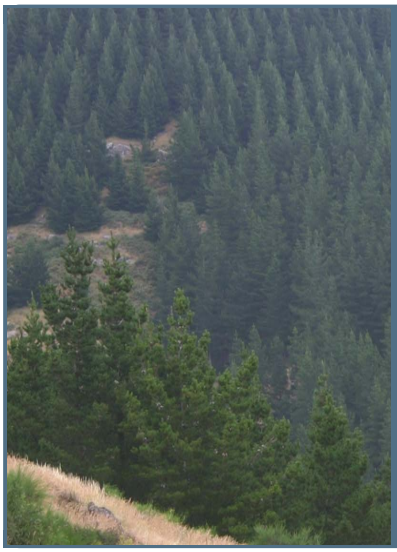
New Zealand Forest Research Institute

International Union of Forest Research Org's



Planted forests and biodiversity conservation

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CBD – FFPRI Symposium, April 2010

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South Island robin
Petroica australis australis (Petroicidae)

What are plantation forests?

- **For production of timber, fibre or biofuel,**
- **… ecosystem services (erosion control…)**
- **… sequester, store C (mitigate climate change)**
- **One or few tree spp. ("monocultures"), native or exotic species, even-aged stands**
- **Fast-growing species: pines, eucalypts, poplars, teak, rubber tree, sugi (*Cryptomeria*)**
- **Intensively managed, 'short' rotations (5-50 yrs)**
- **Area growing by about ~2% per year** (FAO)
- **Global area ~140 M ha (3.5% of all forest)**
- **35% of global roundwood, 44 % by 2020** (MA 2005)
- ***Biodiversity*?**

SCION
Next generation biomaterials

Outline

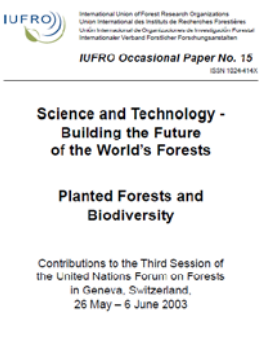
1. Role of plantation forests in biodiversity conservation
2. What to avoid in plantation establishment
3. Functional role of biodiversity in ecosystem functioning
   - Biodiversity and resistance to pests
4. Opportunities for enhancement of biodiversity

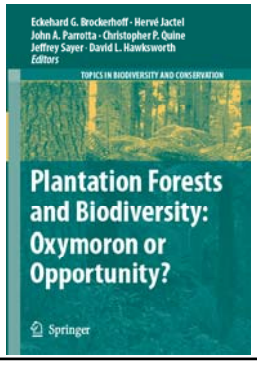
(www.johnleechgallery.co.nz)

IUFRO activies / background

J-M Carnus, J Parrotta, H Jactel, J Sayer, C Quine, D Lamb, K O'Hara, E Brockerhoff

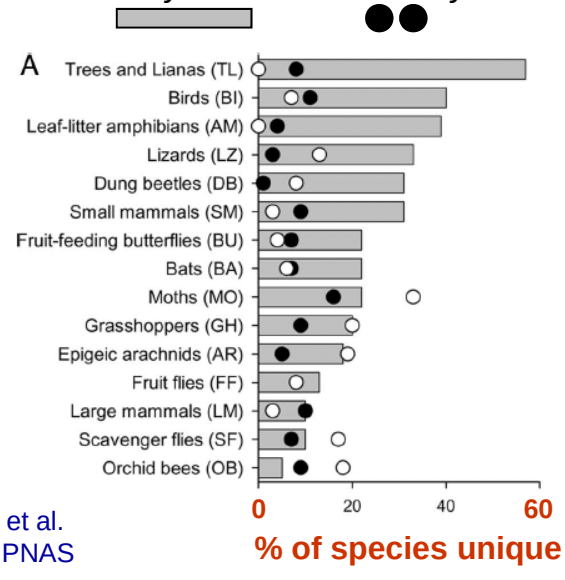
- IUFRO is "the" global network for forest science cooperation: 15 000 scientists, 700 member organizations, > 110 countries
- IUFRO Research Group 'Forest Biodiversity' and WG's
- UNFF Expert Meeting, 2003; 3 IUFRO conferences
- Publications: White paper, Review, Journal issue / book





