REPORT OF PROGRESS
2001 - 2002

Science Division

October 2002

Government of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

CONTENTS

Executive Summary

This document includes the results of the first year of sampling under the FORESTCHECK initiative (Concept Plan available at http://www.naturebase.net/science/science.html). Three FORESTCHECK sites (10 grids) were established in jarrah forests near Manjimup in spring 2001 and autumn 2002. Further sites will be established throughout the forest each year over the next four years.

Particularly notable is the large number of forest organisms recorded and the advance in our understanding of the biodiversity, distribution and disturbance ecology of a broad range of organisms for relatively little effort. This underlines the benefits of well integrated projects that draw together multi-disciplinary teams of skilled people working to a common goal at the landscape scale. I believe that this and the other information collected will serve as a solid foundation for a very important monitoring program to support ecologically sustainable forest management in WA.

In devising FORESTCHECK, we deliberately adopted a 'belt and braces' strategy. Initially, the FORESTCHECK team was asked to err on the side of collecting too much information. We strived to avoid not sampling or undersampling relevant factors or processes, all of course in the context of a finite budget. Although recognizing that an indicator species approach would be warranted for cryptogams, invertebrates and fungi, we were reluctant to commence with a list of species that was too short in case valuable information was omitted. Experience with the Kingston project (1994-9) had demonstrated that there was no cost saving involved with counting only nominated indicator species of birds or trapping only nominated indicator species of mammals, reptiles and frogs. With vascular flora, there is a significant risk that an *a priori* list of indicator species may not be relevant to most parts of the forest, given the marked beta diversity evident with ground flora.

I am confident that reliable lists of indicator species of vertebrates and vascular flora will be able to be assembled after FORESTCHECK has operated for several years and data have been collected from a range of representative sites.

As the data presented in this progress report are from only the first year of monitoring at a small number of sites, it is too early to carry out any meaningful analysis and interpretation. However, a number of interesting observations have emerged. As expected, the species richness and composition of birds at each of the sites varied according to the maturity and structural complexity of the vegetation; generally, bird recovery following timber harvesting parallels that of the vegetation structure . A most striking result is the contrast in the abundance of mammals east and west of the South West Highway. Mammal capture rates were very high on the eastern grids, but very low on the western grids, regardless of treatment. This is probably attributable to natural environmental factors affecting habitat suitability such as climate, landform and vegetation structure and to management history including Western Shield (fox control). At the Kingston monitoring sites, ground dwelling vertebrate and invertebrate fauna are recovering well. Fox control and the extensive network of buffers (temporary exclusion areas – TEAs) have facilitated a relatively rapid recovery following timber harvesting at these sites. While relatively abundant prior to timber harvesting, Western Ringtail Possums were not detected in any of the treatments on the Kingston sites, including the buffers, but Common Brushtail Possums were abundant. Some 588 invertebrate morphospecies were collected including at least 24 with Gondwanan affinity. Good baseline data for more than 200 vascular plant species, 170 fungi species and 160 cryptogams (mosses and lichens) were gathered and further sampling will provide information about the role, recovery and successional pathways of these taxa. Data collected on vascular plants supports the Kingston Project findings, that annual herbs, grasses and weeds are generally favoured by disturbances associated with timber harvesting, but some woody shrubs, perennial herbs and geophytes especially are disadvantaged and may take some time to recover. Monitoring soil damage is not straight forward and further thought needs to be given to developing an efficient but meaningful protocol.

We learned some valuable lessons from this round of sampling; the following points have been collated from the reports submitted by the teams:

- Need to sample mammals with wire cages in spring as well as autumn.
- Need to voucher specimens of mammal species for which taxonomic limits are ill-defined (e.g. *Sminthopsis*).
- Need to refine the sampling procedure for estimating the abundance of vascular flora.
- Need to increase the number of 1m x 1m vegetation sampling quadrats to reduce the standard error.
- Need to ensure that sites have not been burnt more recently than 2 years, otherwise identification of vascular flora is impeded.
- Need to standardise soil damage assessment techniques.
- Need to collate details of management history (logging, fire and fox control) for each site.

It is my intention to subject all of the data collected in the first five years of the program to a rigorous, integrated analysis, report and external review.

I extend my congratulations to all staff involved in the FORESTCHECK team for their professionalism. The project was carried out on time and within budget.

At the time of writing, we are selecting sites for sampling this spring and next autumn. These sites will be in the Collie-Harvey area.

Dr Neil Burrows
Director Science Division
October 2002

INTRODUCTION

Scope

FORESTCHECK is an integrated monitoring system that has been developed to provide information to forest managers in south-west Australia about any changes and trends in key elements of forest biodiversity associated with a variety of forest management activities. As such, it represents the most comprehensive systematic forest monitoring program in Australia and is one of a few of its kind in the world. Although the initial focus of FORESTCHECK will be on timber harvesting and silvicultural treatments in Jarrah 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 consistent with Ministerial Conditions on the Forest Management Plan.

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

The development of FORESTCHECK has taken place over two years and has included input from scientists and managers within the Department of Conservation & Land Management, and from a number of external scientific agencies. Background to this process is described in the FORESTCHECK Concept Plan with details provided in the FORESTCHECK OPERATING PLAN. Science Division of the Department of Conservation and Land Management has primary carriage of FORESTCHECK.

Sampling Strategy

Timber harvesting in jarrah forests is currently undertaken according to Silvicultural Guideline 1/95 (being revised), which recognizes three silvicultural objectives:

Thinning – to promote growth on retained trees,

(1) Release of regeneration by gap creation, where existing advance growth is encouraged to develop unimpeded by the removal of competing overstorey,

(2) 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.

Monitoring will focus on the gap creation and shelterwood treatments initially as these are the most widespread operations and involve the greatest extent of disturbance to the forest. Thinning is more limited in extent, and only results in relatively minor disturbance of the overstorey, understorey or soil.

Monitoring will take place at a number of locations throughout the forest, which are referred to as FORESTCHECK sites. Sites will be stratified according to recognized ecological gradients of rainfall, evapo-transpiration and soil fertility and will be allocated according to mapped forest ecosystems. Allocation of sites will also take 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 four sampling grids, depending on the range of silvicultural prescriptions applied. Grids are established in forest subject to the following treatments:

(1) gap release,
(2) shelterwood,
(3) coupe buffer or internal reference forest i.e. temporary exclusion areas (TEAS) between adjacent gaps or shelterwood forest,
(4) external reference or control forest i.e. not recently harvested, or has had minimal harvesting, and will not be subject to harvesting in the foreseeable future.

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 found in the one locality and there will be occasions when external reference forest may have to be located some distance from their harvested counterparts. It is not always be possible to find gap 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.

During spring 2001 and autumn 2002, three FORESTCHECK sites (ten sampling grids) were established in the Darling Plateau subregion (Bevan, Mattaband, Corbalup, Collis, Yanmah and Warren vegetation complexes of Mattiske and Havel 1998) in Kingston, Thornton, Carter and Easter forest blocks. Four additional sites are scheduled for establishment each year in 2002, 2003, 2004 and 2005 and will probably be located in the Blackwood Plateau subregion (Kingia vegetation complex of Mattiske and Havel 1998) and in the Darling Plateau subregion (Dwellingup and Yalanbee vegetation complexes of Mattiske and Havel 1998). By 2005, up to 80 sample grids will be established throughout the Jarrah forest. It is envisaged that each site will be resampled about every 5 years.

Methodology

A range of ecosystem attributes will be monitored at each site, as follows:

1. Vertebrate fauna (birds, reptiles, frogs, mammals)
2. Invertebrate fauna
3. Vascular plants and cryptogams
4. Macrofungi and coarse woody debris
5. Foliar nutrients and tree growth
6. Forest regeneration and structure
7. Soil disturbance

Sampling methodologies for each set of ecosystem attributes are described in detail in the Operations Plan, together with examples of protocols for data collection and storage. General site attributes such as geology, soils, landform, climate, fire history, logging history, extent of *Phytophthora* impact etc. are also recorded.

Monitoring of biodiversity is based on a sample grid. The main grid is 100 m x 100 m, with 30 m x 30 m vegetation sample plots at each corner. Details of sample design and protocols for each element of the biota and sampling schedules, are provided in the Operating Plan.

Before commencing measurements, each FORESTCHECK site is located in the field, the sample grids installed and then the various monitoring protocols for each taxonomic group (discipline) established on the grid. The figures below are a breakdown of the cost of establishing and assessing the sites for 2001/02.

Reference

Mattiske, E.M. and Havel, J.J. 1998. Regional Forest Agreement Vegetation Complexes (6 maps). Government of Western Australia and Commonwealth Government, Department of Conservation and Land Management, Como.

Consolidated Budget Table

Cost of establishing and monitoring FORESTCHECK sites 2001/02

Task/Activity	OIC	[1]One off	Materials (incl. travel)	Vehicles	Data Entry	Ord OT	[2]Salary + OH	TOTALS
Grid establishment	McCaw		7 080	3 375			29 229	**39 684**
Spotlight Road surveys (verts.)	Liddelow			3 420		10 710		**14 130**
Birds (diurnal)	Liddelow		300	3 300	1 000		12 178	**16 778**
Birds (nocturnal)	Liddelow	500		1 350	500	3 600		**5 950**
Fauna (grid trapping)	Liddelow		1 800	1 800	1 000		12 178	**16 778**
Invertebrates	Farr	2 900	2 400	3 000	900		9 635	**18 8355**
Flora (vasc. plants & cryptogams)	Ward	2 000	450	2 700	4 000		9 220	**18 370**
Forest structure and regeneration	McCaw		1 800	900	3 000		6 286	**12 085**
Soils	Whitford	5 000	9 000	3 000	3 000		20 059	**42 542**
Macrofungi	Robinson		1 980	3 000	2 000		5 982	**12 962**
TOTALS		**10 400**	**24 8100**	**25 845**	**15 400**	**14 310**	**104 767**	**195 532**

GRAND TOTAL (Division and Corporate OH) = 195 532 x 1.4375 = <u>281 077</u>

- [1]One-off costs include: bird census equipment (1 set); invertebrate sampling and storage equipment; digital camera; dust extraction system for processing of soil bulk density cores.
- [2]Salary+ OH = salary x 1.194

SITES STUDIED AND GRID ESTABLISHMENT – 2001/02

The following three tables detail where and when the sampling grids were established.

Table 1.

	Location	Monitoring Grid No.	Start Date [Day]	Start Date [Month]	Start Date [Year]	Recorder(s)	Treatment
1	Kingston	M1	8	10	2001	RJC & BGW	External control
	Kingston	M2	15	10	2001	RJC & BGW	Gap release 1996
	Kingston	M3	8	10	2001	RJC & BGW	Shelterwood 1996
	Kingston	M4	12	10	2001	RJC & BGW	Buffer (Coupe buffer)
2	Yornup	M5	15	10	2001	RJC & BGW	External control
	Thornton	M6	16	10	2001	RJC & BGW	Gap release 1990
	Thornton	M7	16	10	2001	RJC & BGW	Buffer (Coupe buffer)
3	Carter	M8	17	10	2001	RJC & BGW	Gap release 1999
	Carter	M9	17	10	2001	RJC & BGW	Buffer (Coupe buffer)
	Easter	M10	18	10	2001	RJC & BGW	External control

Table 2.

Location	Aspect Code	Aspect Description	Slope (degree)	Latitude	Longitude	GPS
Kingston	NW	Surrounding ha mostly faces north west	1	34°04'03"	116°19'34"	Yes
Kingston	S	Surrounding ha mostly faces south	0.5	34°04'59"	116°21'29"	Yes
Kingston	E	Surrounding ha mostly faces east	±2	34°05'20"	116°22'00"	Yes
Kingston	S	Surrounding ha mostly faces south	0.5-1	34°05'20"	116°21'36"	Yes
Yornup	S	Surrounding ha mostly faces south	3	34°06'24"	116°08'33"	Yes
Thornton	E	Surrounding ha mostly faces east	0.5	34°07'17"	116°03'31"	Yes
Thornton	S	Surrounding ha mostly faces south	0.5	34°07'17"	116°03'26"	Yes
Carter	SE	Surrounding ha mostly faces south east	1	34°05'27"	116°01'46"	Yes
Carter	SE	Surrounding ha mostly faces south east	1	34°05'27"	116°01'46"	Yes
Easter	N	Surrounding ha mostly faces north	3	34°12'43"	115°47'49"	Yes

Table 3.

Location	Locality	Other Site Descriptive	General Comments
Kingston	Winnejup Forest Block, North Boundary Road, 1 km N of Kingston Road	Jarrah/Marri Forest, gravelly clay	Light logging (old), burnt (old 6-8 years), GN80/4 Shield tree on left hand side of track, plot on right hand side of track (E) 132° E, Trapline NB5 right hand side of track.
Kingston	Kingston Forest Block, off S side of Kingston road, 2.5 km E off Lejeune Road,	None	Regrowth - heavily logged and burnt. Brown loam gravel.
Kingston	Tinkers Flat Road, 800 m S of Kingston Road, Kingston Forest Block	Jarrah/Marri disturbed forest, loamy clay gravel.	Moderately logged, highly disturbed (scarified), burnt tops (recent).
Kingston	Kingston Forest Block	Jarrah/Marri Forest. Brown loamy gravel.	Light logging. Burtn 5-6 years. 50 m off track to Line 3.
Yornup	N side of Wagelup Road, 1.4 km W of railway line, Yornup Forest Block	Brown loamy gravel, laterite exposure.	Lightly logged (old).
Thornton	10.7 km on Wagelup Road from railway crossing, Thornton Forest Block	Brown gravel	Highly disturbed - regrowth.
Thornton	10.8 km W on Wagelup road from railway Crossing, Thornton Forest Block	Jarrah/Marri Forest. Brown gravelly clay.	Heavy litter.
Carter	1 km N of intersection of Donnelly Mill Road and Swamp Road, to track (2 km to plot), Carter Forest Block	Jarrah/Marri regrowth forest. Brown clay loam gravel.	No Comment
Carter	1 km N of intersection of Donnelly Mill Road and Swamp Road - track to plot 2 km, next to M8. Carter Forest Block.	None	No Comment
Easter	Dickson Tower, Easter Forest Block	Unlogged Jarrah Forest. Brown loam, some gravel.	No Comment

Plates 1 - 10 demonstrate the appearance of the vegetation at each of the 10 sites

Control M1 Kingston

Gap M2 Kingston regenerated 1996

Shelterwood M3 Kingston regenerated 1996

Buffer M4 Kingston

Control M5 Thornton

Gap M6 Thornton regenerated 1990

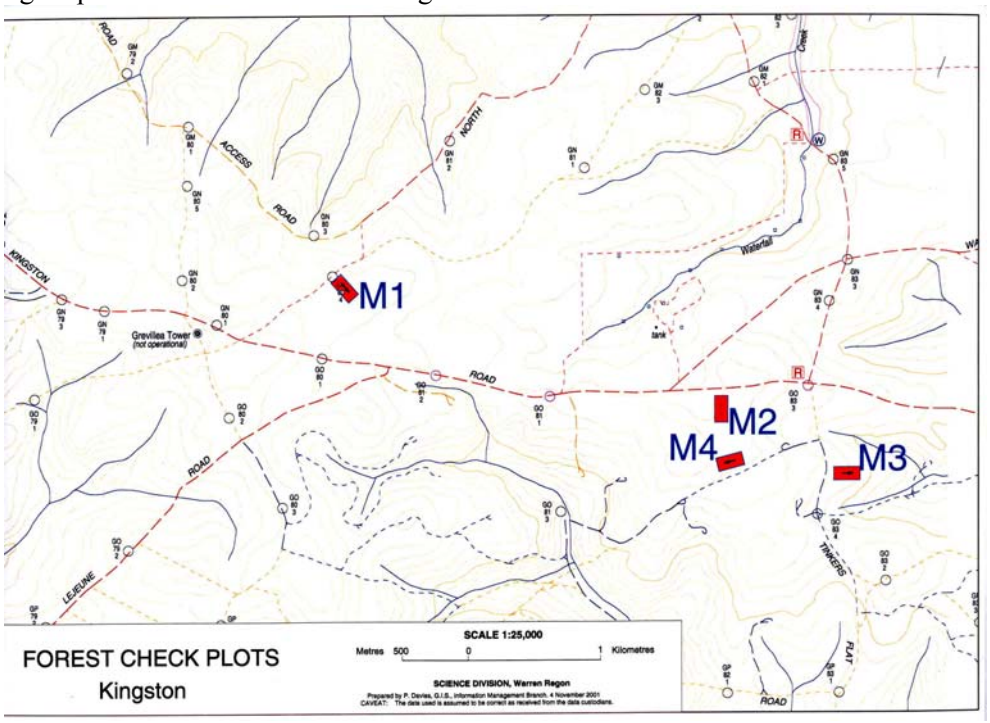
Buffer M7 Thornton

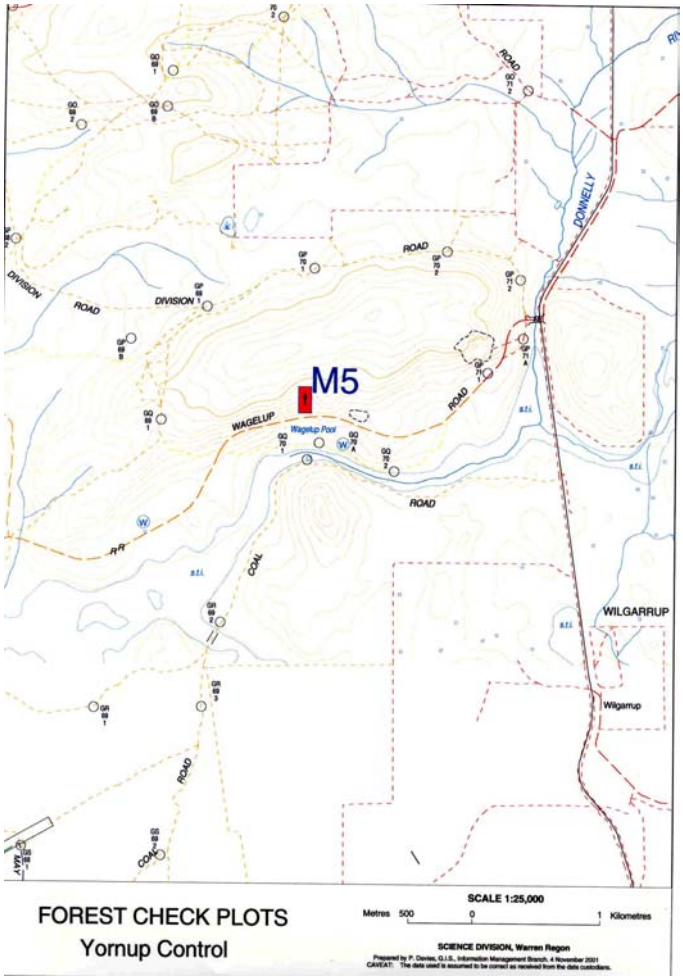
Gap M8 Carter regenerated 1999

Buffer M9 Carter

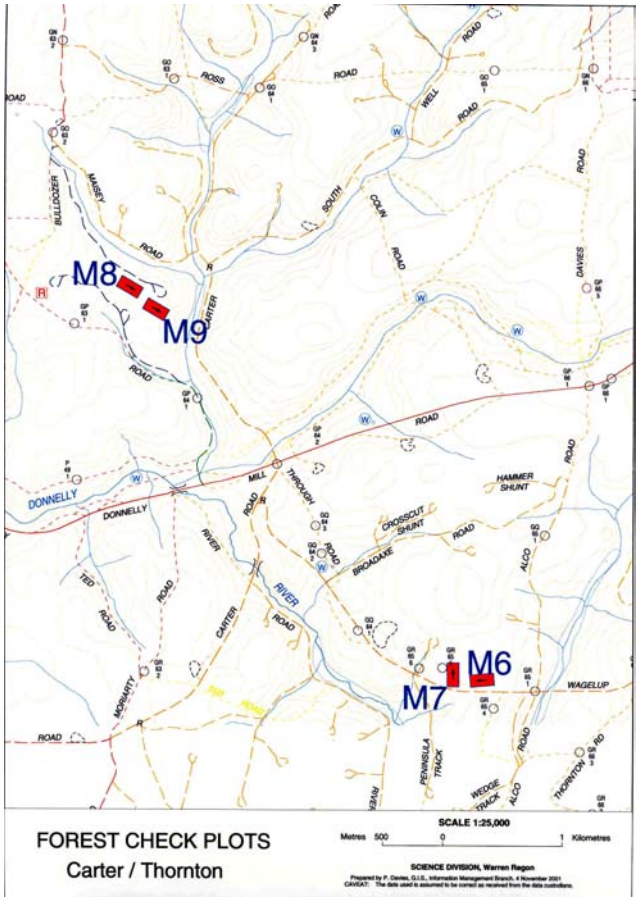
Control M10 Easter

The following maps show the location of each grid.

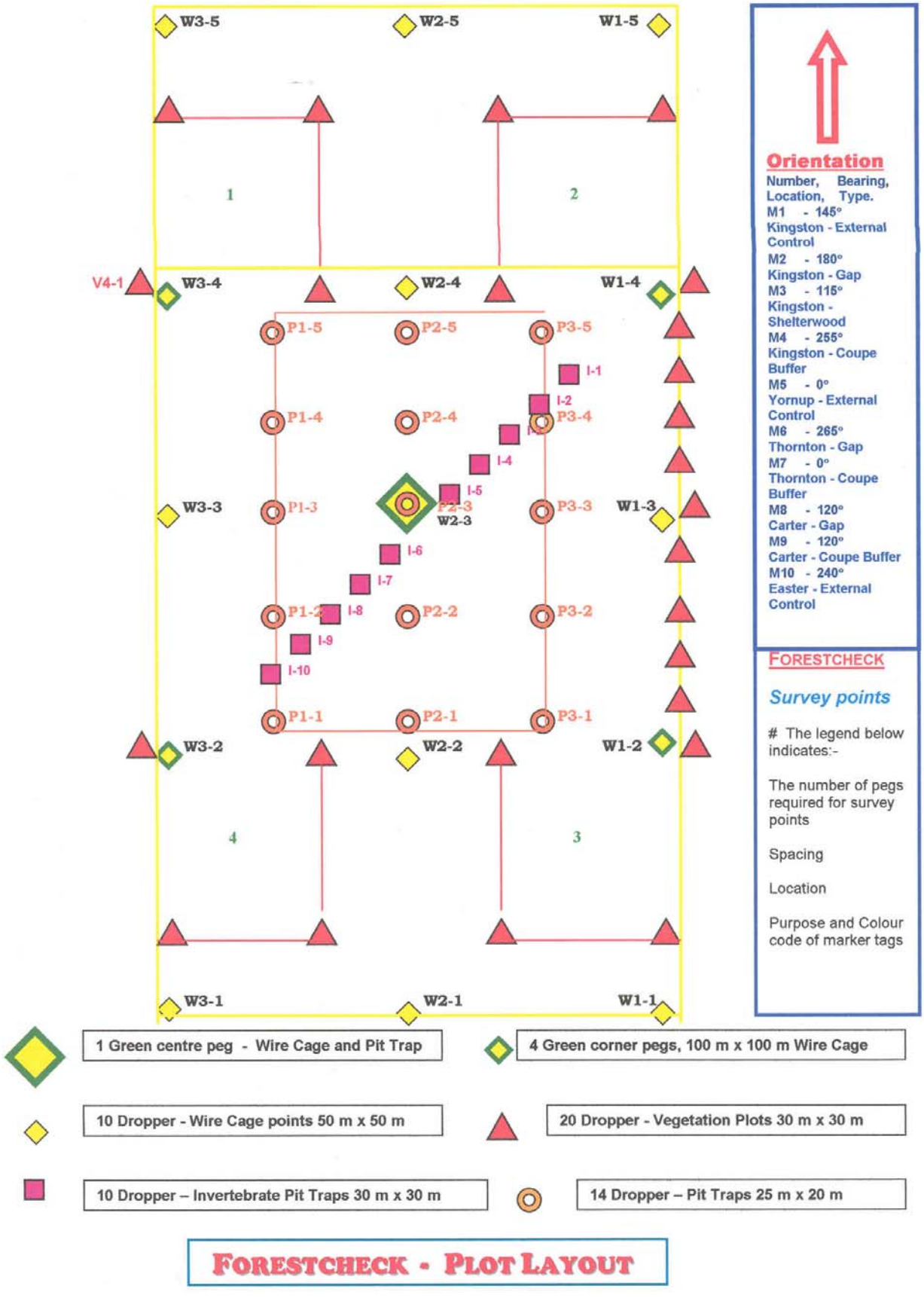





M10
FOREST CHECK PLOTS
Dickson Tower
SCALE 1:25,000
SCIENCE DIVISION, Warren Region


M8
M9
M6
M7
FOREST CHECK PLOTS
Carter / Thornton
SCALE 1:25,000
SCIENCE DIVISION, Warren Region

This diagram shows the layout of a sampling grid.



BIRDS

Graeme Liddelow

Introduction

Ten FORESTCHECK grids selected during early spring 2001 were sampled for diurnal birds to monitor the impacts of logging and associated burning on their composition and abundance.

Sampling

The sampling strategy selected by the consultative group and as outlined in the FORESTCHECK Operating Plan, has worked well in this study and no problems have been encountered nor should any occur in the future.

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

Specimen Processing

It has not proved necessary to collect any specimens. Discussions are carried out on the day if there is a problem with identification and that species is followed up immediately to overcome any further discrepancy.

Database Establishment

The entry protocols have been developed over a number of years with Grey Bird Study and Kingston Bird Study. We are using these standard procedures and do not envisage any problems.

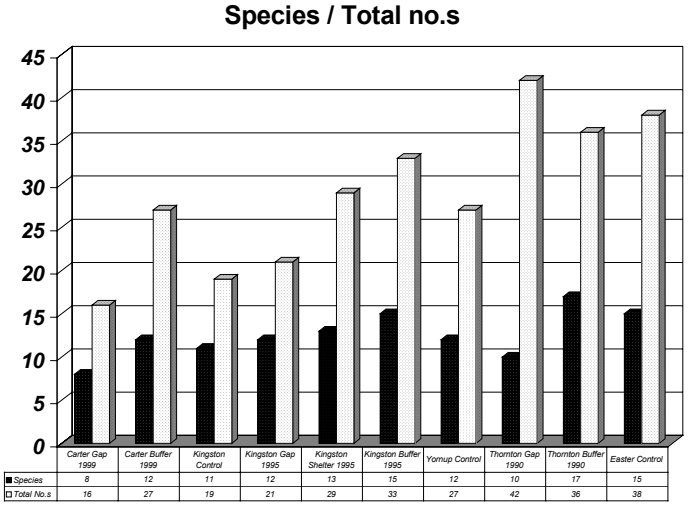
Preliminary Results

We recorded 29 bird species in the ten grids, with only 9 species having at least 9 individuals counted (Table 1).

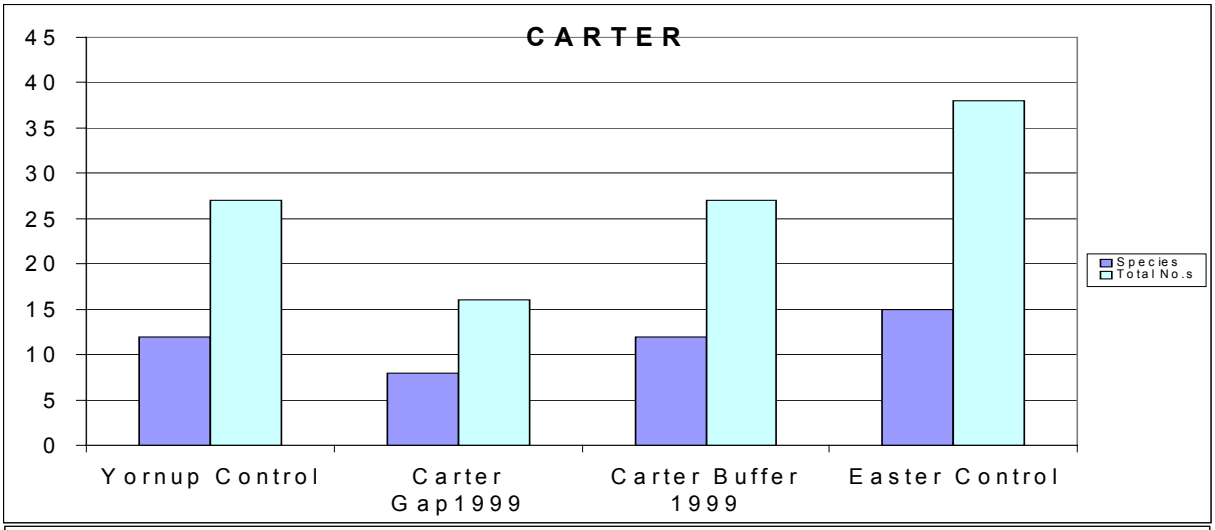
Table 1. Birds species and number of individuals recorded at all 10 grids.

