

Teaching Materials

Teaching Resources

Each Chapter of the Rainforest Restoration Manual offers the academic and research community a wealth of Natural Resource Management knowledge in general and rainforest restoration advice in particular. It is intended that this knowledge be freely used by researchers, teachers and students alike. A number of resources from the Manual and its Supplement are summarised to facilitate quick reference and access to the materials that you may require. These are presented in two forms.

Firstly: a 'Table of Contents' from the Manual and its Supplement (a universal 'finder index') if you like. This is in the form of their appendices, tables, figures and maps arranged by chapter so that you can go straight to the relevant item, consult, copy and adapt it to your research, teaching or student requirements.

Secondly: a series of summaries, suggested reading and student revision exercises for each rainforest restoration step. Each chapter's materials are presented on a separate page to assist teachers and students in printing them off and this also provides spare room for notes at the bottom of the page.

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	Dry Rainforest
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	Littoral Rainforest
	Moisture niche
	Frontline species
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	Warm Temperate Rainforest
	Cool Temperate Rainforest
	Gallery Rainforest
	Dry Rainforest
	Dry Gully Rainforest
	Littoral Rainforest
	Moisture niche
	Hot feet-cold feet species
	Mistletoe hosts
	Frontline species
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	Warm Temperate Rainforest
	Cool Temperate Rainforest
	Gallery Rainforest
	Dry Rainforest
	Dry Gully Rainforest
	Littoral Rainforest
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	Direct seeding
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	Frontline species
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Bird breeding censuses

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Chapter 1 Background

READER-STUDENT COMPREHENSION AND REVISION

1. List some of the global, Australian and local threats to rainforest?
2. How do these threats impact on rainforests?
3. Is there a common thread to these threats and their origins?
4. How can we manage these threats?
5. Using the Snowy River Riparian and Rainforest Restoration Project as a case study: do you think that the global politics of Climate Change, Peak Oil and the tipping points associated with them (such as world food shortages, energy shortages and water shortages) have a direct or indirect impact on rainforest conservation on the lower Snowy River? Tabulate your answers and give reasons for your decisions.
6. If you are uninformed as a land manager or member of the community; how could this be a threat to local rainforests?
7. How can your seeking advice from the Manual and other experts in the field of rainforest restoration and ecological management hold the line for your rainforest remnant?

Chapter 2 Protecting your rainforests and assessing the problem

READER-STUDENT COMPREHENSION AND REVISION

1. Why is there a hierarchy of actions?
2. Why not just go and do what you think is best, in the order you reckon is right?
3. Why break the approach into two sections: emergency management and recovery?
4. Are there other models, how would you do things differently?
5. Do you now know the key elements of rainforest ecology?
6. Can you think of how you might need to take these into account when undertaking rainforest restoration?

Chapter 3 Your rainforest and regional context

This is STEP 1

Objectives

At the end of this STEP:

1. You (or a group of you with the relevant skills) should be able to use the Rainforest Divination Tool to determine whether rainforest used to once occupy the site that you are examining;
2. You (or the group) should be reasonably confident that your Divination Tool result is 'real' and that rainforest did or does still occupy the site that you are examining;
3. After having done several Rainforest Divination assessments, you should feel confident enough to adjust the ratings scale locally: if it is giving you skewed results; and
4. You should be able to determine whether the site has changed so much from its historic state: such that it requires you to shift the restoration trajectory to a different rainforest type to the one that used to occur there.

Step1: Historic context: was it ever rainforest?

Relevant reading:

Supplement: Chapter S7: Fire management at the landscape scale;

Supplement: Chapter S7: Fire management at the local scale;

Further reading: Comprehensive account of historic information for rainforest on the lower Snowy

Further assistance:

Your local TAFE should have NRM teachers, tutors or past students who are familiar with the use of the Rainforest Divination Tool;

The East Gippsland Rainforest Conservation Management Network <www.egrainforest.org.au> may be able to put you in touch with someone who is able to use the Rainforest Divination Tool or to verify your results.

This is STEP 2.

Objective

At the end of this STEP:

- You will have been able to turn you or your group into rainforest detectives so that you can:
1. Determine the Ecological Vegetation Class that is or was present on your site; and
 2. Determine which Floristic Community that is or was present on your site (if sufficient species remain and/or there is a closely matching reference site nearby).

Step 2: What type of rainforest was it?

Revision:

Why is the identity of rainforest so crucial to rainforest restoration?

What are the implications for your restoration efforts if you get the identity of your site's rainforest wrong?

What makes restoration different from gardening?

Relevant reading:

See **Glossary**:

Benchmarks; Ecological Vegetation Class, Floristic Community, rainforest, Distinguishing species, Dominant species, Pre-1750s vegetation mapping, Rainforest Divination Tool, reference sites, typology and usual species.

To better understand rainforest ecology:

Rainforests and Cool Temperate Mixed Forests of Victoria (Peel 1999).

To better understand the EVC level distinctions between rainforests of the region that might occur on your site:

See **DEFINITIONS**:

Differential rainforest definitions for south eastern Australia.

To better understand the reason for site-specificity of rainforest restoration and its implications for your restoration success:

Supplement Chapter S8: Genetics and sourcing plant propagation material:

Genetics: who is bonking who, will the children have two heads and does that really matter?

Conserving rather than preserving rare or threatened species

Maintaining regional genetic integrity

Ensuring genetic diversity

To better understand restoration ecology and its practice:

See **Definitions**:

Ecological Restoration

Further assistance:

Try contacting the authors (though they may be hard to track down), who have described the various rainforest communities listed in the Floristic community keys;
Try also local botanists or rainforest restoration contractors who may know your site, its history and its vegetation; and
Your local TAFE and some of the staff that teach Natural Resource Management and Land Conservation Management courses.

