Asia-Pacific
Economic Cooperation

2025/SOM3/EGILAT/DIA/010
Agenda Item: 4

Wood Identification for Legal Timber Trade

Submitted by: Malaysia

APEC 2025
KOREA

Dialogues and Mini-Exhibition on Enhancing Enforcement and Legal Timber Trade through Stakeholder Collaboration and Innovation
Incheon, Korea
28 July 2025

Wood identification for legal timber trade

Kevin Kit Siong NG, Lee Hong TNAH, Chin Hong NG, Chai Ting LEE, Nurul Farhanah Zakaria, Nur Nabilah Alias, Abd Ramlizauyahhudin Mahli & Soon Leong LEE

Contents

- ❖ Background
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- ❖ What is DNA barcoding?
- ❖ DNA barcoding database
- ❖ Development of new DNA barcodes
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- ❖ Training to enforcement officials
- ❖ Applications
- ❖ Accreditation and recognition

Background

Numerous **international regulations** have been established to **restrict the import of timber products** derived from **illegal logging**, aiming to promote **sustainable forest management** and **curb deforestation**

9.6.2023 EN Official Journal of the European Union

REGULATION (EU) 2023/1115 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 31 May 2023

on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010

(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

EUDR

FLEGT.org

LACEY ACT COMPLIANT

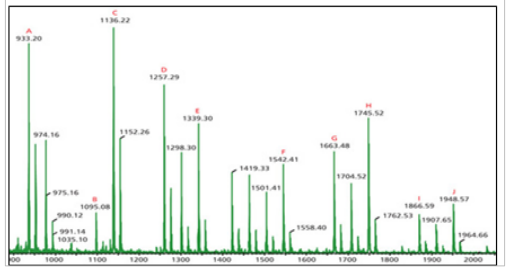
Due diligence requirement - Provide detailed information on the **timber species**, its **source of origin**, and verifiable evidence to demonstrate the **legality** and **authenticity** of the timber product

Background

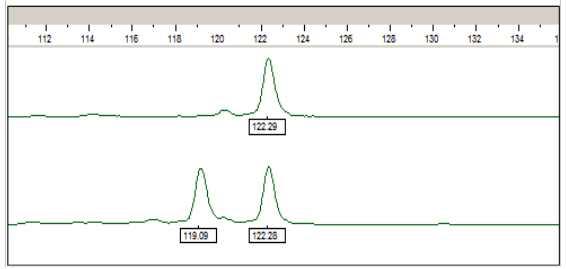
Several **timber tracking** and **species identification** tools can aid in enforcement and regulation efforts

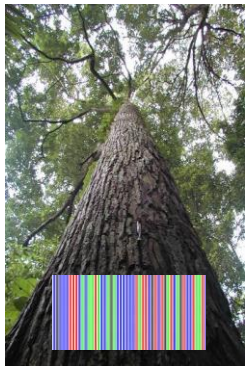
Image identification
(Wood anatomy & dendrochronology)

Chemical methods
(MS, NIRS, stable isotopes & radio-carbon)



Genetic methods
(DNA barcodes, pop gen/phylogeo & DNA profiling)





Since 2008, Malaysia has employed genetic methods to develop comprehensive DNA profiling and barcoding databases for key tropical tree species, supporting efforts in **WOOD TRACKING & SPECIES IDENTIFICATION**

Background

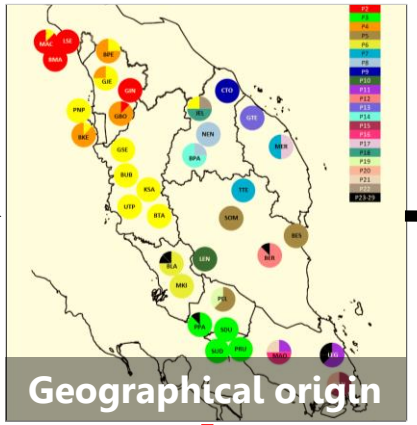
How to use genetic methods for wood tracking and species identification?

It is possible to extract quality DNA from dry wood/wood product?

DNA extraction from wood

How to establish DNA database for species identification?

DNA barcoding



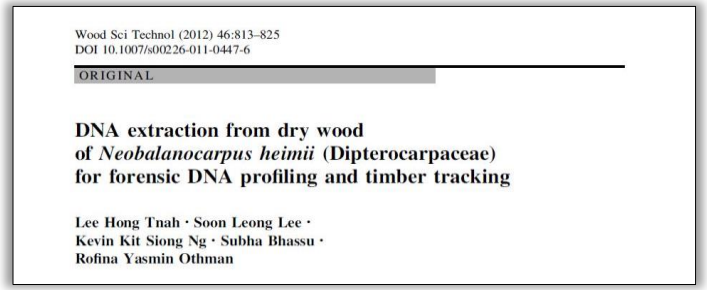
How to establish DNA database for population identification?

DNA profiling

How to establish DNA database for individual identification?

DNA profiling

DNA extraction from wood

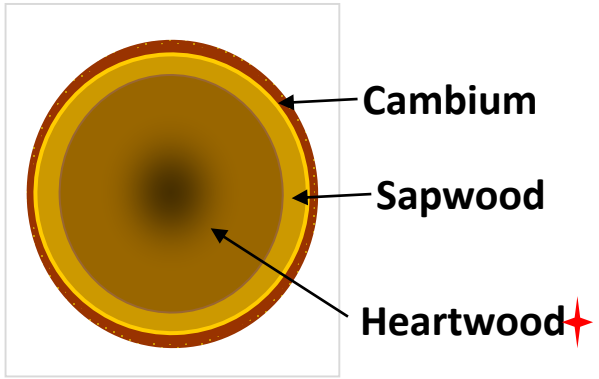


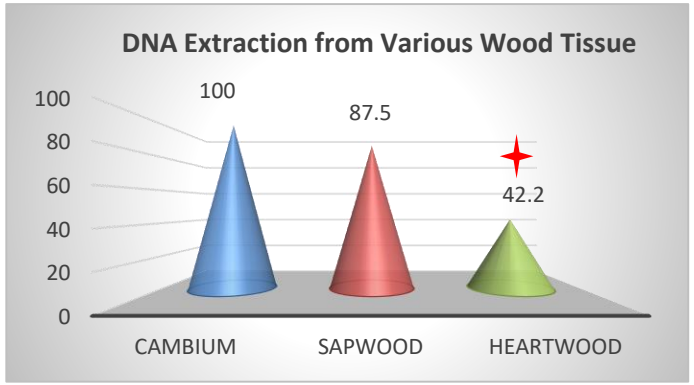
Wood Sci Technol (2012) 46:813–825
DOI 10.1007/s00226-011-0447-6

ORIGINAL

DNA extraction from dry wood of *Neobalanocarpus heimii* (Dipterocarpaceae) for forensic DNA profiling and timber tracking

Lee Hong Tnah · Soon Leong Lee · Kevin Kit Siong Ng · Subha Bhassu · Rofina Yasmin Othman



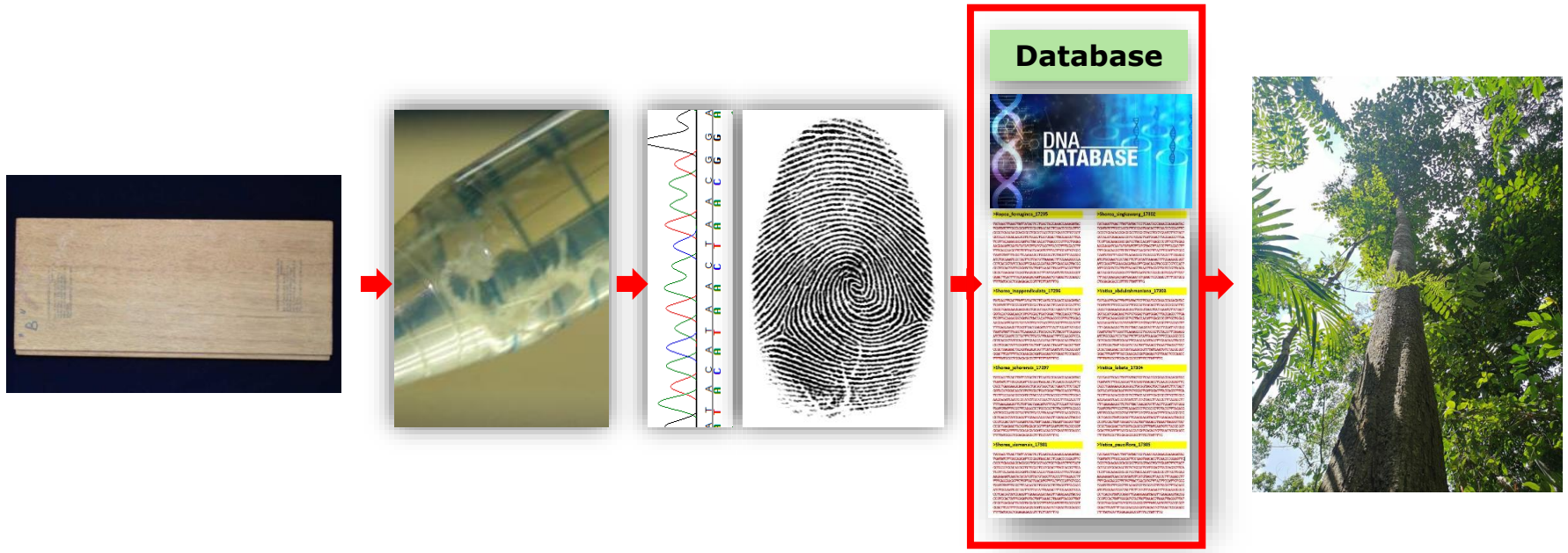


DNA from wood products

DNA Degradation Issues in Wood Products – Exploring **nested PCR protocols** or **genome skimming technique** for difficult wood samples

What is DNA barcoding?

