A PHOTOGRAMMETRICAL INVENTORY OF KARRI (*Eucalyptus diversicolor*) REGROWTH IN THE SOUTH WEST OF WESTERN AUSTRALIA

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SUMMARY

Black and white aerial photographs at various scales (1:25 000 to 1:50 000) and taken in various years (1951 to 1982) were used to identify those areas of even-aged karri regrowth free of overstorey and of suitable size for management.

In some areas the stand age was determined by counting the annular rings of horizontal sections taken from the base of felled stems.

The areas identified were plotted onto 1:25 000 planimetric plans. This base data was coded and entered into a computer programme called Forest Management Information System (F.M.I.S.).

F.M.I.S. manipulated the data and produced an output which listed the area and year of establishment of karri regrowth in every forest block in the study area.

INTRODUCTION

The karri forest of south west Western Australia comprises approximately 150 000 ha, 75 per cent of which is managed for the principal objective of timber production (Beggs, 1982).

A high proportion of the timber production zone is regrowth which followed cutting, wildfire or agricultural clearing. Under current plans, older regrowth stands are scheduled for sawlog production from about the year 2000 (Bradshaw and Lush, 1981).

It has long been known that there are pockets of high quality karri regrowth scattered throughout the forest. However, the location and extent of these stands was not accurately known, and they were not included in management plans as far as protection or production was concerned.

Three sources of error are recognized:

1. inaccurate records of early fires and forest clearance.
2. the use of oblique aerial photography to record boundaries of more recent cutting and regeneration.
3. the inclusion of some areas regenerated following group selection in the years 1940-1966 where overstorey density has precluded regrowth development (Rotheram, 1983).

The current study was undertaken to overcome these inadequacies, and so produce an accurate statement on karri regrowth areas and location.

METHOD

INTERPRETATION OF AERIAL PHOTOGRAPHS

Interpretation of aerial photographs was used to identify regrowth stands. Black and white 1:40 000 scale photographs from the period 1951-1982 were the primary source.

Photographs taken during summer were used to determine species' composition. The dense crowns of karri and the associated understorey inhibits light reflectance from the mineral earth so that karri shows up as a darker tone than the surrounding

marri (*Eucalyptus calophylla*) and jarrah (*E. marginata*) forest, which usually has less vegetative cover and hence greater reflectance. In addition, some species (particularly marri) are in flower at the end of summer and this is readily observed by the photo-interpreter.

Photographs taken during winter were used to determine forest structure. These photos are taken when the sun is at a low azimuth, and the resultant long shadows enhance the definition and contrast of the stereo model. This allows the photo-interpreter to see "down into" the forest and determine structure more accurately.

SPECIFICATIONS FOR INTERPRETATION

Methodology and techniques were tested in the Shannon River Basin. Regrowth that satisfied the following requirements was considered to be manageable, and mapped:

1. a minimum of 2 ha in area
2. a maximum overstorey of 15%
3. a minimum regrowth stocking of 50%

All areas that showed borderline overstorey or dubious regrowth stocking were field checked. The methodology proved adequate, and the interpretation was extended to the main karri forest belt.

An area of approximately 1000 square kilometres, mostly in the forest blocks of Diamond 1 and 2, Hawke, Court, Lindsay, Treen Brook, Channybearup and Solai, was found to contain large tracks of regrowth. These stands resulted from early cutting and regeneration.

Although these stands are of excellent quality, well-stocked and with little overstorey, they include areas that are close to 15% upper strata and/or have a large proportion of marri in the regrowth component. In these areas, it was difficult, using 1:40 000 scale photos, to define accurately the boundary between regrowth with less than 15% upper strata and the surrounding forest.

Subsequently, a series of 1:25 000 photographs were taken in March 1982 and interpreted. The larger scale photos gave better definition of individual large trees and allowed more accurate definition of boundaries.

REGROWTH ESTABLISHED AFTER 1975

This regrowth has been created by regeneration of areas cutover for sawlogs and chiplogs. Oblique aerial photographs of the cutting coupes were taken using a standard 35 mm SLR camera in a light aircraft. These photos were used to transfer boundaries onto management records.

This procedure produces plotting errors when boundaries of coupes are mapped. The individual errors were not large, but when combined they produced discrepancies in area statements.

All regrowth plotted in this manner was re-interpreted from vertical 1:40 000 black and white aerial photographs, and more precisely plotted at 1:25 000 using a Wild plotter.

DETERMINING THE AGE OF REGROWTH STANDS

The age of most of the regrowth mapped was ascertained by reviewing management records. However, there were areas that had never been recorded as regrowth in the past, and had no known date of establishment.

We found the age of these stands by counting the annual rings on horizontal sections taken from the base of a sample of felled stems. The horizontal sections were removed from the stem 0.5 m above mineral soil. It is assumed that karri grows to at least 0.5 m in its first year.

To count the rings, the section was planed flat with an electric planer. It was important that the planer blades be sharp, so as to cut and not tear the fibres. The surface was then watered, which helped highlight individual rings, and a magnifying glass was used to aid counting. Accuracy to within $\pm$ 5% of the true age of the stem has been achieved by this method (White, 1971).

ELECTRONIC DATA PROCESSING

Regrowth identified during the survey was plotted onto 1:25 000 base maps. This information was coded and entered into a computer programme called "Forest Management Information System" (F.M.I.S.).

F.M.I.S. overlays maps which describe the various characteristics of the forest, management activities and constraints (vegetation type, cutting history, tenure, block boundaries, reserves etc.). New composite maps can be created with any combination of base maps. Tabular output of area and resource are also produced for the various parts of the composite map.

