Tropical Weed Identification Workshop

Student Manual

Public preview V.3 – August 2025

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JCU COLLEGE OF SCIENCE AND ENGINEERING

This publication should be cited as: Australian Tropical Herbarium (2025) *Tropical Weed Identification Manual.* ATH, JCU, Cairns, Queensland.

This manual was partially funded by the Queensland Government's Biosecurity Grants – Education (2024)

August 2025

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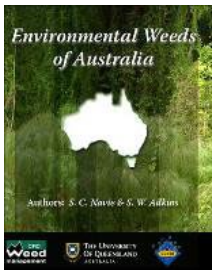
1 Introduction

Welcome to the *Tropical Weeds Identification Workshop*.

Our goal in these workshops is to teach you how to identify plants, and specifically non-native plants, in a systematic and effective manner - how to break a plant down into its constituent parts, how to describe these parts using the correct botanical terminology, and how to use this information to identify the species.

The main tools we'll be using for plant identification are the Environmental Weeds of Australia interactive key (the Weed Key), and the 8th edition of the Australian Tropical Rainforest Plants interactive key (also called the Rainforest Key, or RFK), both freely available through your web browser, and both available as paid apps).



Environmental Weeds of Australia

Covers 1019 weed species, but only 440 from tropical regions.

Intermediate botanical knowledge of botanical terminology required.

Free web (below), paid apps available.

https://keyserver.lucidcentral.org/weeds/

Weeds of SE QLD and Northern NSW

Covers 716 weed species, most of them present through Queensland.

Very simple botanical terminology. Will be used complementarily to the Environmental Weeds of Australia.

Free apps but no web.

https://www.lucidcentral.org/editors-pick-animal-plant-and-mineral-identification-keys/key-to-weeds-of-se-qld-and-northern-nsw/

Australian Tropical Rainforest Plants, Edition 8

Covers 2762 species, but only 245 of them are weeds (there is a "feature" to filter them quickly).

Excellent for rainforest native species. Deeper use of botanical terminology.

Free web (below), paid apps available.

https://apps.lucidcentral.org/rainforest/

The Environmental Weeds of Australia key was developed by Sheldon Navie and Steve Adkins of the University of Queensland to assist with the identification of weed species that invade natural habitats in Australia (*i.e.* environmental weeds). The key features a Lucid-based interactive identification key for about 1 000 plant species that are either significant, emerging or potential environmental weeds in Australia.

The Rainforest Key has been developed over four decades by Bernie Hyland of CSIRO at Atherton. Early editions utilised computer programming cards. Then, in 1993 a computer-based key was developed utilizing a unique, specimen-based coding system. In 2010, it was transferred to a Lucid format, which provides new features and enables web delivery. In this form, the Rainforest Key covers more than 10% of the Australian flora, and includes more than 11 000 specimen images, making it the largest interactive key in the world.

These workshops have been developed to guide you in the use of the plant identification tools, and are presented by the Australian Tropical Herbarium and by the College of Science and Engineering at James Cook University, with the sponsorship of the Queensland Government. We will show you how to use the Lucid system, and introduce you to a few of the botanical terms you are going to need. But before we jump into that, we need to have a bit of background on weeds, plant keys, and plant structure.

2 Plant recognition

2.1 How do you recognise a plant?

How do you tell one species of plant or animal from another? Most people rely on the overall look of a species, what birdwatchers call the *giss*, the general impression of size and shape. It's how we distinguish most things, including faces and even the words on this page.

But what happens when we come across something unfamiliar? If we encounter a new word, we break it down into its constituent syllables or letters. If we come across a new plant, we must do the same thing – consider its constituent parts (leaves, flowers, bark, growth form) and describe each of these parts. This is how plant identification keys are created. Through careful examination of each plant species, the characteristics of the leaves, bark, flowers, fruits, growth form, seedlings and geography have been described, and this has created a unique character set for each species.

The intention of this course is to teach you identify weeds of tropical rainforests using two different interactive keys. To do this, it is important to be able to look at plants in a systematic way, and to recognise the features that will help you with this identification.

DISCUSSION: We've provided you with an example of a common weed. Do you know what it is? If yes, why have you made that decision: what are the features of the specimen that make it distinctive?

The purpose of this exercise is to identify the plant from the distinctive and unique combination of definable features. What are the features that helped you distinguish this species? Describe these features in your own words.

3 Workshop overview

3.1 Workshop Modules

The workshop in which you are now participating provides you with an introduction to identification of weeds that occur in the Australian tropics. The standard workshop is a two day course, but a shortened one is sometimes available.

3.2 Workshop structure (two day workshop)

The workshop is designed for presentation as a two-day stand-alone course. The timing of events for the two-day course is flexible, but a nominal timeframe is provided below. We have set times for morning tea and lunch, but feel free to help yourself to tea/coffee at any time.

Table 1 Workshop program

Title	Content	Timing
Day 1		
Part 1 – Introduction and course overview.	Staff and participant introductions Housekeeping Course overview	0900 - 0930
Part 2 – What is a weed?	What is a weed? What is an environmental weed? Impacts on ecology. Weed legislation (brief), binomial nomenclature (plant naming).	0930 – 1015
Morning tea		1030 – 1100
Part 3 – Plant identification skills.	Introduction to plant structure focusing on leaves. Review of the terminology used in plant identification	1100 - 1230
Lunch		1230 – 1300
Part 3 – Continued...	Field work – check out weeds that grow in and around the workshop venue. Discuss the features introduced in the pre-lunch session and collect specimens for identification. We'll spend some time identifying these specimens this afternoon, and then learn how to press them tomorrow morning.	1300 - 1600
Day 2		
Part 3 - Continued	Introduction to plant structure: flowers, and fruits. Continue with weed identification started yesterday. Plant pressing.	0900 – 1000

Title	Content	Timing
Morning tea		1030 – 1100
Part 3 – Continued...	Field work –discuss family spot characters. Collect some specimens for identification this afternoon.	1100 - 1300
Lunch		1300 – 1330
Part 3 – Completed	Plant identification using the Lucid-based keys.	1330 – 1500
Test		1500 - 1600

3.3 Workshop structure (one day workshop)

In some cases, the module will be presented as a one-day course. This will only be done where participants have completed the ATH's workshop "Introduction to Rainforest Plant Identification".

Table 2 Workshop program

Title	Content	Timing
Day 1		
Part 1 – Introduction and course overview.	Staff and participant introductions Housekeeping Course overview	0900 – 0930
Part 2 – What is a weed?	What is a weed? What is an environmental weed? Impacts on ecology. Weed legislation (brief), binomial nomenclature (plant naming).	0930 – 1015
Morning tea		1015 – 1030
Part 3 – Plant identification skills.	Introduction to plant structure focusing on leaves. Review of the terminology used in plant identification. Practice identification using samples provided.	1100 - 1230
Lunch		1230 – 1300
Part 3 – Plant identification skills.	Field work – check out weeds that grow in and around the workshop venue. Discuss the features introduced in the pre-lunch session and collect specimens for identification.	1300 - 1430
Part 3 – Plant identification skills.	Plant identification practice.	1430 - 1600

3.4 Equipment required

3.4.1 The specimen

The most important piece of equipment is fresh, leafy specimen from the plant you want to identify. If reproductive parts (*e.g.* flowers, fruits) are available, choose these as well. Your specimen should be about 30 cm long, have healthy mature leaves and maybe a few new developing leaves. It's good to have freshly picked specimens, but if you can't identify it straight away, wrap it in wet newspaper and put it in the fridge. Most specimens will keep in good condition for nearly a week if treated like this. Plants stored in a simple plastic shopping bag will quickly dry out and be hard to identify.

