

Managing Sandalwood for Conservation in North Queensland, Australia¹

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Abstract: *Santalum lanceolatum*, the commercial species of sandalwood harvested in Queensland, was worth \$4.2 million in export earnings in 1988. The ecology of the species in natural forests is summarized, and information on seedling regeneration and coppice and root suckering strategies is provided. Stand characteristics and size class distribution in two different environments in northwest Queensland are provided. It is important to manage the resource for conservation. The harvesting guidelines, pricing criteria, and procedures are discussed along with information on heartwood recovery and moisture content of harvested sandalwood. Future research should be undertaken to monitor stand dynamics, growth rates, and the effects of land use practices on the distribution, growth, and dynamics of sandalwood in natural stands.

The trade in this fragrant wood has been going on since the dawn of history and will probably not cease until the connection between santal trees and idolators existing from time immorial, shall have been broken up, by either the one or the other becoming as extinct a race as the Archaeopteryx or the Dodo. (Sawyer 1892)

Long before the southern part of Australia was settled by Europeans, the north may have been invaded by the Malays, primarily in search of sandalwood for use in making joss sticks and to carve idols to decorate temples. The first recording of sandalwood exported from Australia was in the State of Western Australia in 1846, when about 4 tonnes of wood were sent abroad for oil production. Sandalwood then became the State's major export income earner, with between 3000 and 4000 tonnes of sandalwood exported annually to the end of the century (Kealley 1989). Today Western Australia has a robust industry controlled by the Australian Sandalwood Company, which in 1988 exported \$A 9.1 million worth of sandalwood (Anon. 1988).

The sandalwood industry commenced in Queensland in Cape York around 1865 (fig. 1). Initially, sandalwood cutters and export facilities were concentrated in the northern part of Cape York Peninsula around Cooktown, Coen, Weipa, and Somerset (fig. 1). Some cutting was carried out north of Normanton in 1917 and just north of the Mitchell River in 1923 (Wharton 1985).

During the 1920's and early 1930's, the industry developed in Western Queensland and was centered on the basalt wall country near the town of Hughenden (Wharton 1985). During this period, the marketing of sandalwood harvested from both Crown (government-owned) and privately owned land in Queensland

was controlled under the *Sandalwood Act of Queensland of 1934*. Under the provisions of the Act, all sandalwood from Queensland was marketed by the Queensland Forest Service (Q.F.S.) and then sold in accordance with the terms of an agreement with the Australian Sandalwood Company of Perth, Western Australia.

The Sandalwood Act prohibited any person from harvesting, getting, pulling, or removing sandalwood without a license issued by the Government. The sandalwood industry declined in Queensland in the late 1930's, and, although it had died out by 1940, it was revived again in 1983.

The Sandalwood Act of 1934 granted a monopoly to the Australian Sandalwood Company that effectively halted production of sandalwood in Queensland. The revoking of the Act in 1982 made way for the revival of the sandalwood industry in north Queensland with annual sales from Crown land initially limited to 500 tonnes. The quota was divided among three buyers who were operating on Crown land in the Gulf region from Normanton to just north of the Mitchell River—an area of about 30,000 km².

In February 1987, tenders were invited by the Q.F.S. for the exclusive rights to purchase sandalwood from Crown land over a period of 20 years. Although there was no guarantee of

