UNIVERSITY OF COPENHAGEN

Genetic diversity and conservation of *D. cochinchinensis* and *D. oliveri*

Ida Hartvig
Forest Genetics and Diversity
Geosciences and Natural Ressource Management
University of Copenhagen
Denmark

Research collaboration:

Forestry Administration, Ministry of Forestry and Fisheries, Royal Government of Cambodia

Forest Genetics and Conservation, Center for Biodiversity and Biosafety, Institute of Agricultural Genetics, Vietnam Academy of Agricultural Sciences

National Herbarium of Laos, Biotechnology and Ecology Institute, Ministry of Science and Technology, Ventiane, Laos

Forest and Plant Conservation Research Office, Department of National, Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment, Thailand

Forest Genetics and Diversity, Geosciences and Natural Ressource Management, University of Copenhagen, Denmark

Outline

1. Genetic diversity of *D. cochinchinensis* and *D. oliveri*

   - Reproductive system

   - Genetic diversity and structure across mainland SEAsia

2. Future research and conservation

   - Research needs

   - Implications for conservation- suggestion for strategies

Dalbergia cochinchinsis and *D. oliveri* - valuable timber species

Endemic to mainland SEAsia: Cambodia, Vietnam, Laos, Thailand, Myanmar (only *D. oliveri*)

Threatened by illegal logging and deforestation

Confiscated timber, local FA station at Sre Noy, Siem Reap, Cambodia

Dalbergia oliveri, Cat Tien Nationalpark, Vietnam

D. cochinchinensis

Open and semi-deciduous forests

Fast growth when young – pioneer?

Pollination: small insects (?)

Dispersal: Wind (?)

Hermaphroditic: outcrossing

Clonality?

D. oliveri

Evergreen and semi-deciduous forests

Slow growth

Pollination: small insects (?)

Dispersal: Wind + water (?)

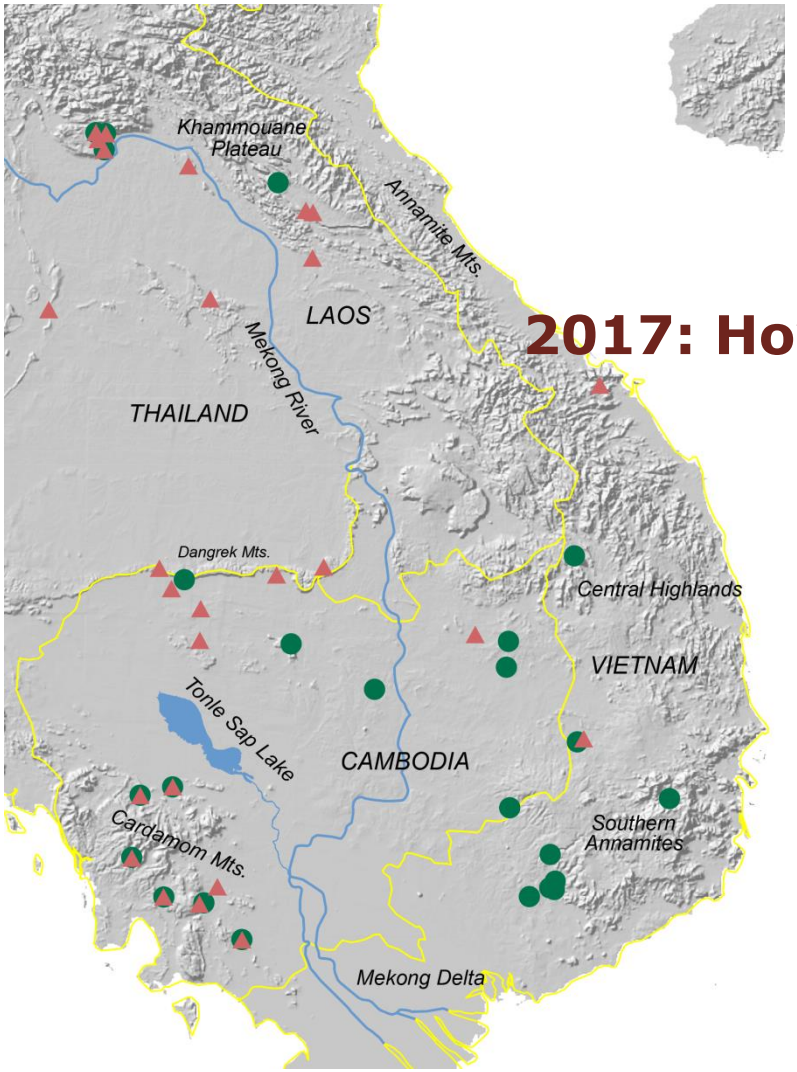
Hermaphroditic : Mating system?