3.4.2 Notebook

It's good to carry a pen and notebook, so you can note features such as:

- Plant height and growth form
- Colour and fragrance of freshly picked flowers or fruits
- Characteristics of the place where the plant was growing (*e.g.* creek bank, ridge top, steep north-facing hillslope)

If you can, write your notes on the back of a leaf on the specimen, or in a little piece of paper attached to it. These features will help you identify the plant when you are at the computer.

3.4.3 Hand lens

Many of the features described, such as stipules and oil dots, require a hand lens to see them. A hand lens is a good investment if you are going to be doing a lot of plant identification. Good quality, reasonably priced hand lenses can be purchased from the Australian Tropical Herbarium and many physical and on-line retailers.

3.4.4 Ruler

A 30 cm ruler is a useful tool for measuring plant parts such as leaves, seeds and flower sizes.

3.4.5 Secateurs

A good sturdy pair of secateurs is a useful tool for plant identification, both in the field and at the computer. Key features you'll discover using secateurs include fruit features such as seed size and number. Clipping specimens from a tree is preferable to breaking them, as the jagged edges of breaks are more likely to admit diseases and pests. Make sure secateurs are cleaned thoroughly after each use, as a dirty pair can transfer diseases between plants.

3.4.6 Plastic bag

The best way to store specimens is in a plastic bag. Use heavy duty plastic bags such as large sized zip-lock bags. Regular shopping bags and garbage bags are made from lightweight material that permit flow of moisture, which means that plants stored within will rapidly wilt. If practical, store specimens in a refrigerator or esky. Keeping weeds in a plastic bag also reduces the risk of seed spread from loose specimens.

PERSONAL COMFORT

This workshop will be presented both in the classroom and in the field. We will not be venturing too far from the classroom, but we may be outside during the heat of the day. To undertake this workshop, you will need the following:

1. Appropriate personal protective equipment (PPE) – sturdy footwear, clothes suitable for field work, sun protection and insect repellent

2. Lunch, water.

We will supply you with hand lenses and forceps taht you need to run the interactive keys. You need to bring a laptop or tablet to use the on-line identification keys. Phones can be used too but are inconvenient due to their small screen.

If there are any weeds you'd like to attempt to identify as part of the course, feel free to bring them along.

3.5 Learning outcomes

The focus of this workshop is weeds of the Australian tropics. Examples and discussion points all refer to alien plant species that occur in or around northern Australia. The skills you learn in this workshop will provide you with sufficient information to identify most weeds on your own. It will also help you identify when you are NOT going to be able to identify a species. For example, to successfully identify most grasses, you need fruit, flowers and/or a microscope to examine them.

The module will also provide you with important background information, including:

- A discussion of environmental and economic weeds;
- An overview of the hierarchical classification system and the system of binomial nomenclature; and
- How to press and preserve plant specimens.

In the next part we discuss the question "What is a weed?"; look at various aspects of weed control legislation, and then introduce the concepts underlying the proper scientific naming of plants.

UNITS OF COMPETENCY

The module structure has been designed around a framework provided by two units of competency established under national Vocational Educational Training guidelines. These units of competency are RTC2016A – Recognise plants and RTD2004A – Collect, prepare and preserve plant specimens.

In summary, the learning outcomes for each of these competencies is:

RTC2016A – Recognise plants

- Prepare for plant recognition
- Recognise specified plants
- Complete recognition of plants

RTD2004A – Collect, prepare and preserve plant specimens

- Collect specimen
- Press plant
- Record data

4 What is a weed?

4.1 Key objectives

- Understand what is meant by the word weed
- Describe the different roles of Commonwealth, State and Local Government in weed control

4.2 Defining a weed

Before launching into a discussion of how to identify weeds, it is important to give some consideration to what is meant by the word weed. Consider the plants illustrated below: are any of them weeds?

Figure 1 Which of these are weeds?

DISCUSSION: Examine the three photos. What are these plants? Which are weeds and why?

The impacts of alien invasive species are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats.

Invasive Species Specialist Group of IUCN

The International Union for the Conservation of Nature (IUCN) regards alien invasive species as one of the greatest threats to biological diversity. The impacts caused by alien species are well documented and often tragic:

Cinnamomum camphora (camphor laurel)[1]

- Camphor Laurel (Cinnamomum camphora) is a large tree whose leaves give off a distinctive, strong camphor smell when crushed.
- A native of Asia, it is widely naturalised in Australia, although it is most commonly found in coast south-east Queensland and north-east New South Wales.
- Seeds are mainly spread by birds.
- It can quickly take over native and agricultural lands, promoting erosion and poisoning baby fish, invertebrates and tadpoles.
- Saplings and older trees are best controlled with a combination of physical removal and chemical treatment.

Pueraria montana var. lobata (kudzu)[2]

- Scattered in the coastal districts of eastern Australia. It is naturalised in northern, central and south-eastern Queensland and in the coastal districts of northern and central New South Wales. It is also naturalised on Norfolk Island.
- A weed of riparian vegetation, moist forests, watercourses, roadsides, waste areas and disturbed sites in warmer temperate, sub-tropical and tropical regions.
- Queensland: Class 2 - landowners must take all reasonable steps to keep land free of this species (throughout the entire state, except the Torres Strait Islands). It is also illegal to sell a declared plant or its seed in this state.

[1] Weeds Australia (not dated) Weed profiles. Camphor laurel https://weeds.org.au/profiles/camphor-laurel-tree/. Date reviewed: 20 April 2025.

[2] Weeds of Australia (not dated). Kudzu. https://keyserver.lucidcentral.org/weeds/data/media/Html/pueraria_montana_var._lobata.htm Date reviewed: 20 April 2025.

Mimosa pigra (giant sensitive plant)[3]

- Native to tropical America, the shrub spreads aggressively in moist environments and establishes dense thickets that smother other vegetation. It is a serious problem in several tropical countries and is well-established across 800,000ha of floodplains in the Northern Territory. It has the potential to colonise other wetlands in tropical Australia.
- In Queensland, *Mimosa pigra* has been found at Peter Faust Dam near Proserpine.
- You must manage the impacts of *Mimosa pigra* on your land.
- You must not give away, sell or release *Mimosa pigra* into the environment.
- You must report all sightings to Biosecurity Queensland within 24 hours.