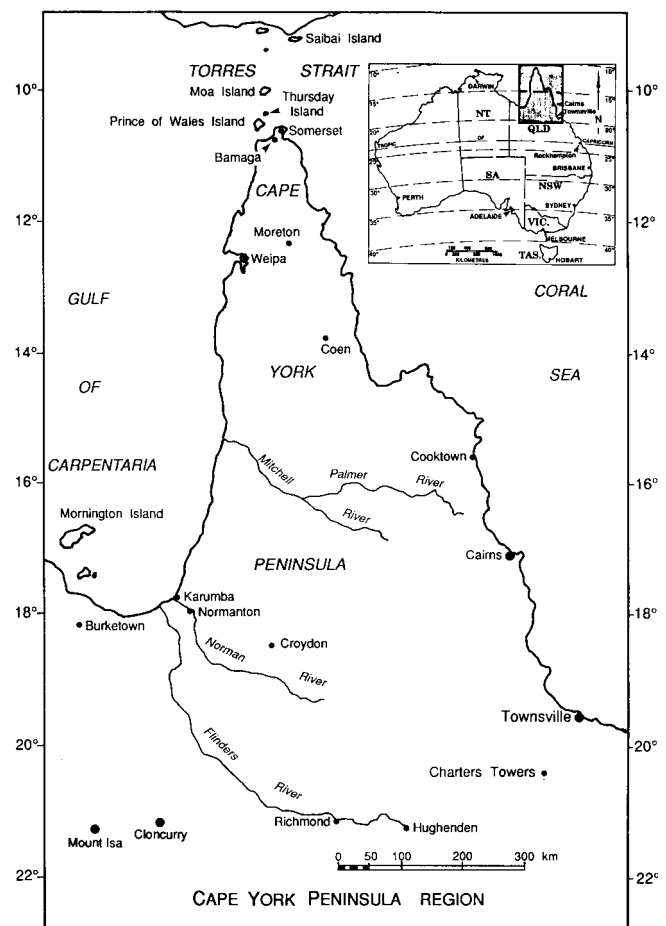


Figure 1—Major sandalwood producing areas in N.W. Queensland.

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availability, the sandalwood was offered at the rate of 1000 tonnes (bark-on) per annum. The rights to purchase sandalwood from Crown land in Queensland was awarded to Unex Industries (Australia) Ltd. based in Sydney. The royalty paid for the sandalwood harvested from Crown land was in excess of \$1500 per tonne (bark-on).

Until late 1989, Unex had contractors harvest sandalwood from Crown holdings on the basalt wall north of Hughenden and in the Gulf region south of the Mitchell River (*fig. 1*).

SANDALWOOD RESOURCE

Species Description

Santalum lanceolatum R.Br. is the most widespread of all the *Santalum* spp. in Australia. It is found in tropical Australia (10°s) extending down into the south of Queensland, New South Wales, Victoria (30°s) and across to Western Australia.

It grows as a tall shrub up to 7 m, with a crown that is deep and usually drooping. There appears to be a good deal of variation in leaf form, size, and color. The species has a wide, but variable (1.5 to 3 cm) pale yellow sapwood band and a brown heartwood. It also appears to have growth rings, which are thought to be annual. The heartwood is quite heavy when freshly cut but dries out quickly when stacked in the open. It has an air dry density between 930 and 950 kg/m³, which makes it a moderately heavy timber.

Habitat of the Species

Macrosite

The general area of northwest Queensland has a sub-humid tropical climate with a distinct wet and dry season. The strongly seasonal rainfall comes from the northwest, with most of the rain falling between December and March. The annual rainfall is between 870 and 1250 mm, with the northern area receiving slightly more rain than the south. Temperatures are high throughout the year, with temperatures of around 22 °C occurring in June and July and exceeding 40 °C in December and January.

The sandalwood found in the Mitchell Plains and Delta Country at the southern end of the Gulf of Carpentaria is concentrated in specific areas on old alluvium and colluvium soils. Some of these areas contain texture-contrast (duplex) soils that are solodised-solonetz formed under high levels of exchangeable sodium or magnesium. They are highly erodible, especially when the subsoil is exposed. Sandalwood is rarely seen in the open woodlands but tends to be more common on the outer edge of the scrubs of *Melaleuca acacioides* and gutta percha (*Excoecaria parvifolia*), adjacent to gilgai areas and around drainage lines. These areas are sometimes adjacent to the woodlands where the topsoil has been disturbed as the subsoil disappears, forming "breakaway" areas. The ecotone in the immediate vicinity of the sandalwood, i.e., at the interface of the melaleuca scrubs and woodlands, has often only a sparse grass cover, if any, and is unlikely to carry a hot fire. Annual fires

throughout the region would probably kill the sandalwood seedlings in the densely grassed open woodland but would seldom extend beyond it into the scrubs. Hence, fire is believed to be a contributing factor to the pattern of sandalwood distribution in the region.