Clonality?

Niyomdham 1997, 2002, CTSP 2004, CoP16 C 2013, So Thea 2010

Genetic diversity and structure? Fieldwork 2010-2014

Sampling and genotyping



▲ ***D. cochinchinensis***
682 individuals from 26 populations

2017: How many populations remain?

● ***D. oliveri*:**
616 individuals from 23 populations

Genotyped with SSRs

Initial genetic analysis: Many identical genotypes

Seedlings or clones?

Clonality - Root suckers

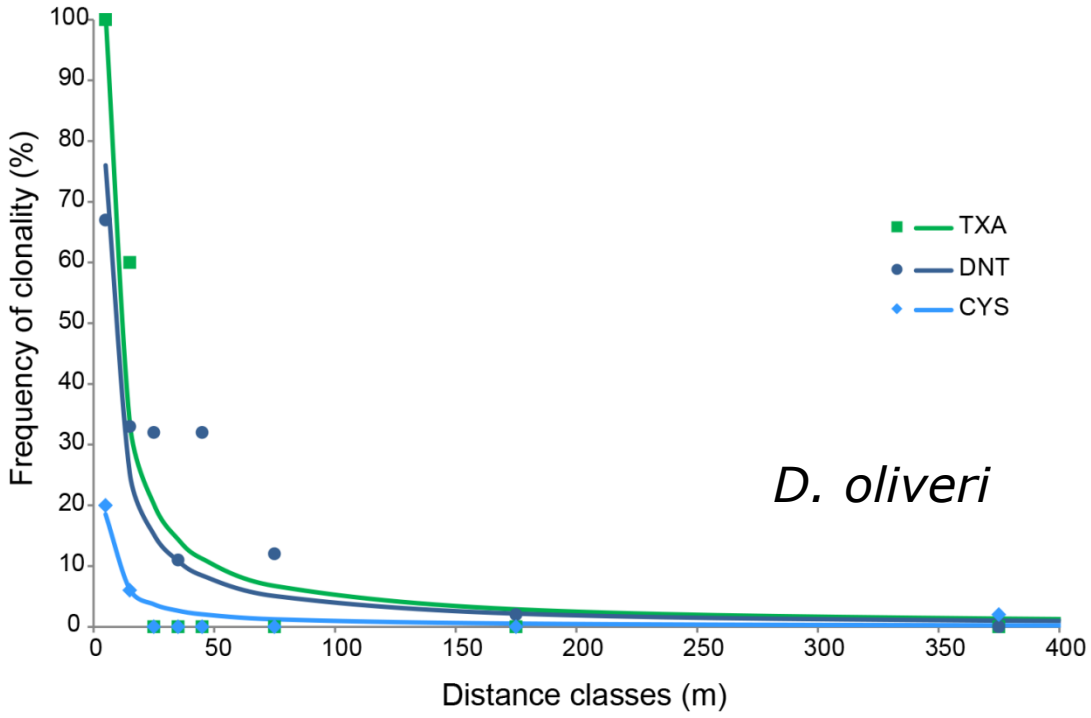
D. cochinchinensis

D. oliveri

Clonality

Individual trees close to each other are likely to be ramets of the same genotype