"A diagnostic technique for species identification or authentication using a short, standardized DNA region"



Need to establish DNA barcoding database

DNA barcoding database (*rbc*L, ITS2 & *trn*H-*psb*A)

APEC 2025 KOREA

Timber species
(699 species from 154 timber trade name)

Bil	Spesies	Nama dagangan
1	*Actinodaphne macrophylla*	MEDANG
2	*Actinodaphne pruinosa*	MEDANG
3	*Adinandra dumosa*	SAMAK
4	*Adinandra villosa*	SAMAK
5	*Agathis borneensis*	DAMAR MINYAK
6	*Aglaia argentea*	PASAK
7	*Aglaia cordata*	PASAK
8	*Aglaia exstipulata*	PASAK
9	*Aglaia forbesii*	PASAK
10	*Aglaia ganggo*	PASAK
11	*Aglaia glabriflora*	PASAK
12	*Aglaia grandis*	PASAK
13	*Aglaia macrocarpa*	PASAK
14	*Aglaia odoratissima*	PASAK
15	*Aglaia oligocarpa*	PASAK
16	*Aglaia oligophylla*	PASAK
17	*Aglaia palembanica*	PASAK
18	*Aglaia sexipetala*	PASAK
19	*Aglaia tenuicaulis*	PASAK
20	*Alangium ebenaceum*	MENTULANG
21	*Alangium nobile*	MENTULANG
22	*Alangium ridleyi*	MENTULANG
23	*Alphonsea maingayi*	MEMPISANG
24	*Alphonsea elliptica*	MEMPISANG
25	*Alseodaphne nigrescens*	MEDANG
26	*Alseodaphne peduncularis*	MEDANG
27	*Alstonia angustiloba*	PULAI
28	*Anisophyllea corneri*	DELEK
29	*Anisoptera costata*	MERSAWA
30	*Anisoptera curtisii*	MERSAWA
31	*Anisoptera grossivenia*	MERSAWA
32	*Anisoptera laevis*	MERSAWA
33	*Anisoptera megistocarpa*	MERSAWA
34	*Anisoptera scaphula*	MERSAWA
35	*Aporosa arborea*	KAYU MASAM
36	*Aporosa aurea*	KAYU MASAM
37	*Aporosa falcifera*	KAYU MASAM
38	*Aporosa globifera*	KAYU MASAM
39	*Aporosa lucida*	KAYU MASAM
40	*Aporosa microstachya*	KAYU MASAM
41	*Aporosa nervosa*	KAYU MASAM
42	*Aporosa nigricans*	KAYU MASAM
43	*Aporosa prainiana*	KAYU MASAM
44	*Aporosa subcaudata*	KAYU MASAM

Bil	Spesies	Nama dagangan
651	*Syzygium pseudocrenulatum*	KELAT
652	*Syzygium pustulatum*	KELAT
653	*Syzygium pycnanthum*	KELAT
654	*Syzygium pyrifolium*	KELAT
655	*Syzygium racemosum*	KELAT
656	*Syzygium ridleyi*	KELAT
657	*Syzygium syzygioides*	KELAT
658	*Syzygium variolosum*	KELAT
659	*Tectona grandis*	TEAK
660	*Teijsmanniodendron coriaceum*	ENTAPULOH
661	*Teijsmanniodendron pteropodum*	ENTAPULOH
662	*Terminalia calamansanai*	KETAPANG
663	*Terminalia catappa*	KETAPANG
664	*Terminalia phellocarpa*	KETAPANG
665	*Terminalia subspathulata*	KETAPANG
666	*Trigoniastrum hypoleucum*	MARAJALI
667	*Triomma malaccensis*	KEDONDONG
668	*Upuna borneensis*	PENYAU
669	*Vatica bella*	RESAK
670	*Vatica cinerea*	RESAK
671	*Vatica dulitensis*	RESAK
672	*Vatica flavida*	RESAK
673	*Vatica havilandii*	RESAK
674	*Vatica lobata*	RESAK
675	*Vatica maingayi*	RESAK
676	*Vatica micrantha*	RESAK
677	*Vatica nitens*	RESAK
678	*Vatica pauciflora*	RESAK
679	*Vatica scortechinii*	RESAK
680	*Vatica stapfiana*	RESAK
681	*Vatica venulosa* subsp. *venulosa*	RESAK
682	*Vitex pinnata*	LEBAN
683	*Xanthophyllum affine*	NYALIN/MINYAK BEROK
684	*Xanthophyllum amoenum*	NYALIN/MINYAK BEROK
685	*Xanthophyllum chartaceum*	NYALIN/MINYAK BEROK
686	*Xanthophyllum ellipticum*	NYALIN/MINYAK BEROK
687	*Xanthophyllum eurhynchum*	NYALIN/MINYAK BEROK
688	*Xanthophyllum griffithii*	NYALIN/MINYAK BEROK
689	*Xanthophyllum rufum*	NYALIN/MINYAK BEROK
690	*Xanthophyllum stipitatum*	NYALIN/MINYAK BEROK
691	*Xerospermum noronhianum*	RAMBUTAN PACHAT
692	*Xylocarpus granatum*	NYIREH
693	*Xylocarpus moluccensis*	NYIREH
699	*Xylopia malayana*	MEMPISANG

DNA barcoding database (*rbc*L, ITS2 & *trn*H-*psb*A)

Forensic Science International: Genetics 23 (2016) 197–209

Contents lists available at ScienceDirect

Forensic Science International: Genetics

journal homepage: www.elsevier.com/locate/fsig

Forensic timber identification: a case study of a CITES listed species, *Gonystylus bancanus* (Thymelaeaceae)

Kevin Kit Siong Ng[a,*], Soon Leong Lee[a], Lee Hong Tnah[a], Zakaria Nurul-Farhanah[a], Chin Hong Ng[a], Chai Ting Lee[a], Naoki Tani[b], Bibian Diway[c], Pei Sing Lai[d], Eyen Khoo[e]

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Keywords:
DNA barcoding
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Ramin
Random match probability
Short tandem repeats (STRs)
Timber tracking

ABSTRACT

Illegal logging and smuggling of *Gonystylus bancanus* (Thymelaeaceae) poses a serious threat to this fragile valuable peat swamp timber species. Using *G. bancanus* as a case study, DNA markers were used to develop identification databases at the species, population and individual level. The species level database for *Gonystylus* comprised of an rDNA (ITS2) and two cpDNA (*trnH-psbA* and *trnL*) markers based on a 20 *Gonystylus* species database. When concatenated, taxonomic species recognition was achieved with a resolution of 90% (18 out of the 20 species). In addition, based on 17 natural populations of *G. bancanus* throughout West (Peninsular Malaysia) and East (Sabah and Sarawak) Malaysia, population and individual identification databases were developed using cpDNA and STR markers respectively. A haplotype distribution map for Malaysia was generated using six cpDNA markers, resulting in 12 unique multilocus haplotypes, from 24 informative intraspecific variable sites. These unique haplotypes suggest a clear genetic structuring of West and East regions. A simulation procedure based on the composition of the samples was used to test whether a suspected sample conformed to a given regional origin. Overall,

Forensic Science International: Genetics 57 (2022) 102658

Contents lists available at ScienceDirect

Forensic Science International: Genetics

journal homepage: www.elsevier.com/locate/fsigen

Research paper

DNA databases of a CITES listed species *Aquilaria malaccensis* (Thymelaeaceae) as the tracking tools for forensic identification and chain of custody certification

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ARTICLE INFO

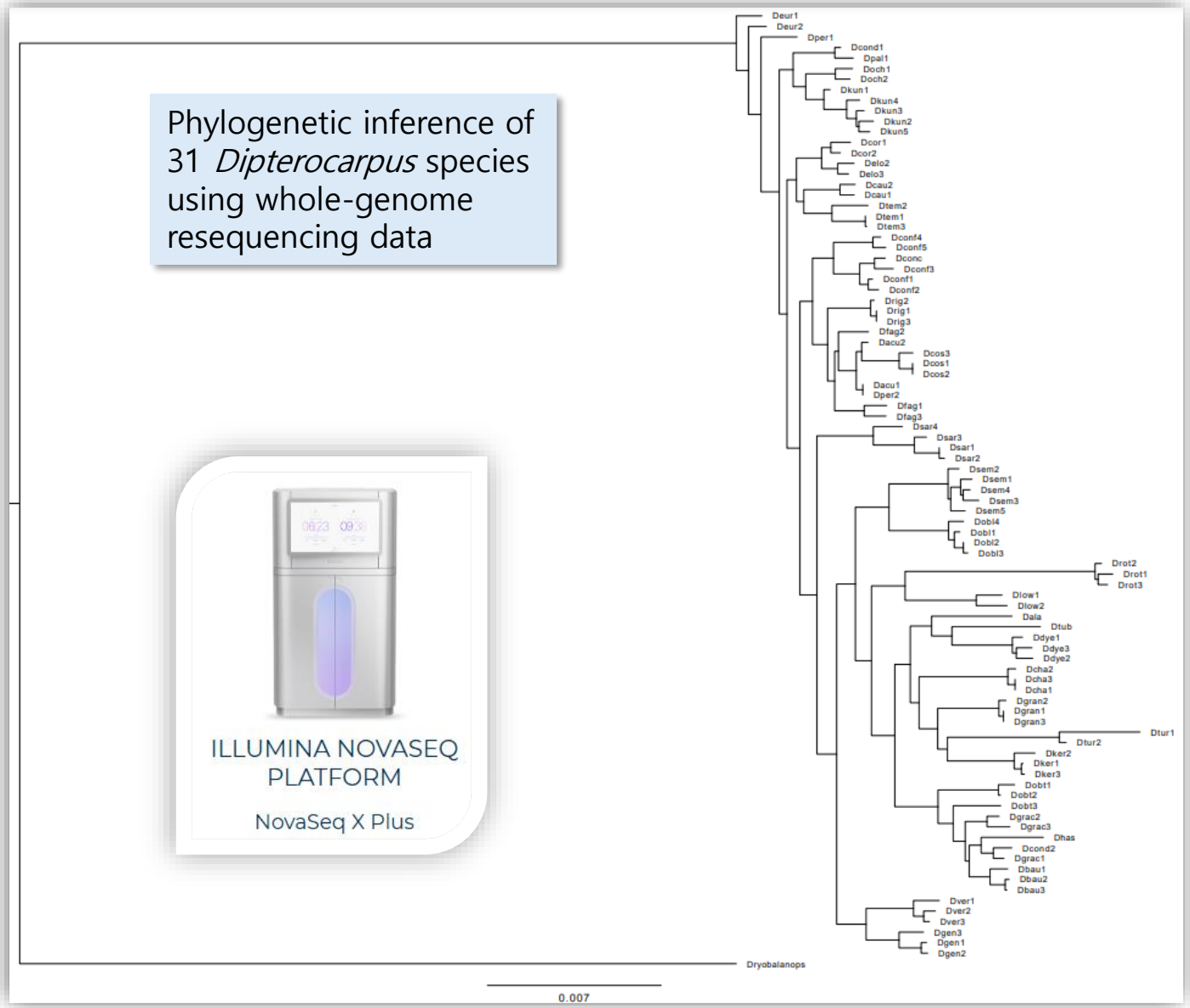
Keywords:
Tropical tree species
Agarwood/Gaharu
Chloroplast DNA
Short tandem repeat (STR)
DNA barcoding
DNA profiling
Allelic ladder

ABSTRACT

Aquilaria malaccensis (Thymelaeaceae) is the main source of high-grade agarwood in Southeast Asia. Aggressive collections and trade activities over the past decades have put great pressure on the natural stands and raised concerns over the long-term survival potential of *A. malaccensis*. Tracking and authentication of agarwood require method with a high degree of accuracy. Therefore, this study aimed to develop DNA databases of *A. malaccensis* as the tracking tools at species, population and individual levels for forensic identification and chain of custody certification. Using two cpDNA (*rbcL* and *matK*) and an rDNA (ITS2) markers, species identification database of *Aquilaria* was developed to distinguish *A. malaccensis* from *A. hirta*, *A. microcarpa*, *A. beccariana*, *A. crassna*, *A. sinensis* and *A. rostrata*. In addition, based on 35 populations of *A. malaccensis* throughout Peninsular Malaysia, cpDNA haplotype and STR allele frequency databases were developed for