1. Role of plantations in BD conservation

NE Brazil: Primary forest / secondary / *Eucalyptus* plantation

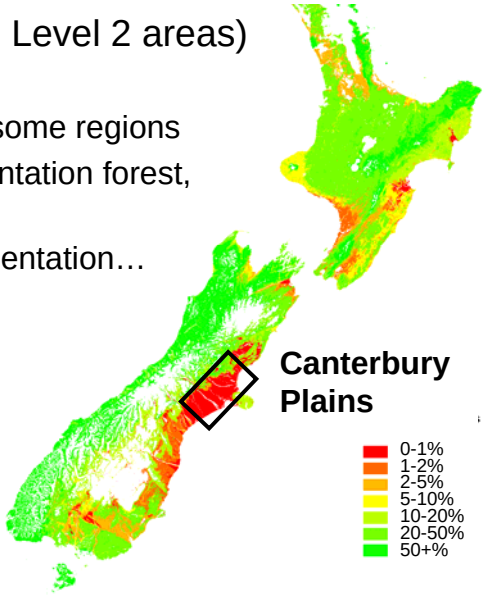


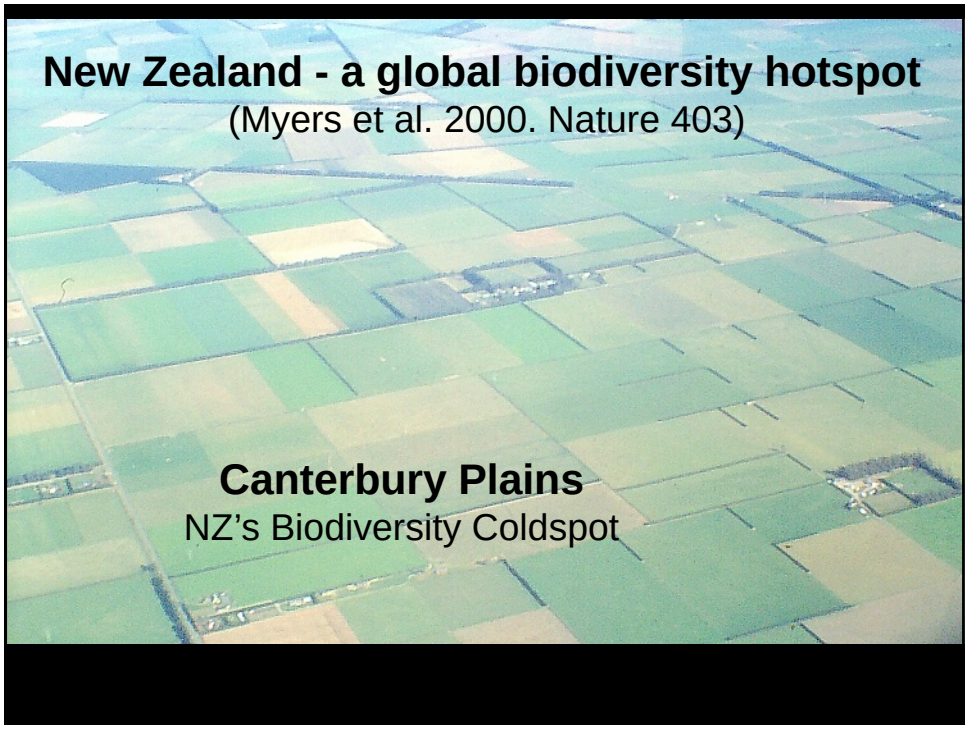
Barlow et al. (2007) PNAS

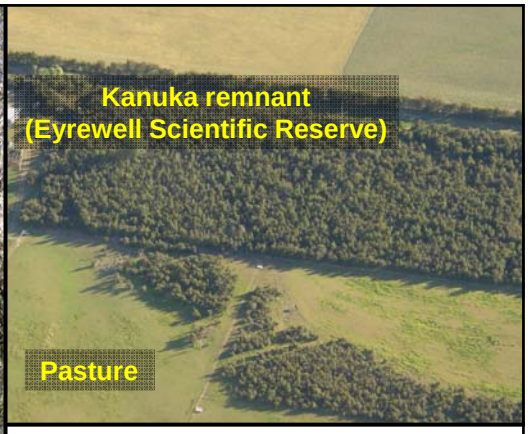
Percentage of indigenous forest/scrub habitat remaining in each ecological 'region'