Cattle graze most of the area; consequently, the grasslands are burnt annually after the summer storms to provide fresh grass for fodder. Partly as a result of the fine-textured soils and present land use practices, erosion is evident over much of the area. On most areas near the Gulf where the vegetation has been disturbed or removed for roads or stockroutes, natural erosion is exacerbated and the loss of top soil and gullyng of the subsoil is conspicuous.

Another region that contains considerable sandalwood trees is the basalt wall near Hughenden (*fig. 1*). The basalt wall, which rises 60 m above the surrounding countryside, is an old tertiary lava flow which runs in an east-west direction just north of Hughenden. The sandalwood grows amongst the boulders, generally on the slopes and in the gullies. Current studies suggest that the trees on the slopes of the wall do not grow as tall or as upright as those in the river systems in the Gulf region.

The basalt wall region is grazed by sheep and, as the ground is covered with basalt boulders, roads are few and grazing is very poor.

Microsite

Sandalwood commonly grows within clumps of other species or adjacent to other sapling sandalwoods (usually < 10 m away). This feature was reported in 1932 on Mt. Frazer. "Rarely was a tree found in isolation in open woodland" (Brass 1932). When the trees do not grow in crowded conditions, the crowns—as expected—are well developed. Often these trees have lighter, less fissured bark than do trees growing in more gregarious conditions. Trees in clumps often have poorly developed crowns with dark fissured bark on their trunks. Although the trees appear overmature, some are quite small. This small size may be explained as follows: the haustoria need to attach themselves to roots of host plants, so seedlings must be close to their hosts to do this; although seedlings derive photosynthates from their hosts, their growth is suppressed by the overtopping crowns of the host plants. Observations of the wood of these trees (in clumps) indicate that they frequently have a slightly narrower sapwood band than open-grown trees of comparable size.

Regeneration Strategy

Seedling Regeneration

Although sandalwood is a reasonably prolific seed producer with a succulent fruit, seedling regeneration in some areas is not very conspicuous. Seeds are easily germinated under nursery conditions, so it is initially surprising that more seedling regeneration is not evident in the field. In some areas, however, seedlings are found in large numbers, often as "wheat field

regeneration" in the drainage lines of river systems after flooding.

Field observations indicate that many of these seedlings do not develop or are not given the opportunity to reach maturity. Some of the reasons why seedling regeneration is not more conspicuous are as follows:

- Seedlings require a reasonable moisture regime to grow, and this is not available for much of the year in the Gulf region or on the basalt wall.
- In the region around Hughenden, annual summer rains are not reliable so conditions there are not conducive to seed germination. These conditions may explain the lack of seedling regeneration in part of this area.
- On the stumps where coppice shoots are observed, all are heavily browsed by animals. The animals grazing the regrowth are either livestock or native fauna.

Vegetative Regeneration

Stump Coppice—The stumps of four different ages showed little coppice development. Although some stumps contained numerous coppice shoots, few—if any—appeared to be of a size that would indicate that they would grow into a tree. It is doubtful (from our observations) whether coppice shoots from stumps would have any effect on the long-term regeneration of the species in many parts of north Queensland.

Root Suckers—Formation of root suckers appears to lead to successful regeneration of *Santalum lanceolatum*. In many of the forest types where sandalwood is found, solitary trees are seldom seen, and where two trees are found close to each other, one is usually smaller than the other. Roots from these larger parent trees were excavated and followed to a distance of 7 m from the stem, where a root sucker had produced the other stem. Other suckers were present on other roots coming from the same parent tree.

Regeneration at least to 5 cm d.b.h. resulting from root suckers from the roots of a parent tree is common. Although fire and browsing animals may invade these areas, the presence of prolific and vigorous sucker regeneration would suggest that these suckers have the capacity to survive and grow even when conditions are not conducive for them to do so. No data is available on what triggers root suckering in this species of sandalwood. In other genera, e.g., *Schima* and *Daphne* spp. whose roots often grow close to the surface and sometimes protrude above it, injury to the exposed root causes a shoot to develop near the point of injury. The injury could result from a number of causal agents including fire, trampling by livestock, damage by falling limbs or trees, and the erosion of soil from around the roots—the latter of which is a common phenomenon in and around drainage lines in the Gulf region.

