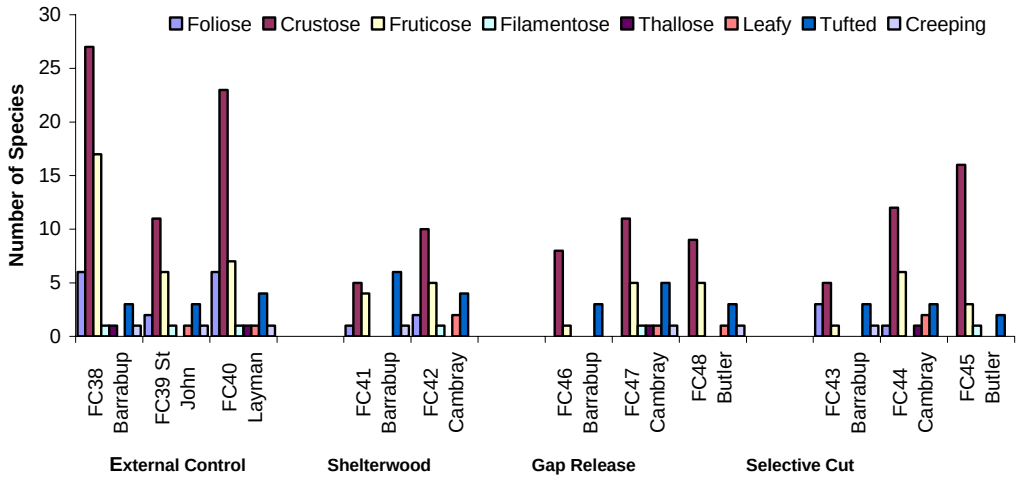


Figure 4. The number of cryptogam species and life form types at each FORESTCHECK grid on the Blackwood Plateau.

Indicator species

At the Blackwood Plateau, investigation continued into the use of possible indicator species. The list of potential indicators includes 35 species, of which 26 are lichens, 4 are liverworts and 6 are mosses (Appendix 2). The species were chosen on the basis of their preferred substrate and the position they occupy in the strata. The current list has been fully revised as it became clear that some of the original suggested species (see 2002-03 Wellington report) were of limited value and required substituting with more suitable species.

Comparison of all FORESTCHECK locations
An overview of all FORESTCHECK locations (Donnelly, Wellington, Perth Hills, Wellington East and Blackwood Plateau) was undertaken in an attempt to see possible similarities and differences between the 5 areas.

Common species
20species of lichens, 3 species of moss and 1 species of liverwort were found to be common to 90% of the grids in the 5 FORESTCHECK locations (see 2004-05, Wellington East report).

Species richness
External control
There was some variation observed in the number of species recorded on the control grids at each location and between locations (Fig. 5). Lichens appear to be the more prolific, but variable group with mosses consistently in moderate numbers while liverwort numbers, although low, fluctuate in accordance with the site location and climatic constraints.

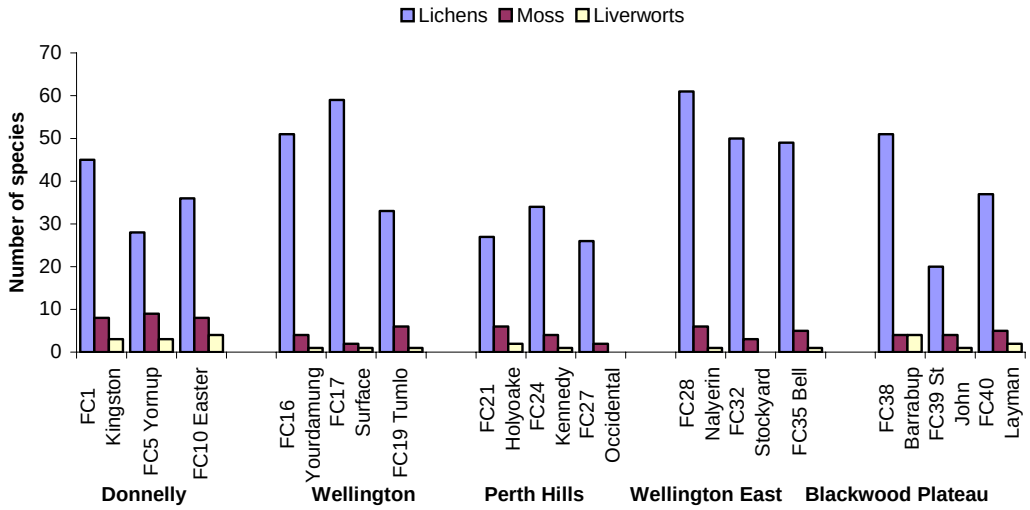


Figure 5. The number of cryptogam taxa recorded on external control sites at the Donnelly, Wellington, Perth Hills, Wellington East and the Blackwood Plateau FORESTCHECK locations.

Gap release
The loss of micro climatic niches is known to impact on several species of cryptogams resulting in the loss of species or population reduction. The lower number of taxa recorded on the gap release sites (Fig. 6) is a result of disturbance and habitat loss, by either tree harvesting, fire or both.. The time since treatment on these gap sites is important in the recovery of the cryptogam flora. Further investigation is needed in order to understand the associated impacts of gap felling and treatments employed to re-establish these areas as rapid regrowth can have detrimental effects upon certain cryptogam species.

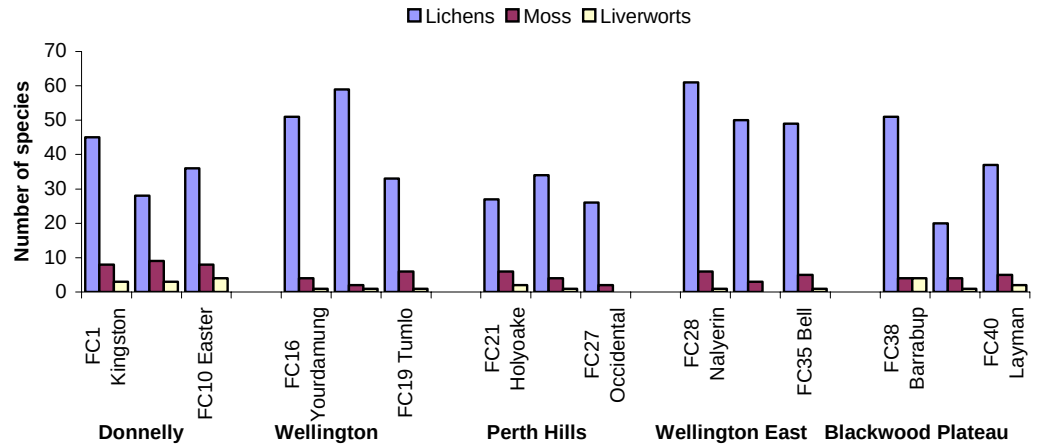


Figure 6. The number of cryptogam taxa recorded on gap release sites at the Donnelly, Wellington, Perth Hills, Wellington East and Blackwood Plateau FORESTCHECK locations.

Strata occupied

The use of particular strata by various cryptogam taxa in the external control grids varied between each location (Fig. 7). In most instances the ground level (0-30 cm) is constantly high and number of species quite regular. The number of species utilising the shrub layer (31 cm-3 m) fluctuates considerably, with the Yourdamung grid (FC16) in the Wellington location recording the highest number of species. The number of species recorded in the tree layer (>3 m) was low at all locations but absent on the Bell grid in the Wellington East location.

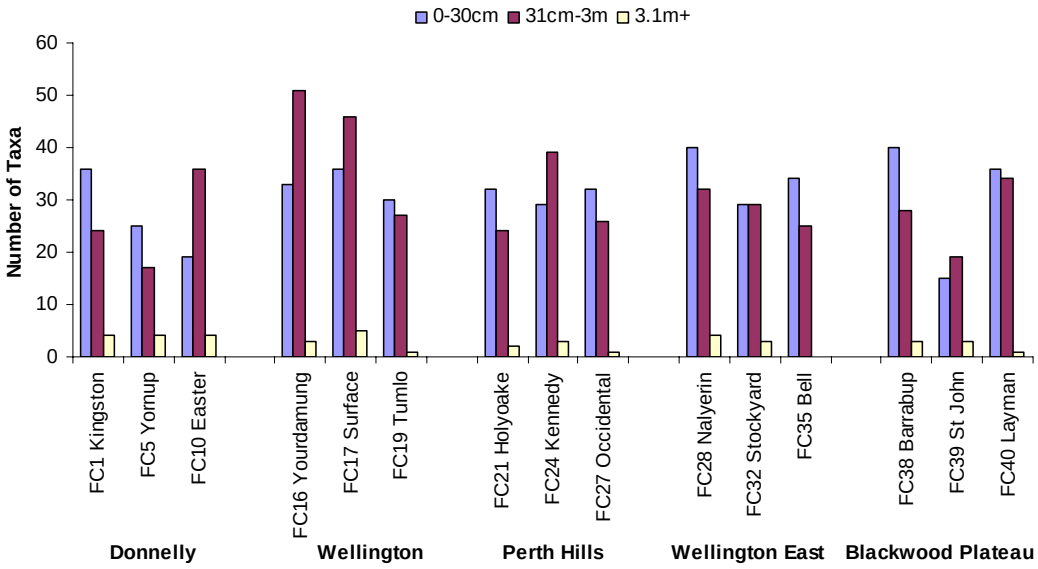


Figure 7. The number of cryptogam taxa occupying the different levels of forest strata in the external control grids at the Donnelly, Wellington, Perth Hills, Wellington East and Blackwood Plateau.

On the gap release sites (Fig. 8), the loss of older trees and mature shrub cover has reduced the availability of suitable substrates suitable for cryptogam colonisation by modification of the micro climatic habitat balance. Rapid tree regrowth, dense canopy cover and removal of

woody debris by fire appear to restrict the establishment of ground and shrub layer occupation. As a result of fire old decaying logs on the ground may have the outer layer of material removed and or charred. This has the effect of removing and retarding the establishment of cryptogams that appear to require a certain stage of decay and time since fire before re-establishment can occur. On wetter locations the desired location for cryptogams appears to be the ground, but it is really a reflection of the predominance of mosses and to a lesser degree liverwort species.

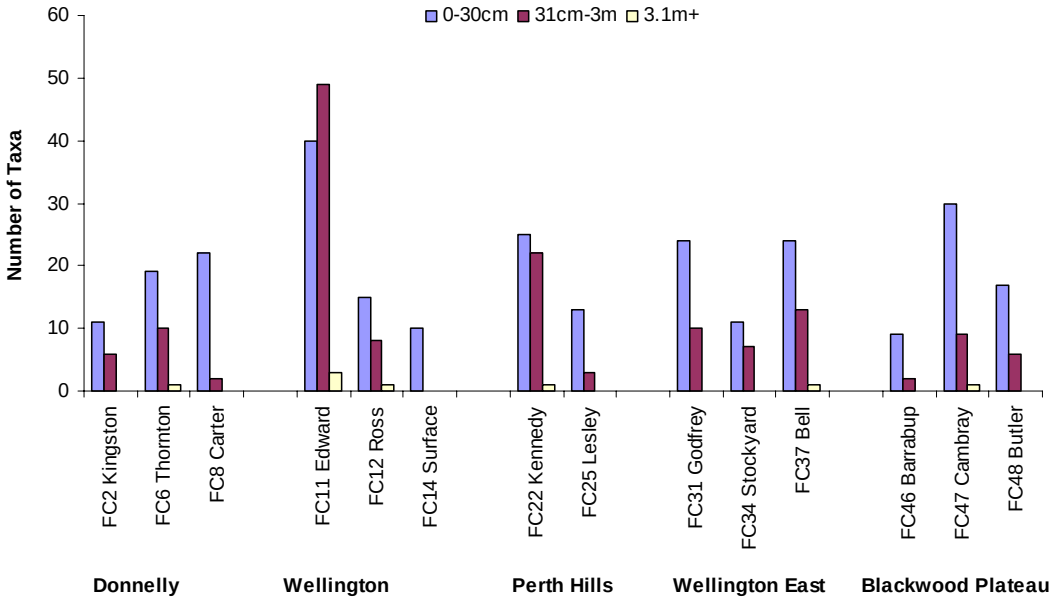


Figure 8. The number of cryptogam taxa occupying the different levels of forest strata in the gap release grids at the Donnelly, Wellington, Perth Hills, Wellington East and Blackwood Plateau locations.

Conclusions

The main observations made following monitoring of cryptogams at Blackwood Plateau were:

- Cryptogam species richness was higher in external control grids.
- Anthill (termite) mounds, a common substrate for several species of lichens and mosses, were not regularly utilised in external controls – reason not clear.
- The most common substrates utilised in all treatments were rocks and decaying logs.
- The most common lichens were the crustose-types.
- The most common mosses were the tufted-types.
- The foliose-type lichens had a moderate representation but the delicate structure of this group means that reaction to changes can be dramatic.
- Liverwort species although present tended to be low in numbers and abundance.

Appendix 1: Presence/absence of cryptogam taxa located on each FORESTCHECK grid on the Blackwood Plateau (names in **bold text** are the nominated indicator species).

	External Control			**Shelterwood**		**Gap Release**			**Selective**		
Grid #	FC38	FC39	FC40	FC41	FC42	FC46	FC47	FC48	FC43	FC44	FC45
Taxa	Barrabup	St John	Layman	Barrabup	Cambray	Barrabup	Cambray	Butler	Barrabup	Cambray	Butler
Mosses (B)											
Barbula calycina	*			*	*	*	*	*	*	*	*
Campylopus bicolor		*	*								
Campylopus introflexus	*	*	*	*	*	*	*	*	*	*	*
Ceratodon purpureus				*							
Dicranoloma billarderi		*		*							
Dicranoloma sp.			*								
Didymodon torquatus				*			*	*	*		
Funaria hygrometrica	*		*	*	*	*	*			*	
Rosulabryum capillare					*						
Sematophyllum homomallum				*							
Sematophyllum subhumile							*				
Sematophyllum subhumile* var. *contiguum	*	*	*					*	*		
Thuidiopsis sparsa							*				
Liverworts (H)											
Cephaloziella exiliflora		*	*		*		*	*		*	
Chiloscyphus semiteres					*						
Fossombronia altilamellosa										*	
Fossombronia sp.	*		*				*				
Lethocolea pansa										*	
Lichens (L)											
Buellia substellulans			*								
Buellia sp.			*	*				*			
Calicium glaucellum	*	*	*		*						
Calicium victorianum	*										*
Calicium victorianum subsp. *desidiosum*	*		*								
Cladia aggregata	*	*	*	*	*		*	*		*	*
Cladia inflata	*										
Cladia schizopora	*	*	*	*	*	*	*	*	*	*	*
Cladonia cervicornis var. ***verticillata***	*	*									
Cladonia humilis	*										
Cladonia imbricata			*								
Cladonia krempelhuberi	*									*	
Cladonia macilenta	*		*								
Cladonia merochlorophaea	*										
Cladonia ochrochlora	*										
Cladonia praetermissa				*							
Cladonia ramulosa			*	*				*			
Cladonia rigida	*	*	*	*	*					*	*
Cladonia scabriuscula								*			
Cladonia southlandica	*										
Cladonia sulcata	*		*				*				
Cladonia tessellata							*				

	External Control			Shelterwood		Gap Release			Selective		
Grid #	FC38	FC39	FC40	FC41	FC42	FC46	FC47	FC48	FC43	FC44	FC45
Taxa	Barrabup	St John	Layman	Barrabup	Cambray	Barrabup	Cambray	Butler	Barrabup	Cambray	Butler
Cladonia ustulata	*	*	*								
Cladonia sp.	*				*					*	
Diploschistes actinostromus						*					
Diploschistes euganeus								*			
Diploschistes scruposus			*								
Diploschistes strictus	*		*			*	*	*	*	*	*
Diploschistes sp.			*						*		
Graphis sp.		*	*								
Graphis sp. (black beans)		*									
Graphis sp. (black lips)							*			*	
Graphis sp. (tram lines)			*								*
Graphis sp. (writhing mass)			*								*
Hafellia disciformis			*								
Hypocenomyce australis	*		*					*		*	*
Hypocenomyce foveata	*		*							*	
Hypocenomyce scalaris	*		*				*				*
Hypogymnia subphysodes	*		*								
Hypogymnia subphysodes var. ***subphysodes***	*	*	*		*						
Lecidella sp.	*						*				*
Megularia grossa	*										
Miroquidica sp.	*										
Ochrolechia sp.	*		*							*	
***Ochrolechia* sp. (G.S. Kantavilas 306/92)**	*	*	*		*					*	
Ochrolechia sp. (twiggy)	*	*			*						
Ochrolechia subrhodotropa		*	*								
***?Opegrapha* sp.**			*		*			*		*	*
Pannoparmelia wilsonii	*	*	*	*	*				*	*	
Paraporpidia glauca	*		*	*		*	*	*	*		*
Parmelina conlabrosa	*		*								
Parmelina pseudorelicina	*		*								
Parmotrema pseudonilgherrense	*										
Ramalea cochleata	*										
Ramboldia petracoides			*								
Ramboldia stuartii	*	*	*		*			*		*	*
Rhizocarpon sp. (grey)	*		*	*		*	*		*		
Rimelia reticulata	*										
Sarcopyrenia sp.	*										
Tephromela atra	*		*							*	*
Thysanothecium hookeri	*		*								
Thysanothecium scutellatum	*	*	*		*		*	*		*	*
Toninia sp.			*								
Trapelia coartata			*								
Trapeliopsis sp.	*		*								*
Usnea inermis	*	*	*		*		*				*
Verrucaria maura	*					*					
Xanthoparmelia antleriformis									*		
Xanthoparmelia sp.			*								

	External Control			Shelterwood		Gap Release			Selective		
Grid #	FC38	FC39	FC40	FC41	FC42	FC46	FC47	FC48	FC43	FC44	FC45
Taxa	Barrabup	St John	Layman	Barrabup	Cambray	Barrabup	Cambray	Butler	Barrabup	Cambray	Butler
Xylographa sp.							*				
Genus sp. (balls)											
Genus sp. (black hairy stepping stones)	*		*								
Genus sp. (blue apo)	*										
Genus sp. (brown crazy path)						*					
Genus sp. (brown doughnuts)		*									
Genus sp. (fans)			*								
Genus sp. (golden coral)										*	
Genus sp. (green crust)		*	*		*		*			*	
Genus sp. (grey crumbs)	*		*								
Genus sp. (grey frosting)	*		*	*				*	*		*
Genus sp. (grey squamules)	*					*	*		*		
Genus sp. (lichen)	*	*	*	*		*	*	*	*	*	
Genus sp. (orange domes)											*
Genus sp. (soot)			*								
Genus sp. (spotty)			*								
Genus sp. (squamules)	*										
Genus sp. (sultanas)					*						
Genus sp. (tan)			*								
Genus sp. (termite mound)	*	*			*						
Genus sp. (yellow crust)									*		

Appendix 1b: Summary of the number of cryptogams in each taxonomic group, and the number of species occupying each habitat (substrate), stratal position and life-form type.

	External Control			**Shelterwood**		**Gap Release**			**Selective Cut**		
Summary	FC38 Barrabup	FC39 St John	FC40 Layman	FC41 Barrabup	FC42 Cambray	FC46 Barrabup	FC47 Cambray	FC48 Butler	FC43 Barrabup	FC44 Cambray	FC45 Butler
Total number of species	67	34	50	18	32	11	29	20	13	28	25
Groups (number of species)											
Lichen (L)	62	28	47	10	26	8	19	15	9	22	21
Mosses (B)	4	5	2	8	4	3	8	4	4	3	4
Liverworts (H)	1	1	1	0	2	0	2	1	0	3	0
Habitats[1] (number of individual records)											
Wood	25	12	33	4	8	1	8	8	1	10	11
Bark	8	13	11	0	15	0	5	2	1	6	5
Anthill	3	1	4	0	1	0	1	0	0	0	0
Soil	10	4	0	4	9	2	6	6	2	6	0
Stone	12	1	15	7	0	7	7	7	8	3	6
Organic	15	4	4	3	4	1	1	1	2	2	3
Charcoal	1	3	1	0	3	0	5	0	0	1	2
Stratal Position[1] (number of individual records)											
0-30 cm	41	15	35	16	13	9	30	17	12	15	16
31 cm – 3 m	28	19	34	2	18	2	9	6	1	13	10
> 3.1 m	3	3	1	0	2	0	1	0	0	0	0
Life Form Types (number of individual records)											
<u>Lichens</u>											
Foliose	6	2	6	1	2	0	0	0	3	1	0
Crustose	27	11	23	5	10	8	11	9	5	12	16
Fruticose	17	6	7	4	5	1	5	5	1	6	3
Filamentose											
<u>Liverworts/Hornworts</u>											
Thallose	1	1	1	0	1	0	1	0	0	0	0
Leafy	0	1	1	0	2	0	1	1	0	2	0
<u>Mosses</u>											
Tufted	3	3	4	6	4	3	5	3	3	3	2
Creeping	1	1	1	1	0	0	1	1	1	0	0

[1] Some species utilize more than one habitat or strata position

Appendix 2: Revised list of FORESTCHECK cryptogam indicator species (L= Lichens, H= Hepatophyte (Liverwort/Hornwort), B= Bryophyte (Mosses)).

Code Number	Group	Taxon
1	L	*Cladia aggregata*
2	L	*Cladia schizopora*
3	L	*Cladonia cervicornis* var. *verticellata*
4	L	*Cladonia krempelhuberi*
5	L	*Cladonia rigida*
6	L	*Cladonia sulcata*
7	L	*Calicium glaucellum*
8	L	*Diploschistes strictus*
9	L	*Flavoparmelia haysomii*
10	L	*Hypocenomyce foveate*
11	L	*Hypocenomyce scalaris*
12	L	*Hypogymnia subphysodes* var. *subphysodes*
13	L	*Menegazia platytrema*
14	L	*?Opegrapha* sp.
15	L	*Ochrolechia* sp. (Kantavilis 306/92)
16	L	*Pannoparmelia wilsonii*
17	L	*Paraporpidia glauca*
18	L	*Parmotrema reticulatum*
19	L	*Ramboldia stuartii*
20	L	*Tephromela atra*
21	L	*Thysanothecium hooheri*
22	L	*Thysanothecium scutellatum*
23	L	*Usnea inermis*
24	L	*Usnea* sp. (leuco)
25	L	*Xanthoparmelia isidiigera*
26	L	*Xanthoparmelia notata*
27	H	*Cephaloziella exiliflora*
28	H	*Chiloscyphus semiteres*
29	H	*Fossombronia* sp. (leafy)
30	H	*Frullania prosbosciphora*
31	B	*Barbula calycina*
32	B	*Campylopus introflexus*
33	B	*Dicranoloma diaphanoneuron*
34	B	*Funaria hygrometrica*
35	B	*Sematophyllum subhumile* var. *contiguum*

VASCULAR PLANTS

Bruce Ward and Ray Cranfield

Introduction

The vegetation complexes of the southwest jarrah forest are considered to be relatively stable and resilient to natural disturbances such as fire. In most circumstances, and in time, the species that were present before the disturbance are generally present after the event, although abundances may change. Where logging is concerned, disturbance might include soil movement, mixing and compaction. This level of disturbance may impact more severely and cause a loss in diversity either through a loss in species richness or a shift in species abundance. The pyric succession of plants would also affect which species are present and an allowance for time since fire needs to be considered in determining species richness. Differences may be successional rather than an impact of logging.

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

- Monitor vascular plant species richness and abundance on each of the FORESTCHECK sites
- Compare species richness, abundance and composition recorded on treatment grids (shelterwood and gap release) to those in uncut reference areas (external control)

Monitoring

Spring is the preferred time to monitor understorey vascular plants as it coincides with the peak flowering time for most plants. Species richness and understorey vegetation structure was determined, by recording each species, estimating its area of cover, and measuring its position in the understorey strata, in four 30 m x 30 m plots in each grid (40 in total). Species density was measured by recording species occurrence and abundance in twenty 1 m x 1 m plots in each grid (800 in total). Vegetation structure is determined from levy contact data at various height categories in the understorey (Levy and Madden 1933). The area around each grid was used to search and voucher flowering plant specimens to aid in or confirm their identification. A full list of species recorded is shown in Appendix 1.

Preliminary Results and Discussion

Species richness:

A total of 232 species were noted from the 30 m x 30 m plots and 167 species from the 1 m x1 m plots (see Table 1 for comparison of species numbers). The area around each grid was used to search for flowering voucher plant specimens. In total 174 vouchers were collected which represents about 60% of the species. A further 56 species were unique to either the 30 m x 30 m plots or the 1 m x1 m plots or were collected from out side of the plot areas which increased the species numbers to 288. In the total species recorded for the study area, 80% were represented in the 30 m x 30 m plots and 58% in the 1 m x 1 m plots. The Blackwood Plateau location is more species rich than any other location measured so far with 22% more species recorded.

Table 1: Showing species diversity comparisons for FORESTCHECK locations at Manjimup, Wellington, Perth Hills, Wellington East and Blackwood Plateau.

Location	30 m x 30 m Plots Species Numbers	1 m x 1 m Plots Species Numbers	% Difference	Number of Weed Species
Donnelly 2002	203	158	22	24
Wellington 2003	181	116	36	10
Perth Hills 2004	188	126	33	4
Wellington East 2005	159	137	14	10
Blackwood Plateau 2006	232	167	28	5

Species richness within treatments showed some variation and suggests that this may be a response to time since fire rather than due to logging activities. Any loss in species would be reflected in lower species richness than was recorded for external controls (Fig 1). In all treatments species richness generally increased with time since treatment (fire or logging) for 9 to 10 years. This appears to be a normal successional trend that might be experienced following a fire event. Natural site variability may also account for some of the variation between grids. Introduced species are present in low numbers, being1.7% of the total. The alien species were only recorded on logged grids, suggesting that disturbance associated with logging has allowed these species to invade.

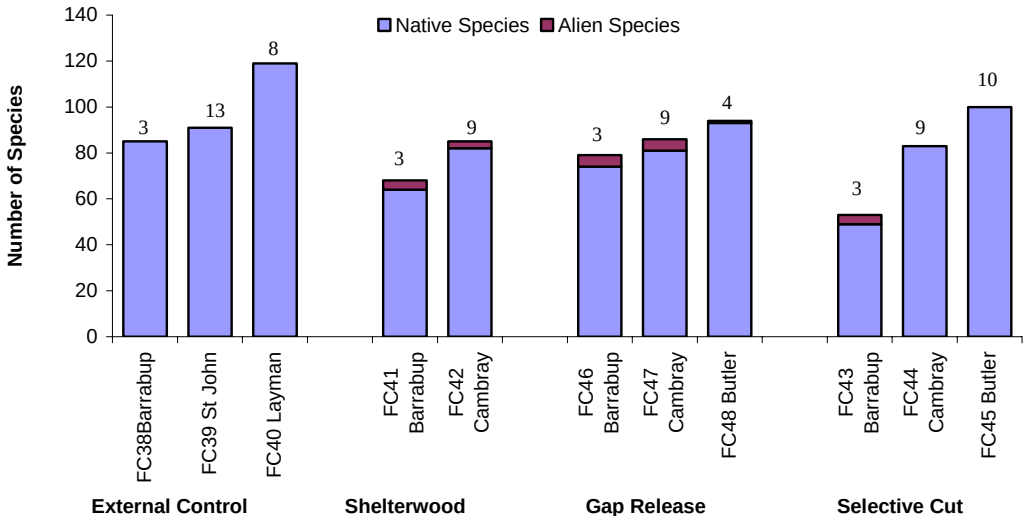


Figure 1: Number of vascular plant species recorded on the Blackwood Plateau FORESTCHECK grids. The time (years) since fire is shown above each grid.

Species density (abundance)
Comparing species abundance across all treatments shows there was no apparent impact of logging. However, within treatments there are indications that some life-form groups may be favoured by logging or fire while others are disadvantaged (fig. 2).

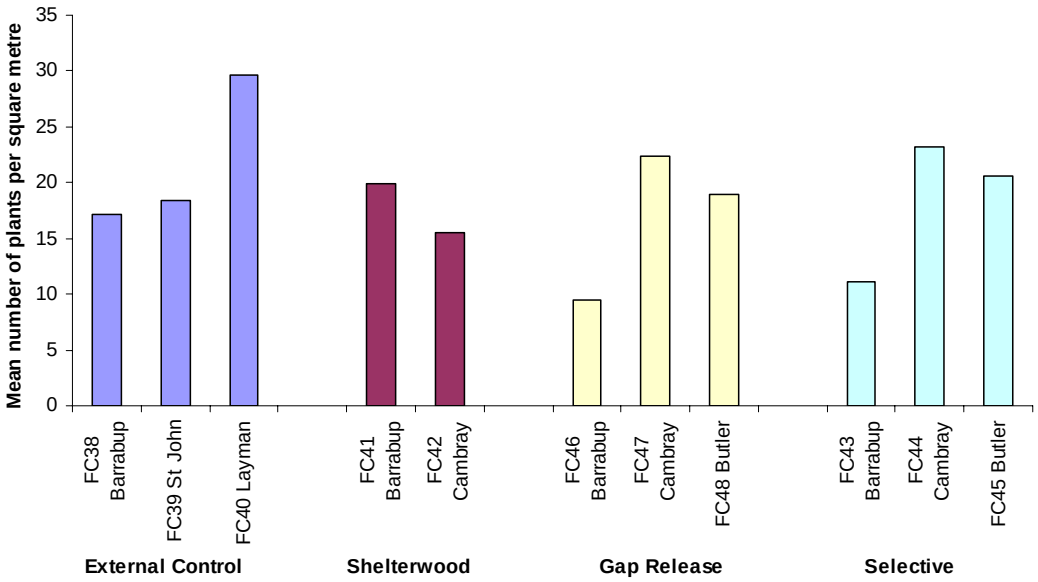


Figure 2: Mean species density (abundance) of vascular plant species recorded on the Blackwood Plateau FORESTCHECK grids

Plant frequency
Plant numbers were rated by plant frequency categories shown in Table 2. The results show that some of the logged grids have lower frequencies than the control plots and support the density data above, which shows a reduction in plant numbers within some grids and an increase in others. This variation is most likely to be due to site attributes such as soil condition, soil type, plant composition and time since fire.

Table 2: The number of plant species recorded in each frequency group for each FORESTCHECK grid on the Blackwood Plateau.

	External Control			**Shelterwood**		**Gap Release**			**Selective Cut**		
Plant Frequency Group	FC38 Barrabup	FC39 St John	FC40 Layman	FC41 Barrabup	FC42 Cambray	FC46 Barrabup	FC47 Cambray	FC48 Butler	FC43 Barrabup	FC44 Cambray	FC45 Butler
1 Plant	7	11	14	15	20	21	14	15	11	12	10
< 10 Plants	65	54	75	37	71	56	53	56	17	50	63
10 - 50 Plants	64	70	87	54	76	55	71	78	53	74	78
50 - 100 Plants	29	42	45	35	27	38	26	47	25	25	46
100-500 Plants	10	9	24	11	14	19	16	6	22	12	23
>500 plants	5	7	4	6	2	7	2	5	4	5	3
Total	**180**	**193**	**249**	**158**	**210**	**196**	**182**	**207**	**132**	**178**	**223**

Importance value from cover, frequency and distribution ratings

Importance values, based on cover, frequency and density of each plant, were calculated to demonstrate the contribution that each species makes to the vegetation complex. Each of the three attributes is rated according to predetermined ranges and the importance value is the proportion of the total of plant species for each plot. Cover, frequency and density importance values were added together to give a total importance value for each species. A sum of the total importance value was plotted for each grid (Fig. 3), which showed that the value was reasonably consistent across all treatments. As plant frequency and distribution declined with time since treatment, the overall importance values also declined within treatments.

