Commonwealth Environment Research Facilities
Marine and Tropical Sciences Research Facility

Impacts and Achievements of the MTSRF

Copy of abstract and presentation given at the 2010 Annual Conference of the Marine and Tropical Sciences Research Facility (MTSRF)
http://www.rrrc.org.au/news/2010_conference.html

Showcasing the Australian Government's investment in the MTSRF for improved sustainability of the North Queensland region, and Australia

18-20 May 2010
Pullman Reef Hotel & Casino
Cairns, North Queensland

Reef & Rainforest RESEARCH CENTRE

Australian Government
Department of the Environment, Water, Heritage and the Arts

Abstract

MTSRF Project Number 4.9.5

Restoring tropical forest landscapes: The devil in the detail

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When the Wet Tropics World Heritage Area was declared in 1988, the conservation agenda was focused on recognising and protecting intact forests in the face of pressures from logging, agriculture and development. In 2010 emerging new global trends have appeared, including firming evidence for climate change and an increased recognition of the potential of reforestation to mitigate the loss of both biodiversity and ecosystem services from past deforestation and other human activities. There is also increased awareness of the wide variety of possible environmental outcomes from restoration conducted using differing techniques or in differing situations, although several recent reviews have noted the scarcity of rigorous scientific study into these issues, in any part of the world. An exception to this scarcity is MTSRF Project 4.9.5, which has aimed to provide scientifically rigorous information about how both biodiversity and ecosystem services develop under different forms of reforestation in the Wet Tropics, including low-diversity plantations focused on tree growth, multispecies environmental plantings, and unassisted regrowth. The project has also sought to provide stakeholders in government and the community with tools and information to enable improved knowledge of outcomes and monitoring techniques to facilitate adaptive management. This talk will provide an overview of the approaches used in the project, its key findings and activities, and important work remaining to be done.

Note: Some of the material presented in the following slides is based on unpublished data, cannot be guaranteed to be free from minor error, and should not be cited as a primary source of information.

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Restoring tropical forest landscapes:

the devil in the detail

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terrain NATURAL RESOURCE MANAGEMENT
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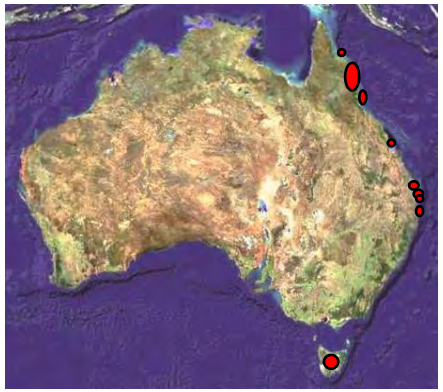
Importance of (rain) forests to people

1. <u>ecosystem functions shared with other forest types:</u>
   - local climate regulation
   - soil stabilisation, replenishment, nutrient cycling
   - water regulation and purification
   - carbon uptake and storage

2. <u>distinctive biodiversity:</u>
   - high diversity of species
   - distinctive and unique species
   - ancient evolutionary lineages

3. <u>other values:</u>
   - inspiring beauty and presence
   - resource for bioprospecting (new drugs and products)
   - provision of materials (eg timber)
     and services (eg pollinators)