As root suckers are often observed on the roots of unlogged parent trees, removal of stumps during logging would sever the roots, disturb any suckers and might cause them to die. Stump removal could have a major impact on the potential for the residual sandalwood stand to develop. At this stage it is unknown at what age or level of development the root suckers

become independent from the root and can survive from the moisture and nutrients obtained by their own roots. This unknown is one of the reasons why living sandalwood roots are not harvested in north Queensland.

Parasitic Habit

Sandalwood appears to be a partial parasite, i.e., the seed is able to germinate readily on its own, but then the seedling seems to require a host plant from which it can sustain itself. One of the reasons why many young seedlings do not grow could be that their haustoria do not find a host plant soon enough after the seedling growth stage.

This parasitic habit could be one reason why many sandalwood trees that appear to be growing well are found among clumps of other species. There is no evidence to suggest that this species of sandalwood kills its host plant.

Stand Structure

The structure of sandalwood stands varies with their environment. Two main sandalwood producing areas are located along the lower part of the Gulf of Carpentaria and on the basalt wall near Hughenden. The sandalwood stands in these areas have different structures and size class distributions. To illustrate these differences, the data from two plots, one at Rocky Creek in the Gulf region north of Normanton and another on the basalt wall near Hughenden, are provided (*fig. 1*). *Table 1* shows the stand characteristics of sandalwood on Rocky Creek and *table 2* shows the stand characteristics of sandalwood found on the

Table 1—Stand characteristics of *Santalum lanceolatum* on Rocky Creek north of Normanton

Parameter	Stems per hectare	Percentage of stand
Total no. of stems >1.3 m ht.	21.0	100
No. of stems >10 cm d.b.h. ¹	13.0	61
No. of stems >12 cm d.b.h.	11.5	54
No. of stems >15 cm d.b.h.	6.5	30
¹ d.b.h. is the diameter at breast height. Plot mean d.b.h. of all stems >12 cm d.b.h.		

Table 2—Stand characteristics of *Santalum lanceolatum* on the basalt wall near Hughenden

Parameter	Stems per hectare	Percentage of stand
Total no. of stems >1.3 m ht.	21.2	100.0
No. of stems >10 cm d.b.h. ¹	6.3	29.3
No. of stems >12 cm d.b.h.	4.9	23.0
No. of stems >15 cm d.b.h.	3.0	13.9
¹ d.b.h. is the diameter at breast height. Plot mean of all stems > 12 cm d.b.h. is 15.7 cm.		

