

# Genetic Conservation of *Pinus merkusii* in Indonesia:

## Present Status of Conservation Stands and Genetic Diversity

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# Introduction

- The rate of forest degradation in the tropics → 20 Mio. Ha (Soonhuae & Sziklai, 1994).
- Conservation of forests → urgently needed to retain **biodiversity** & a balance of ecosystem.
- Conservation of **genetic diversity** → adaptation to changing environmental conditions

# Introduction (*continued*)

- *Pinus merkusii* (*P.m.*) is a tropical pine of Southeast Asia. It occurs naturally in Myanmar, Thailand, Laos, Cambodia, Vietnam, Indonesia and the Philippines (Critchfield & Little, 1966).
- In Indonesia → three disjunct locations: Aceh, Tapanuli & Kerinci. The rather isolated occurrence in Kerinci → the only of its genus which extends across the Equator ( 2° of southern latitude).

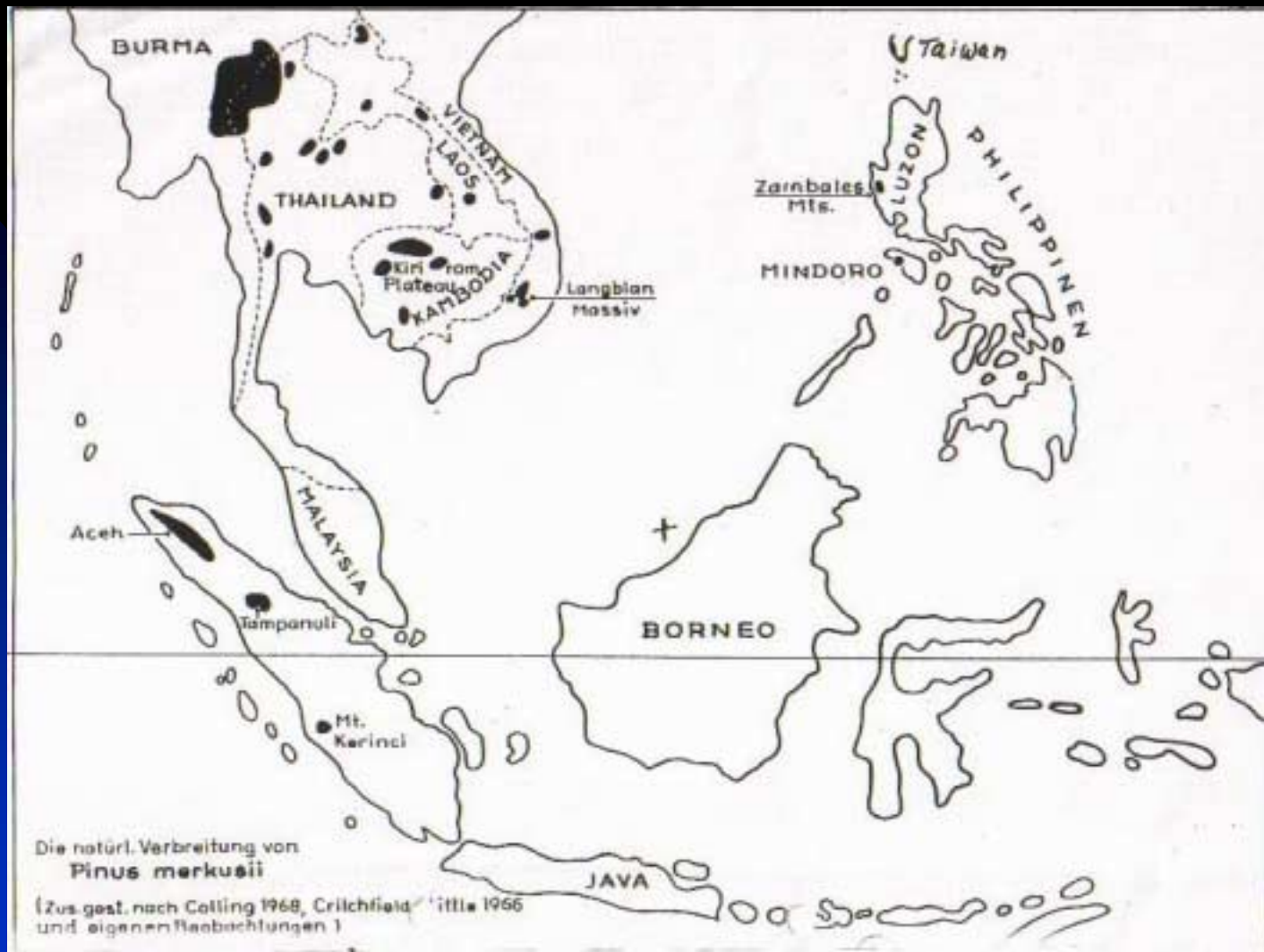


Figure 1. Generalised natural distribution of *Pinus merkusii* (Weidelt, 1991)

