DEPARTMENT OF CONSERVATION
AND LAND MANAGEMENT

SILVICULTURE SPECIFICATION 3/90

JARRAH REGENERATION SURVEYS

1.0 PREAMBLE

Silvicultural objectives in the jarrah forest vary in response to the structure and stage of development of the stand. Where insufficient crop trees exist to permit thinning then regeneration is required. One of two regeneration treatments may be applied.

Complete removal of the overstorey will allow any existing ground coppice to develop unimpeded into saplings, poles and trees (gap creation). Alternatively a partial removal of the overstorey will maintain a forest cover while regeneration develops to the ground coppice stage (shelterwood), (Treemarking & Silviculture and the Jarrah Forest, 1987).

Deciding on the appropriate regeneration treatment requires a knowledge of the status of the advanced growth. This specification outlines a survey technique which can be used to assess the status of advanced growth and the standards to be applied when selecting the appropriate regeneration treatment.

Specification 7/89 identifies those site types in which shelterwood treatments are most likely to be needed.

2.0 OBJECTIVES

To evaluate the status of advanced growth as a guide to treemarking in jarrah forest prior to logging (Section 3.0).

To monitor the post-logging development of regeneration in jarrah forest (Section 4.0 & 5.0).

3.0 PRE-LOGGING SURVEYS

These surveys are to be undertaken at the time of treemarking in areas where the creation of a gap is being considered. The results will be the basis for deciding if sufficient regeneration exists to warrant the creation of a gap or if the area should be marked as a shelterwood.

Advanced burning should be employed in stands likely to require shelterwood treatment as it will improve the visibility of lignotuberous advanced growth.

Refer to Appendix 4 for a worked example of a pre-logging survey.

3.1 Regeneration Standards

A gap may be created where 65% or more of the sample points are stocked. A sample point is regarded as stocked if it has a density of:

i) 1000 or more spha of jarrah ground coppice or marri advanced growth, or

ii) 500 or more spha of jarrah or marri saplings, or

iii) combinations of the above which give the equivalent spha.

3.2 Sampling Intensity

Extremes of regeneration stocking are readily visible where they occur and the treemarker will require only limited sampling in such areas to confirm this visual assessment and decide upon the appropriate silviculture to apply.

Where scattered pockets of regeneration occur within the bounds of a potential gap more intensive sampling will be required to ensure that sufficient stocking exists overall.

Where stocking appears to be marginal the following sampling intensity is to be undertaken:

(i) For gaps of 2 ha or less sample on a grid of 40m x 20m within the proposed boundary of the gap (approximately 12 sample points per ha).

(ii) For gaps of more than 2 ha sample on a grid of 80m x 20m within the proposed boundary of the gap (approximately 6 sample points per ha).

3.3 Sampling Procedure

(i) Avoiding Bias

Care must be taken to avoid bias when selecting sample points, eg. avoid looking specifically for advanced growth until the sample point is located and marked. Sampling on a grid ensures that sample points are located with a minimum of bias and spread evenly across the proposed gap.

Where areas have not been advanced burnt locating advanced growth can be very difficult. Extra care should be taken when searching for advanced growth in these areas to prevent underestimating the stocking.

(ii) Selecting Acceptable Advanced Growth

Refer to Appendix 1 for definitions of advanced growth stages and which stages are to be measured in the survey.

If the advanced growth consists of both saplings and ground coppice carry out the following procedure using only saplings at first.

At each sample point make a mark on the ground and find three acceptable stems which form the most compact triangle (that closest to an equilateral triangle) around the mark, ie. the sample point must fall somewhere within the bounds of the triangle formed by the three selected stems.

(iii) Measure and Record Triangle Sides

Estimate each of the three distances between the selected stems and refer to the prepared table of density estimates (Appendix 2). The distances are to be estimated to the nearest 1m by pacing. With practice visual assessments may be used but these must be checked regularly by pacing.

At each sample point record the point density on the survey sheet (Appendix 3). If the point is stocked record a tick in the stocking status column "Saplings + Ground Coppice".