READER-STUDENT COMPREHENSION AND REVISION

- | |
|---|
| <ol style="list-style-type: none">1. Why should there have been rainforest present previously for it to be restored today?2. Have you tried the Rainforest Divination Tool?3. Can you devise a method (other than the Rainforest Divination Tool) to locate past rainforest habitat?4. Is there a locality that you know of that has not been addressed by the Depletion by locality section?5. Use the Rainforest Divination Tool, then the EVC and FC keys to work out a site's likely rainforest identity?6. When you have worked it out, how will this information help; who would you tell and why? |
|---|

Chapter 4 Immediate actions and site planning

This is STEP 3.

Objectives

At the end of this STEP you will be able to:

1. Understand what ecological brakes are and how they threaten rainforest;
2. Identify the ecological brakes that are operating on your rainforest restoration site; and
3. Implement an adaptive management hierarchy that will release these brakes and allow natural regeneration to proceed (if at all possible);

Step 3: What does the site need for rainforest to recover?

Revision:

What are ecological brakes?

Name one for the site that you wish to restore;

How will you manage this ecological brake? and

Outline the adaptive management approach you would use to verify the effectiveness of your management of this ecological brake.

Relevant reading:

Glossary:

Adaptive management; canopy attrition, canopy decapitation, directional dispersal, ecological management, ecological restoration, ecosystem management, ecosystem recovery, ecosystem resilience, ecotones, **bonfire** trees, fire shadows, fire types, frontline species, gap maintaining species, greenfields regeneration, greenfields site, integrated weed management, let Nature decide, non-rainforest wattles, megafire, natural regeneration, oldfield regeneration, paddock rainforest starters (natives), paddock rainforest starters (weeds), pioneer species, plant community succession, primary (mature phase) species, primary succession, rainforest wattles, secondary growth, secondary species, secondary succession, seral stage, storm shutter, transforming weeds, virtual connections, wind rakes, and wind tunnel gaps.

See **DEFINITIONS:**

Ecological restoration

Further assistance:

Agencies with the relevant responsibilities for fire, pest plants, pest animals and planning.
Staff of the local TAFE that teach NRM or Conservation and Land Management courses, local restoration contractors or botanists and ecologists.

READER-STUDENT COMPREHENSION AND REVISION

1. Define an ecological brake for rainforest, as well as for another EVC with which you are familiar.
2. List the major components of global warming that will affect rainforests in your area.
3. Prioritise these on the basis of those likely to cause the most severe damage to individual sites and why?
4. Which global warming impact will have the most extensive impact across the landscape for rainforest?
5. List one threat that has a low likelihood of occurring but a major impact if it did occur.
6. List one threat that has a high likelihood of occurring but a low level of impact if it did occur.
7. Which of the two previously identified impacts will you put the most effort into guarding against and why?
8. How will you adapt to global warming impacts that you cannot ameliorate?
9. Suggest some ways in which your rainforest stand may adapt to global warming without your intervention?
10. What would you monitor to see if this is occurring?
11. How would you decide whether water tables are too high for intended rainforest restoration works?
12. What choices do you have to change the water table levels? List by: mechanical, successional or planting.
13. List an example and discuss a case of let Nature decide.

Chapter 5 Choosing the method of restoration

This is STEP 4.

Objectives

At the end of this STEP:

1. You will have made an honest and accurate assessment of your ability to undertake some or all of the tasks required of you to restore your site's rainforest;
2. You should realise that this decision is a 'suck it and see' approach for many people: if you haven't tried some or all of the tasks that are needed for your rainforest to recover, then how would you know whether you can do it? and
3. You may wish to delegate, do some or all of the tasks required, delay your participation or, leave it to someone else in the future.

Step 4: Can I actually do or do I need expert help?

Revision:

What do you risk if you go into a rainforest restoration project without an honest appraisal of your ability to undertake the tasks required?

Who and what will suffer if you do not choose carefully at this point?

Can you fit such a project and the required commitments into your life?

Do you want to fit such a project into your life?

Can you do it well?

Are you being half-baked or romantic?

SNAP OUT OF IT, IT IS TIME TO BE RATIONAL; and

Who should you consult before making this decision and why?

Relevant reading:

Supplement Chapter S3:

Human factors: the social context

Gaining support for your project: the social contract

Signage

General attitude

Strategic placement of your project

Fencing

Urban neighbourhood considerations

Rural neighbourhood considerations

Supplement Chapter S6:

Table S17. Project implementation steps and who should participate [local experience and Clewell *et al.* (2005)].

Manual: Chapter 6: Resources required

What resources and money are needed for rainforest restoration?

Introduction

Good funding proposals

Works or funding variations

Matching funding cycles to works programs

Project cost: the whole thing or individual tasks?

Pay to have it done, or organise it yourself?

Technical resources and support

Manual Chapter 6:

Table M12. Approximate unit costs per hectare based on Rainforest Restoration Method.

Subtropical Rainforest restoration: a practical manual and data source for Landcare groups, land managers and rainforest regenerators. (2005). Big Scrub Landcare Group.

Big Scrub Rainforest Landcare Group: <www.bigscrubrainforest.org.au>;

East Gippsland Rainforest Conservation Management Network:

<www.egrainforest.org.au>;

Rainforest Rescue: <www.rainforest.net.au>;

Further assistance:

Talk with someone who has already given it a go: contractors, landholders, land managers; and

Look at their results for the effort and money put into the site and let the site speak to you!

This is STEP 5

Objectives

At the end of this STEP:

1. You should understand each of the Restoration Methods;
2. For each Method you should be able to understand:
 - a. When to use it;
 - b. Its use with other Methods;
 - c. Sites, situations and budgets suited to the use of each Method; and
3. Given your resources (and your site's needs), you should have understood each of the Restoration Methods sufficiently well to be able to choose the right one/s for your rainforest restoration project.

Step 5: What restoration methods are needed?

Revision:

Have you been honest with yourself when answering the question posed by **Step 4** and has this same honesty led to a sensible decision as to which Rainforest Restoration Method you will apply on your restoration site?

How did you come to that conclusion?

Has someone with experience checked your choice?

Were you guided by someone else?

What were the major contributing factors for you in making your choice of Rainforest Restoration Method? and

Do these still seem valid at this review stage?