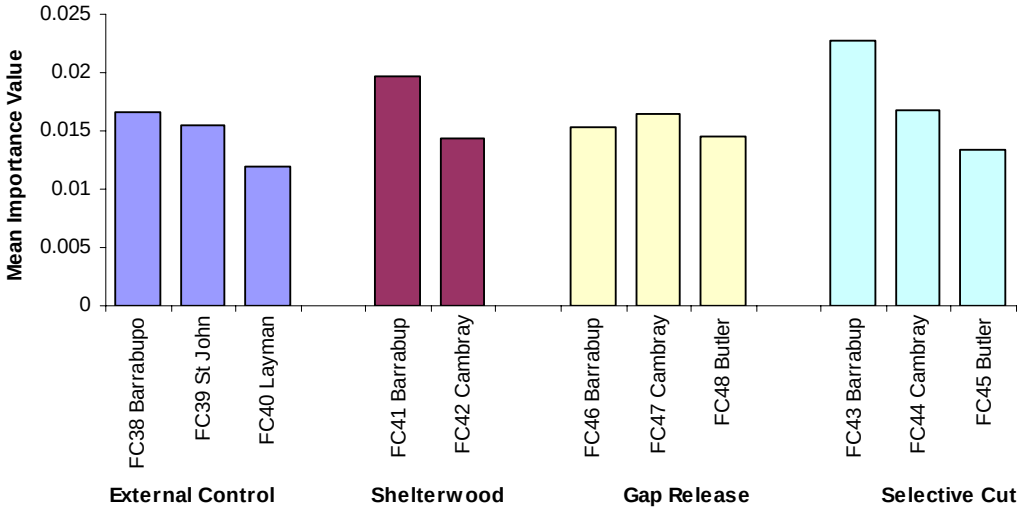


Figure 3: Importance values for each FORESTCHECK grid on the Blackwood Plateau

Life-forms

Plant numbers in the various life-form categories were compared between treatments. Plant numbers in each category were lowest in the shelterwood treatment and generally highest in the external control treatment (Fig. 4), suggesting that shelterwood silvicultural treatment has had an impact on many of the life-form categories.

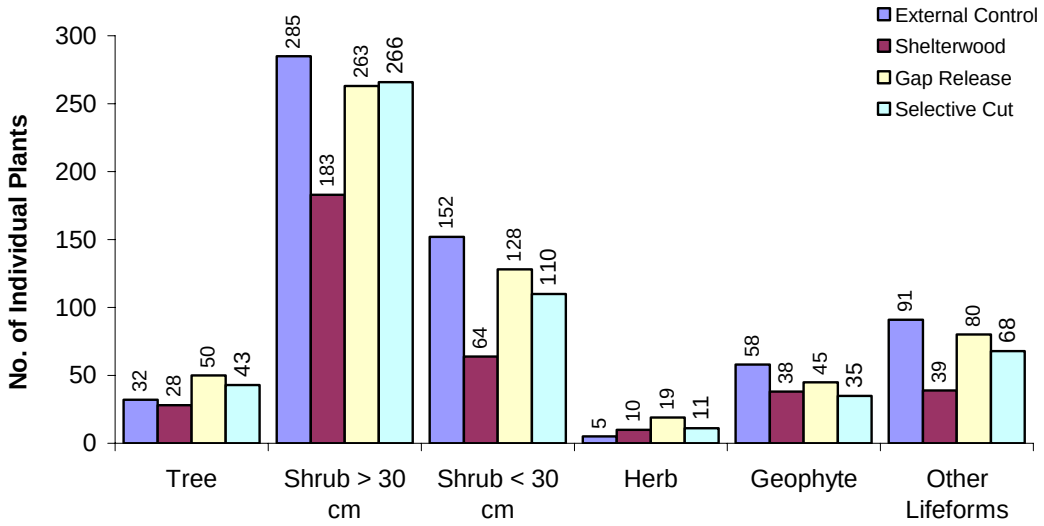


Figure 4: The number of individual plants within each life-form category for each silvicultural and external control treatment in the Blackwood Plateau FORESTCHECK location.

Vegetation heights

Vegetation heights demonstrated a successional effect linked to time since fire (Fig. 5). Thus plant heights were lowest with the shortest time since fire, increased in height with time then declined as certain species reached the end of their life span. Exceptions to this occur when dominant plants are longer lived and grow greater than two metres in height.

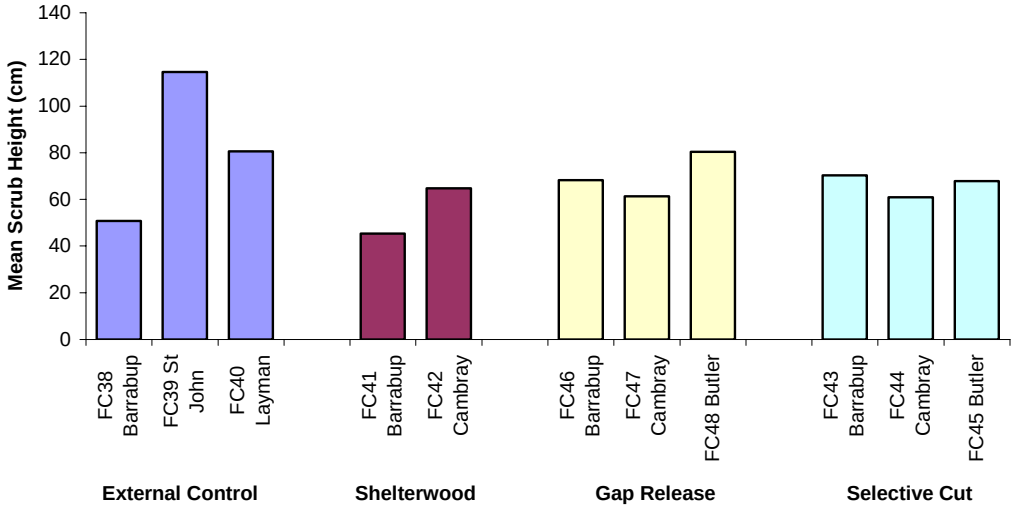


Figure 5: Comparison of vegetation heights for each FORESTCHECK grid on the Blackwood Plateau.

Vegetation structure

The vegetation structure also showed an effect of time since fire with the lowest number of contacts in the shortest time since fire increasing in height categories and contact numbers with increased time since fire.

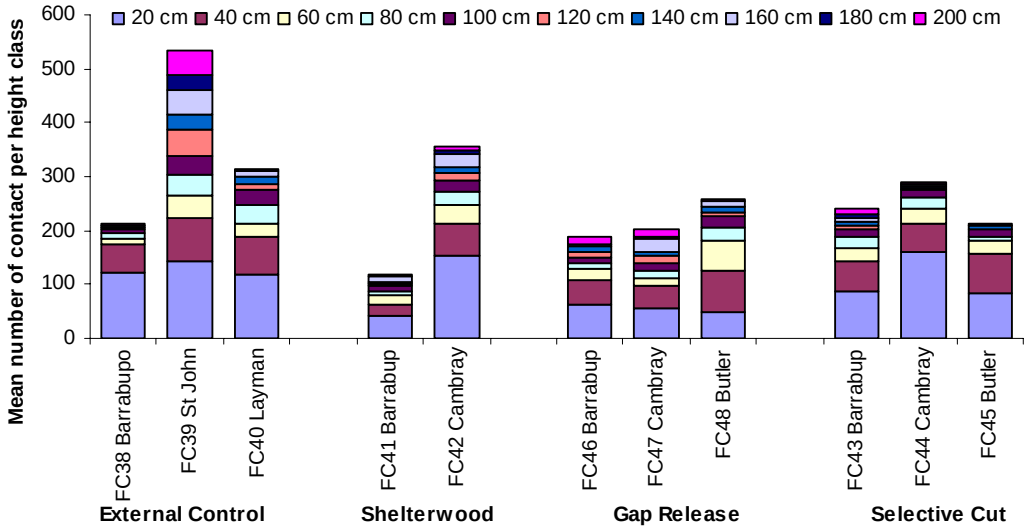


Figure 6: Vegetation structure (determined by mean numbers of levy contacts for height classes up to 2m) for each FORESTCHECK grid on the Blackwood Plateau.

Conclusions

The main observations made following monitoring of vascular plants and measurement of plant structure and density at Blackwood Plateau were:

- The Blackwood Plateau sites have the highest species richness of all locations monitored so far, with 22% more species.
- Harvesting treatments appeared not to have had any significant impact on species richness and abundance. Variations within treatments can be attributed to other site factors and time since fire.
- Low plant numbers for some life-form categories in the shelterwood treatment suggest silvicultural methods associated with this treatment may be impacting on plant numbers for some categories.

APPENDIX 1: Complete species list for vascular plant species recorded on the Blackwood Plateau FORESTCHECK grids.

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
ACAAPP	*Acacia applanata*	S	P	A1	
ACABIC	*Acacia biflora*	S	P	A1	
ACABRO	*Acacia browniana*	S	P	A1	Brown's Wattle
ACADIV	*Acacia divergens*	S	P	A1	
ACADRU	*Acacia drummondii*	S	P	A1	Drummond's Wattle
ACAEXT	*Acacia extensa*	S	P	A1	Wiry Wattle
ACAMYR	*Acacia myrifolia*	S	P	A1	Myrtle Wattle
ACANER	*Acacia nervosa*	S	P	A1	Rib Wattle
ACAOBO	*Acacia obovata*	S	P	A1	
ACAPUL	*Acacia pulchella*	S	P	A1	Prickly Moses
ACAPULPU	*Acacia pulchella* var. *pulchella*	S	P	A1	
ACATAY	*Acacia tayloriana* (P4)	S	P	A1	
ACAVAR	*Acacia varia*	S	P	A1	
ACAWIL	*Acacia willdenowiana*	S	P	A1	Grass Wattle
ACTGLO	*Actinotus glomeratus*	DS	P	A1	
ACTOMN	*Actinotus omnifertilis*	DS	P	A1	
ADEBAR	*Adenanthos barbiger*	S	P	B2	Coastal Jugflower
ADEMEI	*Adenanthos meisneri*	S	P	B2	
ADEOBO	*Adenanthos obovatus*	S	P	B2	Basket Flower
ALLFRA	*Allocasuarina fraseriana*	T	P	B1	Sheoak
AMPAMP	*Amphipogon amphipogonoides*	DS	P	B2	
AMPERI	*Amperea ericoides*	DS	P	B2	
ANAPRO	*Anarthria prolifera*	Z	P	B3	
ANASCA	*Anarthria scabra*	Z	P	B3	
ANDCAE	*Andersonia caerulea*	DS	P	A1	Foxtails
ANDINV	*Andersonia involucrata*	DS	P	A1	
ANDLAT	*Andersonia latiflora*	S	P	A1	
ANIBIC	*Anigozanthos bicolor*	DS	P	B3	Little Kangaroo Paw
APHCYP	*Aphelia cyperoides*	H	H	A1	
ASTPAL	*Asterolasia pallida*	DS	P	A1	
ASTPAL	*Astroloma pallidum*	DS	P	B2	Kick Bush
AUSCAE	*Austrodanthonia caespitosa*	GR	P	B3	Common Wallaby Grass
BAESP.	*Baeckea* sp. Layman	S	P	B2	
BANGRA	*Banksia grandis*	T	P	A2	Bull Banksia
BANMEIAS	*Banksia meisneri* subsp. *ascendens* (P4)	S	P	B2	
BILDRU	*Billardiera drummondii* (P4)	S	P	U	
BILVAR	*Billardiera variifolia*	V	P	A1	
BORSPA	*Boronia spathulata*	S	P	B2	Boronia
BOSLIN	*Bossiaea linophylla*	S	P	A1	
BOSORN	*Bossiaea ornata*	S	P	B2	Broad Leaved Brown Pea
BURUMB	*Burchardia umbellata*	GP	P	B3	Milkmaids
CALDIS	*Caladenia discoidea*	GP	P	B3	Dancing Orchid
CALFLA	*Caladenia flava*	GP	P	B3	Cowslip Orchid
CALLAN	*Callistachys lanceolata*	S	P	A1	Native Willow
CALPAL	*Calothamnus pallidifolius*	S	P	B2	
CALREP	*Caladenia reptans*	GP	P	B3	Little Pink Fairy Orchid
CALREPRE	*Caladenia reptans* subsp. *reptans*	GP	P	B3	
CASRAC	*Cassytha racemosa*	P	P	A1	Dodder Laurel
CASRACRA	*Cassytha racemosa forma racemosa*	P	P	A1	

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
CENERY	*Centaurium erythraea*	H	A	A1	Common Centuary
CENPOL	*Centrolepis polygyna*	H	A	A1	Wiry Centrolepis
CHACOR	*Chamaescilla corymbosa*	GP	P	B3	Blue Squill
CHACORCO	*Chamaescilla corymbosa* var. *corymbosa*	GP	P	B3	
COMCAL	*Comesperma calymega*	DS	P	B2	Blue-spike Milkwort
CONACU	*Conostylis aculeata*	DS	P	B3	Prickly Conostylis
CONCAP	*Conospermum capitatum*	S	P	B2	
CONFLE	*Conospermum flexuosum*	S	P	A1	Tangled Smokebush
CONPEN	*Conostephium pendulum*	S	P		Pearl Flower
CONSET	*Conostylis setigera*	DS	P	B3	Bristly Cottonhead
CONSET	*Conostylis setosa*	DS	P	B3	White Cottonhead
CORCAL	*Corymbia calophylla*	T	P	A2	Marri
CRAVAR	*Craspedia variabilis*	GP	P	B3	Soft Billybuttons
CRYOVA	*Cryptostylis ovata*	GP	P	B3	Slipper Orchid
CYAAVE	*Cyathochaeta avenacea*	Z	P	B3	
CYRHUE	*Cyrtostylis huegelii*	GP	P	B3	
DAMHET	*Dampiera heteroptera* (P3)	S	P	A1	
DAMLIN	*Dampiera linearis*	DS	P	A1	Common Dampiera
DAMSAC	*Dampiera sacculata*	DS	P	A1	Pouched Dampiera
DARSP.	*Darwinia* sp. Williamson (G.J. Keighery 12717)	DS	P	A1	
DARSP.	*Dawinia* sp. Crouch Road (R.J. Cranfield 22087)	DS	P	A1	
DASBRO	*Dasypogon bromeliifolius*	S	P	B3	Pineapple Bush
DASHOO	*Dasypogon hookeri*	S	P	B3	Pineapple Bush
DAVINC	*Daviesia incrassata*	S	P	A1	
DAVINCTE	*Daviesia incrassata* subsp. *teres*	S	P	A1	
DAVPRE	*Daviesia preissii*	S	P	A1	
DESFAS	*Desmocladus fasciculatus*	Z	P	B3	
DESFLE	*Desmocladus flexuosus*	Z	P	B3	
DIAREV	*Dianella revoluta*	H	P	B3	Blueberry Lily
DILLAX	*Dillwynia laxiflora*	S	P	A1	
DRAGLY	*Drakaea glyptodon*	GP	P	B3	King-in-his-carriage
DROERY	*Drosera erythrorhiza*	GP	P	B3	Red Ink Sundew
DROHUE	*Drosera huegelii*	GP	P	B3	Bold Sundew
DROMEN	*Drosera menziesii*	GP	P	B3	Pink Rainbow
DROPAL	*Drosera pallida*	GP	P	B3	Pale Sundew
DROPYG	*Drosera pygmaea*	GP	P	B3	
DROSP.	*Drosera* sp. Barrabup	GP	P	B3	
DROSP.	*Drosera* sp. Barrabup	GP	P	B3	
DROSTO	*Drosera stolonifera*	GP	P	B3	Leafy Sundew
DRYBIPBI	*Dryandra bipinnatifida* subsp. *bipinnatifida*	DS	P	B2	
DRYLIN	*Dryandra lindleyana*	S	P	B2	Couch Honeypot
DRYLINLI	*Dryandria lindleyana* var. *lindleyana*	S	P	B2	
DRYLINME	*Dryandra lindleyana* var. *mellicula*	S	P	B2	
ELYBRU	*Elythranthera brunonis*	GP	P	B3	Purple Enamel Orchid
EUCMAR	*Eucalyptus marginata*	T	P	A2	Jarrah
GENSP.	*Genus* sp. Barrabup (R.J. Cranfield & B.G. Ward FC 991)				
GOMCAP	*Gompholobium capitatum*	DS	P	A1	Yellow Pea
GOMCON	*Gompholobium confertum*	S	P	A1	
GOMKNI	*Gompholobium knightianum*	DS	P	A1	
GOMMAR	*Gompholobium marginatum*	DS	P	A1	
GOMOVA	*Gompholobium ovatum*	DS	P	A1	
GOMPRE	*Gompholobium preissii*	DS	P	A1	

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
GOMTOM	*Gompholobium tomentosum*	DS	P	A1	
GOMVEN	*Gompholobium venustrum*	S	P	A1	
GOOSP.	*Goodenia* sp. Layman	DS	P	A1	
GOOSP.	*Goodenia* sp. Layman	DS	P	A1	
GOOSP.	*Goodenia* sp. Layman (R.J. Cranfield & B.G. Ward FC 909)	DS	P	A1	
GRECEN	*Grevillea centristigma*	S	P	B2	
GREPUL	*Grevillea pulchella*	S	P	B2	Beautiful Grevillea
GRETRI	*Grevillea trifida*	S	P	B2	
HAEPAN	*Haemodorum paniculatum*	H	P	B3	Mardja
HAESIM	*Haemodorum simplex*	GP	P	B3	
HAESPI	*Haemodorum spicatum*	H	P	B3	Mardja
HAKAMP	*Hakea amplexicaulis*	S	P	B2	Prickly Hakea
HAKCYC	*Hakea cyclocarpa*	S	P	B2	Ramshorn
HAKLIS	*Hakea lissocarpha*	S	P	B2	Honey Bush
HAKRUS	*Hakea ruscifolia*	S	P	B2	Candle Hakea
HARCOM	*Hardenbergia comptoniana*	V	P	B2	Native Wisteria
HEMINC	*Hemigenia incana*	S	P	A1	Silky Hemigenia
HEMSER	*Hemigenia sericea*	S	P	A1	Silky Hemigenia
HEMSP.	*Hemiandra* sp. Butler	S	P	A1	
HIBACE	*Hibbertia acerosa*	S	P	B2	Needle-leaved Guinea Flower
HIBAMP	*Hibbertia amplexicaulis*	S	P	B2	
HIBCOM	*Hibbertia commutata*	S	P	B2	
HIBCUN	*Hibbertia cuneformis*	S	P	B2	Cutleaf Hibbertia
HIBCUN	*Hibbertia cunnninghamii*	S	P	B2	
HIBGLO	*Hibbertia glomerata*	S	P	B2	
HIBHYP	*Hibbertia hypericoides*	S	P	B2	Yellow Buttercups
HIBNOT	*Hibbertia notibractea*	S	P	B2	
HIBQUA	*Hibbertia quadricolor*	S	P	B2	
HIBSP.	*Hibbertia* sp. Barrabup (R.J. Cranfield & B.G. Ward FC 1021)	S	P	B2	
HIBVAG	*Hibbertia vaginata*	S	P	B2	
HOMHOM	*Homalosciadium homalocarpum*	H	A	A1	
HOVCHO	*Hovea chorizemifolia*	DS	P	B2	Holly-leaved Hovea
HOVELL	*Hovea elliptica*	S	P	B2	Tree Hovea
HOVTRI	*Hovea trisperma*	S	P	A1	Common Hovea
HOVTRITR	*Hovea trisperma* var. *trisperma*	S	P	A1	
HYDDIA	*Hydrocotyle diantha*	H	A	A1	
HYPANG	*Hypocalymma angustifolia*	S	P	B2	White Myrtle
HYPANGAN	*Hypocalymma angustifolium* subsp. *angustifolium*	S	P	B2	
HYPEXS	*Hypolaena exsulca*	Z	P	B3	
HYPGLA	*Hypochaeris glabra*	H	A	A1	Smooth Catsear
HYPROB	*Hypocalymma robustum*	S	P	B2	Swan River Myrtle
ISOFOR	*Isopogon formosus*	S	P	A1	Rose Coneflower
ISOMAR	*Isolepis marginata*	R	A	A1	Coarse Club-rush
ISOSPH	*Isopogon sphaerocephalus*	S	P	A1	Drumstick Isopogon
JOHLUP	*Johnsonia lupulina*	GP	P	B3	Hooded Lily
KENCOC	*Kennedia coccinea*	V	P	A1	Coral Vine
KINAUS	*Kingia australis*	X	P	B2	Kingia
LABPUN	*Labichea punctata*	DS	P	B2	Lance-leaved Cassia
LAGHUE	*Lagenophora huegelii*	GP	P	B3	Coarse Lagenophora
LECBIL	*Lechenaultia biloba*	S	P	A1	Blue Leschenaultia
LEPCUN	*Leptomeria cunninghamii*	S	P	A1	

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
LEPLEP	*Lepidosperma leptostachyum*	Z	P	B3	
LEPLON	*Lepidosperma longitudinale*	Z	P	B3	Pithy Sword Sedge
LEPSQU	*Lepidosperma squamatum*	Z	P	B3	
LEPSQU	*Leptomeria squarrulosa*	S	P	A1	
LEUAUS	*Leucopogon australis*	S	P	B2	Spiked Beard-heath
LEUCAP	*Leucopogon capitellatus*	S	P	B2	
LEUGLA	*Leucopogon glabellus*	S	P	B2	
LEUPEN	*Leucopogon pendulus*	S	P	B2	
LEUPRO	*Leucopogon propinquus*	S	P	B2	
LEUREV	*Leucopogon revolutus*	S	P	B2	
LEUSP.	*Leucopogon* sp. Cambray (R.J. Cranfield & B.G. Ward FC 1030)	S	P	B2	
LEUSP.	*Leucopogon* sp. Cambray (R.J. Cranfield & B.G. Ward (FC 1032)	S	P	B2	
LEUSP.	*Leucopogon sp.Cambray*	S	P	B2	
LEUUNI	*Leucopogon unilateralis*	S	P	B2	
LEUVER	*Leucopogon verticillatus*	S	P	B2	Tassel Flower
LEVPUS	*Levenhookia pusilla*	H	A	A1	Midget Stylewort
LINLIN	*Lindsaea linearis*	F	P	B3	Screw Fern
LOGSER	*Logania serpyllifolia*	DS	P	B2	
LOGSERSE	*Logania serpyllifolia* subsp. *serpyllifolia*	DS	P	B2	
LOMCAE	*Lomandra caespitosa*	DS	P	B3	Tufted Mat Rush
LOMDRU	*Lomandra drummondii*	DS	P	B3	
LOMHER	*Lomandra hermaphrodita*	DS	P	B3	
LOMINT	*Lomandra integra*	DS	P	B3	
LOMNIG	*Lomandra nigricans*	DS	P	B3	
LOMPAU	*Lomandra pauciflora*	DS	P	B2	
LOMPUR	*Lomandra purpurea*	DS	P	B3	Purple Mat Rush
LOMSER	*Lomandra sericea*	DS	P	B2	Silky mat Rush
LOMSON	*Lomandra sonderi*	DS	P	B3	
LOXCIN	*Loxocarya cinerea*	Z	P	B3	
MACRIE	*Macrozamia riedlei*	CY	P	B3	Zamia
MELTHY	*Melaleuca thymoides*	S	P	B2	
MESTET	*Mesomelaena tetragona*	Z	P	B3	
MILTEN	*Millotia tenuifolia*	H	A	A1	Soft Millotia
MILTENTE	*Millotia tenuifolia* var. *tenuifolia*	H	A	A1	
MONGRA	*Monotaxis grandiflora*	DS	P	A1	Diamond of the Desert
NUYFLO	*Nuytsia floribunda*	P	P	B2	Christmas Tree
OLABEN	*Olax benthamiana*	DS	P	A1	
OPEHIS	*Opercularia hispidula*	S	P	B2	Hispid Stinkweed
ORTLAX	*Orthrosanthus laxus*	GP	P	B3	Morning Iris
PATBAB	*Patersonia babianoides*	GP	P	B3	
PATJUN	*Patersonia juncea*	DS	P	B3	Rush Leaved Patersonia
PATOCC	*Patersonia occidentalis*	DS	P	B3	Purple Flag
PATUMBUM	*Patersonia umbrosa* var. *umbrosa*	DS	P	B3	
PATUMBXA	*Patersonia umbrosa* var. *xanthina*	DS	P	B3	Yellow Flags
PENPEL	*Pentapeltis peltigera*	DS	P	B2	
PENSIL	*Pentapeltis silvatica*	S	P	B2	Southern Pentapeltis
PERELL	*Persoonia elliptica*	T	P	B1	Spreading Snottygobble
PERELLEL	*Pericalymma ellipticum* var. *ellipticum*	S	P	A1	
PERGRA	*Persoonia graminea*	S	P	B2	
PERLON	*Persoonia longifolia*	S	P	B2	Snottygobble
PERSAC	*Persoonia saccata*	S	P	B2	Snottygobble

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
PERSPO	*Pericalymma spongiocaule*	S	P	A1	
PETDIV	*Petrophile diversifolia*	S	P	A1	
PETLIN	*Petrophile linearis*	S	P	A1	Pixie Mops
PHISPI	*Philotheca spicata*	S	P	B2	Pepper and Salt
PHLCIL	*Phlebocarya ciliata*	DS	P	A1	
PIMROS	*Pimelea rosea*	S	P	A1	Rose Banjine
PIMROSRO	*Pimelea rosea* subsp. *rosea*	S	P	A1	
PIMSPE	*Pimelea spectabilis*	S	P	A1	Bunjong
PIMSUA	*Pimelea suaveolens*	S	P	B2	Scented Banjine
PLAFIL	*Platysace filiformis*	S	P	A1	
PLAGAL	*Platytheca galioides*	S	P	U	
PLATEN	*Platysace tenuissima*	DS	P	A1	
PODDRO	*Podocarpus drouynianus*	S	P	B2	Wild Plum
PORHUE	*Poranthera huegelii*	DS	A	A1	
PSELUT	*Pseudognaphalium luteoalbum*	H	A	A1	Jersey Cudweed
PTEBAR	*Pterostylis barbata*	GP	P	B3	Bird Orchid
PTEESC	*Pteridium esculentum*	F	P	B2	Bracken
PTEPYR	*Pterostylis pyramidalis*	GP	P	B3	Snail Orchid
PTEREC	*Pterostylis recurva*	GP	P	B3	Jug Orchid
PTEVIT	*Pterostylis vittatus*	GP	P	B3	Banded Greenhood
PULBRA	*Pultenaea brachytropis*	S	P	A1	
PULERI	*Pultenaea ericifolia*	S	P	A1	
PULRAD	*Pultenaea radiata*	DS	P	A1	
PULRET	*Pultenaea reticulata*	S	P	A1	
PULSKI	*Pultenaea skinneri* (P4)	S	P	A1	Skinner's Pea
PYRNIG	*Pyrorchis nigricans*	GP	P	B3	
RHOCIT	*Rhodanthe citrina*	H	A	A1	Everlasting
SCAGLA	*Scaevola glandulifera*	DS	P	A1	Viscid Hand-flower
SCALAN	*Scaevola lanceolata*	DS	P	A1	
SCASTR	*Scaevola striata*	DS	A	A1	Royal Robe
SCASTRST	*Scaevola striata* var. *striata*	DS	A	A1	
SCHSUB	*Schoenus subbarbatus*	Z	P	B3	Bearded Bog-rush
SCHSUB	*Schoenus subbulbosus*	Z	P	B3	
SENHIS	*Senecio hispidulus*	DS	P	A1	Hispid Fireweed
SONOLE	*Sonchus oleraceus*	H	A	A1	Common Sowthistle
SPHCAP	*Sphaerolobium capitatum*	DS	P	A1	
SPHCAP	*Sphenotoma capitatum*	S	P	A1	
SPHDRU	*Sphaerolobium drummondii*	S	P	B2	
SPHMED	*Sphaerolobium medium*	S	P	B2	
STRSTE	*Strangea stenocarpoides*	S	P	B2	
STYAMO	*Stylidium amoenum*	DS	P	A1	Lovely Triggerplant
STYCAL	*Stylidium calcaratum*	H	A	A1	Book Triggerplant
STYCIL	*Stylidium cilatum*	DS	P	A1	Golden Triggerplant
STYRHY	*Stylidium rhynchocarpum*	DS	P	A1	Black-beaked Triggerplant
STYSCA	*Stylidium scandens*	DS	P	A1	Climbing Triggerplant
STYSP.	*Stylidium* sp. Butler	DS	P	A1	
STYSPA	*Stylidium spathulatum*	DS	P	A1	Creamy Triggerplant
STYSQU	*Stylidium squamosotuberosum*	GP	P	B3	Fleshy-rhizomed Trigger Plant
STYTEN	*Styphelia tenuiflora*	S	P	A1	Common Pinheath
SYNHIA	*Synaphea hians* (P3)	S	P	A1	
SYNPET	*Synaphea petiolaris*	S	P	B3	Synaphea
SYNWHI	*Synaphea whicherensis*	DS	P	A1	

SPECIES CODE	SPECIES NAME	LIFE FORM CODE[1]	LIFE STYLE CODE[2]	FIRE RESPONSE CODE[3]	COMMON NAME (if any)
TAXPAR	*Taxandria parviceps ms*	S	P	A1	
TETAFF	*Tetratheca affinis*	S	P	A1	
TETCAP	*Tetraria capillaris*	S	P	B3	Hair Sedge
TETHIR	*Tetratheca hirsuta*	S	P	A1	Black Eyed Susan
TETLAE	*Tetrarrhena laevis*	GR	P	B3	Forgest Ricegrass
TETOCT	*Tetraria octandra*	Z	P	B3	
TETSET	*Tetratheca setigera*	S	P	A1	
THECRI	*Thelymitra crinita*	GP	P	B3	Blue Lady Orchid
THEGRA	*Thelymitra graminea*	GP	P	B3	
THESP.	*Thelymitra* sp. Barrabup	GP	P	B3	
THOFOL	*Thomasia foliosa*	S	P	A1	
THYMUL	*Thysanotus multiflorus*	GP	P	B3	Many-flowered Fringe Lily
THYPSE	*Thysanotus pseudojunceus*	GP	P	B3	
THYTEN	*Thysanotus tenellus*	H	P	B3	
TRIELA	*Tricoryne elatior*	H	P	B3	Yellow Autumn Lily
TRIHUM	*Tricoryne humilis*	DS	P	A1	
TRISPA	*Trichocline spathulata*	GP	P	B3	Native Gerbera
TRYLED	*Trymalium ledifolium*	S	P	A1	
VELDEA	*Vellereophyton dealbatum*	H	A	A1	White Cudweed
VELTRI	*Velleia trinervis*	DS	A	A1	
XANATK	*Xanthosia atkinsoniana*	DS	P	A1	
XANCAN	*Xanthosia candida*	DS	P	A1	
XANCIL	*Xanthosia ciliata*	DS	P	A1	
XANGRA	*Xanthorrhoea gracilis*	X	P	B2	Slender Balga
XANHUE	*Xanthosia huegelii*	DS	P	A1	
XANPRE	*Xanthorrhoea preissii*	X	P	B2	Common Balga
XANSP.	*Xanthosia* sp. Butler	DS	P	A1	
XANSP.	*Xanthosia* sp. Layman	DS	P	A1	
XANSP.	*Xanthosia* sp. Layman	DS	P	A1	
XANSP.	*Xanthosia* sp. Layman	DS	P	A1	
XANSP.	*Xanthosia* sp. Layman (R.J. Cranfield & B.G. Ward FC 900)	DS	P	A1	
XYLOCC	*Xylomelum occidentale*	S	P	B1	Woody Pear

Code explanation for Appendix 1.