(NZ LCDB 2, LENZ Level 2 areas)

- **>** 99% natural forest loss in some regions
- Role of 'production land' (plantation forest, grassland) in conservation?
- Effects of forest loss & fragmentation…
  - on vascular plants
  - on native forest birds

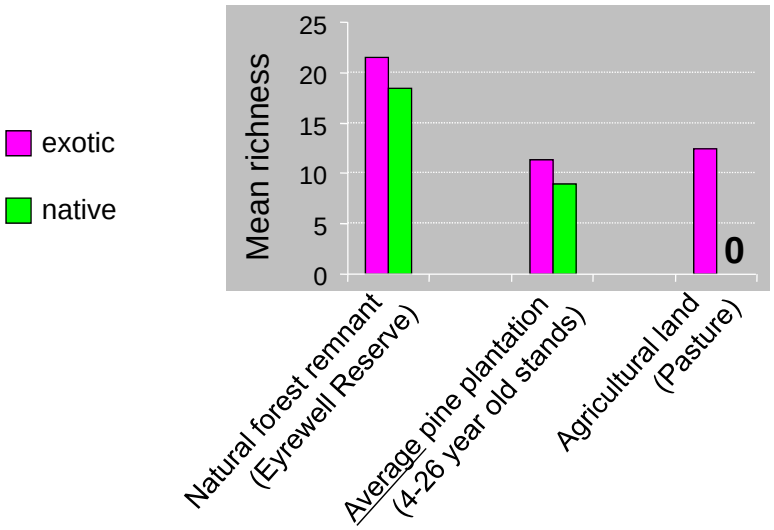






Comparison:
Vascular plants in
- Native forest remnant
- Pasture / grassland
- Pine plantation

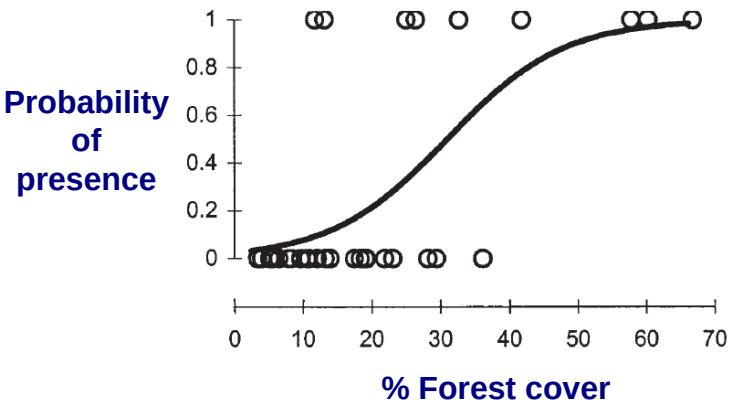
Vascular plant species richness
(Natural forest remnant / pine plantation / pasture)