Levels of clonality varied greatly among populations



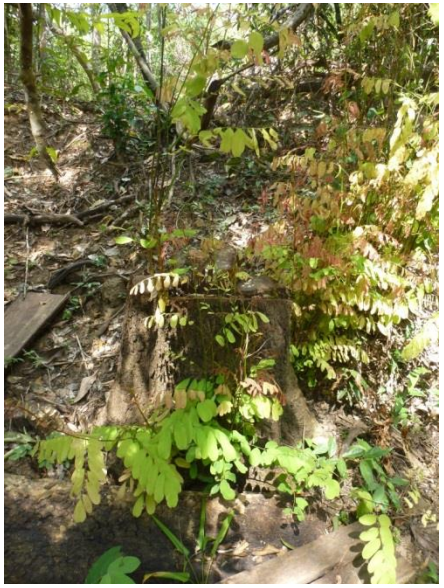
Clonality in *D. cochinchinensis* and *D. oliveri*

Strategy to quickly colonize new areas

- after forest fire
- after logging

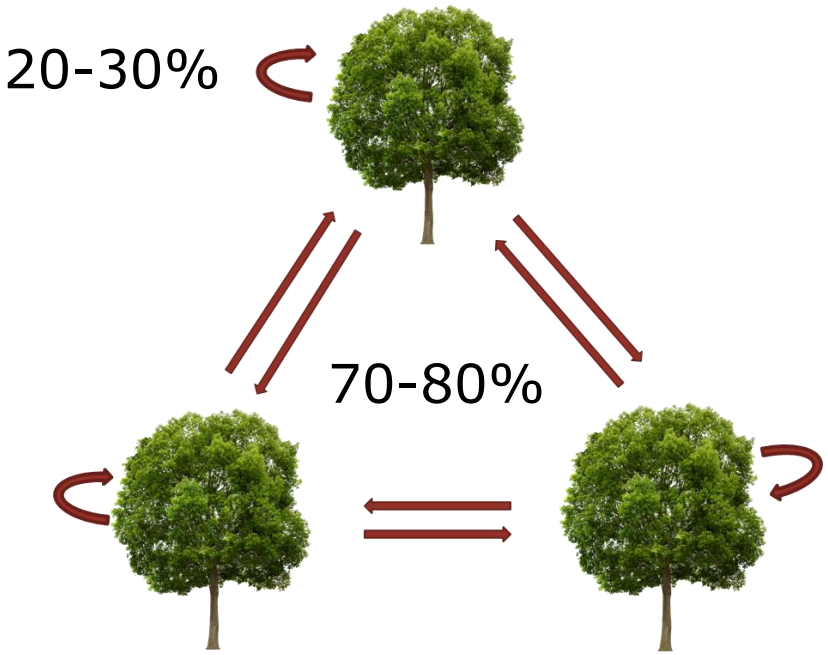
Resprouting from stumps and roots of cut individuals – genotypes not lost?

Potential for vegetative propagation?



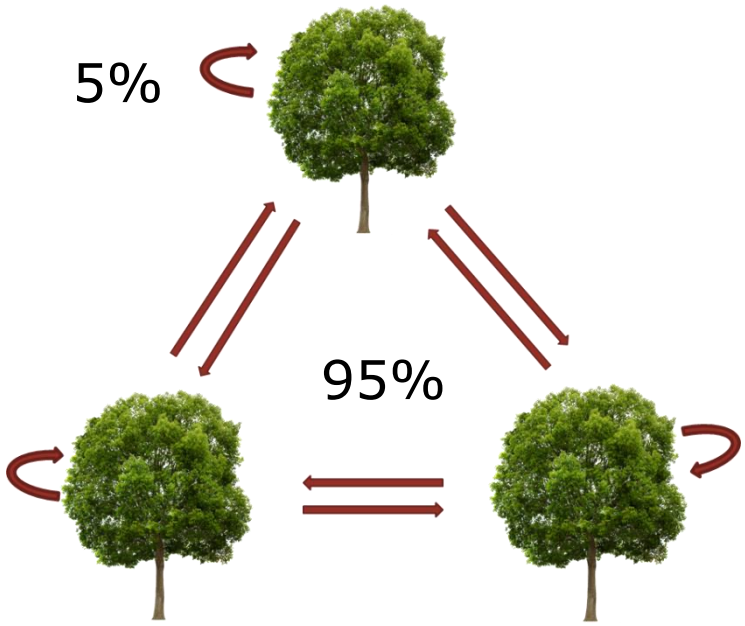
Mating system

D. cochinchinensis (2 pops)



Previous study : 99% outcrossing (Thailand, 1994)

D. oliveri (1 pop)



(First analysis of mating system)

Soonhua *et al* 1994

Selfing in *D. cochinchinensis*?