Relevant reading:

Supplement: Chapter S5 Where your site sits in the landscape:

Landscape context

Contiguity, proximity, size and width: helping your restoration site to be the best it can

Structural complexity and biodiversity: one reason why restoration is better than revegetation

Supplement: Chapter S8 Plant stock and planting:

Genetics and sourcing plant propagation material: *Introduction* (particularly the comparison between gardening, revegetation and restoration)

Glossary:

Adaptive management, background weeds, benchmark, Bradley Weeding Method, ecological brake, ecological management, ecological restoration, ecosystem management, ecosystem recovery, ecosystem resilience, enrichment planting, greenfields regeneration, greenfields site, integrated weed management, natural regeneration, paddock rainforest starters (natives), paddock rainforest starters (weeds), pioneer species, plant community succession, Precautionary Principle, primary (mature phase) species, primary succession, rainforest restoration, recruitment, reference site, relay succession, restoration, restoration ecology, restoration goals, revegetation, secondary growth, secondary species, secondary succession, seed dispersal, seed rain, seral stage, social license, succession, supplementary planting, transforming weeds, Wingham Weeding Method.

DEFINITIONS:

Ecological restoration

East Gippsland Rainforest Conservation Management Network: <www.egrainforest.org.au>;

Big Scrub Rainforest Landcare Group: <www.bigscrubrainforest.org.au>;

Subtropical Rainforest restoration: a practical manual and data source for Landcare groups, land managers and rainforest regenerators. (2005). Big Scrub Landcare Group.

Further assistance:

The East Gippsland Rainforest Conservation Management Network may be of assistance as might the staff of the local TAFE that teach NRM or Conservation and Land Management courses, local restoration contractors or ecologists.

READER-STUDENT COMPREHENSION AND REVISION
<ol style="list-style-type: none">1. List the different Rainforest Restoration Methods canvassed in this chapter.2. List the usual situations in which each is used.3. What are the major differences between each Method?4. What are the implications of using the wrong Method on a site?5. Will the Natural Regeneration Method always work when another rainforest stand is nearby? If not why not?6. Is there a situation that you have come across where none of the Methods listed would work?7. How would you go about developing a new Method or modifying one of the Methods described here?

Chapter 6 Resources

This is STEP 6.

Objectives

At the end of this STEP:

1. You will have an appreciation of what constitutes a good funding proposal;
2. You should know how to submit a funding variation;
3. You should know how to match funding cycles with works programs (including ecological maintenance);
4. You should know whether to do the whole thing or individual tasks;
5. You should be able to decide whether to do it yourself or pay to have it done; and
6. You will know where to obtain technical advice and support.

Step 6: What resources and money are needed for rainforest restoration?

Revision:

Who will fund what you want (or need) to do?

Have you aligned your project with that of the funding organisation, or individual?

Will you realistically achieve what you have said you will in your project application (and on time)?

Have you considered what threats exist to the timely and successful completion of this segment of your restoration project?

Have you made contingency plans to address these possible threats?

Have you established a good relationship with your funding providers should one of these threats materialise and you require a funding variation?

Relevant reading:

Supplement: Chapter S3 Social theory and philosophy

Human factors: the social context

Gaining support for your project: the social contract

Signage

General attitude

Strategic placement of your project

Fencing

Urban neighbourhood considerations

Rural neighbourhood considerations

Supplement: Chapter S5 Where your site sits in the landscape

Integrating landscape theory, ecological theory and social philosophy

Supplement: Chapter S6 General principles

General principles

Accreditation

Project planning and implementation

Community engagement and networking

Pilot projects and trials

Project planning

Project implementation steps

Reference sites

Funding sources and extension advice

Adaptive management

Monitoring methods

Integrated weed management

Soil seed banks: free seed in your soil

Successional planting

Companion planting

Supplement: Chapter S7 Managing disturbance

Fire management at the landscape scale

Fire management at the local scale

Disturbance

Frost and frost management

Supplement: Chapter S8 Plant stock and planting:

Genetics and sourcing plant propagation material

Propagation

Translocation, division and transplanting

Plant stock

Ordering plants from nurseries

Planting seasons across south eastern Australia

Planting times by region, landscape unit and climatic cycle

Timelines: a rainforest by when?

Planting prescriptions

Useful contacts

Further assistance:

Various agency staff with the relevant project management experience may be willing to help (this may include those staff, whose job it is to do just that). Try: local councils, NRM agencies, CMAs or the East Gippsland Rainforest Conservation Management Network.

READER-STUDENT COMPREHENSION AND REVISION
<ol style="list-style-type: none">1. List the key features of a good funding application.2. Why is it important to read funding criteria?3. What is a funding variation, how does it work and when is one required?4. If you have no experience of setting up a project and wish to involve friends and community on your site, is it better to start out big or small?5. List the pros and cons of each scenario.6. If you do not have the social contract to operate on a particular site, is there any point in proceeding?

Chapter 7 Project planning

This is STEP 7.

Objectives:

At the end of this STEP:

1. You will appreciate how important site assessment is to project planning;
2. You will be able to give your site a health assessment and develop recommendations for your site plan;
3. You will be able to construct a site plan;
4. You will be able to develop a project management plan;
5. You will have (through your project plan) prioritised and timed the necessary works, assigned tasks to people; assessed risks and developed contingencies to address these threats to your project;
6. You will be able to compose a project works calendar; and
7. You will appreciate the inherent difficulties associated with rainforest restoration on particular landforms.

Step 7: Develop a project management plan

Revision:

Do you know what you have to do and in what order?

Do you know where you have to do it on the site?

Do you know who is going to do which task?

Do you know by when a particular task must be done so as not to delay other time-linked tasks (such as seed collection, nursery propagation, site preparation and planting)?

Have you assessed threats to your project (such as land tenure, seasonal outlook, disturbance regimes inherent to your site etc.; but also remember this includes community attitudes)? and

Have you developed a contingency for the most likely and most serious of these threats?