If the point is not stocked with saplings repeat the procedure using ground coppice instead.

When searching for saplings all three stems forming the triangle must be within an 8 metre radius of the sample point. If not, record the point as not stocked "X". When searching for ground coppice use a 5 metre radius instead of 8 metres.

(iv) Combining Estimates of Saplings and Ground Coppice

Where both the estimates of saplings and ground coppice indicate understocking combine them as follows:

Estimate = (2 x Saplings) + Ground Coppice

If this estimate is 1000 spha then record the point as stocked.

(v) Record Species Mix

At each sample point tally all the stems used to form the triangle(s) onto the survey sheet under their respective species ie. jarrah or marri.

Finally move on to the next sample point.

3.4 Calculations

All calculations are made at the bottom of the last survey sheet.

(i) Stocking Calculations

For each area surveyed sum the number of sample points recorded as stocked (Saplings + Ground Coppice) and calculate this as a percentage of the total number of sample points.

If the stocking is 65% or more then sufficient advanced growth exists to warrant the creation of a gap. If the stocking is less than 65% then the area should be marked as a shelterwood.

In areas where the stocking is marginal the treemarker may be able to improve the stocking by redefining the boundaries of the proposed gap to include adjacent areas of good stocking and exclude any understocked areas which occur near the boundary of the gap.

The stocking calculation and the silviculture to be applied are to be shown at the bottom of the survey sheet.

(ii) Species Mix Calculations

For each area surveyed sum the number of jarrah and marri recorded on the survey sheet. At the bottom of the survey sheet calculate the number of jarrah as a percentage of the total number of jarrah + marri recorded.

Where the existing overstorey is predominantly jarrah but less than 20% of the regeneration is jarrah the stand is to be marked as a shelterwood with preference for retention given to jarrah. Regular burning can then be used to encourage the development of jarrah regeneration in an attempt to restore the previous species mix.

4.0 INITIAL ESTABLISHMENT SURVEYS

The aim of this survey is to measure the quantity of regeneration which has become established in areas cut to shelterwood and determine whether it meets the regeneration standards. If not, to prescribe remedial measures.

Refer to Appendix 5 for a worked example of an initial establishment survey.

4.1 Timing of Survey

Assessment of regeneration in shelterwood areas is to be carried out approximately 12 months after the establishment burn (Nov-Dec) so that:

(i) regeneration is readily visible, and

(ii) infilling can be arranged before scrub competition is excessive.

4.2 Initial Establishment Standards

A sample point is recorded as stocked if it meets any of the following standards:

(i) 500 spha of saplings, or
(ii) 1000 spha of ground coppice, or
(iii) 5000 spha of lignotuberous seedlings / seedling coppice, or
(iv) combinations of the above which give the equivalent spha.

4.3 Sampling Intensity

(i) For areas of 2 ha or less sample on a grid of 40m x 20m within the proposed boundary of the gap (approximately 12 sample points per ha).

(ii) For areas of more than 2 ha sample on a grid of 80m x 20m within the proposed boundary of the gap (approximately 6 sample points per ha).

4.4 Sampling Procedure

The method for estimating point densities is given in Section 3.3 (ii)-(iii).

Lignotuberous seedlings and seedling coppice are included in this assessment since young regeneration will not have developed to an advanced stage 12 months after the burn.

Estimates of density are to be made in the following order:

1. Saplings
2. Ground Coppice
3. Saplings + Ground Coppice
4. Lignotuberous Seedlings / Seedling coppice (Seedlings).
5. Saplings + Ground Coppice + Seedlings

These estimates need only be made until a stocked point is obtained.

If estimates 1, 2 or 3 give a stocked point record a tick for the stocking status in the "Saplings + Ground Coppice" column and proceed to the next sample point. If not, record a cross and proceed to estimate 4.

If estimates 4 or 5 give a stocked point record a tick for the stocking status in the "Total" column. If not, record a cross and proceed to the next sample point.

The procedure for calculating estimates 3 & 5 is outlined below:

Estimate 3. Saplings + Ground Coppice

Estimate (spha) = (2 x Saplings) + Ground Coppice.

