# SANDALWOOD SURVEY by A. J. WILLIAMSON

# FORESTS DEPARTMENT WESTERN AUSTRALIA

B. J. BEGGS CONSERVATOR OF FORESTS 1982



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# MAP

Sandalwood Survey 1980, 1981.

#### SANDALWOOD SURVEY

#### Introduction

Sandalwood (Santalum spicatum) has been exported from Western Australia since 1845. Whereas once it occurred widely in the wheatbelt, it is now available in commercial quantities mainly in the pastoral areas of the eastern goldfields and Murchison district. In recent years because of the scattered nature of sandalwood occurrence there has been uncertainty about the extent of the remaining commercially available sandalwood and the life of the sandalwood industry.

The present survey began in 1980 and is the first systematic survey of the sandalwood resource carried out in Western Australia. It is funded jointly by the Forests Department and the Australian Sandalwood Company.

The area within which sandalwood occurs is approximately 35 million hectares, shown on map 1. The major aims of the survey are to determine:

- 1) the total sandalwood resource within this vast area.
- 2) the amount of this total sandalwood resource that is commercially available.

Secondary aims are to:

- \* calculate the future life of the sandalwood industry.
- \* record areas of sandalwood regeneration.
- \* suggest areas of sandalwood that should be reserved from pulling.

This survey will therefore be both a resource estimate and a management aid. It will provide a preliminary estimate of the life of the sandalwood industry, and will pinpoint those pastoral leases having a commercially available resource. It will allow systematic planning to be carried out in the field operations of the sandalwood industry.

There are approximately 150 pastoral leases in the 35 million hectare area within which sandalwood now occurs. At our present rate of survey it would take over 9 years to assess each pastoral lease. However some of these are unlikely to have any sandalwood on them and a 5 year survey would appear to be able to provide a satisfactory estimate of the resource. The need for the survey to be confirmed can be reviewed at the end of each year's work.

#### ASSESSMENT METHOD

A two man team was used to carry out the assessment, which extended for about 12 weeks between August and November in each of 1980 and 1981. The vast distances covered meant that there was quite a bit of camping out.

Pastoral lease tracks and mineral exploration lines were assessed from a 4 wheel drive vehicle. In addition some trackless areas were assessed using a motor bike for cross country transport. Air photos were always used as navigational aids. They were also used to eliminate large areas from the survey that had little chance of containing sandalwood, such as sandplain country.

Areas were also eliminated from the survey that are restricted from pulling operations under the conditions of a sandalwood order as follows:

- (1) Areas within 500 m of any watering point.
- (2) Areas within 2 km of any homestead or shearing shed.
- (3) Areas within 100 m of any major arterial road.
- (4) Areas within 20 m of any station service road.

Air photos were used as a basis for calculating the total sandalwood resource on each pastoral lease visited. Those vegetation types on the pastoral lease were identified that did not have any sandalwood on them, using air photos. They included vegetation types such as sandplain, pure mulga, pure eucalypts, mixtures of eucalypt and spinifex, and eucalypt and bluebush. The remaining area of the pastoral lease was then considered to have sandalwood on it at the same rate as the area assessed. This allowed the total sandalwood resource on the pastoral lease to be calculated.

The total sandalwood resource was classified as "pullable" (commercially available at 1981-1982 standards) or "not pullable" based on the experience of the Kalgoorlie staff of the Forests Department. If market conditions change, the proportion of the total sandalwood resource that is pullable will also change. Areas classified as non pullable could nevertheless provide a commercial resource to a pastoral leaseholder who was prepared to work it as a part time operation. However, these areas do not have sufficient sandalwood, either in total amount or stems per hectare, to be of interest to a commercial operator.

All sandalwood present within 20 metres of each side of all tracks travelled in a pastoral lease, was assessed. The diameter of each live sandalwood stem within this 40 metre strip was estimated and recorded in one of the following four size classes: 0 - 25 mm diameter; 25 - 75 mm; 75 - 125 mm; greater than 125 mm. All stems greater than 125 mm diameter at 150mm above ground level, are of merchantable size. Allowance was made for those areas where sandalwood had already been removed except for a strip within 20 metres of a service road.

Dead sandalwood was classified into two categories having different average weights; based on data provided by the Australian Sandalwood Company. "Burnt" sandalwood was found to weigh 6 kg per tree on average, whereas a "piece" (dead sandalwood externally weathered to a grey colour) weighed 3 kg per tree on average.

At several localities within selected pastoral leases, for a distance of 1 kilometre along the track, the diameter of all sandalwood stems was measured, not just estimated. The resulting data, see appendix 2, enabled growth to be taken into account when calculating the long term life of the sandalwood industry.