Relevant reading:

Supplement Chapter S3 Social theory and philosophy

Human factors: the social context

Gaining support for your project: the social contract

Signage

General attitude

Strategic placement of your project

Fencing

Urban neighbourhood considerations

Rural neighbourhood considerations

Integrating landscape theory, ecological theory and social philosophy

Supplement Chapter S4

Ecological principles

Niches (who lives where and why)

Incident light niches (in nature and restoration)

Moisture niches

When it happens and why it happens (phenology)

Wind and water

Supplement Chapter S6

General principles

Accreditation

Project planning and implementation

Community engagement and networking

Pilot projects and trials

Project planning

Project implementation steps

Reference sites

Funding sources and extension advice

Adaptive management

Monitoring methods

Integrated weed management

Soil seed banks: free seed in your soil

Successional planting

Companion planting

Table S17. Project implementation steps and who should participate

Supplement Chapter S8:

Tables S28. Plant container size, features of plants grown and application in the field

Table S29. Nursery order cut-off dates, calculated from likely planting season

Table S30. Planting seasons for rainforest restoration by region across the south eastern Australia

Supplement: Appendix S13: Funding sources suited to rainforest restoration projects

Appendix M2: Plant spacings, planting densities and ratios based on Restoration Method

Appendix M5: Site assessment *pro-forma* (example included);

Appendix M5: Health Assessment; and

Appendix M6: Remnant Management Plan and calendar of works *pro-forma* (example included)

USEFULL CONTACTS

Further assistance:

Various agency staff with the relevant project planning experience may be willing to help (this may include some staff, whose job it is to do just that). Try: local councils, NRM agencies (particularly Landcare coordinators and Trust for Nature), CMAs or the East Gippsland Rainforest Conservation Management Network <www.egrainforest.org.au>.

READER-STUDENT COMPREHENSION AND REVISION

1. List 6 key components that you will have to cover before you can restore your site.
2. Can any of these be skipped?
3. Are some more important than others?
4. Can you delegate any of these components to people or organisations?
5. Why is negotiation (and social interaction in general) so important in restoration?
6. What is a social contract, where do you get one and how much does it cost?
7. Can you do restoration without a social contract from your local community?
8. Will funding bodies provide money if you do not have a social contract?
9. Why are swamped riparian systems a problem for rainforest restoration?
10. Can you list the pasture species from your project area that indicate the various 'water table' niches on your site?
11. Why is zonation on your site so important?
12. List at least 2 EVCs associated with Warm Temperate Rainforest or Littoral Rainforest.
13. What defines their boundaries in relation to the rainforest EVC you have listed?
14. Why is it important to know these?
15. Can rainforest be established in the habitat of another EVC?
16. Why would you want to do such a thing?
17. If so, can it survive in perpetuity?
18. If it cannot, for one of the adjacent EVCs of your chosen rainforest type: list at least 2 reasons why it won't?

Chapter 8 Project Implementation

This is STEP 8.

Objectives

At the end of this STEP:

1. You will have learned how to implement your rainforest restoration project;
2. You will understand and be able to undertake or utilise:
 - a. Site preparation;
 - b. Mulches;
 - c. Herbicide use;
 - d. Planting prescriptions by rainforest ecological vegetation class;
 - e. Direct seeding;
 - f. A range of planting techniques (dependant on the form in which your plants arrive);
 - g. Planting niches (what to plant where);
 - h. Successional planting (when to plant what, where);
 - i. Planting season;
 - j. Pest management; and
 - k. Use of species that are difficult to establish.

THIS IS THE END OF STEP 8

Summary:

Project implementation requires the step-wise implementation of a number of logical steps, beginning with site preparation, seed collection; continues with plant propagation and planting and ending with maintenance of the plantings, before beginning again at the start of the next season. Various techniques are applied depending on the Rainforest Restoration Method, the resources available to you, the season and other limitations that arise from time-to-time.

Revision:

If you have read it all: you deserve a medal and will need a break from revision; and
If you have implemented a project you are already revising what has worked, what hasn't and what you will do differently during the next round!

Relevant reading:

Supplement: Chapter S4 Ecological theory

Ecological factors

Niches (who lives where and why)

Incident light niches (in nature and restoration)

Moisture niches

Emergent trees

Stranglers

The importance of eucalypts in rainforest ecology

Hollows, water and drought

Rainforest gaps

Other niches

Epiphytes and moisture-dependant plants

Parasites

When it happens and why it happens (phenology)

Wind and water

Supplement: Chapter S5 Where your site sits in the landscape

Landscape context

Contiguity, proximity, size and width: helping your restoration site to be the best it can

Structural complexity and biodiversity: one reason why restoration is better than revegetation

Supplement: Chapter S6 General principles

General principles

Accreditation

Project planning and implementation

Community engagement and networking

Pilot projects and trials

Project planning

Project implementation steps

Reference sites

Funding sources and extension advice

Adaptive management

Monitoring methods

Integrated weed management

Soil seed banks: free seed in your soil

Successional planting

Companion planting

Supplement: Chapter S7 Managing disturbance

Fire management at the landscape scale=Fire management at the landscape scale to help protect and restore rainforests

Fire management at the local scale

Disturbance

Frost and frost management

Supplement: Chapter S8 Plant stock and planting

Genetics and sourcing plant propagation material

Propagation

Translocation, division and transplanting

Plant stock

Ordering plants from nurseries

Planting seasons across south eastern Australia

Planting times by region, landscape unit and climatic cycle

Timelines: a rainforest by when?

Planting prescriptions

Supplement Appendices:

Appendix S3. Rainforest weed ecology (transforming and emerging weeds): priorities and management.

Appendix S6. Planting guide for all species.

Appendix S7. Maturation times for species from planting.

Appendix S8. Flowering and seeding calendar with pollinators.

Appendix S10. Plant seed dispersal agents and predators.

Appendix S11. Unpalatable, camouflage and/or deterrent species.

Appendix S12. Edge closing species.

Appendix S14. Adaptive management in rainforest restoration.

Appendix S15. Germination times for natural regeneration by month and by species.

Appendix S16. Successional planting.

Appendix S17. Framework Rainforest Restoration Method species planting guide by rainforest type.

Appendix S18. Fire and ground disturbance responses of rainforest plants (including pioneer species).