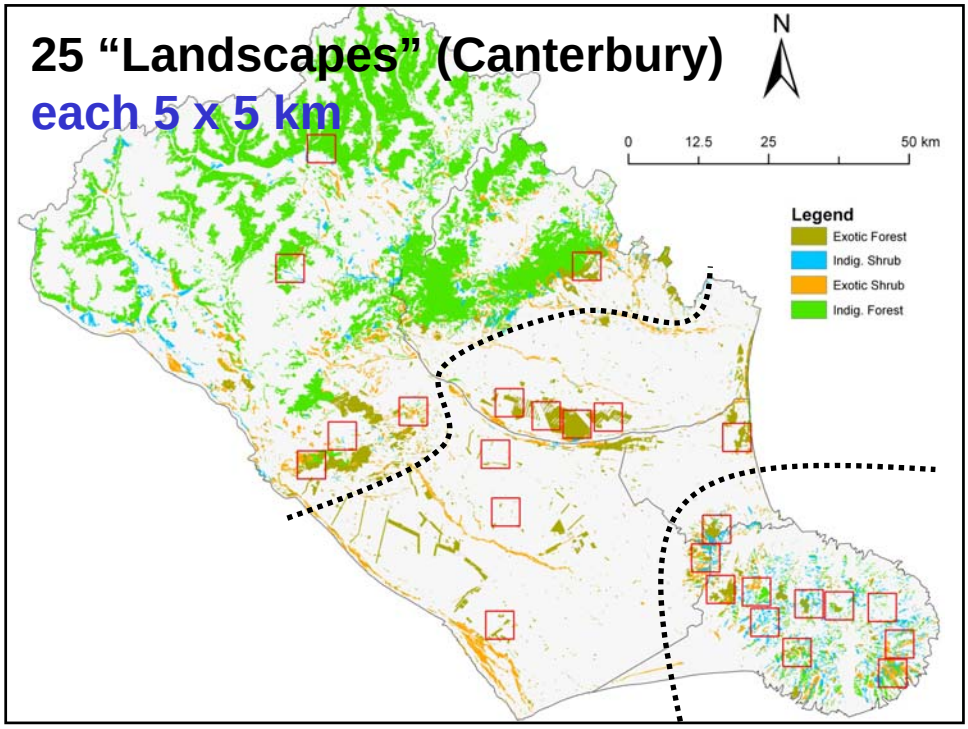


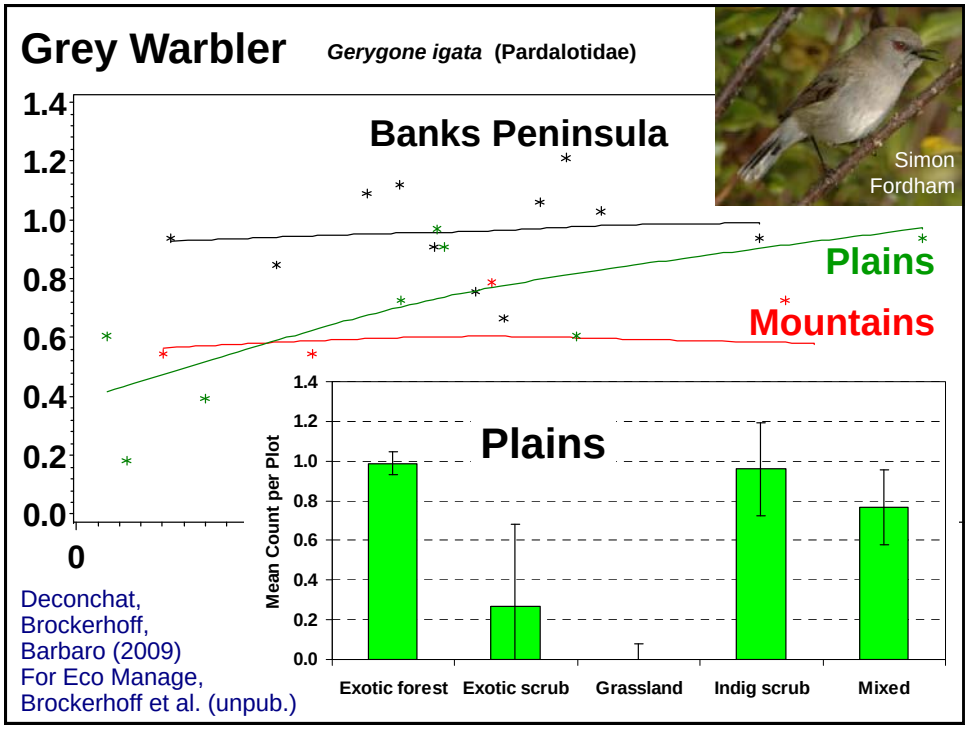
Brockerhoff et al. (2003) For. Ecol. Manage. 185
Ecroyd and Brockerhoff (2005) N.Z. J. Ecology 29