Andropogon gayanus (gamba grass)[4]

- Native to Africa's tropical and subtropical savannas, Gamba grass is a perennial tussock grass introduced to many parts of the world for use as an improved pasture plant.
- Gamba grass was imported into Queensland as a pasture grass in 1942, but was not planted on a large scale until about 1983. Gamba grass is a useful cattle feed in parts of far north Queensland, but also has significant negative impacts, including replacing native plants and increasing fire risk.
- Gamba grass is a category 3 restricted invasive plant under the Biosecurity Act 2014. It must not be given away, sold, or released into the environment. Penalities may apply.

Weeds typically produce large numbers of seeds, assisting their spread and are often excellent at surviving and reproducing in disturbed environments. A weed can be an exotic species or a native species that colonises and persists in an ecosystem in which it did not previously exist.

Undoubtedly there are many weeds that pose significant environmental and economic threats. And yet, a simple definition of a weed is problematic, and open to individual interpretation. One person's weed is another person's food plant, garden ornament or source of income. Plants that fit into these three categories are illustrated on page 10: (a) *Mangifera indica,* (b) *Heptapleurum actinophyllum* and (c) *Lantana camara.* Few people would argue with calling Lantana a weed: it is recognised as a

[3] Business Queensland. Restricted Invasive Plants. *Mimosa pigra*. https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/invasive/restricted/mimosa-pigra. Date reviewed: 20 April 2025.

[4] Business Queensland. Restricted Invasive Plants. Gamba grass. https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/invasive/restricted/gamba-grass. Date reviewed: 20 April 2025.

significant environmental and economic weed by local, State and Commonwealth governments. Yet it was originally imported from its native South America as a colourful, hardy garden plant. On the other hand, *Heptapleurum actinophyllum* is a native of tropical Australia, where it is a widespread and attractive rainforest tree. It has been widely planted as an ornamental tree in south-east Queensland (and Hawaii), where it has escaped cultivation, and can be found invading native vegetation. It is now recognised by Brisbane City Council as an environmental weed[5]. Similarly, *Mangifera indica* produces a crop worth tens of millions of dollars to the Queensland economy, yet it has proven to be a successful invader of moderately intact forests within the Wet Tropics Bioregion[6]. What constitutes a weed is therefore dependent on the context: in a plantation a mango tree is a desirable economic asset; in a national park it is a weed that displaces native species and disrupts natural food chains.

Australia spends considerable time and money each year in combating weed problems and protecting ecosystems and primary production on private and public land. Weed problems are complex, with multiple causes, and efforts to reduce their impacts must be coordinated across all sections of society. Because of the competing interests that might be affected by weed declarations, official definitions of the word 'weed' are varied and often carefully worded:

> *'A weed is any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity.'* [7]
>
> *'Pest plants… are species that occur beyond their natural range and have the potential to cause significant adverse economic, environmental and social impacts'* (Queensland Government 2009)[8]
>
> *'a wild plant growing where it is not wanted and in competition with cultivated plants'* (Compact Oxford Dictionary 2010)

In general, a weed is any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity.

For the purposes of this workshop, the first of these definitions will suffice, although it will be useful to be mindful of the others.

4.3 Weeds in different habitats

4.3.1 How to distinguish and understand the characteristics of different habitats?

The intention of this workshop is to focus on weeds that occur across the Australian tropics, with an emphasis on north Queensland. This includes many different sub-types of climates and habitats. Therefore, it is important that we not only consider what defines a weed, but also what features of a vegetation community determine which weeds will be able to thrive in it.

Vegetation communities can be defined by its structural features, that is, the physical characteristics of the vegetation. One important characteristic is canopy cover. Canopy cover refers to the amount of cover provided by the tallest layer of trees in the forest. It can be thought of as the amount of shadow cast by the forest canopy when the sun is directly overhead (technically known as projected foliage

[5] Brisbane City Council. Weed Identification Tool (not dated). https://weeds.brisbane.qld.gov.au/weeds. Date reviewed: 24 April 2025.

[6] Werren, G, 2001. *Environmental Weeds of the Wet Tropics Bioregion: Risk Assessment and Priority Ranking.* Rainforest CRC, Cairns. 76pp + Appendices.

[7] https://weeds.org.au/national/. Date reviewed: 24 April 2025.

[8] https://parks.desi.qld.gov.au/management/programs/pest-plants-animals. Date reviewed: 24 April 2025.

cover). Where the average canopy cover for a community is greater than 70%, it is deemed a closed forest. Where the canopy cover is 30-70%, the community is deemed an open forest, less than 30% is woodland, and less than 10% is open woodland.

Figure 2 A rainforest has a closed canopy, with little direct light reaching the forest floor.

Figure 3 This woodland community has a sparse canopy, allowing abundant light to reach the ground stratum.

For instance, a rainforest is both by definition and intuitively a closed forest. When you walk into most rainforests, you know it because its canopy lets through little light, even on the brightest of days. But there's more to defining a rainforest than that. In the 1999 edition of the RFK, rainforest is described as:

> *'[encompassing] a wide variety of closed forest types in the higher rainfall areas of northern Australia. It does not include open eucalypt forests or mangrove forests, although it does include closed forests on sand dunes near the sea.'*

On the contrary, another important Queensland habitat, the savanna, is characterised by a dominance of grasses and the presence of trees at low to medium densities. Typically, the canopy of trees is discontinuous and not closed, and allows plenty of light to go through to the grasses underneath.

Habitats are not usually defined by any one species or group of species (although there are exceptions), but rather by the structure of the plant communities that inhabit a specific area with specific climate and geology. Different habitats will present different challenges to introduced species, and would be likely to be invaded by different weeds. For instance, in the absence of disturbance, rainforests, with closed canopies that do not let much light go through, will be invaded primarily by shade tolerant weeds.

4.4 Each habitat hosts different weeds [9]

Most familiar weeds are plant species that are favoured by disturbance. Disturbance processes, such as landslides, road works or using a spade to turn over a garden bed, lead to loss of ground cover, disturbance of the soil surface, removal of competing species and (sometimes) nutrient inputs. The environment thus created provides an opportunity for invasion of short-lived, light-loving weed species that produce abundant small, easily-dispersed seeds. Familiar examples of this include *Themeda quadrivalvis* (grader grass) and *Praxelis clematidea* (praxelis). Given the right circumstances, larger weeds can take hold and dominate disturbed areas: *Ziziphus mauritiana* (chinee apple) and *Cryptostegia grandiflora* (rubber vine) provide particularly spectacular examples of large, long-lived weeds in drier areas of northern Australia.

In savannas, grazing and fire are prime examples of disturbance, with grazing having the additional impact of being particularly suitable for seed dispersal by animals. Obviously the purposeful introduction of grasses and other species for pasture has been historically a main factor of both disturbance and weed invasion. In a rainforest environment, introduced plant species can gain a foothold when there is a clearing created by a cyclone, flood, or clearing. However, to go beyond that area, a plant species must be able to establish itself in the low-light environment of the forest floor, survive for long periods in that location, and effectively compete with a vast array of other species.