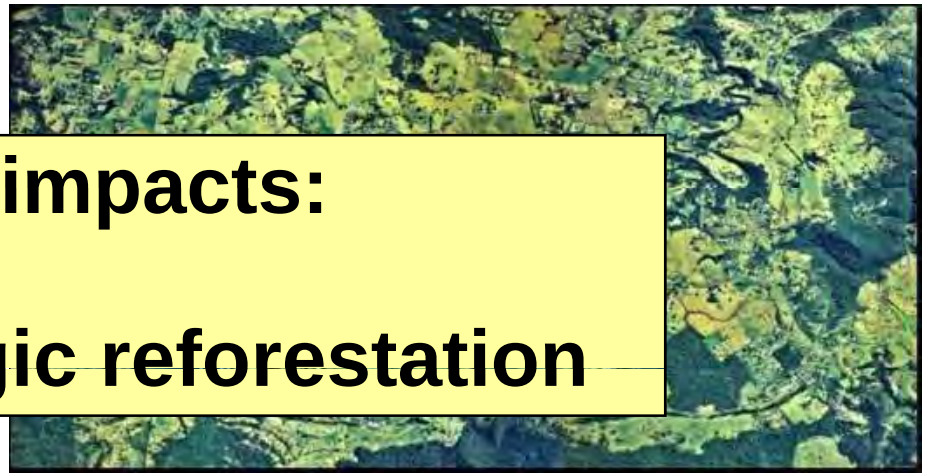


In Australia: - around 3% of the land area;
50% of terrestrial biota

Over-clearing of forest landscapes

→ **Impacts on:**

- global and local climate
- land stability and soil condition
- water quality – rivers and coastal
- current biodiversity
- resilience of biodiversity to climate change
- etc - + interacting effects



To mitigate or reverse impacts:
stop deforestation
& undertake strategic reforestation

Major reforestation pathways

Ecological restoration plantings:

- planted for environmental reasons – to restore forest rapidly;
- many tree species; mostly local natives;
- intended to develop rapidly into "native“ forest;
- establishment cost – c. $20,000-$30,000/ha.

Timber plantations:

- planted for wood harvest;
- 1- few tree species; many may be exotics;
- may progress to "native" forest if not cut;
- establishment cost – c. $4,000-$8,000/ha.

Autogenic regrowth:

- establishes without assistance (large areas);
- trees native or exotic, variable diversity/density;
- gradually progresses towards "native" forest;
- establishment cost $0/ha.

Catterall, et al. 2004, 2008; Catterall & harrison 2005.

Interest in WT reforestation since c. 1985

Mixed goals 1980s-1990s

- employment creation;
- greater community awareness of environment;
- streambank stabilisation
- alternative timber resource (to forest exploitation)
- biodiversity conservation

Encouraged by government-sponsored schemes

eg 1989: OBT, Landcare, CRRP, WTTPS; 1997 NHT; 2008 C4C

Additional goals 2000s

- carbon sequestration;
- development offsets

Encouraged by new government policies

eg 2009 Ecofund; 2009? UN-REDD; 2010? CPRS

but:
there is little rigorous scientific study of environmental outcomes from restoration

...according to recent reviews:

eg

Hilderbrand et. al (2005) *Ecology & Society* 10: 19.

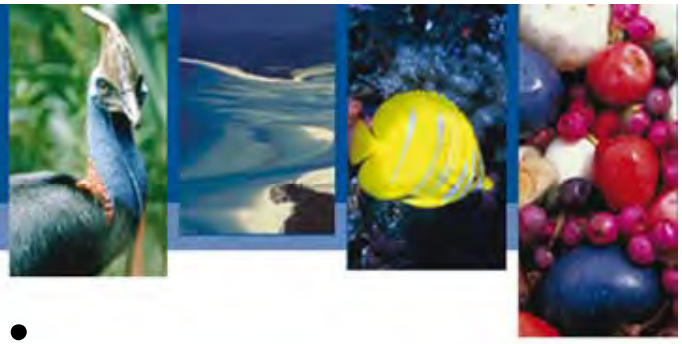
Bowen et al. (2007) *Biological Conservation*140, 273-96.

Munro et al. (2007) *Ecological Management & Restoration* 9, 199- 207.

Dent & Wright (2009) *Biological Conservation* 142, 2833-43.

Gardner et al. (2009) *Ecology Letters* 12, 561-82.

Chazdon et al. (2009) *Conservation Biology* 23, 1406-17.



An exception:

MTSRF Project Restoring Tropical Forest Landscapes

- founded on knowledge and capacity from former Rainforest CRC

Project tasks:

(a) Toolkits and indicators.

Development and application of toolkits and indicators of degradation and restoration.

(b) Reforestation processes.

Advancing knowledge of reforestation processes.

(c) Facilitation and futures.

Improving regional capacity to track & plan restoration outcomes.