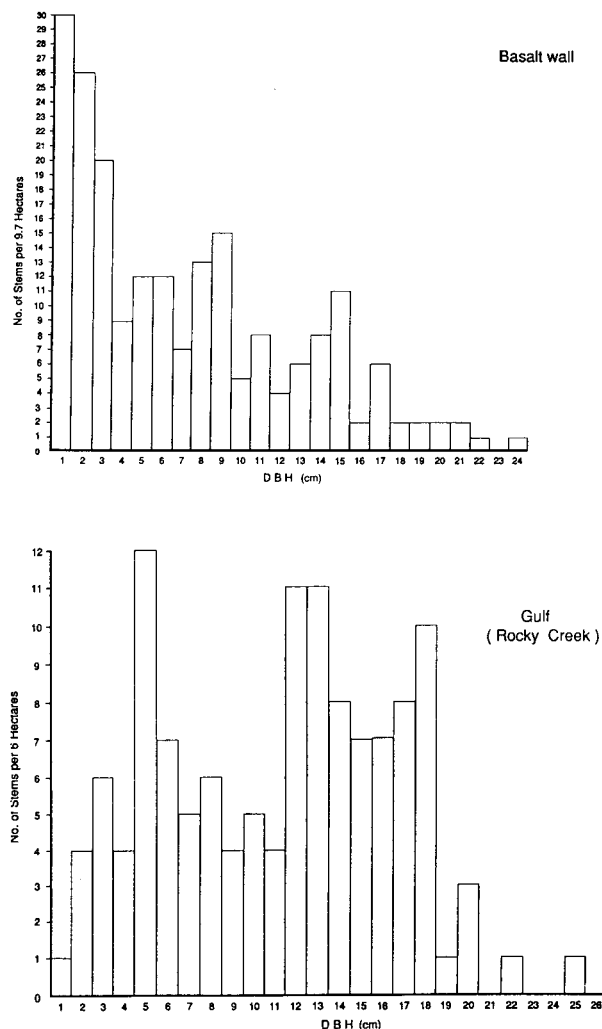


Figure 2—Frequency of sandalwood stands from the Gulf region (Rocky Ck.) and the Basalt Wall.

basalt wall. A frequency distribution diagram for the two sites is given in figure 2.

The diagram for the Rocky Creek plot shows a bimodal distribution of sandalwood, indicating the possibility of two populations. This theory corresponds to examples readily observed in many sandalwood areas, where a large parent tree is seen with one or more smaller trees growing off it as root suckers, or in close proximity to seedling regeneration.

The largest tree that was found in the Rocky Creek plot was 28 cm d.b.h., with a small number in the 20 cm to 25 cm d.b.h. range. Most of the parent population range in size between 12 cm and 18 cm d.b.h., with the progeny centered around 5 cm d.b.h.

The frequency distribution for sandalwood on the basalt wall, as shown in figure 2, indicates that there may be three populations: A large number of young trees in the 1 to 3 cm d.b.h. range, another population centered around 9 cm, and another at 15 cm d.b.h. Although total stocking levels between the two sites are similar, generally the number of stems on the basalt wall in the larger than 10 cm, 12 cm, and 15 cm class are about half that of comparable size classes on the Rocky Creek site. There is,

however, a very large proportion of the stand on the basalt wall site (36 percent) in the 1 cm to 3 cm d.b.h. range as compared with 8.7 percent at Rocky Creek. This difference could be a direct result of land use practices in the region at time of sampling.

MANAGEMENT FOR CONSERVATION

The Industry

Following the successful tender by Unex Industries (Australia) Ltd. in 1987 to secure the sole rights to purchase sandalwood (*Santalum lanceolatum*) from Crown land in Queensland for 20 years, processing plants were established at Richmond and in Brisbane (fig. 1). The harvested sandalwood was transported as small logs or branches to Richmond and Brisbane, where the bark and sapwood were removed and the heartwood baled into wool bales for export. Some higher quality logs were not desapped, and instead exported under license as bark-on. In 1988, Unex Industries employed three cutters who operated on Crown land in the Gulf region and on the basalt wall. During this same period, a number of other companies began cutting and processing sandalwood from private land on the basalt wall in the same region. The five companies also obtained licenses to export their product to Asian countries, including Taiwan and Malaysia.

Most of the sandalwood harvested in 1988 came from Crown land. Export licenses were issued for about 600 tonnes exported in desapped form at an average price of \$A 5000 per tonne free on board (f.o.b.). A further 550 tonnes in the bark-on form were exported at an average price of \$A 2200 per tonne f.o.b. The sandalwood exported had a combined market value of \$A 4.2 million (Anon. 1989).

Alleged breaches of contract by Unex Industries were detected during 1989, resulting in the immediate cancellation of the contract by the Q.F.S. Hence, as of January 1990, no sandalwood is harvested from Crown land in Queensland apart from salvage operations during land clearing for pastoral production. A new management document to solicit new expressions of interest in harvesting sandalwood on Crown land in Queensland is being prepared. Sandalwood is still being harvested from freehold land.

Harvesting Guidelines

Before 1988, the lower cutting limit for sandalwood was set at 10 cm d.b.h. Stand table data showed that if this figure was adopted, about 50 percent of the stand would be harvested. This percentage took an actual account of the trees that cutters accidentally bypassed, and therefore remained standing, trees which contained too many defects (often caused by ants, fire, and heartwood rot) or trees with a wide sapwood band.