Appendix S20. Frost sensitivity for rainforest plants.

Appendix S21. Species not suited to planting near fences and paths.

Manual Appendices:

Appendix M2. Plant spacings, planting densities and ratios based on Restoration Method.

Appendix M3. Planting prescription by category for all species (pioneer, secondary and primary species).

Appendix M4. Maximum Diversity Restoration Method species planting guide by floristic community.

Supplement Tables:

Table S7. Incident light* niches, the species which occupy them and their characteristics.

Table S8. Incident light niches as they relate to successional stage, crown condition and species.

Table S16. What you need to know about your restoration site before you begin.

Table S17. Project implementation steps and who should participate [local experience and Clewell *et. al.* (2005)].

Table S18. Project implementation steps: using the Bairnsdale Urban Landcare Mitchell Walk project's early years

Table S21. What you need to know about your restoration site before you begin

Table S22. The observation action cycle: a comparison of mechanical augers and Hamilton Tree-planters.

Table S23. Adaptive management pathways to successful establishment of Kangaroo Apple

Table S24. Native species that commonly germinate, resprout or colonise following herbicide treatment.

Table S25. Examples of nursery crop species and the time until their maturation/senescence.

Table S26. Advanced tree frost tolerance

Table S27. Canopy types and the frost protection that they afford.

Table S28. Plant container size, features of plants grown and application in the field.

Table S29. Nursery order cut-off dates for south eastern Australia, calculated from likely planting season.

Table S30. Planting seasons for rainforest restoration by region across the south eastern Australia.

Manual Tables:

Table M6. Ecological brakes and adaptive management to remove or reduce their impacts.

Table M7. Site management responses to changing weed composition over time.

Table M8. Nursery crop (pioneer and secondary) species that are useful in the Framework Restoration Method.

Table M9. Framework Method plant numbers by years.

Table M10. Mature stage (primary) species that are useful in the Maximum Diversity Restoration Method.

Table M11. Maximum Diversity Restoration Method plant numbers by years.

Table M12. Approximate unit costs per hectare based on Rainforest Restoration Method.

Table M13. Rainforest restoration activity feedback loop adapted from Joseph (1999).

Table M14. Riparian buffer width cost benefit matrix.

Table M17. Scenarios that illustrate the complexity of herbicide application on rainforest restoration sites.

Table M18. Herbicide application techniques suited to specific Rainforest Restoration Methods.

Definitions:

Ecological restoration

Further reading:

Carbon cycles and rainforest restoration

Mistletoes and rainforest regeneration: vital in fragmented landscapes

Further assistance:

Various agency staff with the relevant project implementation experience may be willing to help (this may include some staff, whose job it is to do just that). Try: local councils, Trust for Nature, NRM agencies, CMAs or the East Gippsland Rainforest Conservation Management Network.

READER-STUDENT COMPREHENSION AND REVISION

8. Why is vehicle access so important in rainforest restoration?
9. We grow crops on ploughed ground, why not use this technique when creating or repairing a rainforest?
10. List 3 reasons why bare soil on your rainforest restoration site could be a problem in the early stages?
11. Why is shade an important tool in rainforest restoration?
12. Apart from shade, what other things do mulches provide for you in rainforest restoration?
13. Define a sun weed and give an example?
14. Define a shade weed and give an example?
15. What is a transforming weed?
16. How do transforming weeds differ from background weeds?
17. Define the conditions of herbicide use in your state or area.
18. What is a CCA?
19. List at least 2 consequences of blanket spraying that are undesirable.
20. Under what conditions or in what circumstances would you consider blanket spraying?
21. What is integrated weed management?
22. Why is carbon so important for rainforest restoration?
23. How can you get nitrogen back into your soils without fertilisers?
24. What is the soil seed bank?
25. List the trials you will conduct to investigate whether you have any soil stored seed?
26. List (as dot points) the key advice in the generalised planting prescriptions for each rainforest EVC.
27. How can direct seeding assist in rainforest restoration?
28. What are the limitations of direct seeding?
29. When should direct seeding not be used?
30. List the advantages and disadvantages of each method of plant production from the restoration point of view.
31. Can you follow the planting season guide, if not: who could you ask? Consult **Chapter S8**.

Chapter 9 What is success in restoration?

This is STEP 9.

Objectives:

At the end of this STEP:

1. You will understand that the choice of monitoring subject depends on what you want to know and who is the audience with which you wish to engage;
2. You will gain an appreciation of a range of monitoring subjects and what the results might indicate with respect to your rainforest restoration success;
3. You will discover that different measures give different results because these components mark the progress of your rainforest restoration success in different ways; and
4. From this, you should begin to realise that rainforest restoration is multi-faceted process: one who's different components will inevitably march to the beat of different drums!

THIS IS THE END OF STEP 9

Summary:

Monitoring can be fun, but it is also a really useful tool. Think carefully about the components of your restoration site that you wish to monitor. Demonstrating success can be simple or complex, depending on the resources that you have at your disposal to do the monitoring. Monitoring success can make you a better project manager, advocate for or restorer of rainforest.

Revision:

Why do some measures of success indicate more progress than others?

If you wish to know more about a particular facet of your site and its progress, how would you design the monitoring so as to provide a direct answer to your initial question?

Are there any indirect measures that would provide the same information?

Are the measures of success that we chose to monitor our restoration sites of the same value? and

Define these values and to whom they are the most useful or valuable.

Relevant reading:

Supplement Appendices:

Appendix S4. Natural regeneration on the Lower Snowy Rainforest Restoration Project

Appendix S9. Butterflies of rainforest in south eastern Australia.

Table S3. Migratory birds reliant on the rainforests of south eastern Australia.

Table S4. Environmental services to agriculture and the wider landscape from animals that rely on rainforests.

Table S10. Rainforest bird of south eastern Australia that use non-vascular epiphytes in their nests.

Table S31. Some criteria for assessing rainforest restoration success based on East Gippsland restoration sites.

Manual Appendices:

Appendix M1. Lower Snowy River bird census results.

Appendix M9. Lower Snowy incidental bird list.