Project achievements (2007-10)

Activities:

- inventory & retrospective assessment of restoration sites
- new field-based research into biodiversity outcomes
- preparation of scientific and nontechnical publications
- stakeholder workshops

Scientific outputs:

journal articles: 11
book chapters: 5
conference presentations: 35
PhD theses: 3

Non-technical outputs:

toolkits, reports, general articles: 5
workshops for practitioners: 5
other nonspecialist presentations: 23 (+some media)

PUBLICATION LIST HANDOUT AVAILABLE FROM CARLA

Key findings about outcomes of restoration:

1. BIODIVERSITY

-comparison of reforestation pathways, at age around 10 yr

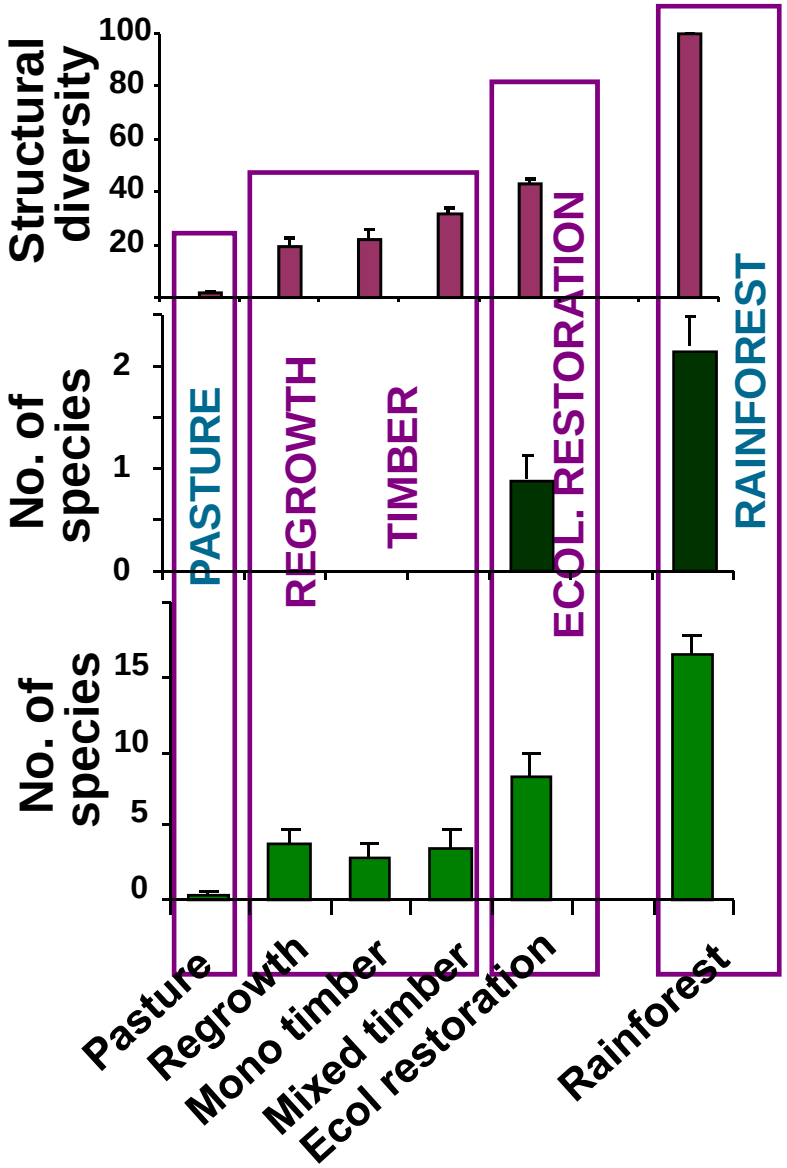
-veg. structure, birds, reptiles, beetles, ants

Biodiversity (rainforest-dependent fauna and vegetation structure) – at c. 10 yr

VEGETATION
structure index

Rainforest-dependent REPTILES

Rainforest-dependent BIRDS



+ broadly similar findings for : ground-active beetles ant genera.