To ascertain a suitable lower cutting limit, two major aspects had to be considered: (1) whether a viable residual stand remained after harvesting and (2) whether, for economic and

conservation reasons, the heartwood constituted the major proportion of the tree that was harvested.

Preliminary investigations showed that the sapwood band could vary considerably between trees of similar diameter. Although in many cases, trees with deeply fissured bark often had a narrower sapwood band than smoother barked trees (the shape and general appearance of these latter trees indicated that they may have been younger), fissured bark was not fully reliable as a means of determining whether a tree had a narrow sapwood band. Sampling was undertaken to assess the width and amount of heartwood likely to be found in a tree of given size. This sampling was carried out to assist in determining the harvesting guidelines with respect to the limits of the sapwood/bark band width for trees of a particular size.

Figure 3 shows a linear regression equation that relates the d.b.h. to the diameter of heartwood estimated from 50 trees sampled from the Gulf region and the basalt wall. Based on the combined equation calculated from data from the two sites, a tree with a 12 cm d.b.h. would have an expected heartwood diameter of 6.2 cm. The heartwood, in this tree as seen in figure 3, represents only about 27 percent of the cross sectional area of the bole section of the tree, i.e., a theoretical heartwood recovery of about 30 percent.

The field sampling showed that increasing the lower cutting limit from 10 cm to 12 cm increases the number of trees in the residual stand by 7 percent on the basalt wall and by 10 percent in the stands in the Gulf if all of the stems greater than or equal to 12 cm d.b.h. were harvested.

Before the commencement of the Unex operation in 1988, some cutters wanted to harvest the sandalwood by removing both stump and root, a practice carried out in parts of India. This practice was partly to blame for the decimation of the sandal-

wood resource in some southern Indian states such as Mysore, since it prevents coppice regeneration from roots and stumps.

In many parts of the Gulf, sandalwood grows on duplex soils which are highly erodible. For this reason, as well as the fact that sandalwood coppices from the root, stump and root harvesting is not practiced in Queensland.

Harvesting Rules and Regulations on Crown Land

Due to the scattered nature of the resource and the huge area over which sandalwood is found, it was not possible to provide resource information to the purchaser. The responsibility for providing such information was given to the purchaser. Once an assessment is made on a Crown holding, logging areas are allocated by Q.F.S. officers, who then direct harvesting on those areas in accordance with harvesting guidelines.

The purchaser is required to comply with the following guidelines, which are primarily aimed at conserving the resource and minimizing environmental disturbance:

- Trees harvested are not to be smaller than 12 cm d.b.h. unless they are dead, dying, damaged, fungus-infected, or otherwise declining.
- Trees harvested should have a maximum stump height of 10 cm.
- Trees harvested should be utilized to a heartwood top-end diameter of 3 cm. This would include all limbs with at least a 3 cm heartwood diameter.
- Under no conditions are the stumps or roots of trees to be harvested.
- To ensure that trees with a large sapwood to heartwood volume ratio are not harvested, trees are to be blazed to the