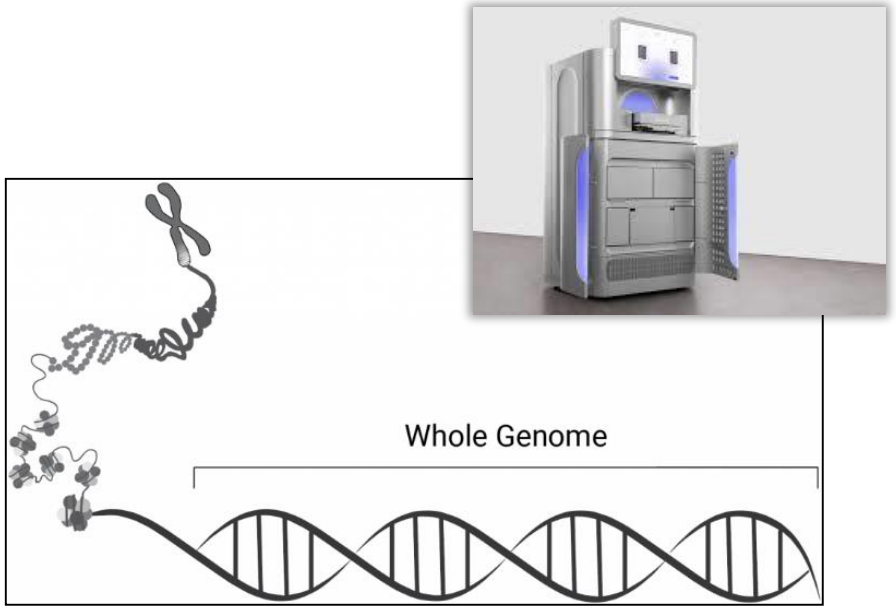
Development of new DNA barcodes

Phylogenetic inference of 31 *Dipterocarpus* species using whole-genome resequencing data



ILLUMINA NOVASEQ PLATFORM

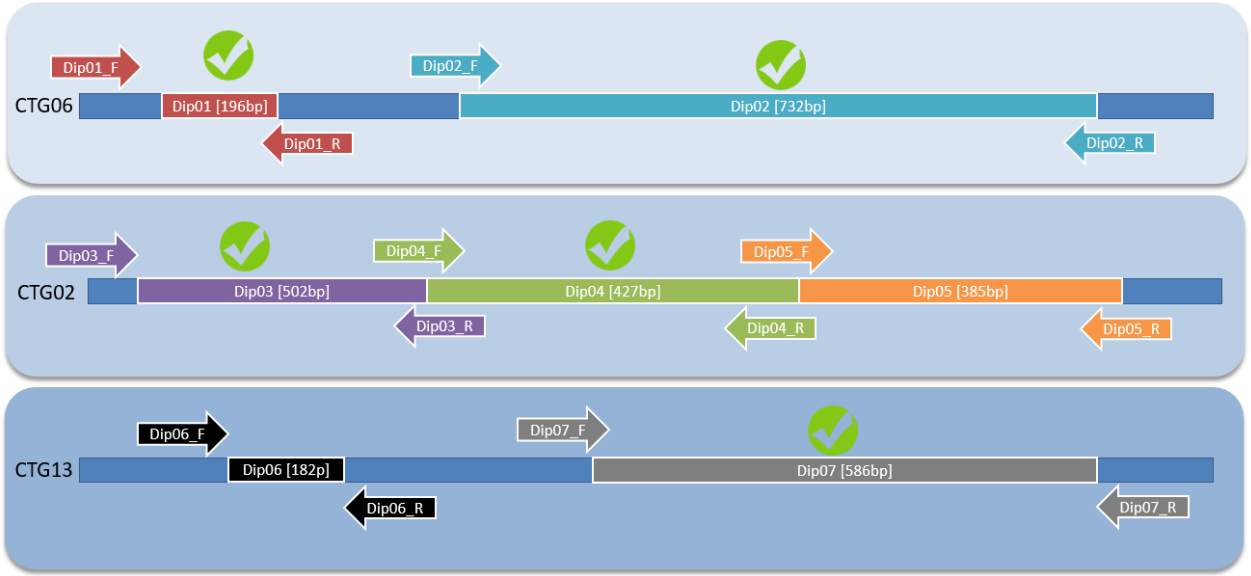
NovaSeq X Plus

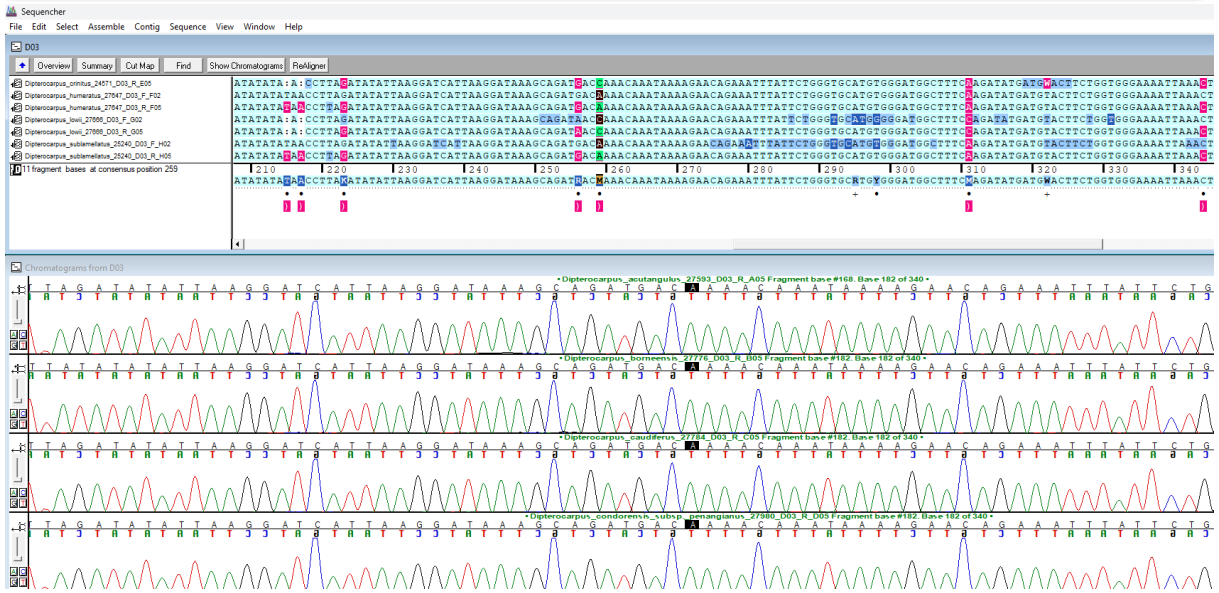


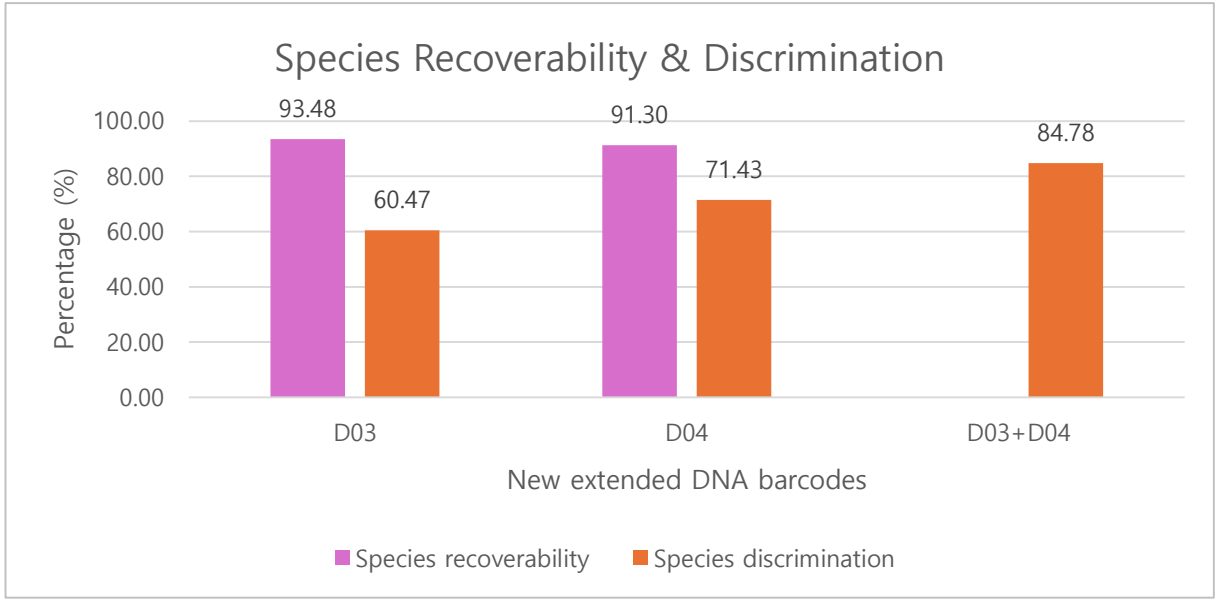
Development of New DNA Barcodes

- Genomes from various species can be analyzed collectively to identify unique DNA sequences that are useful for distinguishing between species.

Development of new DNA barcodes





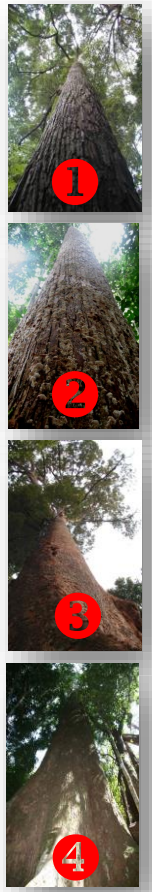


*Barcodes evaluation based on 46 species of *Dipterocarpus*

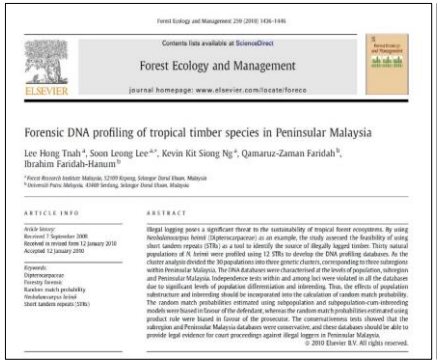
- ✓ Two-locus barcodes: Species discrimination of 84.78%
- ✓ More barcodes (D02 & D07) are included to increase species discrimination

DNA profiling database (SSR)

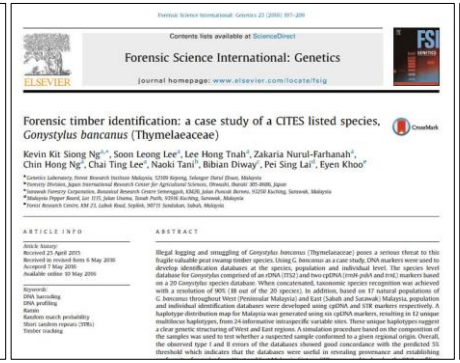
Total 409 pops; 13,196 samples



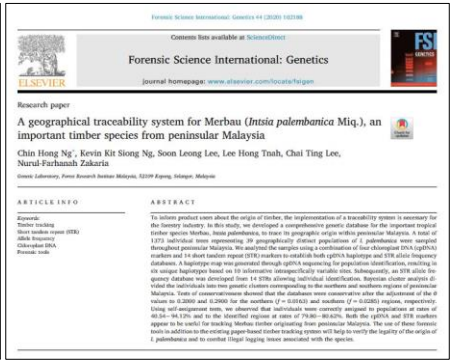
1	*Neobalanocarpus heimii*	30 pops (PM)
2	*Gonystylus bancanus*	17 pops (Ma)
3	*Koompassia malaccensis*	64 pops (Ma)
4	*Rubroshorea platyclados*	30 pops (Ma)
5	*Aquilaria malaccensis*	35 pops (PM)
6	*Intsia palembanica*	39 pops (PM)
7	*Rubroshorea leprosula*	44 pops (PM)
8	*Rubroshorea curtisii*	41 pops (PM)
9	*Rhizophora mucronata*	34 pops (PM)
10	*Rhizophora apiculata*	43 pops (PM)
11	*Dryobalanops aromatica*	11 pops (PM)
12	*Dryobalanops oblongifolia*	5 pops (PM)
13	*Dipterocarpus cornutus*	16 pops (PM)