Observations were also made on the occurrence of sandalwood regeneration.

In the two years that the survey has operated, a total of 36 000 hectares has been assessed. This is 0.8% of the total area of 4.6 million hectares of the pastoral leases visited. This sampling intensity is similar to that used for resource surveys in the forested areas of the south west.

#### Discussion

From appendix 1 it is seen that 8 480 tonnes of pullable wood has been assessed in the two years of the survey. Of this amount, 5 425 tonnes is live material, and 3 055 tonnes is dead material.

On map 1, areas A, B and C represent areas of similar sandalwood occurrence based on the experience of Forests Department field officers and verified by this survey. Assuming that sandalwood occurs at the same rate on the areas of A, B and C still to be assessed, as it has on the areas already assessed, then the grand total of pullable sandalwood is calculated to be 29 000 tonnes. (Table 1).

TABLE 1

TOTAL COMMERCIALLY AVAILABLE SANDALWOOD RESOURCE

Total Area Within Which Sandalwood Occurs		Area Assessed to 12/81	Tonnes Assessed on 4.6x10 <sup>6</sup> ha	Total Resource Calculated on the 35 x 10 ha Within Which Sandalwood Occurs		
	ha 6	ha c	t	t		
Area A	$5 \times 10^{6}$	$1.52 \times 10^{6}$	7 017	23 000		
Area B	$3 \times 10^{\circ}$	$1.15 \times 10^{6}$	1 221	3 000		
Area C	27 x 10°	1.92 x 10°	242	3 000		
	$35 \times 10^6$	$4.6 \times 10^6$		29 000		
	7					

At a harvesting rate of 1 650 tonnes per year, 29 000 tonnes will last 17 years, not allowing for growth.

Further surveys should be carried out for another two to three years to verify this estimate of the life of the sandalwood industry, and to determine on which pastoral leases the commercially available resource occurs.

Three factors could extend the life of the sandalwood industry. One is that pastoral leaseholders, as they have done on occasions in the past, may be prepared to use sandalwood not considered part of the available resource by the commercial operators. Secondly, if the price rises, more of the resource will become commercially available. If it falls, less will be used. The third factor is the growth on the existing resource.

Growth on stems that will reach the marketable diameter of 125 mm in 17 years, the life of the existing resource without growth at a harvesting rate of 1 650 tonnes per year, will extend the life of the resource by about four years. The total life of the commercially available sandalwood resource at a harvesting rate of 1 650 tonnes per year is therefore approximately 21 years.

A description of two options will indicate the kind of possibilities that are available for the future operation of the sandalwood industry. One option is to continue harvesting at the present rate of 1 650 tonnes/year. The resource finishes in about 21 years, in 2003. It is unlikely that there will be enough stems per hectare present after that to enable the industry to continue.

A second option is to reduce the harvesting rate now to a level that will allow newly established regeneration to grow to marketable size. On a site capable of producing 1.5mm diameter increment per year, an average increment in the eastern goldfields, it takes 83 years for a sandalwood tree to reach marketable size of 125 mm diameter. The total commercially available resource including growth is approximately 35 000 tonnes harvested over 83 years. This amounts to 420 tonnes If this option is followed and the industry is to per year. continue indefinitely, sandalwood must be planted each year in sufficient quantities to maintain the desired future level of harvesting after 83 years. For example, for a harvesting rate of 1 650 tonnes per year, 150 000 sandalwood trees each weighing 11 kilograms, are required. Therefore on a site capable of producing 1.5 mm diameter increment per year, 150 000 sandalwood seedlings must be planted each year for 83 years. At a spacing of 100 stems per hectare, which is similar to that observed in the field, a total area of 124 000 hectares of sandalwood plantation would have to be established over the 83 year period. This amounts to establishing 1 500 hectares each year.

#### Sandalwood Regeneration

Only 105 regeneration size stems, that is stems less than 25 mm diameter, were observed on 36 000 hectares assessed. Appendix 2 shows the average stem size distribution on 10 of the pastoral leases assessed. It is quite clear from these observations that there are insufficient small size sandalwood trees in the pastoral leases to sustain the industry much beyond the year 2003. It is not inaccurate to state that sandalwood has become virtually an extinct species in the agricultural areas and it is an endangered species on most pastoral leases.