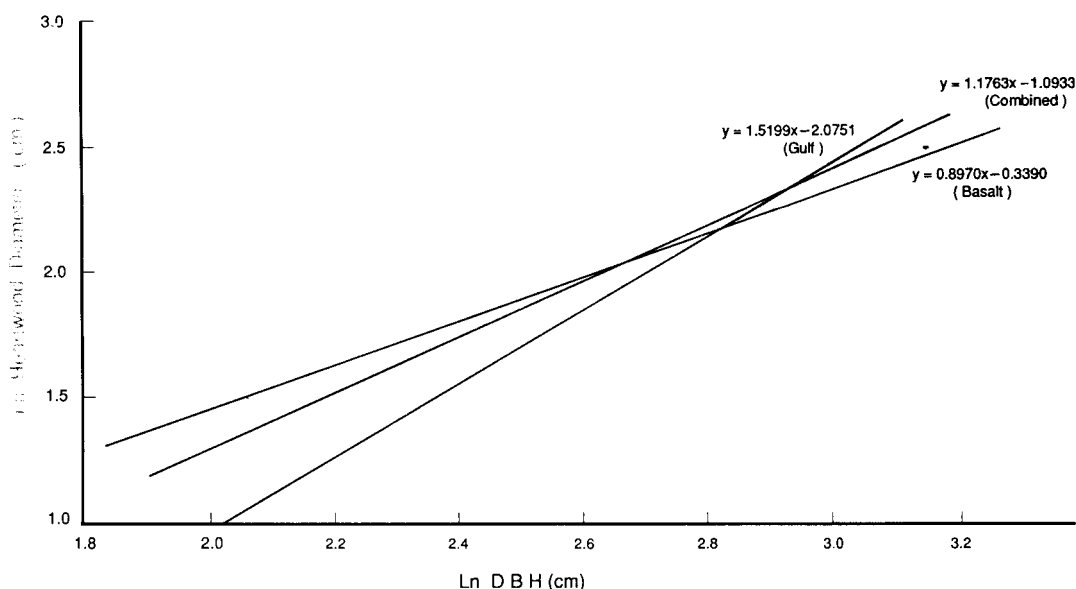


Figure 3—Linear regression equations relating the natural log of the d.b.h. to the natural log of the diameter of heartwood from the Gulf region, the Basalt Wall, and a Combined Equation using data from both sites.

heartwood at 1.3 m above the ground to determine the percentage of sapwood present. Trees should not be harvested if the sapwood plus bark thickness is greater than 1/6 of the d.b.h. outer bark.

- The quantity of timber sold is determined by mass recording over a weighbridge with the documentation of the weights presented for inspection.

Pricing Criteria

Sandalwood growing on Crown land, whether a Crown Holding or State Forest, commands a royalty to be paid by the purchaser. Many timber forest products sold in Queensland by the Q.F.S. are based on volume measurements. There is a tendency to replace this expensive and time consuming form of pricing with weight scaling. Sandalwood is currently sold by weight measurement with the bark on.

The environment in which sandalwood grows becomes very hot in summer, with temperatures often exceeding 40°C for weeks at a time. Consequently when harvested sandalwood is stacked awaiting transportation and subsequent weighing, weight loss occurs. The amount of the loss depends on both the time period between cutting and weighing and the prevailing weather. Hence, if logs are sold by weight, either as bark-on or heartwood only, the royalties payable could be quite variable for a given volume of harvested timber.

To ascertain possible weight losses and subsequent losses in royalty, two studies were undertaken: (1) using bark-on sandalwood and measuring weight loss over a 23-day period, and (2) using heartwood only and recording weight losses over a 6-week period.

1. **Bark-on Drying Study:** This study involved seven sandalwood stems and 28 branches. The samples were weighed immediately after harvesting in February (hot, dry season) and stacked in the open at Richmond. After 3 1/2 weeks (23 days), the pieces were reweighed. The stems had lost 9.8 percent of their initial weight, while the branches had lost 14.2 percent. The overall loss of weight from the stack was 11.7 percent. Based on these figures, the Crown would sustain a considerable loss in royalty if the purchaser waited a month before passing the stack of sandalwood over the weighbridge.

2. **Heartwood Drying Study:** A number of stems and branches cut from trees in three locations near Richmond were processed (within 2 days of harvesting) and the heartwood weighed before it was stacked under cover. Although the results were quite variable, the stems had lost 13 percent of their weight after three and a half weeks (*table 3*). After 6 weeks they had lost 16 percent of their fresh weight. The branches provided similar results to that of the stems with a loss of 12 percent after 3 1/2 weeks and 14 percent after 6 weeks.

Utilization and Recovery

Observations carried out on cut stumps and logs suggest that for a given size tree, the sapwood band can be quite variable.

There are a number of theories concerning the relative amounts of sapwood and heartwood in a tree. Three of these theories are as follows:

1. Trees with a relative wide band of sapwood to heartwood are young, relatively fast-growing trees.
2. The amount of sapwood is genetically controlled and is quite variable. It could be independent of age.
3. It could be a combination of 1 and 2, i.e., the sapwood/heartwood ratio is a variable characteristic (like leaf shape and size) and yet is also dependent to some degree on age or rate of growth.