Forest Ecology and Management

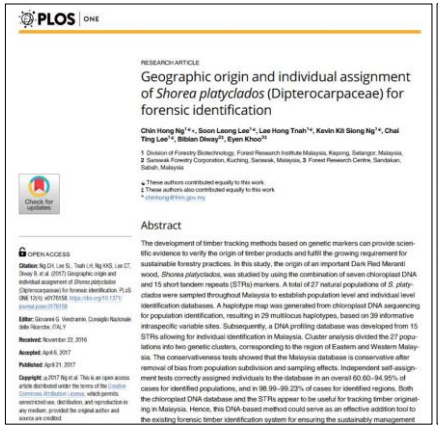
Forensic DNA profiling of tropical timber species in Peninsular Malaysia


Forensic Science International: Genetics

Forensic timber identification: a case study of a CITES listed species, *Gonystylus bancanus* (Thymelaeaceae)


Forensic Science International: Genetics

A geographical traceability system for Merbau (*Intsia palembanica* Miq.), an important timber species from peninsular Malaysia


PLOS ONE

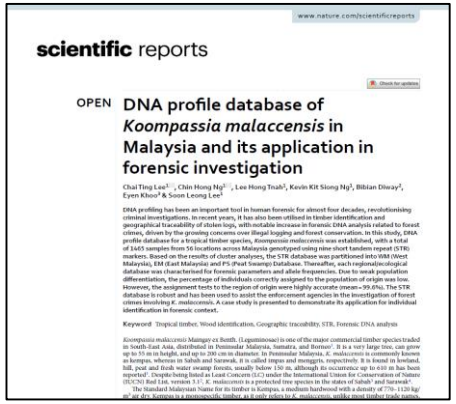
Geographic origin and individual assignment of *Shorea platyclados* (Dipterocarpaceae) for forensic identification


Forensic Science International: Genetics

DNA databases of a CITES listed species *Aquilaria malaccensis* (Thymelaeaceae) as the tracking tools for forensic identification and chain of custody certification


scientific reports

OPEN DNA databases of an important tropical timber tree species *Shorea leprosula* (Dipterocarpaceae) for forensic timber identification


scientific reports

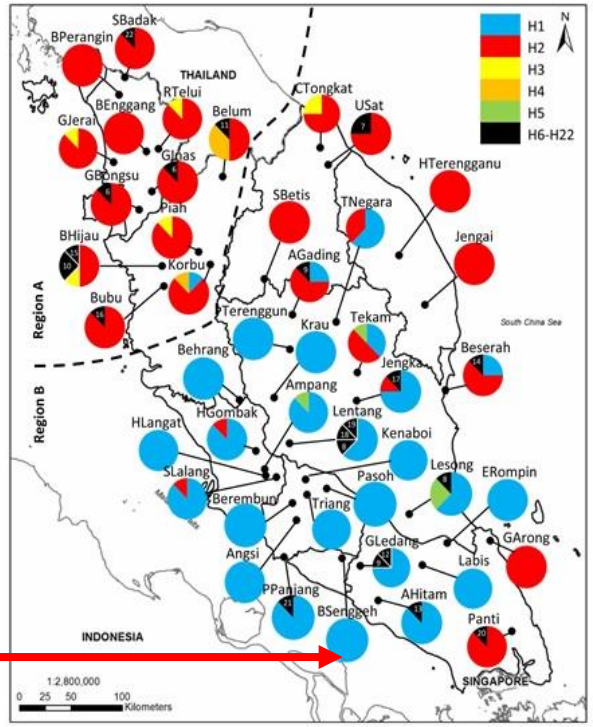
OPEN DNA profile database of *Koompassia malaccensis* in Malaysia and its application in forensic investigation

DNA profiling database

Population identification via assignment test

Suspected log

99.873%



Rubroshorea leprosula (Meranti Tembaga)	
Population	**%**
1) AGading	32.40
2) AHitam	57.10
3) Ampang	50.00
4) Angsi	34.40
5) Behrang	52.90
6) Belum	51.30
7) BEnggang	65.70
8) Berembun	55.60
9) Beserah	53.30
10) BHijau	50.00
11) BPerangin	73.60
12) BSenggeh	53.30
13) Bubu	38.70
14) CTongkat	81.30
15) ERompin	65.00
16) GArong	65.70
17) GBongsu	30.00
18) GInas	44.40
19) GJerai	62.90
20) GLedang	26.70
21) HGombak	50.00
22) HLangat	41.40
23) HTerengganu	37.50
24) Jengai	18.20
25) Jengka	35.30
26) Kenaboi	14.30
27) Korbu	48.60
28) Krau	20.00
29) Labis	33.30
30) Lentang	63.60
31) Lesong	27.30
32) Panti	48.40
33) Pasoh	25.60
34) Piah	45.50
35) PPanjang	46.90
36) RTelui	57.10
37) SBadak	70.60
38) SBetis	47.10
39) SLalang	39.10
40) Tekam	33.30
41) Terenggun	60.00
42) TNegara	30.80
43) Triang	33.30
44) USat	46.20

DNA profiling database

Individual identification

Allele size - frequency													
Ipa013	Ipa018	Ipa022	Ipa030	Ipa037	Ipa049	Ipa052	Ipa068	Ipa099	Ipa149	IpaT01	IpaT31	IpaT32	IpaT38
152 — 0.0299	120 — 0.0008	107 — 0.0033	271 — 0.0041	310 — 0.0008	252 — 0.0008	202 — 0.0025	151 — 0.0008	196 — 0.0099	099 — 0.0017	333 — 0.0207	272 — 0.0008	321 — 0.0008	245 — 0.0008
154 — 0.3027	122 — 0.2682	111 — 0.0008	273 — 0.0083	312 — 0.1242	254 — 0.0008	210 — 0.0108	155 — 0.0158	198 — 0.0083	112 — 0.0762	338 — 0.0008	274 — 0.0008	324 — 0.0017	251 — 0.0066
155 — 0.0100	124 — 0.0008	113 — 0.4785	274 — 0.0008	314 — 0.0762	260 — 0.0017	212 — 0.2492	157 — 0.0008	200 — 0.4313	114 — 0.5861	340 — 0.0025	277 — 0.0505	331 — 0.0836	254 — 0.0017
156 — 0.4934	126 — 0.3584	115 — 0.3700	277 — 0.0356	316 — 0.0017	263 — 0.8104	214 — 0.0397	158 — 0.0075	202 — 0.2086	116 — 0.2997	343 — 0.1407	279 — 0.0008	334 — 0.4553	256 — 0.0033
158 — 0.1177	130 — 0.0050	117 — 0.1258	278 — 0.0298	318 — 0.0033	265 — 0.1730	216 — 0.0017	164 — 0.5083	204 — 0.0041	118 — 0.0141	347 — 0.0075	282 — 0.0050	337 — 0.3179	258 — 0.0041
160 — 0.0249	132 — 0.2765	119 — 0.0215	281 — 0.1200	320 — 0.0687	267 — 0.0008	218 — 0.0853	166 — 0.2371	206 — 0.0099	120 — 0.0033	348 — 0.0017	285 — 0.7243	340 — 0.0008	261 — 0.2219
162 — 0.0191	134 — 0.0654		282 — 0.0323	322 — 0.1209	269 — 0.0124	220 — 0.0364	167 — 0.0506	207 — 0.0025	122 — 0.0033	352 — 0.7310	288 — 0.1863	343 — 0.0894	264 — 0.6722
164 — 0.0025	136 — 0.0083		284 — 0.4586	324 — 0.0679		222 — 0.0174	168 — 0.0713	212 — 0.2988	124 — 0.0017	357 — 0.0149	291 — 0.0033	346 — 0.0364	267 — 0.0861
	138 — 0.0166		286 — 0.1374	326 — 0.0025		225 — 0.0058	169 — 0.0240	214 — 0.0265	129 — 0.0008	361 — 0.0803	294 — 0.0008	349 — 0.0132	270 — 0.0033
			288 — 0.0828	330 — 0.1523		227 — 0.0017	170 — 0.0597		133 — 0.0017		297 — 0.0248	352 — 0.0008	
						229 — 0.1126	174 — 0.0041		135 — 0.0083		300 — 0.0025		
						231 — 0.1647	175 — 0.0017		137 — 0.0008				
						233 — 0.1325	176 — 0.0149		139 — 0.0017				
						234 — 0.0224	178 — 0.0025		141 — 0.0008				
						235 — 0.0935							
						237 — 0.0199							
						239 — 0.0017							
						249 — 0.0008							
						251 — 0.0017							

Homozygote:

$$P(A_rA_i \mid A_rA_i) = \frac{[\theta + (1-\theta)p_i]}{f + (1-f)[\theta + (1-\theta)\,p_i]} \; f^2 + 2f(1-f) \; \frac{[2\theta + (1-\theta)p_i]}{(1+\theta)} + (1-f)^2 \; \frac{[2\theta + (1-\theta)p_i][3\theta + (1-\theta)\,p_i]}{(1+\theta)(1+2\theta)} \quad (1)$$

Heterozygote:

$$P(A_rA_j \mid A_rA_j) = 2(1-f) \; \frac{[\theta + (1-\theta)p_i][\theta + (1-\theta)\,p_j]}{(1+\theta)(1+2\theta)} \quad (2)$$