No signs of inbreeding in the adult populations

- Selfing is a recent condition

  An effect of fragmentation and habitat deterioration: lower density of mates and pollinators?

  Earlier results of 99% outcrossing supports this theory

- Strong selection against selfed progeny in natural habitat (lower fitness)

Inbreeding depression potential problem

especially in small populations

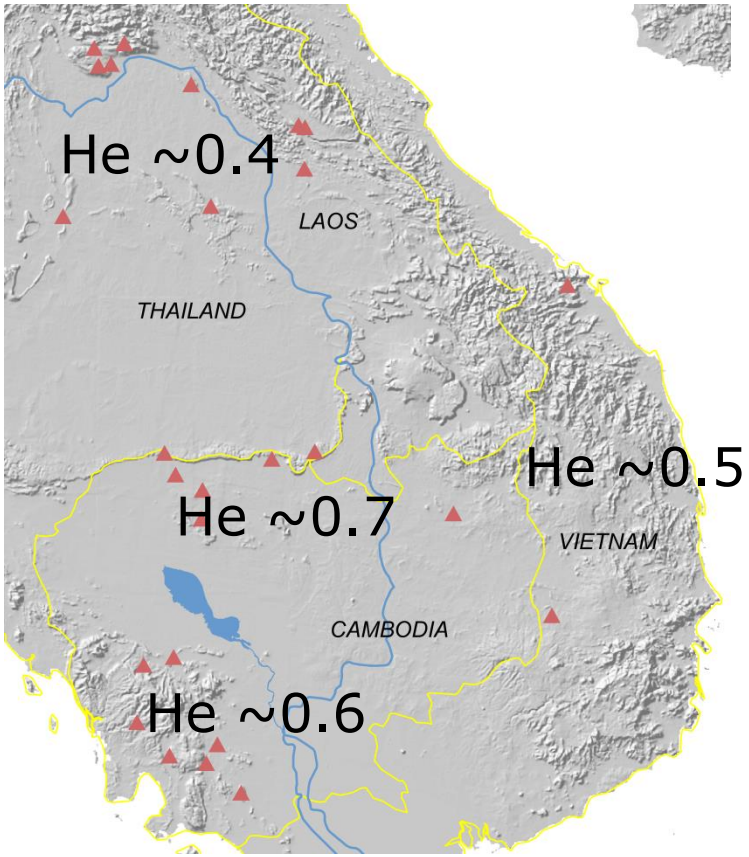