By overlaying the maps depicting 'land tenure', 'Forests blocks', 'method of regeneration', 'decade of regeneration' and 'year of regeneration', it was possible to produce a composite map showing the area and age of all karri regeneration in each forest block. This procedure was carried out using data from the existing record and data resulting from the survey. The differences are tabulated in Table 1.

RESULTS AND DISCUSSION

The major finds of "new" regrowth were in the south of the karri forest, due to its history of severe fires. The majority of this country has poor access, and often contains small islands of karri, occurring on knolls of karri loams surrounded by black sand flats. A good example of this type of country is Maringup block where 361 ha of new regrowth was found.

The large differences in Table 1 for blocks surrounding Pemberton are mainly due to the re-classification of what is "manageable" regrowth: less than 15% overstorey, greater than 50% regrowth stocking and a minimum of 2 ha in extent are the minimum requirements for a regrowth stand that can be protected, treated and harvested as a viable unit. The majority of this country - blocks such as Brockman, Big Brook, Treen Brook, Channybearup are good examples - has regrowth of some description growing on it, but only the areas quoted in Column 2 are considered "manageable" regrowth.

A total of 1 660 ha of "new" regrowth was mapped as a result of this survey, the majority of which resulted from fire and cutting. Other small areas of regrowth occur on repurchased farm land and other crown lands reserves.

Table 2 shows that the total karri regrowth resource in the karri forest region is 28 519 ha, most of which has been established after 1969. There is now a complete and precise record of karri regrowth in the karri forest. This will allow a more confident and efficient approach to land management planning.

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TABLE 1

COMPARATIVE AREA STATEMENT Ex-F.M.I.S.

EXISTING RECORD V's REGROWTH SURVEY RECORD (AS AT DECEMBER 1981)

FOREST BLOCK	EXISTING RECORD (HA)	SURVEY RECORD (HA)	DIFFERENCE (HA)
Manjimup Division			
Gobblecannup	49	43	+ 6
Gray	485	546	+61
Graphite	483	506	+23
Gordon	47	65	+18
Iffley	502	494	- 8
Lindsay	174	177	+ 3
Lewin	60	67	+ 7
Murtin	4	8	+ 4
Mack	95	12	-83
Quillben	0	6	+ 6
Wheatley	0	39	+39
Yanmah	0	36	+36
Solai	189	240	+51
Andrew	45	53	+ 8
Beavis	279	268	-11
Channybearup	839	626	-213
Diamond 1	189	140	-49
Dingup	0	49	+49
Pemberton Division			
Dombakup	1925	2110	+185
Dordagup	8	0	- 8
Diamond 2	175	205	+30
Flybrook	460	498	+38
Hawke	240	122	-118
Nairn	963	924	-39
Quiniup	63	71	+ 8
Sutton	1308	1328	+20
Treen Brook	2659	2730	+71
Warren	1078	1062	-16
Big Brook	1496	1552	+56
Brockman	642	749	+107
Charley	0	8	+ 8
Crowea	522	510	-12
Collins	12	26	+14
Carey	28	36	+ 8
Court	427	463	+36
Maringup	0	361	+361
Mattaband	262	268	+ 6
Muirillup	361	660	+229
Northcliffe	0	59	+59
O'Sullivan	114	142	+28
Poole	2048	2027	-21
Shannon	489	479	-10
Trafalgar	197	244	+46
Wattle	175	167	- 8
Westcliffe	589	599	+10
Weld	1829	1897	+68

TABLE 1 (cont.)

FOREST BLOCK	EXISTING RECORD (HA)	SURVEY RECORD (HA)	DIFFERENCE (HA)
Bobbington	852	902	+ 50
Boorara	1037	997	- 40
Challar	114	106	- 8
Chesapeake	0	30	+ 30
Curtin	217	217	0
Gardner	309	299	- 10
Jane	16	0	- 16
Walpole Division			
Mossop	286	288	+ 2
Ordnance	30	36	+ 6
Sharpe	68	69	+ 1
Swarbrick	656	656	0
Brunett	26	37	+ 11
Dixie	47	63	+ 16
Deep	130	132	+ 2
Dawson	428	510	+ 82
Frankland	224	276	+ 52
Keystone	767	739	- 28
Harewood	0	108	+108
Styx	0	22	+ 22
Giants	144	362	+218
TOTAL	26 861	28 521	+1 660

TABLE 2

EXISTING KARRI REGROWTH FOREST IN THE SOUTHERN REGION

(AS AT 1981) Ex-F.M.I.S.

YEAR OF REGENERATION	AREA (HA)
1875	18
1878	32
1887	18
1911	12
1915	16
1916	14
1918	95
1919	36
1921	36
1922	126
1923	30
1924	6
1925	26
1926	6
1927	10
1928	156
1930	1676
1931	437
1933	20
1934	883
1935	737
1936	59
1937	1643
1938	79
1939	473
1940	83
1941	16
1942	189
1943	55
1944	180
1945	449
1946	53
1947	41
1948	69
1949	203
1950	150
1951	118
1952	49
1953	81
1954	24
1955	47
1956	10
1958	34
1963	63
1964	144
1965	16

TABLE 2 (cont.)

YEAR OF REGENERATION	AREA (HA)
1966	181
1967	325
1968	851
1969	1668
1970	69
1971	97
1972	1842
1973	181
1974	229
1975	932
1976	1724
1977	1883
1978	1812
1979	2311
1980	2271
1981	3461
TOTAL	28 519

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