[1] Life-form

H	Herb
F	Fern
G	Geophyte
GR	Grass
Z	Sedge
T	Tree
S	Shrub (>31 cm)
DS	Dwarf shrub (1-31 cm)
P	Parasite
V	Vine (climber/runner)
R	Rush
C	Cycad
X	*Xanthorrhoea*/*Kingia*
U	Unknown

[2] Life style

A	Annual
P	Perennial

[3] Fire response

A1	Seed stored in soil
A2	Seed stored on plant (serotinous)
A3	No seed on site
B1	Epicormics
B2	Woody root stock/lignotuber
B3	Fleshy underground organ (corm, bulb, tuber, rhizome)
U	Unknown

INVERTEBRATES

Janet Farr, Allan Wills and Paul Van Heurck

Introduction

Invertebrates, including class Insecta, comprise over 95% of the planet's biodiversity and therefore represent a crucial component in any ecosystem. Invertebrates play major roles in decomposition, nutrient recycling, plant pollination and also provide an important food source for vertebrates. In addition a wide range of species are already known to be exclusive to the southwest forests of Western Australia, and some of these are Gondwanan relics. Despite this, current knowledge of the invertebrate taxa present in the jarrah forest is limited.

The objectives of this component of FORESTCHECK monitoring are

- To monitor and record the species of invertebrates in the various treatments of managed jarrah and uncut forest.
- Analyse trends in species composition, richness and abundance
- To monitor the presence of Gondwanan relic and affinity invertebrate species with respect to the above treatments
- To monitor the presence of known insect pest species.

Field and Laboratory Monitoring

Sampling on the Blackwood Plateau was carried out in November (spring) 2005 and April (autumn) 2006 using protocols outlined in the Operations Plan. To briefly summarise: 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 three weeks (there were some light trap failures; 22/11/05 at site FC43; 28/3/06 at sites FC39 and FC40) and 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 back 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 Manjimup where they were sorted and compared to the extensive collection of voucher specimens held there. Morphospecies were assigned and vouchers for each morphospecies were erected as necessary and labelled according to site, date of capture and capture method and preserved as either pinned or alcohol specimens as a reference collection. To constrain sample processing times, only macroinvertebrates were recorded, that is, invertebrates with a body length 10 mm or greater and lepidoptera with a wing length of 12 mm or greater. Highly distinctive and relictual morphospecies smaller than these sizes were also recorded.

This report details results from the Blackwood Plateau FORESTCHECK grids and includes some comparison with the initial Donnelly grids. Note however, this is the fifth preliminary report from the first round of FORESTCHECK monitoring, and results are from data as it exists for July 2006. Morphospecies assignment and Gondwanan relationships may have changed following data refinement from progressive taxonomic evaluation and during more detailed data analysis.

Results

The Blackwood Plateau samples (initiated 2005) increased the number of morphospecies recorded in FORESTCHECK to 1,489 (corrected for the Walpole Fire Mosaic project where species not common to the FORESTCHECK project were not included; morphospecies are listed in Appendix 1). Figure 1 shows the cumulative captures for the successive sampling locations.

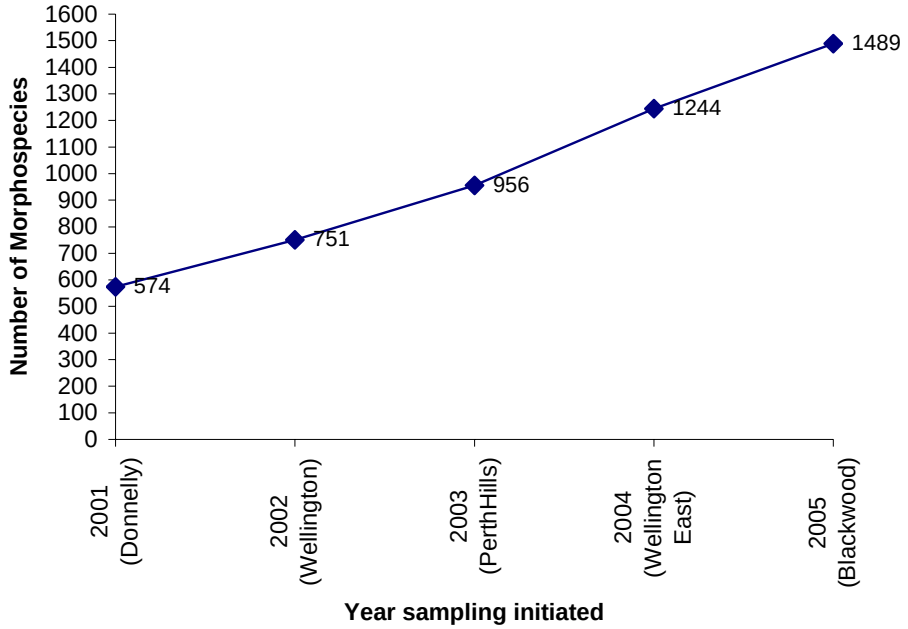


Figure 1: Cumulative morphospecies for 2001 (Donnelly) to 2005 (Blackwood Plateau)

In total 698 morphospecies were collected from Blackwood Plateau. Total morphospecies capture for past sampling districts and periods are shown in Table 1. Blackwood Plateau appears the most diverse site followed by Wellington East and Donnelly. Of those morphospecies collected from Blackwood Plateau, 18 were considered Gondwanan relics and a further 106 species had Gondwanan affinities compared to 15 and 186 respectively for Donnelly (these figures have been reworked from prior reports and reflect the refinement of the morphospecies list and organisation of the voucher collection). Thus, although species diversity is highest in Blackwood Plateau, Donnelly has the greater number of species with Gondwanan affinities. Relictual Gondwanan species diversity is highest in Wellington East and lowest in Wellington.

The numbers of morphospecies for orders where 10 or more morphospecies have been assigned are compared for Blackwood Plateau, Wellington East, Perth Hills, Wellington and Donnelly Districts in Figure 2.

Table 1. Morphospecies comparisons between sample areas, including number of species assigned as Gondwanan relics (GR) or considered having Gondwanan affinities (GA).

District	Sample period	No of Morphospecies	GR	GA
Donnelly	2001 - 02	574	15	186
Wellington	2002 - 03	372	12	50
Perth Hills	2003 - 04	434	16	49
Wellington East	2004 - 05	631	20	77
Blackwood Plateau	2005 - 06	698	18	106

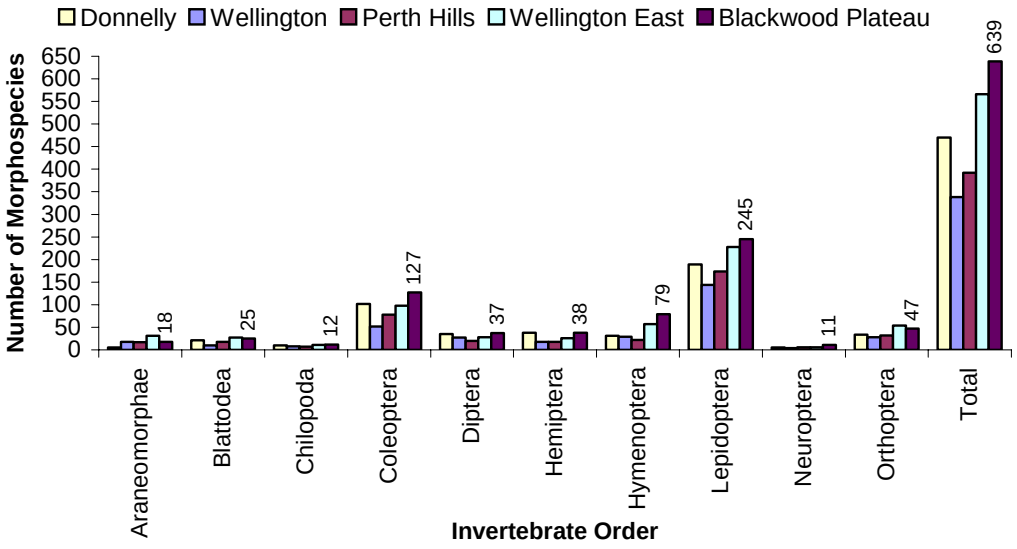


Figure 2. Comparison of Blackwood Plateau, Wellington East, Perth Hills, Donnelly and Wellington District morphospecies numbers for invertebrate orders where ten or greater morphospecies have been assigned.

Overall, Blackwood Plateau had the greatest species diversity, and Wellington East second, with this pattern repeated in Lepidoptera (moths) and to some extent Coleoptera (beetles). Species diversity in Blattodea (cockroaches) and Chilopoda (centipedes) were similar for both Blackwood Plateau and Wellington East; whereas Wellington East had the greatest diversity in Araneomorph spiders (31 species) and Blackwood Plateau had the greatest diversity in Neuroptera (Lacewings, 11 species) with the number of morphospecies nearly double that caught in all other sample districts.

Comparing capture methods

Light trapping resulted in the most abundant and diverse captures (Table 2) with an autumn capture of 284 morphospecies comprising 2319 individuals; and a spring capture of 216 morphospecies comprising 3495 individuals. In general diversity and abundance is highest in spring with the exception of light trap captures. The unusual higher diversity for autumn light traps was perhaps due to the cool conditions experienced in spring 2005. Litter searches result in a low diversity and abundance, however this is still a valid search technique as it can capture species not otherwise encountered with other methods. Targeted pursuit is used as an additional capture technique to catch species which are distinctive and not necessarily part of a particular operator's method or within their specified search protocol; in addition this

technique is employed when habitat for a specific hand sampling method (e.g. litter or CWD) is scarce and thus maintains consistent operator sampling effort within each sample grid.

Table 2. Number of morphospecies and specimen abundance for Blackwood Plateau in spring and autumn for each capture method (CWD = coarse woody debris).

Capture Method	**No Morphospecies**		**Abundance**	
	Spring	Autumn	Spring	Autumn
Light	216	284	3495	2319
Pitfall	67	56	286	174
Sweep	70	48	182	136
Beat	48	39	112	85
CWD	40	19	82	31
Litter	29	9	41	10
Targeted pursuit	0	2	0	2
Total			4198	2757

Figure 3 shows morphospecies comparisons for capture methods from Blackwood Plateau, Wellington East, and Donnelly Districts. These comparisons were chosen because: (1) Donnelly was the first FORESTCHECK sampling region and is therefore used as a base-line for other sites, in addition it is the closest sample area to Blackwood and therefore similarities are expected; and (2) Wellington East was the most diverse area sampled by spring 2004 and was the most recent sample before Blackwood.

Abundance comparisons are shown in Figure 4. In spring, with the exception of the light trap and CWD captures, the Donnelly captures are more diverse (Fig. 3a). Pit fall, beat and litter captures for both Blackwood Plateau and Wellington East samples are similar. Light trap and CWD captures are greatest at Wellington East, Donnelly having the lowest capture rates for these methods. For autumn, Blackwood Plateau diversity is highest for light trap, pitfall, sweep and beat capture methods and lowest for litter and CWD (Fig 3b). Also, the abundance data for autumn show CWD Donnelly captures are greater than those for Blackwood Plateau (Figs 3b & 4b). This reinforces our previous findings that varying the active capture method by dedicating a single operator to this task has not significantly altered capture results.

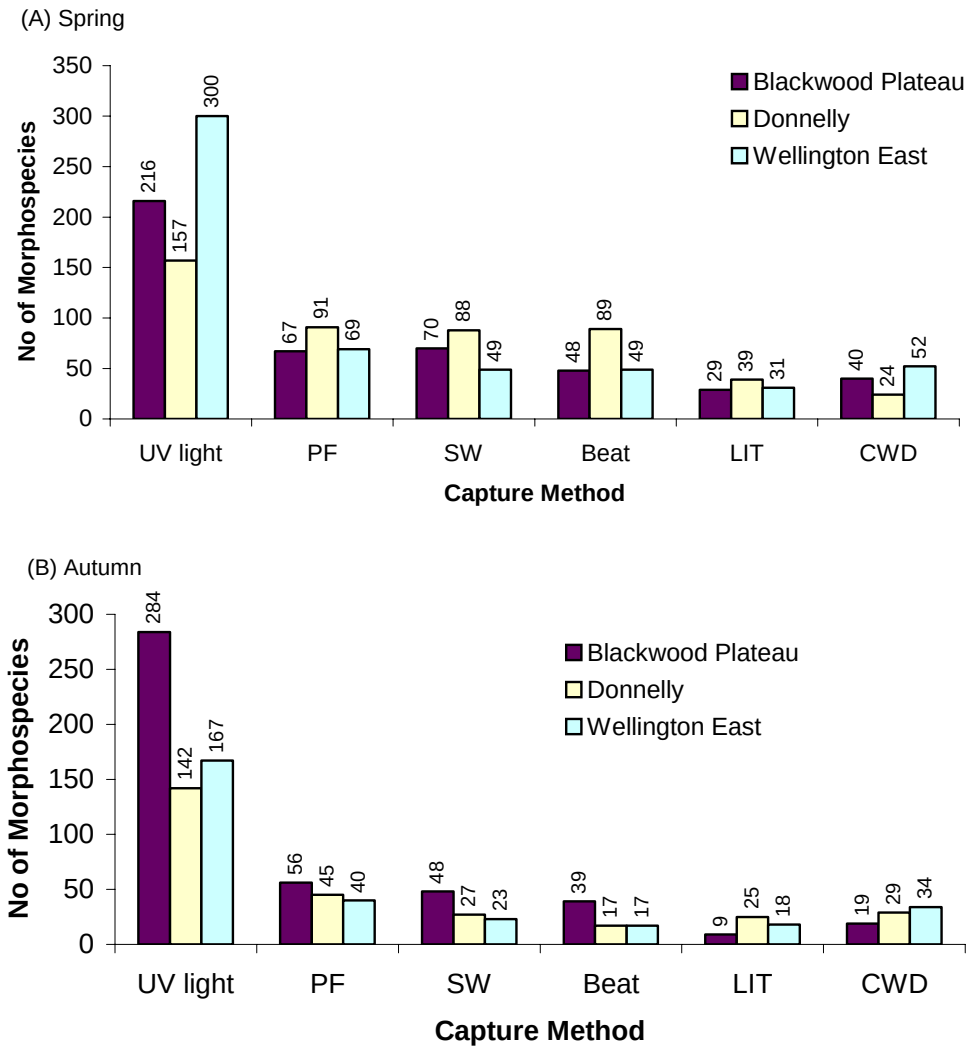


Figure 3. The number of morphospecies in spring (A) and autumn (B) for each capture method; Blackwood Plateau, Wellington East and Donnelly Districts compared. (PF= pitfall trap; SW = sweep net; Beat = beating tray; CWD = coarse woody debris search; LIT = litter search)

For abundance, spring light trap captures were most abundant for Wellington East with 6507 (corrected for high numbers of sp# 14) individuals compared to 3495 individuals for Blackwood Plateau (Fig 4a). In autumn, light trap capture abundance for Blackwood Plateau was high compared to other sampling districts (Fig. 4b) and this trend was reflected in pitfall, sweep and beat capture methods.

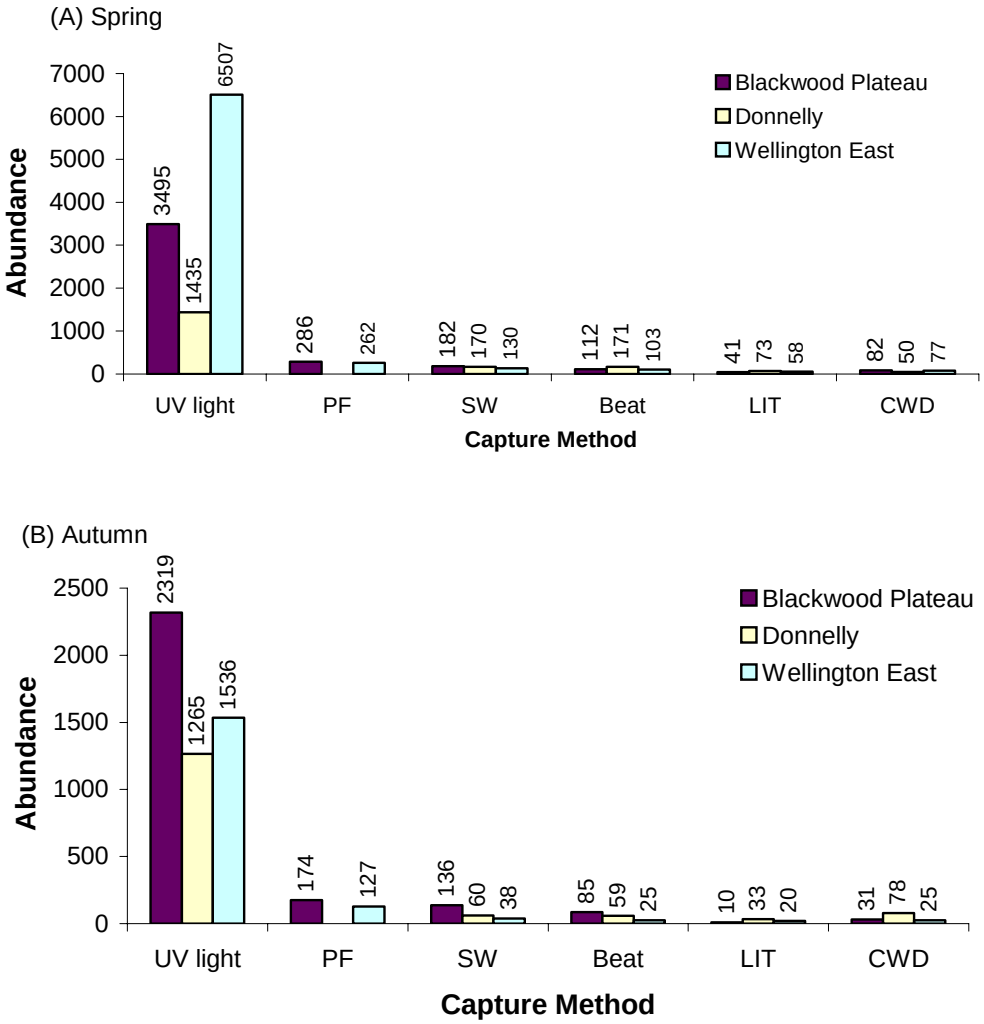


Figure 4. Abundance (measured as the number of individual specimens captured) in spring (A) and autumn (B) for each capture method, from Blackwood Plateau, Wellington East, and Donnelly Districts. Wellington East light trap abundance has been corrected to remove the influence of sp# 14 captures of which there were 19656. Abundance not available for Donnelly pitfalls. (UV Light = light trap captures; PF= pitfall trap captures; SW = sweep net; Beat = beating tray; LIT = litter search; CWD = coarse woody debris search)

Comparing sample grids and silvicultural treatments

Figure 5 shows Blackwood Plateau grid comparisons for silvicultural treatments expressed as the total morphospecies and abundance for all capture methods and summed for spring and autumn seasons. The Cambray selective cut (FC44) had the greatest number of species (191) followed closely by Barrabup shelterwood (FC41 site), Barrabup external control (FC38) and Cambray shelterwood (FC42) grids. Abundance was highest at the Barrabup shelterwood site followed by the Cambray selective cut grid (FC44). The lowest diversity and abundance was at the Layman external control grid (FC40).

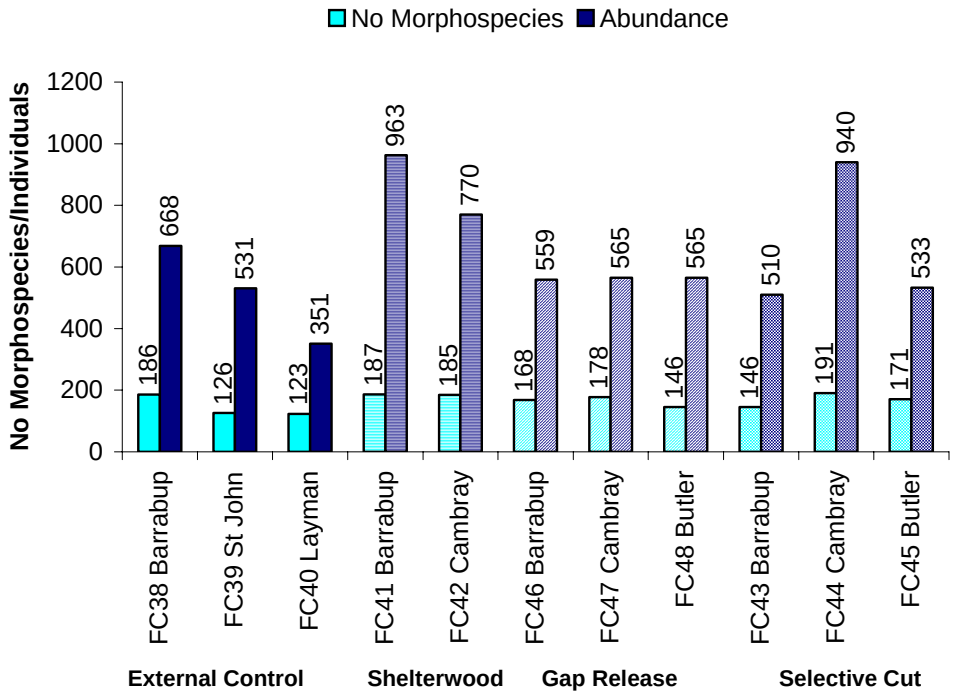


Figure 5. Comparison of individual Blackwood Plateau treatment grids for total morphospecies (No. of Morphospecies, pale blue bars) and number of individuals (abundance, dark blue bars), for all capture methods, combining both seasons (whole filled bars are external control; horizontal hatched is shelterwood; diagonally hatched is selective cut and chequered is gap release treatments).

Comparison of the means between treatments indicates few distinct patterns. For Blackwood Plateau the external control was less diverse but has comparable invertebrate abundance with the gap release (Table 3) and selective cut treatments. Shelterwood had the highest diversity and abundance. For Donnelly, species number and abundance was similar across most treatments, with the coupe buffer (TEAS) treatment having highest diversity and abundance.

Table 3. Comparison of means (± SE) for number of species and abundance (number of individuals) at Blackwood Plateau and Donnelly in respect to silvicultural treatment.

	Blackwood Plateau		**Donnelly**	
Silvicultural Treatment	No. of Species	Abundance	No. of Species	Abundance
External Control	145.0 (20.5)	516.7 (91.7)	141.3 (5.5)	330.3 (32.6)
Shelterwood	186.0 (1.0)	866.5 (86.5)	137.0 (0.0)	383.0 (0.0)
Gap Release	164.0 (9.5)	563.0 (2.0)	137.0 (4.4)	347.7 (31.2)
Selective Cut	169.3 (13.0)	661.0 (139.7)		
Coupe Buffer (TEAS)			152 (3.0)	420.3 (19.9)

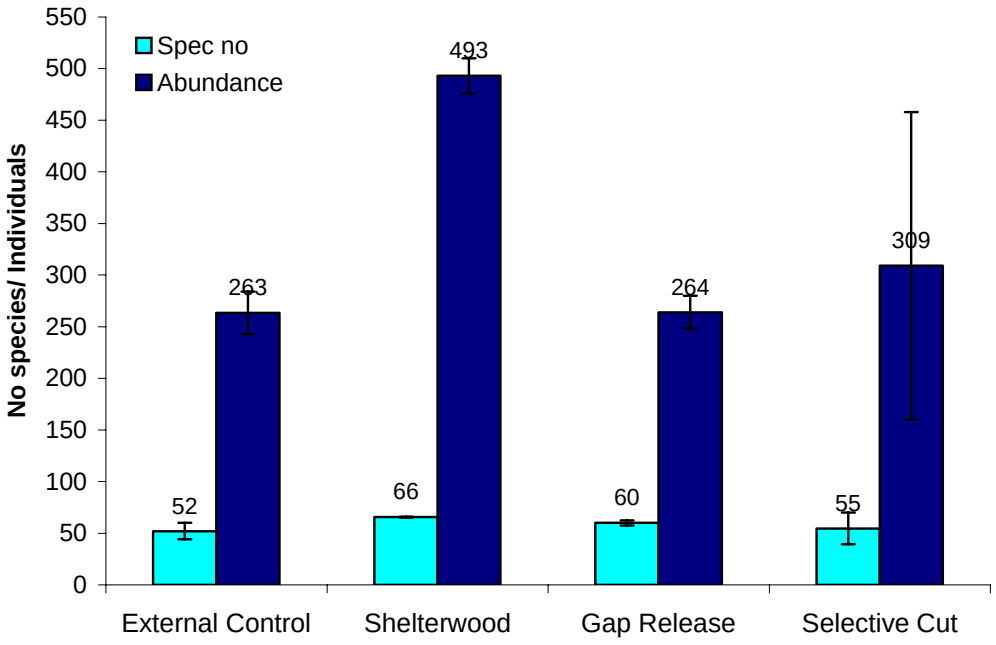
Table 4 shows the number of morphospecies and abundance (number of individuals captured at each grid) for active (beat, sweep, coarse woody debris and litter searches), light and pitfall trap capture techniques in spring and autumn. There were very little differences between treatments for pit fall traps (spring and autumn) except the captures in the gap release sites were lower in abundance and diversity, particularly in autumn (diversity and abundance were also low for Active captures in the gap release sites but this is probably not significant).

Figure 6 shows comparisons for silvicultural treatments for light trap captures between Blackwood Plateau and Donnelly in spring. For Blackwood Plateau, species diversity and abundance were lowest in the external control, whereas shelterwood had the highest diversity and abundance (this trend was also reflective in the active sampling results. In Donnelly however the reverse applied, and as might be expected the coupe buffer (which can be considered a secondary control) compared closely with the external control treatment. In autumn, trends for Blackwood Plateau and Donnelly were similar with lowest diversity and abundance recorded in the external control and highest in the shelterwood treatments (Figure 7; again diversity and abundance tended to be higher in the active capture samples, Table 4). A similar trend was also found in the Wellington East autumn light trap samples in 2004-05.

Table 4. The 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 Blackwood Plateau.

Treatment	Grid No.	Location	Season	Active capture		Light trap		Pitfall trap		All capture methods	
				Abun	Spec No	Abun	Spec No	Abun	Spec No	Abun	Spec No
Ext. Control	FC38	Barrabup	AU	38	18	267	77	15	11	320	104
Ext. Control	FC38	Barrabup	SP	44	32	272	68	32	9	348	104
Ext. Control	FC39	St John	AU	19	14	120	40	23	10	162	64
Ext. Control	FC39	St John	SP	40	23	294	42	35	12	369	71
Ext. Control	FC40	Layman	AU	17	14	41	29	19	13	77	57
Ext. Control	FC40	Layman	SP	28	21	224	46	22	11	274	77
Shelterwood	FC41	Barrabup	AU	26	19	354	90	21	13	401	121
Shelterwood	FC41	Barrabup	SP	34	25	510	65	18	7	562	91
Shelterwood	FC42	Cambray	AU	28	17	186	78	8	6	222	99
Shelterwood	FC42	Cambray	SP	48	35	476	66	24	13	548	112
Gap Release	FC46	Barrabup	AU	30	21	200	73	7	4	237	99
Gap Release	FC46	Barrabup	SP	31	22	265	63	26	8	322	91
Gap Release	FC47	Cambray	AU	13	12	273	96	1	1	287	110
GapRelease	FC47	Cambray	SP	27	21	236	62	15	11	278	92
Gap Release	FC48	Butler	AU	21	14	198	63	4	4	223	81
Gap Release	FC48	Butler	SP	41	21	291	55	10	6	342	81
Selective Cut	FC43	Barrabup	AU	25	19	260	64	40	14	325	96
Selective Cut	FC43	Barrabup	SP	49	30	94	27	42	17	185	68
Selective Cut	FC44	Cambray	AU	23	19	245	71	11	9	279	99
Selective Cut	FC44	Cambray	SP	36	23	595	80	30	19	661	116
Selective Cut	FC45	Butler	AU	24	15	175	62	25	9	224	87
Selective Cut	FC45	Butler	SP	39	31	238	57	32	17	309	101

(A) Blackwood spring light trap samples



(B) Donnelly spring light trap samples

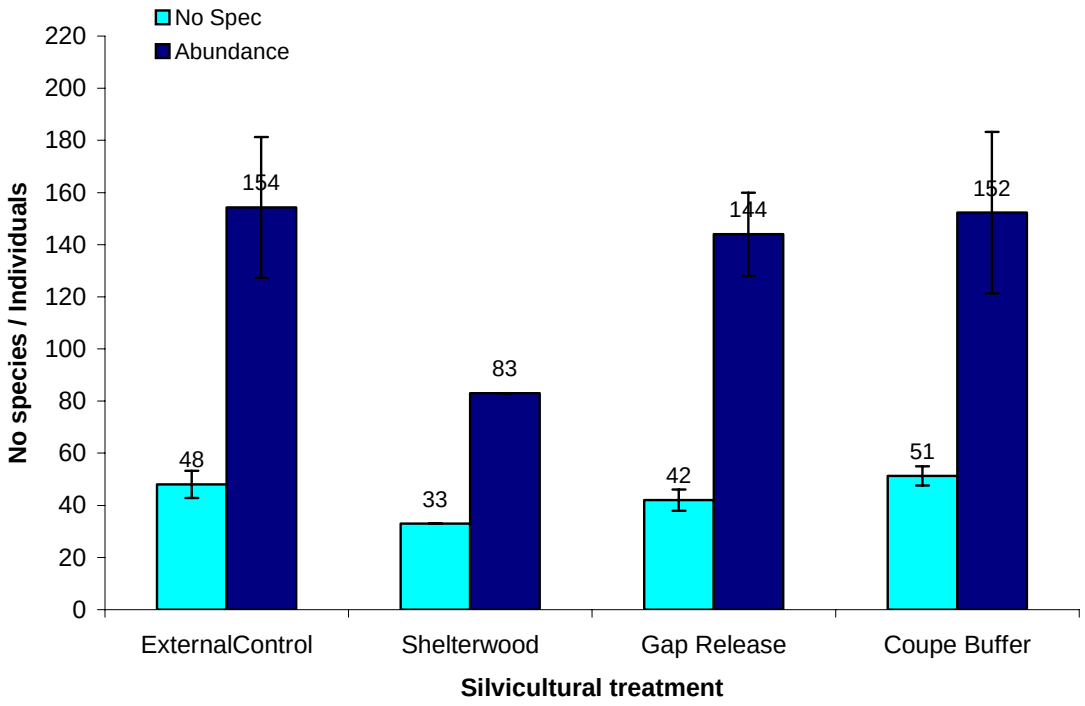
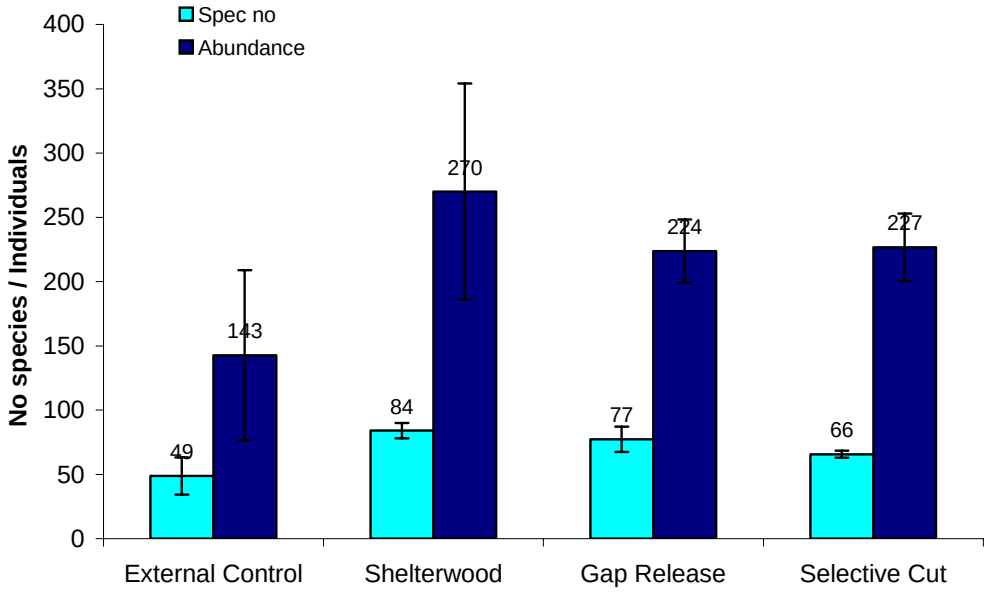


Figure 6. Mean (± se, n = 3) spring light trap captures against treatment grids for (a) Blackwood Plateau (note: Blackwood selective cut n=2) and (b) Donnelly (note: Donnelly shelterwood n=1). No. Spec. = the number of morphospecies, abundance =number of individuals.