Forest loss thresholds / transition points

Chestnut-sided warbler (Ontario, Canada)
M-A Villard et al. (1999) Conserv Biol




25 “Landscapes” (Canterbury)
each 5 x 5 km
N
0
12.5
25
50 km
Legend
Exotic Forest
Indig. Shrub
Exotic Shrub
Indig. Forest


Grey Warbler
Gerygone igata (Pardalotidae)
Simon Fordham
Banks Peninsula
Plains
Mountains
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
Plains
Mean Count per Plot
Exotic forest
Exotic scrub
Grassland
Indig scrub
Mixed
Deconchat, Brockerhoff, Barbaro (2009)
For Eco Manage, Brockerhoff et al. (unpub.)

Holcaspis brevicula (Carabidae)

A critically endangered local endemic

1. **Pine plantation is the only remaining habitat for *H. brevicula*!**
2. **Plantation forest - important surrogate habitat where forest loss was very high**

Brockerhoff et al. (2005) NZ J Ecol

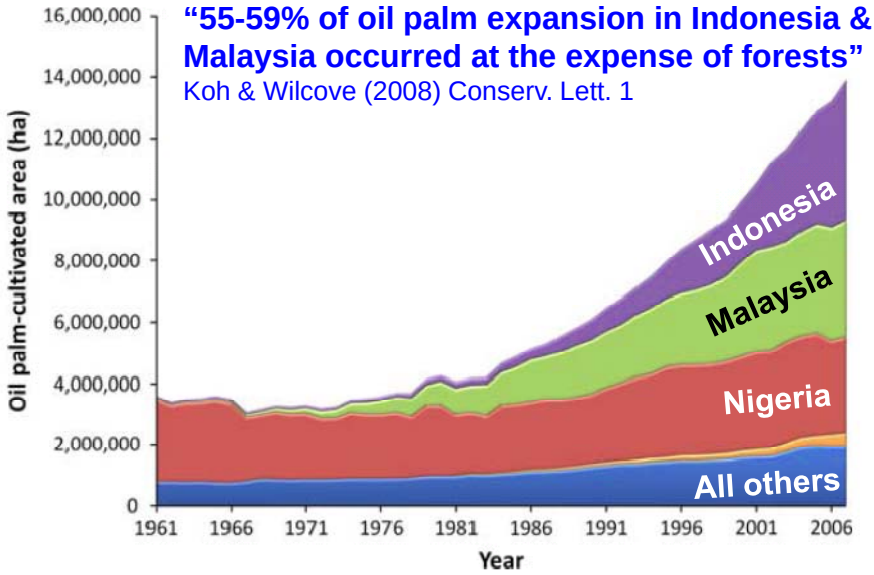
2. What to avoid in plantation establishment

Oil palm agriculture: African oil palm (*Elaeis guineensis*)

