Creating a long-term sustainable future for one of the world’s most precious oils - Sandalwood.

by
Salvatore Battaglia
Santalum album is now registered as a vulnerable species. IUCN Red List states that smuggling has assumed alarming proportions and the timber is banned for export from India.
• Why is *S. album* on the IUCN list as vulnerable?
• What is being done to preserve *S. album*?
• What is *S. spicatum*?
• How do we know that *S. spicatum* will not end up the same as *S. album*?
• Is it possible to cultivate *S. album*?
• How Australia is leading the world in producing *S. album* oil from plantation sandalwood trees?
• The challenges of growing *S. album* trees.
There are six species of sandalwood that are commercially harvested in international markets:

- **S. album** (Native to India and Indonesia and now cultivated in Australia)
- **S. spicatum** (Native to Western Australia)
- **S. lanceolatum** (Native to Queensland).
- **S. yasi** (Native to Fiji and Tonga)
- **S. austrocaledonium** (Native to New Caledonia & Vanuatu)
- **S. macgregorii** (Native to Papua New Guinea and Indonesia)
Sandalwood growing areas in the world
how would you like to feel today?
how would you like to feel today?

A sketch explaining haustorium.

Courtesy of Essential Oil Crops – EA Weiss.
Two of the most detailed and accurate reports on the history of sandalwood

from the Australian perspective

*The Sandalwood Industry in Australia: a History.*

from the Indian perspective

*Perfumed the axe that laid it low: The endangerment of sandalwood in southern India.*
By Ezra D. Rashkow, Indian Economic & Social History Review 51,1(2014):41-70
DOI: 10.1177/0019464613515553

how would you like to feel today?
Sandalwood has always been a precious aromatic raw material used for making incense which is used in offerings to honour spiritual deities and our ancestors.
sandalwood has often been referred to as “botanical ivory”.

how would you like to feel today?
Santalum album essential oil has long been considered an important ingredient in perfumery.

According to Michael Edwards’ research, about 47% of all perfumes created since 1790 contain sandalwood notes.
Subtle Aromatherapy

Holmes explains that sandalwood connects us with the value of being. We can experience this in the presence of certain Tibetan and Indian masters who have developed their actual being more than their intellectual knowledge.

Unlike other earthly fragrances, sandalwood works gently and with compassion. It grounds us in a world of sensuous, unaffected beauty, like that experienced after a deep meditation or love experience.

Sandalwood helps us experience the simplicity and purity of the physical world and experience the immanence of the spirit in the physical world.

how would you like to feel today?
The Squires Companion to the British Pharmacopoeia - 1882, prescribed sandalwood essential oil was prescribed for the treatment of Gonorrhea. The Materia Medica – Pharmacy, Pharmacology and Therapeutics of 1900 also recommended two drops on sugar to relieve a hacking cough. (I recommend manuka honey)

how would you like to feel today?
Veerappan
The Sandalwood Bandit

- Killed 184 people, 97 of them police officers & forest officers.
- Reported to have killed 200 elephants for ivory, then turned to sandalwood.
- Smuggled over 10,000 tonne of illegal sandalwood valued at $US22 million.
- His story has been made into a Bollywood movie in 2016.
- He had a reward of $US2.1 million for his capture.
- Indian government spent over $330 million for his capture – over 20 years.
- Was killed in a gun fight in 2004.

how would you like to feel today?
The main problem facing the sustainable harvest and continued survival of sandalwood in India – worse than the forest department’s emphasis on exploitation and control of the sandalwood market, worse than its failure to cultivate the species and protect it from its natural enemies – came from the advent of the sandalwood oil industry at the beginning of the twentieth century.

Perfumed the axe that laid it low: The endangerment of sandalwood in southern India.

By Ezra D. Rashkow,
Indian Economic & Social History Review
51,1(2014):41-70
DOI: 10.1177/0019464613515553
Traditionally burned in incense and pressed into attars and oils, sandalwood had always been a consumable good, but with the coming of an industrial-scale sandal oil factory located in the heart of sandal country, sandalwood production now ramped up immensely.

Perfumed the axe that laid it low: The endangerment of sandalwood in southern India.

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Ironically, much of the sandalwood consumption in the West seems to be driven by a desire to live a “natural” lifestyle coupled with an utter lack of awareness.

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Santalum spicatum growing in the wild in Western Australia.

how would you like to feel today?
More than 50,000 tonnes of sandalwood spicatum was exported from Western Australia by the beginning of the 20th century.
how would you like to feel today?

Santalum spicatum or Santalum zygnorum

Fusanus spicatus

Eucarya spicata

Santalum spicatum
The Western Australian government along with land owners and producers has been very proactive in developing clear guidelines for the long term sustainability and future of *santalum spicatum*. 

how would you like to feel today?
Wolyies have long played an important role in natural propagation of *S.spicatum* in the wild. However feral cats and foxes have decimated wolyies in the wild.
**S. Spicatum in Australia today**

It is now managed by the Department of Parks and Wildlife under the Biodiversity Conservation Act 2016.