Catterall, et al. 2004. in: Lunney, D. (ed.) Conservation of Australia's Forest Fauna; Kanowski et al. 2006. *Restoration Ecology* 14: 67-76; Grimbacher et al. 2007. *Biodiversity & Conservation* 16: 2167-2184; Piper et al. 2009. *Austral Ecology* 34: 422–434.

General finding - biodiversity:

At around 10 years old:

- **ecological restoration sites show rapid biodiversity development, & have reacquired around 50% of the biodiversity characteristics of rainforest;**
- **timber plantings and regrowth are slower – 20-40%**

Key findings about outcomes of restoration:

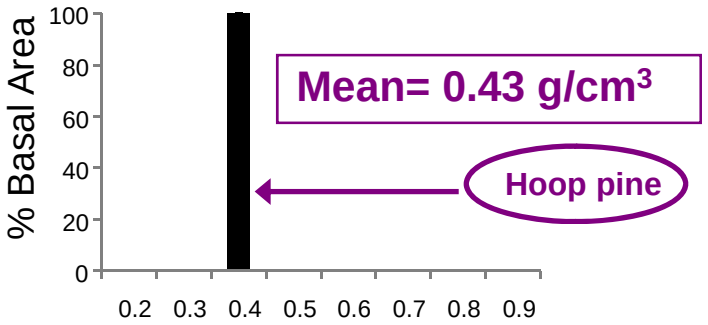
2. CARBON

-comparison of reforestation pathways, at age around 14 yr

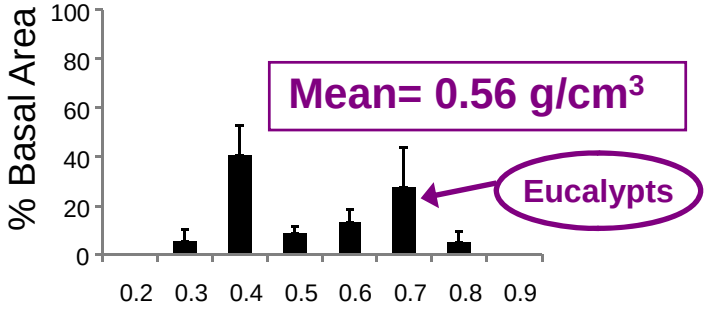
- wood density + stem density + stem size → aboveground biomass/carbon