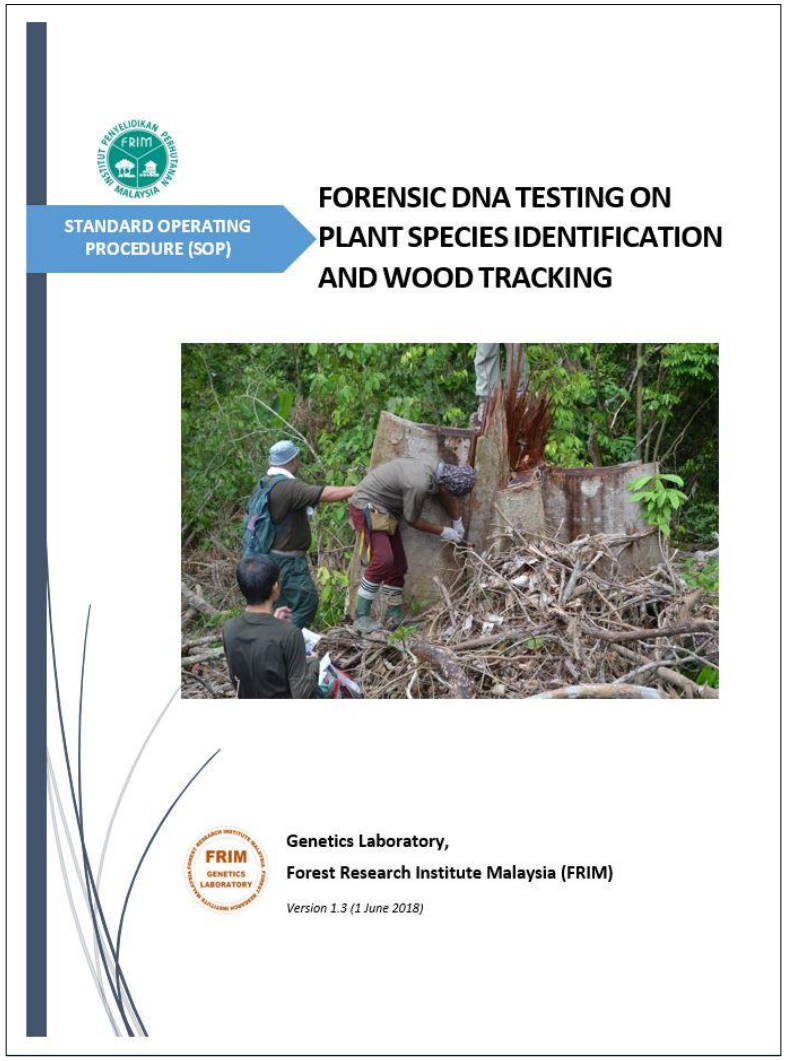
Profile frequency = 1.11 x 10^{-8}

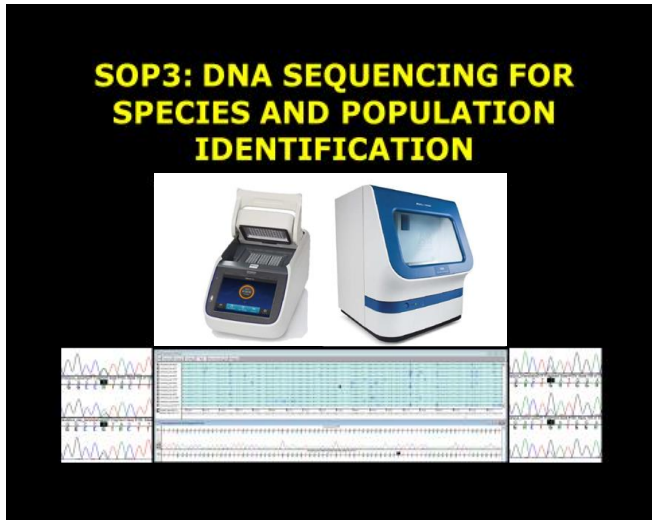
Random match probability = 9.02 x 10^{7}

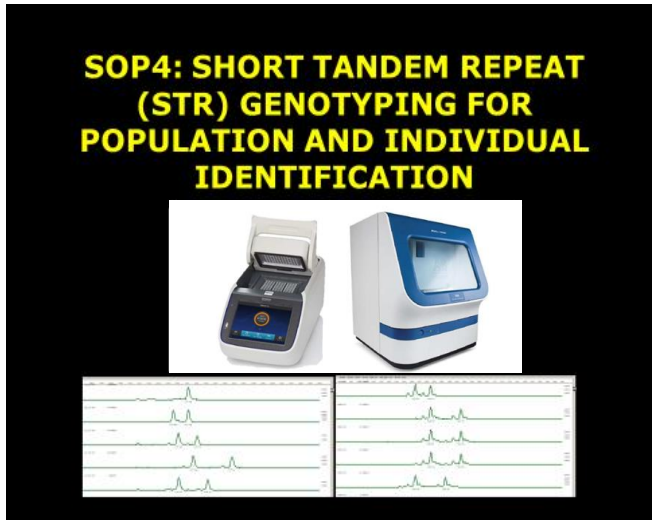
Due to random match = 1 in 9.02 x 10^{7} (90 million)

Likelihood ratio: The DNA evidence indicates that it is **9.02 × 10^{7} times more likely** that the log originated from **this specific stump** than from **any other unknown stump**

Standard operating procedure (SOP)