At any habitat, there are several factors which may give an alien plant a competitive advantage:

- Often, the absence of their natural pest species that are not present in Australia provides a boost for alien species, as they have nothing chewing their leaves, destroying their seed or boring into their wood, they may also have escaped specialized pathogens.
- Many invasives present very fast growth rates, even in the early establishment phase of its life cycle, the ability to outgrow other plants in its environment allows it to take better advantage of nutrients in the soil and available light.
- In the growth phase of its life cycle, it might be able to more rapidly take advantage of sudden increases in light brought about by nearby fallen trees, or produce chemicals that inhibit the growth of its neighbours (allelopathy);
- In the reproductive phase of its life cycle, the weed may produce large quantities of long-lived, highly dispersible seeds.

Rainforest weeds that exhibit some or all of these features include *Spathodea campanulata* (African tulip), an invasive canopy tree, *Annona glabra* (pond apple), which can come to dominate coastal swamps and *Sphagneticola trilobata* (Singapore daisy), which smothers creek banks in near-urban areas.

The impacts of weeds on rainforest environments are varied and often substantial. They include:

- competition with native plants for light, nutrients, moisture, pollinators; and they smother or crowd the soil;
- replacement of native plant communities;

[9] Adapted from Werren, G 2000. *Environmental weeds of the Wet Tropics bioregion: risk assessment and priority ranking*. Report prepared for the Wet Tropics Management Authority, Cairns.

- prevention or inhibition of natural regeneration;
- change in the movement of water in both soil and watercourses;
- increase of soil erosion by shading out ground plants which would normally hold surface soil together;
- change in the shape of the land (*e.g.* different grass types on coastal dune systems may introduce poisons into the soil that prevent other stabilising plants from growing);
- provision of food and/or shelter for pest animals (including indigenous pest animals such as cane rats);
- change in water quality characteristics;
- introduction of foreign genes into local populations by hybridisation (cross breeding and gene swamping);
- changes in fire behaviour by altering quantity and flammability of fuel loads; and
- alteration of disturbance regimes.

Despite their serious impacts on natural environments, rainforest weeds rarely impact significantly on people's income – therefore they are not significant economic threats. Thus, many of the alien species described in this document do not have a legislated requirement for their control. They are considered environmental weeds.

4.5 Weed control in Australia

Weeds are either native species that are colonising ecosystems in which they did not previously exist (*Heptapleurum actinophyllum* is an example), or they are exotic plants introduced to Australia that have formed naturalised populations. Some introductions have been accidental, but most exotic plants have been introduced as garden plants, livestock fodder plants or other horticultural plants: two thirds of the ten or so new weeds reported each year in Australia are escaped garden plants.

Of the 28,000 plant species introduced into Australia from all over the world, approximately 2,700 have formed self-supporting populations in the natural environment[10], that is, they are maintaining their presence through successful reproduction.

Sometimes plants that are now weeds have only become so years after they were first introduced, so-called 'sleeper weeds'. These plants may be currently restricted in their range for a variety of reasons including the absence of suitable environmental conditions. If conditions change in the future these plants may spread and have the potential to cause extensive damage to Australia's natural environment and agricultural systems.

Some weeds are of particular concern and, as a result, have been listed for priority management or in legislation:

[10] *Australian Weeds Strategy 2017-2027.* https://www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/pest-animals-and-weeds Date reviewed: 24 April 2025.

- Thirty-two Weeds of National Significance (WONS)[11] have been identified because of their invasiveness, impacts on primary production and the environment, potential for spread and socioeconomic impacts.
- The National Priority List of Exotic Environmental Pests, Weeds and Diseases[12] focuses on exotic pests, weeds and diseases that are not established in Australia and pose the highest risk to our environment and public spaces. This list will be used to enable activities that help prevent the entry, establishment and spread of exotic pests and diseases.
- There are six species targeted for national eradication[13] under the Natural Resource Management Ministerial Council's National Cost-sharing Eradication Program.

Some weeds are listed as target species for biological control through a cross-jurisdictional government process that allows for research on biological control for that weed.

Legislative control indicates that someone has a legal responsibility for management. In general, responsibility for management lies with landholders or managers, with enforcement of laws a State and local government task. Collective action is necessary where the problem is beyond the capacity of the individual landholder or land manager to address. Successful weed management requires a coordinated national approach which involves all levels of government in establishing appropriate legislative, educational and coordination frameworks in partnership with industry, landholders and the community. Funding for this management may arrive from National, State or local bodies, with rules, policies and regulations in place at all levels to ensure the funding is directed to where the funding body perceives it is needed most.

4.6 The Commonwealth's role in weed control

The Commonwealth has significant land area under its control – including large land areas utilised for Defence purposes. On these lands it is responsible for on-ground weed management. Beyond these lands, however, the Commonwealth plays a number of important roles in coordinating weed management at a national level. The Australian Government has a range of legislation that regulates the import of plants into Australia, including potential new weeds. The legislation is enforced at Australian borders by the Northern Australian Quarantine Service (NAQS) and the Australian Customs Service. A plant could be prohibited, could be allowed entry, or may require a permit. People planning to import any plants or plant material need to check on the requirements under the legislation before they import.

Firstly and most importantly, the Commonwealth is constitutionally[14] responsible for quarantine matters. This means Commonwealth officers are on the front line in assessing plant materials imported into Australia for weed risk, and for ensuring that foreign weed species are recognised and prevented from invading Australian environments. More than 70% of plants now considered to be weeds in Australia were intentionally imported for garden or agricultural use.

Because Australia is an island it has some protection from invasion by foreign plants. However, with increased trade and human movement across our borders comes an increased opportunity for potential

[11] https://weeds.org.au/lists/established/ Date reviewed: 24 April 2025.

[12] https://weeds.org.au/lists/surveillance/ Date reviewed: 24 April 2025.

[13] https://weeds.org.au/lists/eradication/ Date reviewed: 24 April 2025.

[14] The Australian Constitution, Section 51 (ix).

movement of plants. Weeds, or parts of weeds such as seeds, are small enough to enter Australia in or on luggage, cargo, mail, equipment, vehicles, food, animals, plants, bulk seed imports or even people.

In a related role, the Commonwealth is also responsible for identifying targets for biological control. For example, *Anredera cordifolia* (Madeira vine) has been identified as a severe invasive weed in the subtropics (it is present in the tropics but not currently in high densities), and a leaf eating beetle has been identified as potentially suited as a biological control agent. However, before any biological control agent is released into the Australian environment, extensive experiments are conducted to ensure that the agent will not damage native flora, fauna or agricultural stock or crops. The Commonwealth funds this research, and implements release programs.

The Commonwealth funds extensive weed management programs across the country. Funds are directed to State and locally-based weed control programs. To better direct these funds, the Australian Weeds Strategy, developed in consultation with State agencies, has been developed which outlines goals and actions needed to reduce weed impacts.