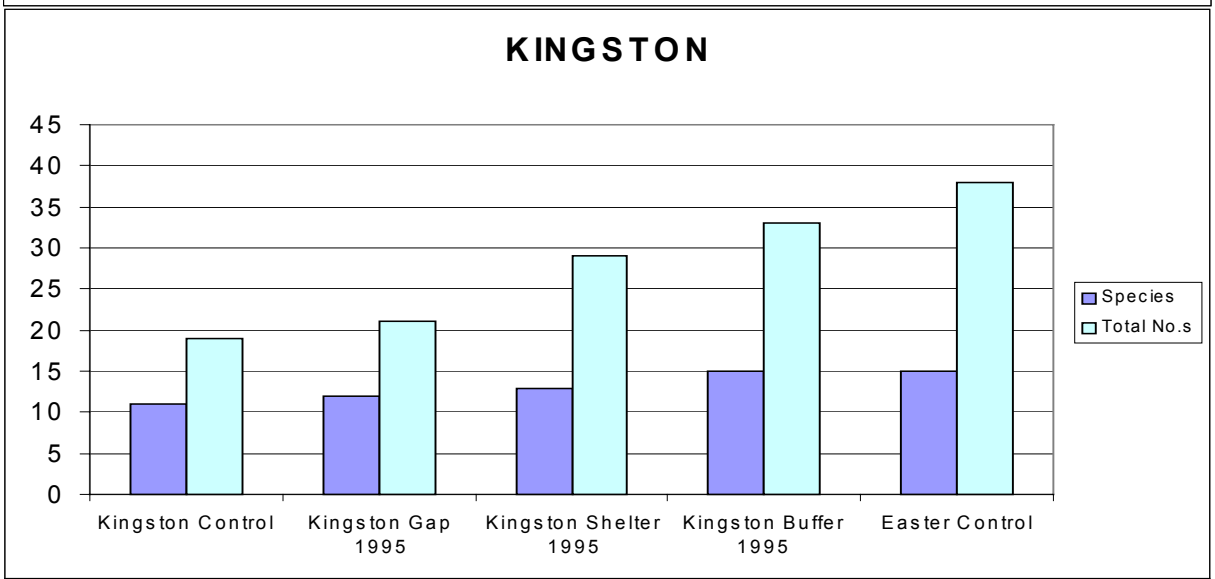
RAOU No.	COMMON NAME	SCIENTIFIC NAME	COUNT OF TOTAL
1	Emu	*Dromaius novaehollandiae*	1
34	Common bronzewing	*Phaps chalcoptera*	3
259	Purple-crowned lorikeet	*Glossopsitta porphyrocephala*	3
266	White-tailed black cockatoo	*Calyptorhynchus baudinii*	2
289	Western rosella	*Platycercus icterotis*	3
290	Red-capped parrot	*P. spurius*	4
294	Australian ringneck	*P. zonarius*	5
322	Laughing kookaburra	*Dacelo novaeguineae*	1
338	Fan-tailed cuckoo	*Cacomantis flabelliformis*	5
344	Shining bronze cuckoo	*Chrysococcyx lucidus*	3
359	Tree martin	*Hirundo nigricans*	7
361	Grey fantail	*Rhipidura fuliginosa*	24
380	Scarlet robin	*Petroica multicolor*	3
387	White-breasted robin	*Eopsaltria georgiana*	2
398	Golden whistler	*Pachycephala pectoralis*	29
408	Grey shrike-thrush	*Colluricincla harmonica*	6
424	Black-faced cuckoo-shrike	*Coracina novaehollandiae*	6
463	Western gerygone	*Gerygone fusca*	33
472	Western thornbill	*Acanthiza inornata*	11
476	Broad-tailed thornbill	*Acanthiza apicalis*	30
488	White-browed scrubwren	*Sericornis frontalis*	16
538	Red-winged fairy-wren	*Malurus elegans*	10
549	Varied sittella	*Daphoenositta chrysoptera*	2
556	Rufous treecreeper	*Climacteris rufa*	5
574	Grey-breasted white-eye	*Zosterops lateralis*	5
578	Western white-naped honeyeater	*Melithreptus chloropsis*	9
597	Brown honeyeater	*Lichmera indistincta*	2
930	Australian raven	*Corvus coronoides*	1
976	Striated pardalote	*Pardalotus striatus*	32

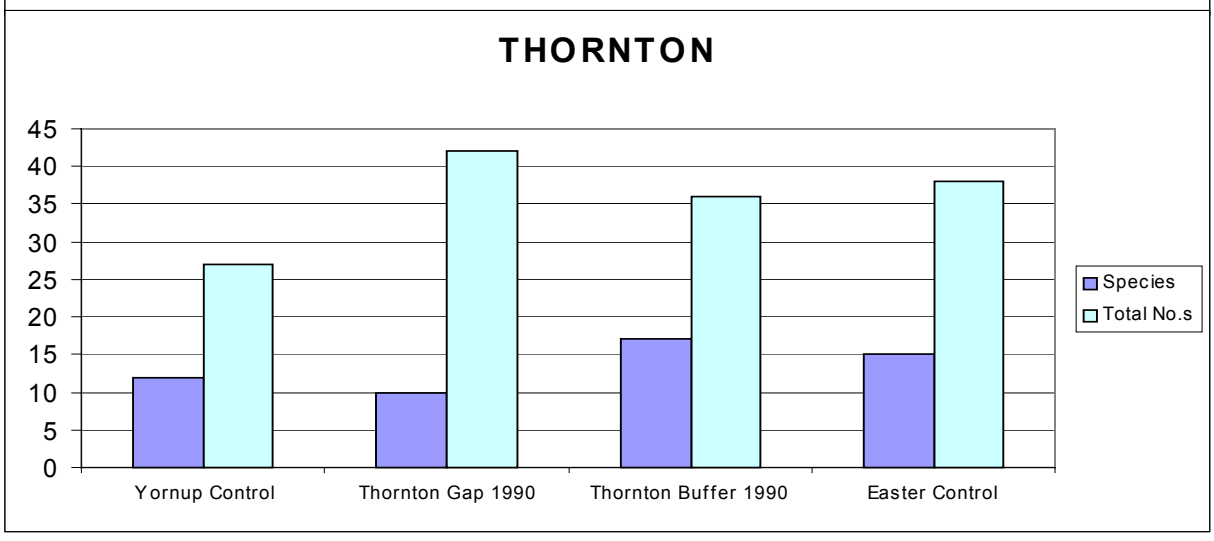
The following graph shows the number of species and the number of individuals recorded in each of the treatments. As expected, the grid with the least was the 1999 Gap at Carter.



The series of graphs below show changes in number of bird species and number of individuals with time since treatment from 1999 at Carter to the 1990 at Thornton. From previous studies (Gray/Kingston) bird species composition and numbers of individuals change as the understorey structure develops following cutting. These changes will continue for some considerable time and may not stabilise until crown separation occurs. Changes will continue even after this time in response to fires.

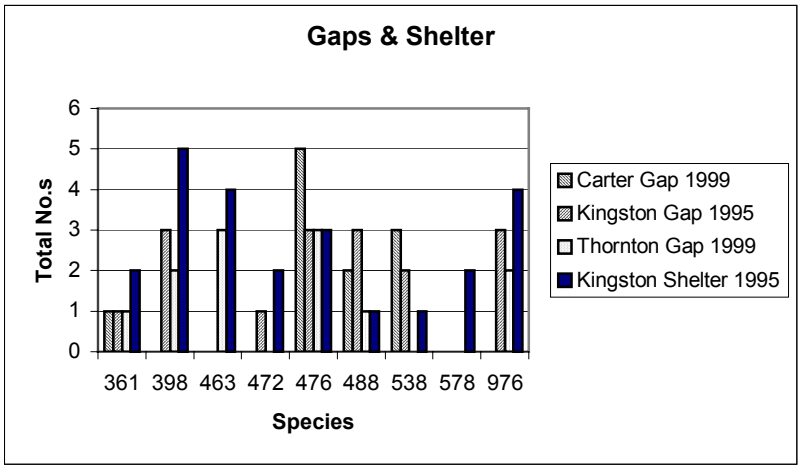


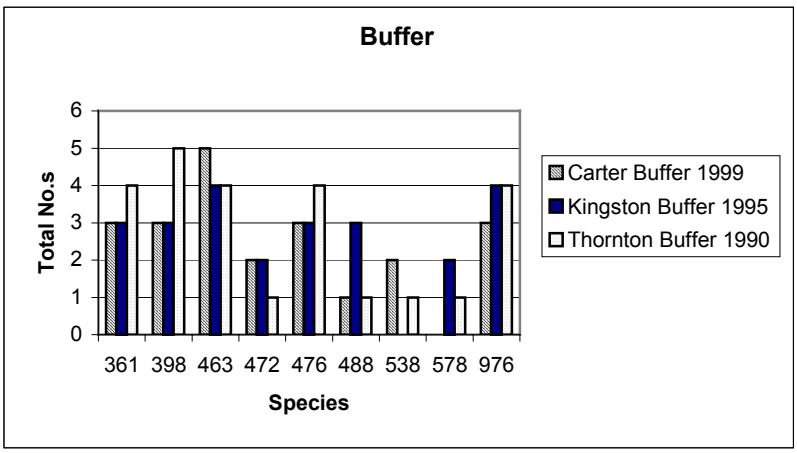


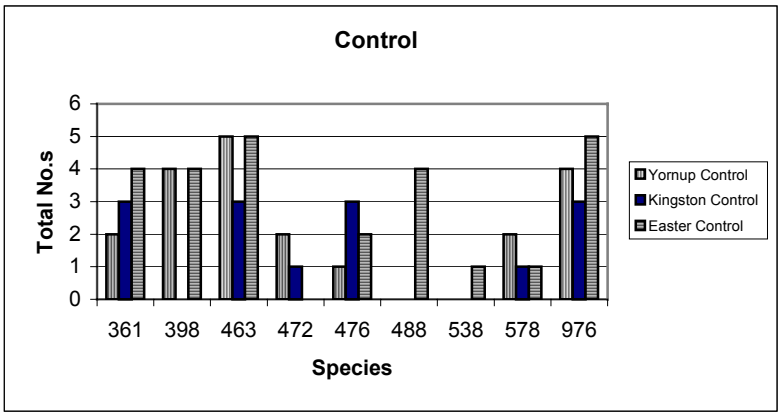


These following graphs focus on the most commonly recorded bird species (9 or more individuals) and the area where they occurred.

The absence of golden whistlers (#398) from the Kingston Control is difficult to explain. It was recorded outside the area but not within the sampling area. Its absence from the Carter Gap, where regeneration is in a very early stage, is to be expected as is the absence of white-browed scrub-wrens (488) and red-winged fairy-wrens (538) from the controls at Yornup and Kingston.







Future Tasks
Select and prepare grids for this year's round of monitoring.

Revisions to Operating Plan
None required.

NOCTURNAL BIRDS

Graeme Liddelow

Introduction
The aim of this program is to monitor the impact of logging and associated burning on the composition and abundance of nocturnal birds at sites selected throughout the southern forests.

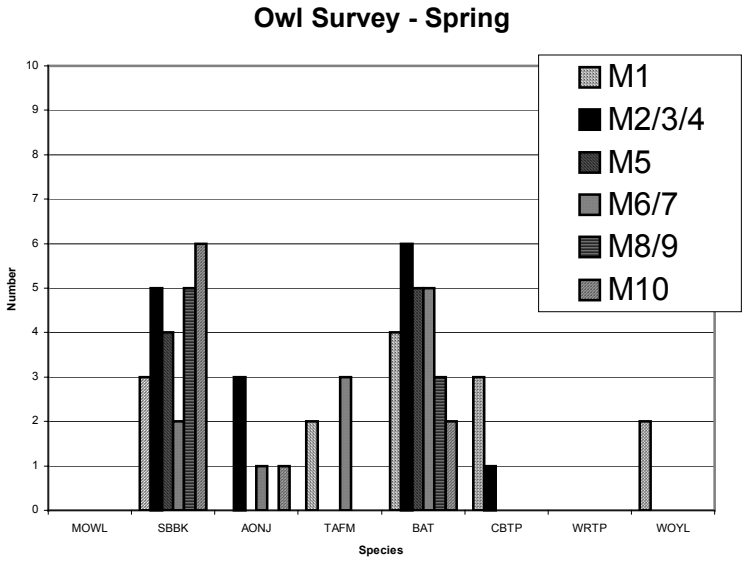
Sampling
It was not possible to monitor the nocturnal birds on an individual grid basis because of the relatively large scale at which these birds hunt. From the 10 FORESTCHECK grids it was possible to sample nocturnal birds at 6 sites. One was at the control at Easter block, one at the Carter block, Buffer and Gap; one at the Thornton block, Buffer and Gap; one at the Kingston block, Control; and the last was a combined Gap, Shelter and Buffer at Kingston. The sampling method used follows that described in Liddelow *et al*. (2002). This sampling system requires site separation by 3 km and it was not possible to achieve this in the 2001/2002 grids.

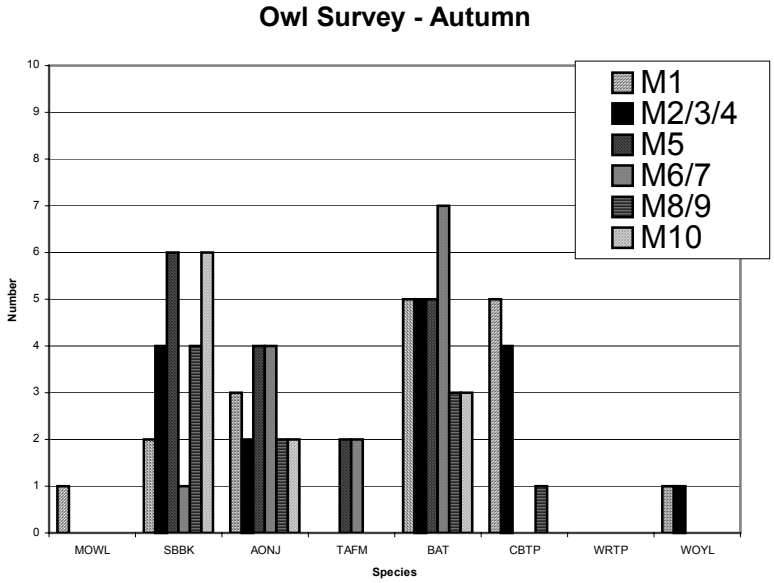
The program was realistic and flexible and no problems were encountered.

Specimen Processing
None required.

Database Establishment
The database has been established and data entry has been undertaken.

Preliminary Results
Spring sampling saw boobook owls (SBBK) recorded at all of the six sites as was expected. This is the only forest owl present in south-west Western Australia. The masked owl (MOWL) was recorded in autumn at the control in Kingston, however it is not unusual as this species has been recorded only 5 km to the east on private property boundaries. Masked owls are recorded occasionally in forest areas but are more typically seen in open forest/woodland country. The graphs below show the species recorded and the sites were they were seen.





Owlet nightjars (AONJ) and tawny frogmouths (TAFM), over the two sample periods, have similar recording rates to that found by Liddelow *et al.* (2002) and these are typical of the forest region of WA.

Future Tasks
Select and prepare this year's sites for monitoring.

Revisions to Operating Plan
Due to the large home range of owls it is not possible to assess them on an individual treatment or grid basis. We will need to monitor the nocturnal birds at the landscape scale within which the treatments have taken place.

Table 1. Nocturnal bird species recorded.

Common name	Scientific name
Boobook owl	*Ninox novaeseelandiae*
Masked owl	*Tyto novaehollandiae*
Tawny frogmouth	*Podargus strigoides*
Australian owlet-nightjar	*Aegotheles cristatus*

References

Liddelow, G.L., Wheeler, I.B. and Kavanagh, R.P. 2002. Owls in the southwest forests of Western Australia. In: Newton, I., Kavanagh, R., Olsen, J. & Taylor, I. (eds.), Ecology and Conservation of Owls, pp. 233-241. CSIRO, Melbourne.

MAMMALS AND HERPETOFAUNA

Graeme Liddelow

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

Sampling Issues Encountered
This program was flexible enough to allow for any inclement weather that did occur during the sampling period.

All went according to the plan and was within the budget allocated. The reason for excluding the wire (Sheffield) traps from the spring session is considered not to be an issue and they should be included in all future spring monitoring.

Specimen Processing
No specimens were vouchered during this sampling period. In future, some type specimens will be included in the sampling procedure.

Database Establishment
As we had the Kingston Study to use as a model, no problems were encountered with establishing a database for this program.

Preliminary Results
This is very early in the life of the program and no conclusions should be drawn from data. Below are a series of graphs showing the results from the wire traps in autumn, pit traps in spring and autumn, spotlight surveys in spring and autumn, road surveys for both seasons and the results of the sand pad monitoring for spring and autumn.

Of concern is the lack of Western ringtail possum (WRTP) sightings at the Kingston site. There appears to be a general decline in their numbers in this country and more work should be done to document the extent of their apparent decline.

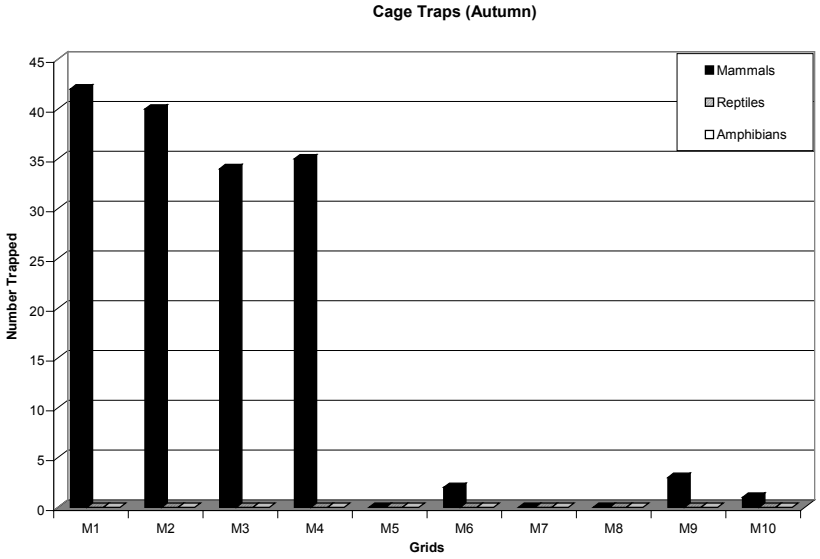
Most notable is the obvious difference in the low number of mammals captured west of the South-west Highway (grids M5-10) both in the control and treated areas. This is thought to be due to environmental factors and long-term fox baiting east of the Highway associated with Western Shield.

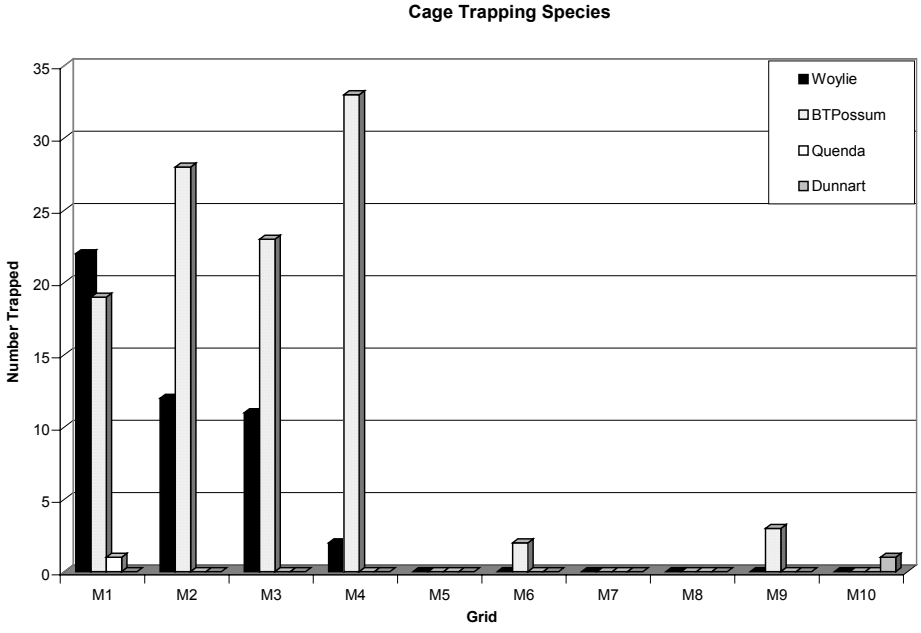
Table 1. Frog, reptile and mammal species recorded from the 10 grids.

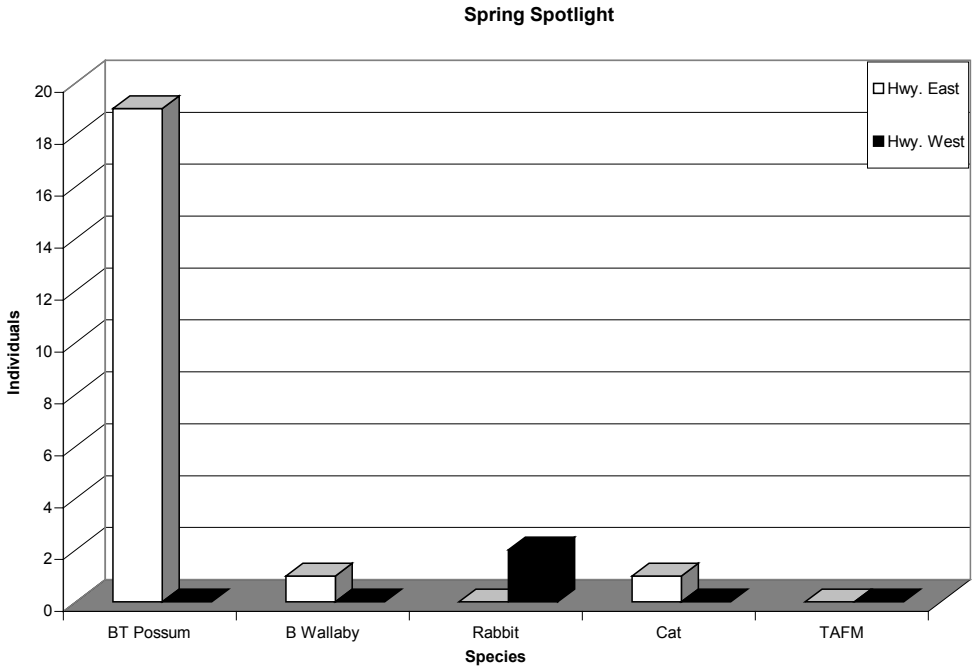
	Species (Scientific name)	Species (Common name)
Frogs	*Crinia georgiana*	Quacking frog
	Crinia glauerti	Glauert's froglet / Clicking froglet
	Crinia pseudinsignifera	Bleating froglet
	Crinia subinsignifera	South coast froglet
	Geocrinia leai	Lea's frog
	Geocrinia lutea	Nornalup frog
	Geocrinia rosea	Roseate frog
	Heleioporus albopunctatus	Western spotted frog
	Heleioporus eyrei	Moaning frog
	Heleioporus inornatus	Whooping frog
	Heleioporus psammophilus	Sand frog
	Limnodynastes dorsalis	Pobblebonk / banjo frog
	Litoria adelaidensis	Slender tree frog

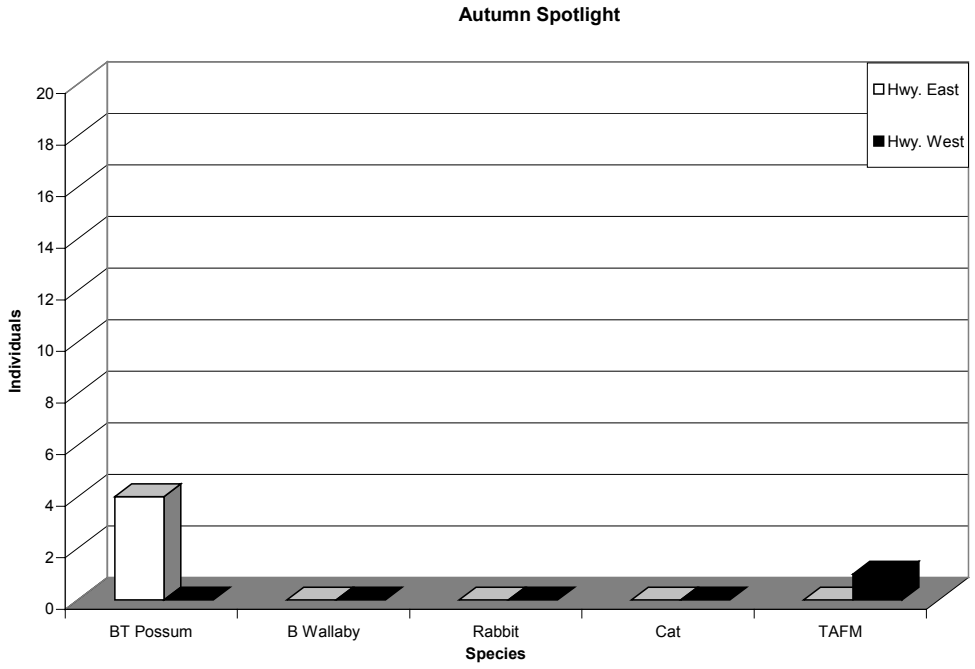
	Species (Scientific name)	Species (Common name)
	Litoria moorei	Motorbike frog / Western bell frog
	Metacrinia nichollsi	Nicholl's toadlet
	Pseudophryne guentheri	Günther's toadlet
Geckoes	*Diplodactylus polyophthalmus*	Speckled stone gecko
	Diplodactylus spinigerus	Western spiny-tailed gecko
	Phyllodactylus marmoratus	Marbled geko
	Underwoodisaurus milii	Thick-tailed geko / Barking geko
Legless lizards	*Aprasia pulchella*	Western granite worm lizard
	Apraisia repens	South western sandplain worm lizard
	Apraisia striolata	Striated worm lizard
	Antichinus flavipes	Marble-faced worm lizard
	Bettongia penicillata	Fraser's legless lizard
	Cercartetus concinnus	Burton's legless lizard
	Dasyurus geoffroii	Common scaly-foot
Monitors	Hydromys chrysogaster	Sand monitor/ Gould's goanna /Bungarra
	Isodon obesulus	Southern heath monitor
Skinks	Mus musculus	South-western cool skink
	Phascogale tapoatafa	Snake-eyed skink
	Pseudocheirus peregrinus	Chain-striped south-west ctenotus
	Rattus fuscipes	Darling range ctenotus
	Rattus norvegicus	Jewelled ctenotus
	Rattus rattus	Odd-striped ctenotus
	Sminthopsis crassidaudata	Red-legged ctenotus
	Sminthopsis griseoventor	King's skink
	Tarsipes rostratus	Mourning skink
	Trichosurus vulpecula	Southern sand skink
	Egernia napoleonis	Smiths skink
	Egernia pulchra	South western spectacled rock skink
	Glaphyromorphus gracilipes	
	Hemergis peronii	Peron's (lowland) earless skink
	Lerista distinguenda	South eestern orange-tailed slider
	Lerista microtis	South western slider
	Menetia greyii	Common dwarf skink
	Morethia lineocellata	Western pale flecked morethia
	Morethia obscura	Southern pale flecked morethia
	Tiliqua rugosa	Bobtail / Shingle back
Mammals	*Antechinus flavipes*	Mardo
	Bettongia penicillata	Woylie
	Cercartetus concinnus	Pygmy possum
	Dasyurus geoffroii	Chuditch
	Hydromys chrysogaster	Water-rat
	Isodon obesulus	Quenda
	Mus musculus	House mouse
	Phascogale tapoatafa	Brush-tailed phascogale
	Pseudocheirus occidentalis	Ngwayir / Western ringtail possum
	Rattus fuscipes	Bush rat
	Rattus norvegicus	Brown rat
	Rattus rattus	Black rat
	Sminthopsis crassidaudata	Fat-tailed dunnart
	Sminthopsis griseoventer	Dunnart
	Tarsipes rostratus	Honey possum
	Trichosurus vulpecula	Koomal / Common brushtail possum

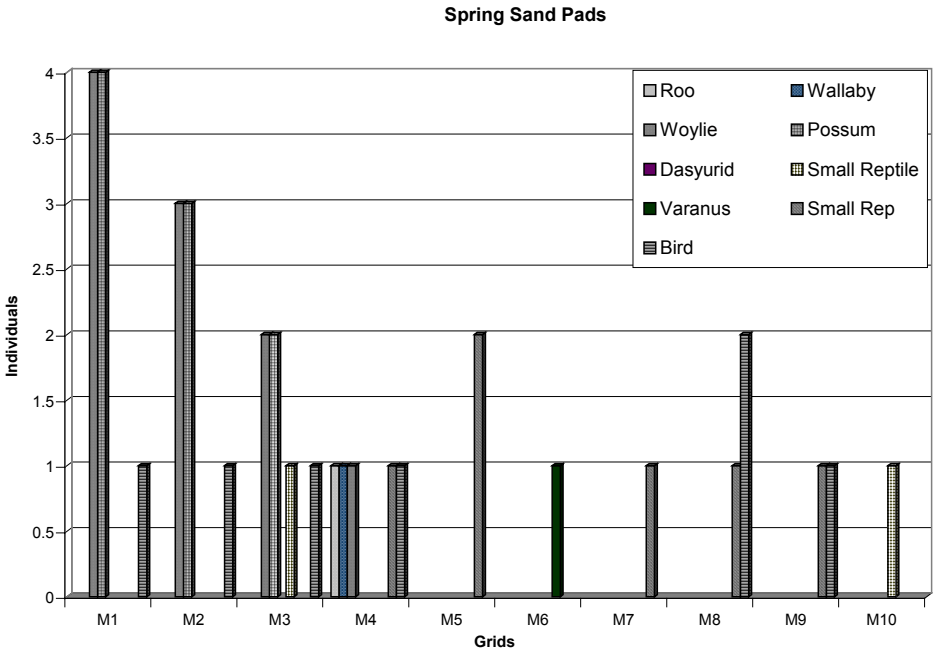
Note: Grids M1= Kingston Control; M2= Kingston Gap; M3= Kingston Shelterwood
M4= Kingston Coupe buffer; M5= Yornup Control; M6= Thornton Gap; M7= Thornton Coupe buffer; M8= Carter Gap; M9= Carter Coupe buffer and M10= Easter Control.