#### Other Observations from the Survey

- A great amount of the sandalwood resource was lost during the fires of 1974-76 in the eastern goldfields. Some of the best sandalwood areas were burnt including Gindalbie, Kirgella Rocks, Mt. Vetters and parts of Pinjin.
- Within its general area of distribution sandalwood does not occur in any pattern that is apparent on air photos. However air photos are useful in demarcating those vegetation types that this survey has shown are most unlikely to have sandalwood. They are the homogeneous types such as pure mulga and pure eucalypt. In addition mixtures of eucalypt and spinifex, and eucalypt and bluebush are also unlikely to have sandalwood.
- 3. Because of the great distances involved, camping out is in most cases the most efficient way of conducting the survey. The survey has been hard on vehicles and during 1981 there were about 50 punctures.
- 4. The incompatibility between the pastoral industry and the long term survival of sandalwood was evident during the survey. Sheep eat young sandalwood and this will eventually wipe out most of the sandalwood regeneration on pastoral leases. To survive, sandalwood regeneration must be fenced to keep out grazing animals.

#### Costs

The survey has so far cost \$21 440 in 1980, \$24 696 in 1981, giving a total of \$46 136 for the two years.

#### Sandalwood areas to be preserved

The following three areas were discovered during the survey, and represent examples of sandalwood that should be set aside from commercial sandalwood operations. This would have virtually no effect on the life of the sandalwood industry.

#### 1. Pinjin

There is a dense group of sandalwood, about half a hectare in extent, with a wide range of size classes on Pinjin pastoral lease.

#### 2. Credo

There is approximately 10 hectares of sandalwood on sandplain country on Credo pastoral lease. Nowhere else has so much sandalwood been seen on sandplain country.

#### Yerilla

Sandalwood is present on a scientific study area of about 40 hectares on Yerilla pastoral lease, from which grazing has been excluded for 15 years.

#### Recommendations:

- Sandalwood assessment should be continued for another two to three years to verify the estimate of the life of the sandalwood industry contained in this report.
- Three areas should be set aside from commercial sandalwood operations as indicated in this report, in order to preserve sandalwood regeneration and outstanding sandalwood areas.
- 3. Further examples of sandalwood areas that should be set aside from commercial sandalwood operations, should be sought, especially in the Murchison and north eastern goldfields.
- 4. Research work should be carried out to determine the techniques necessary to establish commercial sandalwood plantations.
- 5. To determine whether sandalwood is an endangered species on the Forests Department's sandalwood reserves, an assessment of the stem distribution of sandalwood on them, should be carried out.

#### Acknowledgement

It is a pleasure to acknowledge the cheerful advice and cooperation of Bill Brennan, Norm Caporn, Owen Loneragan, Kim Phillips-Jones, Peter Richmond, John Rooney, Colin Verwey and Mapping branch staff, in the planning, field work and map preparation associated with this project.

# APPENDIX 1 SANDALWOOD RESOURCE SUMMARY FOR 31 PASTORAL LEASES ASSESSED TO DECEMBER 1981

STATION	Area of	COMMERCIALLY AVAILABLE RESOURCE			
DIATION	Station	Area	Alive	Dead	Total
	ha	ha	tonnes	tonnes	tonnes
AREA A (SEE MAP 1)		e o			
BLACK FLAG	89,000	8,000	116	44	160
CARBINE	61,400	1,400	67	1	68
COONANA (PART)	31,800	2,250	67	31	98
COWARNA	98,000	-	-	-	-
CREDO	117,800	7,600	260	11	271
GINDALBIE	132,000	53,000	553	535	1,088
HAMPTON HILL	208,300	35,400	548	296	844
KIRGELLA ROCKS (PART)	49,000	21,000	281	343	624
MT. BURGESS	127,250	23,750	660	81	741
MT. CARNAGE	61,000	2,200	20	33	53
MT. MONGER	65,500	13,000	95	54	149
MT. VETTERS	147,000	18,000	98	243	341
PINJIN	98,700	29,900	678	343	1,021
YINDI	232,500	65,100	718	841	1,559
TOTAL EASTERN COLDGIELDS	1,519,250	280,600	4,161	2,856	7,017
AREA B (SEE MAP 1)					
BADGA	113,000	3,500	77	14	91
BIMBIJY	87,000	11,700	196	49	245
KIRKALOCKA	106,000	150	5	-	5
MURALGARRA	139,000	_	_	-	
NALBARRA	128,000	_	_	-	_
NINGHAN	206,700	5,500	170	29	199
OUDABUNNA (PART)	27,000	400	8	1	9
PINDABUNNA	267,600	22,000	523	58	581
PULLAGAROO	76,600	2,000	85	6	91
TOTAL MURCHISON	1,151,000	45,250	1,064	157	1,221