4.7 The State's role in weed control

In the State of Queensland, the legislation that deals with weed control is the *Biosecurity Act (2014)*, complemented by the Queensland Invasive Plants and Animals Strategy 2025-2030. The Biosecurity Act classifies biosecurity risks into seven classes of **restricted matter**, depending on the level of threat. A single species can belong to more than one category (!).

https://www.dpi.qld.gov.au/business-priorities/biosecurity/policy-legislation-regulation/biosecurity-act-2014/biosecurity-matter-report/restricted-matter

- Categories 1 and 2: **Must be reported within 24 h to Biosecurity Queensland on 13 25 23**. Examples include some *Miconia* species, some *Opuntia* species, and many others.
- Category 3: Must not be distributed either by sale, or gift, or released into the environment.
- Category 4: Cannot be moved unless under a permit.
- Category 5: Cannot be possessed or kept.
- Category 6: Cannot be fed to animals.
- Category 7: Cannot be used for production purposes (e.g. some ornamental or crop plants).

In addition to these, all Queensland residents are expected to comply with a General Biosecurity Obligation (GBO), and to take reasonable and practical steps to minimise the risks associated with invasive plants.

4.8 Local government's role in weed control

In Queensland, the main drivers for directing weed control by local governments are the Pest Management Plans, more recently named Biosecurity Plans. They are developed and implemented by local governments, who are, in general, best placed to assess knowledge of local weed infestations, and the practicalities of their control or eradication. They:

- Identify pest plants and animals within the council area. This includes, but is not restricted to, pests declared under the Biosecurity Act. For example, the Cairns City Council Biosecurity Plan[15] identifies *Castilla elastica* (Panama Rubber), a highly invasive South American rainforest tree, as High priority for control. The species is not mentioned in the Biosecurity Act.
- Outline control strategies and priorities for weed management.
- In a perfect world, are reviewed and updated every 5 years.
- Provide for the enforcement of pest control in areas under the Council's control.

Some example local plans:

Cairns Regional Council Biosecurity plan:
https://www.cairns.qld.gov.au/__data/assets/pdf_file/0008/650564/CRC_Biosecurity_Plan_2025-2030.pdf

Townsville Regional Council:
https://www.townsville.qld.gov.au/__data/assets/pdf_file/0004/101011/Biosecurity-Plan-2025-2030.pdf

4.9 Some resources for weed identification

See below some of the most useful guides for weed identification in Australia and northern Queensland.

Grass guides by Nanette Hooker (JCU) are an invaluable resource for that family:

https://researchonline.jcu.edu.au/view/jcu/2246BEDF642C9DD464CE0270D52B54A8.html

Keybase is another on-line resource useful to identify native plants more broadly:

https://keybase.rbg.vic.gov.au/

[15] Cairns City Council, 2005. Cairns City Council Pest Management Plan 2019-2024. Not updated as of 24 April 2025. https://www.cairns.qld.gov.au/community-environment/trees/weeds-and-land-management

5 The use of scientific names

5.1 Key objectives

- Discuss the need for carefully defined scientific names
- Understand why Latin is used for scientific names
- Describe the hierarchical structure used in plant classification

5.2 What is a name?

Throughout this workshop we'll mostly use scientific names instead of common names. At first the use of scientific names can seem challenging, but their use is absolutely imperative in order to avoid ambiguity when referring to plants.

The purpose of a name is to act as an easy form of reference. To be scientifically useful, a name must refer to the same object for all who use it. If the same name refers to different objects, confusion reigns. For example, to some in Queensland, a stinking roger is a member of the mint family, *Mesosphaerum suaveolens*. In the New South Wales, the same name applies to a daisy, *Tagetes minuta*. Although both plants have fragrant leaves, they are in no way related; therefore the name stinking roger is not scientifically useful. In Europe, with its diversity of languages and regional dialects, the confusion created by local common names lead to the development and widespread acceptance of the scientific naming system over 250 years ago.

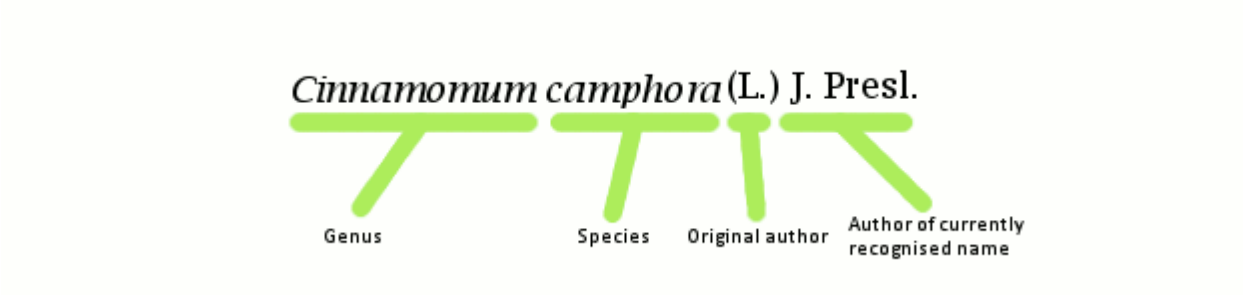
SOME INTERESTING NAMES

Here're some interesting names that taxonomists have given to species occurring in the Wet Tropics region:

Passiflora foetida	Genus name means 'passion flower', with a structure symbolic of Christ's Passion. Species names refers to the foetid (stinking) smell of the crushed leaves
Harungana madagascariensis	Species was first discovered in Madagascar
Tithonia diversifolia	This species name means diverse foliage *i.e.* its leaves occur in many shapes and sizes
Thunbergia grandiflora	The genus is named after Carl Peter Thunberg. The species name means grand flowers, *i.e.* its flowers are large
Senna hirsuta	The species name means hairy or hirsute.

5.3 How is a species named?

This identification workshop is all about learning how to get to the right scientific name for a plant. Before we talk about identifying plants, we'll briefly mention how a scientific name is created. An example of a scientific name is the common invasive tree, the camphor laurel, *Cinnamomum camphora* (L.) J.Presl. The scientific name is made up of several parts:



The genus name is always capitalised; species name is always in lower case. In scientific documents, you will generally find the author's name or names after the description, as shown above. In printed text, the plant's scientific name is usually italicised. Handwritten names are underlined.

The author is the person who has published the currently accepted name. Authors' names are usually abbreviated, for example the abbreviation 'L.' refers to Carl Linnaeus. In the example above, Linnaeus was the first person to describe the taxon (he called it *Laurus camphora*), whilst the Bohemian scientist Jan Svatopluk Presl recognized the species as described by Linnaeus, but transferred it to a different genus (*Cinnamomum*) and changed its name to *Cinnamomum camphora*. The old name, *Laurus camphora* now becomes a **synonym** – an alternative but outdated name. This name change is further explained in the break-out box 'Why Names Change'.

WHY NAMES CHANGE

When the first version of the computer-based Rainforest Key was published in 1993, it covered 1054 tropical rainforest tree taxa, of which about 8% were undescribed or of uncertain affinity. Since then, our understanding of the tropical rainforest flora has moved ahead in leaps and bounds, with additional field collections and herbarium-based research enabling the formal description of many species and varieties. But this research often changes our understanding of a species and its relationships to other plants – two populations that were previously considered separate species may be merged into one, or different populations of one species may be recognized as new species. Because of this, names change.