(A) Blackwood autumn light trap samples



(B) Donnelly autumn light trap samples

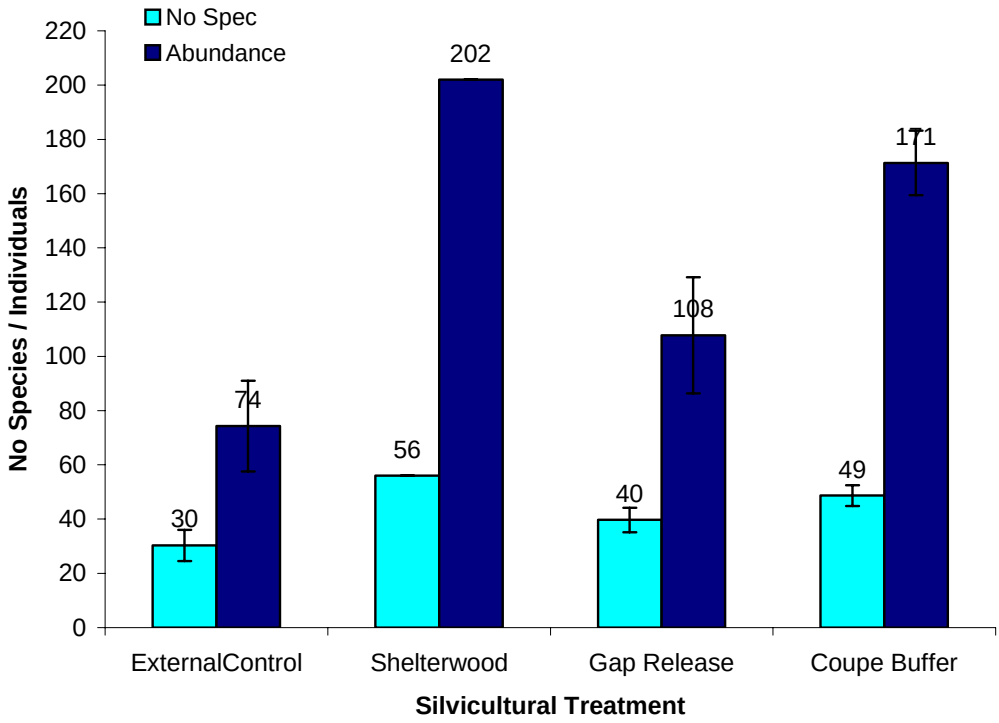


Figure 7. Mean (± se, n = 3,) autumn light trap captures against treatment grids for (a) Blackwood Plateau (note: Blackwood Plateau selective cut n=2) and (b) Donnelly (note: Donnelly shelterwood n=1). No. Spec. = the number of morphospecies, abundance =number of individuals.

Species differences between localities

Table 5 shows the most frequent species captured for Blackwood Plateau, Wellington East, Perth Hills, Wellington and Donnelly. The Lepidopteran species #6 was the most common species collected in Blackwood Plateau, and was also a common species captured in Donnelly. Very few species in the Blackwood Plateau top ten were common across all sampling localities (species #14 & 16 are examples). Only Donnelly and Wellington East had more than one common species with the Blackwood Plateau top ten. After summing the capture frequency ranking for the 10 most common morphospecies, it was concluded that Wellington was the most dissimilar area to Blackwood Plateau, followed closely by Perth Hills.

Overall there were 92 morphospecies common to all localities (Fig. 8). The Blackwood Plateau grids had strongest affinities to Wellington East and Donnelly with 262 and 237 species respectively common to these localities. Of the 1,489 total morphospecies, 301 were exclusive to Blackwood Plateau (43% of Blackwood Plateau capture). Endemism in Donnelly, Wellington, Perth Hills and Wellington East was 34%, 17%, 27% and 35% respectively.

To date for all FC sites sampled we have captured over 52,000 specimens.

Table 5. Ten most frequent species captured for Blackwood Plateau, Wellington East, Perth Hills, Wellington and Donnelly (Capture frequency is the number of times a specimen is collected over all sample site and is not to be confused with abundance levels which refer to the total number of specimens collected; capture frequency ranks relate to Blackwood Plateau samples, eg. a rank of 6 for a Perth Hills specimen means this species was the 6th most frequent species at Blackwood Plateau, a rank >37 indicates single specimen only found in Blackwood Plateau, a rank = 0 indicates no specimen captured in Blackwood Plateau).

Sample Site	Species No.	Capture Frequency	Blackwood Plateau Capture frequency rank	Order	Family	Genus
Blackwood Plateau	6	75	1	Lepidoptera	Arctiidae	
	73	75	1	Lepidoptera	Pyralidae	
	526	56	2	Orthoptera	Stenopelmatidae	Onosandrus
	10	48	3	Lepidoptera	Thaumetopoeidae	Ochrogaster
	333	45	4	Lepidoptera	Pyralidae	
	18	44	5	Lepidoptera	Noctuidae	Agrotis
	13	44	5	Coleoptera	Dytiscidae	
	192	42	6	Coleoptera	Tenebrionidae	Lagria
	7	42	6	Lepidoptera	Thaumetopoeidae	Ochrogaster
	14	40	7	Coleoptera	Hydrophilidae	
	16	35	8	Diptera	Tipulidae	
Wellington East	436	132	12	Lepidoptera	Geometridae	
	14	49	7	Coleoptera	Hydrophilidae	
	4	45	21	Lepidoptera	Notodontidae	Destolmia
	16	40	8	Diptera	Tipulidae	
	145	38	35	Trichoptera		
	424	36	22	Lepidoptera	Geometridae	
	52	36	15	Hymenoptera	Apidae	Apis (honey bee)
	326	32	18	Lepidoptera	Geometridae	
	39	32	14	Lepidoptera	Noctuidae	

Sample Site	Species No.	Capture Frequency	Blackwood Plateau Capture frequency rank	Order	Family	Genus
	423	30	12	Hymenoptera	Formicidae	Camponotus
Perth Hills	436	92	12	Lepidoptera	Geometridae	
	45	34	21	Lepidoptera	Zygaenidae	Pollanisus
	145	32	35	Trichoptera		
	14	26	2	Coleoptera	Hydrophilidae	
	144	23	31	Trichoptera		
	39	22	14	Lepidoptera	Noctuidae	
	424	21	22	Lepidoptera	Geometridae	
	52	20	15	Hymenoptera	Apidae	Apis (honey bee)
	235	20	36	Orthoptera	Acrididae	
	880	19	31	Scorpionida		
	634	19	0	Lepidoptera	Geometridae	
Wellington	436	84	12	Lepidoptera	Geometridae	
	52	72	15	Hymenoptera	Apidae	Apis
	145	52	35	Trichoptera		
	4	27	21	Lepidoptera	Notodontidae	Destolmia
	235	25	36	Orthoptera	Acrididae	
	258	22	33	Dermaptera		
	163	22	38	Hemiptera	Reduviidae	
	11	20	0	Lepidoptera	Thaumetopoeidae	Ochrogaster
	423	19	12	Hymenoptera	Formicidae	Camponotus
	1	19	22	Lepidoptera	Carthaeidae	Carthaea
	16	19	8	Diptera	Tipulidae	
Donnelly	52	64	15	Hymenoptera	Apidae	Apis (honey bee)
	6	54	1	Lepidoptera	Arctiidae	
	235	45	36	Orthoptera	Acrididae	
	373	28	33	Lepidoptera	Hepialidae	Abantiades
	39	28	14	Lepidoptera	Noctuidae	
	145	26	35	Trichoptera		
	18	26	5	Lepidoptera	Noctuidae	Agrotis
	45	26	30	Lepidoptera	Zygaenidae	
	376	26	23	Lepidoptera		
	423	24	12	Hymenoptera	Formicidae	Camponotus

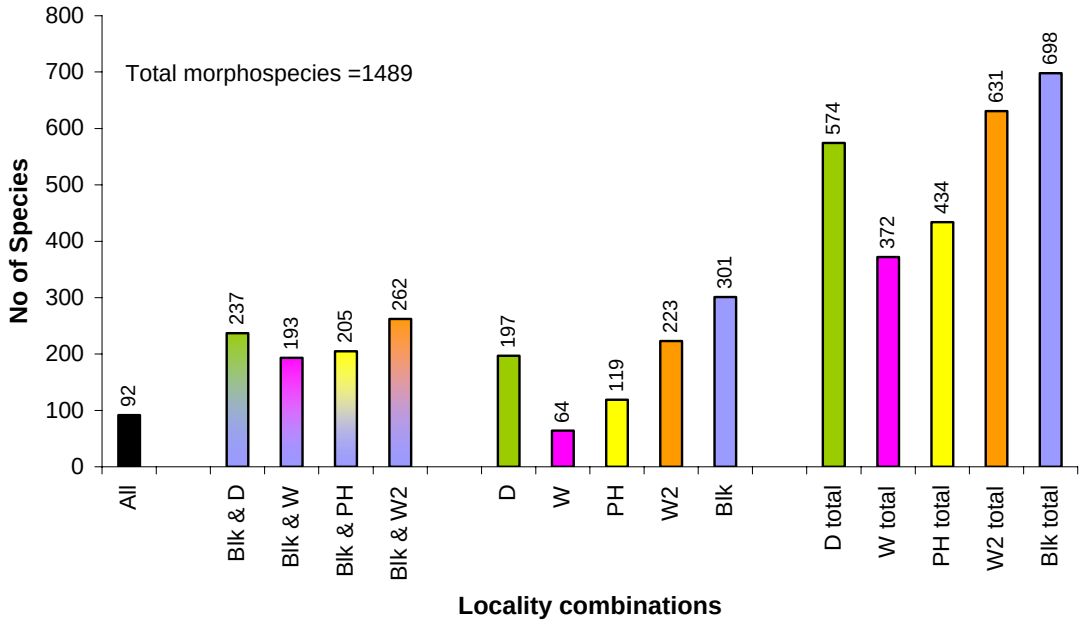


Figure 8. Number of species common and exclusive to Blackwood Plateau (Blk), Wellington East (W2), Perth Hills (PH) Wellington (W) and Donnelly (D). (All refers to number of species common to all localities; locality combinations such as Blk & D refers to the number of species common to both localities; a single locality shows the number of species exclusive to that locality; location totals refer to total morphospecies for the respective locality and is included for comparison)

Pest presence

The forest pest gumleaf skeletonizer was absent from all sites (Table 6). Bullseye borer was present at all sites except Barrabup gap release and selective cut. All silvicultural treatments had a location where Jarrah leaf miner was present and absent.

Table 6: Pest presence and abundance assessment at each Blackwood Plateau grid (JLM = jarrah leafminer; GLS = gumleaf skeletonizer; BEB = bullseye borer; 0 = absent, 1 = present, 2 = abundant).

Silvicultural Treatment	Site No	Location	JLM	GLS	BEB
External Control	FC38	Barrabup	1	0	1
External Control	FC39	St John	0	0	1
External Control	FC40	Layman	1	0	1
Gap Release	FC46	Barrabup	1	0	0
Gap Release	FC47	Cambray	0	0	1
Gap Release	FC48	Butler	1	0	1
Selective Cut	FC43	Barrabup	0	0	0
Selective Cut	FC44	Cambray	0	0	1
Selective Cut	FC45	Butler	1	0	1

Out of session samples
In 2005-06 out of session samples were taken at 2 grids (FC26, FC27) in the Perth Hills locality. This out of session sample was conducted to monitor the short-term impact of a wildfire in FC27 (external control), which occurred during December 2004. Grid FC26 (Shelterwood), cut in 1997, was chosen for comparison because it is the nearest and next least extreme treatment in the northern most group of 3 grids, and has a similar vegetation type to FC27 (Yarragil 2). A total of 162 morphospecies were captured which comprised 26 species that had not previously been captured in FORESTCHECK sites. For the same sites in 2003-2004 a total 213 morphospecies had been captured. Diversity appeared lower at both sites in 2005-2006, however abundance was higher, particularly in the burnt grid (FC27, Table 7).

Table 7. Comparison of out of session sampling for Perth Hills plots FC26 & FC27 (2003-2004 & 2005-2006)

			2003-2004		2005-2006	
	Site No	Location	No Spec	Abun	No Spec	Abun
Shelterwood	FC26	Lesley	147	658	106	739
External Control	FC27	Occidental	136	685	92	975

Databases
The invertebrate databases are in Microsoft Access® and are comprised of two main sections:

Specimen capture records
Consist of separate files for each sample session, which are named progressively Ento1-5.

- In each file there is a separate table for each capture method (i.e. light trap, pitfall trap, active capture); and for sampling conditions (eg night minimum temperatures, moon illumination, day maximum temperatures during hand sampling for both soil and air). There is also a table for pest observations at each site.
- Separate tables on site, microhabitat intersection (i.e. an estimate of ground covered by moss, litter, CWD) are also included in each session file.
- Other tables are to facilitate the relational nature of the database.
- There is a linked table for species identity (FC Morpho-spec master; see below). Each specimen is sorted to a field number that is represented in the Morpho-spec master by an identity. This field number is unchangeable and remains with the specimen as its original identity both in the morphospecies master list and in the capture records. However, after further taxonomic assessment the original morphospecies assignment may be revised, thus there are two identity numbers for each voucher specimen, the original number and a working number from which the specimen's identity is used for analysis. This second number is also included in the capture records.

Specimen identity (named: AA FCk morpho-spec master Inverts) is a separate universal file for both FORESTCHECK and Walpole Fire Mosaic, which contain the identity of each morphospecies number assigned to a specimen. There are two main tables in this file:

- AA FCk morpho-Spec Master Inverts.
- Trophic guild & morpho.

Other tables are to facilitate the relational nature of the database. It is from this database that Appendix I is constructed.

A third database file is essentially a duplicate of the Morphospecies master but contains a table linking specimen images to the original master table. This was done to keep the original Morphospecies master file at a moderate size so that data could be linked to the capture files and manipulated more easily during analysis. At present this file is under development as new digital images are added. An example is shown in Fig 9. It is anticipated that this file will serve as an identification aid in the second round of FORESTCHECK**.**

Five-year analysis considerations

Differences in overall morphospecies diversity, abundance and diversity within and between functional groups (e.g. trophic guilds, habitat preferences, sampling regime, taxonomic/habitat groups such as ants or carabid beetles, Gondwanan relics) needs to be examined in relation to site habitat and treatment aspects as follows:

- Silvicultural treatments.
- Basal area.
- Soil factors such as compaction, nutrient analysis, structure and type.
- Vegetation factors such as structure, composition and foliar nutrient analysis (particularly in relation to sweep, beat, light trap captures and foliar insects such as herbivores).
- Litter depth and CWD amount and quality (particularly in relation to litter, CWD and pit fall captured insects).
- Environmental gradients such as rainfall.

In addition, common (species numerically common and species common to all sampling regions) and the number of uncommon (singleton) species can be compared across sites and treatments. Grid similarity can also be compared in relation to geographical distance. Analysis of data will need to remove the effects of failed light and pitfall traps and consider co-variables measured during sampling (e.g. temperature, moon illumination).

Conclusions

The main observations made following monitoring of invertebrates at Blackwood Plateau were:

- The 2005-2006 sampling for Blackwood took place during some unusual weather patterns. Spring appeared cooler than usual and autumn was not only cool, but also wet.
- As a consequence of the unusual weather the spring light trap capture was less diverse than the autumn capture (the inverse of other sample periods). Despite this Blackwood was the most diverse locality sampled.
- The greatest diversity was at the Shelterwood (FC41, FC42) and External Control (FC38) grids. Abundance was greatest at the Shelterwood (FC41) grid, followed closely by the Selective Cut (FC44) grid (Fig. 5). No consistent associations with diversity, abundance and silvicultural treatments are as yet apparent, however the data needs refining to account for variates such as temperature, lunar illumination and trap failures.
- Some morphospecies, initially caught in Donnelly and since then not sampled at other localities, were recollected at Blackwood. Despite this affiliation with Donnelly, Blackwood has the greatest number of shared species with Wellington2.

Morphosp # 3 Capture Method UV Light Site M 01

Field # 3 Date 21-Nov-01 Voucher state p

Order Lepidoptera

Family Thaumetopoeidae

Tax 3

Genus *Epicoma*

Species *melanostica*

Indicator Class K

Synonomy

Affinities

Troph Juv Guild P

Troph Adu Guild DF

Comments

Morphosp # 52 Capture Method UV Light Site M 08

Field # 52 Date 21-Nov-01 Voucher state p a

Order Hymenoptera

Family Apidae

Tax 3

Genus *Apis*

Species *melifera*

Indicator Class K

Synonomy 297, 474, 499

Affinities

Troph Juv Guild P

Troph Adu Guild P

Comments alc spec M3 30/11/01

Morphosp # 445 Capture Method UV Light Site M 01

Field # 445 Date 26-Mar-02 Voucher state p

Order Lepidoptera

Family Arctiidae

Tax 3 Arctiinae

Genus *Spilosoma*

Species

Indicator Class K

Synonomy

Affinities 2111, 2112

Troph Juv Guild P

Troph Adu Guild P

Comments

Figure 9: Extract from Access database file linking the "Morpho-species Master" to specimen images.

Appendix I: Morphospecies list for FORESTCHECK invertebrates for July 2006. Data sorted on Taxa (Tax 3 = subfamily or other; K = assigned indicator species; GA = species with Gondwanan affinities; GR = suspected Gondwanan relic species

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
261	Amphipoda		Not found			GR
472	Araneomorphae		Degraded			
1680	Araneomorphae	Araneidae		*Eriophora*		K
2038	Araneomorphae	Araneidae		*Eriophora*		
1213	Araneomorphae	Araneidae		*Gasteracantha*	*minax ?*	K
1551	Araneomorphae	Araneidae		*Nephila*	*edulis*	K
1471	Araneomorphae	Araneidae		*Phonographa*	*graffei*	K
285	Araneomorphae	Araneidae		*Eriophora*		
536	Araneomorphae	Corinnidae		*Supunna*	*albopuncta*	K
2073	Araneomorphae	Ctenidae				
1980	Araneomorphae	Ctenidae ?				
553	Araneomorphae	Ctenidae ?				
1544	Araneomorphae	Deinopidae		*Deinopis ?*		K
941	Araneomorphae	Gnaphosidae				
975	Araneomorphae	Gnaphosidae				
560	Araneomorphae	Gnaphosidae				
938	Araneomorphae	Gnaphosidae		*Rebilus*		
1427	Araneomorphae	Gnaphosidae		*Rebilus*		
742	Araneomorphae	Gnaphosidae				
620	Araneomorphae	Gnaphosidae		*Rebilus*		
1558	Araneomorphae	Lycosidae				
1581	Araneomorphae	Lycosidae				
1588	Araneomorphae	Lycosidae				
1589	Araneomorphae	Lycosidae				
1593	Araneomorphae	Lycosidae				
1595	Araneomorphae	Lycosidae				
2106	Araneomorphae	Lycosidae				
554	Araneomorphae	Lycosidae				
733	Araneomorphae	Lycosidae				
741	Araneomorphae	Lycosidae				
743	Araneomorphae	Lycosidae				
740	Araneomorphae	Miturgidae				
933	Araneomorphae	Miturgidae				
1428	Araneomorphae	Miturgidae				
1448	Araneomorphae	Miturgidae				
1449	Araneomorphae	Miturgidae				K
1476	Araneomorphae	Miturgidae				K
1477	Araneomorphae	Miturgidae				
1564	Araneomorphae	Miturgidae				
1574	Araneomorphae	Miturgidae				
1579	Araneomorphae	Miturgidae				
1580	Araneomorphae	Miturgidae				
1885	Araneomorphae	Miturgidae				
597	Araneomorphae	Miturgidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
271	Araneomorphae	Miturgidae				
794	Araneomorphae	Miturgidae				
812	Araneomorphae	Miturgidae				
1044	Araneomorphae	Sparassidae				
1432	Araneomorphae	Sparassidae				
1446	Araneomorphae	Sparassidae				
1986	Araneomorphae	Sparassidae				
2055	Araneomorphae	Sparassidae				
286	Araneomorphae	Sparassidae				K
939	Araneomorphae	Sparassidae		*Olios*		K
724	Araneomorphae	Sparassidae				
1570	Araneomorphae	Stiphidiidae				
2083	Araneomorphae	Stiphidiidae				
732	Araneomorphae	Stiphidiidae		*Balami*		
735	Araneomorphae	Stiphidiidae		*Balami*	*volucripes*	
725	Araneomorphae	Stiphidiidae		*Balami ?*	*volucripes*	
793	Araneomorphae	Theridiidae				
788	Araneomorphae	Theridiidae ?				
972	Araneomorphae	Zodariidae				
1007	Araneomorphae	Zodariidae				
1015	Araneomorphae	Zodariidae				
468	Araneomorphae	Zodariidae		*Storena*		K
731	Araneomorphae	Zodariidae				
783	Araneomorphae	Zodariidae				
932	Araneomorphae	Zoridae				
1584	Araneomorphae	Zoridae				
1462	Blattodea		not found			
509	Blattodea		lost			
1101	Blattodea	Blaberidae				
1115	Blattodea	Blaberidae				
148	Blattodea	Blaberidae				
410	Blattodea	Blaberidae				K
479	Blattodea	Blaberidae				
147	Blattodea	Blaberidae		*Calolampra*		
27	Blattodea	Blaberidae	Epilamprinae	*Laxta*		K
119	Blattodea	Blaberidae	Epilamprinae	*Laxta*		K
926	Blattodea	Blattelidae				
1118	Blattodea	Blattelidae				
2017	Blattodea	Blattelidae				
190	Blattodea	Blattelidae				K
120	Blattodea	Blattellidae		*Neotemnopteryx*		K
591	Blattodea	Blattellidae		*Neotemnopteryx*		
780	Blattodea	Blattellidae		*Neotemnopteryx*		
121	Blattodea	Blattellidae		*Platyzosteria*		K
122	Blattodea	Blattellidae		*Platyzosteria*		K
878	Blattodea	Blattidae				
891	Blattodea	Blattidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
936	Blattodea	Blattidae				
961	Blattodea	Blattidae				
967	Blattodea	Blattidae				
1434	Blattodea	Blattidae				
1460	Blattodea	Blattidae				K
1559	Blattodea	Blattidae				
1573	Blattodea	Blattidae				
1587	Blattodea	Blattidae				
1780	Blattodea	Blattidae				
1933	Blattodea	Blattidae				
1974	Blattodea	Blattidae				
1991	Blattodea	Blattidae				
2037	Blattodea	Blattidae				
2098	Blattodea	Blattidae				
483	Blattodea	Blattidae		*Platyzosteria*		K
874	Blattodea	Blattidae		*Platyzosteria*		
899	Blattodea	Blattidae		*Platyzosteria*		
905	Blattodea	Blattidae		*Platyzosteria*		
968	Blattodea	Blattidae		*Platyzosteria*		
971	Blattodea	Blattidae		*Platyzosteria*		
1016	Blattodea	Blattidae		*Platyzosteria*		
1035	Blattodea	Blattidae		*Platyzosteria*		
1474	Blattodea	Blattidae		*Platyzosteria*		
1888	Blattodea	Blattidae		*Platyzosteria*		
1897	Blattodea	Blattidae		*Platyzosteria*		
2008	Blattodea	Blattidae		*Platyzosteria*		
2013	Blattodea	Blattidae		*Platyzosteria*		
2015	Blattodea	Blattidae		*Platyzosteria*		
2033	Blattodea	Blattidae		*Platyzosteria*		K
2003	Blattodea	Blattidae		*Polyzosteria*		K
2007	Blattodea	Blattidae		*Polyzosteria*		
490	Blattodea	Blattidae				
508	Blattodea	Blattidae				K
254	Blattodea	Blattidae		*Platyzosteria*		
282	Blattodea	Blattidae		*Platyzosteria*		K
781	Blattodea	Blattidae		*Platyzosteria*		K
219	Blattodea	Blattidae		*Platyzosteria*		K
266	Blattodea	Blattidae		*Platyzosteria*		K
507	Blattodea	Blattidae		*Platyzosteria*		
706	Blattodea	Blattidae		*Platyzosteria*		
292	Blattodea	Blattidae		*Polyzosteria*		K
592	Blattodea	Blattidae		*Polyzosteria*		
269	Blattodea	Blattidae		*Polyzosteria*		
777	Blattodea	Blattidae	Michells cocky	*Polyzosteria*	*mitchelli*	K
1531	Chilopoda	Geophilida				
226	Chilopoda	Geophilida				
227	Chilopoda	Geophilida				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1429	Chilopoda	Lithobiida				
1563	Chilopoda	Lithobiida				
228	Chilopoda	Lithobiida				
229	Chilopoda	Lithobiida				
586	Chilopoda	Scolopendrida				
1882	Chilopoda	Scolopendrida				
1883	Chilopoda	Scolopendrida				
2050	Chilopoda	Scolopendrida				
225	Chilopoda	Scolopendrida				
267	Chilopoda	Scolopendrida				
277	Chilopoda	Scolopendrida				
623	Chilopoda	Scolopendrida				
223	Chilopoda	Scolopendrida		*Ethnostigmus ?*		
224	Chilopoda	Scolopendrida		*Ethnostigmus ?*		
875	Chilopoda	Scolopendrida ?				
877	Chilopoda	Scolopendrida ?				
1583	Chilopoda	Scolopendrida ?				
716	Chilopoda	Scolopendrida ?				
815	Chilopoda	Scolopendrida ?				
865	Coleoptera					
116	Coleoptera					
158	Coleoptera					
173	Coleoptera					
194	Coleoptera					
215	Coleoptera					
100	Coleoptera	Belidae				GR
201	Coleoptera	Belidae		*Araiobelus*		GR
168	Coleoptera	Belidae		*Rhinotia*		GR
1943	Coleoptera	Bostrichidae				
1437	Coleoptera	Buprestidae				K
1464	Coleoptera	Buprestidae				K
1890	Coleoptera	Buprestidae				K
1999	Coleoptera	Buprestidae				K
1443	Coleoptera	Buprestidae		*Melobasis*		K
1435	Coleoptera	Buprestidae		*Melobasis*	*gloriosa ?*	K
159	Coleoptera	Buprestidae		*Xyroscelis*	*crocata*	
299	Coleoptera	Buprestidae				K
701	Coleoptera	Buprestidae		*Melobasis*		K
795	Coleoptera	Cantharidae		*Chauliognathus*		
198	Coleoptera	Cantharidae		*Heteromastix*		
566	Coleoptera	Carabidae				GA
839	Coleoptera	Carabidae				GA
842	Coleoptera	Carabidae				GA
851	Coleoptera	Carabidae				GA
992	Coleoptera	Carabidae				GA
1000	Coleoptera	Carabidae				GA
1059	Coleoptera	Carabidae				GA