Although the cutting regulations were partly based on achieving a 40 percent recovery of heartwood, variation in the sapwood band from tree to tree and within the same tree necessitated actual field sampling of the processed tree to determine more accurately the heartwood recovery.

To provide such information for the cutting regulations, sample trees were harvested from three sites: two from the basalt wall and one from a tributary of the Flinders River leading to the Gulf of Carpentaria. The stems were weighed before processing and the sapwood was immediately removed using the contractor's desapping machine at Richmond. Not only were trees of commercial size sampled, but also those below 12 cm d.b.h. (*table 4*).

Table 3—Weight losses recorded from the trial at Richmond

Location	Percent Loss in Weight	
	3 1/2 weeks	6 weeks
Kara (Basalt Wall)		
Stems	12.4	14.8
Branches	14.4	16.5
Torquay (Basalt Wall)		
Stems	11.6	15.4
Branches	8.6	10.0
Saxby (Gulf)		
Stems	13.8	16.6
Branches	15.3	17.7
Mean		
Stems	12.8	15.8
Branches	12.3	14.2

Table 4—Recovery details of the heartwood expressed as a percentage of the bark-on weight of sandalwood harvested from three locations in N.W. Queensland (fig. 1)¹

Location	Recovery of Heartwood		
	All Stems	Stems >12 cm	Stems <12 cm
	<i>Percent</i>		
Kara (Basalt wall)	35.4 (29.5-41.3)	41.6 (32.9-50.2)	29.3 (22.7-35.8)
Torquay (Basalt wall)	36.1 (32.9-39.3)	37.0 (34.1-39.9)	33.5 (18.7-48.3)
Saxby (Gulf)	27.0 (22.4-31.6)	29.9 (24.7-35.0)	18.4 (13.1-25.4)

¹Numbers in parentheses are the 95 percent confidence limits of the

RESEARCH ACTIVITIES

Stand Dynamics

Preliminary data collected to date indicate that stands of sandalwood show a large variation in the number of stems per hectare, size class distribution, both on apparently similar sites and between different sites. Further research should be undertaken in the natural stands monitoring growth rates of existing stems, seedling regeneration, and coppice regeneration and also by looking at the processes that result in the different size class distributions between sites.

Effects of Land Use

Signs are clear that the pattern of sandalwood distribution is influenced by current and past land use practices. It is necessary, therefore, to monitor sandalwood plots in detail to study stand dynamics and the effects that various events and land uses have on the distribution and growth of the tree. These include livestock grazing (light and heavy), floods, fire and browsing by the native fauna.

Marketing

Because of the variable nature of sandalwood, it would greatly benefit both the Crown and the purchasers to investigate alternative methods of selling the product that might take more account of the variability of heartwood recovery and the quantity and type of oils contained in the heartwood and sapwood. Other factors that should also be taken into account include climate and its effect on drying rates, the land tenure from which the sandalwood is harvested, and the isolated and comparatively scattered location of much of the resource.

Plantations

Only some very basic plantings have been undertaken with *S. lanceolatum* as part of Australian Center for International Agricultural Research (A.C.I.A.R.) plantings in the dryland region of north Queensland. Other sandalwood species should be planted in some of the wet tropical regions closer to the east coast of north Queensland.

CONCLUSIONS

Conservation of sandalwood and the long-term viability of the associated industry are economically important to Queensland. The harvesting guidelines devised by the Queensland Forest Service are designed to meet both of these goals. Even though no State Forests exist in areas with commercial stands of sandalwood, National Park reservations in Cape York and the lower Gulf region do cover areas with sandalwood.

It is an essential part of the Queensland Forest Service's conservation philosophy that a sandalwood management plan include (1) harvesting guidelines designed to protect the environment, particularly in areas dominated by highly erodible duplex soils, and (2) harvesting and marketing strategies that take account of the wide range of this resource and results from land use practice studies. This information will help define practices that promote regeneration and development of sandalwood in the predominately pastoral areas in which it is found.

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