If this estimate is > 1000 spha then the point is stocked.

Estimate 5. Saplings + Ground Coppice + Seedlings

Estimate (spha) = (2 x Saplings) + Ground Coppice + (Seedlings / 5).

If this estimate is > 1000 spha then the point is stocked.

4.5 Calculations

Proceed as for Section 3.4 but make two stocking calculations. Firstly using only those points stocked in the "Saplings + Ground Coppice" column and secondly using the total number of stocked points, ie. "Saplings + Ground Coppice" column + "Total" column.

4.6 Infill Requirements

Where a stand is less than 65% stocked (Saplings + Ground Coppice + Total column) infilling is required and should be undertaken in the planting season immediately following.

Infilling will aim at obtaining 100% stocking across the surveyed area.

The number of plants required is given by :

No. Plants = (100% - Current % Stocked) x Area of Survey x 1000 spha.

For an 80 x 20 metre sample grid the area surveyed can be estimated in hectares by dividing the number of sample points by 6.25.

A quick sketch map showing the location of understocked points may reveal where the majority of these plants are required. If not it will be necessary to walk the entire area, bypassing well stocked patches and infilling areas where the average spacing of plants exceeds 3-4 metres.

For larger areas or where more detail is required the guidelines for mapping and infill planting given in Silviculture Specification 1/90 can be applied.

If the stocking (Saplings + Ground Coppice + Total column) is > 65% then regeneration has been successfully established. Further monitoring is required (Section 5).

5.0 MONITORING REGENERATION IN SHELTERWOOD AREAS

The aim of this survey is to monitor the development of regeneration in areas cut to shelterwood to determine when the site is available for gap creation.

The procedures and standards used are the same as for pre-logging surveys, (Section 3.0). The removal of the shelterwood overstorey may be undertaken once sufficient ground coppice or saplings are established.

The first monitoring survey should be carried out about 10 years after the shelterwood cut and thereafter every 5 years if logging is contemplated.

6.0 RECORDS

Initial establishment and monitoring survey sheets must be filled out correctly and retained in the HOCS system as a reference for future treatment.

F.J. BRADSHAW
MANAGER, SILVICULTURE BRANCH.

APPENDIX 1 STAGES OF JARRAH REGROWTH DEVELOPMENT

Successful and rapid development of jarrah regeneration following its release depends on the stage of development of the advanced growth.

The characteristics of the various regeneration stages are outlined below.

1. SEEDLING

Less than 1 year old, usually with cotyledons still present, but with no lignotuberous swelling.

2. LIGNOTUBEROUS SEEDLING

Original single shoot still present, but with a small lignotuberous swelling

3. SEEDLING COPPICE

Lignotuber is obvious and multiple shoots have developed after the removal of the original shoot by fire or other causes.

4. GROUND COPPICE

Shoot growth up to 1.5m. Lignotuber 5 - 10cm in diameter. Capable of rapid development into a sapling.

Incipient Ground Coppice - multiple shoots, no defined leader.

Dynamic Ground Coppice - multiple shoots but with a defined leader.

5. SAPLING

Stem taller than 1.5m, D.O.B. less than 15cm. Lignotuber large and ill-defined.

(Modified from Abbott and Loneragan)

Except on very favourable sites, advance growth smaller than ground coppice will not develop immediately into saplings.

For the purposes of the pre-logging survey only advanced growth at the ground coppice and sapling stages is to be considered when sampling.

Marri advanced growth with shoot growth >30 cm high is also to be included.

APPENDIX 2 PREPARED TABLE OF DENSITY ESTIMATES

This table gives the point density estimate for possible triangles at each sample point.

A. For each sample point select the table in which the corner box has the same value as the shortest recorded triangle side.

B. Within the table selected locate the longest triangle side on the horizontal axis and the remaining side on the vertical axis.

C. Read off the point density in stems per hectare (spha) given by the selected triangle sides and record it on the survey sheet.