Levels of genetic diversity

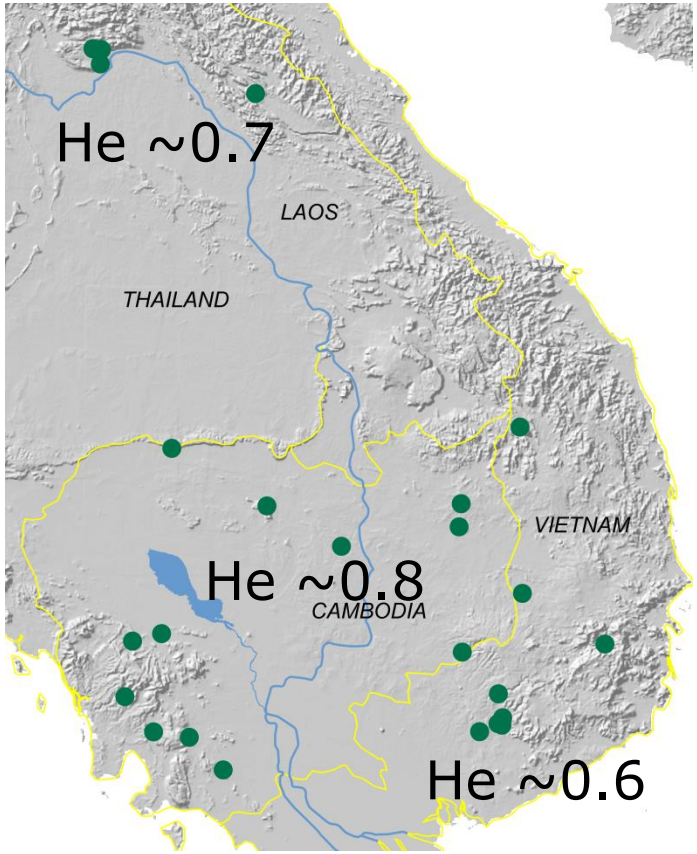
D. cochinchinensis

He=0.55 ➡ Medium diversity

D. oliveri

He=0.73 ➡ High diversity





Genetic differentiation

D. cochinchinensis

Fst=0.24 ➡

High differentiation

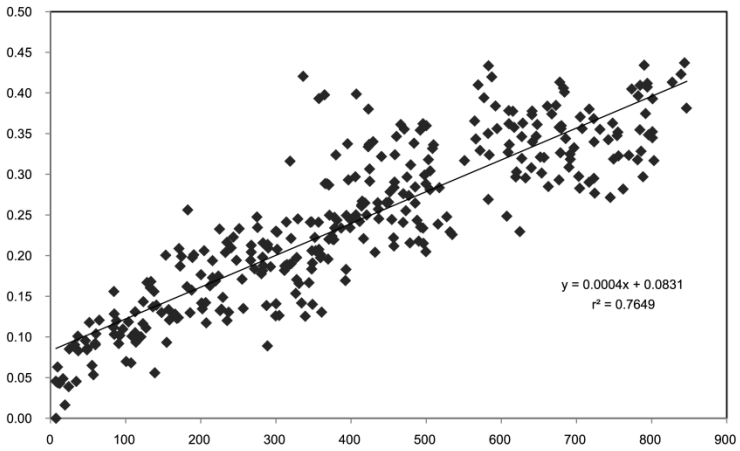
D. oliveri

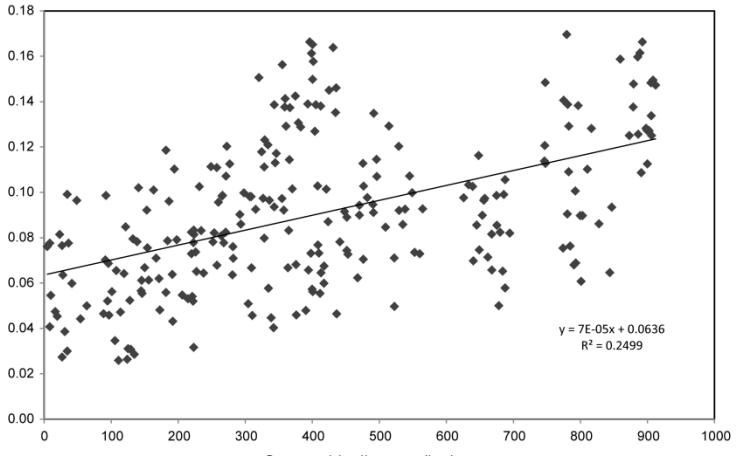
Fst=0.13 ➡

Moderate differentiation

Isolation-by-distance:

FST

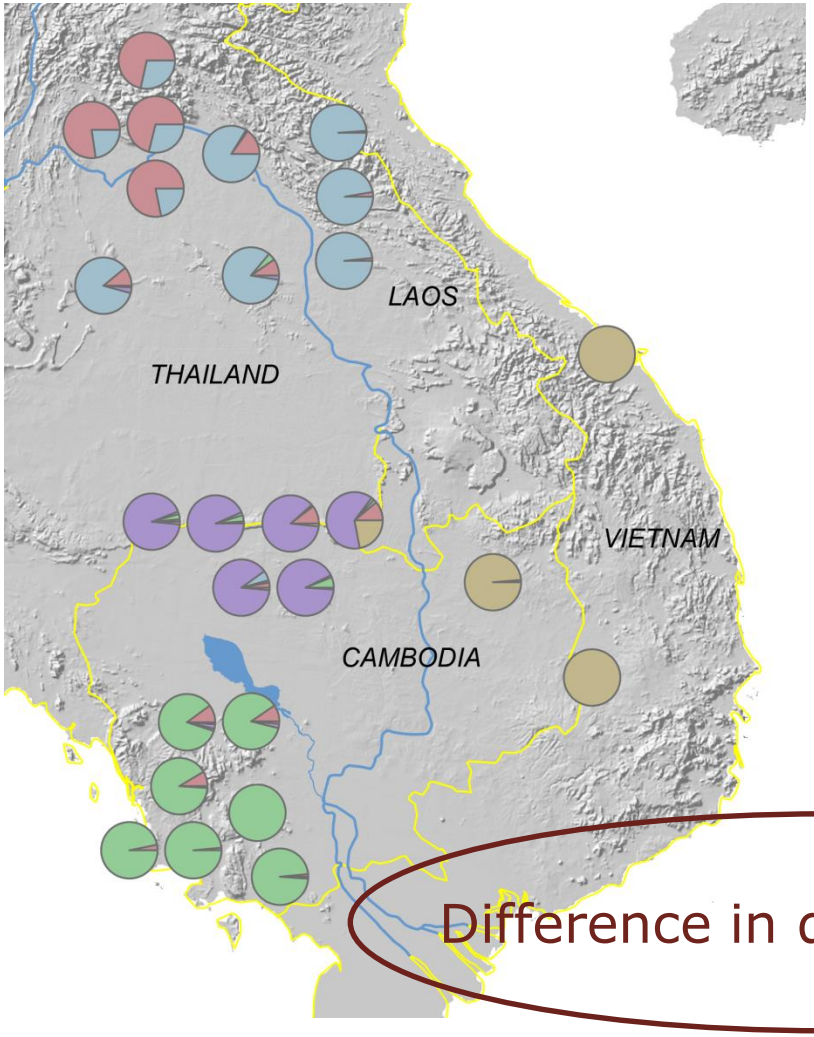




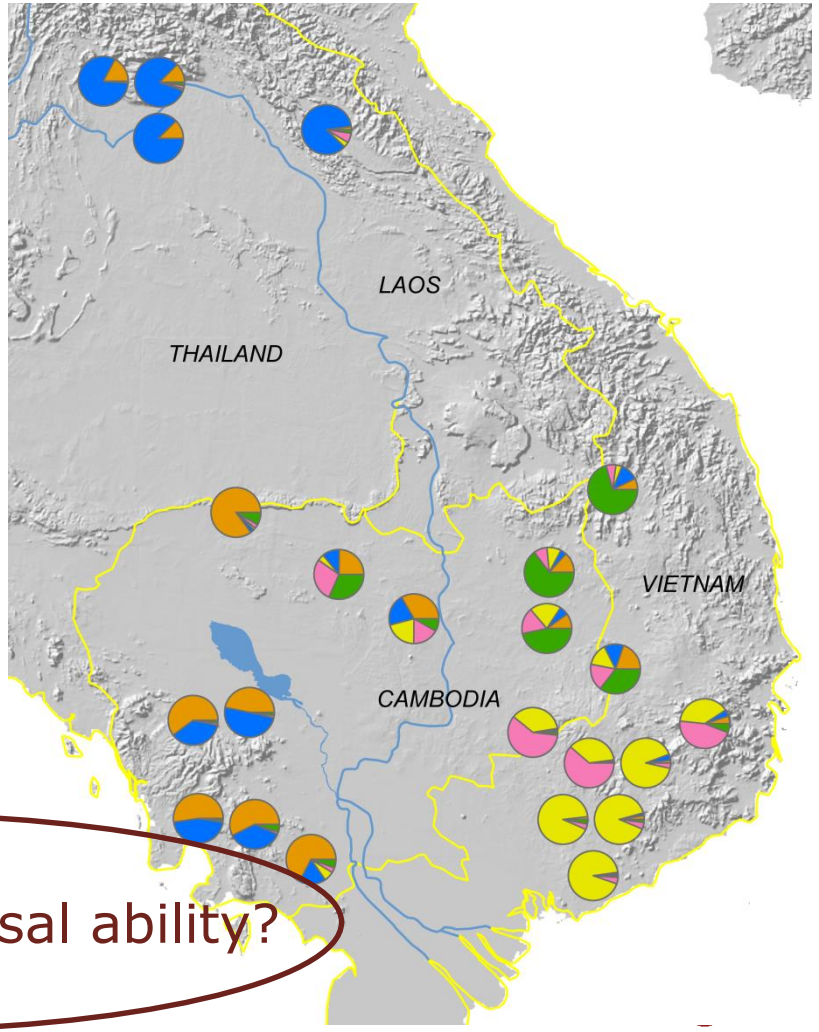
Distance between populations (km)