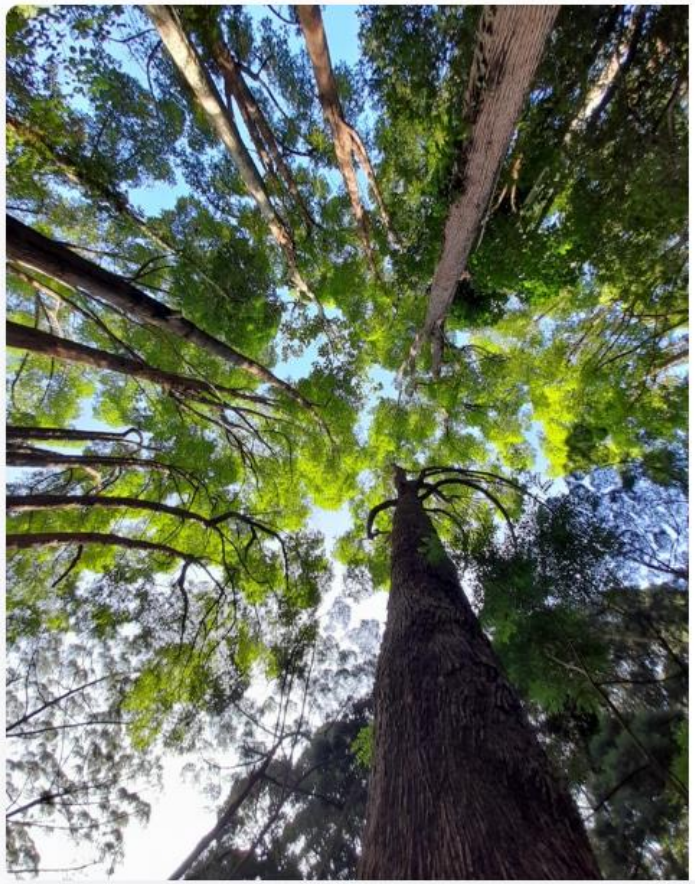
Training to enforcement officials

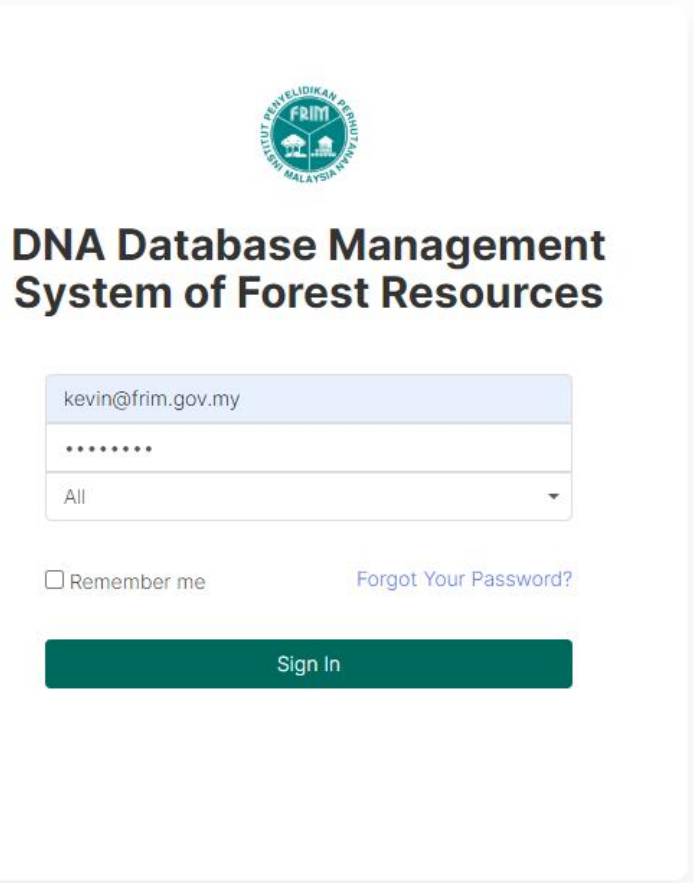
Training to enforcement officials

Training to enforcement officials

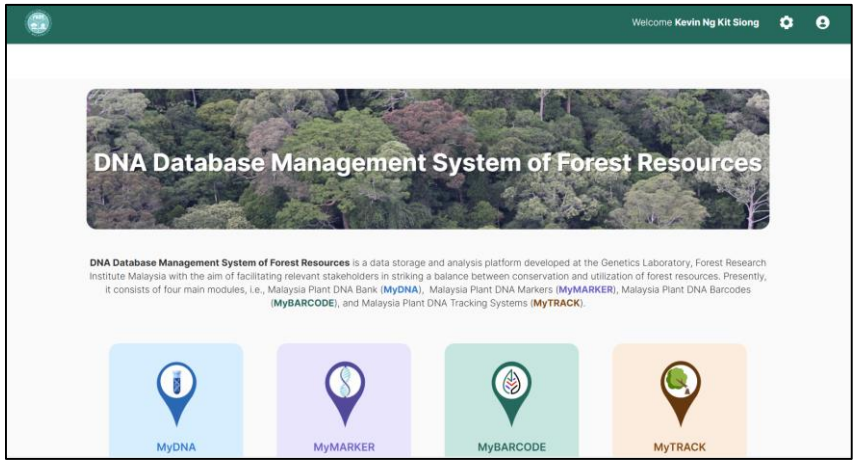
DNA Database Management System

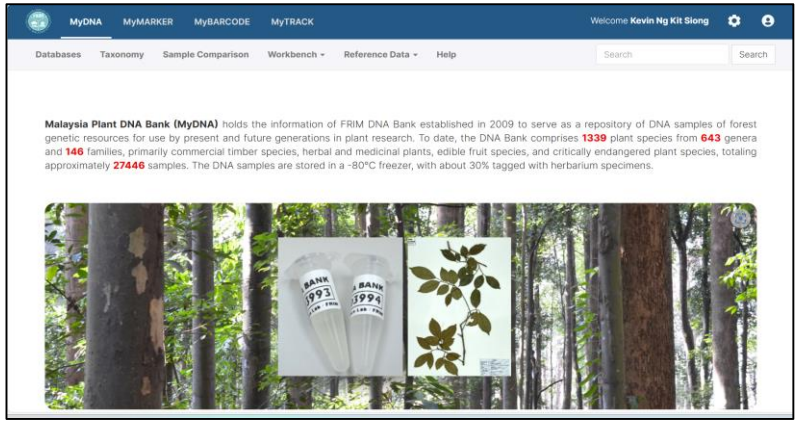
URL: https://DNA.frim.gov.my

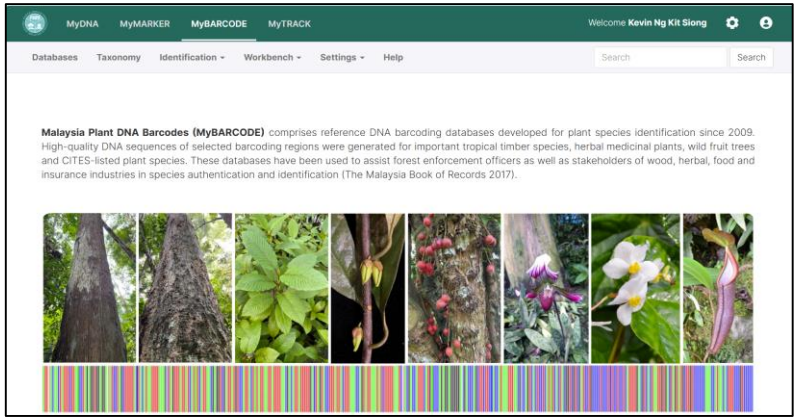


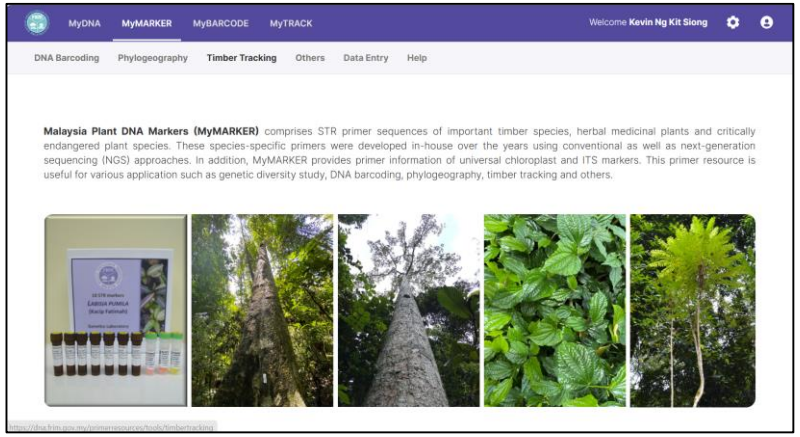


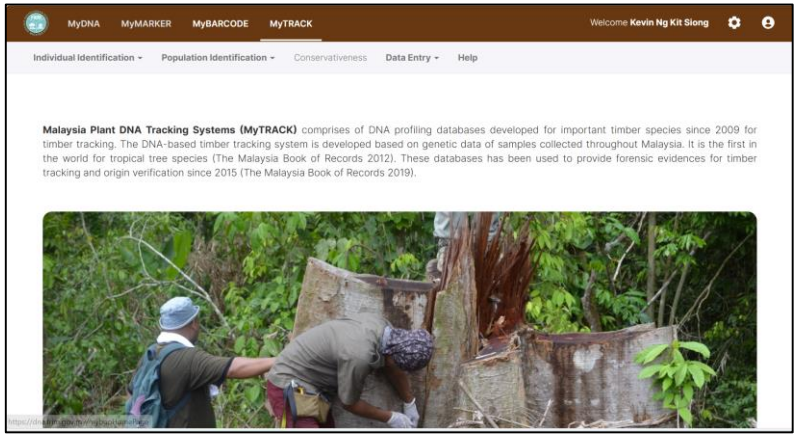
DNA Database Management System





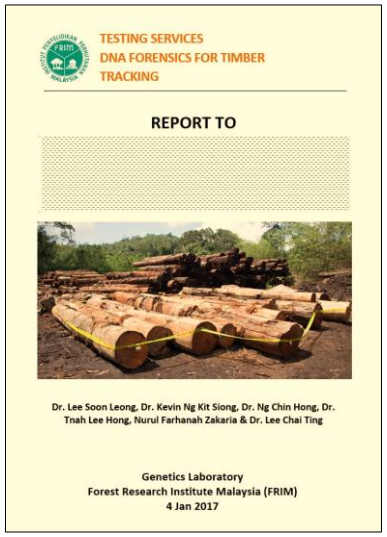






Applications

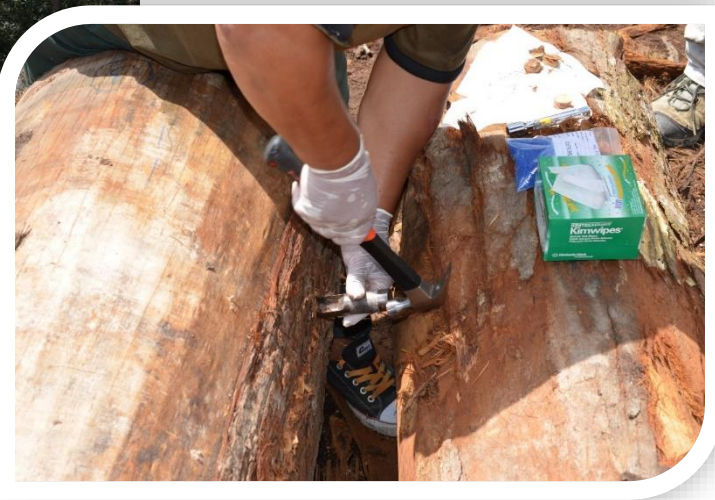
To provide forensic evidences for the conviction of illegal loggers

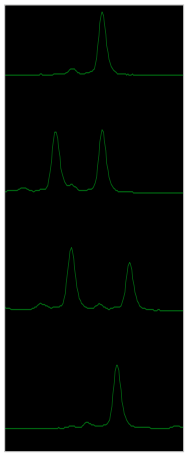

TESTING SERVICES
DNA FORENSICS FOR TIMBER TRACKING

REPORT TO

Dr. Lee Soon Leong, Dr. Kevin Ng Kit Siong, Dr. Ng Chin Hong, Dr. Tnah Lee Hong, Nurul Farhanah Zakaria & Dr. Lee Chai Ting

Genetics Laboratory
Forest Research Institute Malaysia (FRIM)
4 Jan 2017

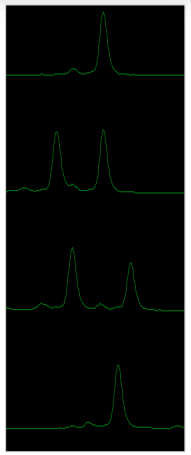



Log

100% Match

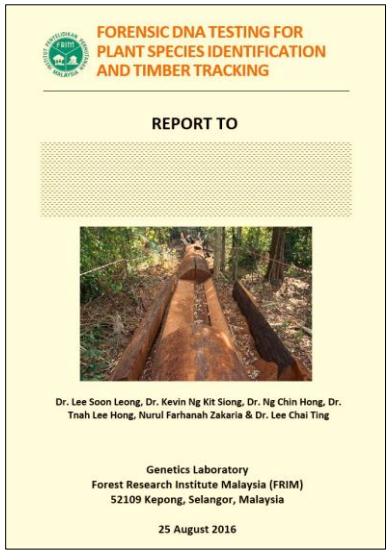
Using Individual Identification Database:

- Profile frequency
  = 7.95×10^{-11}
- Random match probability
  = 1 in 1.26×10^{10}
- Likelihood ratio
  = 1.26×10^{10} (1.26 billion)


Stump

Applications

To provide forensic evidences for the conviction of illegal loggers



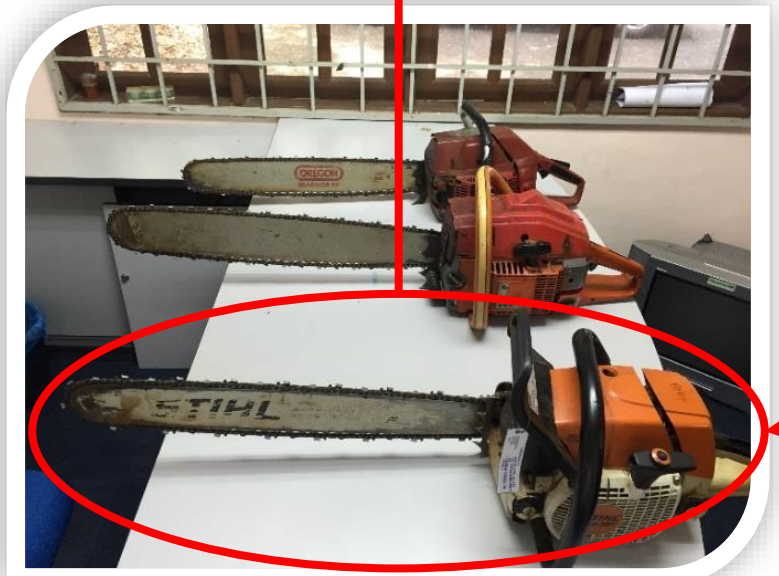
FORENSIC DNA TESTING FOR PLANT SPECIES IDENTIFICATION AND TIMBER TRACKING

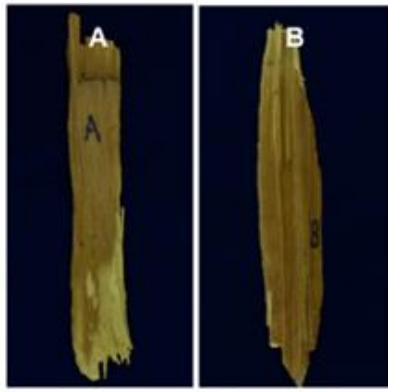
REPORT TO

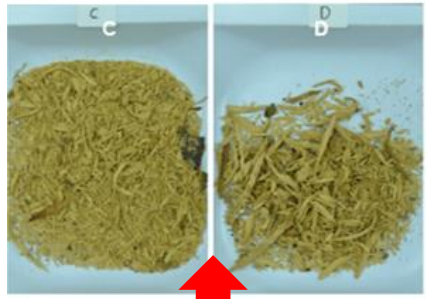
Dr. Lee Soon Leong, Dr. Kevin Ng Kit Siong, Dr. Ng Chin Hong, Dr. Tnah Lee Hong, Nurul Farhanah Zakaria & Dr. Lee Chai Ting

Genetics Laboratory
Forest Research Institute Malaysia (FRIM)
52109 Kepong, Selangor, Malaysia

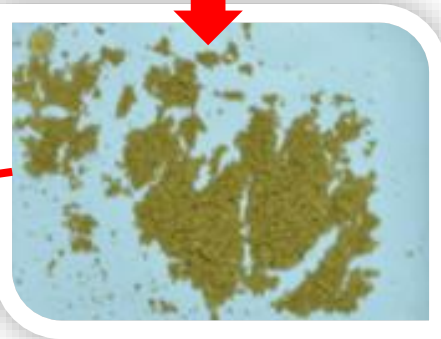
25 August 2016







100% Match



Applications

To identify geographical origin of Agarwood


TESTING SERVICES
DNA FORENSICS FOR PLANT SPECIES IDENTIFICATION AND TIMBER TRACKING

REPORT TO

Dr. Kevin Ng Kit Siong, Ms. Nurul Farhanah Zakaria, Dr. Lee Chai Ting, Dr. Ng Chin Hong, Dr. Tnah Lee Hong & Dr. Lee Soon Leong (Head of Genetics Laboratory)

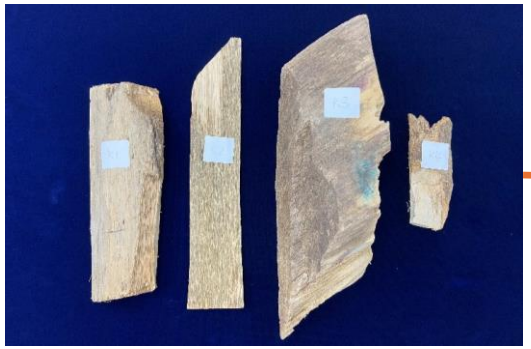
Genetics Laboratory
Forest Research Institute Malaysia (FRIM)
52109 Kepong, Selangor, Malaysia