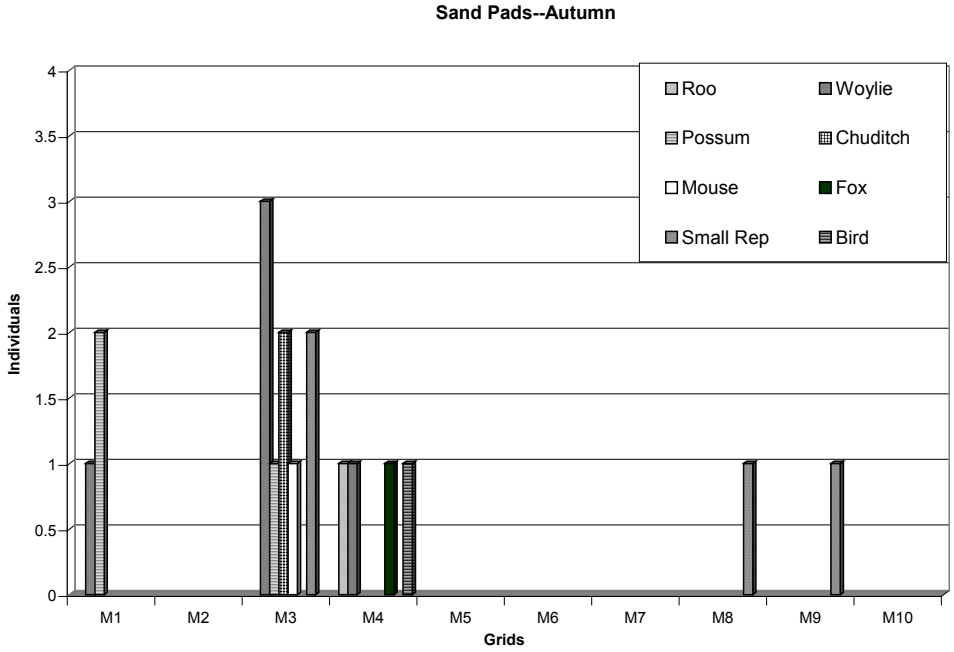


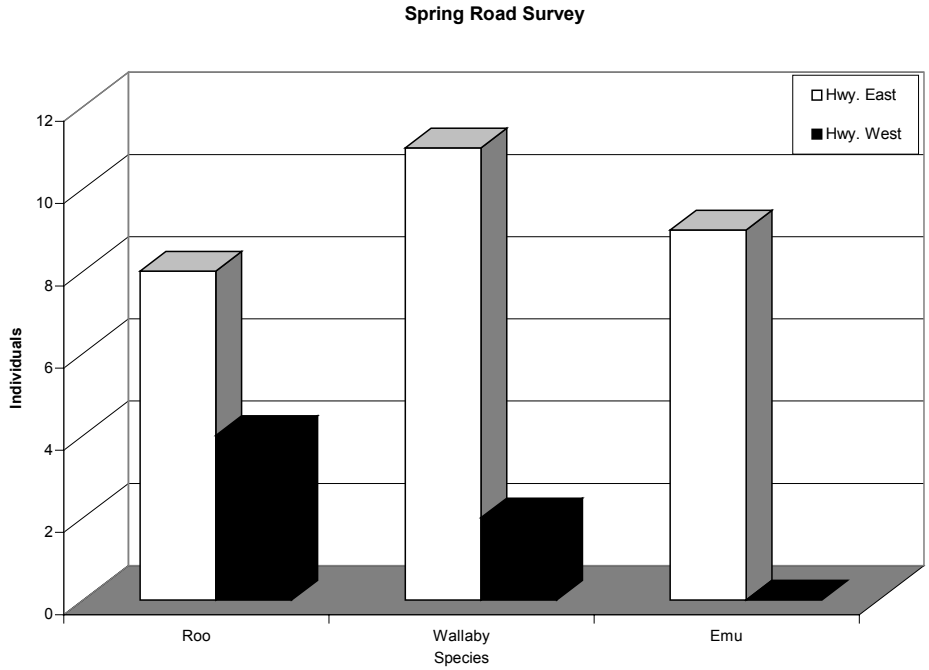


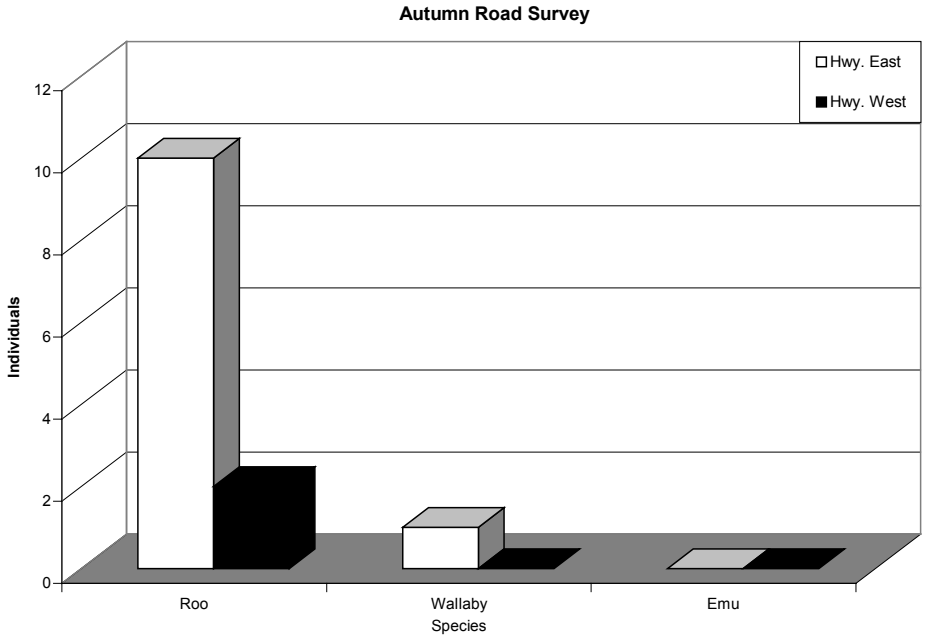

Spring Spotlight
Hwy. East
Hwy. West
Individuals
0
2
4
6
8
10
12
14
16
18
20
BT Possum
B Wallaby
Rabbit
Cat
TAFM
Species


Autumn Spotlight
Hwy. East
Hwy. West
Individuals
0
2
4
6
8
10
12
14
16
18
20
BT Possum
B Wallaby
Rabbit
Cat
TAFM
Species


Spring Sand Pads
Roo
Wallaby
Woylie
Possum
Dasyurid
Small Reptile
Varanus
Small Rep
Bird
Individuals
0
0.5
1
1.5
2
2.5
3
3.5
4
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
Grids


Sand Pads--Autumn
Roo
Woylie
Possum
Chuditch
Mouse
Fox
Small Rep
Bird
Individuals
0
0.5
1
1.5
2
2.5
3
3.5
4
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
Grids


Spring Road Survey
Hwy. East
Hwy. West
Individuals
0
2
4
6
8
10
12
Roo
Wallaby
Emu
Species


Autumn Road Survey
Hwy. East
Hwy. West
Individuals
0
2
4
6
8
10
12
Roo
Wallaby
Emu
Species

Sampling Methods
The main issue with sampling methods is the need to include wire cage trapping in spring as well as autumn.

The use of sand pads in the form used during this session was not adequate. We should revert to the approach stated in the operating plan and treat this technique as landscape monitoring and not try to impose it on individual treatments.

Future Tasks
Locate and set up next sites.

Revisions to Operating Plan
Add wire cage trapping to spring session for medium-sized mammals.

Increase sampling by sand pads to landscape scale as per macro-vertebrate survey.

It is difficult to pre-determine indicator species at this stage and it is preferred to sample all species.

INVERTEBRATES

Janet Farr, Allan Wills and Tom Burbidge

Introduction

Our objective was to sample invertebrate biodiversity for the FORESTCHECK grids in a manner that employed efficient use of available time and resources, effective coverage of habitats and thus potential diversity, and minimal specimen processing time. Two main capture techniques were employed; (1) Passive capture techniques used both light and pitfall traps; (2) Active techniques involved beating with a beating tray, sweeping with a net and habitat searches for set periods of time. Employing a wide range of habitats and sampling techniques maximized our chances of intercepting a wide range of species that may be limited by a single capture method. In addition known pest species (Gumleaf Skeletonizer, Jarrah leafminer and Bullseye borer) were recorded for each site.

Specimens from active and passive captures were sorted in the laboratory as this was considered the most efficient and accurate means of dealing with samples. Specimens were sorted to order and a morphospecies number assigned to differentiate between species. A reference collection was therefore established and a morphospecies master-list erected (Appendix 1) where Indicator Species (K) and those species with Gondwanan affinities (GA) and Gondwanan Relict (GR) species were assigned.

Sampling Issues

In our initial active sampling methods, habitat sampling was partitioned into: litter, coarse woody debris (CWD), ash beds, moss swards, tree boles and bark, and bare ground. However it very quickly became apparent that separation of habitats such as ash beds from CWD, and moss swards from litter and CWD was difficult, and in many cases sampling for each habitat was repetitive. In addition the yield from tree boles and bark was limited and therefore not time efficient. Therefore active habitat searches were reduced to 1 hr each for litter and CWD.

Beating and sweeping were initially partitioned into morning and afternoon sessions for each technique (1 hr each). This meant that for each site, beating and sweeping took 4 hrs. However morning sweeping often yielded little, if anything; and afternoon beating results could also be lean since insects were more active and difficult to catch (this was particularly evident in spring, with cool mornings and warm afternoons). Therefore beating was done in the morning and sweeping was confined to late morning or afternoon, taking a total of 2 hrs. Alternatively, we used 2 people for beating done in the afternoon to maximize insect capture. This allowed more than one plot to be done in a day and also allowed more flexibility to accommodate bad weather.

The passive capture techniques were also adjusted to more practical methods. Pitfall traps were initially to be left open for 24 hrs after which the contents would be bulked and collected for sorting. Due to low apparent capture levels during this period, we decided to open the pitfall traps for a 10 day period at all sites simultaneously. This expanded our capture window, made allowances for adverse weather, and allowed more flexibility in trap setting and closure.

Although the total effective light trap period of three nights remained unchanged, it initially involved a rotation cycle through the sites such that not all sites were trapped simultaneously. This was initially done to save on purchase of batteries; however, this method relied on more nights during the 3 week trapping period during which lights were operating and thus less opportunity for selecting good trapping nights or repeating a trapping session should there be light failure. It also required more site visits to clear traps. Also this method meant greater variability across sites as not all sites were trapped on the same night. The difficult weather during spring 2001 was in some ways fortunate as it gave us an example of a bad case sampling scenario at the outset of the project. This therefore forced us to reconsider our sampling regime to build flexibility into our system. Light traps were therefore set for 3 night periods simultaneously at

each site within the 3 week sampling period. This allowed us to adjust our trapping to accommodate lunar phases and weather extremes whilst maintaining continuity across sites. A longer period, for example a continuous trapping regime for 1 week across all sites, was considered inappropriate, as it would generate too large a sample for efficient sorting.

Specimen processing

During the initial sorting it quickly became apparent that a size threshold was required to restrict capture size to manageable levels. This was set at 10 mm with the exception of Gondwanan Relict (GR) and Gondwanan Affinity (GA) species (as identified in the Operating Plan) and in some cases some Indicator species. This size threshold halved the time needed to sort each sample. We determined indicator species as those invertebrates that were overtly distinctive, such that they are immediately recognizable and significantly notable. An attempt was also made to assign Indicator species to each major habitat (e.g. capture technique). Endemism was also considered (see also discussion on Indicator species in Operating Plan). With the exception of the pitfall samples, all samples were sorted and identified within the 3 week sampling period. An additional week was required after the sample sort and databasing to examine the reference collection, check morphospecies assignment and determine Indicator species.

Because of the large amount of material generated by the pitfall traps, the specimens in the traps from M1 and M2 areas (Kingston forest block, external control and gap treatments respectively) were enumerated. This resulted in

37 species with 1 individual specimen
11 species with 2 individual specimens
3 species with 3 individual specimens
1 species with 4 individual specimens
2 species with 5 individual specimens
1 species with 10 individual specimens and
1 species with 16 individual specimens

Of the total of 56 species, 37 were represented by only 1 specimen. We concluded that there was no merit in counting the abundance of each species.

Database establishment

It was inevitable that in the initial morphospecies assignment some specimens would be assigned a different species number when in fact they are the same. This presented the main problem in database establishment. In addition the pitfall trap samples were numbered using a different system. Thus some species can have 2 or more numbers, one of which can be from a different numbering system. Consequently we have 3 morphospecies names for each specimen, its original number, its pitfall trap number where appropriate, and its database working number. This makes database manipulation awkward.

Preliminary Results

We assigned 588 morphospecies (Table 1), of which 24 were recognized as potential Gondwanan relicts, 33 with Gondwanan affinity and 203 were Indicator species. Of the morphospecies sampled, Lepidoptera (209) and Coleoptera (111) were the most abundant and diverse orders, as would be expected (Table 1).

Light trapping resulted in the most abundant and diverse captures (Table 2), followed by pitfall trapping, sweep netting and beating (respectively). Species diversity and abundance were greatest in spring for all capture methods with the exception of coarse woody debris searches, where morphospecies numbers were comparatively similar between the two seasons and specimen abundance was greater in autumn.

Grid M9 (Carter buffer), showed the greatest spring diversity for active capture techniques, M7 (Thornton buffer) for light trapping and M1(Kingston control) for pitfall (Table 3). During autumn site M7 and M10 (Easter control) were most diverse for active capture techniques, M4 (Kingston buffer) for light trapping and M2 (Kingston gap) for pitfall (Table 3).

Spring specimen abundance was greatest at M9 for active capture techniques and M7 for light trapping (Table 4). Autumn abundance followed diversity with greatest abundance at M7 and M10 for active capture techniques and M4 for light trapping (Table 4).

The forest pest Jarrah leafminer was present at all sites and abundant at M1, M2 and M4 (Table 5). Evidence of Bullseye borer attack was present at all sites except M8. No evidence of Gumleaf Skeletonizer was found at any site.

Comparison of sampling methods used
Table 6 outlines capture efficiency and Table 7 summarizes the perceived advantages and disadvantages of techniques.

Future Tasks
All samples have been processed and data entered.

The morphospecies master list will need to be updated and revised as new information is gathered, particularly in respect to collection at new sampling sites.

Table 1. Number of morphospecies collected using active and passive capture techniques in spring-autumn 2001-2002, showing allocation of Gondwanan Relicts (GR), species with Gondwanan affinity (GA) and indicator species (K).

Order	No of Species	GR	GA	K
Amphipoda	1	1		
Annelida	1			
Araneae	7			1
Araneomorphae	7			2
Blattodea	26			15
Chilopoda	10			
Coleoptera	111	3	6	28
Dermaptera	8			5
Diplopoda	2			1
Diptera	46		12	7
Hemiptera	42			15
Hymenoptera	51		13	10
Isopoda	4	1		
Lepidoptera	209		2	99
Mantodea	3			1
Mecoptera	3	3		
Mygalomorphae	6	6		
Neuroptera	5	5		
Odonata	1	1		
Orthoptera	35			16
Phasmatodea	2			
Platyhelminthes	1			
Scorpionida	3			3
Trichoptera	4	4		
Total	588	24	33	203

Table 2. Number of morphospecies and specimen abundance in spring and autumn for each capture method (CWD = coarse woody debris search; - = not available).

Capture Method	No of Morphospecies		Abundance	
	Spring	Autumn	Spring	Autumn
Light	168	144	1511	1264
Pitfall	84	45	-	-
Sweep	78	27	150	60
Beat	77	18	119	59
CWD	24	29	50	78
Litter	36	24	72	32

Table 3. Number of morphospecies (diversity) captured at each site for active light and pit fall capture techniques in spring and autumn.

Site	Treatment	Active capture		Light trap		Pitfall	
		Spring	Autumn	Spring	Autumn	Spring	Autumn
M1	Control	13	8	59	54	30	9
M2	Gap	12	14	56	55	25	15
M3	Shelter	25	16	43	74	16	11
M4	Buffer	9	15	62	77	11	9
M5	Control	47	17	71	40	11	9
M6	Gap	29	17	66	52	15	8
M7	Buffer	27	23	84	57	23	5
M8	Gap	44	12	49	40	15	10
M9	Buffer	50	18	51	58	11	7
M10	Control	43	23	52	24	15	9

Table 4. Specimen abundance at each site for active and light capture techniques in spring and autumn.

Site	Treatment	Active capture		Light trap	
		Spring	Autumn	Spring	Autumn
M1	Control	17	9	120	92
M2	Gap	14	18	121	92
M3	Shelter	41	30	83	202
M4	Buffer	10	20	138	194
M5	Control	58	19	208	90
M6	Gap	40	22	175	150
M7	Buffer	37	30	211	154
M8	Gap	50	25	136	81
M9	Buffer	79	24	108	168
M10	Control	58	32	135	41

Table 5. Pest presence and abundance assessment at each site (JLM = Jarrah leafminer; GLS = Gumleaf Skeletonizer; BEB = Bullseye borer; 0 = absent, 1 = present, 2 = abundant).

Site	JLM	GLS	BEB
M1	2	0	1
M2	2	0	1
M3	1	0	1
M4	2	0	1

M5	1	0	1
M6	1	0	1
M7	1	0	1
M8	1	0	0
M9	1	0	1
M10	1	0	1

Table 6. Comparison of efficiency of collection methods.

Collection method	Number of individuals collected	Trap or collection time (hrs)	Process time excluding database and analysis (person hours)	Trap efficiency (individuals per collection hr)	Process efficiency (individuals per person hour)
SPRING					
Light	1511[1]	360	About 60 for trap tending About 90 for sample sort	4.2	10.1
Pitfall	84[2]	240	16 hours trap tending 150 hours sample sort	0.35	0.56
Sweep	150[1]	10	Active searches disrupted by rain.	15.0	Active searches disrupted by rain
Beat	119[1]	10	See as for Sweep above	11.9	See as for sweep above
CWD	50[1]	10	See above	5.0	See above
Litter	72[1]	10	See above	7.2	See above
AUTUMN					
Light	1264	360	About 90 for sample sort About 60 for trap tending	3.5	8.4
Pitfall	45[2] 24[2,3]	240	16 hours trap tending 120 hours sample sort	0.19 0.1[3]	0.38
Sweep	60	10	About 150 for field collection of combined active search samples. About 90 for sample sort of combined active search samples.	6.0	0.95 combined active search methods
Beat	59	10	See for sweep above	5.9	See above
CWD	78	10	See above	7.8	See above
Litter	32	10	See above	3.2	See above

Notes: 1 Includes some individuals smaller than acceptable size.
2. Number of species.
3. New species

Table 7. Summary of comparison of collection methods.

Collection method	Disadvantages of collection method	Advantages of collection method
Light	Collects only light attracted fauna. Faunal fidelity to survey site unknown	Abundant individuals collected: implies higher probabilities of collecting rare species. High process efficiency (small effort needed and overall costs are low per unit of information gathered).
Pitfall	Bias towards sampling most active species of ground fauna. Low capture and process efficiency	High faunal fidelity to survey site. Ability to capture species otherwise not captured with other methods
Sweep	Capture efficiency vulnerable to poor air temperature conditions (too hot or too cold for flying insects). Extremely low process efficiency due to small sample sizes (catch effort carries time penalty of travel between sites). Faunal fidelity to survey site unknown	Good catch efficiency in suitable conditions (acceptable samples can be gathered relatively quickly).
Beat	Extremely low process efficiency due to small sample sizes (catch effort carries time penalty of travel between sites). Upper canopy not sampled.	Good catch efficiency (acceptable samples can be gathered relatively quickly). Less affected by air temperature and rain than sweep. High faunal fidelity to survey site.
CWD	Extremely low process efficiency due to small sample sizes (catch effort carries time penalty of travel between sites). Only a superficial sample of CWD fauna.	Good catch efficiency (acceptable samples can be gathered relatively quickly). Relatively unaffected by air temperature and rain. High faunal fidelity to survey site.
Litter	Extremely low process efficiency due to small sample sizes (catch effort carries relatively large penalty of unproductive time in travel between sites). Duplication of pitfall sampling?	Good catch efficiency (acceptable samples can be gathered relatively quickly) Relatively unaffected by air temperature and rain. High faunal fidelity to survey site.

Appendix 1. Morphospecies list for invertebrates

Spec #	Order	Family	Tax 3	Genus	Species	Status
1	Lepidoptera	Carthaeidae		*Carthaea*	*saturnioides*	K
2	Lepidoptera	Geometridae	Oenochrominae	*Arhodia*	sp	K
3	Lepidoptera	Thaumetopoeidae		*Epicoma*	*melanosticta*	K
4	Lepidoptera	Notodontidae		*Destolmia*	*lineata*	K
5	Lepidoptera					
6	Lepidoptera	Arctiidae				K
7	Lepidoptera	Thaumetopoeidae		*Ochrogaster*	sp 1	K
8	Lepidoptera	Thaumetopoeidae		*Ochrogaster*	sp 2	K
9	Lepidoptera	Thaumetopoeidae		*Ochrogaster*	sp 3	K
10	Lepidoptera	Thaumetopoeidae		*Ochrogaster*	*lunifer*	K
11	Lepidoptera	Thaumetopoeidae		*Ochrogaster*	sp 4	K
12	Lepidoptera	Geometridae				K
13	Coleoptera	Dytiscidae			447	
14	Coleoptera	Hydrophilidae				
15	Coleoptera	Elateridae				
16	Diptera	Tipulidae				K
17	Coleoptera	Scarabeidae		*Onthophagus*	*ferox*	K
18	Lepidoptera	Noctuidae		*Agrotis*	*munda*	K
19	Lepidoptera	Geometridae		*Chlorocoma*	*dicloraria*	K
20	Lepidoptera					

21	Lepidoptera				
22	Lepidoptera	Geometridae	*Chlorocoma*	sp	K
23	Lepidoptera	Geometridae			K
24	Lepidoptera	Geometridae			K
25	Lepidoptera				
26	Coleoptera	Elateridae			
27	Blattodea	Blaberidae	*Cololampra*	sp	K
28	Coleoptera	Melolonthinae	*Heteronyx*	sp 1	
29	Coleoptera	Melolonthinae	*Heteronyx*	sp 2	
30	Lepidoptera	Noctuidae	*Dasypodia*	*selenophora*	
31	Lepidoptera	Geometridae	*Parepisparis*	*excusata*	K
32	Lepidoptera	Thaumetopoeidae			K
33	Lepidoptera				
34	Lepidoptera	Lymantriidae	*Teia*	*athlophora*	K
35	Lepidoptera	Thaumetopoeidae	*Ochrogaster*	sp 5	K
36	Lepidoptera	Thaumetopoeidae	*Ochrogaster*	sp 6	K
37	Lepidoptera				K
38	Lepidoptera				
39	Lepidoptera	Noctuidae			K
40	Lepidoptera	Noctuidae	*Persectania*	sp	K
41	Lepidoptera	Geometridae			K
42	Lepidoptera	Geometridae	*Gastrina*	*cristaria*	K
43	Lepidoptera	Pyralidae ?			K
6	Lepidoptera	Arctiidae			K
45	Lepidoptera	Zygaenidae	*Pollanisus*	*viridipulverulenta*	K
46	Lepidoptera	Geometridae			
47	Lepidoptera	Geometridae			
48	Lepidoptera				
49	Hemiptera	Cicadidae	*Cicadetta*	sp	
50	Lepidoptera	Geometridae			K
51	Diptera	Muscoidea			
52	Hymenoptera	Apidae	*Apis*	*melifera*	K
53	Diptera	Calliphoridae	*Calliphora*		
54	Diptera	Syrphidae			
55	Coleoptera	Dytiscidae			
56	Coleoptera	Chrysomelidae			
57	Lepidoptera	Notodontidae	*Danima*	*banksiae*	K
58	Lepidoptera	Notodontidae			K
59	Lepidoptera	Geometridae			K
60	Lepidoptera				
61	Lepidoptera				
62	Lepidoptera				K
63	Lepidoptera				
64	Lepidoptera	Oecophoridae			K
65	Lepidoptera				
66	Lepidoptera	Geometridae			
67	Lepidoptera				
68	Diptera	?			
69	Trichoptera				GR
70	Coleoptera	Melolonthinae	*Heteronyx*	sp 3	

71	Lepidoptera					
72	Lepidoptera	Geometridae				
73	Lepidoptera					
74	Lepidoptera	Noctuidae				
75	Lepidoptera	Noctuidae				
76	Lepidoptera					
77	Lepidoptera					
78	Lepidoptera	Zygaenidae		*Pollanisus*	*viridipulverulenta*	K
79	Lepidoptera	Geometridae	Oenochrominae	*Arhodia*	sp	K
80	Lepidoptera					K
81	Lepidoptera	Limacodidae		*Doratifera*	sp	K
82	Lepidoptera	Geometridae				
83	Lepidoptera	Geometridae				
84	Lepidoptera	Pyralidae		*Uresiphita*	*ornithopteralis*	K
85	Lepidoptera	Geometridae				
86	Lepidoptera	Geometridae				
87	Hymenoptera	Ichneumonidae		*Ophion*	sp	GA
88	Diptera	Pyrgotidae				K
89	Mecoptera	Meropeidae		*Austromerope*	*poultoni*	GR
90	Lepidoptera	Limacodidae				K
91	Lepidoptera	Anthelidae		*Chenuala*	sp	K
92	Lepidoptera	Tortricidae ?				
93	Coleoptera	Carabidae				
94	Coleoptera	Melolonthinae		*Heteronyx*	sp 4	
95	Lepidoptera	Geometridae				
96	Lepidoptera	Geometridae				
97	Lepidoptera	Geometridae				
98	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*	sp	
99	Coleoptera	Lycidae		*Metriorrhynchus*	sp	K
100	Coleoptera	Curculionoidea	Belidae			GR
101	Coleoptera	Chrysomelidae				
102	Coleoptera	Curculionidae				
103	Coleoptera	Curculionidae				
104	Lepidoptera					
105	Hemiptera	Pentatomidae				K
106	Orthoptera	Tettigoniidae				K
107	Hemiptera					
108	Hemiptera	Membracidae				K
109	Hemiptera					
110	Hemiptera					
111	Lepidoptera					
112	Coleoptera	Chrysomelidae	Paropsinae			
113	Coleoptera	Curculionidae				
114	Coleoptera	Curculionidae				
115	Coleoptera	Chrysomelidae				
116	Coleoptera	?				
117	Hemiptera	Pentatomidae				
118	Orthoptera	Tettigoniidae				
119	Blattodea	Blaberidae		*Calolampra*	sp 1	K
120	Blattodea	Blatellidae		*Neotemnopteryx*	sp	K