Appendix M10. Kinkuna bird census results.

Supplement Tables:

Table S31. Some criteria for assessing rainforest restoration success.

Manual Tables:

Table M21. Measures of success in rainforest restoration using a number of criteria.

Table M22. Summary of Snowy River bird census results for the year 2004-2005.

Further assistance:

Depending on the level or complexity of the monitoring you wish to undertake, your skills and time, you may wish to do it yourself (it is certainly very satisfying). However there are a lot of resources available out there to help you do your monitoring (especially if it is about success or failure of rainforest restoration). This is partly because, little has been done (a recent literature review by the author revealed only a handful of examples in the Australian literature), and partly because such monitoring presents a fantastic learning and teaching experience. So consider the following groups and organisations and give them a call: you never know your luck until your standing in it:

- Birds Australia; Bird Observers Club (your nearest branch); Field naturalists (individuals) and clubs; fishing clubs; local experts; TAFE colleges specialising in NRM and Land Conservation and Management courses; local university campuses; and locals experts with particular skills.

READER-STUDENT COMPREHENSION AND REVISION
32. Why monitor in the first place?
33. Why is monitoring so important?
34. What are some of the pitfalls for the restorer when assessing monitoring results and gauging success?
35. How does monitoring and setting up trials relate to adaptive management?
36. If birds say you have succeeded, but fungi say you haven't: what is going on?
37. With whom should you share your monitoring results?
38. List some ways in which weed cover can impact on birds and reptiles in rainforest restoration?
39. Why does natural regeneration matter?
40. Of the dispersal methods plants use, list their relevance to your rainforest restoration success.

Chapter 10. Maintenance ongoing ecological management

What resources are needed to maintain the restored rainforest and where to from here?

This is STEP 10.

Objectives

At the end of this STEP:

1. You will learn how to do an annual health assessment for your site that will update your site management plan and project calendar;
2. You should understand the difference between maintenance during the restoration phase on your rainforest site and ecological management (which occurs following the restoration works);
3. You should be aware that pest control is not a black and white issue (either for you or those around you); however:
4. You will have recognised that timely intervention are far more beneficial than sitting on your hands and hoping that the problem/s will go away; and
5. You will appreciate that your interventions are themselves a form of disturbance and that your bush will react to them. The response may not be what you had in mind, but if you do some trials early on, or watch what happens when you do intervene: these surprises will not be project-threatening.

THIS IS THE END OF STEP 10

Summary:

- Once you have restored your site, (having brought the 'thinking time' you need by recovering your rainforest stand); ecological management is the next task;
- Ecological management interventions are the maintenance tasks that are applied to a restored rainforest site that ensure that it continues to thrive and prosper;
- Maintenance of restoration sites is a regular task that is mediated by the most immediate and serious threats to your restoration efforts (usually weeds and sometimes animals) and the need to minimise effort and maximise the result (acting early to save future time and money);
- Do not forget that you yourself and your actions are a disturbance in their own right. Be careful that your maintenance does not create more problems than it solves. Be ready to act if any foreseen or unforeseen problems arise as a result of you maintenance mediated disturbance; and
- Ecological management is as much about keeping threats at bay as it is about looking into the future and anticipating new threats and changes that will have to be managed (e.g. an approaching subdivision, the arrival of a new weed, what is happening in the catchment, climate change and so on);

Revision:

When considering maintenance works remember:

- "A gram of prevention is worth a tonne of care" (notice the metric conversion!);
- "One years weeding means seven years seeding"; and
- "A stitch in time saves nine".

Your Nana was a wise woman after all! Well these potted philosophies say it all really: as in life: ecological management is all about anticipation and acting on threats to rainforest at the right time and with the right amount of effort to save you, your community and our government's time, effort and resources into the future.

Do you know what the impact of your maintenance will be?

Have you done some small scale trials to test the likely impacts (on non-target species) and the new weeds that arrive soon after your initial maintenance?

Have you done the trials over a wet period and a dry period and in each of the seasons?

Remember **ALWAYS** to consider each weed on its merits and its context: why and when you wish to give it a poke, 'cause chances are: it or its mates will BITE BACK!

Remember not everything you consider to be a weed or a pest is considered thus by your neighbours or project partners in the same light. Consult the relevant people if you feel it is necessary (or legally required) before conducting pest control works.

Relevant reading:

Supplement: Chapter S5 Where your site sits in the landscape

Landscape context

Contiguity, proximity, size and width: helping your restoration site to be the best it can

Structural complexity and biodiversity: one reason why restoration is better than revegetation

Integrating landscape theory, ecological theory and social philosophy

Supplement: Chapter S7 Managing disturbance

Fire management at the landscape scale

Fire management at the local scale

Disturbance

Frost and frost management

Listing advice under the *Flora and Fauna Guarantee Act* (1988) for Sambar Deer as a potentially threatening process;

Supplement Appendix S3: Weed ecology and management priorities;

Further assistance:

Relevant State agencies will be able to advise you on the legal status of pest plants and animals;

In most cases they will also be able to advise you on useful and legal control measures;

Any community contacts you have with hunters may prove useful for controlling pest animals if other methods are not available or have not worked;

The East Gippsland Rainforest Conservation Management Network has developed and accreditation process with the local branch of the Australian Deer Association to provide appropriately trained and accredited shooters for deer control for private land managers. Both the ADA and the Field and Game Association have schemes of hunter accreditation to ensure pest control methods and tasks are legally and humanely carried out.

READER-STUDENT COMPREHENSION AND REVISION
41. How is ecological management different to restoration? (see also: Definitions)
42. Who were the Bradleys?
43. Why did the Wingham Weeding Technique arise?
44. Why is knockdown weeding required?
45. Under what situations should it be used and what else needs to happen at the same time?
46. What is the philosophy encapsulated in the Wingham Weeding Technique?
47. Define a pest animal?
48. List a species that you regard as an ally that is a pest to someone else.
49. How can the differences in perception be reconciled?
50. If such differences cannot be reconciled, is your restoration project under threat?