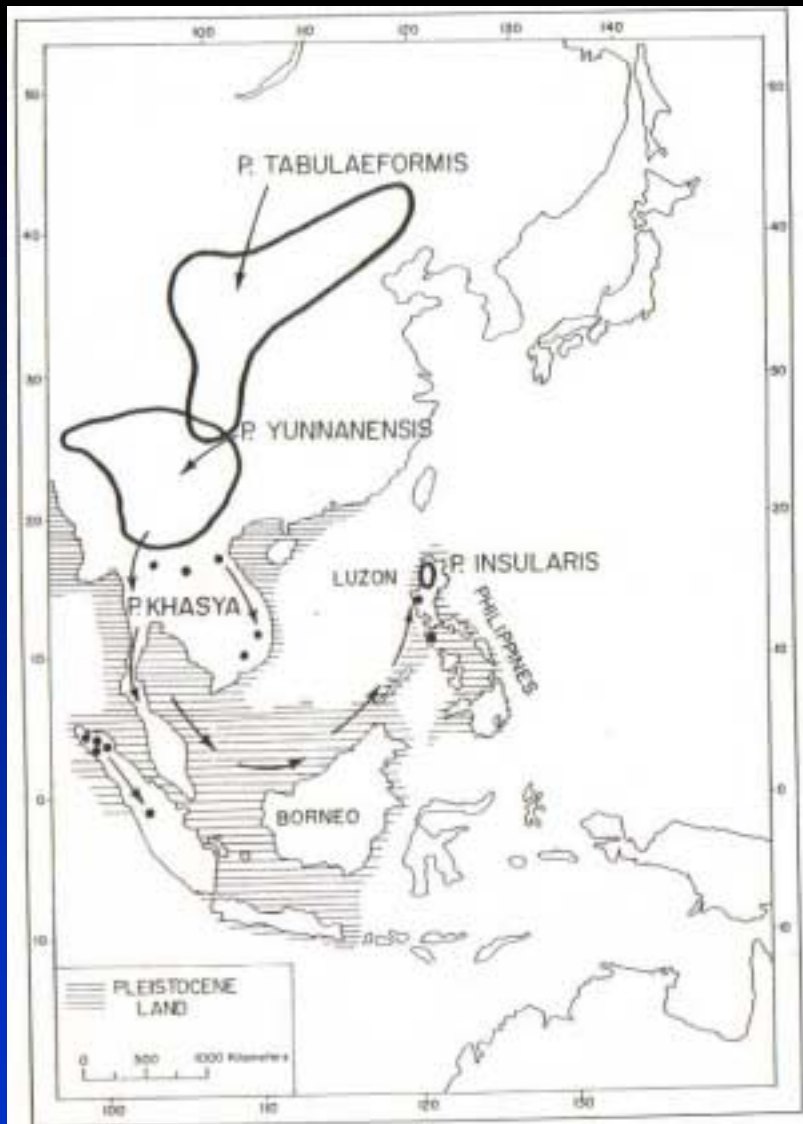


Figure 2. Pleistocene migration of *Pinus merkusii* (Mirov, 1967)



# Introduction (*continued*)

- *P.m.* has been planted quite extensively → in Java around 900.000 ha (Anonymous, 1998).
- Due to its present and future ecological & economic importance → conservation efforts in natural habitats or plantations.
- However, the rational basis of conservation has not been available.
- Basic Information → Surveying the patterns of genetic diversity.

# Objectives

- To find out the present status of conservation stands in Indonesia.
- To determine the patterns of genetic variability and diversity.