Description and publication of a name is not always the end of the process. Subsequent researchers may reach different conclusions, resulting in name changes. For example, the camphor laurel was first described by Linnaeus as *Laurus camphora* in 1753. A closer review undertaken by J. S. Presl and published in 1825 concluded it belonged to a group closely related to cinnamon. The species was therefore transferred to the genus *Cinnamomum* and renamed *Cinnamomum camphora* (L.) J. Presl. Note the original author's name has been retained, but relegated to brackets, whilst the new author is recognised.

The assignment of names of plants and animals is called nomenclature, and is carried out by scientists called taxonomists. Naming of plants is governed by a set of rules called the International Code of

Botanical Nomenclature (the ICBN). A fundamental provision of the ICBN is that scientific plant names must be Latin ones, or at least treated as such even if derived from other languages. Latin was chosen for a number of reasons:

- Historically, it was the language of learned persons in Europe, where the science of botany developed. Therefore, communication of science was carried out in Latin, and it was a natural progression to apply Latin names to the objects of scientific study. It very early became established as the language of botany, and that convention has continued to this day.
- As it is a dead language, the use of Latin avoids any element of nationalistic bias or jealousy.

Naming of species follows a set procedure set down in the ICBN. For the new species being named (or described), specimens must be carefully studied, and flowers, fruits, leaves and sometimes seedling characteristics must be precisely described. A formal Latin diagnosis must be prepared, a preserved herbarium specimen that best represents the characteristics of the new species is selected to become the **type**, and the name and description published. The **type** is the reference standard for the species name (**Figure 4**). They must be treated with special care, as they may need to act as reference material for hundreds of years, for example, the type for *Parthenium hysterophorus*, described by Linneaus, is over 250 years old. It can be viewed online at https://linnean.access.preservica.com/uncategorized/IO_354d0fdb-fe58-4275-9c12-bbb96b5acd8d/ [16].

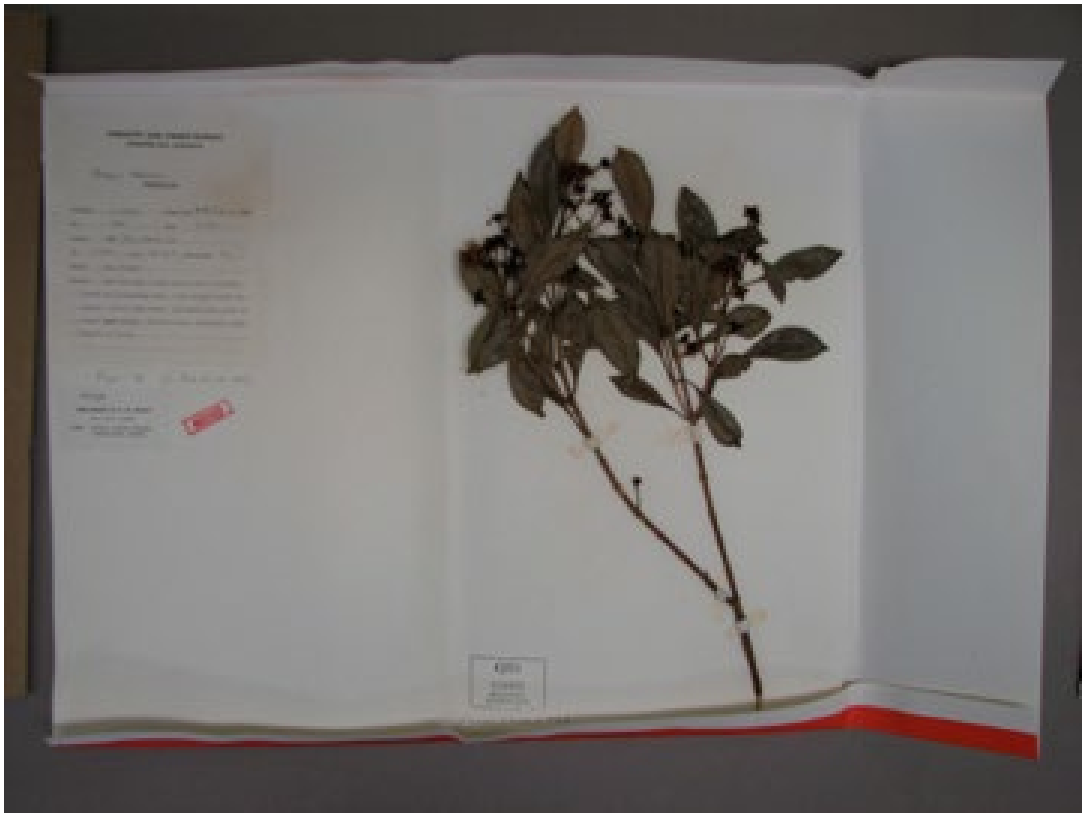


Figure 4 The type specimen for *Syzygium papyraceum*, held in the Australian Tropical Herbarium, Cairns.

[16] Website reviewed April 2025.

In Australia, currently accepted plant names are listed in the Australian Plant Name Index (APNI – www.anbg.gov.au/apni[17]). This index is maintained by the Australian National Botanic Gardens as part of its larger Integrated Botanical Information System database, in collaboration with the Centre for Plant Biodiversity Research and the Australian Biological Resources Study.

WATCH FOR THE STARS

Often when weed species are listed you'll see their name preceded by a star, or asterisk (*) *e.g.* **Sphagneticola trilobata*. This means the species named is not native to Australia. An asterisk is not used for Australian native species that are found outside their natural range.

*****

5.4 What is a plant family?

Although genus and species provide you with an easy reference for a particular plant, it can often be useful to know groups of related plant species. When assigning names, taxonomists seek to give names that have meaning and reflect the species evolutionary descent and its relationships with other species. Taxonomists recognise a hierarchy of groups, each containing a larger number of related species than that preceding it. For example:

Kingdom: Plantae (including all green plants)

Division: Magniolopsida (all flowering plants)

Order: Laurales (includes Lauraceae, Monimiaceae, and five other families)

Family: Lauraceae (includes *Cinnamomum*, *Cryptocarya*, *Persea*, *Cassytha*, *Neolitsea*, about 45 other genera.

Genus: *Cinnamomum* (includes over 300 species of cinnamon)

Species: *Cinnamomum camphora* (includes all members of this weedy tree species, which has become established in New South Wales and Queensland)

For common usage, the most useful grouping is the family. Plant families provide a useful way of grouping related plant genera. Many plant families are familiar and often intuitive to the non-specialist. For example, all daisies belong to the Asteraceae and peas belong to the Fabaceae. Family names use a genus as the base name, and always end in '-ceae'. Thus, *Cinnamomum camphora* belongs to the family Lauraceae, a name based on the genus name for the northern hemisphere laurel, *Laurus*. Other genera in the Lauraceae include *Persea, Cryptocarya* and the parasitic weed *Cassytha*.

[17] Website reviewed April 2025.