The ten rainforest restoration steps

Our take on rainforest restoration is that it has 10 STEPS:

STEP 1 [CHAPTER: M3]: Was it ever rainforest?

STEP 2 [CHAPTER: M3]: What type of rainforest was it?

STEP 3 [CHAPTER: M4]: What does the site need for rainforest to recover?

STEP 4 [CHAPTER: M5]: Can I actually do it or do I need expert help: a note of caution?

STEP 5 [CHAPTER: M5]: What Rainforest Restoration Methods are needed?

STEP 6 [CHAPTER: M6]: What resources and money are needed for rainforest restoration?

STEP 7 [CHAPTER: M7]: Develop a project management plan

STEP 8 [CHAPTER: M8]: Project implementation

STEP 9 [CHAPTER: M9]: How to measure success? and

STEP 10 [CHAPTER: M10]: What resources are needed to maintain the restored rainforest?

Summary of the ten rainforest restoration steps

For planners this ten step process has been summarised (as an **Operationalisation Plan for Restoration of Rainforest in south eastern Australia**). For teachers and students the following summary is presented.

STEP 1. Was it ever rainforest? [See Chapter M3 for detailed treatment]

To answer this question you should consult the pre-1750s maps for your area. Pre-1750s maps of past vegetation are created by people adept at interpreting past vegetation patterns and distributions from a range of evidence. For most people, there is a strong tendency for us to have landscape amnesia (Diamond 2004): that is we assume that what we see every day is what has always been and thus will always be. If the pre-1750s maps do not cover your restoration site, then use the Rainforest Divination Tool in **Chapter M3: STEP 1**. If you want to restore landscapes you have to open your eyes to what was there in the past and whether it can ever come back with your help. This process leads to some exciting findings (learning more about your area and its past history). This involves discovering what constitutes rainforest habitat, through an appreciation of the factors that limit the development of rainforest (mostly fire frequency and intensity) and proximity of seed sources (other rainforests).

STEP 2: What type of rainforest was it? [See Chapter M3 for detailed treatment]

This depends on the landform (gully, creek flat, river levee, dune, rock outcrop etc.), climatic zone, local climate, soils, elevation and position in the landscape. You can determine the likely rainforest ecological vegetation class by finding your site on a pre-1750s map or by using the Rainforest Divination Tool (which may give you an indication of the floristic community). Use these tools then consult **Appendix S6** to determine the species you need for your site.

The generalized descriptions in **Chapter S1: Rainforest types** covered by the **Manual** will tell you what it looked like, where it grew and where you can go to look at a stand that is still present. **Further Reading** will give you still more information if you wish to find out more.

It is only on rare and quite specific occasions that you will need to restore a type of rainforest to your site other than the type that originally occurred there. These situations are outlined in **Chapter M3: Setting your restoration trajectory and goals: what rainforest was it and should this be the one to be put back?**

STEP 3: What does the site need for rainforest to recover? [See Chapter M4 for detailed treatment]

The crux of this question is: If it once was rainforest, why isn't it spontaneously returning rainforest? This is a fundamental question that must be asked first up as it can save you a lot of time, effort and money. Most of the answers are really simple: you just need to know what to ask and where to find the answer. Using natural regeneration as a guide to your site's prospects, we have drawn together the following example:

Prospects for recovery of your site through natural regeneration are related to the timescale (how long you are prepared to wait); the context of your site in the landscape with regard to other remnants and dispersal pathways (**Chapter S5: Why proximity to existing bush is important**). From what the literature

says (Neilan 2005 *et. al.*), the data we have collected¹ and the analyses we have done the following are suggested:

- **If you are in the warm temperate climate zones of East Gippsland and southern New South Wales** [where much of the fruit-based dispersal is reliant on honeyeaters, and silveryeyes, but also includes the larger dispersing species such as Satin Bowerbird *Ptilonorhynchus violaceus*, Pied Currawong *Strepera graculina*, Topknot Pigeon *Lopholaimus antarcticus*, Grey-headed Flying Fox *Pteropus poliocephalus* that are bolder (and prepared to cross open ground)], then the prospects for recovery are very good if your restoration site is within 1km of an existing rainforest stand and you expect results in timescales of 10-15 years (Peel 2001 unpubl.). If your site already has a range of mature fruiting trees, and you are prepared to wait for a decade or more, then your site could be as far away as 8-14km from existing stands (**Chapter S5: Why proximity to existing bush is important**) and still have recruitment from them;
- **If you are in the subtropical climate zone** where these larger dispersal species (i.e. those that are prepared to rapidly cross open ground) are more common and less seasonal and/or sporadic than further south, then regular dispersal within years is likely over distances of 1-30km or more kilometres; and
- **Rapid regeneration** is likely (provided there are no ecological brakes operating) if your restoration site is within 500m of an existing rainforest stand (if you are in the **warm temperate climate zone** you expect results within 3-5 years (**Further Reading: mistletoes and rainforest regeneration: vital in fragmented landscapes**);

Make sure that you are not expecting dispersal before there is a reason for your dispersers to visit your site. Remember the problem with no other 'lollies' to attract them (fruit or nectar): there needs to be a good variety (or number) of mature and freely fruiting rainforest plants or prodigious nectar producers on your site first. If the landscape context for your site fits one of the above scenarios but your site has still not started to show natural regeneration from offsite, then what is the problem? It is likely that you have one or more ecological brakes (threatening processes) such as grazing, severe frost, weed invasion etc. operating on the site that are preventing rainforest from regenerating. Alternatively, the problem may be off-site (nearby remnants in poor condition or a lack of dispersers prepared to cross from there to your site. If identified correctly, you can do something about most of these ecological brakes.

Ecological brakes are very important, since they are the threats that hold back the rainforest's regeneration. Taking steps that are often quite simple such as (fencing); or relatively cheap ones (especially if applied consistently) such as weeding newly emerging transforming weeds can often rejuvenate the stand with little further assistance.

STEP 4: Can I actually do it or do I need expert help: a note of caution? [See Chapter M5 for detailed treatment]

This is a very important question. Where natural regeneration is not possible on your site; if it will take a very long time; or the adjacent rainforest stand is species-poor due to past disturbance then other restoration techniques will be required. These techniques can be very complex and may require a considerable time commitment, resources and/or a significant level of expertise.