121	Blattodea	Blatellidae		*Platyzosteria*	sp 1	K
122	Blattodea	Blatellidae		*Platyzosteria*	sp 2	K
123	Dermaptera					K
124	Coleoptera	Curculionidae	Gonipterinae			
125	Diptera	Drosophilidae				
126	Diptera	Tabanidae				
127	Diptera	?				
128	Diptera	Muscoidea				
129	Diptera	Syrphidae				
130	Diptera	Syrphidae				
131	Neuroptera	Hemerobeidae				GR
132	Mantodea					
133	Lepidoptera	Noctuidae				
134	Diptera	Muscoidea				
135	Coleoptera	Elateridae				
136	Diptera	Tachinidae				K
137	Lepidoptera	Noctuidae				
138	Lepidoptera					
139	Lepidoptera	Noctuidae				
140	Lepidoptera	Noctuidae				
141	Lepidoptera	Tineidae		*Moerarchis*	*australasiella*	K
142	Diptera	Therevidae				K
143	Diptera	Syrphidae				
144	Trichoptera					GR
145	Trichoptera					GR
145	Trichoptera					GR
147	Blattodea	Blaberidae		*Calolampra*	sp 2	
148	Blattodea	Blaberidae				
149	Orthoptera	Tettigoniidae				K
150	Hemiptera	Reduvidae				K
151	Trichoptera					GR
6	Lepidoptera	Arctiidae			6	K
153	Hemiptera	Pentatomidae				
154	Coleoptera	Melolonthinae		*Liparetrus*	sp	
155	Coleoptera	Chrysomelidae				
156	Coleoptera	Curculionidae				
157	Coleoptera	Curculionidae	Rhadinosominae	*Rhadinosomus*	sp	K
158	Coleoptera	?				
159	Coleoptera	?				
160	Coleoptera	Curculionidae	Gonipterinae	*Gonipterus*	sp	
161	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*	*fasciata*	K
162	Coleoptera	Scarabaeidae	Melolonthinae	*Liparetrus*	*jenkinsi*	
163	Hemiptera	Reduviidae				
164	Hemiptera					
165	Diptera	Asilidae				GA
166	Hemiptera					
167	Orthoptera	Tettigoniidae				
168	Coleoptera	Belidae		*Belus*	*suturalis*	GR
169	Coleoptera	Curculionidae				
170	Hemiptera					

171	Coleoptera	Scarabaeidae	Melolonthinae	*Liparetrus*	sp	
172	Coleoptera	Scarabaeidae	Melolonthinae	*Heteronyx*	sp	
173	Coleoptera	?				
174	Orthoptera					
175	Coleoptera	Chrysomelidae	Paropsinae			
176	Hemiptera	Pentatomidae				
177	Hemiptera					
178	Diptera	Tabanidae				GA
179	Diptera	Drosophilidae				
180	Orthoptera	Grillidae				K
181	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*	sp	
182	Coleoptera	Chrysomelidae				
183	Hymenoptera	Colletidae				K
184	Hymenoptera	Doryctinae				
185	Lepidoptera	Noctuidae		*Periscepta*	*polystieta*	K
186	Hymenoptera	Colletidae				K
187	Hemiptera					
188	Hemiptera					
189	Coleoptera	Scarabeidae	Dynastinae	*Cryptodus*	sp	K
190	Blattodea	Blatidae				K
191	Coleoptera	Phycosecidae	Phycosecis			
192	Coleoptera	Tenebrionidae	Lagriinae	*Lagria*	*aneouiobcea*	GA
193	Coleoptera	Coccinellidae		*Coccinella*	*repanda*	
194	Coleoptera	?				
195	Diptera	?				
196	Hemiptera	Reduviidae				
197	Lepidoptera					
198	Coleoptera	Lycidae				
199	Coleoptera	Curculionidae				
200	Hemiptera					
201	Coleoptera	Belidae				GR
202	Orthoptera	Tettigoniidae				
203	Hymenoptera	Colletidae				
204	Diptera	Asilidae				GA
205	Diptera	Muscoidea				
206	Diptera	Syrphidae				
207	Hemiptera	Cicadidae		*Cicadetta*	sp	K
208	Coleoptera	Lycidae		*Metriorrhynchus*	sp	K
209	Coleoptera	Curculionidae				K
210	Coleoptera	Curculionidae				
153	Hemiptera	Pentatomidae				
212	Coleoptera	Scarabeidae	Melolonthinae	*Liparetrus*	sp	
163	Hemiptera	Reduviidae				
214	Coleoptera	Curculionidae				
215	Coleoptera	?				
216	Orthoptera	Gryllidae				
217	Diptera	Asilidae				GA
218	Orthoptera	Tetigoniidae				K
219	Blattodea	Blattidae		*Platyzosteria*		K
220	Coleoptera	Elateridae				

221	Hemiptera	Pentatomidae				
222	Hymenoptera	Formicidae		*Myrmecia*	sp 2	
223	Chilopoda					
224	Chilopoda					
225	Chilopoda					
226	Chilopoda					
227	Chilopoda					
228	Chilopoda					
229	Chilopoda					
230	Hemiptera	Pseudococcidae				
231	Orthoptera	Acrididae				K
232	Orthoptera	Acrididae				K
233	Orthoptera	Acrididae		*Goniaea*	sp	K
174	Orthoptera	Acrididae				K
235	Orthoptera	Acrididae				K
236	Lepidoptera					
237	Odonata	Zygoptera				GR
238	Lepidoptera					
239	Hemiptera					
240	Hemiptera	Pentatomidae				K
241	Hemiptera					
242	Diptera	Syrphidae				
243	Hymenoptera	Evaniidae				
244	Coleoptera	Curculionidae				K
245	Diptera	Bombyliidae				K
246	Orthoptera	Tetigoniidae				K
247	Coleoptera	Curculionidae				
248	Coleoptera	Chrysomelidae	Paropsinae			
249	Hemiptera					
250	Mecoptera	Bittacidae		*Harpobittacus*	sp	GR
251	Hemiptera	Pentatomidae				
252	Hymenoptera	Formicidae		*Myrmecia*	sp 1	
253	Coleoptera	Carabidae				
254	Blattodea	Blattidae		*Platyzosteria*	sp	
232	Orthoptera	Acrididae		*Goniaea*	sp	K
235	Orthoptera	Acrididae				K
257	Dermaptera					K
258	Dermaptera					K
259	Diplopoda					
260	Diplopoda					K
261	Amphipoda					GR
262	Isopoda					GR
258	Dermaptera					K
264	Coleoptera	Carabidae	Harpalinae	*?Cenogmus*	sp	GA
265	Coleoptera	Carabidae	Esydrinae			GA
266	Blattodea	Blattidae		*Platyzosteria*		K
267	Chilopoda					
268	Orthoptera	Tettigoniidae				
269	Blattodea					
270	Hemiptera	Reduviidae				

271	Araneae					
235	Orthoptera	Acrididae				K
235	Orthoptera	Acrididae				K
235	Orthoptera	Acrididae				K
275	Hymenoptera	Formicidae		*Iridomyrmex*	sp 3	
276	Orthoptera					
277	Chilopoda					
278	Orthoptera					
279	Hymenoptera	Formicidae		*Myrmecia*	sp 4	
280	Coleoptera	Carabidae		*Carenum*	sp	GA
281	Hymenoptera	Formicidae		*Myrmecia*	sp 3	
282	Blattodea	Blattidae		*Platyzosteria*	sp	K
283	Mygalomorphae					GR
284	Hemiptera	Reduviidae				K
285	Araneae					
286	Araneae	Araneomorphae	Sparassidae			
287	Coleoptera	Scarabeidae				
288	Coleoptera	Carabidae		*Chlaenius*		GA
289	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*	sp	
290	Coleoptera	Curculionidae				K
291	Coleoptera	Curculionidae	Molytinae	*Tranes*	sp	K
292	Blattodea	Blaberidae		*Laxta*		K
293	Orthoptera	Acrididae		*Phaulacridium*	*vitatum*	K
294	Orthoptera	?				
295	Hymenoptera	Pompilidae				
296	Lepidoptera	Lycinidae				K
52	Hymenoptera	Apidae		*Apis*	*melifera*	K
297	Lepidoptera	Nymphalidae	Heteronympha	*Merope*	*duboulayi*	K
299	Coleoptera	Buprestidae				K
300	Coleoptera	Curculionidae	Amycterinae			K
301	Hemiptera	Membracidae				K
302	Hemiptera	Membracidae				K
303	Phasmatodea					
304	Orthoptera	Acrididae		*Goniae*		K
305	Neuroptera	Mermelontidae				GR
306	Lepidoptera	Nymphalidae		*Geitoneura*	*klugit*	K
307	Coleoptera	Chrysomelidae	Paropsinae			K
308	Coleoptera	Chrysomelidae	Paropsinae			K
309	Mantodea					
310	Orthoptera					
311	Hemiptera	Reduviidae				K
312	Diptera	Asilidae				GA
312	Diptera	Asilidae				GA
314	Orthoptera					
315	Lepidoptera					
316	Lepidoptera					
317	Lepidoptera	Geometridae				
318	Lepidoptera	Geometridae				
319	Lepidoptera	Tineidae		*Moerarchis*	*clathrella*	K
320	Lepidoptera	Geometridae		*Arhodia*	sp	K

321	Lepidoptera	Geometridae				K
322	Lepidoptera	Limacodidae		*Doratifera*	*quadirguttata*	K
323	Lepidoptera	Geometridae				
324	Lepidoptera	Tineidae		*Moerarchis*	sp	K
325	Lepidoptera	Psychidae		*Iphierga*	*euphragma*	K
326	Lepidoptera	Geometridae				
327	Lepidoptera	Geometridae				
328	Lepidoptera	Saturnidae		*Opodiphthera*	*helena*	K
329	Lepidoptera	Noctuidae				K
330	Lepidoptera	Geometridae		*Crypsiphora*	*ocultaria*	K
331	Lepidoptera	Oecophoridae		*Wingia*	*aurata*	K
332	Lepidoptera	Lymacodidae		*Doratifera*	sp	K
333	Lepidoptera	Pyralidae				
334	Lepidoptera	Geometridae		*Gastrina*	*cristarina*	K
89	Mecoptera	Meropeidae		*Austromerope*	*poultoni (male)*	GR
336	Lepidoptera	Noctuidae		*Chrysodeixis*	*argentifera*	K
337	Lepidoptera					
338	Lepidoptera	Geometridae				
339	Lepidoptera	Geometridae				
340	Coleoptera	Carabidae	Chlaeniiae			
341	Lepidoptera	Pyralidae				
342	Lepidoptera	Pyralidae				
343	Hymenoptera	Formicidae		*Myrmecia*	sp 5	
344	Lepidoptera	Noctuidae				K
345	Lepidoptera					K
346	Lepidoptera	Noctuidae				K
347	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*		
340	Coleoptera	Carabidae	Chlaeniiae			
349	Coleoptera	Curculionidae				K
350	Lepidoptera					
351	Coleoptera	Cerambycidae		*Uracantha*	*triangularis*	K
352	Lepidoptera	Anthelidae		*Anthela*	sp	K
353	Coleoptera	Scarabeidae		*Colpochila*	sp	K
354	Coleoptera	Scarabeidae		*Cryptodus*	*dynastinae*	K
355	Lepidoptera	Geometridae				
356	Lepidoptera	Pyralidae				
357	Lepidoptera	Geometridae		*Eucyclodes*	*buprestaria*	K
358	Lepidoptera	Geometridae				
359	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*		
360	Neuroptera	Hemerobiidae				GR
361	Neuroptera	Chrysopidae		*Chrysopa*		GR
362	Lepidoptera					
363	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*		
364	Lepidoptera	Noctuidae				
365	Lepidoptera	Pyralidae				
366	Lepidoptera					
367	Lepidoptera					
368	Coleoptera	Curculionidae	Amycterinae			K
369	Lepidoptera					
370	Lepidoptera	Notodontidae		*Hylaeora*	*dilucida*	K

371	Lepidoptera	Lasiocampidae		*Entometa*	*fervens*	K
372	Lepidoptera	Hepialidae		*Abantiades*	*hydrographis*	GA
373	Lepidoptera	Hepialidae		*Abantiades*	*ocellatus*	GA
374	Lepidoptera	Notodontidae				K
375	Lepidoptera	Geometridae				K
376	Lepidoptera					
377	Lepidoptera	Geometridae		*Phallaria*	*ophiusaria*	K
373	Lepidoptera	Hepialidae		*Abantiades*	*ocellatus*	GA
379	Lepidoptera	Noctuidae		*Peripyra*	*sanguinipucta*	K
380	Lepidoptera					
381	Lepidoptera	Anthelidae				K
382	Lepidoptera					
383	Lepidoptera					
384	Lepidoptera	Geometridae		*Pholodes*	sp 1	K
385	Lepidoptera	Geometridae		*Pholodes*	sp 2	K
386	Lepidoptera	Noctuidae				
387	Lepidoptera					
388	Lepidoptera	Noctuidae		*Pantydia*	sp	
389	Lepidoptera	Geometridae				K
390	Lepidoptera	Notodontidae				K
391	Lepidoptera	Noctuidae				
392	Lepidoptera	Geometridae				K
393	Lepidoptera	Geometridae				K
394	Lepidoptera					
395	Lepidoptera	Geometridae				
396	Lepidoptera	Oecophoridae				
397	Lepidoptera	Pyralidae				
398	Lepidoptera	Limacodidae		*Doratifera*	sp	K
399	Lepidoptera					
400	Neuroptera	Myremeleontidae				GR
401	Lepidoptera	Pyralidae				
402	Lepidoptera	Geometridae				
403	Lepidoptera	Geometridae				K
404	Lepidoptera	Thaumetopoeidae		*Oenosandra*	sp	K
405	Lepidoptera	Noctuidae				
406	Lepidoptera					
407	Lepidoptera					
408	Hymenoptera					
409	Hymenoptera	Formicidae				
410	Blattodea	Blaberidae				K
411	Lepidoptera					
412	Lepidoptera	Noctuidae				K
413	Lepidoptera					
414	Lepidoptera					
415	Lepidoptera	Geometridae				K
416	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*	sp	
417	Lepidoptera	Geometridae		*Gastrina*	sp	K
418	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*	sp	
419	Lepidoptera					
420	Lepidoptera					

421	Lepidoptera					
422	Lepidoptera					
423	Hymenoptera	Formicidae	Dolichoderinae	*Iridomyrex*	sp 2	K
424	Lepidoptera	Geometridae				K
425	Lepidoptera	Geometridae				K
426	Lepidoptera	Lasiocampidae		*Entometa*	sp	K
427	Coleoptera	Scarabeidae	Melolonthinae	*Heteronyx*		
428	Lepidoptera					
429	Lepidoptera					
430	Lepidoptera					
431	Lepidoptera					
432	Lepidoptera	Pyralidae				K
433	Mantodea	Mantidae		*Archimantis*	sp	K
434	Lepidoptera					
435	Lepidoptera	Noctuidae				K
436	Lepidoptera	Geometridae				K
437	Coleoptera	Lucanidae		*Syndesus*	sp	K
438	Lepidoptera					
439	Coleoptera	Carabidae	Carabinae			GA
440	Coleoptera	Dytiscidae				
441	Lepidoptera					
442	Lepidoptera					
443	Lepidoptera					
444	Coleoptera	Elateridae				
445	Lepidoptera	Artctiidae	Arctiinae	*Spilosoma*	sp	K
446	Lepidoptera					K
13	Coleoptera	Dytiscidae				
368	Coleoptera	Curculionidae	Amycterinae			K
449	Lepidoptera	Noctuidae				K
450	Lepidoptera	Geometridae		*Thalaina*	*clara*	K
451	Lepidoptera	Geometridae				K
452	Lepidoptera					K
453	Lepidoptera					
454	Lepidoptera					
455	Lepidoptera	Geometridae		*Gastrina*	*cristaria*	
456	Lepidoptera					
457	Lepidoptera	Anthelidae				K
458	Phasmatodea					
459	Lepidoptera					
460	Lepidoptera					
437	Coleoptera	Lucanidae		*Syndesus*	sp	K
462	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*		
463	Coleoptera	Chrysomelidae	Paropsinae			K
464	Diptera	Tachinidae				K
465	Coleoptera	Chrysomelidae	Paropsinae			K
466	Diptera	Tabanidae				
467	Diptera	Tabanidae				GA
468	Araneae					K
469	Scorpionida				Scorpion sp 2	K
470	Coleoptera	Curculionidae	Gonipterinae	*Oxyops*		

471	Coleoptera	Chrysomelidae	Paropsinae	*Chrysophtharta*		
472	Araneae					
473	Diptera	Tabanidae				
52	Hymenoptera	Apidae		*Apis*	*melifera*	K
475	Hemiptera	Pentatomidae				K
476	Coleoptera	Cerambycidae	Laminae			
477	Hymenoptera	Formicidae		*Myrmecia*	*callima*	K
478	Hymenoptera	Formicidae		*Myrmecia*	sp 7	K
479	Blattodea	Blaberidae				
480	Diptera	Calliphoridae		*Calliphora*		
481	Hymenoptera	Pompilidae				GA
482	Hemiptera	Reduviidae				K
483	Blattodea	Blaberidae				
484	Dermaptera					K
485	Orthoptera					
486	Hymenoptera	Formicidae		*Myrmecia*	sp 1	
487	Hymenoptera	Formicidae		*Myrmecia*	sp 6	
488	Coleoptera	Curculionidae	Gonipterinae	*Gonipterus*		
489	Hemiptera					K
490	Blattodea					
491	Dermaptera					
492	Dermaptera					
493	Hymenoptera	Braconinae				K
494	Hymenoptera	Pompilidae				
495	Diptera	Tabanidae				
496	Coleoptera	Curculionidae	Amycterinae			K
497	Araneae					
498	Diptera	Muscoidea				
52	Hymenoptera	Apidae		*Apis*	*melifera*	K
500	Hymenoptera	Evaniidae				K
501	Orthoptera	Acrididae				K
502	Araneae					
503	Hemiptera	Eurymelidae		*Pogonoscopus*	sp	K
504	Hymenoptera					
505	Hymenoptera	Sphecidae				K
506	Diptera	Bombylidae				K
507	Blattodea					
508	Blattodea					K
509	Blattodea					
510	Hymenoptera	Formicidae				
511	Coleoptera	Scarabeidae		*Onthophagus*		
512	Hemiptera	Reduviidae				K
513	Hemiptera	Pentatomidae				K
514	Coleoptera	Curculionidae				
515	Hymenoptera	Ichneumonidae				GA
516	Hymenoptera	Pompilidae				
517	Lepidoptera	Geometridae				
518	Lepidoptera	Noctuidae				
519	Isopoda	collective sp				
520	Annelida	collective sp				

521	Platyhelminthes					
522	Dermaptera					
525	Blattodea	Blattidae				K
526	Orthoptera	Stenopelmatidae		*Onosandrus*	sp	K
527	Hemiptera	Gelastocoridae		*Nerthra*	sp	
528	Coleoptera	Carabidae				K
529	Coleoptera	Carabidae				K
530	Diptera	Anthomyiidae				
531	Diptera	Tabanidae				GA
532	Diptera	Asilidae				GA
533	Hymenoptera	Ichneumonidae	Branchinae	*Australoglypta*	sp	
534	Hymenoptera	Mutilidae				
535	Hymenoptera	Formicidae	Dolichoderinae	*Iridomyrmex*	sp 1	
536	Araneomorphae	Corinnidae		*Supunna*	*albopunctata*	K
537	Araneomorphae	Corinnidae		*Supunna*	*picta* sp1	K
538	Mygalomorphae	Nemesiidae			juvenile	GR
539	Isopoda					
540	Isopoda					
541	Diptera	Asilidae				GA
542	Hymenoptera	Formicidae	Ponerinae	*Prionopella*	sp	
543	Hymenoptera	Formicidae	Poneri	*Rhytidoponera*	sp	
545	Hymenoptera	Colletidae				
546	Hymenoptera	Colletidae				
547	Blattodea	Blaberidae		*Laxta*	sp 2	K
548	Orthoptera	Acrididae				
550	Coleoptera	Scarabaeidae	Melolonthinae			
552	Hymenoptera	Formicidae	Myrmeciinae	*Myrmecia*	sp 1	
553	Araneomorphae	Ctenidae				
554	Araneomorphae	Lycosidae				
555	Orthoptera	Gryllidae				
557	Coleoptera	Carabidae				K
558	Coleoptera	Carabidae	Pentagonicinae	*Scapodes*	*boops*	
560	Araneomorphae	Gnaphosidae				
562	Coleoptera	Scarabaeidae	Melololonthinae	*Heteronyx*	sp	
564	Diptera	Asilidae				GA
565	Diptera	Syrphidae				
567	Mygalomorphae	Nemesiidae		*Chenistonia*	sp 1	GR
568	Scorpionida				Scorpion sp 1	K
570	Blattodea	Blaberidae			sp 4	K
571	Coleoptera	Elateridae				
573	Hemiptera	Reduviidae				
576	Orthoptera	Acrididae		*Cedarinia*	sp 2	
577	Diptera	Tipulidae				
579	Diptera	Sarcophagidae				
580	Hymenoptera	Mutilidae				
581	Mygalomorphae	Nemesiidae		*Chenistonia*	sp 2	GR
584	Hymenoptera	Tiphiidae				GA
585	Mygalomorphae	Nemesiidae			juvenile	GR
587	Coleoptera	Carabidae				K
588	Diptera	Tipulidae				

589	Lepidoptera	Noctuidae			
590	Mygalomorphae		*Nemesiidae*	juvenile	GR
591	Blattodea	Blatellidae	*Neotemnopteryx*	sp	
592	Blattodea	Blattidae	*Polyzosteria*	sp	
593	Lepidoptera	Hesperiidae	*Hesperilla*	*chrysotricha*	K
594	Lepidoptera	Nymphalidae	*Vanessa*	*kershawi*	K
596	Hymenoptera	Colletidae			
597	Araneomorphae	Miturgidae	*genus2*	sp 1	
598	Lepidoptera	Noctuidae			
603	Diptera	Tabanidae			GA
604	Hymenoptera	Tiphiidae			GA
607	Hymenoptera	Pompilidae			GA
608	Orthoptera	Gryllidae			
609	Orthoptera	Gryllidae			
611	Hymenoptera	Pompilidae			GA
612	Hymenoptera	Pompilidae			GA
613	Orthoptera	Acrididae			
614	Hymenoptera	Tiphiidae			GA
616	Hymenoptera	Pompilidae			GA
617	Hymenoptera	Pompilidae			GA
618	Orthoptera	Gryllidae			
619	Hymenoptera	Pompilidae			GA
620	Araneomorphae	Trochanteridae	*Rebilus*	sp	
621	Coleoptera	Elateridae			
622	Hymenoptera	Pompilidae	*Cryptocheilus*	*fabricolor*	GA
623	Chilopoda				
628	Coleoptera	Staphylinidae			K
629	Scorpionida			Scorpion sp 3	K

PLANTS

Bruce Ward and Ray Cranfield

Introduction
The objective of this report is to present preliminary results of the first stage of monitoring for FORESTCHECK and to discuss any issues with the concept plan for monitoring protocols. Three sites (10 grids) from within the Donnelly District were selected and set up as monitoring sites according to the operations plan. Four plots each of 1 000 m^2 and twenty x 1 m^2 were used to record species richness and abundance of vascular plants. A point transect was used on two sides of the 30 m x 30 m plots to record vegetation structure and were vertical contacts of shrubs at every 2 m intervals for 60 m (2 sides). This gave a total of 120 records per grid.

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

Sampling
Vegetation in the FORESTCHECK grids was sampled in accordance with the operations plan. Species richness was assessed using four 30 m x 30 m plots in each grid (40 in total) and species abundance from twenty 1 m x 1 m plots (200 in total) (Fig. 1). 158 species were identified for the 1 m x 1 m quadrats and 203 for the 30 x 30 m quadrats and a complete list is attached (Appendix 1).

Time estimates to complete the task were accurate and were based on experience from the Kingston study where similar plots were measured. Time estimates were designed around a two-person team, which from experience is the most efficient method of sampling.

Cost estimates were also based on experience from the Kingston study and resulted in the work being completed within budget. The next site will need a careful review of the budget required as travel and accommodation costs will increase with the greater distance from Manjimup Research Centre.

Sampling Issues
Our brief was to monitor plant species abundance and species richness. We recommend that we include in addition to what is already being measured the "Bragg" system of rating cover, distribution and density for all species within the 30 m x 30 m plots. This system is quite sensitive and can provide data on all species, which will give a better measure of species abundance. Relying on the 1 m x 1 m quadrats for abundance will provide detail about the number of individual plants, but does not describe cover and does not pick up all species. Only 75% of the species were recorded in these quadrats compared with the 30 m x 30 m plots.

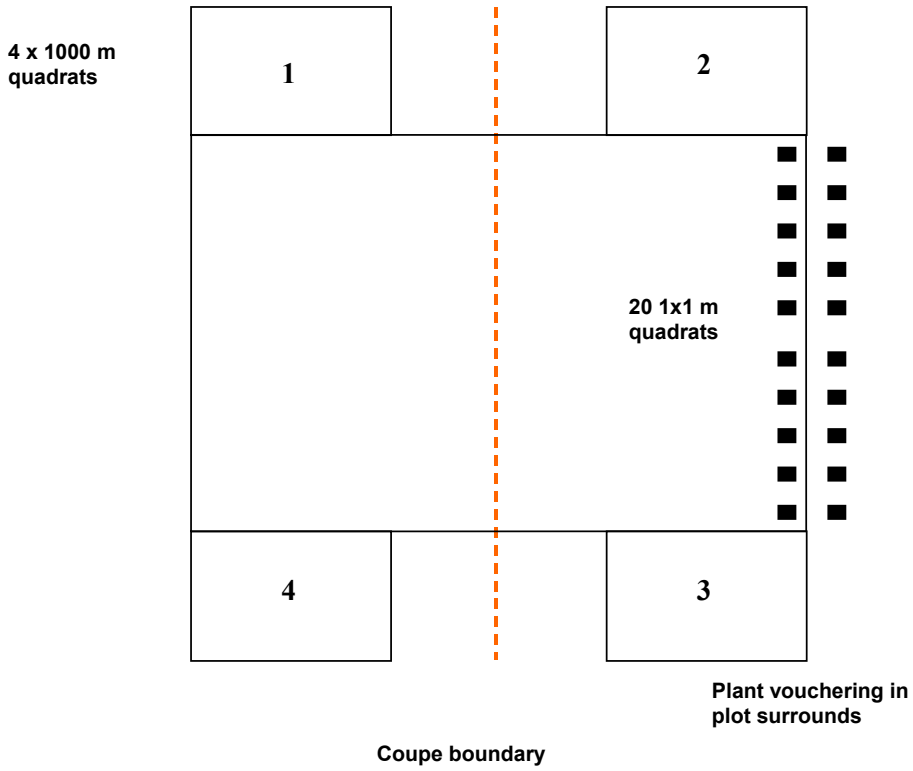


Figure 1. Vegetation plot layout for both 30 m x 30 m plot and 1 m x 1 m plots.

The "Bragg" plant species abundance rating system"

Cover Code	0	=	No plants
	1	=	< 1% cover
	2	=	1 – 5% cover
	3	=	5 – 25% cover
	4	=	25 – 50% cover
	5	=	50 – 75% cover
	6	=	75 – 95% cover
	7	=	95 – 99% cover
	8	=	100% cover

Note: when estimating cover, ignore bare ground and only estimate the percentage of live cover of each species being rated.

Frequency Code	0	=	No plants
	1	=	1 plant
	2	=	< 10 plants
	3	=	10 – 50 plants
	4	=	50 – 100 plants
	5	=	> 100 plants

Distribution Code

1	**2**
3	**4**

The plot is divided into 4 quadrants and if plants occur in equivalent to only 1 quadrant then:

1 = $^1/_4$
2 = $^2/_4$
3 = $^3/_4$
4 = $^4/_4$

Canopy cover was measured as a separate task, using a point method transect (see forest structure report). As part of the structural measurements for vegetation a point method system is used and these two tasks can be incorporated into one measurement making this more efficient and cost effective.

Time since fire is an important aspect in plant succession and for monitoring purposes it is necessary to record this. We recommend that a column in the site details be added to record time since last fire.