D. If the three sides recorded on the survey sheet do not appear on any table keep adding 1.0 metre to the shortest side until the first possible triangle is obtained.

ESTIMATION OF POINT DENSITY USING TRIANGLES
JARRAH REGENERATION

Example: 3 metres x 4 metres x 6 metres = Density of 937 spha.

Longest Triangle Side (metres)

Shortest Triangle Side (metres)

Remaining Triangle Side (metres)

Estimate of Point Density (spha)

3	3	4	5	6
3	1283	1118	1206	
4		899	833	937
5			699	668
6				574

1	1	2	3	4	5	6	7	8	9	10
1	11547									
2		5164								
3			3381							
4				2520						
5					2010					
6						1672				
7							1432			
8								1252		
9									1113	
10										1001

2	2	3	4	5	6	7	8	9	10
2	2887	2520							
3		1786	1721						
4			1291	1316					
5				1021	1068				
6					845	899			
7						722	777		
8							630	684	
9								559	611
10									503

3	3	4	5	6	7	8	9	10
3	1283	1118	1206					
4		899	833	938				
5			699	668	770			
6				574	559	654		
7					488	481	569	
8						424	423	504
9							376	377
10								337

4	4	5	6	7	8	9	10	11	12	13	14
4	722	641	630	738							
5		546	504	510	611						
6			442	417	430	523					
7				373	357	372	458				
8					323	313	329	406			
9						285	278	295	367		
10							255	250	267	334	
11								231	228	244	306
12									211	209	225
13										195	193
14											180

5	5	6	7	8	9	10	11	12	13	14
5	462	417	400	417	510					
6		367	340	334	354	439				
7			306	289	287	308	386			
8				263	251	252	273	344		
9					231	223	225	245	311	
10						207	200	204	223	284
11							187	182	186	204
12								170	167	171
13									157	154
14										145

6	6	7	8	9	10	11	12	13	14
6	321	293	280	280	302	379			
7		264	246	238	242	264	334		
8			225	213	208	214	234	300	
9				196	188	185	191	211	272
10					175	168	167	173	192
11						157	152	152	159
12							143	139	140
13								132	128
14									122

7	7	8	9	10	11	12	13	14
7	236	218	207	204	210	231	296	
8		199	186	180	179	186	206	266
9			172	163	159	160	167	186
10				152	146	143	144	152
11					137	132	130	132
12						124	120	119
13							114	111
14								105

8	8	9	10	11	12	13	14
8	180	168	160	156	157	165	184
9		155	146	141	139	141	149
10			136	130	126	125	128
11				122	117	114	114
12					110	106	104
13						101	98
14							93

9	9	10	11	12	13	14
9	143	134	128	124	124	126
10		124	118	114	111	111
11			111	106	102	101
12				100	96	93
13					91	88
14						84

10	10	11	12	13	14
10	115	109	104	101	100
11		102	97	94	92
12			92	88	85
13				83	80
14					76

APPENDIX 3 JARRAH REGENERATION SURVEY SHEET

Date:_________ District:______________ BLOCK / COUPE:______________________

Assessor:________________ Page No.:____

SURVEY: PRE-LOGGING / INITIAL ESTABLISHMENT / MONITORING

Point	Density Estimate (spha)			Stocking Status		Species Mix	
No.	Saplings	G.Coppice	Seedlings	Sap.+ G.Copp.	Total	Jarrah	Marri
A	TOTALS			B	C	D	E

Stocking (Sap.+ G.Copp.) = $\frac{B}{A} \times 100 =$ _____% If ≥65% Gap may be created.

Stocking (Total) = $\frac{B + C}{A} \times 100 =$ _____% If <65% Infill required.