Recent years have seen our understanding of the evolutionary relationships between plant families undergo a major transformation. New technologies that allow for the rapid and cheap unravelling of the DNA code have allowed scientists to sequence genes from hundreds of species, with these sequences being made publicly available as soon as they are confirmed. Sophisticated statistical programs allow comparison of these sequences and analysis of their relationships. The outcomes have in most cases reinforced our understanding of evolutionary relationships between different groups of plants, but occasionally lead to major revisions. The outcomes of these international collaborative studies are published by the Angiosperm Phylogeny Group[18], and are continually updated and revised in the light of new research. The Rainforest Key has included the new family concepts described by the Angiosperm Phylogeny Group, and this is reflected in the inclusion of a number of new families (Putranjivaceae, Dipentodontaceae) and the major restructuring of others (Scrophulariaceae, Euphorbiaceae, Flacourtiaceae).

Despite the major revisions described above, plant families must comprise related plant species, and related plant species must have many things in common with one another. Thus, many plant families can be accurately determined based on observations of a few leaf or floral features. It's worth getting to know a few, as this knowledge is invaluable in narrowing down the identity of the species at hand.

[18] http://www.mobot.org/MOBOT/research/APweb/ . Date reviewed: 24 April 2025.

6 Using Keys for Plant Identification

6.1 Key objectives

- Describe different kinds of keys and how they are used to identify things.

6.2 Introduction

In the preceding sections we've looked at what defines a weed, their significance and the laws that regulate their management. We can now move on to developing an understanding of the plant features needed for successful plant identification.

6.3 What is a key?

A key is a tool that facilitates the identification of an unknown thing. Keys can be built to identify any group of things, for example, the larvae of aquatic insects, the different rainforest communities of the Wet Tropics or the frogs of New South Wales. There are two main types of keys – dichotomous and interactive or multi-access keys.

6.3.1 Dichotomous keys

Dichotomous keys are the most common keys encountered. They may be laid out in various ways, but usually form a series of numbered questions arranged in **couplets**. A group of rainforest weeds is illustrated below, and a dichotomous key for their identification follows.

Physalis

Ipomoea

Ageratum

Centrosema

Macrotyloma

Solanum

1	Leaves simple ..... Leaves compound	2 4
2	Leaf margins entire (not toothed), plant a twining vine ..... Leaf margins toothed, plant an erect herb	*Ipomoea* 3
3	Flower heads blue or mauve ..... Flowers yellow or green	*Ageratum* *Physalis*
4	Flowers regular, star shaped, in bunches at the end of stems ..... Flowers pea-shaped, borne along stems	*Solanum* 5
5	Flowers green ..... Flowers blue	*Macrotyloma* *Centrosema*

Dichotomous like the one above keys suffer from one problem – the unanswerable couplet. For example, the key may ask questions about fruit features. If you've collected the plant in the wrong season, no fruits will be available. Since the user of a dichotomous key has no choice about the order in which features have to be dealt with, if a couplet is difficult or impossible to answer, the identification session often ends, or you have to continue by guessing.

Despite this shortcoming, most plants can only be identified with reference to dichotomous keys, and they provide a vital primary or backup reference for plant identification. The Flora of Australia series[19], published by CSIRO and the Australian Biological Resources Study, is the most complete reference for many Australian plant families and uses dichotomous keys for identification.

6.3.2 Interactive or matrix keys

Interactive keys, also called matrix keys, multi-entry keys or computer keys, do not suffer the unanswerable couplet problem because they allow you to start at any point you choose and to proceed in any order you choose. Computers are ideal to handle such keys. In its database, the key contains all the information about the taxa that are to be identified. The user chooses a state of a selected feature, and the key discards those species that do not have that particular state. Next, another feature is chosen and the same process is repeated. You can avoid features that are difficult for you (indeed, it is advisable to leave such features out) or not appropriate for your specimen. The limitations of matrix keys arise if the specimens are inadequate, or if the interpretation of the features by the user does not match that of the key's creator. The former problem can be remedied by collecting better specimens, the latter problem can be alleviated only through experience and training.

[19]Parts of the Flora of Australia are available onlineat: http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/main/index.html (date checked 20 May 2010). Most libraries will have copies of all volumes published to date.

The following table provides an example of the data that might underlie a matrix key. Each plant species is described in terms of its features (or characters), where each feature can have two or more states. For example, if the feature is dominant flower colour, then the different states of flower colour are yellow, pink, blue/purple or green. Sometimes a plant can exhibit more than one state for a particular feature – for example, Grewia is described as having two feature states for growth form, tree and shrub. As you move through the feature set selecting the states that match your specimen, the key will eliminate all of the species that do not match your specimen.

	Ageratum	*Centrosema*	*Ipomoea*	*Macrotyloma*	*Physalis*	*Solanum*
Dominant flower colour						
Yellow/green				X	X	
Pink			X			
Blue/mauve	X	X				X
Leaves simple or compound						
Simple	X		X		X	
Compound		X		X		X
Growth form						
Vine		X	X	X		X
Herb	X				X	

Using an interactive key, you might be able to eliminate all taxa except the one that matches your specimen. However, more often you will be left with a small group of taxa that can be compared more closely, using the information pages that are associated with those remaining taxa.

7 Using Lucid Keys

7.1 Introduction

The Lucid platform provides a software framework to develop identification keys. Many are available for all kinds of taxa, through the world, and offers many tools and options to make identification easier, including images of the features states, the ability to compare feature states between two or more species, and the ability to select the best feature to identify the specimen in hand.

7.2 Getting started

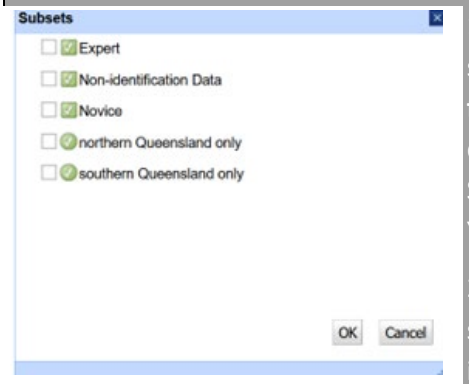
The Lucid opening screen is typically like the one shown on the following page. It typically comprises four panels, a menu bar and a button bar. The panels are labelled:

- Features or characters available
- Features or characters chosen
- Weeds or Entities remaining
- Weeds or Entities discarded

You can adjust around these panels to suit your needs.

KEEP YOUR SCREEN TIDY

If your computer has a tiny screen, it doesn't take much for that screen to become cluttered with useless windows, icons and pictures. There's a couple of things you can do right at the outset to reduce that clutter:



1. In the Weed Key, you can reduce the number of features on show by going to the button bar (see **Error! Reference source not found.** below), and then selecting the 'Subsets' option from the drop down menu. A little dialog box will open, as shown below. Select expert or novice, depending on how confident you feel. You can also select only plants from northern Queensland.

2. In the RFK, you can reduce the number of features on show by selecting only the subsets that are relevant to your specimen. For instance, IF your specimen only has leaves and fruits, follow the same procedure to open the 'Subsets" dialog box, then tick whatever feature subsets are going to be useful.