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1087	Coleoptera	Carabidae				GA
1104	Coleoptera	Carabidae				GA
1522	Coleoptera	Carabidae				GA
1939	Coleoptera	Carabidae				GA
1978	Coleoptera	Carabidae				GA
1979	Coleoptera	Carabidae				GA
2085	Coleoptera	Carabidae				GA
2127	Coleoptera	Carabidae				GA
1058	Coleoptera	Carabidae		*Calosoma*	*schayeri*	K
956	Coleoptera	Carabidae		*Philophloeus*	*eucalypti*	GA
2081	Coleoptera	Carabidae		*Scaraphites ?*		GA
253	Coleoptera	Carabidae				GA
528	Coleoptera	Carabidae				K
529	Coleoptera	Carabidae				K
727	Coleoptera	Carabidae				GA
280	Coleoptera	Carabidae		*Carenum ?*		GA
288	Coleoptera	Carabidae		*Chlaenius*		GA
439	Coleoptera	Carabidae	Carabinae			GA
340	Coleoptera	Carabidae	Chlaeniiae			GA
340	Coleoptera	Carabidae	Chlaeniiae			GA
348	Coleoptera	Carabidae	Chlaeniiae			GA
1442	Coleoptera	Carabidae	Esydrinae			GA
265	Coleoptera	Carabidae	Esydrinae			GA
264	Coleoptera	Carabidae	Harpalinae	*Cenogmus ?*		GA
914	Coleoptera	Carabidae	Licininae	*Dicrochile ?*		GA
747	Coleoptera	Carabidae	Pterostichinae	*Notonomus ?*		GA
746	Coleoptera	Carabidae	Pterostichinae	*Notonomus ?*		GA
1033	Coleoptera	Cerambycidae				
1041	Coleoptera	Cerambycidae				
1418	Coleoptera	Cerambycidae				
1917	Coleoptera	Cerambycidae				
1067	Coleoptera	Cerambycidae		*Phoracantha*		
677	Coleoptera	Cerambycidae		*Sceleocantha*		
1082	Coleoptera	Cerambycidae		*Sceleocantha*		
1040	Coleoptera	Cerambycidae		*Scolecobrotus*	*westwoodi ?*	
654	Coleoptera	Cerambycidae		*Coptocercus*	*rubripes*	
762	Coleoptera	Cerambycidae		*Phoracantha*	*semipuncta*	
673	Coleoptera	Cerambycidae		*Stenoderus*	*suturalis*	
351	Coleoptera	Cerambycidae		*Uracantha*	*triangularis*	K
476	Coleoptera	Cerambycidae	Laminae	*Ancita*		
182	Coleoptera	Chrysomelidae	Chrysomelinae			
56	Coleoptera	Chrysomelidae	Chrysomelinae	*Calomela*		
101	Coleoptera	Chrysomelidae	Chrysomelinae	*Calomela*		
115	Coleoptera	Chrysomelidae	Chrysomelinae	*Calomela*		
155	Coleoptera	Chrysomelidae	Chrysomelinae	*Calomela*		
807	Coleoptera	Chrysomelidae	Chrysomelinae	*Chalcolampra*		K
112	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
308	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		K
463	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		K
465	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		K
677	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
786	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
800	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
803	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
804	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
805	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
808	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
1444	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
1540	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
175	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
248	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
471	Coleoptera	Chrysomelidae	Chrysomelinae	*Chrysophtharta*		
307	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		K
667	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		K
707	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
913	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
1554	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
1826	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
1827	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
2034	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*		
665	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsis*	*yilgarnensis*	K
1092	Coleoptera	Chrysomelidae	Chrysomelinae	*Paropsisterna*		
1103	Coleoptera	Cleridae		*Eunatalis*	*spinicornis*	
684	Coleoptera	Cleridae				
695	Coleoptera	Cleridae		*Eleale*		
912	Coleoptera	Coccinellidae		*Parapriasus*		
193	Coleoptera	Coccinellidae		*Coccinella*	*repanda*	
843	Coleoptera	Curculionidae				
852	Coleoptera	Curculionidae				
911	Coleoptera	Curculionidae				
1110	Coleoptera	Curculionidae				
1182	Coleoptera	Curculionidae				
1438	Coleoptera	Curculionidae				
1505	Coleoptera	Curculionidae				
368	Coleoptera	Curculionidae				K
2051	Coleoptera	Curculionidae		*Catasarcus*		
2088	Coleoptera	Curculionidae		*Catasarcus ?*		
1225	Coleoptera	Curculionidae		*Leptopius*		
1050	Coleoptera	Curculionidae		*Pelororhinus*	*sulcirostris*	
209	Coleoptera	Curculionidae		*Rhinaria ?*		
102	Coleoptera	Curculionidae				
114	Coleoptera	Curculionidae				
156	Coleoptera	Curculionidae				
169	Coleoptera	Curculionidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
199	Coleoptera	Curculionidae				
214	Coleoptera	Curculionidae				
244	Coleoptera	Curculionidae				K
349	Coleoptera	Curculionidae				K
514	Coleoptera	Curculionidae				
736	Coleoptera	Curculionidae				
1560	Coleoptera	Curculionidae				
709	Coleoptera	Curculionidae		*Leptopius*		
744	Coleoptera	Curculionidae	Amycterinae			GR
496	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
869	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
970	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1215	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1409	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1486	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1523	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1775	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
2091	Coleoptera	Curculionidae	Amycterinae	*Acantholophus*		GR
1596	Coleoptera	Curculionidae	Amycterinae	*Aedriodes*		GR
1597	Coleoptera	Curculionidae	Amycterinae	*Aedriodes*		GR
1014	Coleoptera	Curculionidae	Amycterinae	*Aedriodes*	*fastigiatus*	GR
1571	Coleoptera	Curculionidae	Amycterinae	*Cucullothorax*	*horridus*	GR
934	Coleoptera	Curculionidae	Amycterinae	*Hyborrhinus ?*		GR
748	Coleoptera	Curculionidae	Amycterinae	*Hyborrhinus ?*		GR
814	Coleoptera	Curculionidae	Amycterinae	*Neohyborrhynchus ?*		GR
2090	Coleoptera	Curculionidae	Amycterinae	*Parahyborrhynchus*	*convexiuculus*	GR
1789	Coleoptera	Curculionidae	Amycterinae	*Sclerorinus ?*		GR
910	Coleoptera	Curculionidae	Amycterinae	*Talaurinus*		GR
1461	Coleoptera	Curculionidae	Amycterinae	*Talaurinus*		GR
817	Coleoptera	Curculionidae	Amycterinae	*Talaurinus*		GR
906	Coleoptera	Curculionidae	Amycterinae	*Talaurinus*	*roei ?*	GR
157	Coleoptera	Curculionidae	Aterpinae	*Rhadinosomus*	*lacordaire*	K
103	Coleoptera	Curculionidae	Aterpinae	*Rhinaria*	*aberrans ?*	
710	Coleoptera	Curculionidae	Entiminae			
210	Coleoptera	Curculionidae	Entiminae	*Aesolithna*		
113	Coleoptera	Curculionidae	Entiminae	*Polyphrades*	*aesalon ?*	
488	Coleoptera	Curculionidae	Gonipterinae	*Gonipterus*		
160	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*		
161	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*		
462	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*		
161	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*	*fasciata*	K
98	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*	*pictipennis*	
290	Coleoptera	Curculionidae	Molytinae	*Melanotranes*	*roei*	K
291	Coleoptera	Curculionidae	Molytinae	*Tranes*	*vigorsii*	K
1123	Coleoptera	Dytiscidae		*Cybister*		K
850	Coleoptera	Dytiscidae		*Lancetes*		
13	Coleoptera	Dytiscidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
440	Coleoptera	Dytiscidae				
774	Coleoptera	Dytiscidae		*Eretes*		
651	Coleoptera	Dytiscidae		*Lancetes*		
989	Coleoptera	Elateridae				K
1083	Coleoptera	Elateridae				
1817	Coleoptera	Elateridae				
1914	Coleoptera	Elateridae				
909	Coleoptera	Elateridae		*Conoderus*		
1818	Coleoptera	Elateridae		*Conoderus*		
1819	Coleoptera	Elateridae		*Conoderus*		
997	Coleoptera	Elateridae		*Conoderus ?*		
1062	Coleoptera	Elateridae		*Conoderus ?*		
1109	Coleoptera	Elateridae		*Conoderus ?*		
1120	Coleoptera	Elateridae		*Conoderus ?*		
1121	Coleoptera	Elateridae		*Conoderus ?*		
15	Coleoptera	Elateridae				
220	Coleoptera	Elateridae				
444	Coleoptera	Elateridae				
571	Coleoptera	Elateridae				
621	Coleoptera	Elateridae				
636	Coleoptera	Elateridae				
26	Coleoptera	Elateridae		*Conoderus*		
135	Coleoptera	Elateridae		*Conoderus ?*		
831	Coleoptera	Geotrupidae		*Blackbolbus*		K
959	Coleoptera	Histeridae				
14	Coleoptera	Hydrophilidae				
1932	Coleoptera	Lucanidae		*Syndesus*		
437	Coleoptera	Lucanidae		*Syndesus*		K
1992	Coleoptera	Lycidae				
1994	Coleoptera	Lycidae				
2000	Coleoptera	Lycidae		*Metriorrhynchus*		
99	Coleoptera	Lycidae		*Metriorrhynchus*		K
208	Coleoptera	Lycidae		*Metriorrhynchus*		K
802	Coleoptera	Lycidae		*Metriorrhynchus*		K
191	Coleoptera	Phycosecidae	Phycosecis			
2052	Coleoptera	Rhipiphoridae	Ptilophorinae			K
1836	Coleoptera	Scarabaeidae				
1838	Coleoptera	Scarabaeidae				
1945	Coleoptera	Scarabaeidae				
2068	Coleoptera	Scarabaeidae				
2076	Coleoptera	Scarabaeidae				
1889	Coleoptera	Scarabaeidae		*Diphucephala*		
189	Coleoptera	Scarabaeidae	Dynastinae	*Cryptodus*		K
1160	Coleoptera	Scarabaeidae	Dynastinae	*Cryptodus*		
824	Coleoptera	Scarabaeidae	Dynastinae	*Semanopterus*		
1021	Coleoptera	Scarabaeidae	Dynastinae	*Semanopterus*		
1846	Coleoptera	Scarabaeidae	Dynastinae	*Semanopterus*		

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1562	Coleoptera	Scarabaeidae	Dynastinae	*Trissodon*		
2084	Coleoptera	Scarabaeidae	Dynastinae	*Trissodon*		
1847	Coleoptera	Scarabaeidae	Melolonthinae			
1853	Coleoptera	Scarabaeidae	Melolonthinae			
1856	Coleoptera	Scarabaeidae	Melolonthinae			
1863	Coleoptera	Scarabaeidae	Melolonthinae			
1904	Coleoptera	Scarabaeidae	Melolonthinae			
1905	Coleoptera	Scarabaeidae	Melolonthinae			
1911	Coleoptera	Scarabaeidae	Melolonthinae			
1915	Coleoptera	Scarabaeidae	Melolonthinae			
1922	Coleoptera	Scarabaeidae	Melolonthinae			
1923	Coleoptera	Scarabaeidae	Melolonthinae			
1925	Coleoptera	Scarabaeidae	Melolonthinae			
1926	Coleoptera	Scarabaeidae	Melolonthinae			
1948	Coleoptera	Scarabaeidae	Melolonthinae			
212	Coleoptera	Scarabaeidae	Melolonthinae	*Automolus ?*		
1823	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*		
1866	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*		
2006	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*		
846	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*	*antennalis*	K
1063	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*	*bogaria ?*	
353	Coleoptera	Scarabaeidae	Melolonthinae	*Colpochila*	*major*	K
55	Coleoptera	Scarabaeidae	Melolonthinae	*Colymbomorpha*	*vittata*	
1985	Coleoptera	Scarabaeidae	Melolonthinae	*Diphucephala*		
28	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
29	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
70	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
94	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
154	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
171	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
172	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
289	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
363	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
416	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
418	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
823	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
951	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
991	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1073	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1116	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1192	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1566	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1820	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
1822	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
347	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
359	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		
427	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*		

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
162	Coleoptera	Scarabaeidae	Melolonthinae	*Liparetrus*	*jenkinsi*	
287	Coleoptera	Scarabaeidae	Melolonthinae	*Maechidius*		
826	Coleoptera	Scarabaeidae	Melolonthinae	*Maechidius*		
1388	Coleoptera	Scarabaeidae	Melolonthinae	*Maechidus ?*		
668	Coleoptera	Scarabaeidae	Melolonthinae	*Phyllotocus*	*ustulatus*	
1813	Coleoptera	Scarabaeidae	Melolonthinae	*Scitalini*		
1824	Coleoptera	Scarabaeidae	Scarabaeinae	*Onthophagus*		
511	Coleoptera	Scarabaeidae	Scarabaeinae	*Onthophagus*		
17	Coleoptera	Scarabaeidae	Scarabaeinae	*Onthophagus*	*ferox*	K
1656	Coleoptera	Silphidae		*Ptomophila*		
924	Coleoptera	Silphidae		*Ptomophila*	*lacrymosa*	GR
2094	Coleoptera	Staphylinidae				GA
628	Coleoptera	Staphylinidae				K
904	Coleoptera	Tenebrionidae				GA
995	Coleoptera	Tenebrionidae				GA
1536	Coleoptera	Tenebrionidae				GA
1012	Coleoptera	Tenebrionidae		*Helea*		K
711	Coleoptera	Tenebrionidae		*Oectosis*		K
778	Coleoptera	Tenebrionidae		*Oectosis*		GA
930	Coleoptera	Tenebrionidae	Amarygmini	*Chalcopteroides*		K
1958	Coleoptera	Tenebrionidae	Copidita ?			GA
1962	Coleoptera	Tenebrionidae	Copidita ?			GA
1392	Coleoptera	Tenebrionidae	Heleini			GA
1389	Coleoptera	Tenebrionidae	Heleini	*Pterohelaeus*		GA
192	Coleoptera	Tenebrionidae	Lagriinae	*Lagria*	*aneouiobcea*	GA
1136	Coleoptera	Trogidae				
1843	Coleoptera	Trogidae				
1871	Coleoptera	Trogidae				
1949	Coleoptera	Trogidae				
825	Coleoptera	Trogidae		*Omorgus*		K
848	Coleoptera	Trogidae		*Omorgus*		
935	Coleoptera	Trogidae		*Omorgus*		K
1086	Coleoptera	Trogidae		*Omorgus*		
1097	Coleoptera	Trogidae		*Omorgus*		
1112	Dermaptera					
1113	Dermaptera					
1390	Dermaptera					
1433	Dermaptera					
1538	Dermaptera					
1790	Dermaptera					
1919	Dermaptera					
1951	Dermaptera					
123	Dermaptera					K
257	Dermaptera					K
258	Dermaptera					K
484	Dermaptera					K
491	Dermaptera					

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
492	Dermaptera					K
734	Dermaptera					
682	Dermaptera	Anisolabididae	Isolabelli			
999	Dermaptera	Spongiphoridae				
2070	Diplopoda	Craspedosomatida				
876	Diplopoda	Julida				
966	Diplopoda	Julida				
1526	Diplopoda	Julida				
1546	Diplopoda	Julida				
259	Diplopoda	Julida				
260	Diplopoda	Julida				K
717	Diplopoda	Julida				
195	Diptera					
1472	Diptera	Acroceridae				K
127	Diptera	Anthomyiidae				
1424	Diptera	Asilidae				GA
1478	Diptera	Asilidae				GA
1529	Diptera	Asilidae				GA
1842	Diptera	Asilidae				GA
1869	Diptera	Asilidae				GA
564	Diptera	Asilidae				GA
165	Diptera	Asilidae				GA
204	Diptera	Asilidae				GA
217	Diptera	Asilidae				GA
312	Diptera	Asilidae				GA
313	Diptera	Asilidae				GA
532	Diptera	Asilidae				GA
541	Diptera	Asilidae				GA
751	Diptera	Asilidae				GA
775	Diptera	Asilidae				GA
810	Diptera	Asilidae				GA
683	Diptera	Bombyliidae				K
907	Diptera	Bombyliidae				K
1053	Diptera	Bombyliidae				K
1542	Diptera	Bombyliidae				K
2063	Diptera	Bombyliidae				K
245	Diptera	Bombyliidae				K
506	Diptera	Bombyliidae				K
719	Diptera	Bombyliidae				K
745	Diptera	Bombyliidae				K
2080	Diptera	Calliphoridae				
53	Diptera	Calliphoridae		*Calliphora*		
480	Diptera	Calliphoridae		*Calliphora*		
1419	Diptera	Calliphoridae ?				
1561	Diptera	Calliphoridae ?				
1987	Diptera	Conopidae				K
676	Diptera	Conopoidea	Conopidae			

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
125	Diptera	Drosophilidae				
179	Diptera	Drosophilidae				
1725	Diptera	Helosciomyzidae				
2014	Diptera	Lauxanidae				K
68	Diptera	Lauxaniidae				
2058	Diptera	Muscidae				
2075	Diptera	Muscidae				
51	Diptera	Muscidae				
128	Diptera	Muscidae				
205	Diptera	Muscidae				
498	Diptera	Muscidae				
675	Diptera	Muscidae				
818	Diptera	Muscidae				
1850	Diptera	Pyrgotidae				
88	Diptera	Pyrgotidae				K
1940	Diptera	Pyrgotidae ?				
1151	Diptera	Sarcophagidae				
1961	Diptera	Sarcophagidae				
579	Diptera	Sarcophagidae				
575	Diptera	Sarcophaidae ?				
2044	Diptera	Stratiomyidae				GA
54	Diptera	Syrphidae				
130	Diptera	Syrphidae				
569	Diptera	Syrphidae				
572	Diptera	Syrphidae				
1203	Diptera	Syrphidae				
1421	Diptera	Syrphidae				
1422	Diptera	Syrphidae				
1424	Diptera	Syrphidae				
1425	Diptera	Syrphidae				
1983	Diptera	Syrphidae				
2128	Diptera	Syrphidae				
129	Diptera	Syrphidae				
206	Diptera	Syrphidae				
473	Diptera	Tabanidae				GA
884	Diptera	Tabanidae				GA
901	Diptera	Tabanidae				GA
1297	Diptera	Tabanidae				GA
1440	Diptera	Tabanidae				GA
1548	Diptera	Tabanidae				GA
1630	Diptera	Tabanidae				GA
603	Diptera	Tabanidae				GA
126	Diptera	Tabanidae				GA
178	Diptera	Tabanidae				GA
466	Diptera	Tabanidae				GA
467	Diptera	Tabanidae				GA
495	Diptera	Tabanidae				GA

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
929	Diptera	Tachinidae				
2048	Diptera	Tachinidae				
136	Diptera	Tachinidae				K
464	Diptera	Tachinidae				K
142	Diptera	Therevidae				K
577	Diptera	Tipulidae				
16	Diptera	Tipulidae				K
792	Diptera	Tipulidae				K
969	Gastropoda					
1431	Gastropoda					
1527	Gastropoda					
1565	Gastropoda					
1590	Gastropoda					
1683	Hemiptera	Alydidae				
2020	Hemiptera	Alydidae				
2021	Hemiptera	Alydidae				
1072	Hemiptera	Cicadellidae				GA
1239	Hemiptera	Cicadellidae				GA
1934	Hemiptera	Cicadellidae				
2036	Hemiptera	Cicadellidae				GA
107	Hemiptera	Cicadellidae				GA
166	Hemiptera	Cicadellidae				GA
170	Hemiptera	Cicadellidae				GA
177	Hemiptera	Cicadellidae				GA
187	Hemiptera	Cicadellidae				GA
200	Hemiptera	Cicadellidae				GA
239	Hemiptera	Cicadellidae				GA
787	Hemiptera	Cicadellidae				GA
241	Hemiptera	Cicadellidae ?				GA
916	Hemiptera	Cicadidae				
1851	Hemiptera	Cicadidae				
1873	Hemiptera	Cicadidae				
2078	Hemiptera	Cicadidae				
2087	Hemiptera	Cicadidae				
49	Hemiptera	Cicadidae		*Cicadetta*		
207	Hemiptera	Cicadidae		*Cicadetta*		K
164	Hemiptera	Coccoidea				
700	Hemiptera	Coreidae		*Amorbus*	*bispinus*	
1524	Hemiptera	Dictyopharidae				
503	Hemiptera	Eurymelidae		*Pogonoscopus*		K
1415	Hemiptera	Flatidae				
1090	Hemiptera	Fulgoridae				
764	Hemiptera	Fulgoridae				
1567	Hemiptera	Gelastocoridae				
964	Hemiptera	Hyocepahlidae ?				
573	Hemiptera	Hyocephalidae				
482	Hemiptera	Hyocephalidae				K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1445	Hemiptera	Lygaeidae				GA
213	Hemiptera	Lygaeidae				GA
679	Hemiptera	Lygaeidae				GA
885	Hemiptera	Lygaeidae ?				GA
108	Hemiptera	Membracidae				K
109	Hemiptera	Membracidae				
110	Hemiptera	Membracidae				GA
301	Hemiptera	Membracidae				K
302	Hemiptera	Membracidae				K
188	Hemiptera	Miridae				GA
221	Hemiptera	Pentatomidae				
838	Hemiptera	Pentatomidae				
960	Hemiptera	Pentatomidae				
962	Hemiptera	Pentatomidae				
963	Hemiptera	Pentatomidae				
1049	Hemiptera	Pentatomidae				
1227	Hemiptera	Pentatomidae				
1302	Hemiptera	Pentatomidae				
1466	Hemiptera	Pentatomidae				
1697	Hemiptera	Pentatomidae				
1993	Hemiptera	Pentatomidae				
1995	Hemiptera	Pentatomidae				
678	Hemiptera	Pentatomidae				
779	Hemiptera	Pentatomidae				
2066	Hemiptera	Pentatomidae		*Hypogomphus*		
105	Hemiptera	Pentatomidae				K
117	Hemiptera	Pentatomidae				
153	Hemiptera	Pentatomidae				
176	Hemiptera	Pentatomidae				
240	Hemiptera	Pentatomidae				K
251	Hemiptera	Pentatomidae				
475	Hemiptera	Pentatomidae				K
513	Hemiptera	Pentatomidae				K
670	Hemiptera	Pentatomidae				
680	Hemiptera	Pentatomidae				
669	Hemiptera	Pentotomidae				
270	Hemiptera	Reduviidae				
863	Hemiptera	Reduviidae				
886	Hemiptera	Reduviidae				
1024	Hemiptera	Reduviidae				
1122	Hemiptera	Reduviidae				
2049	Hemiptera	Reduviidae				
2089	Hemiptera	Reduviidae				
150	Hemiptera	Reduviidae				K
163	Hemiptera	Reduviidae				
196	Hemiptera	Reduviidae				
284	Hemiptera	Reduviidae				K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
311	Hemiptera	Reduviidae				K
512	Hemiptera	Reduviidae				K
714	Hemiptera	Reduviidae				
433	Hemiptera	Reduviidae	Emesinae			
1102	Hemiptera	Reduviidae	Emesinae			
2016	Hemiptera	Reduviidae	Emesinae			
2065	Hemiptera	Reduviidae	Emesinae			
2079	Hemiptera	Reduviidae	Emesinae			
489	Hemiptera	Reduviidae	Emesinae			K
1954	Hemiptera	Reduviidae ?				
504	Hymenoptera					
2018	Hymenoptera	Anthophoridae				K
186	Hymenoptera	Anthophoridae				K
203	Hymenoptera	Anthophoridae				K
52	Hymenoptera	Apidae		*Apis*	*melifera*	K
499	Hymenoptera	Apidae		*Apis*	*melifera*	K
1258	Hymenoptera	Braconidae				
1467	Hymenoptera	Braconidae				
1525	Hymenoptera	Braconidae				
1528	Hymenoptera	Braconidae				
2057	Hymenoptera	Braconidae				
184	Hymenoptera	Braconidae				
493	Hymenoptera	Braconidae				K
1552	Hymenoptera	Chrysididae				K
1977	Hymenoptera	Colletidae				K
2028	Hymenoptera	Colletidae				K
2056	Hymenoptera	Colletidae				K
2095	Hymenoptera	Colletidae				K
696	Hymenoptera	Colletidae				K
704	Hymenoptera	Colletidae				K
730	Hymenoptera	Colletidae	Hylaeinae			K
2001	Hymenoptera	Colletidae ?				K
1553	Hymenoptera	Evaniidae				K
2069	Hymenoptera	Evaniidae				
2103	Hymenoptera	Evaniidae				
243	Hymenoptera	Evaniidae				K
500	Hymenoptera	Evaniidae				K
888	Hymenoptera	Formicidae				
889	Hymenoptera	Formicidae				
952	Hymenoptera	Formicidae				
1006	Hymenoptera	Formicidae				
1011	Hymenoptera	Formicidae				
1479	Hymenoptera	Formicidae				
1495	Hymenoptera	Formicidae				
1496	Hymenoptera	Formicidae				
1497	Hymenoptera	Formicidae				
1507	Hymenoptera	Formicidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1537	Hymenoptera	Formicidae				
423	Hymenoptera	Formicidae		*Camponotus*		K
1585	Hymenoptera	Formicidae		*Camponotus*		
1594	Hymenoptera	Formicidae		*Camponotus*		
1602	Hymenoptera	Formicidae		*Camponotus*		
1661	Hymenoptera	Formicidae		*Camponotus*		
1575	Hymenoptera	Formicidae		*Rhytidoponera*		
510	Hymenoptera	Formicidae				
275	Hymenoptera	Formicidae		*Camponotus*		
1569	Hymenoptera	Formicidae	Cerapachinae			
535	Hymenoptera	Formicidae	Dolichoderinae	*Iridomyrmex*		
1912	Hymenoptera	Formicidae	Formicinae			
1969	Hymenoptera	Formicidae	Formicinae	*Polyrachis ?*		
222	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
252	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
279	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
281	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
343	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
486	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
487	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
552	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
712	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
945	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
974	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
998	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1457	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1473	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1534	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1535	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1577	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1668	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1879	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1880	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1886	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
1918	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
2011	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
2046	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
408	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
409	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
664	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*		GA
477	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*	*callima*	GA
2104	Hymenoptera	Formicidae	Ponerinae			
737	Hymenoptera	Formicidae	Ponerinae	*Pachycondyla*		K
542	Hymenoptera	Formicidae	Ponerinae	*Prionopella*		
543	Hymenoptera	Formicidae	Ponerinae	*Rhytidoponera*		
2002	Hymenoptera	Gasteruptiidae				
697	Hymenoptera	Gasteruptiidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1037	Hymenoptera	Ichneumonidae				GA
1038	Hymenoptera	Ichneumonidae				GA
1055	Hymenoptera	Ichneumonidae				GA
1077	Hymenoptera	Ichneumonidae				GA
1079	Hymenoptera	Ichneumonidae				GA
1089	Hymenoptera	Ichneumonidae				GA
1105	Hymenoptera	Ichneumonidae				GA
1146	Hymenoptera	Ichneumonidae				GA
1153	Hymenoptera	Ichneumonidae				GA
1164	Hymenoptera	Ichneumonidae				GA
1436	Hymenoptera	Ichneumonidae				GA
1771	Hymenoptera	Ichneumonidae				GA
1947	Hymenoptera	Ichneumonidae				GA
1953	Hymenoptera	Ichneumonidae				GA
1970	Hymenoptera	Ichneumonidae				GA
2004	Hymenoptera	Ichneumonidae				GA
2099	Hymenoptera	Ichneumonidae				GA
515	Hymenoptera	Ichneumonidae				GA
698	Hymenoptera	Ichneumonidae				GA
87	Hymenoptera	Ichneumonidae		*Ophion*		GA
893	Hymenoptera	Megachilidae				K
183	Hymenoptera	Megachilidae				K
2093	Hymenoptera	Mutillidae				
2096	Hymenoptera	Mutillidae				
2100	Hymenoptera	Mutillidae				
2101	Hymenoptera	Mutillidae				
1550	Hymenoptera	Pergidae		*Perga*		GA
1002	Hymenoptera	Pompilidae				GA
1017	Hymenoptera	Pompilidae				GA
1591	Hymenoptera	Pompilidae				GA
1598	Hymenoptera	Pompilidae				GA
1601	Hymenoptera	Pompilidae				GA
1788	Hymenoptera	Pompilidae				GA
2102	Hymenoptera	Pompilidae				GA
2105	Hymenoptera	Pompilidae				GA
584	Hymenoptera	Pompilidae				GA
611	Hymenoptera	Pompilidae				GA
612	Hymenoptera	Pompilidae				GA
790	Hymenoptera	Pompilidae				GA
813	Hymenoptera	Pompilidae				GA
1859	Hymenoptera	Scoliidae				
1212	Hymenoptera	Sphecidae				K
1344	Hymenoptera	Sphecidae				K
505	Hymenoptera	Sphecidae				K
720	Hymenoptera	Sphecidae				
723	Hymenoptera	Sphecidae				
1071	Hymenoptera	Tiphiidae				GA

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1458	Hymenoptera	Tiphiidae				GA
1479	Hymenoptera	Tiphiidae				GA
1848	Hymenoptera	Tiphiidae				GA
1891	Hymenoptera	Tiphiidae				GA
1892	Hymenoptera	Tiphiidae				GA
1893	Hymenoptera	Tiphiidae				GA
1894	Hymenoptera	Tiphiidae				GA
1971	Hymenoptera	Tiphiidae				GA
1972	Hymenoptera	Tiphiidae				GA
2012	Hymenoptera	Tiphiidae				GA
2024	Hymenoptera	Tiphiidae				GA
2026	Hymenoptera	Tiphiidae				GA
2060	Hymenoptera	Tiphiidae				GA
2062	Hymenoptera	Tiphiidae				GA
2064	Hymenoptera	Tiphiidae				GA
295	Hymenoptera	Tiphiidae				GA
699	Hymenoptera	Tiphiidae				GA
796	Hymenoptera	Tiphiidae				GA
806	Hymenoptera	Tiphiidae				GA
2023	Hymenoptera	Tiphiidae	Thyninnae			GA
2025	Hymenoptera	Tiphiidae	Thyninnae			GA
1325	Hymenoptera	Tiphiidae	Thynninae			GA
1530	Hymenoptera	Tiphiidae	Thynninae			GA
1861	Hymenoptera	Tiphiidae	Thynninae			GA
1982	Hymenoptera	Tiphiidae	Thynninae			GA
481	Hymenoptera	Tiphiidae	Thynninae			GA
494	Hymenoptera	Tiphiidae	Thynninae			GA
516	Hymenoptera	Tiphiidae	Thynninae			GA
685	Hymenoptera	Tiphiidae	Thynninae			GA
801	Hymenoptera	Tiphiidae	Thynninae			GA
894	Hymenoptera	Vespidae				
2029	Hymenoptera	Vespidae		*Polistes*		
544	Isopoda					
1430	Isopoda					
1586	Isopoda					
2053	Isopoda					
519	Isopoda		collective			
262	Isopoda					GR
539	Isopoda					
671	Isopoda					
63	Lepidoptera					
316	Lepidoptera					
366	Lepidoptera					
559	Lepidoptera					
583	Lepidoptera					
797	Lepidoptera					
828	Lepidoptera					

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
829	Lepidoptera					
840	Lepidoptera					
849	Lepidoptera					
866	Lepidoptera					
900	Lepidoptera					
917	Lepidoptera					
921	Lepidoptera					
944	Lepidoptera					
950	Lepidoptera					
954	Lepidoptera					
983	Lepidoptera					
984	Lepidoptera					
985	Lepidoptera					
1019	Lepidoptera					
1031	Lepidoptera					
1032	Lepidoptera					
1047	Lepidoptera					
1060	Lepidoptera					
1070	Lepidoptera					
1075	Lepidoptera					
1078	Lepidoptera					
1081	Lepidoptera					
1085	Lepidoptera					
1095	Lepidoptera					
1129	Lepidoptera					
1140	Lepidoptera					
1149	Lepidoptera					
1158	Lepidoptera					
1169	Lepidoptera					
1179	Lepidoptera					
1488	Lepidoptera					
1490	Lepidoptera					
1492	Lepidoptera					
1493	Lepidoptera					
1499	Lepidoptera					
1504	Lepidoptera					K
1506	Lepidoptera					
1510	Lepidoptera					
1513	Lepidoptera					
1519	Lepidoptera					
1628	Lepidoptera					
1829	Lepidoptera					
1833	Lepidoptera					
1840	Lepidoptera					
1854	Lepidoptera					
1860	Lepidoptera					
1864	Lepidoptera					