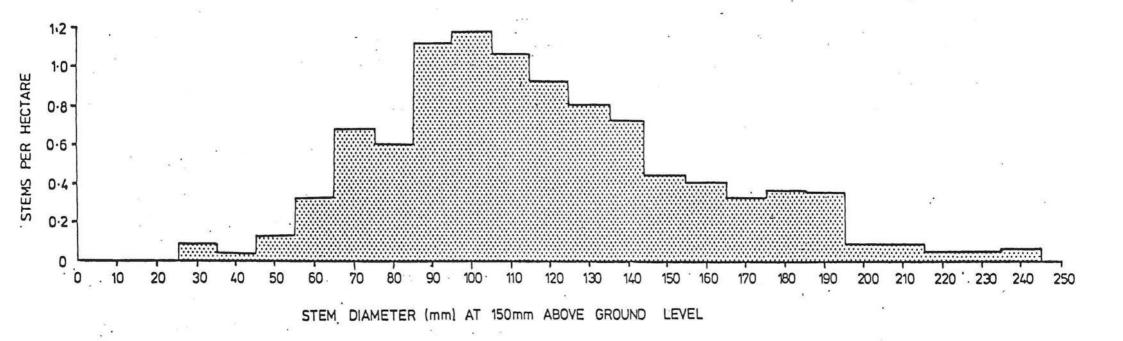
# APPENDIX 1 (CONTINUED)

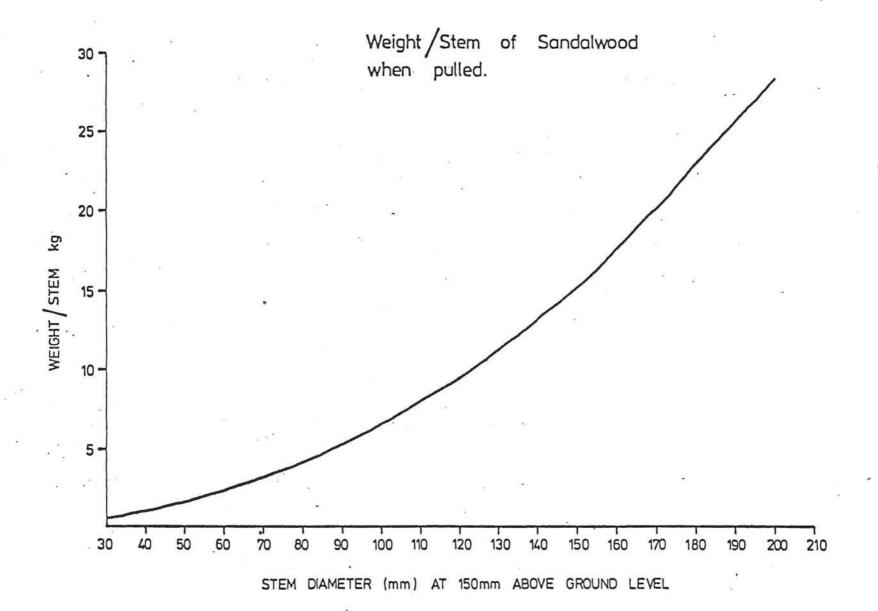
STATION	Area of COMMERCIALLY AVAILABLE RESC				ESOURCE*
STATION	Station	Area	Alive	Dead	Total
	ha	ha	tonnes	tonnes	tonnes
8					
AREA C (SEE MAP 1)					
IDA VALLEY	180,000	55	3	-	3
MELROSE	248,000	4,000	70	18	88
NAMBI	269,000	3,800	127	24	151
PERRINVALE	334,000	-	-	_	-
TARMOOLA	172,600	_		-	\$ × <b>-</b>
TOTAL N.E. GOLDFIELDS	1,203,600	7,855	200	42	242
THREE RIVERS AND PART					
DOOLGUNNA (GASCOYNE)	396,700	-	-	-	. =
FRAZER RANGE	318,000	-		_	-
TOTAL	4,588,550	333,705	5,425	3,055	8,480

<sup>\*1</sup> COMMERCIALLY AVAILABLE RESOURCE:

That portion of the total resource considered commercially available under existing market conditions.

Sandalwood stem distribution by diameter for green stems in pullable areas on 10 Pastoral Leases in 1981.





#### APPENDIX 4

#### GLOSSARY OF TERMS

Burnt wood:

Dead sandalwood killed by fire, generally from the 1974-76 fires in the eastern goldfields.

Commercially

available:

That part of the total resource considered commercially available under existing market conditions.