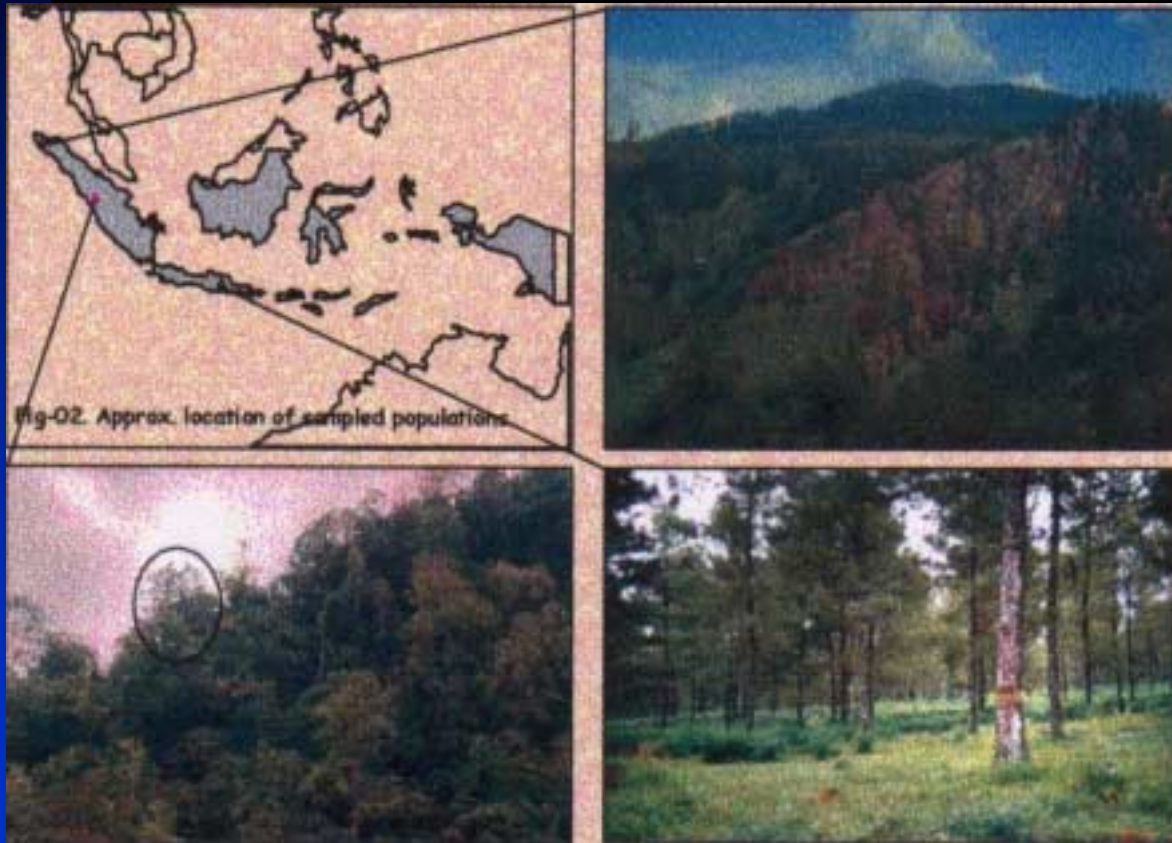
- Basic information for future activities in genetic conservation and tree breeding.

# Methodology (*continued*)

- Review of literature
- Lab. work → Analysis of isoenzym :  
*Three Populations : Aceh, Kerinci & Java*  
*Horizontal starch gel electrophoresis of seeds and embryos.*  
*5 enzyme systems : GOT (E.C.1.4.1.3), PGM (E.C. 2.7.5.1), SKDH (E.C.1.1.1.25), NDH (E.C.1.6.99.3) & FDH (E.C.1.2.1.2).*  
*Analysis of Data : A/L, PPL,  $V$ ,  $V_{gam}$ ,  $H_e$  and  $H_a$ .*



# Methodology (*continued*)



Aceh

Java

Kerinci

# Results and Discussions

- Previous genetic studies

Very low genetic variation within population was observed in Thailand and Vietnam (Changtragoon & Finkeldey, 1995; Szmidt et al., 1996)

*Previous bottleneck & reduced gene flow among populations.*

# Results and Discussions (*continued*)

High level of genetic variation within four artificial populations in Java (Na'iem & Indrioko, 1996).

*P.m. in Java was introduced from a population in Aceh.*

# Results and Discussions (*continued*)

- *In situ* Conservation Attempts

Suggested stands to be conserved  
(Harahap, 1995):

Aceh : 17 stands; Tapanuli : 7 stands ;

Kerinci : 4 stands.