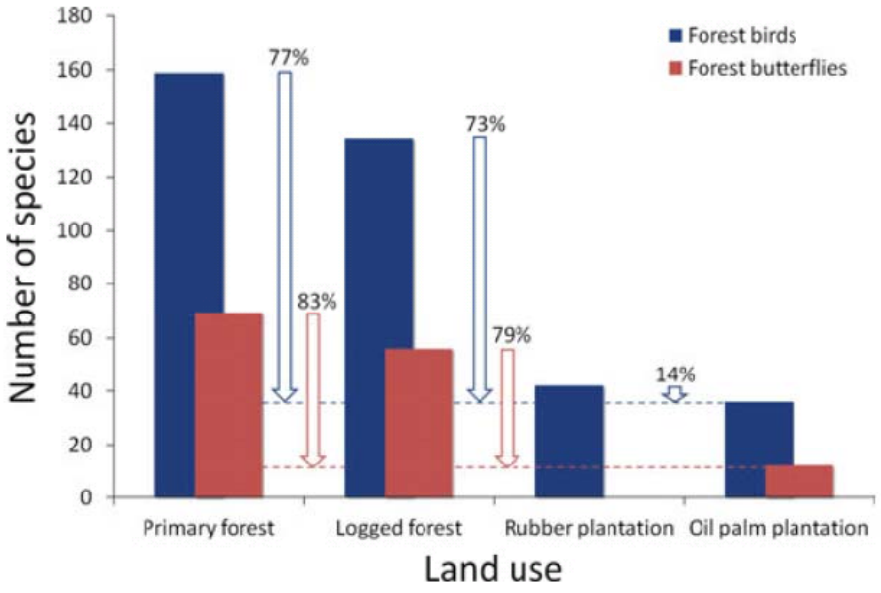
Photo: Wetlands International

Oil palm expansion and deforestation

"55-59% of oil palm expansion in Indonesia & Malaysia occurred at the expense of forests"
Koh & Wilcove (2008) Conserv. Lett. 1

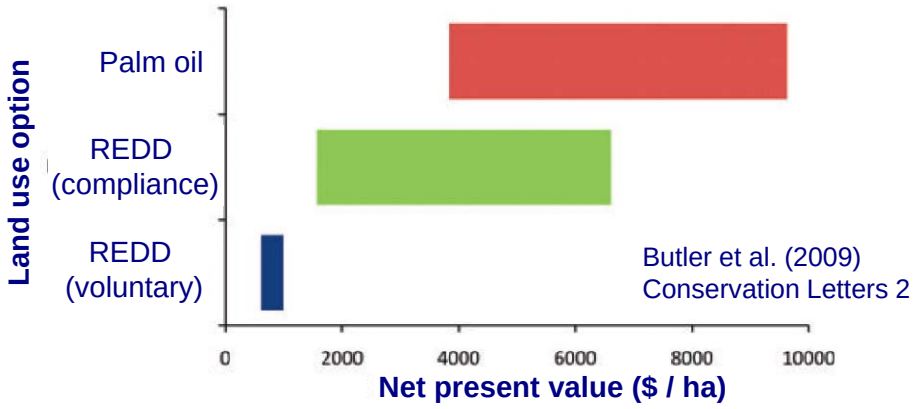


Wilcove and Koh (2010) Biodiversity and Conservation Vol. 19



Koh & Wilcove (2008) Conserv. Lett. 1

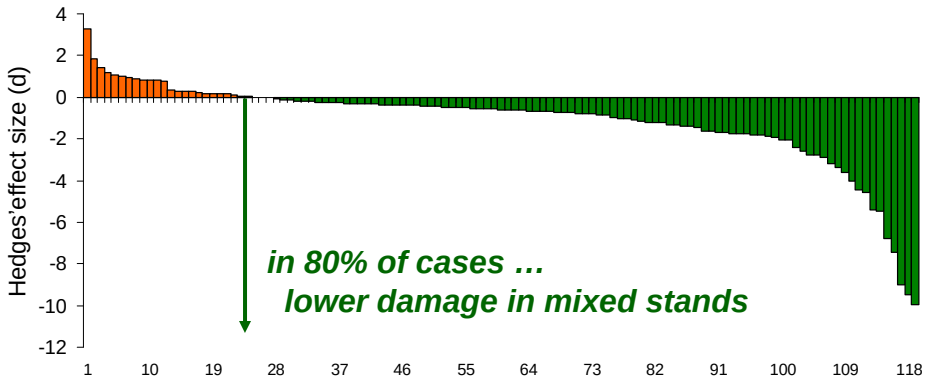
Profitability of oil palm expansion (deforestation) vs. preserving forest (REDD mechanisms)



Notes: 10,000 ha forest, NPV models, 30 yr. No compensation for other ecosystem services
Palm oil : 2 yield and price scenarios
REDD (compliance): Joint Implementation (Article 6, Kyoto Protocol); Certified Emission Reductions (Kyoto Protocol Clean Development Mechanism); EU Allowances
REDD (voluntary): Carbon Financial Instruments (Chicago Climate Futures Exchange)