% Jarrah = $\frac{D}{D + E} \times 100 =$ _____%

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APPENDIX 4 COMPLETED JARRAH REGENERATION SURVEY SHEET - PRE-LOGGING

Date: 1/12/91 District: Pemberton BLOCK / COUPE: Poole 10

Assessor: S. Monden Page No.: 1

SURVEY: PRE-LOGGING / ~~INITIAL ESTABLISHMENT~~ / ~~MONITORING~~

Point No.	Density Estimate (spha) Saplings	G.Coppice	Seedlings	Stocking Status Sap.+ G.Copp.	Total	Species Mix Jarrah	Marri
1	630			✓		2	1
2	—	1206		✓		3	
3	400	400		✓		3	3
4	400	130		X		2	4
5	—	—		X		—	—
6	510			✓		1	2
7	180	504		X		5	1
8	1118			✓			3
9	109	899		✓		4	1
10	—	938		X		2	1
11	—	1021		✓			3
12	—	—		X		—	—
13	2520			✓		3	
14	321	238		X		2	4
15	3381			✓		3	
16	—	2010		✓		1	2
17	481	213		✓		4	2
18	—	11 547		✓		3	
19	264	574		✓		6	
20	630			✓		2	1
A 20	TOTALS			B 14	C	D 46	E 28

Stocking (Sap.+ G.Copp.) = $\frac{B}{A} \times 100 = 70$ % If ≥65% Gap may be created.

Stocking (Total) = $\frac{B + C}{A} \times 100 =$ ____ % If <65% Infill required.

% Jarrah = $\frac{D}{D + E} \times 100 = 62$ %

APPENDIX 5 COMPLETED JARRAH REGENERATION SURVEY SHEET - INITIAL ESTABLISHMENT

Date: 10/12/91 District: Manjimup BLOCK / COUPE: Gobblecannup 2

Assessor: M. Spog. Page No.: 1

SURVEY: ~~PRE-LOGGING~~ / INITIAL ESTABLISHMENT / ~~MONITORING~~

Point No.	Density Estimate (spha) Saplings	G.Coppice	Seedlings	Stocking Status Sap.+ G.Copp.	Total	Species Mix Jarrah	Marri
1	559			✓		3	
2	—	1206		✓		2	1
3	—	—	5164		✓		3
4	—	770	2010		✓	4	2
5	140	400	1001		X	6	3
6	—	—	—		X	—	—
7	—	—	11547		✓	1	2
8	—	—	5164		✓	3	
9	481	—	770		✓	5	1
10	—	630	2520		✓	6	
11	—	—	2520		X	3	
12	833			✓			3
13	—	1721		✓		2	1
14	699			✓		3	
15	—	—	11547		✓	1	2
16	115	180	1786		X	9	
17	302	321	770		✓	7	2
18	—	—	2887		X	3	
19	—	—	5164		✓		3
20	—	—	845		X	2	1
21	—	938	770		✓	5	1
22	481	—	—		X	3	
23	306	—	3381		✓		6
24	—	845	1786		✓		6
25	—	—	11547		✓	3	
26	200	280	504		X	8	1
27	481	180		✓		2	4
28	—	770	1721		✓	3	3
29	—	1021		✓		1	2
30	—	510	2887		✓	3	3
31	—	—	—		X	—	—
A 31	TOTALS			B 7	C 15	D 88	E 50

Stocking (Sap.+ G.Copp.) = $\frac{B}{A} \times 100 = 23$ % If ≥65% Gap may be created.

Stocking (Total) = $\frac{B + C}{A} \times 100 = 71$ % If <65% Infill required.

% Jarrah = $\frac{D}{D + E} \times 100 = 64$ %

JARRAH REGENERATION SURVEY SHEET

Date:__________ District:________________ BLOCK / COUPE:__________________________

Assessor:__________________ Page No.:_____

SURVEY: PRE-LOGGING / INITIAL ESTABLISHMENT / MONITORING

Point	Density Estimate (spha)			Stocking Status		Species Mix	
No.	Saplings	G.Coppice	Seedlings	Sap.+ G.Copp.	Total	Jarrah	Marri
A	TOTALS			B	C	D	E

Stocking (Sap.+ G.Copp.) = $\frac{B}{A}$ x 100 =_____% If ≥65% Gap may be created.

Stocking (Total) = $\frac{B + C}{A}$ x 100 =_____% If <65% Infill required.

% Jarrah = $\frac{D}{D + E}$ x 100 =_____%