*13 Natural stands in central Aceh from  
500-1350 above sea level with size 20-425  
ha. No rational basis for the selection.*

Table 1. Conservation Stands in Aceh (Sumatra)

<b>No</b>	<b>Conservation Stands</b>	<b>Size (ha)</b>
<b>1</b>	<b>Blang Kuyu</b>	<b>30</b>
<b>2</b>	<b>Baleq Rajawali</b>	<b>120</b>
<b>3</b>	<b>Burni Telong</b>	<b>32</b>
<b>4</b>	<b>Bidin Timur</b>	<b>35</b>
<b>5</b>	<b>Danau Laut Tawar</b>	<b>425</b>
<b>6</b>	<b>Isaq</b>	<b>70</b>
<b>7</b>	<b>Gelampang/Batu Belah</b>	<b>38</b>
<b>8</b>	<b>Penarun Simpang Umo</b>	<b>22</b>
<b>9</b>	<b>Serule/Uyem Ratus</b>	<b>20</b>
<b>10</b>	<b>Pantan Nangka/Manggis</b>	<b>31</b>
<b>11</b>	<b>Lumut</b>	<b>42</b>
<b>12</b>	<b>Ise Ise</b>	<b>25</b>
<b>13</b>	<b>Blang Kejeren</b>	<b>50</b>
	<b>Total</b>	<b>940</b>

**Table 2.** Seed Production Areas (SPA) and Seedling Seed Orchards (SSO) in Java

N o.	Province	Size (ha)	
		SPA	SSO (ha)
1	West Java	65	88
2	Central Java	234	117
3	East Java	100	96
	Total	399	301

Source : Anonymous (2000)



# Results and Discussions (*continued*)

- Present Study on Genetic Variability and Diversity

*P.m.* form Aceh & Java → high levels of Genetic variation ( $PPL=80$ ,  $He= 0.395$  and  $A/L = 2.40$ ).