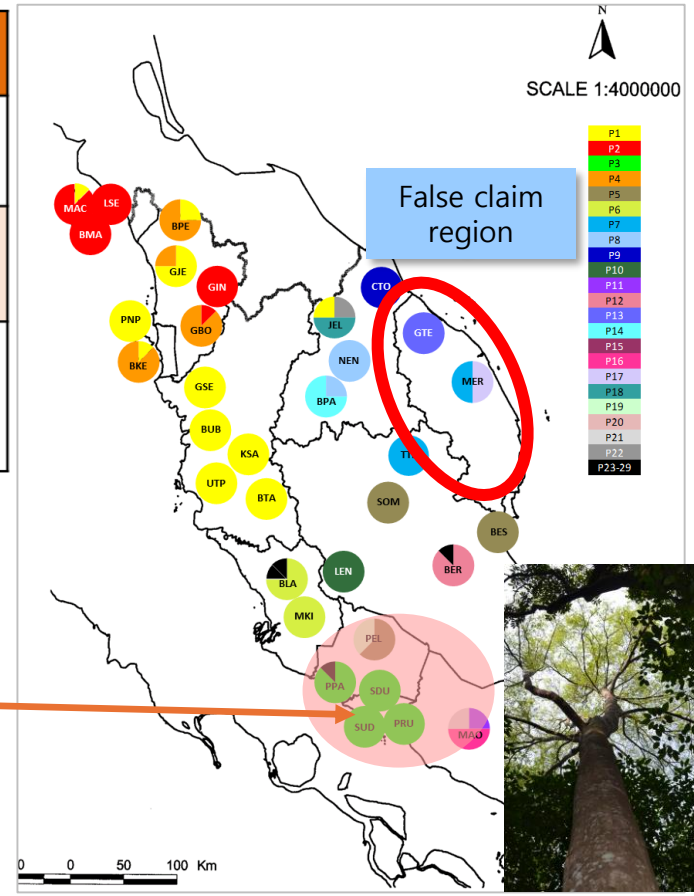
21 May 2020

Sample ID	STR DNA profiles	Assigned population	Probability of assignment
K1	083/087; 096/104; 166/166; 103/105;186/186; 099/099; 106/106	Paya Rumput (Melaka)	98.772%
K2	083/119; 098/104; 166/166; 103/105; 157/157; 188/188; 099/099;108/110; 136/136	Panti (Johor)	55.805%
K4	097/100; 096/096; 170/178; 103/105; 157/157; 188/188; 099/099; 187/187; 219/219; 283/289; 112/116; 136/136	Som (Pahang)	68.667%


BH ONLINE

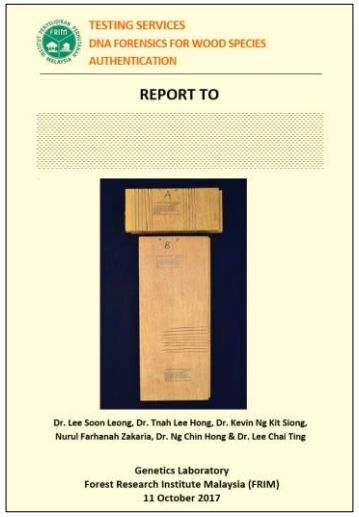
Kilang haram proses gaharu diserbu





Applications

Wood industry: Wood product identification prior export to international market

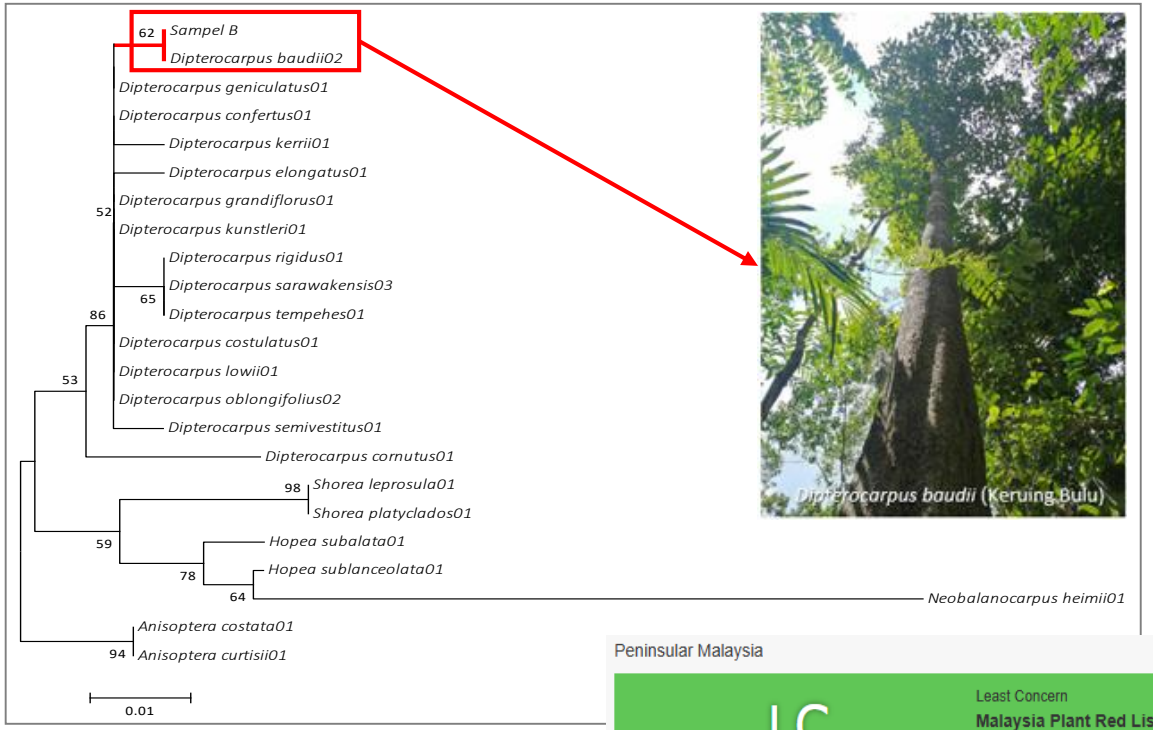

TESTING SERVICES
DNA FORENSICS FOR WOOD SPECIES AUTHENTICATION

REPORT TO

Dr. Lee Soon Leong, Dr. Tnah Lee Hong, Dr. Kevin Ng Kit Siong, Nurul Farhanah Zakaria, Dr. Ng Chin Hong & Dr. Lee Chai Ting

Genetics Laboratory
Forest Research Institute Malaysia (FRIM)
11 October 2017

Query ID	Subject ID	% identity
Sample B	*Dipterocarpus baudii*	100.00
Sample B	*Dipterocarpus grandiflorus*	99.56
Sample B	*Dipterocarpus geniculatus*	99.56
Sample B	*Dipterocarpus oblongifolius*	99.12



- Several species within the genus *Dipterocarpus* are listed as threatened by the IUCN Red List.

Applications

Wood industry: Wood product identification prior export to international market


CONFIDENTIAL Service Code: 1 of 5

IDENTIFICATION AND AUTHENTICATION OF PLANT SPECIES WITH DNA BARCODES

GENETICS LABORATORY, FOREST RESEARCH INSTITUTE MALAYSIA (FRIM), 52109 KEPONG, SELANGOR, MALAYSIA.

TEST REPORT TO

PREPARED BY

DR. TNAH LEE HONG
Research Officer
Date: 09th April 2025

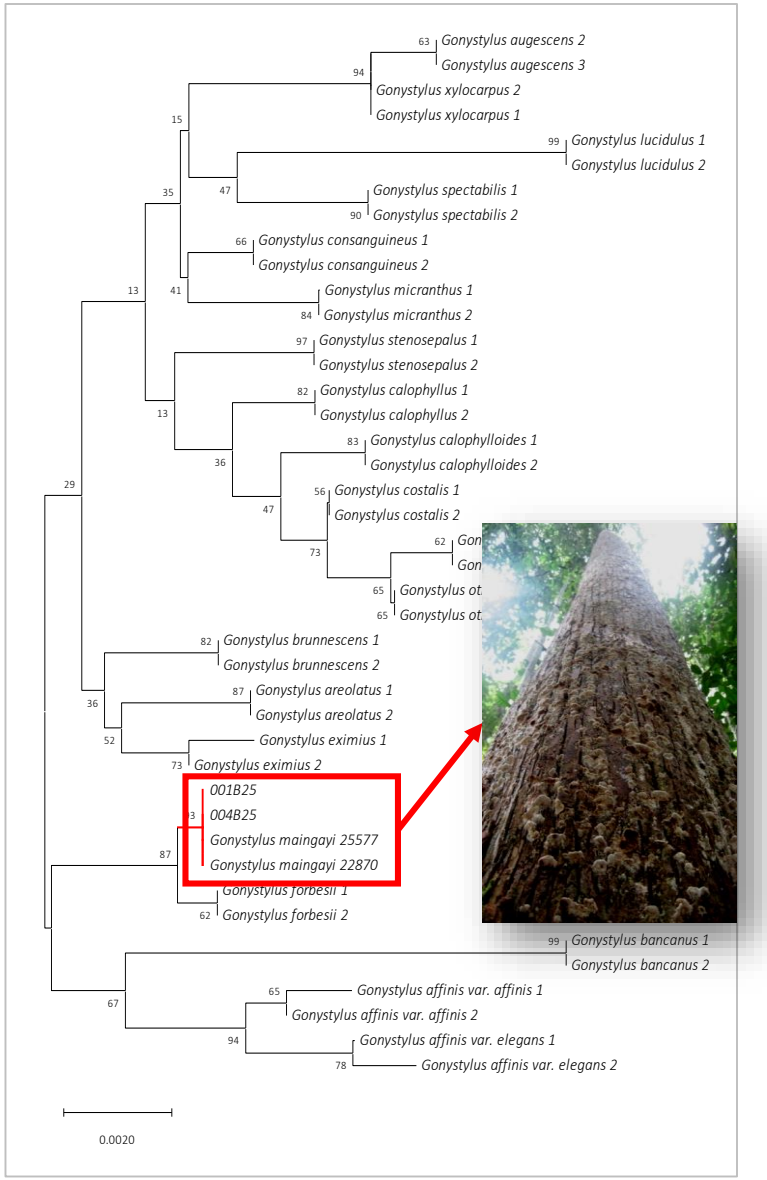
APPROVED BY

DR. KEVIN NG KIT SIONG
Head of Genetics Laboratory
Date: 09th April 2025

- *Gonystylus* species, commonly known as ramin, are listed in CITES Appendix II.
- International trade in Ramin is regulated and requires permits.

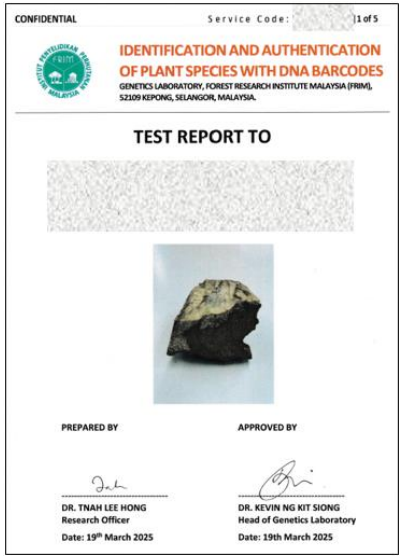

Ramin (*Gonystylus* sp.)

Query ID	Subject ID	% identity
001B25	*Gonystylus maingayi*	100.00
001B25	*Gonystylus forbesii*	98.91
001B25	*Gonystylus stenosepalus*	98.32
001B25	*Gonystylus eximius*	98.08
001B25	*Gonystylus brunnescens*	97.96
001B25	*Gonystylus areolatus*	97.96
001B25	*Gonystylus calophylloides*	97.84



Applications

Wood industry: *Aquilaria* species identification & authentication



CONFIDENTIAL Service Code: [redacted] 1 of 5

IDENTIFICATION AND AUTHENTICATION OF PLANT SPECIES WITH DNA BARCODES

GENETICS LABORATORY, FOREST RESEARCH INSTITUTE MALAYSIA (FRIM), 52109 KEPONG, SELANGOR, MALAYSIA.