We discussed whether control sites should be burnt and when. For vegetation we recommend that normal burning operations should be carried out according to burning schedules and vegetation monitoring planned to be done not less that 2 years following fire. This is so that regenerating vegetation has sufficiently matured to facilitate the identification of species.

Specimen Processing
The area around each grid was used to search and voucher flowering plant specimens. In total 128 vouchers were collected, representing about 58% of the species (Appendix 1). This includes a number of duplicates and in successive measurements additional vouchers need to be collected to complete the list.

In the budget estimates, there needs to be an allocation of funds were for specimen processing, which was mostly materials and databasing. However there is the possibility that the WA Herbarium may put a charge on each specimen processed. We will need to be aware of this and factor it into future budgets. At present this is still under review and pricing is not yet available.

Database Establishment
Three database files have been established to record vegetation data; vegbook1 which contains data from the 30 m x 30 m plots, vegbook2 has the 1 m x 1 m plot data and vegbook3 has Levy structural measurements. The databasing of the voucher specimens is contained in the Herbarium system under MAX system program. These data are unique and can be retrieved for each grid. The voucher specimens collected from outside of the 30 m x 30 m plots included an additional 13 species not collected in either of the vegetation plots. The data have been entered for the Manjimup plots but have yet to be retrieved and analysed to any extent.

Preliminary Results
From the 4 sites there were 203 species recorded from the 30 m x 30 m plots and there were 11 species that were not in these plots that were picked up in the 1 m x 1 m plots. Only 158 species in total were noted from the 1 m x 1 m plots, which is 56 fewer than the 30 m x 30 m plots. In addition there were 24 weed species (11.5% of species) within the 209 total species collected from both series of plots (see Appendix 1 this section). The non-linear multi-dimensional scaling analysis based on species presence/absence (Figure 1) shows the spatial relationship between the sites and the treatments with respect to similarity of floristic assemblages. While there is general similarity within forest blocks (e.g., the Kingston sites – M1-M4 - are semi-clustered), across the range of sites, species composition is dis-similar, with climatic, topographic and edaphic factors driving species composition. There is a general clustering of grids in the same vegetation complex (Mattiske & Havel 1998). There is a general east-west

trend in the scatterplot (Figure 1) with little or no obvious influence of harvesting treatment. Figure 2 shows the total number of native species recorded in the 30m x 30 m quadrats at each grid and treatment. Species richness was greatest in the Yornup external control (M5) and least in the Kingston gap treatment (M2). At Kingston, which was logged in 1995/96, species richness is lowest in the logged treatments, especially the gap treatment (M2) and highest in the external control and the buffer (M1 & M4). Apart from the external control (M1), the differences between other treatments, including the buffer, are not significant. At other sites, with the exception of M5, there is no significant difference in overall species richness.

Tables 1 and 2 show the mean number of species and number of plants recorded, by life form, per m^2 in the 1 m x 1 m quadrats. Although the standard errors are high, indicating that a greater sampling intensity is required, some trends are apparent. Annual herbs and weeds (introduced species) are generally more abundant on the disturbed sites, while both the species richness and abundance of geophytes and woody shrubs is generally lowest on these sites and greatest in the buffers and the control sites. This supports earlier research findings from the Kingston project and suggests that the understorey vegetation is still recovering from logging treatments, the earliest of which was conducted in 1990.

Future Tasks

- Further detailed analysis of the vegetation data.
- Prepare and measure the next site for FORESTCHECK monitoring.
- Track any occurrence of priority species that may be present on monitoring sites (none located in current plots).

Operating Plan Revision

There is no need for any major revision to the operating plan, except to include the "Bragg abundance rating system" for the 30 m x 30 m plots (see above rating system). Consideration should be given to doubling the number of 1 m x 1 m sampling quadrats at each site.

Indicator Species

At this stage, the use of indicator species as a method of monitoring vascular plants is not recommended for the following reasons:

- While there are changes in abundance, biodiversity in terms of species richness, does not appear to be markedly changed in the logging treatments. Most variation in species richness and composition is due to site variation. If only indicator species are used, presence or absence may be site-related, not due to treatments. That is, identifying reliable indicators for each site prior to full assessment is problematical.
- Many species occur in low numbers and may or may not be present at sampling through chance.
- Time since fire effects species composition and abundance. As a result, fire frequency and intensity impacts may have more significant impact on plant abundance and dramatically affect results from a survey based solely on indicator species.

Figure 1: Non-linear mds based on species presence in 30 m x 30 m quadrats - FORESTCHECK sites

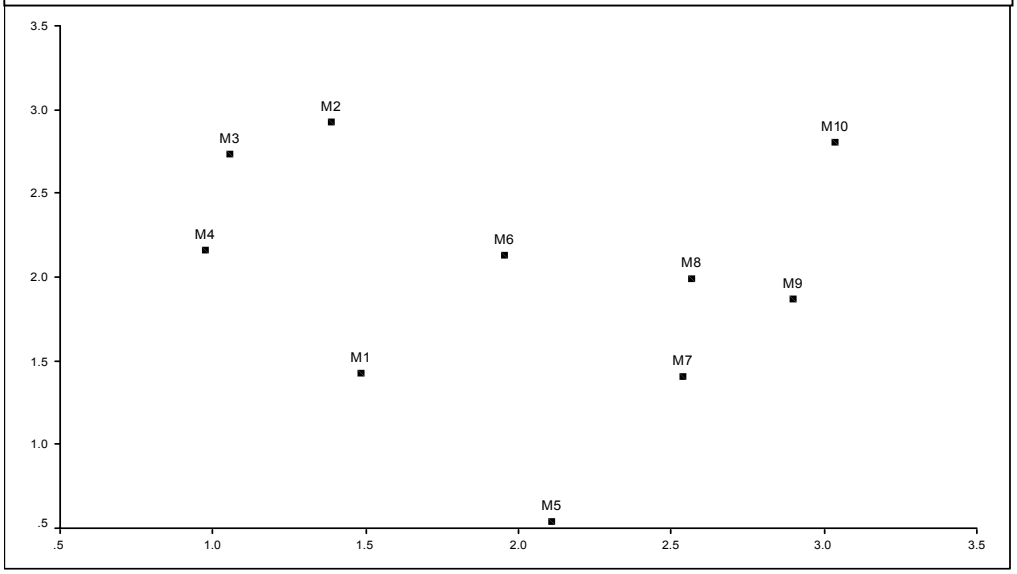
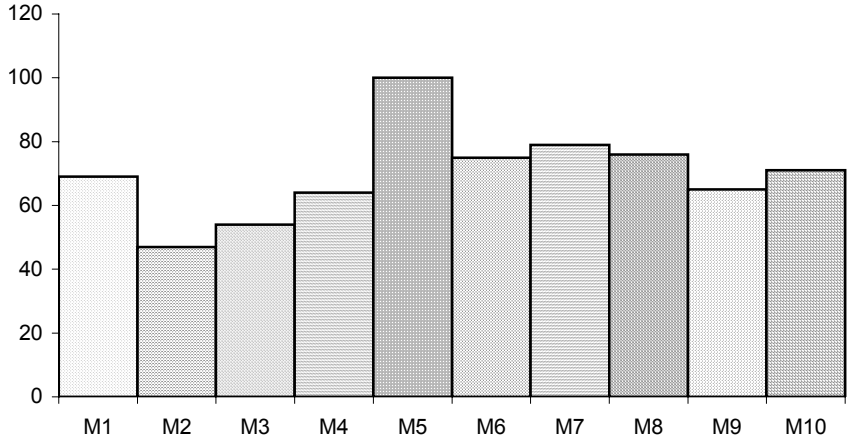


Figure 2: Total number of native vascular plant species recorded in 30 m x 30 m plots for each treatment.



FORESTCHECK - TABLE 1

Mean No. of species m^{-2} found on 1x1 m quadrats. Standard errors in parentheses

	Treatment Site									
LIFE FORM	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Annual herb	0.75 (1.25)	2.10 (2.31)	4.15 (1.63)	4.15 (2.46)	0.50 (0.69)	2.10 (1.65)	0.50 (0.76)	1.75 (1.25)	0.15 (0.37)	-
Perennial herb	1.40 (0.88)	2.15 (1.27)	2.35 (1.42)	2.55 (1.47)	3.05 (1.64)	1.85 (1.42)	1.80 (1.28)	2.00 (1.08)	1.95 (1.05)	2.45 (1.23)
Fern	0.15 (0.37)	0.35 (0.49)	0.35 (0.49)	0.55 (0.51)	-	0.05 (0.22)	0.10 (0.31)	0.05 (0.22)	0.40 (0.50)	0.70 (0.47)
Geophyte	3.40 (1.47)	1.50 (1.19)	1.35 (1.53)	2.90 (1.59)	2.30 (1.17)	1.10 (0.79)	1.65 (1.04)	0.90 (0.97)	1.95 (0.89)	1.80 (1.24)
Grass	0.65 (0.49)	1.00 (0.46)	0.40 (0.50)	1.40 (0.68)	0.30 (0.57)	0.40 (0.50)	0.45 (0.60)	0.50 (0.61)	0.15 (0.37)	0.55 (0.51)
Sedge	-	-	-	-	0.50 (0.61)	0.20 (0.41)	-	0.05 (0.22)	-	-
Tree	1.05 (0.83)	0.85 (0.59)	0.25 (0.44)	0.65 (0.59)	0.85 (0.75)	0.75 (0.72)	1.10 (0.79)	0.40 (0.60)	0.95 (0.83)	1.40 (0.60)
Shrub (woody)	4.10 (1.71)	3.20 (1.36)	1.10 (0.79)	1.95 (1.23)	5.70 (1.81)	3.70 (2.27)	5.70 (1.89)	4.25 (2.02)	5.20 (1.88)	6.25 (2.07)
Parasite	-	0.10 (0.31)	-	-	-	-	0.10 (0.31)	-	-	0.05 (0.22)
Vine	1.45 (0.76)	0.95 (0.60)	0.45 (0.60)	1.25 (0.64)	0.05 (0.22)	0.45 (0.51)	0.20 (0.41)	0.55 (0.60)	0.40 (0.50)	0.15 (0.37)
Rush	-	-	0.05 (0.22)	0.10 (0.31)	-	-	-	-	-	-
Cycad	0.05 (0.22)	0.10 (0.31)	0.30 (0.47)	0.25 (0.44)	0.05 (0.22)	0.05 (0.22)	-	-	-	0.05 (0.22)
Xanthorrhoea	-	-	-	-	0.20 (0.41)	0.05 (0.22)	0.10 (0.31)	-	-	-
Total Native	13.00 (3.61)	12.30 (4.00)	10.75 (4.04)	15.75 (4.15)	13.50 (3.62)	10.70 (3.31)	11.70 (3.08)	10.45 (3.80)	11.15 (3.12)	13.40 (2.82)
Total Weed	0.60 (0.68)	1.25 (1.52)	7.95 (2.26)	2.80 (1.74)	0.20 (0.41)	0.90 (0.97)	0.15 (0.49)	1.20 (0.83)	0.05 (0.22)	0.15 (0.37)

FORESTCHECK - TABLE 2

Mean No of plants m^{-2} found on 1x1 m^2 quadrats. Standard error in parentheses

	Treatment Site									
LIFE FORM	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Annual herb	7.15 (20.08)	30.55 (74.08)	46.60 (33.52)	46.80 (49.61)	2.85 (5.33)	34.20 (39.64)	1.80 (4.02)	15.50 (18.55)	0.30 (0.73)	-
Perennial herb	3.25 (2.86)	3.95 (2.84)	8.20 (9.95)	7.75 (10.96)	9.45 (11.13)	4.10 (5.63)	5.50 (4.55)	6.45 (7.55)	6.50 (4.20)	7.05 (6.25)
Fern	0.20 (0.52)	0.40 (0.60)	0.45 (0.69)	0.80 (0.83)	-	0.05 (0.22)	0.50 (1.82)	0.10 (0.45)	0.60 (0.88)	0.95 (0.83)
Geophyte	11.80 (6.19)	5.70 (6.12)	3.50 (4.84)	15.50 (10.55)	7.40 (6.44)	2.95 (3.66)	4.35 (3.47)	2.15 (3.38)	5.45 (3.90)	6.75 (6.37)
Grass	1.20 (1.20)	3.45 (2.54)	1.35 (2.58)	4.00 (2.64)	0.50 (1.19)	0.70 (0.98)	0.55 (0.83)	0.90 (1.17)	0.15 (0.37)	0.85 (0.99)
Sedge	-	-	-	-	0.85 (1.09)	0.20 (0.41)	-	0.10 (0.45)	-	-
Tree	2.55 (2.50)	1.60 (1.67)	0.35 (0.75)	0.80 (0.83)	1.25 (1.45)	1.20 (1.32)	1.85 (1.66)	0.50 (0.76)	1.50 (1.50)	2.85 (1.73)
Shrub (woody)	9 (4.8882)	6.9 (4.5294)	2.25 (1.9702)	3.65 (3.0826)	14.85 (6.36)	6.5 (4.6396)	15.5 (7.5359)	19.1 (18.8509)	19.65 (13.903)	15.25 (6.1548)
Parasite	-	0.10 (0.31)	-	-	-	-	0.15 (0.49)	-	-	0.05 (0.22)
Vine	3.15 (2.28)	2.25 (2.69)	0.80 (1.79)	2.30 (1.17)	0.10 (0.45)	0.60 (0.75)	0.20 (0.41)	0.90 (1.12)	0.55 (0.83)	0.45 (1.28)
Rush	-	-	0.05 (0.22)	0.15 (0.49)	-	-	-	-	-	-
Cycad	0.05 (0.22)	0.10 (0.31)	0.40 (0.68)	0.35 (0.75)	0.05 (0.22)	0.05 (0.22)	-	-	-	0.25 (1.12)
Xanthorrhoea	-	-	-	-	0.20 (0.41)	0.10 (0.45)	0.15 (0.49)	-	-	-
Total Native	38.35 (21.65)	55.00 (80.09)	63.95 (36.17)	82.10 (44.65)	37.50 (17.77)	50.65 (37.57)	30.55 (9.91)	45.70 (27.07)	34.70 (14.84)	34.45 (9.52)

Appendix 1. Total species list 2002 FORESTCHECK sampling

Alien Sp	Taxon Name	Voucher	SpCode	Lifeform	Fire Reponse	Lifestyle
	Acacia alata	V	ACAALA	S	A1	P
	Acacia browniana	V	ACABRO	S	A1	P
	Acacia dentifera		ACADEN	S	A1	P
	Acacia divergens	V	ACADIV	S	A1	P
	Acacia drummondii		ACADRU	S	A1	P
*	*Acaena echinata*	V	ACAECH	DS	A1	P
	Acacia extensa	V	ACAEXT	S	A1	P
	Acacia myrtifolia		ACAMYR	S	A1	P
	Acacia pulchella	V	ACAPUL	S	A1	P
	Acacia stenoptera	V	ACASTE	S	A1	P
	Adenanthos obovatus		ADEOBO	S	B2	P
	Agonis flexuosa		AGOFLE	T	U	P
	Agonis parviceps	V	AGOPAR	S	B2	P
*	*Aira cupaniana*	V	AIRCUP	AGR	A1	A
	Amphipogon amphipogonoides		AMPAMP	DS	B2	P
	Amperea ericoides	V	AMPERI	DS	B2	P
*	*Anagallis arvensis* var. *arvensis*		ANAARV	AHW	A1	A
*	*Anagallis arvensis* var. *caerulea*	V	ANAARV	AHW	A1	A
	Andersonia caerulea	V	ANDCAE	DS	A1	P
	Anigozanthos flavidus		ANIFLA	S	B3	P
*	*Arctotheca calendula*	V	ARCCAL	AHW	A3	A
	Astroloma ciliatum		ASTCIL	DS	B2	P
	Astroloma drummondii		ASTDRU	DS	B2	P
	Astroloma pallidum	V	ASTPAL	DS	B2	P
	Austrodanthonia caespitosa		AUSCAE	GR	B3	P
	Austrostipa campylachne		AUSCAM	GR	B3	P
	Banksia grandis	V	BANGRA	T	A2	P
	Billardiera floribunda		BILFLO	V	A1	P
	Billardiera variifolia		BILVAR	V	A1	P
	Boronia crenulata		BORCRE	DS	B2	P
	Boronia megastigma		BORMEG	S	A1	P
	Boronia spathulata		BORSPA	S	B2	P
	Bossiaea aquifolium subsp. *laidlawiana*	V	BOSAQULA	S	A1	P
	Bossiaea linophylla	V	BOSLIN	S	A1	P
	Bossiaea ornata	V	BOSORN	S	B2	P
*	*Briza minor*	V	BRIMIN	GRW	A1	A
	Burchardia umbellata	V	BURUMB	G	B3	P
	Caesia micrantha	V	CAEMIC	G	B3	P
	Caladenia flava subsp. *flava*	V	CALFLAF	G	B3	P
	Callistachys lanceolata	V	CALLAN	S	A1	P
	Caladenia macrostylis	V	CALMAC	G	B3	P
	Caladenia reptans subsp. *reptans*	V	CALREP	G	B3	P
	Caladenia sp.		CALSP.	G	B3	P
	Calytrix simplex	V	CALSIM	S	A1	P
	Cassytha racemosa	V	CASRAC	P	A1	P
	Centrolepis aristata	V	CENARI	H	A1	A
	Centrolepis drummondiana	V	CENDRU	AH	A1	A
*	*Centaurium erythraea*	V	CENERY	AHW	A1	A
*	*Cerastium glomeratum*	V	CERGLO	AHW	A1	A
	Chamaescilla corymbosa	V	CHACOR	G	B3	P
	Chorizema nanum	V	CHONAN	DS	A1	P
	Chorizema rhombeum	V	CHORHO	DS	A1	P

	Clematis pubescens	V	CLEPUB	V	A1	P
	Comesperma calymega		COMCAL	DS	B2	P
	Conostylis aculeata		CONACU	DS	B3	P
*	*Conyza bonariensis*	V	CONBON	AHW	A1	A
	Conospermum capitatum		CONCAP	S	B2	P
	Conostylis setigera		CONSET	DS	B3	P
	Corymbia calophylla		CORCAL	T	A2	P
	Cotula coronopifolia	V	COTCOR	AH	A1	A
	Crassula decumbens	V	CRADEC	AH	A1	A
	Crassula peduncularis		CRAPED	AH	A1	A
	Craspedia variabilis	V	CRAVAR	G	B3	P
*	*Crepis foetida*		CREFOE	AHW	A1	A
	Cyanicula deformis		CYADEF	G	B3	P
	Cyanicula sericea	V	CYASER	G	B3	P
	Cyrtostylis huegelii	V	CYRHUE	G	B3	P
	Daucus glochidiatus		DAUGLO	AH	A1	A
	Daviesia cordata		DAVCOR	S	U	P
	Daviesia preissii		DAVPRE	S	A1	P
	Desmocladus fasciculatus	V	DESFAS	Z	B3	P
	Desmocladus flexuosus	V	DESFLE	Z	B3	P
	Dodonaea ceratocarpa		DODCER	S	A1	P
	Drosera erythrorhiza		DROERY	G	B3	P
	Drosera huegelii		DROHUE	G	B3	P
	Drosera pallida	V	DROPAL	G	B3	P
	Drosera stolonifera	V	DROSTO	G	B3	P
	Elythranthera brunonis	V	ELYBRU	G	B3	P
*	*Erodium cicutarium*	V	EROCIC	AHW	A1	A
	Euchiton collinus	V	EUCCOL	AH	A1	A
	Eucalyptus marginata	V	EUCMAR	T	A2	P
*	*Galium murale*	V	GALMUR	AHW	A1	A
	Gastrolobium bilobum	V	GASBIL	S	A1	P
	Geranium solanderi	V	GERSOL	DS	A1	A
	Gompholobium marginatum	V	GOMMA	DS	A1	P
	Gompholobium ovatum	V	GOMOVA	DS	A1	P
	Gompholobium polymorphum		GOMPOL	DS	A1	P
	Gompholobium tomentosum		GOMTOM	DS	A1	P
	Gonocarpus benthamii		GONBEN	DS	A1	P
	Goodenia eatoniana		GOOEAT	DS	A1	A
	Hakea amplexicaulis	V	HAKAMP	S	B2	P
	Hakea lissocarpha		HAKLIS	S	B2	P
	Hakea oleifolia	V	HAKOLE	S	B2	P
	Hardenbergia comptoniana	V	HARCOM	V	B2	P
	Hemigenia rigida		HEMRIG	DS	B2	P
	Hibbertia amplexicaulis	V	HIBAMP	S	B2	P
	Hibbertia commutata	V	HIBCOM	S	B2	P
	Hibbertia cuneiformis		HIBCUN	S	B2	P
	Hibbertia racemosa	V	HIBRAC	S	A1	P
	Hibbertia spicata		HIBSPI	S	B2	P
	Hibbertia spicata		HIBSPI	S	B2	P
	Hovea chorizemifolia	V	HOVCHO	DS	B2	P
	Hovea elliptica	V	HOVELL	S	B2	P
	Hyalosperma cotula	V	HYACOT	AH	A1	A
	Hybanthus debilissimus	V	HYBDEB	DS	A1	P
	Hydrocotyle callicarpa	V	HYDCAL	AH	A1	A
	Hydrocotyle diantha		HYDDIA	AH	A1	A

	Hydrocotyle diantha		HYDSP.	AH	A1	A
	Hypocalymma angustifolium	V	HYPANG	S	B2	P
*	*Hypochaeris glabra*	V	HYPGLA	AHW	A1	A
	Isotropis cuneifolia	V	ISOCUN	S	A1	P
	Isotoma hypocrateriformis		ISOHYP	AH	A1	A
*	*Isolepis marginata*	V	ISOMAR	AR	A1	A
	Johnsonia lupulina		JOHLUP	G	B2	P
*	*Juncus capitatus*	V	JUNCAP	AW	A1	A
	Kennedia carinata	V	KENCAR	DS	A1	P
	Kennedia coccinea	V	KENCOC	V	A1	P
	kennedia prostrata	V	KENPRO	S	A1	P
	Labichia punctata	V	LABPUN	DS	B2	P
	Lagenophora huegelii	V	LAGHUE	G	B3	P
	Leptomeria cunninghamii		LEPCUN	S	A1	P
	Lepidosperma leptostachyum		LEPLEP	Z	B3	P
	Lepidosperma squamatum	V	LEPSQU	Z	B3	P
	Leucopogon australis	V	LEUAUS	S	B2	P
	Leucopogon capitellatus	V	LEUCAP	S	B2	P
	Leucopogon propinquus	V	LEUPRO	S	B2	P
	Leucopogon pulchellus		LEUPUL	S	B2	P
	Leucopogon verticillatus	V	LEUVER	S	B2	P
	Levenhookia pusilla	V	LEVPUS	AH	A1	A
	Lindsaea linearis		LINLIN	F	B3	P
	Logania serpyllifolia	V	LOGSER	DS	B2	P
	Logania vaginalis	V	LOGVAG	S	B2	P
	Lomandra caespitosa	V	LOMCAE	DS	B3	P
	Lomandra drummondii		LOMDRU	DS	B3	P
	Lomandra hermaphrodita	V	LOMHER	DS	B2	P
	Lomandra integra	V	LOMINT	DS	B3	P
	Lomandra pauciflora		LOMPAU	DS	B2	P
	Lomandra purpurea		LOMPUR	DS	B3	P
	Lomandra sericea		LOMSER	DS	B3	P
*	*Lotus suaveolens*		LOTSUA	AHW	A1	A
	Luzula meridionalis	V	LUZMER	R	B3	P
	Macrozamia riedlei	V	MACRIE	C	B3	P
	Microlaena stipoides	V	MICSTI	GR	A1	P
	Millotia tenuifolia	V	MILTEN	AH	A1	A
	Myoporum tetrandrum	V	MYOTET	S	A1	P
	Oligochaetochilus vittatus		OLIVIT	G	B3	P
	Opercularia hispidula	V	OPEHIS	S	B2	P
	Orthrosanthus laxus	V	ORTLAX	G	B3	P
*	*Oxalis corniculata*	V	OXACOR	G	B3	P
	Ozothamnus ramosus		OZORAM	S	U	P
*	*Parentucellia latifolia*	V	PARLAT	AHW	A1	A
	Patersonia babianoides	V	PATBAB	G	B3	P
	Patersonia occidentalis		PATOCC	DS	B3	P
	Patersonia umbrosa		PATUMB	DS	B3	P
	Patersonia umbrosa var. *xanthina*	V	PATUMB	DS	B3	P
	Pelargonium littorale	V	PELLIT	DS	A1	P
	Pentapeltis silvatica	V	PENSIL	S	B2	P
	Persoonia longifolia	V	PERLON	S	B2	P
	Phyllanthus calycinus	V	PHYCAL	DS	B2	P
	Phyllangium paradoxum		PHYPAR	AH	A1	A
	Pimelea angustifolia		PIMANG	S	A1	P
	Pimelea ciliata	V	PIMCIL	S	A1	P

	Pimelea rosea	V	PIMROS	S	A1	P
	Pimelea suaveolens		PIMSUA	S	B2	P
	Platytheca galioides	V	PLAGAL	S	U	A
	Platysace tenuissima	V	PLATEN	DS	A1	P
*	*Poa annua*		POAANN	AGR	A1	A
	Podocarpus drouynianus	V	PODDRO	S	B2	P
	Podotheca gnaphalioides		PODGNA	AH	A1	A
	Poranthera huegelii	V	PORHUE	DS	A1	P
	Poranthera microphylla	V	PORMIC	DS	A1	A
*	*Pseudognaphalium luteoalbum*		PSELUT	AHW	A1	A
	Pteridium esculentum	V	PTEESC	F	B2	P
	Pterostylis pyramidalis	V	PTEPYR	G	B3	P
	Pterostylis recurva		PTEREC	G	B3	P
	Ptilotus manglesii		PTIMAN	G	B3	P
	Ranunculus colonorum	V	RANCOL	G	B3	P
	Rhodanthe citrina	V	RHOCIT	AH	A1	A
	Scaevola striata		SCASTR	DS	A1	A
	Senecio hispidulus	V	SENHIS	S	A1	A
*	*Silene gallica*		SILGAL	AHW	A1	A
	Sollya heterophylla	V	SOLHET	S	U	P
*	*Sonchus asper*	V	SONASP	AHW	A1	A
	Sowerbaea laxiflora	V	SOWLAX	G	B3	P
	Sphenotoma capitatum	V	SPHCAP	DS	A1	P
	Sphaerolobium medium	V	SPHMED	S	B2	P
	Stackhousia monogyna	V	STAMON	S	B2	P
	Stylidium amoenum		STYAMO	DS	A1	P
	Stylidium brunonianum		STYBRU	DS	A1	P
	Stylidium calcaratum	V	STYCAL	AH	A1	A
	Stylidium ciliatum		STYCIL	DS	A1	P
	Stylidium luteum		STYLUT	DS	A1	P
	Stylidium rhynchocarpum		STYRHY	DS	A1	P
	Styphelia tenuiflora		STYTEN	S	A1	P
	Tetratheca affinis	V	TETAFF	S	A1	P
	Tetraria capillaris		TETCAP	S	B3	P
	Tetratheca hirsuta		TETHIR	S	A1	P
	Tetratheca hispidissima	V	TETHIS	S	A1	P
	Tetrarrhena laevis		TETLAE	GR	B3	P
	Thelymitra crinita		THECRI	G	B3	P
	Thysanotus manglesianus	V	THYMAN	G	B3	P
	Thysanotus sp.	V	THYSP.	G	B3	P
	Thysanotus thyrsoideus		THYTHY	G	B3	P
	Trachymene pilosa	V	TRAPIL	AH	A1	A
	Tremandra diffusa	V	TREDIF	S	A1	P
	Tremandra stelligera		TRESTE	DS	B2	P
*	*Trifolium campestre*		TRICAM	AH	A1	A
	Tricoryne humilis		TRIHUM	DS	A1	P
	Trichocline spathulata		TRISPA	G	B3	P
	Trymalium floribundum	V	TRYFLO	S	A1	P
	Trymalium ledifolium		TRYLED	S	A1	P
*	*Vellereophyton dealbatum*	V	VELDEA	AHW	A1	A
	Velleia trinervis	V	VELTRI	DS	A1	A
	Veronica calycina		VERCAL	DS	B3	P
*	*Vulpia myuros*		VULMYU	AGRW	A1	A
	Wahlenbergia gracilenta	V	WAHGRA	AH	A1	A
	Xanthosia atkinsoniana	V	XANATK	S	B2	P

Xanthosia candida	V	XANCAN	DS	B2	P
Xanthorrhoea gracilis		XANGRA	X	B2	P
Xanthosia huegelii	V	XANHUE	DS	A1	P
Xanthorrhoea preissii		XANPRE	X	B2	P

CRYPTOGAMS

Ray Cranfield

Introduction
Ten FORESTCHECK grids were visited during May 2002 and cryptogams (lichens, mosses and liverworts [LBH]) were sampled. Macro and micro habitats, species occurrence and frequency were recorded at each grid. Biodiversity of LBH was determined by using 10 cm x 10 cm grids over a 100 m transect.