Wood densities in plantings c. 14 yr old

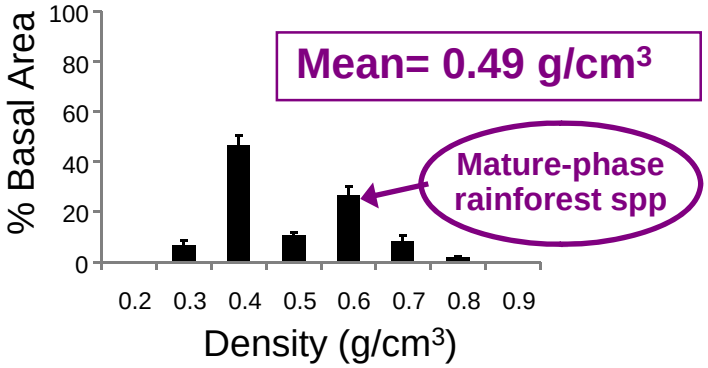
Monoculture timber plantations



Mixed-species timber plantations



Ecological restoration plantings



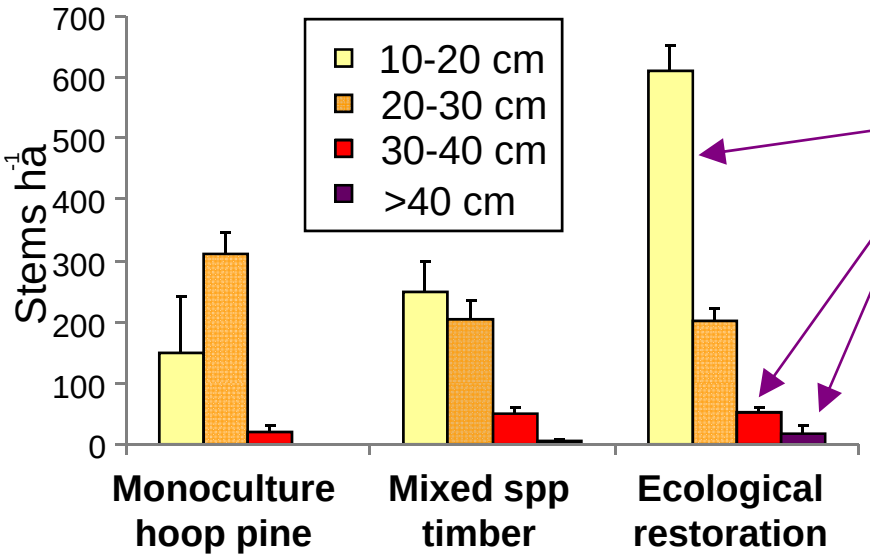
→ denser wood on average in ecol restoration and mixed-species timber (due to eucs and rainforest species)

Wood densities from Ilic et al. (2002)

Kanowski & Catterall 2010. *Ecological Management & Restoration* In press

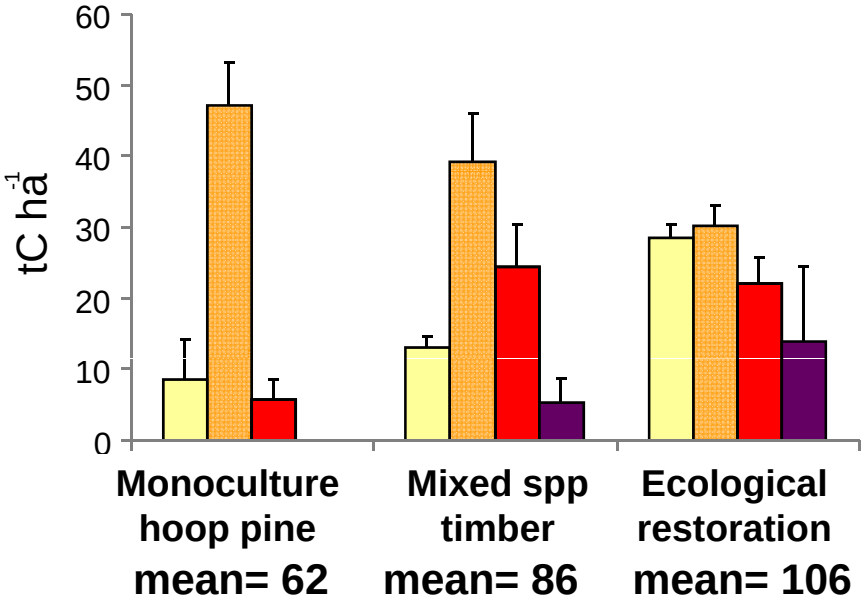
Stem size, density, carbon - plantings c 14 yr

Tree densities stems per ha



many large stems in ecological restoration

Above ground carbon in trees C tonne/ha



Most carbon/ha in ecological restoration.

Least in monoculture hoop pine.

= effect of wood density + stems/ha

Biomass estimates from Chave et al. 2005 X 0.5 to give carbon

Kanowski & Catterall 2010. *Ecological Management & Restoration* In press

General finding - carbon:

Successfully-practised ecological restoration techniques also have good short-term carbon outcomes