TEST REPORT TO

[redacted]

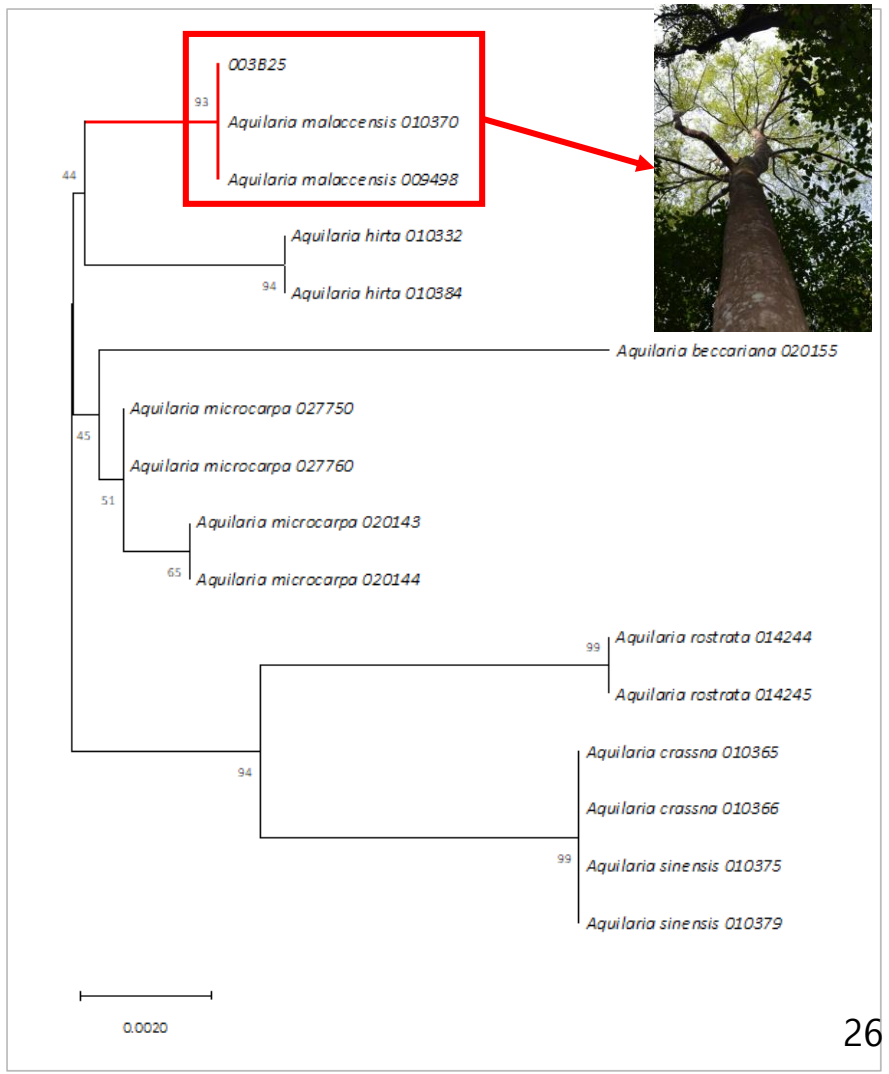
PREPARED BY

DR. TNAH LEE HONG
Research Officer
Date: 19th March 2025

APPROVED BY

DR. KEVIN NG KIT SIONG
Head of Genetics Laboratory
Date: 19th March 2025

Query ID	Subject ID	% identity	Alignment length	Mismatches	E-value	Bit score
003B25	*Aquilaria_malaccensis_010370*	100.000	996	0	0	1829
003B25	*Aquilaria_microcarpa_027760*	99.297	996	7	0	1805
003B25	*Aquilaria_hirta_010384*	99.197	996	8	0	1801
003B25	*Aquilaria_microcarpa_020144*	99.197	996	8	0	1799
003B25	*Aquilaria_beccariana_020155*	98.695	996	13	0	1773
003B25	*Aquilaria_sinensis_010379*	98.594	996	13	0	1766
003B25	*Aquilaria_rostrata_014245*	98.594	996	13	0	1766
003B25	*Aquilaria_crassna_010366*	98.594	996	13	0	1766



Testify in the court

Defendant: Dr

IN THE STATE COURTS OF TH

Between

And

AFFIDAVIT OF EVI

I, **DR LEE SOON LEONG** (Malays
Kepong, Selangor, Malaysia, do affirm and sa

1. I am the head of Genetics Laboratory, Research Institute Malaysia ("**FRIM**") on the behalf of the Defendant.

2. Insofar as the matters deposed to her context otherwise suggest, they are documents in my possession, and are within my personal knowledge, the information and belief.

3. I have been appointed by the Defer identify the species of timber in respe Defendant.

4. Copies of the following are exhibited

4.1 my Report to for DNA Forensics for Wood Species dated 05.11.2015 (at pages 4 to 10);

4.2 my Report to for DNA Forensics for Wood Species dated 03.02.2017 (at pages 11 to 16);

4.3 my Report to for DNA Forensics for Wood Species dated 14.04.2017 (at pages 17 to 22); and

4.4 my curriculum vitae (at pages 23 to 30).

5. In preparing my Reports and making this affidavit, my attention has been drawn to my obligation as an Expert Witness by the Defendant's solicitors. I confirm that the Reports are mine. I accept full responsibility for the same and in giving these Reports and making this affidavit, I accept that my duty is to the Honourable Court and overrides any obligation to the Defendant.

Affirmed by the abovenamed)
DR LEE SOON LEONG)
at Malaysia on this - 4 MAY 2017)
day of May 2017)

DR LEE SOON LEONG

Before me

A Notary Public

NOTARY PUBLIC
PALAKRISHNAN A/L R. SUPPIAH
PN/WKL/HQ/25/10/2007
Expiry Date: 30-10-2017
WP. KUALA LUMPUR MALAYSIA

PALAKRISHNAN A/L R. SUPPIAH
NOTARY PUBLIC
Lot G-AB, Ground Floor, Sam Mansion
Jalan Akar / Jalan Tuba
Off Jalan Kampung Attap
50460 Kuala Lumpur
Tel: 03-22607624/5 Fax: 03-2260 6430
Email: palalaw49@gmail.com

- 4 MAY 2017

This Affidavit on filed on behalf of the Defendant.

Accreditation & recognition

MS ISO/IEC 17025: 2017

Schedule

Issue date: 4 Disember 2024
Valid until: 20 June 2028

NO: SAMM 558
Issue 2, 4 December 2024 replacement of SAMM 558 dated 3 April 2023)

GENETICS LABORATORY (MG)

SCOPE OF TESTING: MOLECULAR

Materials/ Products Tested	Type of Test/ Properties Measured/ Range of Measurement	Standard Test Methods/ Equipment/Techniques
Plant Tissues	Identification and authentication of plant species with DNA barcodes	In-house method AK2-02 based on DNA barcoding database and DNA sequencing method published in journals: 1) Food Control, issue 95, pp.318-326, 2019 (DNA barcode database of common herbal plants in the tropics: a resource for herbal product authentication); 2) Forensic Science International: Genetics, issue 23, pp. 197-209, 2016 (Forensic timber identification: a case study of a CITES listed species, *Gonystylus bancanus* [Thymelaeaceae]); 3) Forensic Science International: Genetics, issue 57, pp. 102658, 2022 (DNA databases of a CITES listed species *Aquilaria malaccensis* [Thymelaeaceae] as the tracking tools for forensic identification and chain of custody certification); & 4) 3 Biotech, 14: 7, 2024 (DNA barcode identification of cultivated and wild tropical fruit species).

Schedule

Issue date: 4 Disember 2024
Valid until: 20 June 2028

NO: SAMM 558
Issue 2, 4 December 2024 replacement of SAMM 558 dated 3 April 2023)

GENETICS LABORATORY (MG)

SCOPE OF TESTING: MOLECULAR

Materials/ Products Tested	Type of Test/ Properties Measured/ Range of Measurement	Standard Test Methods/ Equipment/Techniques
Plant Tissues (*Continue*)	Wood tracking of plant species with forensic DNA	In-house method AK2-03 based on DNA profiling database and STR genotyping method published in journals: 1) Forest Ecology and Management, issue 259, pp. 1436-1446, 2010 (Forensic DNA profiling of tropical timber species in Peninsular Malaysia); 2) Forensic Science International: Genetics, issue 23, pp. 197-209, 2016 (Forensic timber identification: a case study of a CITES listed species, *Gonystylus bancanus* [Thymelaeaceae]); 3) PLoS ONE, issue 12, pp. e0176158, 2017 (Geographic origin and individual assignment of *Shorea platyclados* [Dipterocarpaceae] for forensic identification); 4) Forensic Science International: Genetics, issue 44, 102188, 2020 (A geographical traceability system for Merbau [*Intsia palembanica* Miq], an important timber species from Peninsular Malaysia); 5) Forensic Science International: Genetics, issue 57, pp. 102658, 2022 (DNA databases of a CITES listed species *Aquilaria malaccensis* [Thymelaeaceae] as the tracking tools for forensic identification and chain of custody certification); & 6) Scientific Reports, issue 12, pp. 9546, 2022 (DNA databases of an important tropical timber tree species *Shorea leprosula* [Dipterocarpaceae] for forensic timber identification).

Scan this QR Code or visit www.jsm.gov.my/cites-directories for the current scope of accreditation

Accreditation & recognition

Wildlife forensic testing laboratory

https://cites.org/sites/default/files/EST/CITES_Directory_of_forensic_labs_rev_January_2025.pdf

Laboratory name and country	QA standard	Sample types analyzed	Contact name / email
ASIA			
Centre for Wildlife Forensics Singapore, Singapore	ISO17025	Terrestrial animal, Aquatic animal, Elephant ivory, Pangolin	Dr Anna Wong CITES@nparks.gov.sg, anna_wong@nparks.gov.sg Dr Charlene Judith Fernandez Charlene_fernandez@nparks.gov.sg
National Wildlife Forensic Laboratory Kuala Lumpur, Malaysia	ISO17025	Terrestrial animal, Aquatic animal, Rhino horn, Elephant ivory, Pangolin	Ybhg. Dato' Abdul Kadir Bin Abu kadir@wildlife.gov.my
Forest Research Institute Malaysia (FRIM) Kepong, Malaysia	ISO9001 : 2015 MS ISO / IEC 17025 : 2017	Plant species identification and wood traceability	Dr. Lee Soon Leong leesl@frim.gov.my
Research Institute of Wood Industry – Chinese Academy of Forestry Beijing, China	ISO17028	Timber and timber products	Dr. Feng Fu feng@caf.ac.cn Dr. Yafang Yin yafang@caf.ac.cn
EUROPE			
Criminalistic Service, Guardia Civil, Madrid, Spain	ISO17025	Terrestrial animal and birds (Individiual ID, parentage testing in some species; Species Identification), Aquatic animal and Plant (Specie ID, Microorganisms)	David Parra Pecharromán crim-medioambiente@guardiacivil.org
Genomia s.r.o Plzeň, Czech Republic	ISO17025	Birds (only parentage testing of certain species)	Markéta Dajbychová marketa.dajbychova@genomia.cz
Institute of Forensic Medicine Zurich, Switzerland	ISO17025	Terrestrial animal, Aquatic animal, Elephant ivory	Nadja Morf Nadja.Morf@irm.uzh.ch

Thank you


Managing our forests through science,
For biodiversity conservation & sustainable utilisation of forest resources