*Confirmation to the statement that *P.m.* in Java from Aceh.*

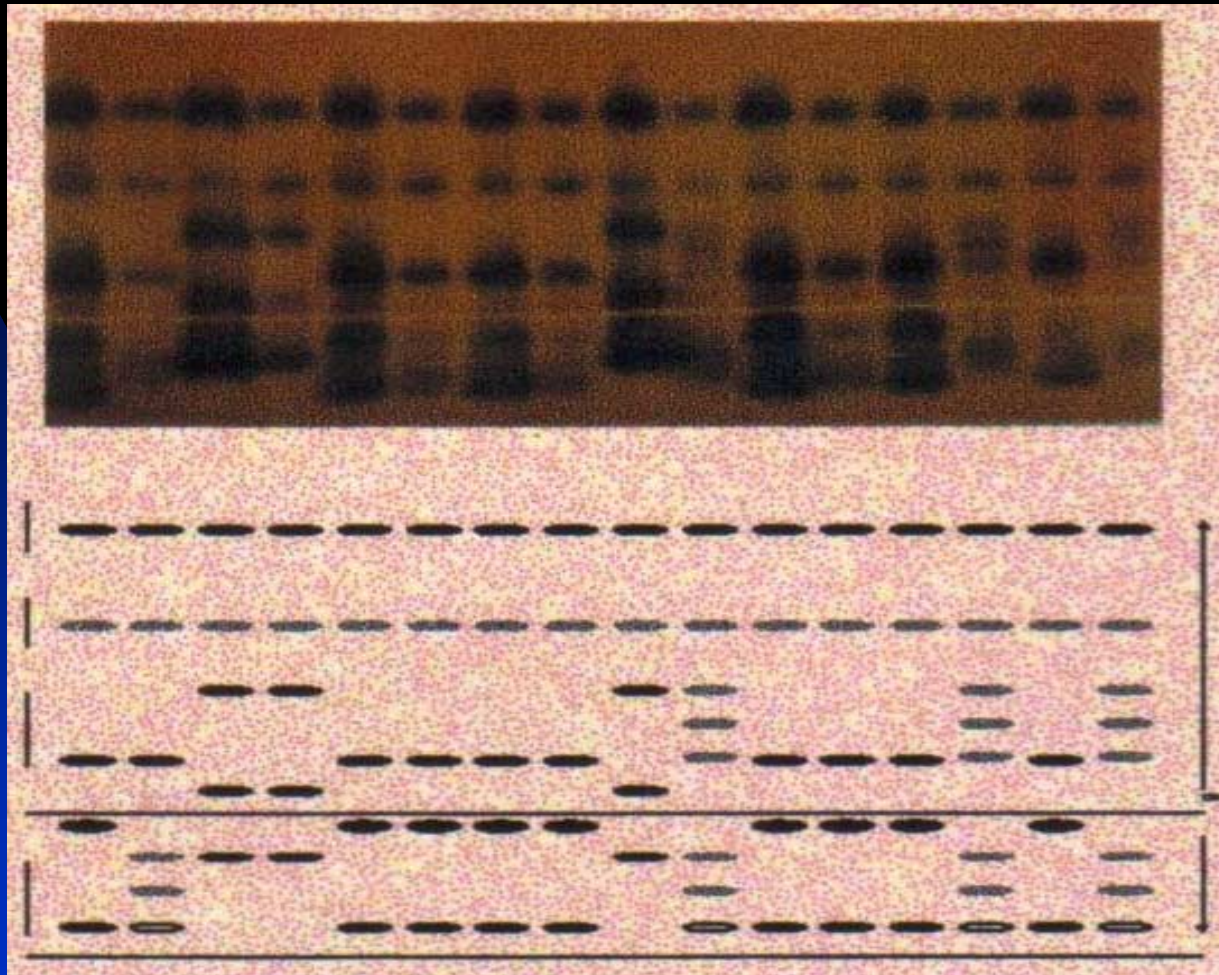


Figure. Zymogram of Glutamate Oxaloacetate Transaminase (GOT)

**Table 3. Genetic variation measures of seed trees and progenies in the investigated populations of *P. merkusii* based on a survey of 10 enzyme gene loci.**

Population	Sample		Genetic Multiplicity		Allelic Diversity	Gametic Diversity	Heterozygosity	
	Material	Size (N)	$A/L$	$P$	$v$	$v_{gam}$	$H_a$	$H_e = \delta_T$
Aceh	Seed trees	21	2.0	80.0	1.544	40.953	0.369	0.361
	Embryos	253	2.0	80.0	1.565	46.023	0.348	0.362
Java	Seed trees	30	2.4	80.0	1.630	62.516	0.433	0.395
	Embryos	797	2.4	80.0	1.636	63.448	0.355	0.389
Kerinci	Seed trees	25	1.0	00.0	1.000	1.000	0.000	0.000
	Embryos	200	1.0	00.0	1.000	1.000	0.000	0.000

$A/L$ =Number of allele per locus;  $P$ =Percentage of polymorphic loci (among 10 loci studied);  $\delta_T$ =Total population differentiation

Table 4. Allelic diversity (Gregorius,1978) of seed trees, their progeny (embryos) and their effective pollen clouds in the investigated populations.

Gene loci	Allelic diversity $v = (\sum_i p_i^2)^{-1}$								
	Aceh			Java			Kerinci		
	seed trees	Embryos	pollen	Seed trees	embryos	Pollen	seed trees	embryos	pollen
GOT-B	1.105	1.157	1.147	1.342	1.222	1.230	1.000	1.000	1.000
GOT-C	1.288	1.250	1.817	1.529	1.676	1.638	1.000	1.000	1.000
GOT-D	1.995	1.998	1.997	1.998	1.956	1.950	1.000	1.000	1.000
PGM-A	1.152	1.084	1.066	1.035	1.100	1.108	1.000	1.000	1.000
PGM-B	1.690	1.814	1.919	1.923	1.952	1.962	1.000	1.000	1.000
SKDH-A	1.995	1.997	1.993	1.946	1.877	1.908	1.000	1.000	1.000
NDH-A	1.893	1.898	1.930	2.024	1.955	1.832	1.000	1.000	1.000
FDH-A	1.960	1.998	1.989	1.946	1.995	1.980	1.000	1.000	1.000
Gene pool	1.544	1.582	1.631	1.630	1.635	1.625	1.000	1.000	1.000

# Results and Discussions (*continued*)

*P.m.* in Kerinci → No variation at all (fixed).

*Speculations about the possible causes: drastic reductions in the number of trees in Kerinci during the geological age → small population size and repeated bottlenecks.*

*Protection of the Kerinci Population → little effective as a gene resource.*

# Conclusions

- Genetic diversity of *P.m.* in Indonesia → fixed to high. Populations in Aceh & Java had higher diversity than Populations in Thailand and Vietnam.
- For the non-variable population of Kerinci → implies that the genetic conservation of this species should not only be based on information on the expression of genetically controlled adaptive phenotypic traits but requires also the results of surveys of genotypes at marker gene loci. Protection of the Kerinci Population → little effective as a gene resource.





Thank you