Rainforest restoration is a bit like building a house, anyone can learn the steps if they have the patience and aptitude, but care must be taken to do a good job at each stage: foundation, framework and finishing detail, lest your work falls down around your ears. Short cuts in restoration, as with building a house, produces a poor result that may lack one or more of the fundamental elements integral to the long-term health and vitality of the rainforest stand that you are restoring. Do a good and carefully thought-out job and the results will reflect the effort and skill that you have applied to the task!

Rainforest restoration using techniques other than the Natural Regeneration Method requires a detailed understanding of many ecological principles, a good knowledge of botany and a mindset that enables you to observe natural systems and processes closely, develop hypotheses about cause and effect in these systems and an aptitude to apply these results. The bulk of this Manual is aimed at people who already have this ability or are keen to learn it, but lack experience in rainforest restoration.

The Manual provides guidance and information that will help you to successfully restore rainforests. This will work for you if you have an aptitude and a willingness to learn (or already possess these

¹ You will note that the timescales and dispersal distances are variable and disparate: it is likely that this reflects the studies and analyses that we have done: rather than any meaningful and correlated link between dispersal distance and the time required for you to notice the recruitment of rainforest plant species onto your restoration site.

abilities) and you have the time and organisational skills to apply them. You will then be able to design management techniques, schedules and actions that should ensure that the rainforest's restoration proceeds at a pace that is in harmony with the site and is achieved with the best economy of money, time and effort.

If however, you don't have these skills, the inclination or the time to learn them, but still want to proceed, it is imperative that you engage an expert who can do these tasks for you. Failure to be honest with yourself at this point will inevitably lead to a poor job, a bad result and the wasting of a lot of time, money and effort on your part as well as of those that you enlist to help you. In Victoria the experts that you need are called rainforest regenerators, whilst in New South Wales they are called bush regenerators (with rainforest regeneration experience). Their contact details are provided under **Useful Contacts**.

STEP 5: What Rainforest Restoration Methods are needed? [See Chapter M5 for detailed treatment]

There are four major Rainforest Restoration Methods and these are the:

- Natural Regeneration Method;
- Framework Method;
- Maximum Diversity Method; and
- Clumped Mixed Species Method.

The choice of restoration technique is very important and is based on a detailed site assessment before you proceed any further. The Restoration Method becomes the road map that will determine how you proceed, what further steps you may need to take and when to take them. Based on an assessment of your own resources and skills, it will also determine whether you do the job yourself, or engage someone who has the time and/or expertise to do it for you.

STEP 6: What resources and money are needed for rainforest restoration? [See Chapter M6 for detailed treatment]

There are four essential resources needed for the restoration of rainforest:

- **A site where rainforest used to once exist** or can exist now as the result of changed site conditions from those that existed historically on the site (lowered water table, less frequent or intense fire regimes etc.);
- **An agreeable land owner/manager that wants to restore the rainforest** and is willing to protect the restored area in perpetuity;
- **The skills and commitment necessary** to restore the rainforest (see STEP 4); and
- **The money and time** to undertake the task.

This step is closely related to both the Restoration Method that you have chosen and then a whole series of cycles that range from:

- **Funding cycles** (when to apply, did you succeed, can it be spent within timelines etc.);
- **Flowering and fruiting cycles** (when seed is ready, and does this match your needs?);
- **Propagation cycles**: (when can you get the seed to the nursery; is it winter growing or summer growing, how fast does it grow?); and
- **Climatic cycles** that regulate planting seasons (soil moisture for planting, frost and planting season etc.).

STEP 7: Project planning [See Chapter M7 including site assessment]

This draws together all of the previous STEPS as well as site assessment, reading the physical features of the site (such as landforms and the disturbance regimes and conditions that go with them) so that you can:

- Develop a project management plan;
- Develop a project calendar;
- Talk with your community;
- Know how to restore the site;
- Understand the threats to rainforest renewal;
- Know what to plant where;
- The sequence in which to plant; and
- When to plant it and how to look after it.

STEP 8: Project implementation [See Chapter M8 for detailed treatment]

This step covers:

- Site preparation (from vehicle access to mowing, mulching and herbicides);
- Planting (methods, species, when to plant, how to maintain your plantings until established); and

- Pest animal management (what you may encounter and how to deal with them).

STEP 9: How to measure success [See **Chapter M9** for detailed treatment]

Apart from seeing your planting establish; what other measures of success can be used to determine whether ecological health is returning to your restored rainforest stand? Two relatively easy measures that have been used to date include bird censuses and natural regeneration (but there are many others).

The species of birds that use your restored site tell you things such as the diversity of fruiting plants available, the development of the leaf litter layer, the colonisation of the site by lichens and many other factors that relate to the ecological function of the site. Similarly natural regeneration can indicate the state of the site, regeneration niches that are available and what seed dispersing mechanisms can reach the rainforest stand or the species that are using the site. It also tells you if your site is 'dispersal-connected' to another rainforest stand when species that are absent at your site begin to appear.

STEP 10: What resources are needed to maintain the restored rainforest and where to from here? [See **Chapter M10** for detailed treatment]

Rainforest restoration is the hardest part of the processes but the next phase: that of ecological management and conservation is about to begin. This phase: that of maintaining the restored rainforest is much less expensive than the restoration process itself (from our experience in fragmented landscapes: ~\$2,000ha⁻¹ year⁻¹; less in more intact areas). Any of the threats that stalled natural rainforest regeneration on your site in the first instance, may still re-occur. Awareness of the threats will ensure that you are able to anticipate them, eliminate, reduce or manage them. Be sure to identify the threats, when they occur (including their cycle of occurrence for example after floods) and their magnitude PRIOR to their appearance, so that you (as the land manager) can combat them. Early diagnosis of a threat and prompt action will keep maintenance costs and the time needed to implement them to a minimum. Now you have that all under your belt: complete the project, get organised for the next or, perhaps start a conservation management network.