Genetic cluster analysis

D. cochinchinensis, K=5



D. oliveri, K=5



Difference in dispersal ability?

Research needs

Clonality better understood

- can heavily logged populations be restored?

- production of clones for breeding purposes?

Pollination biology

- What are the main pollinators of *D. cochinhinensis* and *D. oliveri*?

- How to manage wild populations and *ex situ* conservation stands for optimal pollination?

Research needs

Outcrossing rate – selfing in *D. cochinchinensis?*

- Does outcrossing rate differ among regions?

- Between undisturbed vs disturbed habitats?

Natural regeneration – reported as poor

- abscence of fruiting and/or germination issue?

Local adaption

- studies of genetic differentiation in adaptive characters

- can be studied in combination with ex situ conservation

Recommendations for conservation plans

***In-situ* conservation**:

Conserve many populations across regions to maintain genetic variation
- locally adapted?

Special priority to diverse regions (Cambodia?) – large, diverse populations

Level of clonality taken into account – conservation stand size

Clonal growth and resprouts: restoration of heavily logged populations possible

***Ex-situ* conservation**

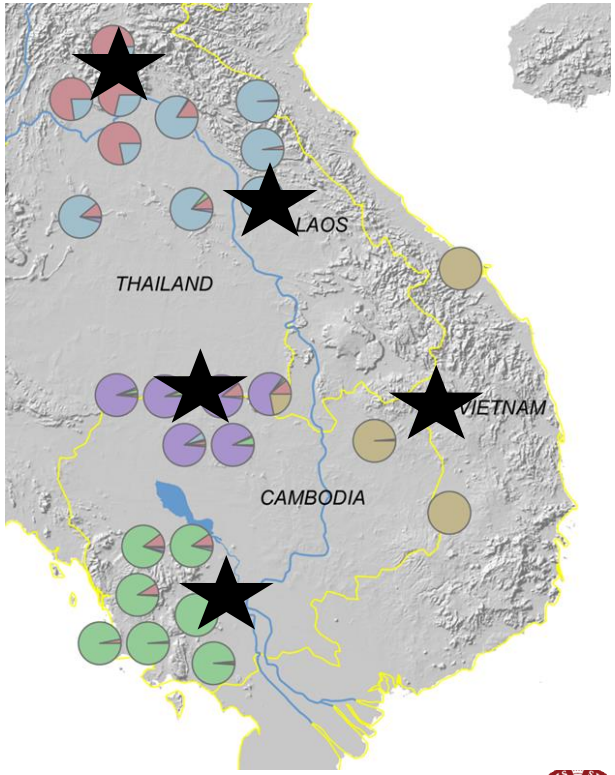
Establish local seed sources – seed collection from trees min. 50 m apart, to avoid sampling clones

Use local material for plantations!

Suggestion for an integrated conservation and use strategy:

A network of *ex situ* conservation stands across SEAsia

- representing genetic diversity patterns
- placed locally
- each with material from multiple populations (seeds or vegetative?)



Several functions:

- conservation of local genetic diversity
- seed source for breeding
- seed source for restoration programmes
- research set-up (breeding seed orchard)


Thanks for your attention!