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1865	Lepidoptera					
1870	Lepidoptera					
1874	Lepidoptera					
1875	Lepidoptera					
1895	Lepidoptera					
1896	Lepidoptera					
1900	Lepidoptera					
1907	Lepidoptera					
1910	Lepidoptera					
1913	Lepidoptera					
1924	Lepidoptera					
1937	Lepidoptera					
1942	Lepidoptera					
1952	Lepidoptera					
1963	Lepidoptera					
1966	Lepidoptera					
1967	Lepidoptera					
2022	Lepidoptera					
2109	Lepidoptera					
2110	Lepidoptera					
2113	Lepidoptera					
2126	Lepidoptera					
322	Lepidoptera			“the dart”		
48	Lepidoptera					
60	Lepidoptera					
62	Lepidoptera					K
76	Lepidoptera					
197	Lepidoptera					
238	Lepidoptera					
315	Lepidoptera					
367	Lepidoptera					
376	Lepidoptera					
399	Lepidoptera					
411	Lepidoptera					
420	Lepidoptera					
422	Lepidoptera					
428	Lepidoptera					
430	Lepidoptera					
456	Lepidoptera					
458	Lepidoptera					
459	Lepidoptera					
657	Lepidoptera					K
752	Lepidoptera					
760	Lepidoptera					
768	Lepidoptera					
861	Lepidoptera					
946	Lepidoptera	Aganaidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1627	Lepidoptera	Anthelidae				
381	Lepidoptera	Anthelidae				K
457	Lepidoptera	Anthelidae				K
352	Lepidoptera	Anthelidae		*Anthela*		K
1091	Lepidoptera	Arctiidae		*Nyctemera*	*amica*	K
987	Lepidoptera	Arctiidae		*Utetheisa*	*pulchelloides*	
4	Lepidoptera	Arctiidae				K
6	Lepidoptera	Arctiidae				K
44	Lepidoptera	Arctiidae				K
2112	Lepidoptera	Arctiidae	Arctiinae			K
445	Lepidoptera	Arctiidae	Arctiinae	*Spilosoma*		K
2111	Lepidoptera	Arctiidae	Arctiinae	*Spilosoma*		K
749	Lepidoptera	Bombycidae				
1	Lepidoptera	Carthaeidae		*Carthaea*	*saturnioides*	K
324	Lepidoptera	Depressariidae				K
141	Lepidoptera	Depressariidae		*Thalamarchella*	*alveola*	K
658	Lepidoptera	Gelechiodea				
77	Lepidoptera	Geometridae				
323	Lepidoptera	Geometridae				
358	Lepidoptera	Geometridae				
652	Lepidoptera	Geometridae				
821	Lepidoptera	Geometridae				K
827	Lepidoptera	Geometridae				
836	Lepidoptera	Geometridae				
855	Lepidoptera	Geometridae				
856	Lepidoptera	Geometridae				
861	Lepidoptera	Geometridae				
915	Lepidoptera	Geometridae				
919	Lepidoptera	Geometridae				
923	Lepidoptera	Geometridae				
925	Lepidoptera	Geometridae				
942	Lepidoptera	Geometridae				
952	Lepidoptera	Geometridae				
977	Lepidoptera	Geometridae				
978	Lepidoptera	Geometridae				
986	Lepidoptera	Geometridae				
1003	Lepidoptera	Geometridae				
1028	Lepidoptera	Geometridae				
1034	Lepidoptera	Geometridae				
1036	Lepidoptera	Geometridae				K
1098	Lepidoptera	Geometridae				
1106	Lepidoptera	Geometridae				
1132	Lepidoptera	Geometridae				
1503	Lepidoptera	Geometridae				
1509	Lepidoptera	Geometridae				
1514	Lepidoptera	Geometridae				
1515	Lepidoptera	Geometridae				K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1516	Lepidoptera	Geometridae				
1517	Lepidoptera	Geometridae				K
1828	Lepidoptera	Geometridae				
1831	Lepidoptera	Geometridae				
1835	Lepidoptera	Geometridae				
1857	Lepidoptera	Geometridae				
1876	Lepidoptera	Geometridae				
1908	Lepidoptera	Geometridae				
1955	Lepidoptera	Geometridae				
1957	Lepidoptera	Geometridae				
1964	Lepidoptera	Geometridae				
2123	Lepidoptera	Geometridae				
320	Lepidoptera	Geometridae		*Arhodia*		K
1518	Lepidoptera	Geometridae		*Ciampa*	*arietaria*	
23	Lepidoptera	Geometridae		*Ectropis ?*		
955	Lepidoptera	Geometridae		*Hypobapta*		K
180	Lepidoptera	Geometridae		*Hypobapta*	*barnardi*	
835	Lepidoptera	Geometridae		*Hypobapta*	*barnardi*	
1521	Lepidoptera	Geometridae		*Hypographa ?*		
832	Lepidoptera	Geometridae		*Lissomma*	*serpentaria*	
31	Lepidoptera	Geometridae		*Parepisparis*	*excusata*	K
858	Lepidoptera	Geometridae		*Stibaroma*	*melanotoxa*	
417	Lepidoptera	Geometridae				K
20	Lepidoptera	Geometridae				
24	Lepidoptera	Geometridae				K
41	Lepidoptera	Geometridae				K
47	Lepidoptera	Geometridae				
50	Lepidoptera	Geometridae				K
59	Lepidoptera	Geometridae				K
61	Lepidoptera	Geometridae				
66	Lepidoptera	Geometridae				
67	Lepidoptera	Geometridae				
72	Lepidoptera	Geometridae				K
82	Lepidoptera	Geometridae				
85	Lepidoptera	Geometridae				
86	Lepidoptera	Geometridae				
95	Lepidoptera	Geometridae				
96	Lepidoptera	Geometridae				
97	Lepidoptera	Geometridae				
317	Lepidoptera	Geometridae				
318	Lepidoptera	Geometridae				
321	Lepidoptera	Geometridae				K
326	Lepidoptera	Geometridae				
338	Lepidoptera	Geometridae				
339	Lepidoptera	Geometridae				
345	Lepidoptera	Geometridae				
350	Lepidoptera	Geometridae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
355	Lepidoptera	Geometridae				K
362	Lepidoptera	Geometridae				
369	Lepidoptera	Geometridae				
375	Lepidoptera	Geometridae				K
382	Lepidoptera	Geometridae				
383	Lepidoptera	Geometridae				
387	Lepidoptera	Geometridae				
389	Lepidoptera	Geometridae				K
392	Lepidoptera	Geometridae				K
395	Lepidoptera	Geometridae				
402	Lepidoptera	Geometridae				
403	Lepidoptera	Geometridae				K
407	Lepidoptera	Geometridae				
424	Lepidoptera	Geometridae				K
425	Lepidoptera	Geometridae				K
431	Lepidoptera	Geometridae				
434	Lepidoptera	Geometridae				
436	Lepidoptera	Geometridae				K
438	Lepidoptera	Geometridae				
442	Lepidoptera	Geometridae				
451	Lepidoptera	Geometridae				K
517	Lepidoptera	Geometridae				K
635	Lepidoptera	Geometridae				
638	Lepidoptera	Geometridae				
639	Lepidoptera	Geometridae				
646	Lepidoptera	Geometridae				
655	Lepidoptera	Geometridae				
691	Lepidoptera	Geometridae				
694	Lepidoptera	Geometridae				
754	Lepidoptera	Geometridae				
756	Lepidoptera	Geometridae				
757	Lepidoptera	Geometridae				
758	Lepidoptera	Geometridae				
759	Lepidoptera	Geometridae				
765	Lepidoptera	Geometridae				
776	Lepidoptera	Geometridae				
22	Lepidoptera	Geometridae		*Chlorocoma*		K
19	Lepidoptera	Geometridae		*Chlorocoma*	*dicloraria*	K
330	Lepidoptera	Geometridae		*Crypsiphona*	*ocultaria*	K
357	Lepidoptera	Geometridae		*Eucyclodes*	*buprestaria*	K
663	Lepidoptera	Geometridae		*Heliomystis*		
377	Lepidoptera	Geometridae		*Phallaria*	*ophiusaria*	K
384	Lepidoptera	Geometridae		*Pholodes*		K
393	Lepidoptera	Geometridae		*Prasinocyma ?*		K
83	Lepidoptera	Geometridae	Ennominae			
2116	Lepidoptera	Geometridae	Ennominae	*Plesanemma*		K
450	Lepidoptera	Geometridae	Ennominae	*Thalaina*	*clara*	K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
455	Lepidoptera	Geometridae	Larentiina	*Xanthorhoe*		
1029	Lepidoptera	Geometridae	Larentiinae			
42	Lepidoptera	Geometridae	Larentiinae	*Xanthorhoe*		K
2	Lepidoptera	Geometridae	Oenochrominae	*Arhodia*		K
79	Lepidoptera	Geometridae	Oenochrominae	*Arhodia*		K
976	Lepidoptera	Geometridae	Oenochrominae	*Oenchroma*		K
1045	Lepidoptera	Geometridae	Phalaria ?			K
625	Lepidoptera	Geometridae ?				
830	Lepidoptera	Geometridae ?				
862	Lepidoptera	Geometridae ?				
896	Lepidoptera	Geometridae ?				
918	Lepidoptera	Geometridae ?				
1022	Lepidoptera	Geometridae ?				
1056	Lepidoptera	Geometridae ?				
1099	Lepidoptera	Geometridae ?				
1494	Lepidoptera	Geometridae ?				
1965	Lepidoptera	Geometridae ?				
406	Lepidoptera	Geometridae ?				
421	Lepidoptera	Geometridae ?				
441	Lepidoptera	Geometridae ?				
641	Lepidoptera	Geometridae ?				
652	Lepidoptera	Geometridae ?				
662	Lepidoptera	Geometridae ?				
753	Lepidoptera	Geometridae ?				
772	Lepidoptera	Geometridae ?				
958	Lepidoptera	Hepialidae		*Abantiades*		GA
761	Lepidoptera	Hepialidae		*Abantiades*		GA
372	Lepidoptera	Hepialidae		*Abantiades*	*hydrographis*	GA
373	Lepidoptera	Hepialidae		*Abantiades*	*ocellatus*	GA
1657	Lepidoptera	Lasiocampidae				
1832	Lepidoptera	Lasiocampidae				
91	Lepidoptera	Lasiocampidae		*Entometa*	*fervens*	K
90	Lepidoptera	Lasiocampidae				K
380	Lepidoptera	Lasiocampidae				
693	Lepidoptera	Lasiocampidae				
755	Lepidoptera	Lasiocampidae				K
426	Lepidoptera	Lasiocampidae		*Entometa*		K
895	Lepidoptera	Limacodidae		*Doratifera*		
1625	Lepidoptera	Limacodidae		*Doratifera*		
551	Lepidoptera	Limacodidae		*Doratifera*	*quadriguttata*	
81	Lepidoptera	Limacodidae		*Doratifera*		K
332	Lepidoptera	Limacodidae		*Doratifera*		K
398	Lepidoptera	Limacodidae		*Doratifera*		K
296	Lepidoptera	Lycaenidae				
2067	Lepidoptera	Lycaenidae				
296	Lepidoptera	Lycaenidae		*Neolucia*	*agricola*	K
34	Lepidoptera	Lymantriidae		*Teia*	*athlophora*	K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
99	Lepidoptera	Noctuidae				
345	Lepidoptera	Noctuidae				K
413	Lepidoptera	Noctuidae				
523	Lepidoptera	Noctuidae				
556	Lepidoptera	Noctuidae				
563	Lepidoptera	Noctuidae				
656	Lepidoptera	Noctuidae				
833	Lepidoptera	Noctuidae				
847	Lepidoptera	Noctuidae				
853	Lepidoptera	Noctuidae				
859	Lepidoptera	Noctuidae				
996	Lepidoptera	Noctuidae				
1020	Lepidoptera	Noctuidae				
1046	Lepidoptera	Noctuidae				
1088	Lepidoptera	Noctuidae				
1139	Lepidoptera	Noctuidae				
1150	Lepidoptera	Noctuidae				
1501	Lepidoptera	Noctuidae				
1502	Lepidoptera	Noctuidae				
1511	Lepidoptera	Noctuidae				
1512	Lepidoptera	Noctuidae				
1858	Lepidoptera	Noctuidae				
1872	Lepidoptera	Noctuidae				
1898	Lepidoptera	Noctuidae				
1899	Lepidoptera	Noctuidae				
1909	Lepidoptera	Noctuidae				
1944	Lepidoptera	Noctuidae				
1956	Lepidoptera	Noctuidae				
2117	Lepidoptera	Noctuidae				
2122	Lepidoptera	Noctuidae				
844	Lepidoptera	Noctuidae		*Agrotis*		
1054	Lepidoptera	Noctuidae		*Ophiusa*		K
336	Lepidoptera	Noctuidae				K
25	Lepidoptera	Noctuidae				
33	Lepidoptera	Noctuidae				
38	Lepidoptera	Noctuidae				
39	Lepidoptera	Noctuidae				K
75	Lepidoptera	Noctuidae				
133	Lepidoptera	Noctuidae				
137	Lepidoptera	Noctuidae				
138	Lepidoptera	Noctuidae				
139	Lepidoptera	Noctuidae				
140	Lepidoptera	Noctuidae				
344	Lepidoptera	Noctuidae				K
364	Lepidoptera	Noctuidae				
386	Lepidoptera	Noctuidae				
391	Lepidoptera	Noctuidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
394	Lepidoptera	Noctuidae				
405	Lepidoptera	Noctuidae				
412	Lepidoptera	Noctuidae				
414	Lepidoptera	Noctuidae				
419	Lepidoptera	Noctuidae				
435	Lepidoptera	Noctuidae				K
443	Lepidoptera	Noctuidae				
446	Lepidoptera	Noctuidae				K
449	Lepidoptera	Noctuidae				K
452	Lepidoptera	Noctuidae				K
454	Lepidoptera	Noctuidae				
518	Lepidoptera	Noctuidae				
640	Lepidoptera	Noctuidae				
642	Lepidoptera	Noctuidae				
648	Lepidoptera	Noctuidae				
649	Lepidoptera	Noctuidae				
650	Lepidoptera	Noctuidae				
750	Lepidoptera	Noctuidae				
769	Lepidoptera	Noctuidae				
770	Lepidoptera	Noctuidae				
771	Lepidoptera	Noctuidae				
799	Lepidoptera	Noctuidae				
18	Lepidoptera	Noctuidae		*Agrotis*	*munda*	K
659	Lepidoptera	Noctuidae		*Chrysodeixis*	*argentifera*	
346	Lepidoptera	Noctuidae		*Chrysodeixis*	*eriosoma*	K
30	Lepidoptera	Noctuidae		*Dasypodia*	*selenophora*	
415	Lepidoptera	Noctuidae		*Lyncestis*	*melanoschista*	K
5	Lepidoptera	Noctuidae		*Pantydia*		
329	Lepidoptera	Noctuidae		*Pantydia*		K
388	Lepidoptera	Noctuidae		*Pantydia*		
379	Lepidoptera	Noctuidae		*Peripyra*	*sanguinipucta*	K
185	Lepidoptera	Noctuidae		*Periscepta*	*polystieta*	K
40	Lepidoptera	Noctuidae		*Persectania*	*ewingii*	K
43	Lepidoptera	Noctuidae		*Sandava*	*scitisigna*	K
686	Lepidoptera	Noctuidae		*Uraba*	*lugens*	K
2114	Lepidoptera	Noctuidae	Plusiinae	*Chrysodeixis*		
1927	Lepidoptera	Noctuidae	unknown battered noctuid			
1928	Lepidoptera	Noctuidae	unknown battered noctuid			
1929	Lepidoptera	Noctuidae	unknown battered noctuid			
1930	Lepidoptera	Noctuidae	unknown battered noctuid			
1094	Lepidoptera	Noctuidae ?				
766	Lepidoptera	Noctuidae ?				
4	Lepidoptera	Notodontidae		*Destolmia*		K
1839	Lepidoptera	Notodontidae		*Destolmia*		

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
80	Lepidoptera	Notodontidae				K
374	Lepidoptera	Notodontidae				K
57	Lepidoptera	Notodontidae		*Danima*	*banksiae*	K
370	Lepidoptera	Notodontidae		*Hylaeora*	*dilucida*	K
58	Lepidoptera	Notodontidae		*Sorama*	*bicolor*	K
298	Lepidoptera	Nymphalidae		*Heteronympha*	*merope dub*	K
1201	Lepidoptera	Nymphalidae		*Vanessa*	*kershawi*	
1202	Lepidoptera	Nymphalidae		*Vanessa*	*kershawi*	
306	Lepidoptera	Nymphalidae		*Geitoneura*	*klugii*	K
594	Lepidoptera	Nymphalidae		*Vanessa*	*kershawi*	K
1903	Lepidoptera	Oecophoridae				
64	Lepidoptera	Oecophoridae				K
65	Lepidoptera	Oecophoridae				
396	Lepidoptera	Oecophoridae				
331	Lepidoptera	Oecophoridae		*Wingia*	*aurata*	K
325	Lepidoptera	Oecophoridae	Oecophorinae	*Zonopetala*	*clerota*	K
1626	Lepidoptera	Oecophoridae ?				
104	Lepidoptera	Oecophoridae ?				
236	Lepidoptera	Oecophoridae ?				
1454	Lepidoptera	Psychidae	Taleporiinae	*Iphierga*		K
333	Lepidoptera	Pyralidae				
337	Lepidoptera	Pyralidae				
948	Lepidoptera	Pyralidae				
953	Lepidoptera	Pyralidae				
982	Lepidoptera	Pyralidae				
1051	Lepidoptera	Pyralidae				
1134	Lepidoptera	Pyralidae				
1135	Lepidoptera	Pyralidae				
1489	Lepidoptera	Pyralidae				
1491	Lepidoptera	Pyralidae				
1837	Lepidoptera	Pyralidae				
1864	Lepidoptera	Pyralidae				
2115	Lepidoptera	Pyralidae				
979	Lepidoptera	Pyralidae		*Hednota*	*hoplitella*	K
922	Lepidoptera	Pyralidae		*Hednota*	*recurvella*	
342	Lepidoptera	Pyralidae				
356	Lepidoptera	Pyralidae				
365	Lepidoptera	Pyralidae				
397	Lepidoptera	Pyralidae				
401	Lepidoptera	Pyralidae				
631	Lepidoptera	Pyralidae				K
84	Lepidoptera	Pyralidae		*Uresiphita*	*ornithopteralis*	K
432	Lepidoptera	Pyralidae		*Uresiphita*	*ornithopteralis*	K
460	Lepidoptera	Pyralidae	Epipaschiinae			
1126	Lepidoptera	Pyralidae	Epipaschiinae			
73	Lepidoptera	Pyralidae	Epipaschiinae ?			
460	Lepidoptera	Pyralidae	Epipaschinae			

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
837	Lepidoptera	Pyralidae ?				
928	Lepidoptera	Pyralidae ?				
947	Lepidoptera	Pyralidae ?				
957	Lepidoptera	Pyralidae ?				
1170	Lepidoptera	Pyralidae ?				
1633	Lepidoptera	Pyralidae ?				
1834	Lepidoptera	Pyralidae ?				
12	Lepidoptera	Pyralidae ?				K
661	Lepidoptera	Pyralidae ?				
328	Lepidoptera	Saturniidae		*Opodiphthera*	*helena*	K
32	Lepidoptera	Thaumetopoeidae				K
71	Lepidoptera	Thaumetopoeidae				K
1068	Lepidoptera	Thaumetopoeidae				
10	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
36	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
819	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
692	Lepidoptera	Thaumetopoeidae				K
3	Lepidoptera	Thaumetopoeidae		*Epicoma*	*melanostica*	K
7	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
8	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
9	Lepidoptera	Thaumetopoeidae		*Ochrogaster*		K
404	Lepidoptera	Thaumetopoeidae		*Oenosandra*	*boisduvalii*	K
864	Lepidoptera	Thaumetopoeidae ?				
1084	Lepidoptera	Thaumetopoeidae ?				
319	Lepidoptera	Tineidae		*Moerarchis*	*clathrella*	K
111	Lepidoptera	Tineidae ?				
943	Lepidoptera	Tortricidae				
92	Lepidoptera	Tortricidae				
1172	Lepidoptera	UNIDENTIFIABLE		“unidentifiable”		
78	Lepidoptera	Zygaenidae		*Pollanisus*		K
45	Lepidoptera	Zygaenidae		*Pollanisus*	*cupreus*	K
132	Mantodea	Amorphoscelidae	Paraoxypilinae			
739	Mantodea	Amorphoscelidae	Paraoxypilus	*Paroxypilus*	*tasmaniensis ?*	K
1459	Mantodea	Mantidae				
1541	Mantodea	Mantidae				
1959	Mantodea	Mantidae				
2107	Mantodea	Mantidae				
309	Mantodea	Mantidae				
674	Mantodea	Mantidae				
718	Mantodea	Mantidae				
767	Mantodea	Mantidae				
784	Mantodea	Mantidae				
789	Mantodea	Mantidae				
981	Mantodea	Mantidae	Mantinae			
1001	Mantodea	Mantidae	Mantinae			
1453	Mecoptera	Bittacidae				GA
1456	Mecoptera	Bittacidae				GA

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
1463	Mecoptera	Bittacidae				GA
908	Mecoptera	Bittacidae		*Harpobittacus*		GA
250	Mecoptera	Bittacidae		*Harpobittacus*		GA
89	Mecoptera	Meropeidae		*Austromerope*	*poultoni*	GR
1901	Megaloptera	Corydalidae	Chauliodinae	*Archichauliodes*		GR
1532	Mygalomorphae	Barychelidae				GR
497	Mygalomorphae	Barychelidae ?				GR
887	Mygalomorphae	Nemesiidae				GR
1367	Mygalomorphae	Nemesiidae				GR
1560	Mygalomorphae	Nemesiidae				GR
1792	Mygalomorphae	Nemesiidae				GR
1887	Mygalomorphae	Nemesiidae				GR
2042	Mygalomorphae	Nemesiidae				GR
567	Mygalomorphae	Nemesiidae		*Chenistonia*		GR
581	Mygalomorphae	Nemesiidae		*Chenistonia*		GR
590	Mygalomorphae	Nemesiidae				GR
538	Mygalomorphae	Nemesiidae				GR
585	Mygalomorphae	Nemesiidae				GR
283	Mygalomorphae	Nemesiidae				GR
502	Mygalomorphae	Nemesiidae				GR
721	Mygalomorphae	Nemesiidae		*Chenistonia*		GR
949	Neuroptera	Chrysopidae				GA
1057	Neuroptera	Chrysopidae				GA
2047	Neuroptera	Chrysopidae				GA
2054	Neuroptera	Chrysopidae				GA
822	Neuroptera	Chrysopidae		*Chrysopa*		GA
361	Neuroptera	Chrysopidae		*Chrysopa*		GA
131	Neuroptera	Hemerobiidae				GA
360	Neuroptera	Hemerobiidae				GA
1921	Neuroptera	Mantispidae				GA
2010	Neuroptera	Mantispidae				GA
687	Neuroptera	Mantispidae				GA
1906	Neuroptera	Myrmeleontidae				GA
1946	Neuroptera	Myrmeleontidae				GA
305	Neuroptera	Myrmeleontidae				GA
400	Neuroptera	Myrmeleontidae				GA
1920	Neuroptera	Osmylidae				GA
1938	Neuroptera	Osmylidae				GA
1005	Odonata	Zygoptera				GR
1758	Odonata	Zygoptera				GR
1996	Odonata	Zygoptera				GR
1004	Odonata	Zygoptera	Lestoidea			GR
237	Odonata	Zygoptera	Lestoidea			GR
1475	Oligochaeta	Megascolecidae				
1482	Oligochaeta	Megascolecidae				
1484	Oligochaeta	Megascolecidae				
1556	Oligochaeta	Megascolecidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
2072	Oligochaeta	Megascolecidae				
2077	Oligochaeta	Megascolecidae				
2082	Oligochaeta	Megascolecidae				
520	Oligochaeta	Megascolecidae	collective			
937	Onychophora					GR
1481	Onychophora					GR
1447	Opiliones					GR
1210	Orthoptera	Acrididae				
1372	Orthoptera	Acrididae				
1452	Orthoptera	Acrididae				
1465	Orthoptera	Acrididae				
1498	Orthoptera	Acrididae				
1533	Orthoptera	Acrididae				
1545	Orthoptera	Acrididae				
1599	Orthoptera	Acrididae				
1666	Orthoptera	Acrididae				
1677	Orthoptera	Acrididae				
1976	Orthoptera	Acrididae				
2009	Orthoptera	Acrididae				
2031	Orthoptera	Acrididae				
2032	Orthoptera	Acrididae				
2045	Orthoptera	Acrididae				
2061	Orthoptera	Acrididae				
2086	Orthoptera	Acrididae				
2131	Orthoptera	Acrididae				
2133	Orthoptera	Acrididae				
174	Orthoptera	Acrididae				K
294	Orthoptera	Acrididae				
501	Orthoptera	Acrididae				K
293	Orthoptera	Acrididae		*Phaulacridium*		K
681	Orthoptera	Acrididae	Acridinae			
703	Orthoptera	Acrididae	Acridinae			
868	Orthoptera	Acrididae	Catantopinae	*Adreppus*		
1323	Orthoptera	Acrididae	Catantopinae	*Adreppus*		
576	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
690	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
722	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
726	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
890	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
892	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
1572	Orthoptera	Acrididae	Catantopinae	*Cedarinia*		
231	Orthoptera	Acrididae	Catantopinae	*Coryphistes*		K
1010	Orthoptera	Acrididae	Catantopinae	*Ecphantus*		
713	Orthoptera	Acrididae	Catantopinae	*Ecphantus*	sp. *nova*	K
232	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
233	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
255	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
871	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
872	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
1441	Orthoptera	Acrididae	Catantopinae	*Goniaea*		
1470	Orthoptera	Acrididae	Catantopinae	*Goniaea*		
1547	Orthoptera	Acrididae	Catantopinae	*Goniaea*		
1984	Orthoptera	Acrididae	Catantopinae	*Goniaea*		
2019	Orthoptera	Acrididae	Catantopinae	*Goniaea*		
235	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
272	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
274	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
304	Orthoptera	Acrididae	Catantopinae	*Goniaea*		K
273	Orthoptera	Acrididae	Catantopinae	*Goniaea ?*		K
1345	Orthoptera	Eumastacidae				
1469	Orthoptera	Eumastacidae				
738	Orthoptera	Eumastacidae				
816	Orthoptera	Eumastacidae				
1935	Orthoptera	Gryllacrididae ?	super f Gryllacridoidea			
834	Orthoptera	Gryllidae				
857	Orthoptera	Gryllidae				
994	Orthoptera	Gryllidae				
1349	Orthoptera	Gryllidae				
1508	Orthoptera	Gryllidae				
1916	Orthoptera	Gryllidae				
1981	Orthoptera	Gryllidae				
180	Orthoptera	Gryllidae				K
216	Orthoptera	Gryllidae				
608	Orthoptera	Gryllidae				
609	Orthoptera	Gryllidae				
618	Orthoptera	Gryllidae				
809	Orthoptera	Gryllidae				
811	Orthoptera	Gryllidae		*Apterogryllus*		
1936	Orthoptera	Gryllotalpidae				
2092	Orthoptera	Gryllotalpidae				
883	Orthoptera	Pyrgomorphidae				
782	Orthoptera	Pyrgomorphidae				
524	Orthoptera	Stenopelmatidae				
931	Orthoptera	Stenopelmatidae				
1008	Orthoptera	Stenopelmatidae				K
1557	Orthoptera	Stenopelmatidae				
1582	Orthoptera	Stenopelmatidae				
526	Orthoptera	Stenopelmatidae	Henicinae	*Onosandrus*		K
2097	Orthoptera	Stenopelmatidae ?				
2129	Orthoptera	Tetigoniidae				
106	Orthoptera	Tettigoniidae				K
578	Orthoptera	Tettigoniidae				
582	Orthoptera	Tettigoniidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
873	Orthoptera	Tettigoniidae				
881	Orthoptera	Tettigoniidae				
882	Orthoptera	Tettigoniidae				
902	Orthoptera	Tettigoniidae				
903	Orthoptera	Tettigoniidae				K
980	Orthoptera	Tettigoniidae				
988	Orthoptera	Tettigoniidae				
1013	Orthoptera	Tettigoniidae				
1026	Orthoptera	Tettigoniidae				
1043	Orthoptera	Tettigoniidae				
1224	Orthoptera	Tettigoniidae				
1420	Orthoptera	Tettigoniidae				
1426	Orthoptera	Tettigoniidae				
1485	Orthoptera	Tettigoniidae				
1487	Orthoptera	Tettigoniidae				
1539	Orthoptera	Tettigoniidae				
1675	Orthoptera	Tettigoniidae				
1931	Orthoptera	Tettigoniidae				
2041	Orthoptera	Tettigoniidae				
2130	Orthoptera	Tettigoniidae				
118	Orthoptera	Tettigoniidae				
149	Orthoptera	Tettigoniidae				K
167	Orthoptera	Tettigoniidae				
201	Orthoptera	Tettigoniidae				
218	Orthoptera	Tettigoniidae				K
246	Orthoptera	Tettigoniidae				K
268	Orthoptera	Tettigoniidae				
276	Orthoptera	Tettigoniidae				
278	Orthoptera	Tettigoniidae				
310	Orthoptera	Tettigoniidae				
314	Orthoptera	Tettigoniidae				
688	Orthoptera	Tettigoniidae				
705	Orthoptera	Tettigoniidae				
715	Orthoptera	Tettigoniidae				
791	Orthoptera	Tettigoniidae				
485	Orthoptera	Tettigoniidae	Phaneropterinae	*Caedicia*		K
1997	Orthoptera	Tettigoniidae	Phasmatidinae			
1039	Orthoptera	Tettigoniidae	Phasmodinae			K
1052	Orthoptera	Tettigoniidae	Phasmodinae			K
1080	Orthoptera	Tettigoniidae	Phasmodinae			
729	Orthoptera	Tettigoniidae ?				
973	Phasmatodea	Phasmatidae				
1520	Phasmatodea	Phasmatidae				
1968	Phasmatodea	Phasmatidae				
2005	Phasmatodea	Phasmatidae				
2043	Phasmatodea	Phasmatidae				
303	Phasmatodea	Phasmatidae				

Spec No.	Order	Family	Tax 3	Genus	Species	GR/K
458	Phasmatodea	Phasmatidae				
785	Phasmatodea	Phasmatidae				
1385	Platyhelminthes	Tricladida				
1404	Platyhelminthes	Tricladida				
1568	Platyhelminthes	Tricladida				
521	Platyhelminthes	Tricladida				
879	Scorpionida					
880	Scorpionida					
965	Scorpionida					
1451	Scorpionida					
1592	Scorpionida					
1600	Scorpionida					
469	Scorpionida					K
568	Scorpionida					K
1042	Trichoptera					GA
1849	Trichoptera					GA
1852	Trichoptera					GA
69	Trichoptera					GA
144	Trichoptera					GA
145	Trichoptera					GA
146	Trichoptera					GA
151	Trichoptera					GA

BIRDS

Graeme Liddelow and Chris Vellios

Introduction

The object of recording birds in FORESTCHECK is to monitor the impacts of logging and associated burning on bird species composition and abundance. This is achieved by:

- Recording species richness and abundance within each treatment (external control, shelterwood, selective cut and gap release).
- Comparing species richness and abundance between each treatment.
- Analyzing trends within species between treatments.

Monitoring

All Blackwood Plateau grids were monitored for diurnal birds in the spring of 2005 by Science Division personnel without the need to engage outside assistance. The census technique is outlined in the FORESTCHECK Operating Plan, and birds are identified primarily by sight and sound.