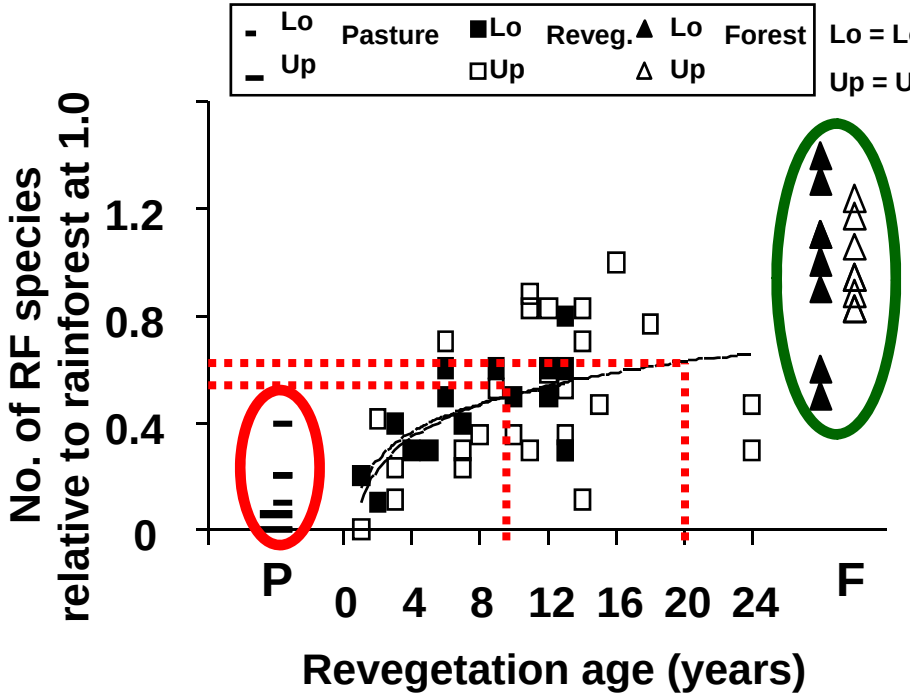
Age: 10 yr

Key findings about outcomes of restoration:

3. UNCERTAINTY OF OUTCOME

- variation in biodiversity development
- risk of failure to establish

Variation in biodiversity in established ecological restoration – eg birds in wet tropics uplands & lowlands



Sites of different age: development curves for rainforest birds are identical in lowlands and uplands

→ **c. 50% of rainforest levels by 10 yr**

→ **c. 65% by 20 yr**

Estimated time to build to average rainforest level?

mean - 256 years

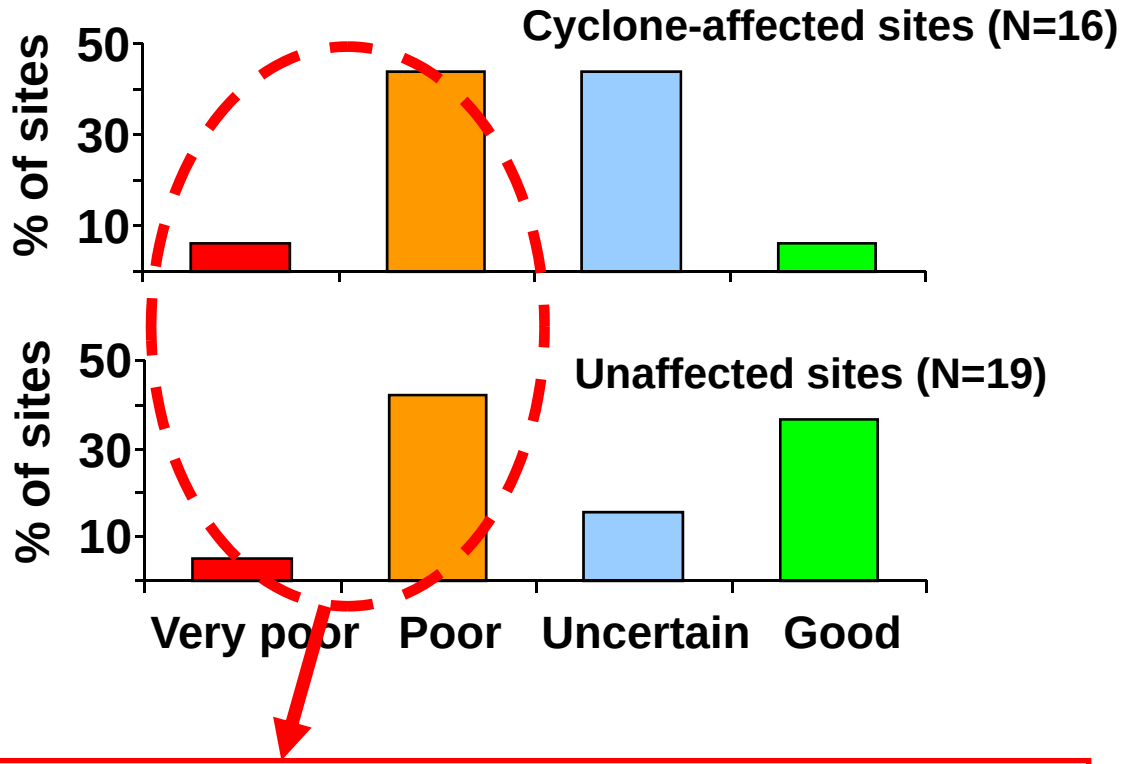
range (95%) - 27 to 10,000,000 years!