3. Functional role of biodiversity in forest ecosystem functioning

Regulating services: Insect herbivory in…
… single-species forests (monocultures) vs. mixed forests
- **119 published case studies (1966 – 2006)**
- **34 tree species, 34 insect species**



Meta-analysis: Overall mean effect size = - 0.67

Tree species in more diverse forests are significantly less affected by insect herbivory than in monocultures

Jactel & Brockerhoff (2007) Ecology Letters

Less insect herbivory in diverse forests:

➔ **main ecological mechanisms?**

1. Reduced accessibility to host trees

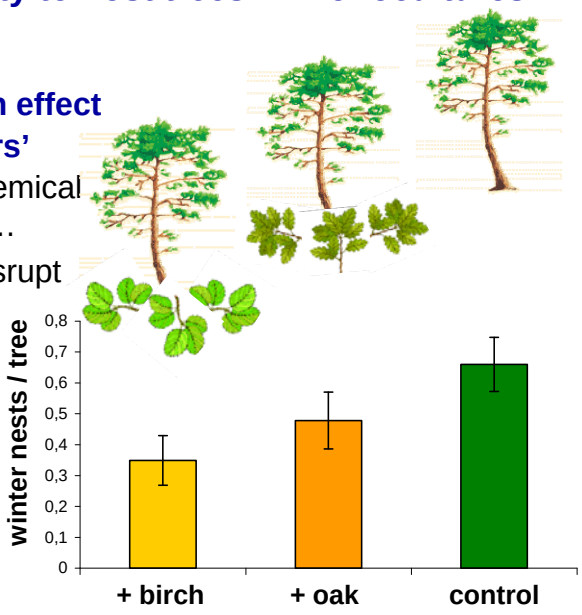
2. Increased effect of natural enemies ('biological control')



Pine processionary moth (PPM) – *Thaumetopoea pityocampa*

Reduced accessibility to host trees in monocultures…

- **Spatial concentration effect**
- **No 'chemical barriers'**
  - Female PPM use chemical cues to locate pines…
  - Non-host volatiles disrupt host recognition.



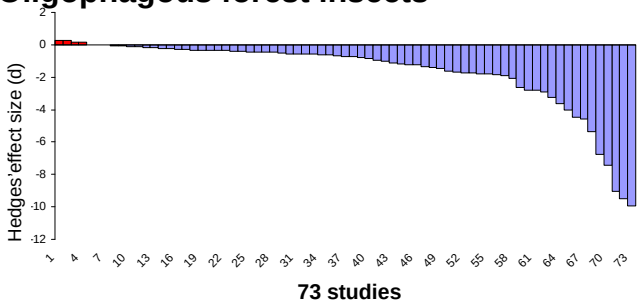
Impact of natural enemies …

Mixed, more diverse forests provide:
- **Higher structural complexity**
- **Better availability of resources (food, micro habitats, etc.) required by natural enemies (parasitoids, predators …)**

- Hoopoe (*Upupa epops*) feeds on PPM pupae in the soil
- Nests in large cavities, mainly in the stem of old oaks (*Quercus)*
- Abundance much greater in mixed forests (near nesting sites)