Preliminary Results and Discussion

Diurnal birds

A total of 491 individuals from 28 species of birds were recorded on grids, with 11 species having 10 or more individuals (Table 1). There were 18 species and 111 individuals in the controls, 18 species and 91 individuals in the shelterwood, 18 species and 142 individuals in the gap release and 19 species and 147 individuals in the selective cut treatment.

When numbers of birds per hectare were compared the external controls had 7.4, the shelterwood 9.8, the gap release 9.5 and the selective cut treatment 9.8. The overall density was 8.9 birds per hectare.

The 2001-02 Manjimup FORESTCHECK location had 5.3 birds per hectare; 2002-03 Collie location 15.4 birds per hectare, 2003-04 Perth Hills location 9.7 birds per hectare and the 2004-05 Wellington East location 9.7 birds per hectare. The 8.9 birds per hectare recorded this year at the Blackwood Plateau was similar to the ongoing Kingston Study in an “average” year with 10.4 birds per hectare. The density of birds at Kingston in 2005, 9 years following regeneration, was 13.4 birds per hectare.

Table 1. All bird species and number of individuals recorded on each Blackwood Plateau FORESTCHECK grid.

RAOU	Common Name	Scientific Name	Total	External Control			Shelterwood		Gap Release			Selective		
				FC38 Barrabup	FC39 St John	FC40 Layman	FC41 Barrabup	FC42 Cambray	FC46 Barrabup	FC47 Cambray	FC48 Bulter	FC43 Barrabup	FC44 Cambray	FC45 Butler
264	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	2					2						
266	Baudin's Cockatoo	*Calyptorhynchus baudinii*	2										2	
289	Western Rosella	*Platycercus icterotis*	6		2		2			1			1	
290	Red-capped Parrot	*Platycercus spuruius*	9			6				1	2			
294	Twenty-eight Parrot	*Platycecrus zonarius semitorquatus*	8	4		2	2							
322	Laughing Kookaburra	*Dacelo novaeguineae*	2					2						
342	Horsefield's Bronze-cuckoo	*Chrysococcyx basalis*	1											1
344	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	3						1		1			1
361	Grey Fantail	*Rhipidura fuliginosa*	2				1			1				
380	Scarlet Robin	*Petroica multicolor*	19	1	3		4	4	1	1		4		1
394	Western Yellow Robin	*Eopsaltria griseogularis*	3	1					2					
398	Golden Whistler	*Pachycephala pectoralis*	41	2	4	2	1	3	3	5	4	8	9	
408	Grey Shrike-thrush	*Colluricincla harmonica*	10	1	1	3		1		2		1		1
424	Black-faced Cuckoo-shrike	*Corcacina novaehollandiae*	5			1		2	1				1	
463	Western Gerygone	*Gerygone fusca*	36	3	3	3	5	3	5	2	2	3	4	3
472	Western Thornbill	*Acanthiza inornata*	10		3		2					5		
476	Broad-tailed (Inland) Thornbill	*Acanthiza apicalis*	118		10	12	15	8	11	16	14	17	15	
488	White-browed Scrubwren	*Sericornis frontalis*	16		5	1	1		1	2	1	3	2	
532	Splendid Fairy-wren	*Malurus splendens*	4										4	
538	Red-winged Fairy-wren	*Malurus elegans*	11		2			3		2			4	
549	Varied Sitella	*Daphoenositta chrysoptera*	5			1			4					
556	Rufous Treecreeper	*Climacteris rufa*	4			2		1					1	
565	Spotted Pardalote	*Pardalotus puntatus*	59	3	5		6	3	7	4	5	13	9	4
574	Silvereye	*Zosterops lateralis*	6						3			3		
578	Western White-naped Honeyeater	*Melithreptus chloropsis*	2									2		
592	Western Spinebill	*Acanthorhynchus superciliosus*	44		5	5	3		9	5	4	1	1	11
697	Grey Currawong	*Sterpera versicolor*	1					1						
976	Striated Pardalote	*Pardolotus striatus*	62	6	3	6	8	8	8	4	8	3	3	5
		Total Species	**28**			**18**		**18**			**18**			**19**
		Total Individuals	**491**	**21**	**46**	**44**	**50**	**41**	**56**	**46**	**41**	**63**	**56**	**27**

Six species of birds were recorded as occurring in only one treatment (external control, shelterwood, gap release or selective cut, see Table 1). However, none of these would be expected to be restricted to that treatment. Of the six species, two had only one individual, the Horsefield's bronze-cuckoo (*Chrysococcyx basalis*) and the grey currawong (*Sterpera versicolor*), three species had two individuals, the forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*), Baudin's cockatoo (*C. baudinii*) and the laughing kookaburra (*Dacelo novaeguineae*), and the splendid fairy-wren (*Malurus splendens*) had four individuals (Fig 1).

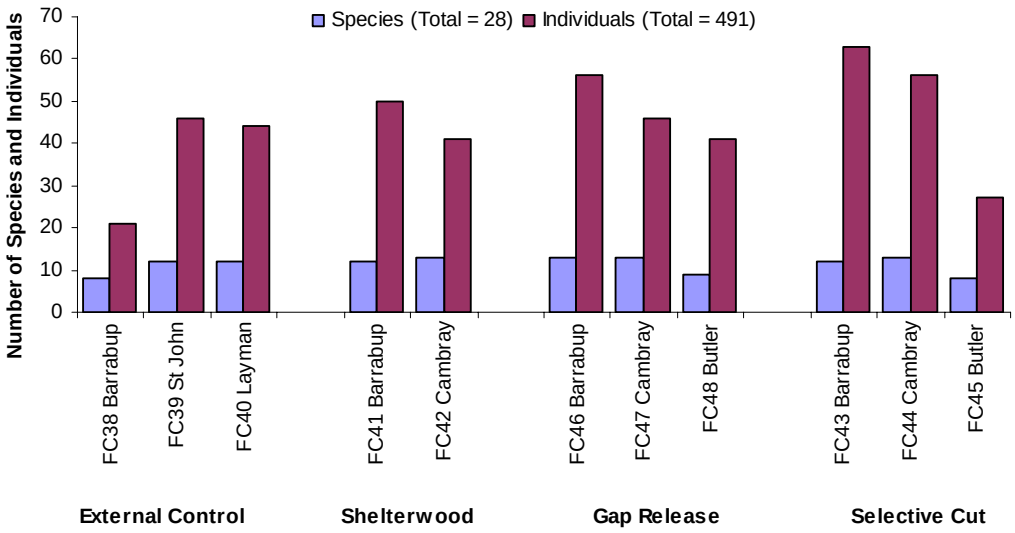


Figure 1. The number of species and individuals recorded on each Blackwood Plateau FORESTCHECK grid.

The most recorded species was the broad-tailed (inland) thornbill (*Acanthiza apicalis*) with 118 individuals. Even though this species prefers the vegetation structure that forms in the early stages of regenerated forest it was observed in all treatments, being most common in wth the gap release treatment (41 records). striated pardalote's (*Pardalotus striatus*) and spotted pardalote's (*P. puntatus*) were the next most commonl with 62 and 59 individuals respectively. Both species were more common in the logged areas than the external controls.

Unlike the 2004-05 Wellington results where only one small scrub bird was recorded, on the Blackwood Plateau 31 individuals comprising of 16 white-browed scrubwrens (*Sericornis frontalis*), 11 red-winged fairy-wrens (*Malurus elegans*) and 4 splendid fairy-wrens (*M. splendens*) were recorded. This may be related to a higher scrub density and scrub height on the Blackwood Plateau grids, compared to the lower (20 cm) scrub height at Wellington.

Western spinebill (*Acanthorhynchus superciliosus*) was also recorded more frequently than at previous FORESTCHECK locations, possibly due to the sandy soils present on the Blackwood Plateau grids with an abundance of flowering plants preferred by western spinebills.

Other species of interest include the scarlet robin (*Petroica multicolor*) which was more frequent in the shelterwood, the golden whistler (*Pachycephala pectoralis*) mostly recorded in the gap release and the selective cut sites and the western gerygone (*Gerygone fusca*) which was recorded equally across all of the treatments.

The Kingston jarrah forest bird study monitors annual changes in bird species and numbers that occur following logging and regeneration. 2006 was the 10th consecutive year of monitoring (logged and burnt in 1996) and as FORESTCHECK locations will be monitored on a 5-6 year rotation it is important that the Kingston study continues on an annual basis, at least until crown separation occurs, in order to document changes within the bird population, especially those species utilizing or inhabiting the scrub.

Nocturnal birds

Due to weather, time and availability of personnel, only one survey for nocturnal birds was carried out at the Blackwood Plateau location. Results are shown in Figure 2. Opportunistic records were also collected when possible. The survey by Liddelow *et al*. carried out in 2002 does not suggest any anomalies should be encountered in the area surrounding the Blackwood Plateau grids.

Southern boobook owls (*Ninox novaeseelandiae*) were recorded on 9 of the 11 grids on the one survey, and heard at all sites during other activities. Southern Boobook owls are common in this type of forest.

One masked owl (*Tyto novaehollandiae*) was recorded at the Butler selective cut (FC45) on Cul-De-Sac road during the survey. Following the scheduled survey, another was seen on private property fence posts to the south-east of the Layman external control (FC40) on Jalbarragup Rd near the Blackwood River and another 2km west of Nannup on the Vasse Highway. One was also seen at Barrabup Pool on St. John Brook.

Australian owlet-nightjars (*Aegotheles cristatus*) were recorded on three of the grids surveyed and were commonly seen on the roads between grids when traveling at night before the spotlight surveys commenced. Australian owlet-nightjars also appear to be common in this habitat.

Tawny frogmouths (*Podargus strigoides*) were seen at six of the grids surveyed and were commonly seen at all grids during other night activities. Tawny frogmouths are also common in this habitat.

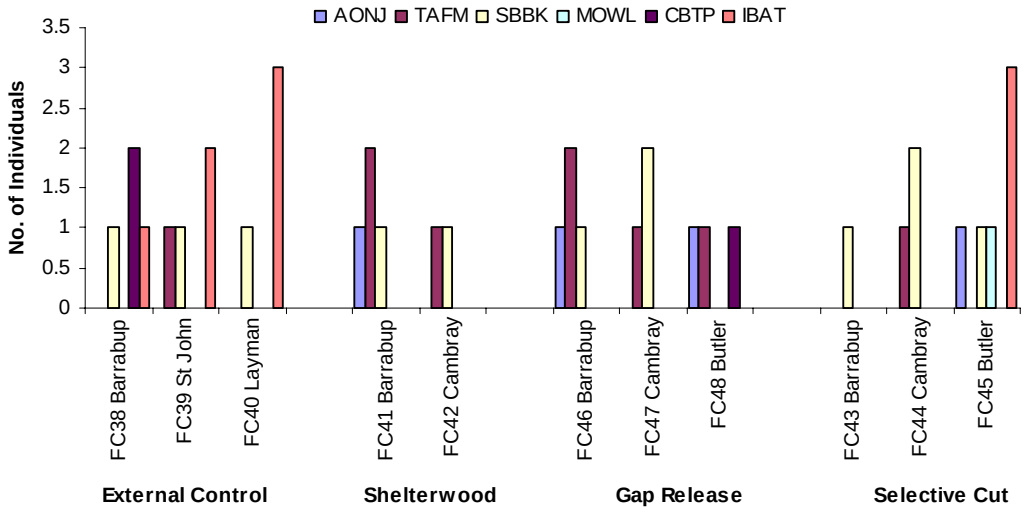


Figure 2. Results of the night survey for nocturnal birds on the Blackwood Plateau.

Conclusions

The main observations made following monitoring of birds at Blackwood Plateau and some general trends to emerge were:

- The number of birds per hectare was similar in each treatment, with an overall density of 8.9 birds per hectare.
- High scrub density in the Blackwood Plateau grids resulted in more records of scrub bird species than the northern FORESTCHECK locations in Wellington and Perth Hills Districts.
- All major species of nocturnal birds were recorded throughout the Blackwood Plateau location. However, barking owls (*Ninox connivens*) have not been recorded at any of the FORESTCHECK locations.
- The Kingston bird study continues to be an important study to compare with FORESTCHECK results.

FORESTCHECK MAMMALS AND HERPETOFAUNA

G.L.Liddelow

Introduction

The object of recording mammals and herpetofauna in FORESTCHECK is to monitor the impacts of logging and associated burning on species status and abundance. This is achieved by:

- Trapping and recording the suite of medium and small sized mammals, reptiles and amphibians on each FORESTCHECK grid.
- Recording the presence of small mammals in nest boxes placed within each grid.
- Comparing species richness, abundance, sex ratios and trap percentages within and between treatments and between FORESTCHECK locations.
- Recording the presence of the larger mammals along set transects that cover all treatments of the FORESTCHECK location on a landscape basis
- Record the presence of nocturnal mammals by spotlighting along set transects that cover all the treatments of the FORESTCHECK location

The species and abundance of feral animals is also recorded with the use of sand pads placed at regular intervals along pre-determined tracks and roads within each FORESTCHECK location.

Monitoring

Trapping was carried out on all Blackwood Plateau grids in spring 2005 and autumn 2006. The program went according to plan with no interruption to any activities due to inclement weather.

Voucher Specimens

No specimens have been lodged with the Western Australian Museum at this time, however one snake, the square-nosed snake (*Rhinoplocephalis bicolor*) will be lodged with them. There were no problems with identification of species during these trapping sessions.

Preliminary Results

Trapping

A total of 274 individuals were trapped in 2005-06, with168 in spring and 106 in autumn sessions (Table 1& 2). The spring total was made up of 51 mammals, 110 reptiles and 7 amphibians and the autumn total consisted of 96 mammals, 8 reptiles and 2 amphibians (Table 1 & 2 & Fig. 1). Autumn numbers of reptile captures were considered low and the amphibians were low in both seasons. Brushtail possums accounted for 49% of the mammal captures in spring and 90% of the captures in autumn.

Table l. Number of individual animals captured in spring and autumn on the FORESTCHECK Blackwood Plateau grids.

Species		Barrabup				St John/Cambray				Layman/Butler			
Common Name	**Scientific Name**	**External Control**	**Shelterwood**	**Gap Release**	**Selective Cut**	**External Control**	**Shelterwood**	**Gap Release**	**Selective Cut**	**External Control**	**Gap Release**	**Selective Cut**	**TOTAL**
MAMMALS													
Mardo / Yellow-footed Antichinus	*Antichinus flavipes*		1			1	1	1					4
Woylie / Brush-tailed Bettong	*Bettongia penicillata ogilbyi*										1		1
Western Pygmy Possum ? Mundarrda	*Cercartetus concinnus*							1	2	3	5	5	16
Chuditch / Western Quoll	*Dasyurus geoffroii*		1	1				1					3
Gilberts Dunnart	*Sminthopsis gilbertii*						2						2
Dunnart	*Sminthopsis griseoventor*	1	2		1	1	2	2					9
Common Brushtail possum	*Trichosurus vulpecula vulpecula*	22	17	5	6	27	6	11	18				112
REPTILES													
Western Granite Worm Lizard	*Aprasia pulchella*	5							2				7
Marbled Gecko	*Christinus marmoratus*	1			1								2
Chain-striped South-west Ctenotus	*Ctenotus catenifer*						1						1
Red-legged Ctenotus	*Ctenotus labillardieri*		2				9		2				13
South West Crevice Skink	*Egernia napoleonis*		1	1	7		8	2			1	2	22
Southwerstern Mulch Skink	*Glaphyromorphus gracilipes*					1							1
Perion's (Lowland) Earless Skink	*Hemiergis peroni*	4	2	2		3	1	5	1	1		1	20
Two-toed Earless Skink	*Hemiergis quadrilineata*									1			1
South Western Orange-tailed Slider	*Lerista distinguenda*		1	1	2			4	1		1		10
Common Dwarf Skink	*Menetia greyii*		1	1			1						3
Western Pale Flecked Morethia	*Morethia linocellata*	1	1	2			1	2	1				8
Woodland Morethia	*Morethia obscura*	1	1	1			1		3				7

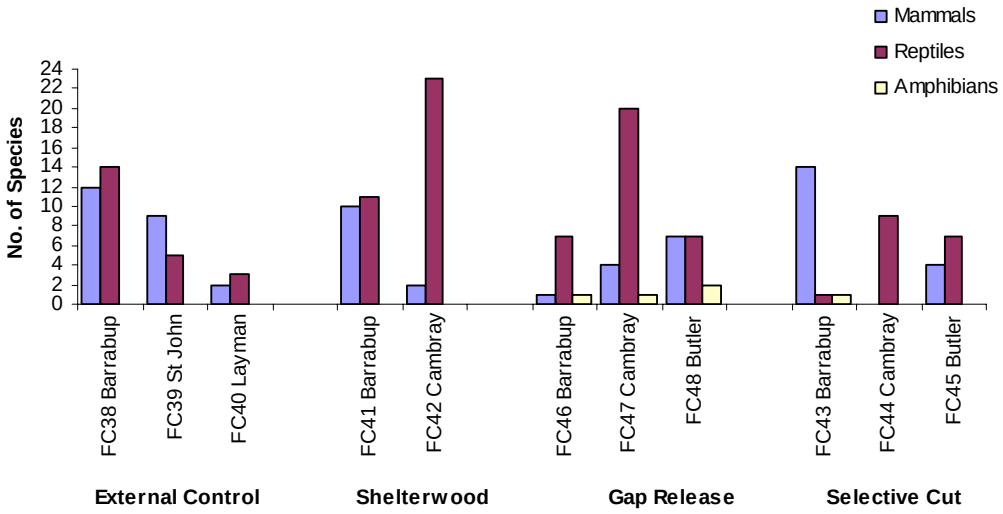
Species		Barrabup				St John/Cambray				Layman/Butler			
Common Name	**Scientific Name**	**External Control**	**Shelterwood**	**Gap Release**	**Selective Cut**	**External Control**	**Shelterwood**	**Gap Release**	**Selective Cut**	**External Control**	**Gap Release**	**Selective Cut**	**TOTAL**
Black-headed Snake / Gould's Snake	*Parasuta gouldi*							1					1
Southern Blind Snake	*Ramphotyphlops australis*		1		1		1	1			3	3	10
Square Nosed Snake / Muller's Snake	*Rhinoplocephalus bicolor*								1		2		3
Bobtail / Shingke Back	*Tiliqua rugosa*	2	1				1			2	1		7
Sand Monitor / Gould's Goanna	*Varanus rosenbergi*		1			1							2
AMPHIBIANS													
South Coast Froglet	*Crinia subinsignifera*									1			1
Moaning Frog	*Heleioporus eyrei*			2	1			1					4
Pobblebonk / Banjo Frog / Bullfrog	*Limnodynastes dorsalis*							2					2
Slender Tree Frog	*Litoria adelaidensis*										2		2
	Total on each grid	37	33	16	19	34	35	34	31	8	16	11	274

Table 2. Number of individuals animals captured in spring and autumn by treatment and trap type.

Species		External Control				Shelterwood				Gap Release				Selective			
		Spring		Autumn		Spring		Autumn		Spring		Autumn		Spring		Autumn	
		Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire
MAMMALS																	
Mardo / Yellow-footed Antichinus	*Antichinus flavipes*				1	1	1			1							
Woylie / Brush-tailed Bettong	*Bettongia penicillata ogilbyi*												1				
Western Pygmy Possum / Mundarrda	*Cercartetus concinnus*	2		1						6				4		3	
Chuditch / Western Quoll	*Dasyurus geoffroii*								1				2				
Gilberts Dunnart	*Sminthopsis gilbertii*					2											
Dunnart	*Sminthopsis griseoventor*	2				4				2				1			
Common Brushtail possum	*Trichosurus vulpecula vulpecula*		18		31		7		16				16				24
REPTILES																	
Western Granite Worm Lizard	*Aprasia pulchella*	5												1		1	
Marbled Gecko	*Christinus marmoratus*	1												1			
Chain-striped South-west Ctenotus	*Ctenotus catenifer*							1									
Red-legged Ctenotus	*Ctenotus labillardieri*					11								2			
South West Crevice Skink	*Egernia napoleonis*					9				4				9			
Southwerstern Mulch Skink	*Glaphyromorphus gracilipes*	1															
Perion's (Lowland) Earless Skink	*Hemiergis peroni*	8				2		1		5		2		2			
Two-toed Earless Skink	*Hemiergis quadrilineata*			1													
South Western Orange-tailed Slider	*Lerista distinguenda*					1				6				3			
Common Dwarf Skink	*Menetia greyii*					2				1							
Western Pale Flecked Morethia	*Morethia linocellata*	1				2				4				1			
Woodland Morethia	*Morethia obscura*	1				2				1				3			
Black-headed Snake / Gould's Snake	*Parasuta gouldii*									1							

Species		External Control				Shelterwood				Gap Release				Selective			
		Spring		Autumn		Spring		Autumn		Spring		Autumn		Spring		Autumn	
		Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire	Pit	Wire
Southern Blind Snake	*Ramphotyphlops australis*					2				4				4			
Square Nosed Snake / Muller's Snake	*Rhinoplocephalus bicolor*											2		1			
Bobtail / Shingke Back	*Tiliqua rugosa*		4				2			1							
Sand Monitor / Gould's Goanna / Bungarra	*Varanus rosenbergi*		1				1										
AMPHIBIANS																	
South Coast Froglet	*Crinia subinsignifera*			1													
Moaning Frog	*Heleioporus eyrei*									2		1		1			
Pobblebonk / Banjo Frog / Bullfrog	*Limnodynastes dorsalis*									2							
Slender Tree Frog	*Litoria adelaidensis*									2							
	TOTAL/274	21	23	3	32	38	11	2	17	42	0	5	19	33	0	4	24

(a) Spring



(b) Autumn

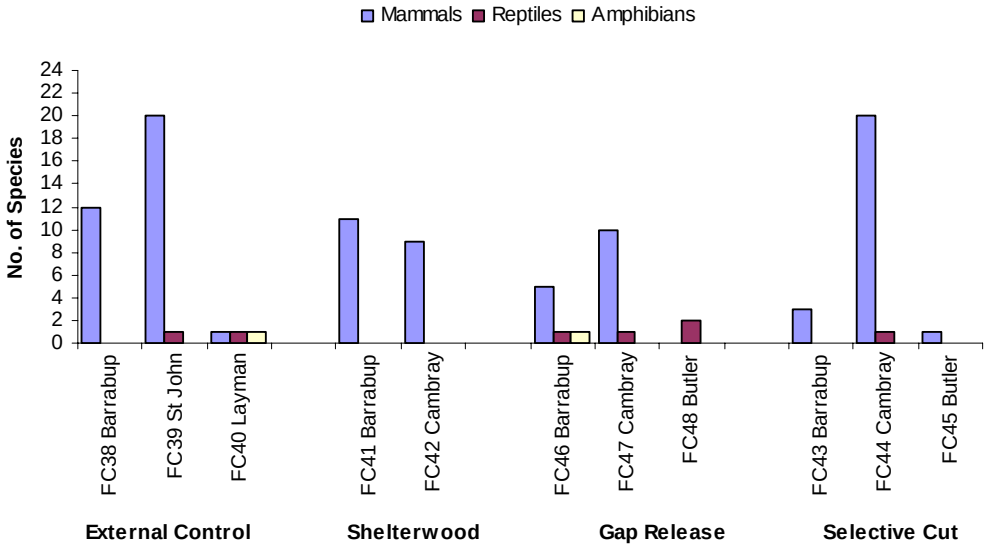


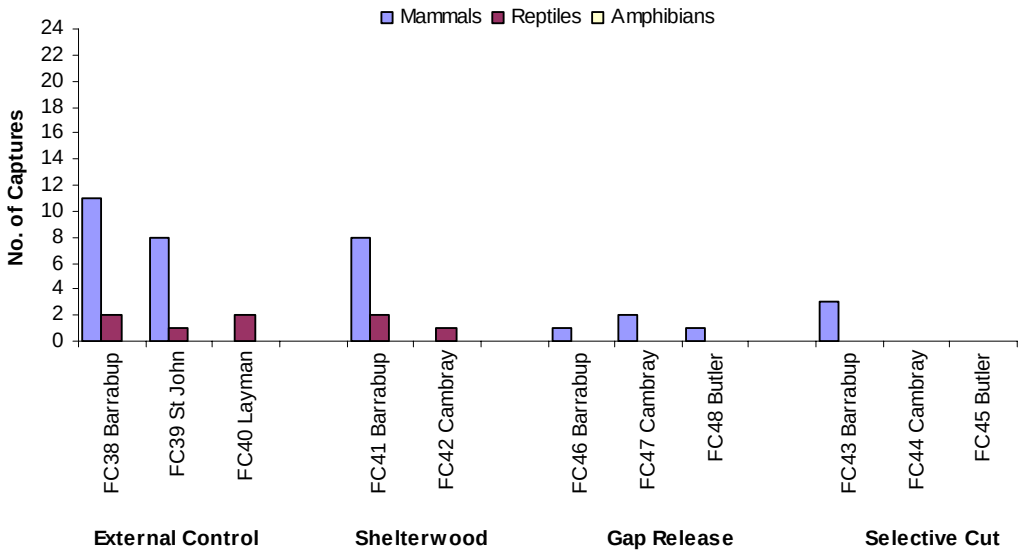
Figure 1. The number of individual animals, reptiles and amphibians recorded in all trap types in spring (a) and autumn (b) in the Blackwood Plateau FORESTCHECK grids.

The highest total numbers of captures occurred in the external control treatment (79), followed by the shelterwood (68), gap release (66) and the selective cut treatments (61).

Wire traps were very successful especially in the Barrabup, St. John and Cambray blocks (Fig. 2) where excellent captures of brushtail possum (*Trichosurus vulpecula vulpecula*) were recorded. The autumn trapping session was more successful than spring for this species (Table 2).

There was one capture of a woylie (*Bettongia penicillata ogilbyi*) at Butler block which is approximately 15 km from where this species was released at St John in the 1980's. The only reptiles captured in wire cages were the bobtail (*Tiliqua rugosa*) and the southern heath monitor (*Varanus rosenbergi*).

(a) Spring – wire traps



(b) Autumn – wire traps

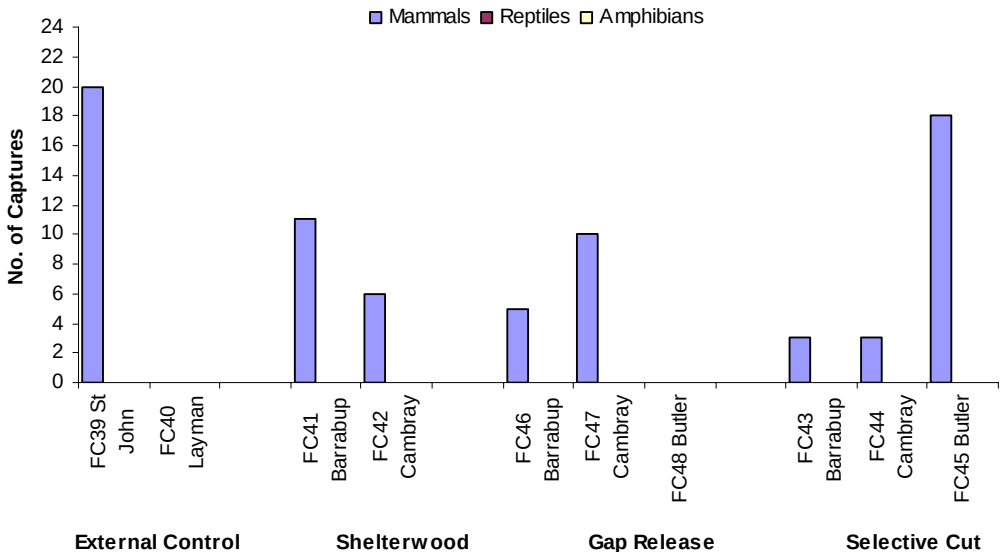
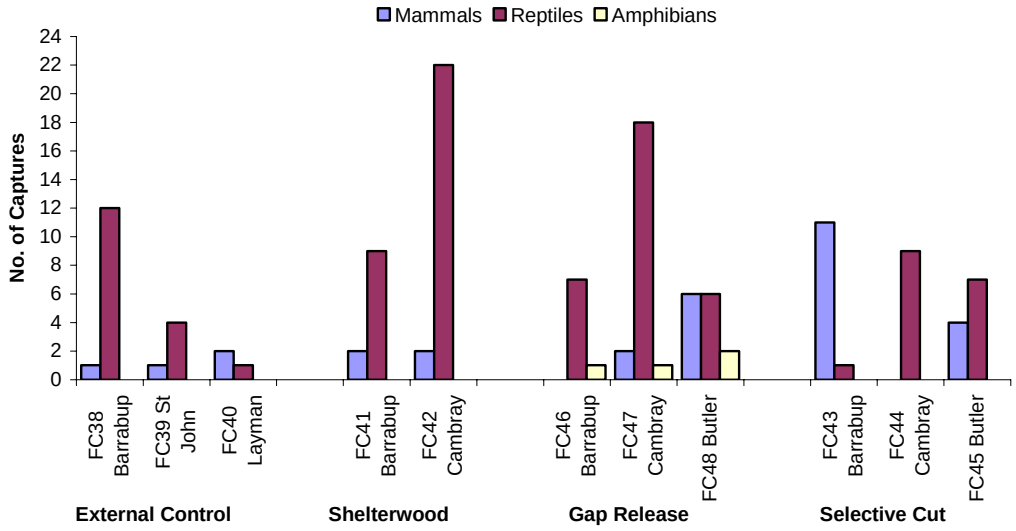


Figure 2. The number of individual mammals, reptiles and amphibians recorded in wire traps in the spring (a) and autumn (b) on the Blackwood Plateau FORESTCHECK grids.

Pit fall trapping was again a successful method of surveying the reptile species of the area (Fig. 3). A total of 134 individuals were trapped in spring and as already stated autumn was not conducive to pit/reptile trapping with a total of 14 captures being recorded (Table 2 & Fig. 3). The highest numbers were recorded on the gap release treatment (46) followed by the shelterwood (40), the selective cut (37) and then the external controls (24) (Table 2 & Fig. 3). Apart from the bobtailed lizard and the southern heath monitor, all of the reptiles and amphibians were caught in pit traps.

(a) Spring – pit traps



(b) Autumn – pit traps

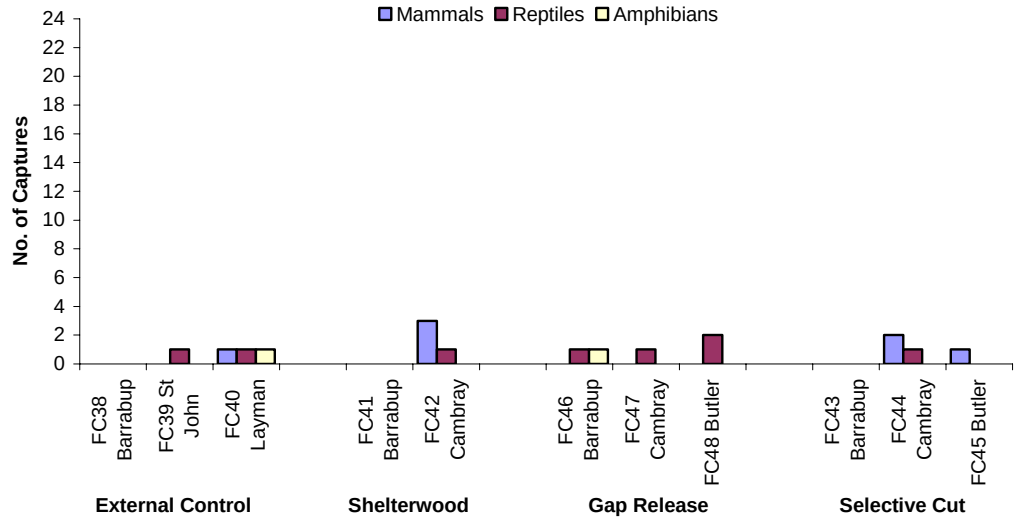


Figure 3. The number of individual mammals, reptiles and amphibians recorded in pit fall traps in the spring (a) and autumn (b) on the Blackwood Plateau FORESTCHECK grids.