Sampling
The initial sampling was carried out as a series of 4 x 100 m transects around the edge of the FORESTCHECK grid within the 300 m x 300 m area. Two collectors sampled 2 m either side of the 100 m transects, collecting all LBH independently. These site collections were sorted in the laboratory on the same day and any replicate samples combined. Species descriptions were prepared and notes made about substrates. An estimate of frequency and occurrence for each substrate and grid was made. The position occupied by each species within the stratal layers was also estimated.

Using established 100 m (1 x 1 m^2) vegetation transects for each grid, the presence or absence of the LBH groups within a grid 10 x 10 cm^2 every 10 m laterally spaced at 1 m and 2 m was mapped. This was to examine LBH diversity at each grid and establish the relevance of nominated indicator species. It soon became apparent that this was a waste of time and effort as the results were too inconsistent and were impacted upon by other external factors. Several transects resulted in zero records, which did not reflect the actual abundance obtained by the above method from the same sites. Another problem encountered was that of LBH above 1 m from ground level as these had to be ignored due to difficulty of scoring.

The sampling time appears to be on target with a window of opportunity covering many months that may improve the quality of some samples collected. The prospect of conducting an end of season re-sampling was considered but may be of little benefit as the expected species increase is low and best left to future monitoring programs.

Specimen Processing
At this stage the processing of specimens is on target with all identifications completed, with the exception of taxonomic problem species, which I have phrase-named to assist in listing and data entry. All lichen samples have been processed and are ready to send to the Herbarium. Moss and liverwort samples that require the additional step of washing and redrying are taking a bit longer, with completion expected before the start of the next set of sites. Database entry and label generation is in hand and most samples will be ready to send to the Herbarium for future reference. Once completed, problem species can be sent to experts within Australia or externally. As this will take time I consider this to be an ongoing aspect of FORESTCHECK.

Number of samples collected including repeats for all grids = 498
- Number of lichen samples = 266
- Number of moss samples = 58
- Number of liverwort samples = 33

Excluding repeat samples, 159 individual cryptogam species have been recognized from 10 grids. Note that 20 additional samples of algae and fungi were sampled and placed into the Herbarium but identified only as Genus sp.

Database Establishment

The entry protocols have been developed and data entry has been undertaken. Re-adjustment of the data recorded in the collecting book and the ranking of appropriate fields has meant that the 10 cm x 10 cm grid data can be obtained and the species diversity rated.

Preliminary Results

Table 1. FORESTCHECK Cryptogam site data

Grids		M1	M5	M10	M4	M7	M9	M2	M6	M8	M3
Type of site		C	C	C	B	B	B	G	G	G	S
	Number of samples	82	53	50	76	49	47	31	33	15	62
Groups		Number of taxa									
L	Lichen	45	28	36	45	25	22	13	20	8	28
B	Moss	8	9	8	5	7	5	4	2	6	4
H	Liverwort	3	3	4	3	3	6	6	3	1	1
		Number of species									
Habitats											
1	Wood	18	14	27	21	10	10	5	8	5	18
2	Bark	16	9	10	9	11	8	2	3	1	4
3	Ant Hill	1	0	2	5	2	1	1	0	0	2
4	Soil	6	12	5	5	4	9	12	8	4	7
5	Stone	6	7	0	6	4	2	2	4	3	2
6	Organic Material	13	5	7	10	5	8	2	4	2	3
7	Charcoal	3	2	0	4	1	2	2	1	1	3
Stratal Position											
1	0 - 30 cm	36	25	19	33	24	20	22	19	11	24
2	31 cm - 3 m	24	17	36	31	17	14	2	10	6	15
3	3.1 m +	4	4	4	1	2	3	0	1	0	1
Habitat Frequency											
1	71%+	0	0	0	0	0	0	0	0	0	0
2	50 - 70%	15	10	11	22	9	11	6	5	5	10
3	10 - 49%	20	22	23	16	15	13	12	16	3	13
4	0 - 9%	21	6	14	15	11	9	5	3	7	11
Site Frequency											
1	50%+	0	0	0	0	0	0	0	0	0	0
2	15-49%	1	1	0	2	0	1	2	0	0	2
3	3-14%	19	17	15	18	14	10	6	9	4	9
4	1-2%	36	22	34	33	21	21	15	15	11	23
Indicator species		21	15	14	17	15	15	9	10	9	14

C = control, B = coupe buffer, G = gap, S = Shelterwood timber harvest treatments.

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

	Microhabitats (Substrates)							Strata levels		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Ground**	**Shrub**	**Tree**
Grids										
M1	18	16	1	6	6	13	3	36	24	4
M2	5	2	1	12	2	2	2	22	2	0
M3	18	4	2	7	2	3	3	24	15	1
M4	21	9	5	5	6	10	4	33	31	1
M5	14	9	0	12	7	5	2	25	17	4
M6	8	3	0	8	4	4	1	19	10	1
M7	10	11	2	4	4	5	1	24	17	2
M8	5	1	0	4	3	2	1	11	6	0
M9	10	8	1	9	2	8	2	20	14	3
M10	27	10	2	5	0	7	0	19	36	4

Note that in several instances individual species of LBH were located in several habitats or several strata.

Table 3. FORESTCHECK Cryptogam Habitat and Stratal Levels Usage [Showing Number of Species in all 3 Groups: Lichens (L), Mosses (B) and Liverworts (H)].

		Habitats							Strata Levels		
Grids	**Groups**	**Wood**	**Bark**	**Ant Hill**	**Soil**	**Stone**	**Organic**	**Charcoal**	**0-30cm**	**31cm-3m**	**3.1m+**
M1	L	18	16	1	0	5	7	3	25	2	4
	B	0	0	0	5	1	4	0	8	0	0
	H	0	0	0	1	0	2	0	3	0	0
M5	L	13	9	0	3	5	5	1	13	14	2
	B	0	0	0	7	2	1	1	6	1	0
	H	1	0	0	3	0	0	0	2	1	0
M10	L	22	8	2	1	0	5	0	10	29	4
	B	3	1	0	3	0	2	0	6	4	0
	H	2	1	0	1	0	0	0	4	2	0
M4	L	18	9	5	1	7	8	3	25	28	1
	B	1	0	0	3	0	2	1	5	1	0
	H	2	0	0	1	0	1	0	3	2	0
M7	L	6	9	0	2	3	5	1	15	14	2
	B	3	1	2	1	1	0	0	7	1	0
	H	1	1	0	1	0	0	0	2	2	0
M9	L	10	8	1	0	2	4	1	10	13	3
	B	0	0	0	4	0	4	0	5	0	0
	H	1	0	0	5	0	0	1	4	2	0
M2	L	5	2	1	3	2	2	0	12	1	0
	B	0	0	0	4	0	0	1	4	0	0
	H	0	0	0	5	0	0	1	6	1	0
M6	L	8	3	0	3	4	4	1	14	10	1
	B	0	0	0	2	0	1	0	2	0	0
	H	0	0	0	3	0	0	0	3	0	0
M8	L	3	1	0	0	2	1	1	5	4	0
	B	2	0	0	3	1	1	0	5	2	0
	H	0	0	0	1	0	0	0	1	0	0
M3	L	15	4	2	3	2	3	3	18	15	1
	B	2	0	0	3	0	0	0	4	0	0
	H	1	0	0	1	0	0	0	2	0	0

M1, M2 &M10 control grids
M2, M6 & M8 gap grids
M4, M7 & M9 coupe buffer grids
M3 shelterwood grids

Table 4. Presence / Absence of Cryptogam taxa located on each site (Names in **bold text** are the nominated indicator species).

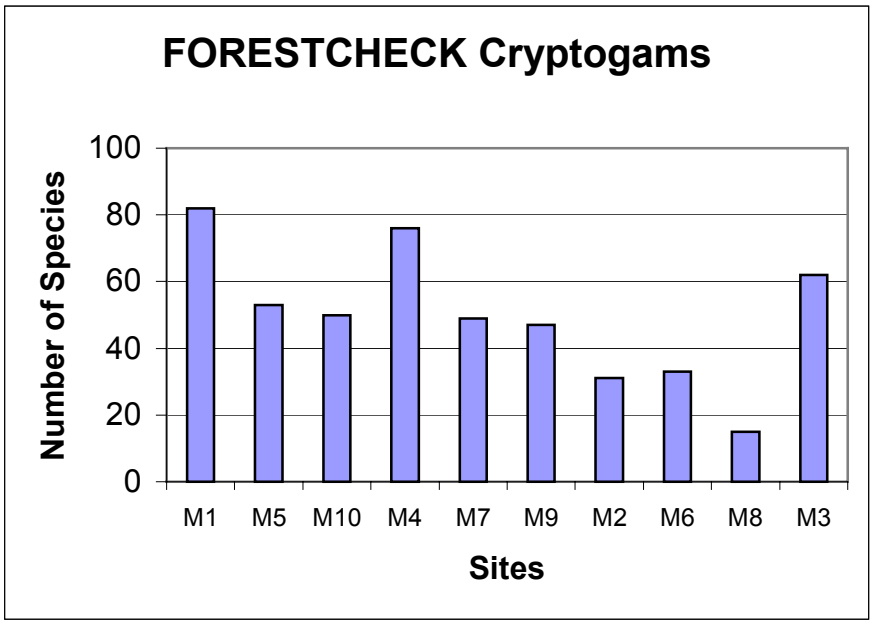
Taxa Grids	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Mosses (B)										
Barbula calycina	*	*	*	*	*		*	*	*	*
Barbula sp.	*									
Campylopus bicolor					*					
Campylopus introflexus	*	*	*	*	*	*	*	*	*	*
Campylopus sp RJC 18080								*		
Ceratodon purpureus					*	*	*		*	
Dicranoloma diaphanoneum					*					*
Dicranoloma sp.		*					*	*		*
Fissidens tenellus	*					*	*		*	*
Fissidens sp.				*						
Funaria hygrometrica	*	*	*	*	*		*	*		*
Hypnum cupressiforme	*				*					
Racopilum cuspidigerum* var. *convolutaceus					*					*
Sematophyllum contiguum	*		*		*		*	*		*
Genus sp. RJC 17806				*						
Genus sp. (Emerald Moss)									*	
Liverworts (H)										
Anthoceros laevis	*	*			*	*			*	
Cephaloziella exiliflora	*	*	*	*	*	*	*		*	*
Chiloscyphus semiteres	*		*	*			*			*
***Fossombronia* sp. (leafy)**		*		*				*	*	
Fossombronia sp. (lettuce)		*			*	*			*	
Fossombronia sp. (purple lipped clam)		*								
Fossombronia sp. (salvinia)		*					*		*	*
Frullania sp.										*
Genus sp. RJC 18121									*	
Lichens (L)										
Buellia stellulata	*				*		*		*	
Calicium glaucellum	*			*						*
Calcium salicinum	*									
Calcium victorianum subsp. *Victorianum*	*									
Caloplaca ferruginea	*			*						
?Chaenotheca chlorella			*							
Cladia aggregata	*	*	*	*	*	*	*	*	*	*
Cladia schizopora	*		*	*	*	*	*	*	*	*
Cladonia cervicornis* var. *verticellata	*			*	*		*		*	
Cladonia ?chlorophaea	*			*						*
Cladonia crispata var. *cetrariiformis*				*		*				
Cladonia humilis var. *humilis*			*							
Cladonia kremplehuberi	*		*	*	*	*	*		*	*
Cladonia macilenta	*									
Cladonia aff. *Ochrochlora*										*
Cladonia ochrochlora										*
Cladonia ?praetermissa			*							
Cladonia ramulosa	*								*	*
Cladonia rigida	*		*	*	*	*				*
Cladonia aff. *rigida*										
Cladonia scabriuscula	*			*			*			

Cladonia ?southlandica				*						*
Cladonia sulcata		*	*	*	*		*			*
Cladonia tessellata	*				*	*	*		*	
Cladonia sp.	*									
Cladonia sp. RJC 17704			*							
Cladonia sp. RJC 18155										*
Cladonia sp. (fine)										*
Cladonia sp. (pipes)			*							
Diploschistes sp. (ant hill)		*								*
Diploschistes sp.		*								
Fuscidea cyathoides				*						
Graphis sp. (black beans)				*						
Graphis sp. (blackrays)	*		*	*		*	*		*	
Graphis sp. (black tram lines)								*		*
Graphis sp, (brown lips)				*	*					
Hypocenomyce australis	*			*	*					
Hypocenomyce foveata	*			*						
Hypocenomyce scalaris							*			
Hypocenomyce sp. (lead grey)	*						*			
Hypogymnia pulchrilobata										*
Hypogymnia pulverata					*					
Hypogymnia subphysodes var. *austerodioides*	*		*	*	*					
Hypogymnia subphysodes* var. *subphysodes	*		*	*	*		*		*	
Imshaigia aleurites					*					
?*Lecidea* sp. (black dots)			*	*						
?*Lepraria* sp.										*
Menegazzia platytrema	*						*		*	*
Neuropogon ?antarcticus	*			*						
Neuropogon ?subcapillaris									*	
Ochrolechia sp. GS (Kantavilas 306/92)	*	*	*	*	*	*	*		*	*
Ochrolechia sp. (buff doughnuts)										*
Ochrolechia sp. (cream doughnuts)								*		
Ochrolechia sp. (white pustules)	*									
Ochrolechia sp. (tan doughnuts)										*
Ochrolechia sp. (twiggy)	*			*	*				*	*
Ochrolechia sp. RJC 18056							*			
Pannaria sp. (grey flakes)				*						
Pannoparmelia wilsonii	*		*	*	*		*		*	*
Paraporpidia glauca	*			*	*	*	*	*	*	
Parmotrema cooperi				*						
Parmotrema praesorediosum	*									
Parmotrema tinctorum			*							
Peltigera didactyla		*								
Pertusaria ?pertusa			*							
Ramboldia stuartii	*		*	*	*	*	*	*	*	*
Rhizocarpon sp. (grey)	*			*			*	*		
Tephromelia atra	*			*	*					*
Thelotrema lepadinum	*									
Thysanothecium hookeri				*						*
Thysanothecium scutellatum	*		*	*	*	*	*	*	*	*
Trapeliopsis sp. (green grey chunks)			*							

Usnea inermis		*	*	*	*	*			*	*
Usnea oncodeoides			*	*					*	
Usnea pulvinata					*					*
Usnea aff. *rubicunda*	*									
Usnea scabrida subsp. *Scabrida*	*									
Usnea ?subalpine				*						
Usnea subeciliata	*				*		*			
***Xanthoparmelia* sp.**	*									
***Xanthoparmelia* sp. RJC 17992**					*					
Xylographa sp. (eye slits)				*						
Genus sp. (black chelsea buns)						*				
Genus sp. (black dots)							*			
Genus sp. (black freckels)					*	*				
Genus sp. (black ganglia)				*						
Genus sp. (black & tan dots)				*						
Genus sp. (black hairy stepping stones)				*					*	
Genus sp. (brown freckles)										
Genus sp. (brown papillae)				*						
Genus sp. (brown warts)	*						*			
Genus sp. (brown waxy dots)			*							
Genus sp. (green algae-like)				*						
Genus sp. (green flecks)			*	*		*				
Genus sp. (green powder)										*
Genus sp. (grey green)					*	*	*			
Genus sp. (green flecks ant hill)									*	
Genus sp. (grey flecks)						*				
Genus sp. (grey frosting)				*						
Genus sp. (grey powder)					*					*
Genus sp. (grey slick)	*									
Genus sp. (lead grey)									*	
Genus sp. (orange blobs)			*							
Genus sp. (orange powder)	*									
Genus sp. (pale yellow blobs)							*			
Genus sp. (pebbles)										*
Genus sp. (soot)						*				
Genus sp. (tan apo flake)						*				
Genus sp. (tan jelly caps)	*									
Genus sp. (white powder)										*
Genus sp. (yellow powdery blobs)			*							
Genus sp. RJC 17783				*						
Genus sp. RJC 17824		*								
Genus sp. RJC 17825		*								
Genus sp. RJC 17835										
Genus sp. RJC 17905	*									
Genus sp. RJC 17915	*									
Genus sp. RJC 17955						*				
Genus sp. RJC 18168										*
Genus sp. RJC 18169										*
Genus sp. RJC 18177										*

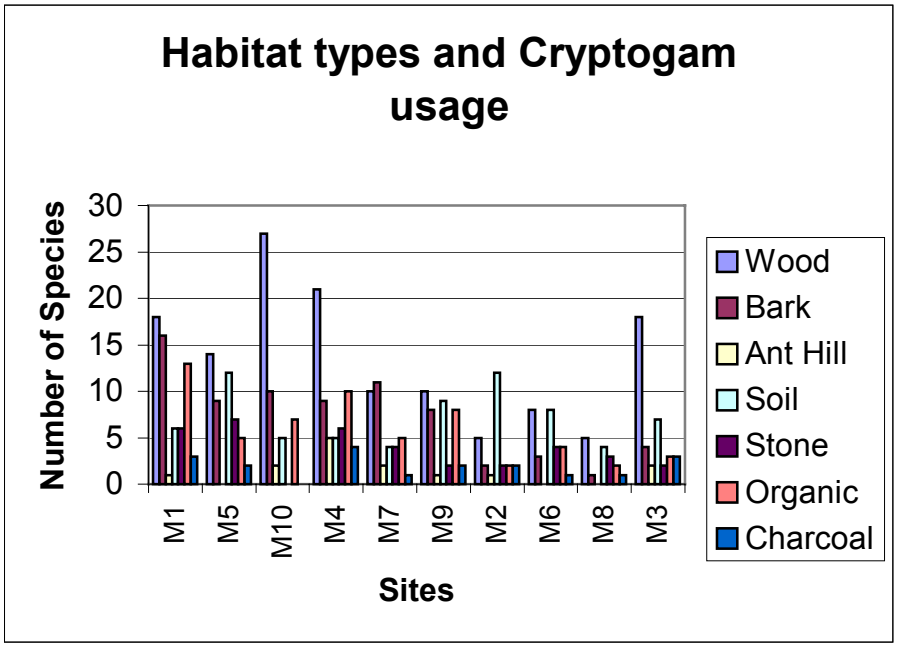
Note: The higher proportion of Genus sp. listed for the lichen section illustrates the degree of uncertainty that exists due to the limited available information.

Figure 1. Combined Cryptogam Groups, Occurrences per Grid.



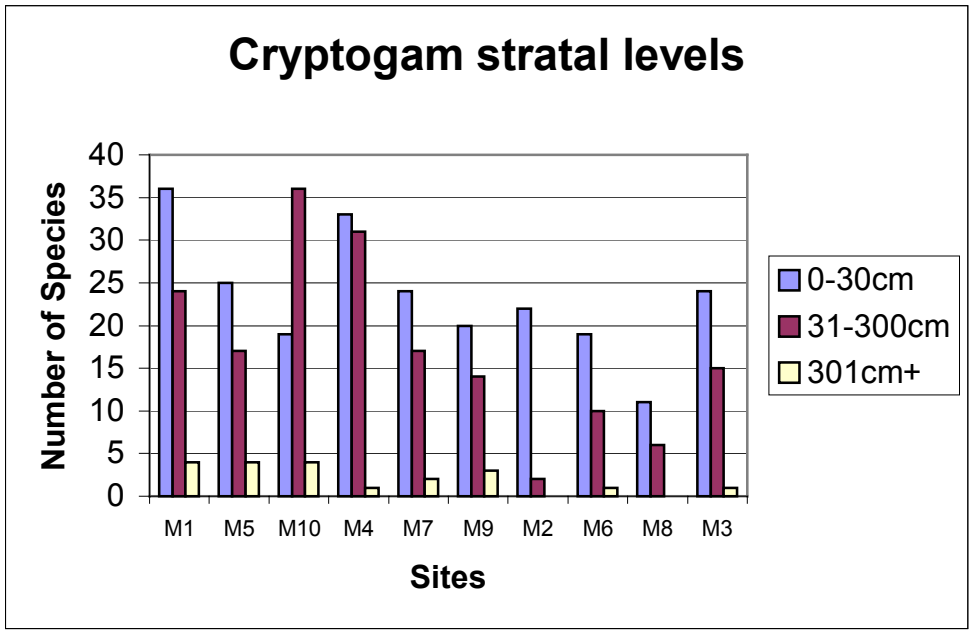
A decline in the number of species is evident with minimal changes between the control (M1, M5, M10) and the buffer (M4, M7,M9) grids. A decline is apparent in the gap grids (M2, M6, M8). The shelterwood grid (M3) shows minimal decline in species and is similar to the buffer grids. The decline in species numbers in all of the gap grids would appear to be the direct result of habitat loss or damage.

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



Preferred habitats used on all grids are 1 wood, 2 bark, 3 soil and 4 old organic materials, with other substrates not as readily colonized.

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



This data indicate that the 0 - 30 cm level is preferred. M10 shows a greater preference for the shrub layer, and may reflect the observed densities of tree canopies, undergrowth and litter found on this grid.

Figure 4. Frequency and number of species of cryptogams occurring at each grid (300 m x 300 m).

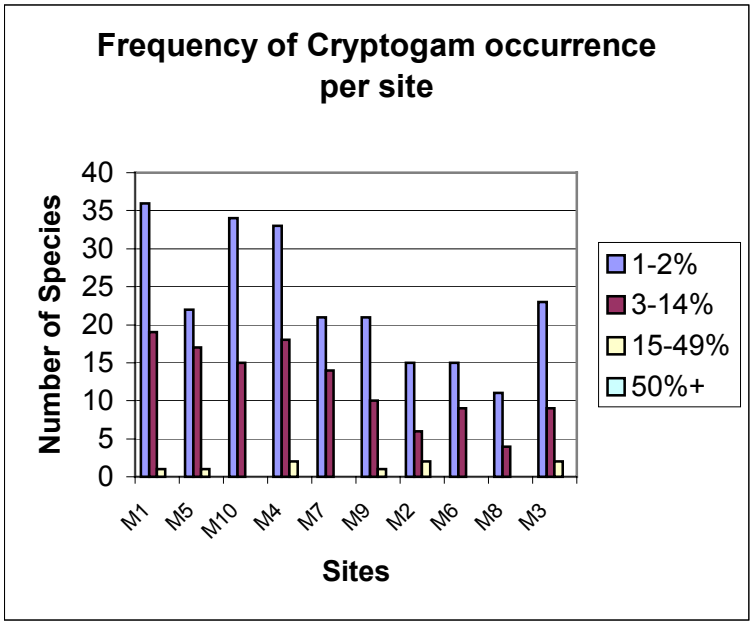
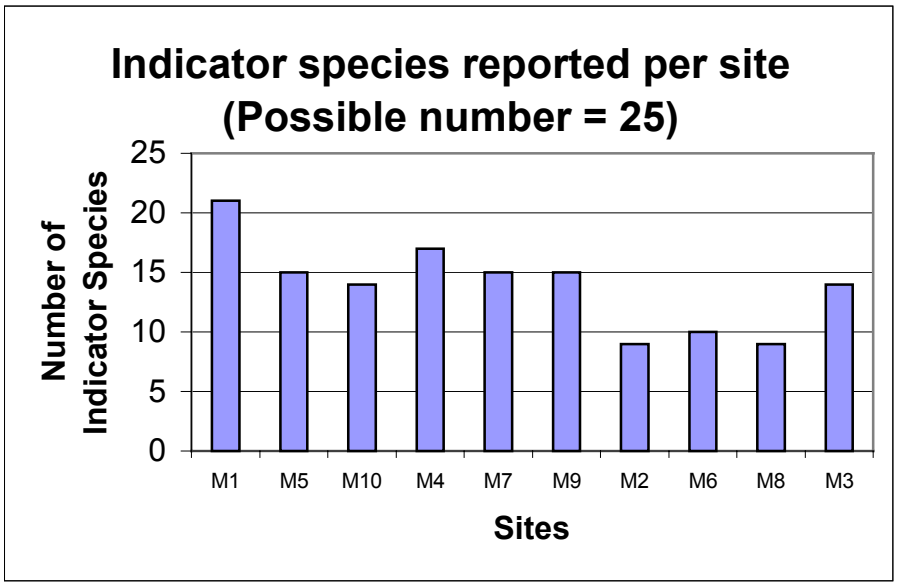


Figure 4 shows the percentage of total area per site occupied by the 3 cryptogam groups and the number of species involved. Although large number of species may be involved at each grid, the actual area occupied is only 1-2% of the total area available.

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



Indicator Species
The indicator species recommended in 2001 appeared to perform satisfactorily. It must be emphasized that this list of indicator species requires constant review as new site locations are established.

Conclusions
Although cryptogams are difficult to study and interpret in the field, the methods used proved simple and reliable.

Future Tasks
The limited available information and high degree of complex issues associated with cryptogams will necessitate the development of a backlog. It is envisaged that a portion of this material can be passed onto relevant experts for identification, though few experts are available. To address this problem I have provided phrase names for many of these unknown species that can be linked to a voucher with an exclusive Perth Herbarium identification bar code. This will facilitate future access to these samples via interrogation of Perth Herbarium databases and capture any name changes resulting from identifications supplied either by experts or from taxonomic revisions. By using phrase names it is possible to designate a specific species that can be cited in reports and publications.

It may be useful to prepare a field guide for nominated cryptogam indicator species, with illustrations and information to help recognize individual species in the field. It would also be desirable to prepare a photographic or scanned record of all cryptogam taxa identified in this initial FORESTCHECK survey and for any other sites in future surveys.

FOREST STRUCTURE AND REGENERATION STOCKING

Lachlan McCaw

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, and in some cases all, of the area of forest subject to harvesting. For uneven-aged forest stands, there is a need to consider the existing structure of the stand and whether sufficient sapling and advance growth is present to re-establish the stand following harvesting. Under the current silvicultural guidelines for Jarrah-Marri forest the decision as to whether the stand should be cut to gap or to a shelterwood is influenced by the density of existing lignotuberous advance growth.

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

The objectives of this component of FORESTCHECK monitoring are therefore:

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

Fieldwork

Regeneration stocking was assessed using a sampling procedure based on triangular tessellation, similar to that applied operationally in the silvicultural guideline for Jarrah forest. The procedure used for FORESTCHECK embodies the changes that have been recommended in the current revision of the silvicultural guideline, currently in draft as Guideline 1/02 as it is expected that these will be implemented over the period of the next Forest Management Plan. Stand structure was assessed using conventional measurement techniques. Procedures are detailed in the attachment which forms an updated section for the FORESTCHECK Operating Plan. In stands cut to gap and shelterwood treatments, the height and species of regeneration was assessed at 4 locations on each grid to indicate the rate of regrowth.

Field procedures were developed and validated in May 2002, and data collected at the ten FORESTCHECK grids in Donnelly District in the period from mid-May to the end of June. A two-person team was able to complete 2 grids in a normal working day, and no particular difficulties arose during the field program. Field work is not suited to wet weather because of the need to record data and refer to calculation sheets.

The draft Operating Plan prepared in August 2001 indicated that litter depth and foliar nutrient content would be sampled in conjunction with regeneration and stand structure. Litter depth and loading have instead been incorporated in the sampling done for macrofungi, as litter forms a key substrate for fungi.

Data management

Two to three hours work are required to summarize the regeneration stocking assessment and process the stand structure data for each grid, resulting in 3 to 4 days work from the ten sites sampled this year. The design of fields for the database has been discussed with the FORESTCHECK Project Database Manager, and original paper copies of booking sheets compiled into a file record to be retained at Manjimup.

Regeneration stocking data are summarized onto a separate sheet before being entered onto the FORESTCHECK database. This sheet indicates the following key information:

- whether the grid meets current stocking standards,
- species composition,
- 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.

Canopy cover is aggregated into a single value for each grid.

Stand structure information will be summarized in the form of basal area values for each species, and histograms showing stems per ha by size class for each species. This work is currently underway and will be finalized when the relevant section of the database has been finalized.

Key findings

Most grids were well stocked with sapling and ground coppice regeneration, and exceeded the current stocking standard for western jarrah forest (65 per cent stocked at 500 stems per ha of saplings, or 1000 stems per ha of ground coppice -/+ saplings). The most notable exception to this pattern was the Yornup control grid in mature forest, with only 16 per cent of sample points stocked with regeneration. This is likely to reflect unfavourable site characteristics that are apparent in the obvious laterite cap-rock occurrence and shallow soils at this location. The grid in the Coupe buffer at Carter block was only 56 per cent stocked with regeneration, and would therefore not, under current guidelines, be available for cutting to gap in the next cutting cycle.