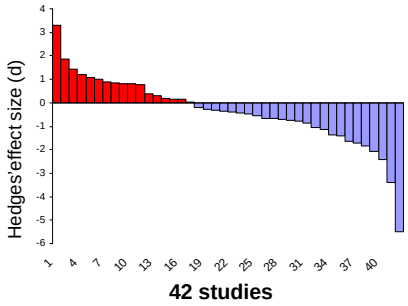
Barbaro et al. (2008) Biodiv Conserv

Oligophagous forest insects

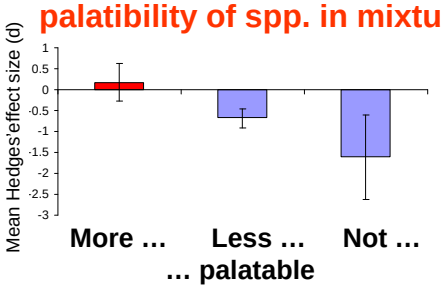


Jactel & Brockerhoff (2007) Ecol Lett

Polyphagous forest insects



Effect depends on palatibility of spp. in mixture



4. Opportunities for enhancement of plantation forests for BD conservation

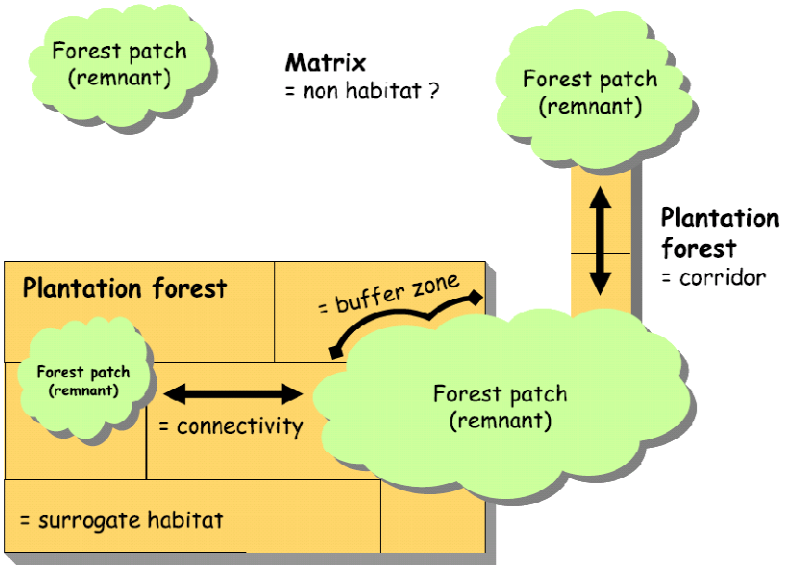
Stand scale

- **Preferably plant native tree species (native flora & fauna)**
- **Introduce structural & spp diversity (canopy, understorey)**
- **Avoid large-scale clearfells**

Landscape scale

- **Protect and enhance remnants of indigenous vegetation**
- **Create mosaics of (stand age, tree species …)**
- **Buffers against edge effects**
- **Corridors linking habitat patches**
    - **forest corridors / non-forest corridors**

Hartley (2002) For Ecol Manage
Lindenmayer and Franklin (2002) Conserving forest biodiversity
Carnus et al. (2006) Journal of Forestry
Brockerhoff et al. (2008) Biodiversity and Conservation



'Corridor-patch-matrix' landscape model of a highly-fragmented landscape

Brockerhoff et al. (2008) Biodiversity & Conservation

Plantation Forest Certification: Maintenance of BD: one of the main criteria

FSC FOREST STEWARDSHIP COUNCIL Plantations Review español >>

Home | About FSC | Principle 10 | History of Principle 10 | Review Process | Get involved | Briefings | Resources | FAQ | Contact

Principle 10: Plantations

Plantations shall be planned and managed in accordance with Principles and Criteria 1 - 9, and Principle 10 and its Criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

Criteria:

10.1 The management objectives of the plantation, including natural forest conservation and restoration objectives, shall be explicitly stated in the management plan, and clearly demonstrated in the implementation of the plan.

- Reports of audits can be accessed at www.fsc.org
- Other certification bodies: **PEFC**

Conclusions

- Plantation forests vary among countries - context !
- Afforestation of agriculture, marginal land - BD benefits
- Replacement of natural vegetation - BD losses
- Planting native tree species is preferable
- Plantation forests can provide important habitat
- Biodiversity provides ecosystem services ('pest' control)
- We do understand some mechanisms
- 'Type' of biodiversity important (identity of species)
- Opportunities for improving biodiversity in plantations:
    - Management at stand / landscape scales
- Plantation forests can be an important part of a biodiversity conservation strategy