Possible causes of variation?

1. **Spatial issues: patch size; patch location;**
2. **Local habitat: eg vegetation - floristics, structure, disturbance, etc**

Uncertain establishment success in ecological restoration: - NHT1 outcomes assessment

35 randomly-selected sites
6-11 years old



c. 50% of sites were in poor condition:
canopy <50%, &
grass/weeds common or dominant on ground

General findings - uncertainty:

1. even “best practice” ecol. restoration shows huge variation among sites
- many may never replicate rainforest

2. many restored sites fail to establish if they are simply planted and then left alone after the first few years.

(& similar outcomes under CRRP farm forestry scheme)

→ need for
- offset ratios that compensate for uncertainty.
- monitoring rather than assumptions about outcomes.

Revegetation monitoring toolkit

(Kanowski et al. 2009)

- Written to assist practitioners.
- Designed to be "as simple as possible while still useful"

Version 2:

- recording site establishment
- condition assessment
- vegetation structure
- floristic composition
- carbon sequestered
- analysis

Fauna (bird diversity) module in prep

See RRRC website:
http://www.rrrc.org.au/publications/research_reports.html

Unknown zones:

1. establishing causes of outcome variation among sites (*we have data, not analysed*)

2. What is happening with plant recruitment? (*we have data, not analysed*)

3. What will happen in the longer term and can this be influenced by different planting designs? (*needs trial + monitoring*)

4. Are there novel "biodiversity-friendly" designs that could produce even better carbon outcomes? (*ditto*)

   eg – wet sclerophyll analogues

Identifying other important unknowns:

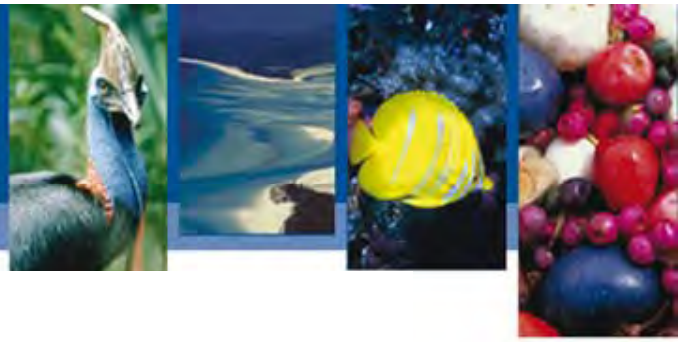
Building Restoration Knowledge – integrating science and practice to fill knowledge gaps about restoring rainforest

Workshop held 22 April 2010, Cairns

46 expert managers, practitioners and researchers

Areas identified as priority knowledge gaps that could be filled by collaboration between researchers & practitioners:

- **Cost effectiveness of restoration method**
- **Monitoring restoration**
- **Autogenic regrowth as a restoration tool**
- **Institutional capacity and information sharing**
- **How to design for resilience**
- **Water quality benefits of revegetation**
- **How to combine different restoration goals**
- **Designing landholder incentives**



thanks to:

Grant Wardell-Johnson
Peter Grimbacher
Terry Reis
Elinor Scambler
Stephen McKenna
Will Goulding
Anna Koetz
Ian Northcott
Cath Moran
Heather Proctor
Scott Piper

many others,

including landholders for permission to work on their properties

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