All three grids in areas cut to gap were very well stocked with regeneration (>84 per cent).

Jarrah comprised at least 40 per cent of regeneration at all grids.

The Kingston shelterwood grid did not meet the regeneration stocking standard, and has a higher level of retained basal area than the 10 -15 m^2/ha recommended in Silviculture Guideline 1/95 which applied at the time of harvesting in Kingston block. Counts with a basal area prism (6 x factor) indicated that 84 per cent of sample points has a retained basal area of >12 m^2/ha which is regarded as excess overwood under the revised silvicultural guideline for Jarrah forest (1/02, in draft). Retained basal area measured on transects averaged 17.8 m^2/ha, with a range from 3 to 26 m^2/ha between individual 200 m^2 transects. The high level of retained overwood is likely to have restricted effective seedling regeneration.

Table 1. Regeneration stocking and species composition, and canopy cover for ten FORESTCHECK sampling grids established in May-June 2002

Grid	Treatment	Per cent stocked with regeneration	Species composition J/M/Yarri %	Per cent of grid affected by overwood	Canopy cover %
Kingston M1	Uncut control	92	59/41	[1]N/a	54
Kingston M2	Gap	84	50/50	8	53
Kingston M3	Shelterwood	52	38/62	84 (BA>12 m^2/ha)	41
Kingston M4	Coupe buffer	80	56/44	N/a	60
Yornup M5	Uncut control	16	66/34	N/a	49
Thornton M6	Gap	86	44/56	2	42
Thornton M7	Coupe buffer	82	57/43	N/a	62
Carter M8	Gap	98	48/52	6	10
Carter M9	Coupe buffer	56	70/28/2	N/a	51
Easter M10	Uncut control	98	47/53	N/a	69

1. Retained overwood is not assessed in uncut stands or Coupe buffer.

Discussion

There are obvious differences in regeneration stocking that can be attributed to site characteristics, and these need to be kept in mind when making comparisons between grids. The RFA vegetation mapping of Mattiske and Havel (1998) at 1:250 000 should provide a useful basis for stratification of sites and is currently being examined (Table 2). Two of the three uncut control grids established in this years program occur in quite different vegetation complexes to the gap and Coupe buffer grids with which they are grouped in the experimental design, as shown in Table 2. This reflects the practical problems associated with finding areas of uniform site type that reflect the full range of silvicultural treatment. Comparisons of attributes that are site-related and that vary over short distances, such as regeneration stocking, are likely to be most valid between paired gap and Coupe buffer grids.

Table 2. Allocation of FORESTCHECK sampling grids to vegetation complex based on interpolation from 1:250 000 mapping.

Grid	Treatment	Vegetation complex
Kingston M1	Uncut control	Corbalup 2
Kingston M2	Gap	Corbalup 2
Kingston M3	Shelterwood	Corbalup 2
Kingston M4	Coupe buffer	Corbalup 2
Yornup M5	Uncut control	Mattaband 1
Thornton M6	Gap	Corbalup 1
Thornton M7	Coupe buffer	Corbalup 1
Carter M8	Gap	Collis 1
Carter M9	Coupe buffer	Collis 1 & edge of Yanmah 2
Easter M10	Uncut control	Warren

FOLIAR AND SOIL NUTRIENTS

Lachie McCaw

Introduction

Foliar and soil nutrient sampling has not been completed, but has been programmed for spring 2002 and samples collected will then be submitted for processing at the Department's Kensington laboratory.

SOIL DISTURBANCE

Kim Whitford

Introduction
This report covers the 2001/2002 assessments of seven FORESTCHECK grids at Carter (gap and Coupe buffer), Thornton (gap and Coupe buffer) and Kingston (gap, shelterwood, and Coupe buffer) forest blocks. External controls were not used in this study as the variation in soil type across the landscape make these physically distant sites inappropriate as reference sites for bulk density measurements. In addition, there is no reason to suspect that disturbance on the treatment plots adjacent to the internal control plots (Coupe buffer) would alter soil physical properties on these internal control plots. Consequently, external controls are not required for the soil disturbance monitoring.

The objectives of this work were to:
1. Monitor the intensity and extent of changes to soil physical properties induced by logging.
2. Establish a database to examine the change in these properties over long time periods.
3. Examine the relationship between visual assessments of soil disturbance and soil compaction
4. Commence the establishment of a database that over time and across sites could enable the use of visual assessment as a surrogate for bulk density measurements.
5. Examine the relationship between visual assessment of soil disturbance and shear strength.
6. Examine the relationship between bulk density and soil shear strength.

Sampling issues encountered
I planned to stratify the sampling on the basis of soil disturbance classes (Rab 1989, Whitford 2001). This could only be attempted at the most recently logged site (Carter), as it is inappropriate for retrospective sites. Unfortunately the logging at Carter was not sufficiently recent for the signs of disturbance to be visibly clear. The assessment of the disturbance strata on this site was not of a high standard and consequently does not serve objectives 3, 4 and 5 well.

At the older retrospective grids sampling was stratified on the basis of operational categories (eg. landing, snig track, harvested area, etc). Though easier to identify than disturbance classes, these strata are of a lower quality and include greater variability than disturbance classes. On these older grids some snig tracks that were clear on old aerial photographs could not be identified on the ground. This failure to clearly identify some snig tracks lowers the quality of these operational category strata.

The sampling program was too ambitious. The collection of soil moisture measurements along with the shear strength measurements significantly increased the time required to collect this information. I underestimated the amount of time required for this. The intensive collection of this large number of bulk density sample was too physically demanding, and this work needs to be spread out over a greater time period, or amongst more people.

Sampling processing
No unforeseen problems occurred in sample processing. The costs of sample processing were correctly estimated. The dust extraction system installed was successful. My original proposal made greater use of Department staff. These staff were not available to assist and consequently more funds were spent on casual employees than was originally proposed.

Database establishment
There were no unforeseen problems in establishing the database.

Preliminary results
The grids and treatments assessed and measured are listed in Table 1. Table 2 gives the means and standard errors for bulk density, soil shear strength and gravel content of operational categories at seven

FORESTCHECK grids. As low numbers of measurements points occurred in some the snig track operational categories, Table 3 shows the means for combined snig track categories.

Visual assessment of disturbance classes was only possible the most recently logged site (Carter gap). This assessment is not appropriate at the retrospective sites where evidence of disturbance has changed over time.

At this stage sampling intensity appears to be adequate but the analysis needs to be completed before a definite conclusion is reached.

Table 1. The number of assessment points and sample or measurements collected at each FORESTCHECK grid. The disturbance classes and operational categories used are described in the FORESTCHECK operating plan.

Grid	Grid code	Disturbance class sample points	Operational category sample points	Shear strength sample points	Total bulk density sample points	Soil moisture samples
Kingston gap	M2		160	160	160	54
Kingston Shelterwood	M3		100	100	100	41
Kingston Coupe buffer	M4		40	40	40	14
Thorton Gap	M6		166	166	166	52
Thornton Coupe buffer	M7		40	40	40	14
Carter Gap	M8	338		152	152	51
Carter Coupe buffer	M9		40	40	40	14
TOTAL		**338**	**546**	**698**	**699**	**240**

Table 2. Bulk density, soil shear strength and gravel content of operational categories at seven FORESTCHECK grids.

Grid	Grid code	Operational category	n	Fine earth bulk density (g cm^{-3})	SE	Gravel content (%)	SE	Shear strength (kPa)	SE	n
Kingston gap	M2	HA	68	0.798	0.023	32.0	2.4	446	24	67
		LL	20	1.123	0.037	22.4	2.8	1156	111	20
		OST	11	0.891	0.058	40.9	6.4	386	56	8
		ST0	3	1.173	0.055	12.1	2.1	824	196	3
		ST1	23	1.007	0.030	30.3	2.7	689	48	23
		ST2	30	0.935	0.040	32.5	4.7	625	38	27
		ST3	5	0.863	0.030	49.6	4.7	714	108	5
Kingston shelterwood	M3	HA	66	0.931	0.022	8.1	1.2	365	20	66
		LL	21	1.196	0.042	13.3	2.2	697	97	21
		ST1	4	0.864	0.049	19.5	5.0	1280	262	4
		ST2	9	1.100	0.045	11.7	3.3	685	112	9
Kingston Coupe buffer	M4	OST	1	1.156		9.6		490		1
		UA	39	0.925	0.022	9.8	2.9	347	21	39
Thorton gap	M6	HA	75	0.984	0.025	16.6	2.2	358	34	75
		LL	23	0.732	0.035	59.2	2.0	264	24	23
		ROAD	11	1.322	0.036	6.6	1.4	678	98	11
		ST0	7	1.205	0.025	58.9	2.5	1550	384	7
		ST1	4	1.019	0.004	22.3	0.3	775	111	4
		ST2	34	1.167	0.028	8.9	2.0	401	46	33
		ST3	12	1.144	0.053	4.1	2.4	427	47	12
Thorton Coupe buffer	M7	UA	40	0.756	0.036	46.8	3.1	306	17	38
Carter gap	M8	HA	137	0.795	0.013	35.4	1.3	383	18	137
		LL	5	0.932	0.082	29.5	3.6	628	62	5
		ST1	1	1.053		24.2		1098		1
		ST2	5	0.904	0.078	38.6	10.5	698	118	5
		ST3	4	0.959	0.124	36.5	4.3	310	53	4
Carter Coupe buffer	M9	UA	40	0.777	0.025	54.8	2.2	243	13	40

Table 3. Mean bulk density, soil shear strength and gravel content of operational categories at seven FORESTCHECK grids. Operational categories ST0 and ST1 have been grouped as category ST01, and categories ST2 and ST3 have been grouped as category ST23.

Grid	Grid code	Operational category	n	Fine earth bulk density ($g\ cm^{-3}$)	SE	Gravel content (%)	SE	Shear strength (kPa)	SE	n
Kingston gap	M2	HA	69	0.803	0.023	31.8	2.4	450	24	68
		LL	20	1.123	0.037	22.4	2.8	1156	111	20
		OST	11	0.891	0.058	49.0	6.4	386	56	11
		ST01	23	1.027	0.032	26.2	2.3	721	52	23
		ST23	37	0.926	0.033	36.2	4.1	632	34	34
Kingston shelterwood	M3	HA	66	0.931	0.022	8.1	1.2	365	20	66
		LL	21	1.196	0.042	13.3	2.2	697	97	21
		ST01	4	0.902	0.064	18.0	5.4	1393	248	4
		ST23	9	1.083	0.051	12.3	3.4	635	72	9
Kingston Coupe buffer	M4	OST	1	1.156		9.6		490		1
		UA	39	0.925	0.022	9.8	2.9	347	21	39
Thorton gap	M6	HA	75	0.984	0.025	16.6	2.2	358	34	75
		LL	23	0.732	0.035	59.2	2.0	264	24	23
		ROAD	11	1.322	0.036	6.6	1.4	678	98	11
		ST01	7	1.205	0.025	58.9	2.5	1550	384	7
		ST23	50	1.150	0.023	8.8	1.6	438	37	50
Thorton Coupe buffer	M7	UA	40	0.756	0.036	46.8	3.1	306	17	38
Carter gap	M8	HA	137	0.795	0.013	35.4	1.3	383	18	137
		LL	5	0.932	0.082	29.5	3.6	628	62	5
		ST1	1	1.053		24.2		1098		1
		ST2	5	0.904	0.078	38.6	10.5	698	118	5
		ST3	4	0.959	0.124	36.5	4.3	310	53	4
Carter Coupe buffer	M9	UA	40	0.777	0.025	54.8	2.2	243	13	40

Table 4. Mean bulk density, soil shear strength and gravel content of disturbance classes at the Carter site.

Site	Grid code	Soil disturbance class	n	Fine earth bulk density ($g\ cm^{-3}$)	SE	Gravel content (%)	SE	Shear strength (kPa)	SE
Carter gap	M8	D0	77	0.787	0.015	0.342	0.016	367	19
		D1	23	0.818	0.044	0.277	0.033	407	38
		D2	26	0.850	0.035	0.374	0.033	451	42
		D3	26	0.826	0.033	0.429	0.028	463	70
Carter Coupe buffer	M9	D0	40	0.777	0.025	0.548	0.022	243	13

Table 5. The total area of the fallers block, the area of snig tracks and landings identified at each FORESTCHECK grid, and the proportion of the block area that has been disturbed by snig tracks and landings. Snig track classes are first order (ST1), second order (ST2), third order (ST3), old snig track from a previous logging that has been reused (OST) and an old road that has been reused as a snig track. Snig track area calculations are based on measurements of snig track lengths and assumed widths of 4.90m for ST0, 4.67 for ST1, 4.46 for ST2, and 4.13 for ST3.

Grid	Grid code	ST1 (m^2)	ST2 (m^2)	ST3 (m^2)	OST (m^2)	Old Road (m^2)	Total snig track area (m^2)	Landing area (m^2)	Block area (m^2)	Proportion of block disturbed
Kingston Shelterwood	M3	1538	1635	318			3491	941		
Kingston gap	M2	2739	5251	1217	454		9662	1410		
Thorton gap west	M6	1663	2582	1605		1562	7412	1792		
Thorton gap east		1566	1998	182			3745	1942		
Thorton gap total		3229	4580	1787		1562	11158	3734	133,773	0.111

Bulk density and shear strength observation discussion points

- The results reaffirm that fine earth bulk density is a more meaningful measure of soil disturbance than total bulk density. The total bulk density at Carter Coupe buffer is higher than the total bulk density for harvest area (HA) at Carter gap. This is not the case for fine earth bulk density highlighting the reasons for using fine earth bulk density.
- The use of reference sites for comparisons of soil impacts is problematic as the undisturbed soil at the reference site can have higher bulk density than disturbed soil on a logged site.
- The Kingston Coupe buffer site seems to provide a good reference site.
- It makes more sense to use the undisturbed harvested area as a reference rather than the Coupe buffer, even though the HA will have some increase in bulk density due to disturbance.
- The bulk density on the log landings (LL) is highly variable because the landings have been ripped.

Relationship between bulk density, and shear strength and soil moisture

Several regressions were developed to examine the relationship between soil shear strength and bulk density. Additional variables included in this analysis were soil gravel content, and soil moisture content at the time of the shear strength measurement.

Regression relationships

1. Strength = -71.879 + 84.756*FEBD + 53.361*Gravel% + 128.748*Moisture content r^2 = 0.224 n = 234
2. FEBD = 1.149 + 0.00234*Strength - 0.571*Gravel% - 0.892*Moisture content r^2 = 0.482 n = 234
3. FEBD = 0.937 + 0.002197*Strength + 0.6087*Moisture content r^2 = 0.152 n = 234
4. TBD = 1.168 + 0.00239*Strength + 0.471*Gravel% - 1.127*Moisture content r^2 = 0.467 n = 234
5. TBD = 1.343 + 0.00251*Strength - 1.360*Moisture content
   r^2 = 0.301 n = 234

Equations 2 and 4 are the only regressions with reasonable r^2. These relate bulk density to shear strength and moisture content. However the r^2 of these relationships indicates that they would provide poor predictions of bulk density. I conclude that shear strength cannot provide worthwhile estimates of soil bulk density.

Comparison of sampling methods used

I attempted to identify sampling strata and stratify the sampling in a single survey operation. There were some problems in doing this. This resulted in some strata being over sampled and other strata being under sampled. This was a relatively minor problem. There were inefficiencies in the system I used to identify the sampling strata and in stratifying and labelling the sample points. I am not sure how to improve this, as other methods would be less efficient.

As noted previously the visual assessment of soil disturbance needs to occur soon after logging has finished, and is not well suited to sites where a post logging treatment is applied. Even the most recently logged site (Carter gap) was too old for visual assessment to be of a high standard.

Future tasks

Data entry and summary is complete. The areas of the Kingston gap and shelterwood treatments need to be determined to complete Table 5.

Discussion

Stratification

- The description and measurement of soil disturbance across a logging site requires the grouping of measurement points into identifiable strata with common intensity of disturbance.
- Soil disturbance classes are best determined a short time after completion of logging. The required delay of 2 to 3 years between logging and vegetation assessment on Forestcheck sites makes the use of disturbance classes inappropriate for this monitoring system.
- Operational classes are distinguished more readily than disturbance classes for a longer period after logging. However post logging treatments can obscure these classes. At the Carter gap treatments the post logging machine disturbance and fire made identification of operational classes impossible.
- Operational categories were difficult to distinguish at all sites.
- Few snig tracks could be identified on the Kingston shelterwood treatment. Consequently bulk density and shear strength were measured at regularly spaced grid points rather than at points of known operational categories on the grid.

Shear strength

Fine earth bulk density could be related to shear strength gravel content and soil moisture. However the r^2 was low indicating that FEBD predicted in this manner would have large errors associated with it. In addition this predictive model required soil moisture and gravel content which are difficult and expensive to collect. The necessity of determining these values reduces the efficiency of using shear strength measurements to an extent that the more expensive but considerably more meaningful bulk density measurements are cost effective.

- Shear strength measurements were clearly effected by gravel (particularly large and angular gravel) and plant roots in the soil. This necessitated repeated measures at most measurement locations and the rejection of unusually high values. This repeated measurements and the judgement required to identify erroneous measurements lower the value of shear strength measurements.
- All of these factors indicate that these shear strength measurements have limited value for long term monitoring of soil disturbance in gravely soils.

Conclusions

- The extent of soil disturbance cannot be readily determined on retrospective sites or recently logged sites that have experienced post harvest silvicultural treatments and/or fire.
- The intensity of soil disturbance cannot be successfully determined from visual assessment on retrospective sites or recently logged sites that have experienced post harvest silvicultural treatments and/or fire.
- On retrospective sites, operational categories are best identified when good quality aerial photography collected a short time after the completion of logging is available, and no post harvest soil disturbance, such as machine knock down, has occurred.
- Soil shear strength is unlikely to provide meaningful information on the long term changes in soil condition because of the influence of soil moisture and the effect of gravel and roots in the soil.
- The design of FORESTCHECK, which is intended to accommodate a wide variety of monitoring exercises, is unsuited to monitoring the extent of soil disturbance. This is best done shortly after the completion of logging operations.
- Similar the intensity of disturbance from logging operations is best determined shortly after the completion of logging operations.
- Soil disturbance monitoring within FORESTCHECK is best confined to measurements of bulk density at known locations with clearly identified operational categories or disturbance classes that could be used to determine the changes in the intensity of disturbance over time at representative sites.

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MACROFUNGI, COARSE WOODY DEBRIS, AND LEAF LITTER DEBRIS

Richard Robinson and Bob Smith

Introduction
Fungi are considered some 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.

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

Research on fungi in Western Australia's southern forests is in its infancy. Knowledge on fungal diversity and the ecological roles that fungi play and the maintenance and/or recovery of a diverse habitat for both ground dwelling organisms and as substrates for nutrient enhancing organisms is of vital importance to forest managers making decisions on sustainable forest management.

The objective of this component of the FORESTCHECK program was to:
1. Monitor and record the species of macrofungi in the various treatments of managed jarrah forest (gap, shelterwood, coupe buffer) and in uncut forest. Trends in species composition, richness and abundance and substrate utilization will be analysed over time.
2. Measure and record the amount of litter, small wood and twigs (SWT) and coarse woody debris (CWD) on the ground in the various treatments of managed jarrah forest (gap, shelterwood, coupe buffer) and in uncut forest. Trends within and between the treatments will be analysed over time.

Field and Lab Work 2001/2002
Litter and CWD assessment was carried out from Feb-April and the SWT assessment in July 2002.

Macrofungi transects were installed at all sites during Feb - April 2002. Assessment of all the sites was carried out in June 2002. Voucher specimens have been processed and where possible identified. An overall species list and one for each individual site has been determined.

Weather disrupted and significantly increased the time period over which the macrofungal assessment was done. Normally light rain is not too disruptive but during June frequent heavy rain was encountered. In addition to difficulties in recording data and negotiating often-difficult terrain (logs, discarded tops etc), voucher specimens deteriorate rapidly if collected wet.

In total, 314 voucher specimens were collected representing 170 species. Processing had to be completed almost immediately as they deteriorate rapidly. This proved to be a more time consuming task than anticipated as the vast majority of species had not been encountered previously and detailed descriptions were necessary to validate their identity.

Data Management
All fungi data have been entered onto a Microsoft Excel worksheet. Species diversity and abundance at each site and a frequency rating of 1 (rare) to 8 (very common) for each species at each site has been

determined. The data includes a complete list of 192 species recorded across all the sites, their life modes (mycorrhizal, saprotrophic, parasitic) and the substrate on which they were fruiting. Analysis is ongoing.

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

Key Findings

1. Macrofungi

A total of 192 species of macrofungi were recorded across all the sites. Preliminary analysis shows that there were no obvious differences in species diversity between the treatments, but the abundance in the gap treatment appears to be higher (Fig. 1). Species diversity and abundance on the Kingston gap treatment, however, does appear to be higher than the same treatment at Thornton and Carter.

Species composition at each site has not yet been investigated. This may have some bearing on the higher abundance in the gap treatments. Field observation suggests that within these treatments there was a higher number of wood decay species, such as *Calocera* sp., *Gymnopilus* spp. and *Pholoiota* spp., which tend to fruit in high numbers. These species may also reflect the state of decay of the wood on these sites as they appear to be early colonisers of wood and are not found in such large numbers on well-rotted wood. Some species may also prefer burnt wood.

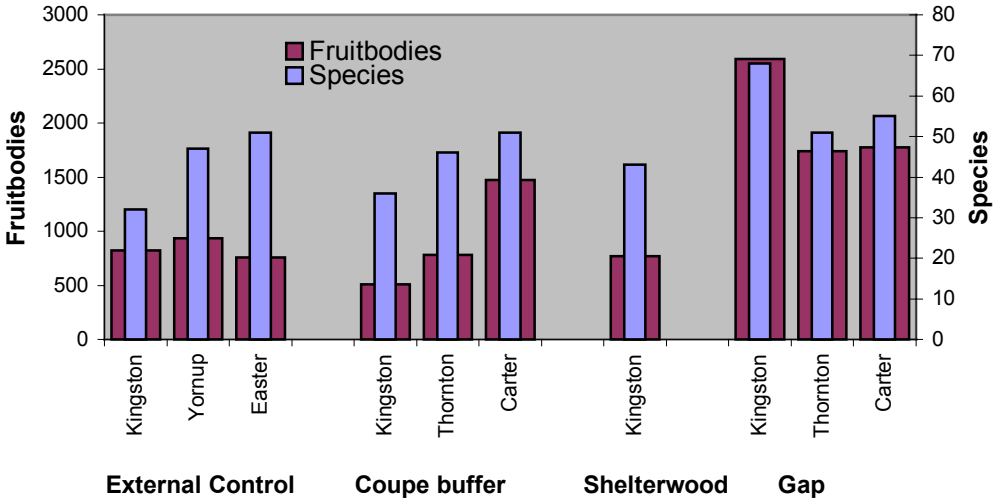

Figure 1. Macrofungi species diversity and abundance at each FORESTCHECK site in June 2002.

2. Litter, Small Wood and Twigs (SWT) and Coarse Woody Debris (CWD)

Litter loads on all sites ranged from 2.1 t ha^{-1} to 10.2 t ha^{-1} (Fig.2), and generally reflect the ages of the various treatments. The uncut control at Easter is an old growth site and has the greatest accumulation of litter, while the gap at Carter has only recently been cut and burnt and has the lowest litter load. The coupe buffer treatments have similar litter loads to those on the uncut controls. Litter is rapidly accumulating on the older gap treatments at Kingston and Thornton.

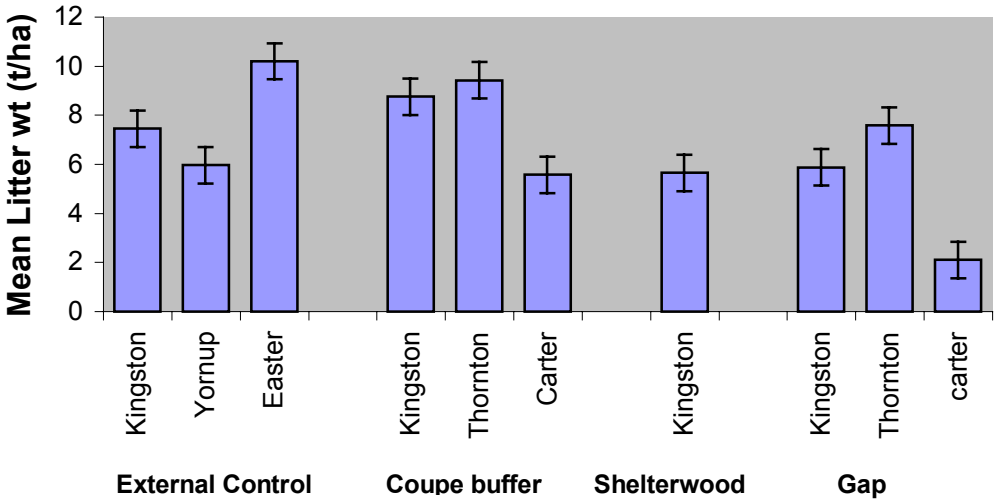

Figure 2. The mean litter loads (t ha^{-1}) calculated at each FORESTCHECK grid in April 2002.

As was the case with the litter, the SWT loads generally reflected the age of the forest within the treatments (Fig. 3). Loads ranged from 2.0 t ha^{-1} to 11.1 t ha^{-1}, with the heaviest load on the old growth site at Easter and the lowest loading on the gap at Thornton. Coupe buffers have similar loads to those on the uncut controls. This component of the ground cover is very variable, as indicated by the large standard errors.

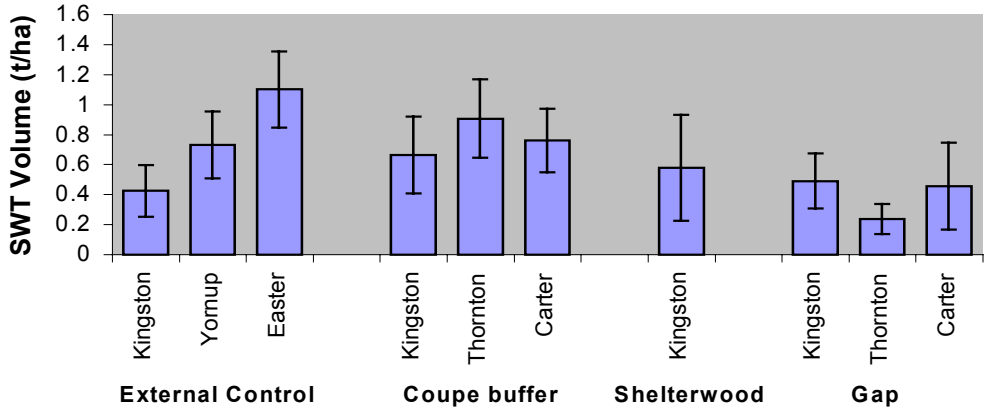

Figure 3. The weight (t ha^{-1}) of SWT measured at each FORESTCHECK site in July 2002.

The greatest volume of CWD was measured at the Thornton gap site (Fig. 4). This may be due to the fact that one end of this transect was close to the road where logs and debris had been pushed into heaps. Generally, however, all treatment sites had volumes of CWD within the range of that found on the uncut control sites, about 110-300 m^3 ha^{-1}. The quality or state of decay was not assessed, but observation suggests that the wood on the gap and shelterwood sites was more solid that that generally found on the uncut controls.

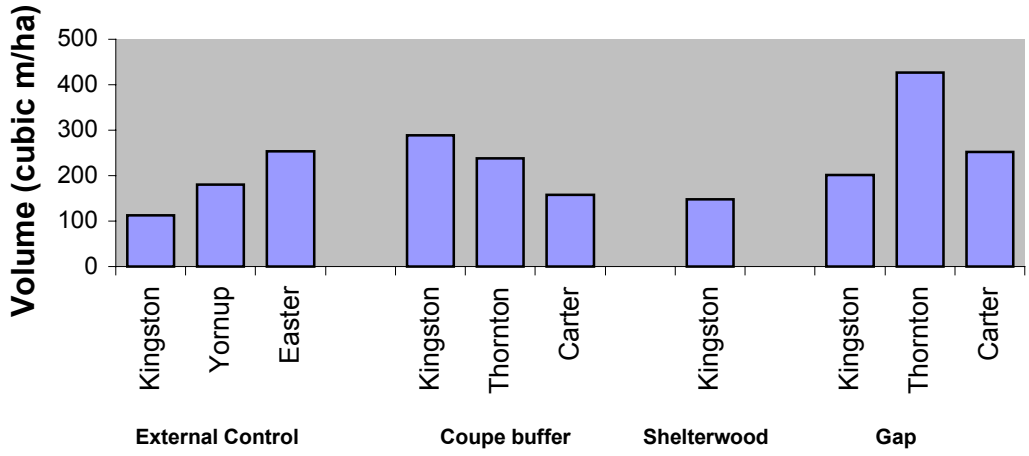

Figure 4. The volume (m^3 ha^{-1}) of CWD measured at each FORESTCHECK grid in April 2002.