- Annual quota of 2500 tonnes – 1,250 tonnes of greed wood & 1,250 tonnes of dead wood.
- Only trees with a minimum circumference of 400mm measured 150mm above ground.
- 10 tonnes of seeds have been replanted each year.
- To date 20,000 hectares of S. spicatum plantations have been planted.
- Harvesting is expected by 2026.
ISO Standards for sandalwood

**ISO 3518 for S. album essential oil**
Z-α-santalol (41.0 – 55.0%) and Z-β-santalol (16.05 – 24.0%).

**ISO 22769 for S. spicatum essential oil**
Z-α-santalol (15.0 – 25.0%), epi-α- bisabolol (2.0 – 12.5%), z-α-trans bergamotol (2.0 – 10%), (E,E) – farnesol (2.5 -15%), epi-β-santalol ( 0.5 – 3.5%), z-β-santalol (5 – 20.0%), (Z) – nuciferol (2.0 – 15.0%), (Z)-lanceol (1.0 – 10.0%).

how would you like to feel today?
## Comparison of the chemistry of different sandalwood oils

<table>
<thead>
<tr>
<th>Constituent</th>
<th>S. album (Australian)</th>
<th>S. Spicatum green wood</th>
<th>S. Spicatum dead wood</th>
<th>S. lanceolatum</th>
<th>S. austrocaledonicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dendrolasin</td>
<td>0.04</td>
<td>2.39</td>
<td>0.77</td>
<td>0.84</td>
<td>0.12</td>
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<tr>
<td>Epi-β–bisabolol</td>
<td>0.23</td>
<td>3.86</td>
<td>-</td>
<td>-</td>
<td>2.19</td>
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<td>cis-α –santalol</td>
<td>44.49</td>
<td>17.38</td>
<td>1.78</td>
<td>1.03</td>
<td>25.41</td>
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<tr>
<td>Epi-α–bisabolol</td>
<td>0.28</td>
<td>5.41</td>
<td>25.01</td>
<td>2.62</td>
<td>0.60</td>
</tr>
<tr>
<td>Cis-α-trans-bergamotol</td>
<td>5.85</td>
<td>3.53</td>
<td>0.22</td>
<td>-</td>
<td>5.54</td>
</tr>
<tr>
<td>Cis-epi-β–santalol</td>
<td>3.64</td>
<td>1.22</td>
<td>0.18</td>
<td>0.10</td>
<td>1.88</td>
</tr>
<tr>
<td>Cis-β-santalol</td>
<td>18.6</td>
<td>4.81</td>
<td>0.31</td>
<td>0.10</td>
<td>12.04</td>
</tr>
<tr>
<td>Cis-nuciferol , Cis-γ-curumen-12-ol</td>
<td>4.18</td>
<td>15.98</td>
<td>13.59</td>
<td>20.10</td>
<td>20.72</td>
</tr>
<tr>
<td>Trans-farnesol</td>
<td>-</td>
<td>12.10</td>
<td>0.62</td>
<td>3.70</td>
<td>-</td>
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<tr>
<td>Cis-β-curumen-12-ol</td>
<td>1.59</td>
<td>8.62</td>
<td>5.95</td>
<td>11.86</td>
<td>8.65</td>
</tr>
<tr>
<td>Cis-lanceol</td>
<td>3.018</td>
<td>2.01</td>
<td>5.73</td>
<td>26.57</td>
<td>9.37</td>
</tr>
</tbody>
</table>

**how would you like to feel today?**
Once the S. spicatum wood has been harvested it needs to be debarked.

how would you like to feel today?
Santalum spicatum wood ready for processing

how would you like to feel today?
Unique pieces of wood are worth much more if they are turned into pieces of art

how would you like to feel today?
A beautiful piece of *Santalum spicatum* wood.

how would you like to feel today?
Santalum album plantations in the Ord River irrigation Area.

how would you like to feel today?
how would you like to feel today?
Santalum album trees being propagated in the nursery

how would you like to feel today?
how would you like to feel today?

The second host tree being propagated in the nursery
A young *Santalum album* tree with its host in the nursery.

how would you like to feel today?
Success!

The sandalwood tree roots have successfully attached themselves to the first host plant.

how would you like to feel today?
A 12 year old plantation

how would you like to feel today?
A very healthy *Santalum album* tree growing in the field. 15 years old

how would you like to feel today?
Growing a tree with a straight long trunk ensures big heartwood with lots of essential oil.

how would you like to feel today?
how would you like to feel today?
how would you like to feel today?

Every piece of timber is precious and is salvaged.
You can clearly see the heartwood on this tree that had just been felled.

how would you like to feel today?
Collecting the sandalwood logs after the tree has been felled.

how would you like to feel today?
Sandalwood pieces ready to take for processing

how would you like to feel today?
how would you like to feel today?
The roots have the best oil!
Collecting the roots once they have been cut out

how would you like to feel today?
The roots have been cleaned and are ready for processing

how would you like to feel today?
Within two years of harvesting the trees the land is ready for new trees.

how would you like to feel today?
In the processing plant the heart wood is cored out using sophisticated machinery custom built for the process.

how would you like to feel today?
Sandalwood timber at different stages of processing

how would you like to feel today?
The sapwood is carefully removed

how would you like to feel today?
Back at the distillation plant the wood is chipped so that the oil can be easily distilled.

how would you like to feel today?
Wood chips (not sandalwood chips!) from the local timber mills are used to keep the furnace going for the boiler that operates the distillation process.
Spent wood after the distillation. This will be sold for incense making.

how would you like to feel today?
The distillation of sandalwood.

how would you like to feel today?
The final product – divine sandalwood oil

how would you like to feel today?
“How can we trust the wisdom of our inner self and still be in control? How can we feel safe in the embrace of the unknown?”

Holmes suggests that sandalwood helps us confront the ultimate mystery – the mystery of our earthly existence.

We all have a responsibility to preserve the sandalwood tree which provides us with a precious oil of enlightenment for future generations.