There were 16 captures of pygmy possum (*Cercartetus concinnus*) of which 12 were caught in spring. Only 3 were captured in the external control treatment and all of these were in the Layman grid (FC40). Of the remaining 13, 10 were captured in Butler block, 5 in the gap release grid (FC48) and 5 in the selective cut grid (FC45). The other 3 were captured in Cambray block, with 2 in the selective cut (FC44) and 1 in the gap release grid (FC47).

There were 11 dunnarts (*Sminthopsis* spp.) captured in pit fall traps, all in spring, with 2 captured in external controls, 6 in shelterwood, 2 in gap release and 1 in selective cut treatments.

Of the 110 reptiles captured (102 in spring, 8 in autumn), 4 species of skinks and one species of snake accounted for 75 of the individuals, these being *Egernia napoleonis* (22), *Hemiergis peroni* (20), *Ctenotus labillardieri* (13), *Lesita distinquenda* (10) and the southern blind snake, *Ramoptyphlops australis* (10). Only 18 retiles captures came from external control grids, 33 from shelterwood, 31 from gap release and 28 from selective cut grids. (Table 2 & Fig. 3).

Sandpads

As with previous FORESTCHECK locations, sand pads were installed on a landscape scale with the pads installed at 1km intervals over a distance of 50 km. The sand pads were used to monitor the presence of feral predators and were checked for tracks each morning during spring and autumn trapping sessions. After checking each morning the pads were swept clean for the next days recording.

There were 75 animal prints recorded in spring and 105 in autumn (Table 3 & Fig. 4). Mammals accounted for approximately 63% of activity in spring and 84% in autumn and included native animals such as kangaroo, wallaby, possum, quokka and chuditch. Birds were more prevalent in autumn than spring and the varanids made up 28% of the prints recorded in spring with none being recorded in autumn (Table 3 & Fig. 5)

The majority of feral animals were recorded in autumn, when all 12 cat prints were recorded. Foxes were recorded in low numbers, only 2 recorded in each season. Both records in spring were on Keene Rd, and in the autumn one record was on Keene Rd and the other on St. John Rd. There were also 5 dog, 1 pig and 2 rabbit prints seen during the two seasons (Table 3 & Fig. 6).

Table 3. Total numbers of animal prints recorded over 4 days on the Blackwood Plateau sand pads.

Species		Spring	Autumn
Birds		2	15
Brushtail possum	*Trichosurus vulpecula vulpecula*	17	12
Chuditch	*Dasyurus geoffroii*	1	4
Goanna			1
Kangaroo	*Macropus fuliginosus*	24	48
Quokka	*Setonix brachyurus*		3
Small lizards		4	1
Varanid	*Varanus rosenbergi*	21	
Wallaby	*Macropus irma*	3	
Cat	*Felis catus*		12
Dog	*Canus lupis*		5
Fox	*Vulpes vulpes*	2	2
Pig	*Sus scrofa*		1
Rabbit	*Oryctolargus cuniculus*	1	1
	Total	75	105

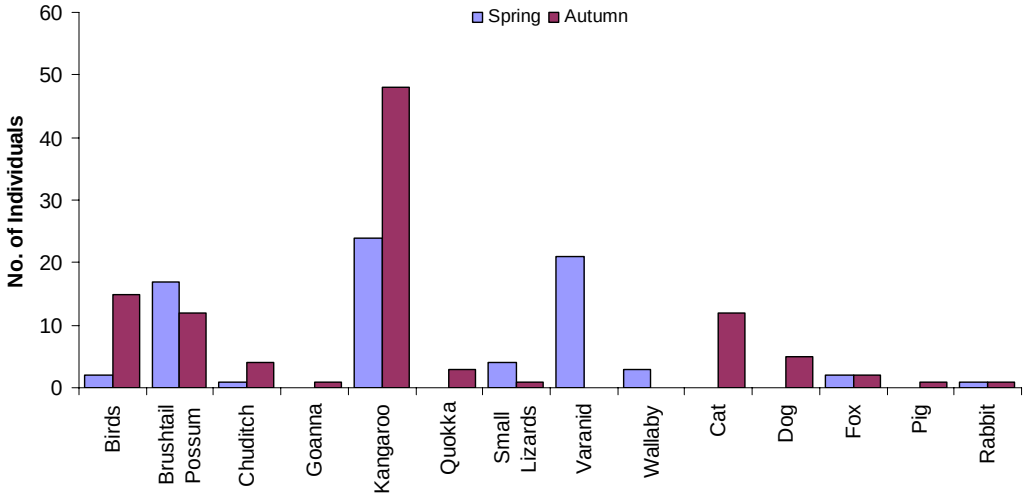
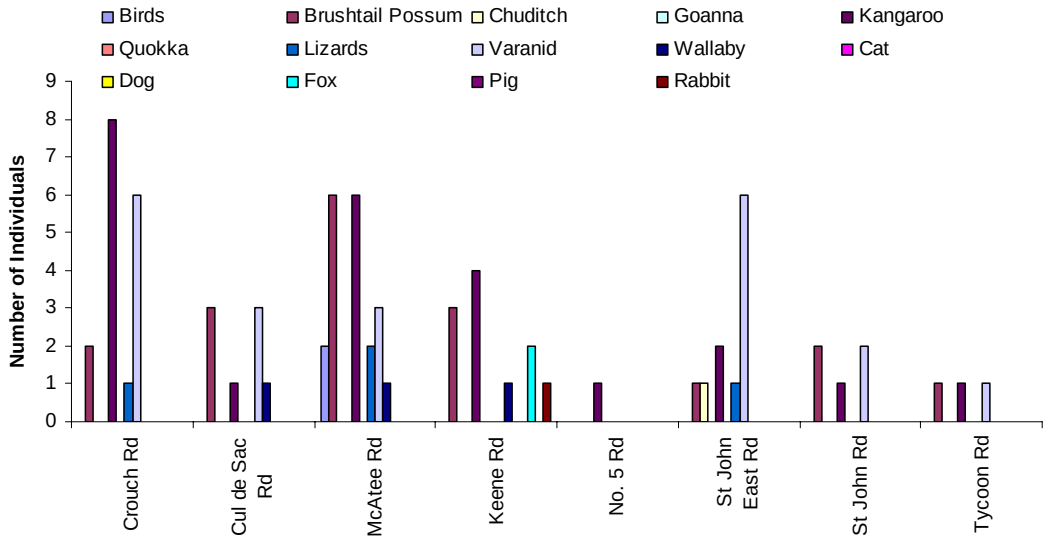


Figure 4. The numbers of individual animals recorded by prints on sand pads in the spring and autumn on the Blackwood Plateau FORESTCHECK road transects.

(a) Spring



(b) Autumn

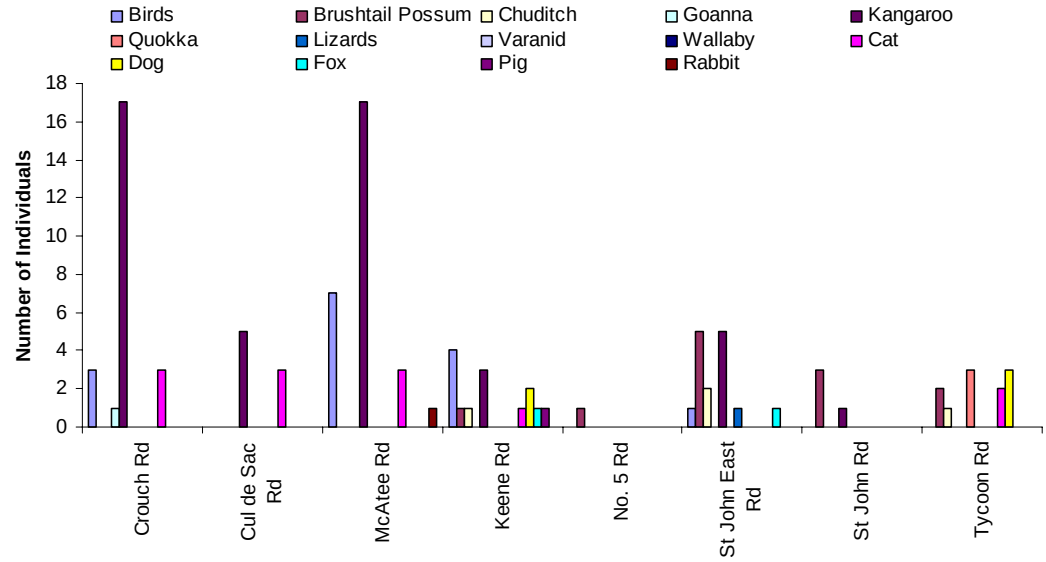


Figure 5. Species prints by season and location on sand pads on the Blackwood Plateau.

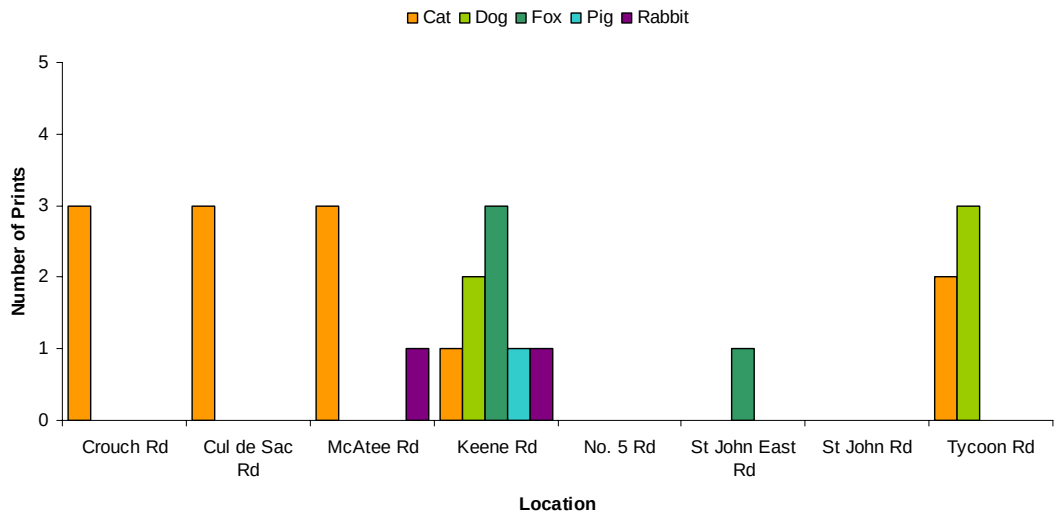


Figure 6: The number of individual feral animals recorded by prints on sand pads in the spring and autumn on the Blackwood Plateau FORESTCHECK road transects

Road survey

The road surveys were undertaken on a landscape basis with the emphasis on differences between blocks as treatment grids within the blocks are close together. The distance traveled in each survey was 40km.

Only two species were recorded on these surveys, the western grey kangaroo (*Macropus fuliginosus*) and the western brush wallaby (*Macropus irma*) with the kangaroo dominating the counts (Fig. 7). Numbers of both species were similar to the FORESTCHECK surveys from Donnelly in 2001-02. Both the Blackwood Plateau and Donnelly road surveys travel entirely through state forest and the survey route does not pass alongside private property at any stage.

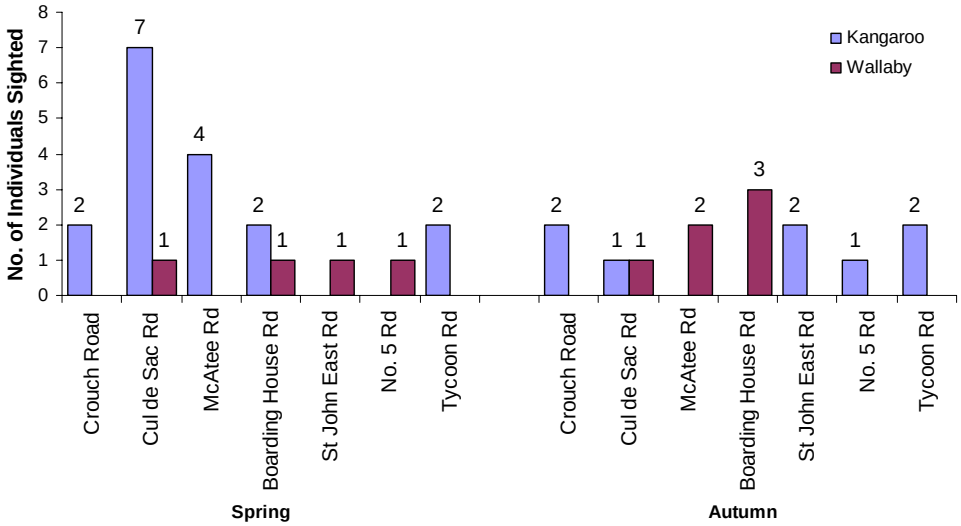


Figure 7. The numbers of individual animals recorded during spring and autumn road surveys in the Blackwood Plateau FORESTCHECK location.

Spotlighting

A total of 16 animals, 2 western grey kangaroos, 1 wallaby, 10 brushtail possums, 2 tawny frogmouths and 1 cat were recorded in the two seasons (spring and autumn) of spotlighting. The majority of animals were seen in Barrabup forest block (Fig. 8) including 8 of the brushtail possums, the other two were recorded in Cambray (Fig. 9). Parts of both these blocks are included in the St Johns Brook Conservation Park, which is ideal habitat for brushtail possums. Only one species of nightbird, the Tawny Frogmouth, was recorded. One feral cat was seen on Crouch Rd in Layman block, which is in the area where the majority of cat prints were recorded on the sand pads (see Fig. 9).

It may have been expected to see more brushtail possums while spotlighting, as 112 captures were recorded during trapping sessions.

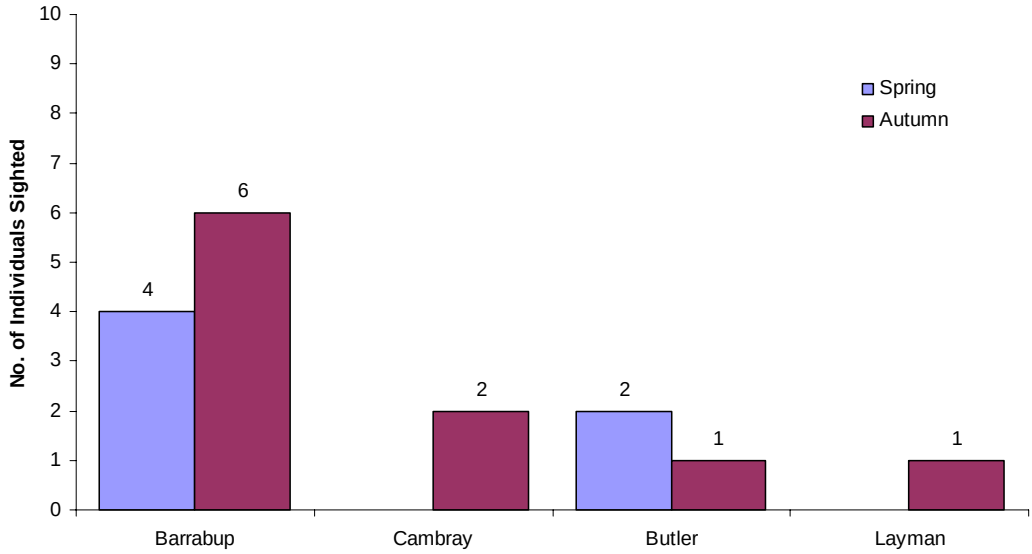
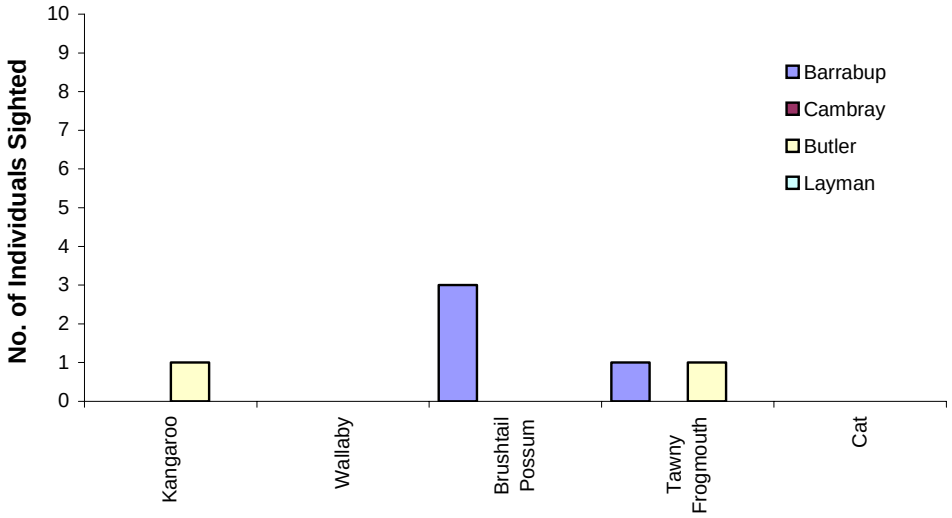
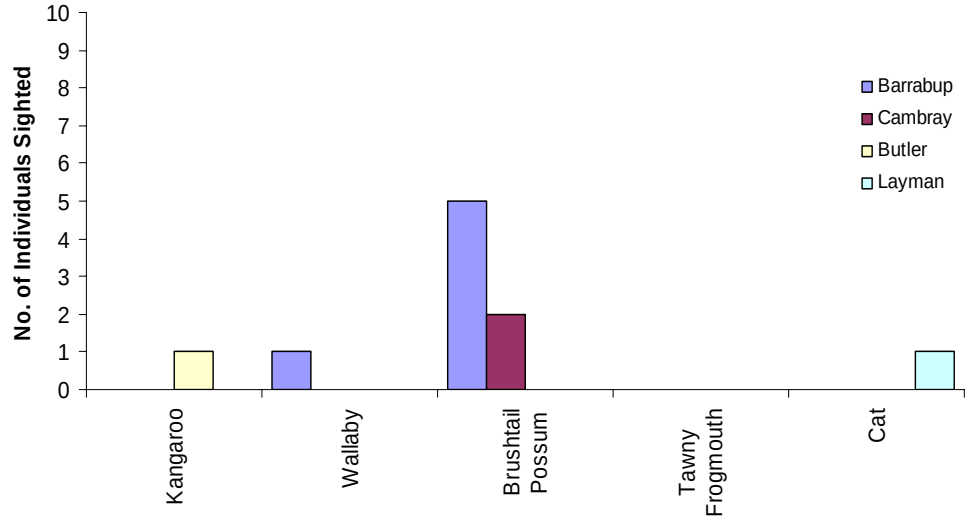


Figure 8: The number of individual animals recorded during spring and autumn spotlighting in each forest block within the Blackwood Plateau FORESTCHECK location.

(a) Spring - Spotlighting



(b) Autumn - Spotlighting



F**igure 9**. The number of individual animals recorded during spotlighting in the spring (a) and autumn (b) within the Blackwood Plateau FORESTCHECK location.

Conclusions

The main observations made following mammal and herpetofauna monitoring at Blackwood Plateau were:

- The brushtail possum was the dominant mammal recorded on the Blackwood Plateau (49% and 90% of captures in spring and autumn respectively).
- Reptile captures were low on the external control grids.
- The single woylie capture at Butler block was about 15 km from where the species was released in 1980.
- Cats were recorded on 5 of the 8 sandpad transects. Cats, dogs, foxes, pigs and rabbits were all recorded on Keene Rd., which is close to the town of Nannup and the local refuse site.

DATA MANAGEMENT AND STORAGE

Amanda Mellican and Verna Tunsell

Introduction

The group is responsible for entering the collected data into electronic format for Macro Vertebrates, Dirurnal Birds, Nocturnals, Mammals and Herpetofauna, Vascular Plants, Fungi 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 two 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 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 survey sheets have been 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
The 276 vascular plant, 209 (128 collections for Blackwood Plateau and 70 for Donnelly) fungi and 557 cryptogam specimens collected during the period, have been identified (as far as possible), prepared, and the vascular plants and cryptogams lodged at the WA Herbarium. The fungi collection is housed at the Tony Annels Herbarium in Manjimup to enable further work to be carried out.

Each specimen is allocated its own unique barcode so that each specimen is readily located by electronic means or by physical means as required.

Vascular plant specimens are pressed and dried, then mounted, with specialised herbarium tape, on card, and placed in separate folders.

Cryptogams are dried (friable specimens are stabilised with emulsion), placed on a card with adhesive to keep the specimen together (mosses are washed prior to drying to remove debris). The specimens are then secured in cardboard boxes to prevent damage.

Fungi specimens are also dried and placed into greaseproof paper, then into ziplock bags, most go into boxes to cryptogams, the very large specimens remain unboxed.

Each voucher specimen is data based on the Max system and submitted electronically to the WA Herbarium for incorporation into the herbarium database. Max was developed by Simon Woodman and Paul Gioia and is used as the primary means of submitting specimen information to the WA Herbarium. While there are many facets to Max, the sections used for FORESTCHECK are the collecting book, specimen tables and reporting facilities.

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 in MAX-V3

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Pterostylis recurva Benth.

Orchidaceae

Identified by:

Erect open rhizomatous perennial dwarf shrub, height to 35 cm, width to 3 cm; flowers green with white stripe. locally occasional. Ridge; brown to grey sandy clay over laterite with 10-20% outcropping; soil pH 6. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Xanthorrhoea preissii.

Loc.: Plot FC38, St John Road East, 1 km N of junction with Mowen Road, Barrabup Forest Block,

Lat.: 33°57'16.3" S **Long.:** 115°42'14.5" E (WGS84)

Coll.: R.J. Cranfield & B.G. Ward FC 838 **Date:** 09/09/2005

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia pulchella in W.T.Aiton var. ***pulchella***

Mimosaceae

Identified by:

Erect open pungent perennial shrub, height to 75 cm, width to 50 cm; flowers yellow. frequent. Ridge; brown to grey sandy clay over laterite with 10-20% outcropping; soil pH 6. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Xanthorrhoea preissii. Percentage of population flowering 30%

Loc.: Plot FC38, St John Road East, 1 km N of junction with Mowen Road, Barrabup Forest Block,

Lat.: 33°57'16.3" S **Long.:** 115°42'14.5" E (WGS84)

Coll.: R.J. Cranfield & B.G. Ward FC 840 **Date:** 09/09/2005

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Dryandra lindleyana var. ***mellicula*** A.S.George in Lehm.

Proteaceae

Identified by:

Erect compact perennial dwarf shrub with underground stems, height to 30 cm, width to 75 cm. frequent. Ridge; brown to grey sandy clay over laterite with 10-20% outcropping; soil pH 6. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Xanthorrhoea preissii.

Loc.: Plot FC38, St John Road East, 1 km N of junction with Mowen Road, Barrabup Forest Block,

Lat.: 33°57'16.3" S **Long.:** 115°42'14.5" E (WGS84)

Coll.: R.J. Cranfield & B.G. Ward FC 839 **Date:** 09/09/2005

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Grevillea centristigma (McGill.) Keighery

Proteaceae

Identified by:

Erect compact to open perennial dwarf shrub, height to 27 cm, width to 35 cm; flowers yellow. frequent. Ridge; brown to grey sandy clay over laterite with 10-20% outcropping; soil pH 6. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Xanthorrhoea preissii. Percentage of population flowering 30%.

Loc.: Plot FC38, St John Road East, 1 km N of junction with Mowen Road, Barrabup Forest Block,

Lat.: 33°57'16.3" S **Long.:** 115°42'14.5" E (WGS84)

Coll.: R.J. Cranfield & B.G. Ward FC 841 **Date:** 09/09/2005

Voucher: Forestcheck Monitoring Program.

Appendix C: Example of Cryptogam labels generated in MAX-V3

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Campylopus introflexux

Dicranaceae

Identified by: R.J. Cranfield

Moss: active growth phase; fruit bodies present; growing in sheltered wet positions on soil at ground level. frequent on occasional sites. Ridge; bare to littered moist brown clayey sand to grey sand over laterite with 20-30 % outcropping. Erosion present from logging. Last burnt 2003-04. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Allocasuarina fraseriana.

Loc.: Plot FC41, 100 m off Keene Road on logging track, Barrabup forest block, NNW of Nannup

Lat.: 33°56'39.5" S **Long.:** 115°44'6.3" E (GDA94)

Coll.: R.J. Cranfield 21366 **Date:** 06/09/2005

Voucher: Forestcheck Monitoring Program

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Ceratodon purpureus

Ditrichaceae

Identified by: R.J. Cranfield

Moss: active growth phase; growing in sheltered wet positions on decaying wood in shrub layer. occasional on isolated sites. Ridge; bare to littered moist brown clayey sand to grey sand over laterite with 20-30 % outcropping. Erosion present from logging. Last burnt 2003-04. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Allocasuarina fraseriana. Also present: Campylopus introflexus.

Loc.: Plot FC41, 100 m off Keene Road on logging track, Barrabup forest block, NNW of Nannup

Lat.: 33°56'39.5" S **Long.:** 115°44'6.3" E (GDA94)

Coll.: R.J. Cranfield 21368 **Date:** 06/09/2005

Voucher: Forestcheck Monitoring Program

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Funaria hygrometrica

Funariaceae

Identified by: R.J. Cranfield

Moss: active growth phase; growing in sheltered wet positions on soil at ground level. frequent on frequent sites. Ridge; bare to littered moist brown clayey sand to grey sand over laterite with 20-30 % outcropping. Erosion present from logging. Last burnt 2003-04. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Allocasuarina fraseriana.

Loc.: Plot FC41, 100 m off Keene Road on logging track, Barrabup forest block, NNW of Nannup

Lat.: 33°56'39.5" S **Long.:** 115°44'6.3" E (GDA94)

Coll.: R.J. Cranfield 21367 **Date:** 06/09/2005

Voucher: Forestcheck Monitoring Program

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Dicranoloma billarderi

Dicranaceae

Identified by: R.J. Cranfield

Moss: active growth phase; growing in sheltered wet positions on soil at ground level. frequent on occasional sites. Ridge; bare to littered moist brown clayey sand to grey sand over laterite with 20-30 % outcropping. Erosion present from logging. Last burnt 2003-04. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla and Allocasuarina fraseriana.

Loc.: Plot FC41, 100 m off Keene Road on logging track, Barrabup forest block, NNW of Nannup

Lat.: 33°56'39.5" S **Long.:** 115°44'6.3" E (GDA94)

Coll.: R.J. Cranfield 21369 **Date:** 06/09/2005

Voucher: Forestcheck Monitoring Program

Appendix D: Example of Fungi labels generated in MAX-V3

WESTERN AUSTRALIAN HERBARIUM, PERTH
Fungi of Western Australia

Cortinarius sp. sticky creamy beige (R.M. Robinson FC 1113)

Cortinariaceae

Identified by:

Fruiting on soil. Plain; bare to littered gravelly moist brown to black clay soil over laterite with 5 % outcropping, with litter depth of 3 cm composed of new, old and decomposed litter. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis.

Loc.: Plot FC1, Winnejup forest block, North Boundary Road, 1 km N of Kingston Road

Lat.: 34°4'33.5" S **Long.:** 116°19'38.1" E (GDA94)

Coll.: R.M. Robinson and J. Fielder FC 1109 **Date:** 29/06/2006

Voucher: Forestcheck Monitoring Program

PERTH 6661718

WESTERN AUSTRALIAN HERBARIUM, PERTH
Fungi of Western Australia

Cortinarius sp. yellow-olive (R.M. Robinson FC 182)

Cortinariaceae

Identified by:

See general description sp. 124 (FC 182). Fruiting on soil. Plain; bare to littered gravelly moist brown to black clay soil over laterite with 5 % outcropping, with litter depth of 3 cm composed of new, old and decomposed litter. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis.

Loc.: Plot FC1, Winnejup forest block, North Boundary Road, 1 km N of Kingston Road

Lat.: 34°4'33.5" S **Long.:** 116°19'38.1" E (GDA94)

Coll.: R.M. Robinson and J. Fielder FC 1110 **Date:** 29/06/2006

Voucher: Forestcheck Monitoring Program

PERTH 6661696

WESTERN AUSTRALIAN HERBARIUM, PERTH
Fungi of Western Australia

***Phellodon* sp. niger brown (R.M. Robinson FC 844)**

Bankeraceae

Identified by:

See general description sp. 479 (FC 844). Fruiting on soil. Plain; bare to littered gravelly moist brown to black clay soil over laterite with 5 % outcropping, with litter depth of 3 cm composed of new, old and decomposed litter. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis.

Loc.: Plot FC1, Winnejup forest block, North Boundary Road, 1 km N of Kingston Road

Lat.: 34°4'33.5" S **Long.:** 116°19'38.1" E (GDA94)

Coll.: R.M. Robinson and J. Fielder FC 1111 **Date:** 29/06/2006

Voucher: Forestcheck Monitoring Program

PERTH 6661688

WESTERN AUSTRALIAN HERBARIUM, PERTH
Fungi of Western Australia

Cortinarius sp. stubby domes (R.M. Robinson FC 585)

Cortinariaceae

Identified by:

Cap: (20-button) 30-35 mm diameter, broadly convex, dry, yellow beige with appressed fibrils, even colour over whole cap. Margin inrolled at first then even. Flesh ; white, solid.
Gills: andate, light grey-brown, greyish towards edge, face smooth, edge narrow and ± wavy or uneven. Moderately crowded with two sometimes three sets of lamellulae.
Stem: up to 20 mm tall with bulbous base, 10 mm thick at apex and 15 mm wide at base. In fully developed specimen 30 mm tall and 8 mm thick and ± even. White with mauve or lilac tint above veil and creamy yellow below. Veil remnants on stem, cob-web-like , rusty in older specimens. Flesh: white solid.
Odour: mushroomy.
Spore print: brown. Fruiting in and under deep leaf litter. Plain; bare to littered gravelly moist brown to black clay soil over laterite with 5 % outcropping, with litter depth of 3 cm composed of new, old and decomposed litter. Forest with associated vegetation of Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis.

Loc.: Plot FC1, Winnejup forest block, North Boundary Road, 1 km N of Kingston Road

Lat.: 34°4'33.5" S **Long.:** 116°19'38.1" E (GDA94)

Coll.: R.M. Robinson and J. Fielder FC 1112 **Date:** 29/06/2006

Voucher: Forestcheck Monitoring Program

PERTH 6661661