Further analysis will examine the relationship between litter loads and CWD volumes and the composition of the fungal community found in each treatment. Data pertaining to litter and CWD can also be incorporated in the analyses of the data collected by other FORESTCHECK teams.

Indicator Species Approach

At present we do not have sufficient of knowledge of the fungal flora present in WA forests or the roles that individual species play in ecosystem function that would enable an indicator species approach to be taken for monitoring. Also, it is especially difficult to take this approach with fungi. The only practical method of recording fungi is on the presence of fruit bodies, and many species do not produce fruit bodies regularly. Therefore the absence of fruit bodies does not indicate the absence of the fungus. For now, at least, the more appropriate approach to monitoring fungi is to record diversity.

Modification to Methods, Difficulties

The position of transects was modified from the original proposal. Due to site constraints in several of the treatments, transects were surveyed at 60 m either side of the centre line instead of 90 m as stated in the original proposal. Each transect was divided into 4 sectors (0-50, 50-100, 100-150 and 150-200 m) on which the fungi species frequency rating (1-8) was based.

Originally 3 visits to each grid to collect fungal data were proposed on a fortnightly basis. This proved to be very ambitious. The amount of data collected, voucher collection and processing and species identification all proved to be an enormous amount of work. Inclement weather often halted field work but it also made available the extra time needed to process voucher collections. A maximum of 2 grids could only be completed in one day, followed by a full day to process voucher collections. This resulted in taking 3 weeks to do a single circuit of all 10 grids. However, it appears that the timing of assessment coincided with the peak of the fruiting season, resulting in a large number of species being recorded.

Litter SWT and CWD measurements went smoothly. The measurement of small wood and twigs (10-25 mm diam.) on each grid has been added to the operating plan.

Appendix 1. List of fungal species recorded in FORESTCHECK survey, June 2002.

Sp #`	Species
46	Agaric "creamy white"
115	Agaric "orange frosty"
82	Agaric "Lepiota-like, cream-grey"
156	Agaric "light brown - red scales on stem"
18	Agaric "light brown-olive"
12	Agaric "olive"
76	Agaric "orange with brick red scales/white gills"
97	Agaric "pure white"
174	Agaric "red/yellow/red"
170	Agaric "yellow brown-moist"
23	Agaric ?*Clitocybe*
71	*Agaricus* sp. "small - flat- red stain"
38	*Agaricus* sp. "small"
33	*Agaricus* sp. "yellow stainer"
39	*Agaricus* sp. "large cap, purplish scales"
120	*Aleuria rhenana*
114	*Amanita* sp. "apricot-pink margin"
186	*Amanita* sp. "grey-brown"
45	*Amanita* sp. "white, deeply rooted"
28	*Amanita* sp. "white, stout"
6	*Amanita xanthocephala*
35	*Amanita xanthocephala* forma *macalpiniana*
180	*Armillaria luteobubalina*
188	*Austroboletus laccunosa*
103	*Boletellus obscurecoccineus*
93	*Boletus ananiceps*
29	*Boletus* sp. "dull maroon"
49	*Boletus* sp. "red pores and stem"
95	*Boletus* sp. "small yellow/cream pores"
99	*Boletus* sp. "yellow-red, stains blue"
9	*Calocera* sp. "yellow"
140	*Clavaria* sp. "pink-buff coral"
81	*Clavulina* sp. "grey-brown"
14	*Clitocybe* sp.
181	*Collybia* aff. *butracea*
143	*Collybia* sp. "buff funnel"
151	*Collybia* sp. "large"
15	*Coltricia oblectans*
32	*Coprinus* sp.
128	*Coprinus* sp. "basal hairs"
147	*Cortinarius* (*Dermocybe*) *austroveneta*
34	*Cortinarius (Dermocybe)* sp. "olive-yellow gills"
168	*Cortinarius* (*Dermocybe*) sp. "brown with mustard yellow gills"
40	*Cortinarius (Dermocybe)* sp ."chestnut"
110	*Cortinarius* (*Dermocybe*) sp. "red orange"
146	*Cortinarius* (*Myxacium*) sp. "orange-brown"
125	*Cortinarius (Phlegmacium)* sp. "purple-grey"
158	*Cortinarius* aff. *micro archerii*
173	*Cortinarius basirubescens*

172 *Cortinarius* sp. "banded stem"
73 *Cortinarius* sp. "brown with purplish tints"
68 *Cortinarius* sp. "brown" ?(34)
154 *Cortinarius* sp. "chestnut"
57 *Cortinarius* sp. "dark brown/lemon-yellow gills"
7 *Cortinarius* sp. "rooting stem"
121 *Cortinarius* sp. "slender brown"
131 *Cortinarius* sp. "slender lilac"
124 *Cortinarius* sp. "yellow-olive"
184 *Cortinarius* spp. (unidentified)
171 *Cortinarius vinaceolamellatus*
22 *Crepidotus* sp. "dark brown"
118 *Crepidotus* sp. "large creamy-tan"
83 *Crepidotus* sp. "on marri stag"
61 *Crepidotus* sp. "small brown"
21 *Crepidotus* sp. "small white"
148 *Crucibulum laeve*
138 *Daldina concentrica*
187 *Dictyoporus* sp.
123 *Discomycete* "yellow stalked"
31 *Entoloma* (*Leptonia*) *sp.* "blue-black"
153 *Entoloma* (*Leptonia*) sp. "small dark grey-brown"
30 *Entoloma* sp. "creamy white"
167 *Entoloma* sp. "dark grey - blue gill edge"
25 *Entoloma* sp. "grey-brown - blue stem"
77 *Entoloma* sp. "grey-brown - brown stem"
135 *Entoloma* sp. "tall, grey-brown"
78 *Entoloma/Leptonia* "grey - decurrent gills"
159 *Exidia glandulosus*
41 *Fistulina hepatica*
91 *Fistulinella mollis*
11 *Galerina* sp. "hanging gills" and "conic"
111 *Galerina* sp. "large"
58 *Galerina* sp. "small cap, eccentric stipe - on wood"
42 *Galerina* sp. "small on bark"
8 *Gymnopilus austrosapineus*
43 *Gymnopilus* sp.
105 *Gymnopilus* sp. "chestnut scales, forked gills"
26 *Gymnopilus* sp. "reddish cap, orange gills"
85 *Gymnopilus* sp. "slender"
117 *Hebeloma* sp.?
56 *Heterotexus peziziformis*
132 Hydnoid crust "light yellow"
100 *Hypholoma australe*
59 *Hypholoma brunneum*
108 *Hypomyces chrysospermus*
1 *Incoybe australiensis*
20 *Incoybe* sp. "scaly cap" see sp. 277 Fire Fungi
53 *Incybe* sp. "tan skirt"
137 *Inocybe* sp. "creamy-brown"
48 *Inocybe* sp. "grey"
65 *Inocybe* sp. "large scaly cap"
113 *Inocybe* sp. "radially fibrillose, pink stem"

169 *Inocybe* sp. "shaggy stem"
162 *Inocybe* sp. "small light brown, fibrillose"
74 *Laccaria* aff. *masonii*
36 *Laccaria lateritia*
142 *Lactarius eucalypti*
185 *Lepiota cristata*
166 *Lepiota* sp. "creamy-brown"
24 *Lycoperdon* sp.
190 *Macrolepiota konradii*
55 *Marasmius crinis-equi*
183 *Marasmius elegans*
191 *Marasmius* sp. "white umbrella"
75 *Marasmius* sp. "large brown, on Zamia stems"
101 *Merulius* sp.″pink-buff″
50 *Mycena* aff. *rorida*
134 *Mycena* aff. *subcapillaris*
44 *Mycena* aff. *subgallericulata*
66 *Mycena pura*
144 *Mycena sanguinolenta*
163 *Mycena* sp. "brown-grey, on wood"
51 *Mycena* sp. "buff umbrella"
80 *Mycena* sp. "ginger foot"
27 *Mycena* sp. "long stem"
165 *Mycena* sp. "small grey - bleach"
88 *Mycena* sp. "tiny white with decurrent gills"
64 *Mycena* sp. "tiny white, on twigs"
182 *Mycena* spp. (unidentified)
164 *Nidula candida*
112 *Omphalina chromacea*
122 *Omphalina* sp. "orange in moss - on log"
127 *Omphalina*sp. "flesh-brown"
130 Orange parasite on white resupinate polypore (sp.116)
104 *Panellus ligulatus*
179 *Paxillus* sp. "yellow, brown scales"
126 *Peziza* sp ."small khaki cup"
37 *Phellinus* sp.
136 *Phellinus* sp. "resupinate"
70 *Phellodon niger*
87 *Phellodon* sp. "brown, white margin"
160 *Pholiota lighlandensis*
119 *Pholiota multicingulata*
192 *Plectania* sp. "black"
133 *Pluteus attromarginata*
47 *Pluteus lutescens*
4 *Pluteus* sp. "brown velvet"
157 *Podoserpula pusio*
13 Polypore "brown with white margin"
3 Polypore "long white shelf"
116 Polypore "white resupinate"
145 *Poronia ericii*
155 *Protubera canescens*
17 *Psathyrella* sp.
98 *Psathyrella* sp. "very tall, slender"

177	*Psilocybe coprophila*
129	*Pulvinula* sp.
176	*Pycnoporus coccineus*
52	*Ramaria* aff. *aurea* "yellow, flat tops"
102	*Ramaria ochroceosalmonicolor*
139	*Ramaria* sp. "lemon-yellow"
86	*Ramaria* sp. "orange-red, yellow stem"
72	*Ramaria* sp. "purple-pink"
79	*Resupinatus* sp. "grey with light margin"
69	*Russula adusta*
89	*Russula clelandii* group
90	*Russula* multicolor (aff. *cyanothanxa)*
92	*Russula neerimea*
178	*Russula persanguinea* (white stem)
107	*Russula* sp. "grey-white"
10	*Russula* sp. "white/white/white"
150	*Scutellina* aff. *margaritacea*
106	Slimy white marri nuts
62	*Stereum hirsutum*
84	*Stereum* sp. "black, hirsute, purplish hymenium"
141	*Stereum* sp. "chocolate borwn"
152	*Stereum* sp. "chocolate brown with cream underside"
149	*Stereum* sp. "dark brown - yellowish margin"
5	*Stereum* sp. "grey-brown white hirsute, purple fertile layer"
109	*Stereum* sp. "purpureum"
67	*Stropharia semiglobata*
94	Thelephore "shelved hydnoid"
16	Thelephore "translucent funnels"
19	*Trametes lilacino-gilva*
63	*Trametes versicolor* (brown or grey)
60	*Tremella mesentericia*
161	*Tricholoma* sp. "grey-white"
96	*Tricholoma* sp.? "beige slimy cap'
54	*Tricoloma eucalypticum*
189	*Tubaria rufofulva*
2	*Xerula australis*
175	*Xylaria hypoxylon*

DATA MANAGEMENT AND STORAGE

Amanda Mellican

Introduction
The group is responsible for entering the collected data into electronic format for Macro Vertebrates, Birds, Nocturnal Birds, Mammals, Reptiles and Amphibians, Plants and Cryptogams, and the collected 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 names were pre-listed in the program. Date as in Day, Month and Year (from 2001 to 2010) was also created as drop down lists. Thus, location, treatment and personnel are only entered once for all the records for a particular data sheet. If there was nothing to comment on, then the program will automatically record in the Comments section as "No comment". If any one of the fields is missing or left it as blank, an error message is given and the data would not be inserted into the data file until 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 except cryptogams were completed by Verna Tunsell. Only M8, M9 and M10 grids were left to complete. The Metadata form as shown in Appendix A is also completed.

Currently, I am writing two data entry programs for the Forest Structure group and am completing one of the programs. The electronic data for Invertebrates has been received. Data from the remaining groups will be received in a short time.

Data Validation
As soon as the programs for Forest Structure are finalized, I will validate 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 each group.

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

Collected Specimens
Of the 781 flora and cryptogam specimens collected during the period, all of the flora specimens have been identified, prepared and lodged at the Herbarium. The cryptogams collected from two sites have also been prepared and have been lodged. The remaining sites have been prepared and are ready for databasing. The fungi are still progressing as these are later collections.
The specimens that have been lodged at the Herbarium have been databased on the "Max" system and submitted electronically. Max is used as the primary means of submitting specimen information to the

Herbarium. There are many facets to Max but the main ones relevant to FORESTCHECK are the collection book, specimen tables and reporting facilities. (Examples are illustrated in Appendices B, C and D).

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

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

Appendix A. Example of Metadata Form.

Group Name →

Leader →

Contact Officer →

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

Appendix B. Example of Flora labels generated by Max.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Persoonia longifolia R.Br.

Proteaceae

Identified by:

Erect to compact perennial shrub, height to 2.6 m, width to 1.7 m; fruiting only. State Forest; plain; brown to black clay. Frequent. Forest with associated Corymbia calophylla, Eucalyptus marginata, Persoonia longifolia.

Loc.: North Boundary Road, 1 km N of Kingston Road, Winnejup Forest Block,

Lat. 34° 4' 3"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield, B.G. Ward. 1 **Date:** 08/10/2001

Voucher: FORESTCHECK

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Rhodanthe citrina (Benth.)Paul G.Wilson

Asteraceae

Identified by:

Erect annual herb, height to 7 cm, width to 0.5 cm; flowers yellow; shallow tap root. State Forest; plain; brown to black clay. Locally abundant. Forest with associated Corymbia calophylla, Eucalyptus marginata, Persoonia longifolia.

Loc.: North Boundary Road, 1 km N of Kingston Road, Winnejup Forest Block,

Lat. 34° 4' 3"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield, B.G. Ward. 2 **Date:** 08/10/2001

Voucher: FORESTCHECK

WESTERN AUSTRALIAN HERBARIUM, PERTI
Flora of Western Australia

Macrozamia riedlei (Gaudich.)C.A.Gardner

Zamiaceae

Identified by:

Erect open to compact perennial cycad, height to 1 m, width to 1.5 m; some in fruit. State Forest; plain; brown black clay. Frequent. Forest with associated Corymbia calophylla, Eucalyptus marginata, Persoonia longifolia.

Loc.: North Boundary Road, 1 km N of Kingston Road Winnejup Forest Block,

Lat. 34° 4' 3"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield, B.G. Ward. 3 **Date:** 08/10/2001

Voucher: FORESTCHECK

WESTERN AUSTRALIAN HERBARIUM, PERT
Flora of Western Australia

Caladenia flava R.Br. subsp. ***flava***

Orchidaceae

Identified by:

Erect open dwarf shrub, height to 30 cm, width to 20 c flowers yellow; modified root system. State Forest; pla brown to black clay. Frequent. Forest with associated Corymbia calophylla, Eucalyptus marginata, Persoonia longifolia. Population flowering: 30%.

Loc.: North Boundary Road, 1 km N of Kingston Roa Winnejup Forest Block,

Lat. 34° 4' 3"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield, B.G. Ward. 4 **Date:** 08/10/2001

Voucher: FORESTCHECK

Appendix C. Example of Cryptogam labels generated by Max.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Hypogymnia subphysodes var. ***austerodioides***

Hypogymniaceae

Identified by: R.J. Cranfield 23/05/2002

Lichen: active growth phase; grey with black lower surface, tan fruiting bodies present; growing in sheltered wet positions on dead wood in ground layer (0cm - 30 cm) and shrub layer (31 cm-3 m). Plain running east to west with 1° slope; bare to littered gravelly, cryptogamic moist brown to black clay over laterite with 5% outcropping, and a litter depth of 3 cm comprising, new old and decomposed litter. Frequent on occasional sites. Forest with five stratal layer and associated Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis with a few weed species present..

Loc.: Winnejup Forest Block, North Boundary Road, 1 km N of Kingston Road,

Lat. 34° 4' 30"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield and K. Knight 17852 **Date:** 15/05/2002

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Cladonia ? macilenta

Cladoniaceae

Identified by: R.J. Cranfield 23/05/2002

Lichen: active growth phase; tan fruiting bodies present; growing in sheltered wet positions on dead wood in shrub layer (31 cm-3 m).
Chemistry: Cortex K+ yellow, C-, KC-. Plain running east to west with 1° slope; bare to littered gravelly, cryptogamic moist brown to black clay over laterite with 5% outcropping, and a litter depth of 3 cm comprising, new old and decomposed litter. Occasional on isolated sites. Forest with five stratal layer and associated Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis with a few weed species present..

Loc.: Winnejup Forest Block, North Boundary Road, 1 km N of Kingston Road,

Lat. 34° 4' 30"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield and K. Knight 17854 **Date:** 15/05/2002

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Hypogymnia subphysodes var. ***subphysodes***

Hypogymniaceae

Identified by: R.J. Cranfield 23/05/2002

Lichen: active growth phase; grey with black lower surface; growing in sheltered wet positions on live and dead bark of Leucopogon capitellatus in shrub layer (31 cm-3 m). Plain running east to west with 1° slope; bare to littered gravelly, cryptogamic moist brown to black clay over laterite with 5% outcropping, and a litter depth of 3 cm comprising, new old and decomposed litter. Frequent on occasional sites. Forest with five stratal layer and associated Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis with a few weed species present..

Loc.: Winnejup Forest Block, North Boundary Road, 1 km N of Kingston Road,

Lat. 34° 4' 30"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield and K. Knight 17853 **Date:** 15/05/2002

Voucher: Forestcheck Monitoring Program.

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Thysanothecium scuttellatum

Cladoniaceae

Identified by: R.J. Cranfield 23/05/2002

Lichen: active growth phase; tan fruiting bodies present; growing in sheltered wet positions on charred dead wood in ground layer (0 cm-30 cm). Plain running east to west with 1° slope; bare to littered gravelly, cryptogamic moist brown to black clay over laterite with 5% outcropping, and a litter depth of 3 cm comprising, new old and decomposed litter. Frequent on occasional sites. Forest with five stratal layer and associated Eucalyptus marginata, Corymbia calophylla, Persoonia longifolia and Banksia grandis with a few weed species present..

Loc.: Winnejup Forest Block, North Boundary Road, 1 km N of Kingston Road,

Lat. 34° 4' 30"S **Long.** 116° 19' 34"E (WGS84)

Coll. R.J. Cranfield and K. Knight 17855 **Date:** 15/05/2002

Voucher: Forestcheck Monitoring Program.

Appendix D. Example of specimen table generated in Max.

Forestcheck Vegetation LFR

	Taxon Name	TaxonID	SpCode	Lifeform	Fire Reponse
			HYDSP.	AH	A1
			CALSP.	G	B3
	Acacia alata	3207	ACAALA	S	A1
	Acacia browniana	3247	ACABRO	S	A1
	Acacia dentifera	3294	ACADEN	S	A1
	Acacia divergens	3307	ACADIV	S	A1
	Acacia drummondii	3311	ACADRU	S	A1
	Acacia extensa	3331	ACAEXT	S	A1
	Acacia myrtifolia	3453	ACAMYR	S	A1
	Acacia pulchella	3502	ACAPUL	S	A1
	Acacia stenoptera	3557	ACASTE	S	A1
*	*Acaena echinata*	3184	ACAECH	DS	A1
	Adenanthos obovatus	1791	ADEOBO	S	B2
	Agonis flexuosa	5316	AGOFLE	T	U
	Agonis parviceps	5324	AGOPAR	S	B2
*	*Aira cupaniana*	185	AIRCUP	AGR	A1
	Amperea ericoides	4585	AMPERI	DS	B2
	Amphipogon amphipogonoides	194	AMPAMP	DS	B2
*	*Anagallis arvensis* var. *arvensis*	19404	ANAARV	AHW	A1
*	*Anagallis arvensis* var. *caerulea*	19405	ANAARV	AHW	A1
	Andersonia caerulea	6306	ANDCAE	DS	A1
	Anigozanthos flavidus	1407	ANIFLA	S	B3
*	*Arctotheca calendula*	7838	ARCCAL	AHW	A3
	Astroloma ciliatum	6323	ASTCIL	DS	B2
	Astroloma drummondii	6325	ASTDRU	DS	B2
	Astroloma pallidum	6334	ASTPAL	DS	B2
	Austrodanthonia caespitosa	17950	AUSCAE	GR	B3
	Austrostipa campylachne	17233	AUSCAM	GR	B3
	Banksia grandis	1819	BANGRA	T	A2
	Billardiera floribunda	3157	BILFLO	V	A1
	Billardiera variifolia	3165	BILVAR	V	A1
	Boronia crenulata	4413	BORCRE	DS	B2
	Boronia megastigma	4428	BORMEG	S	A1
	Boronia spathulata	4441	BORSPA	S	B2
	Bossiaea aquifolium subsp. *laidlawiana*	14397	BOSAQU	S	A1
	Bossiaea linophylla	3713	BOSLIN	S	A1
	Bossiaea ornata	3714	BOSORN	S	B2
*	*Briza minor*	245	BRIMIN	GRW	A1
	Burchardia umbellata	1387	BURUMB	G	B3
	Caesia micrantha	1276	CAEMIC	G	B3
	Caladenia flava subsp. *flava*	15348	CALFLAF	G	B3
	Caladenia reptans subsp. *reptans*	15377	CALREP	G	B3
	Callistachys lanceolata	10861	CALLAN	S	A1
	Cassytha racemosa	2957	CASRAC	P	A1
*	*Centaurium erythraea*	6539	CENERY	AHW	A1
	Centrolepis aristata	1121	CENARI		
	Centrolepis drummondiana	1125	CENDRU	AH	A1
*	*Cerastium glomeratum*	2889	CERGLO	AHW	A1
	Chamaescilla corymbosa	1280	CHACOR	G	B3
	Chorizema nanum	12765	CHONAN	DS	A1
	Chorizema rhombeum	3761	CHORHO	DS	A1
	Clematis pubescens	2929	CLEPUB	V	A1
	Comesperma calymega	4550	COMCAL	DS	B2

* = Alien species

22/07/2002 **Forestcheck Flora Nos 1 - 50** 1

COLLECT_NO	FAMILY	GENUS	SPECIES	INFSP_TYPE	INFSP_NAME
1	Proteaceae	Persoonia	longifolia		
2	Asteraceae	Rhodanthe	citrina		
3	Zamiaceae	Macrozamia	riedlei		
4	Orchidaceae	Caladenia	flava	subsp.	flava
5	Papilionaceae	Hardenbergia	comptoniana		
6	Ranunculaceae	Clematis	pubescens		
7	Droseraceae	Drosera	pallida		
8	Dilleniaceae	Hibbertia	amplexicaulis		
9	Dilleniaceae	Hibbertia	commutata		
10	Epacridaceae	Leucopogon	capitellatus		
11	Papilionaceae	Isotropis	cuneifolia		
12	Poaceae	Briza	minor		
13	Epacridaceae	Leucopogon	verticillatus		
14	Asteraceae	Craspedia	variabilis		
15	Oxalidaceae	Oxalis	corniculata		
16	Rosaceae	Acaena	echinata		
17	Asteraceae	Lagenophora	huegelii		
18	Ranunculaceae	Ranunculus	colonorum		
19	Apiaceae	Platysace	tenuissima		
20	Epacridaceae	Astroloma	pallidum		
21	Euphorbiaceae	Poranthera	huegelii		
22	Myrtaceae	Hypocalymma	angustifolium		
23	Epacridaceae	Leucopogon	propinquus		
24	Myrtaceae	Agonis	parviceps		
25	Anthericaceae	Chamaescilla	corymbosa		
26	Orchidaceae	Pterostylis	pyramidalis		
27	Orchidaceae	Caladenia	reptans	subsp.	reptans
28	Euphorbiaceae	Amperea	ericoides		
29	Papilionaceae	Chorizema	nanum		
30	Tremandraceae	Tetratheca	affinis		
31	Gentianaceae	Centaurium	erythraea		
32	Dasypogonaceae	Lomandra	integra		
33	Colchicaceae	Burchardia	umbellata		
34	Juncaceae	Luzula	meridionalis		
35	Euphorbiaceae	Phyllanthus	calycinus		
36	Dennstaedtiaceae	Pteridium	esculentum		
37	Rubiaceae	Opercularia	hispidula		
38	Asteraceae	Senecio	hispidulus		
39	Myrtaceae	Eucalyptus	marginata		
40	Orchidaceae	Caladenia	macrostylis		
41	Proteaceae	Banksia	grandis		
42	Proteaceae	Hakea	amplexicaulis		
43	Dasypogonaceae	Lomandra	caespitosa		
44	Crassulaceae	Crassula	decumbens		
45	Euphorbiaceae	Poranthera	microphylla		
46	Caryophyllaceae	Cerastium	glomeratum		
47	Anthericaceae	Sowerbaea	laxiflora		
48	Proteaceae	Hakea	oleifolia		
49	Asteraceae	Millotia	tenuifolia		
50	Poaceae	Aira	cupaniana		

* = Alien species

31/05/2002 **M1 Cryptogams** 1

COLLECT_NO	FAMILY	GENUS	SPECIES	INFSP_TYPE	INFSP_NAME
17850	Parmeliaceae	Xanthoparmelia	sp.		
17849	Fungi	Genus	sp.(fungi)		
17851	Fungi	Genus	sp.(fungi)		
17852	Hypogymniaceae	Hypogymnia	subphysodes	var.	austerodioides
17853	Hypogymniaceae	Hypogymnia	subphysodes	var.	subphysodes
17854	Cladoniaceae	Cladonia	macilenta		
17855	Cladoniaceae	Thysanothecium	scuttellatum		
17856	Cladoniaceae	Cladonia	scabriuscula		
17857	Cladoniaceae	Cladonia	rigida		
17858	Cladiaceae	Cladia	aggregata		
17859	Cladoniaceae	Cladonia	chlorophaea		
17860	Cladoniaceae	Cladonia	ramulosa		
17861	Cladoniaceae	Cladonia	ramulosa		
17862	Cladoniaceae	Cladonia	krempelhuberi		
17863	Cladoniaceae	Cladonia	sp.		
17864	Parmeliaceae	Pannoparmelia	wilsonii		
17865	Cladoniaceae	Cladonia	tessellata		
17866	Cladoniaceae	Cladonia	cervicornis	var.	verticillata
17867	Cladoniaceae	Cladonia	scabriuscula		
17868	Cladoniaceae	Cladonia	krempelhuberi		
17869	Cladoniaceae	Cladonia	krempelhuberi		
17869A	Cladoniaceae	Cladonia	krempelhuberi		
17870A	Cladoniaceae	Cladonia	krempelhuberi		
17870	Cladoniaceae	Cladonia	krempelhuberi		
17871	Parmeliaceae	Parmotrema	praesorediosum		
17872	Cladoniaceae	Cladonia	krempelhuberi		
17873	Usneaceae	Usnea	subeciliata		
17874	Usneaceae	Neuropogon	antarcticus		
17875	Usneaceae	Usnea	scabrida	subsp.	scabrida
17876	Usneaceae	Usnea	rubicunda		
17877	Algae	Genus	sp		
17878	Hypogymniaceae	Menegazzia	platytrema		
17879	Pertusariaceae	Ochrolechia	sp.(twiggy)		
17880	Cladoniaceae	Cladonia	rigida		
17881	Lichen	Genus	sp.(orange powder)		
17882	Teloschistaceae	Caloplaca	ferruginea		
17883	Parmeliaceae	Xanthoparmelia	sp.		
17884	Algae	Genus	sp.		
17885	Phyllopsoraceae	Hypocenomyce	sp.(lead grey)		
17885A	Lichen	Genus	sp.(RJC 14485A)		
17886	Phyllopsoraceae	Hypocenomyce	sp.(lead grey)		
17887	Pertusariaceae	Ochrolechia	sp. G.S.		
17888	Caliciaceae	Calicium	glaucellum		
17889	Cladiaceae	Cladia	schizopora		
17890	Lichen	Genus	sp.(brown warts)		
17891	Caliciaceae	Calicium	glaucellum		
17892	Caliciaceae	Calicium	salicinum		
17893	Graphidaceae	Graphis	sp.(Blackrays RJC		
17894	Cladiaceae	Cladia	schizopora		
17895	Algae	Genus	sp.		
17896	Algae	Genus	sp.		
17896	Algae	Genus	sp.		