Merchantable:

Live sandalwood over 125mm diameter at 150mm above ground level. Dead sandalwood from trees of any size.

Pastoral

lease:

Crown land over which grazing rights have been granted. Forest produce, including sandalwood, remains the property of the crown.

Pieces:

Dead sandalwood externally weathered to a grey colour.

Pullable:

Commercially available.

Station:

Pastoral lease.

#### APPENDIX 5

#### RELEVANT CONDITIONS APPLYING TO SANDALWOOD OPERATORS

- No person shall cut down, pull out, injure or destroy any sandalwood tree growing:
  - a) within 500m of any watering point
  - b) within 2km of any homestead or shearing shed
  - c) within 100m of any major arterial road
  - d) within 20m of any station service road
  - e) any living tree of less than 400mm in circumference measured over the bark @ 150mm from ground level.
- 2. All sandalwood supplied must have the bark completely removed and where there is brittle, shelly, charred or worm eaten wood, this must also be removed until only sound wood remains. All pieces must be free of earth, at least 90% of the consignment shall not be less than 200mm in length and each piece shall not wiegh less than 230gms.
- 3. All sandalwood trees must be pulled from the ground. In addition all limbs containing heart wood down to 25mm diameter and all living roots down to 25mm diameter must be included.

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#### APPENDIX 6

# FORESTS DEPARTMENT

54 BARRACK STREET, PERTH, WESTERN AUSTRALIA 6000 TELEPHONE 3258077 Como 367 6333

Address all correspondence: Conservator of Forests Your ref:

Our ref: H.O. 383/74
Inquiries: Mr P.C. Richmond Institute of Forest Research Hayman Road, COMO, W.A. 6152

JULY 7 1980

During the period August to November, 1980, it is planned to carry out a field assessment to ascertain the approximate quantity of green and dead sandalwood over an area which includes Station covered by your pastoral lease.

The assessment field work will be carried out by Assistant Forester N.C. Caporn and Technical Assistant K. Phillips-Jones who will be using a Ford F100 utility and motor-cycles.

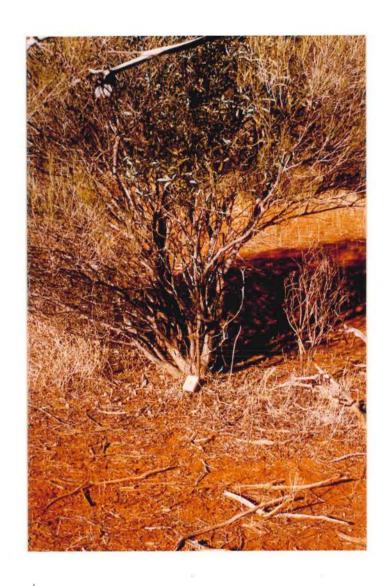
They will be instructed to contact you or your Manager prior to commencing any field work on your station lease, and they will in no way disturb or interfere with the management of your station.

Your co-operation and assistance would be appreciated.

Yours faithfully

B. J. BEGGS CONSERVATOR OF FORESTS

PCR/me



Advanced sandalwood regeneration, Yindi station 1981. Note protective effect of nurse/host acacia species.



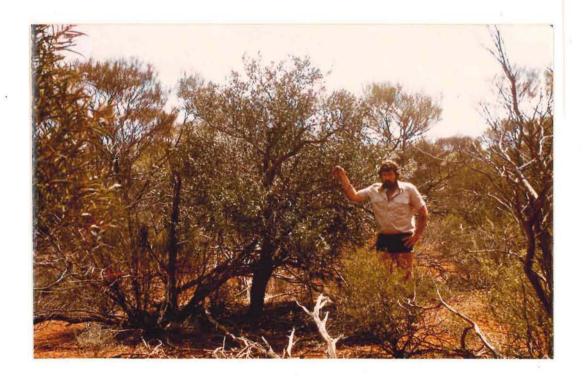
Assessing in the eastern goldfields, December 1981. Sandalwood in the foreground.



Motor bike used for assessment in inaccessible areas in the eastern goldfields, 1981. A mature sandalwood is on the right of the assessor.



One of numerous breakdowns in typical Mulga country in the north eastern goldfields near Melrose station. Here sandalwood was mainly confined to water gaining sites.



Sandalwood tree near Yindi station in the eastern goldfields.



Large sandalwood tree in creek systems of Pinjin station in the eastern goldfields, August 1980. Note the many sandalwood fruit on the tree.



Young sandalwood regeneration on Yindi station in the eastern goldfields, 1981. On the ground alongside there is abundant sandalwood seed from the parent tree nearby.