3. Finally, when using the key, always close images and unused windows when you've finished using them. Simply click on the 'close' text in the top right of the picture window.

If you look at the **Characters Available** panel (Error! Reference source not found.), you'll notice the character subsets (such as Leaf characters) are shown, but the various feature states are hidden for the moment. If you click on the character subset Leaf characters, it will reveal all the different leaf features available for identification. Click one of these, such Leaf arrangement, and it will open up six possible feature states. To select a feature state, click on the box net to the descriptive text – it will appear in the Characters chosen panel. You'll also notice that the number of species in the Entities remaining

panel decreases, whilst those species that don't have the feature you've selected end up in the Entities discarded panel.

If you change your mind about a feature state, you don't have to start again. Just click once on this feature state in the Characters chosen panel. The feature thumbnail will fade to grey (or the tick will disappear), and will not be considered any further.

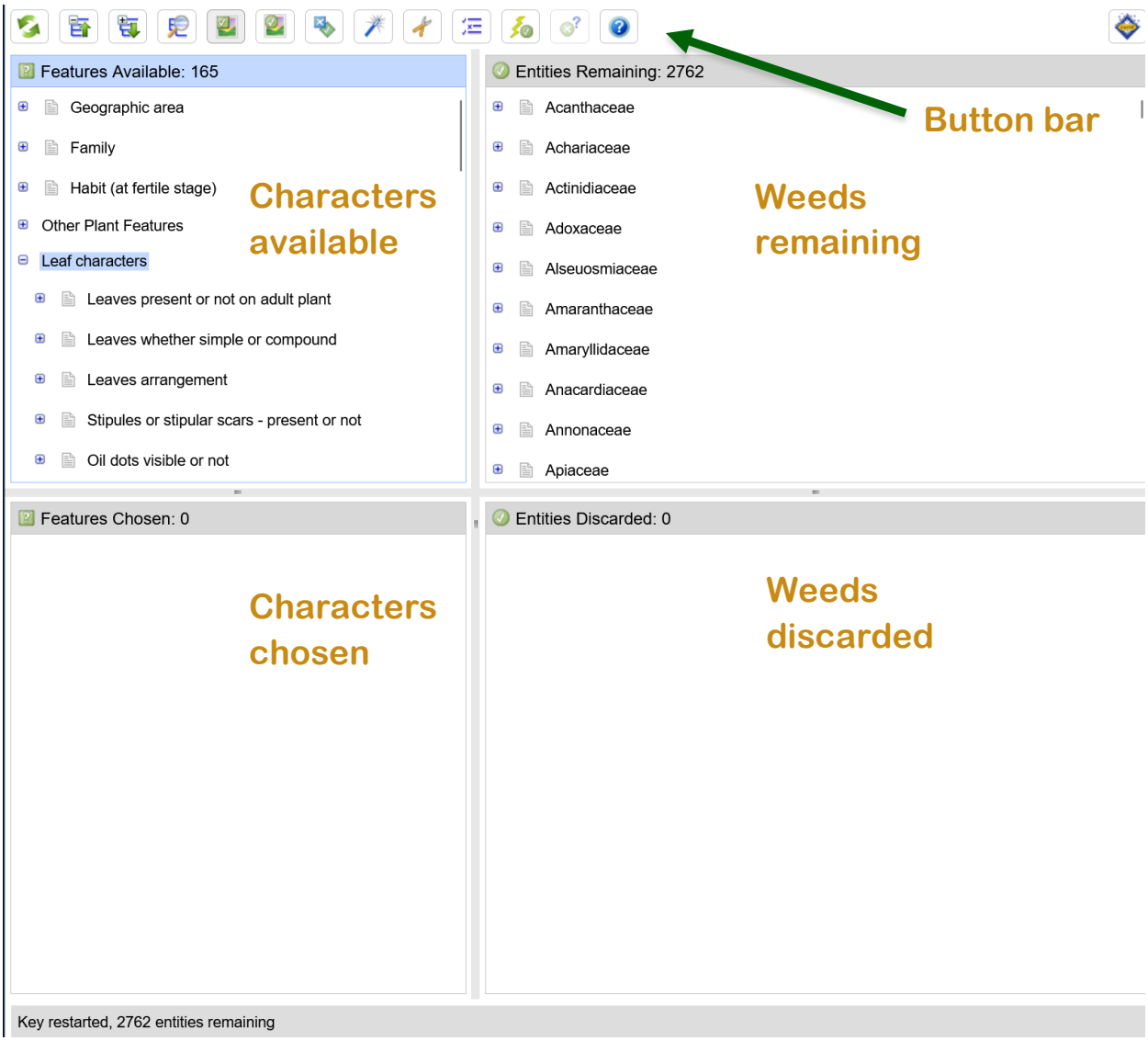
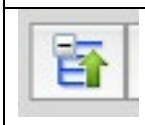
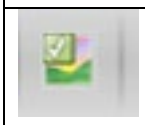
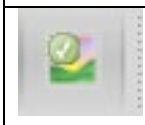
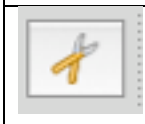


Figure 5 Lucid opening screen

You'll notice Lucid Player utilizes several graphical features, or **icons**, both in the button bar across the top of the window, and associated with the features available panel. These icons have various functions, described below.

Table 3 Lucid button bar icons and their meaning

Icon	Name	What does it do?
	Restart key	Deletes all features selected and starts the key again.
	Collapse selected list	Closes up the list of Features Available so that only the basic summary is visible. This tidies up the Features Available panel and makes it easier to find characters.
	Expand selected list	Opens up the list of Features Available so that all features and all feature states are visible.
	Find feature	With more than 150 features to choose from, it's easy to lose your way in this key. Selecting this button opens up a dialog box which allows you to search for a particular feature or keyword.
	Feature thumbnails	Turns the feature thumbnail images on and off. If you are operating the key over the internet, turning thumbnail images off can improve processing time.
	Entity thumbnails	Turns the entity thumbnail images on and off. If you are operating the key over the internet, turning thumbnail images off can improve processing time.
	Subsets	**Subsets** are groups of features or species pre-defined by the author of the key. For example, feature subsets in the Weed Key include Expert and Novice character sets.
	Best	Once you've selected a few features, in order to rapidly narrow down the identity of the species you are identifying, some features may be more useful for the next step than others. For example, some features may be scored the same for all species remaining, in which case choosing a state of that feature would not contribute to the identification. The **Best** button finds the feature that will eliminate the greatest number of species remaining. Before using the Best button, make sure you have the appropriate character subsets selected.
	Prune redundant features	Selecting this button will get rid of all features which aren't useful for identifying the specimen at hand. For example, if you've selected Leaves absent, then it will remove all leaf-related features from the Features available panel.

Icon	Name	What does it do?
	Shortcuts	Formerly called the Bingo! button, this is a useful feature to use when you've got just a few species remaining. It brings up a list of features which may enable you to narrow down your specimen to just one species. If your specimen matches any one of the list of available **shortcut features**, then Bingo!, you've got an identification. If it doesn't then continue to work through the Features available list.
	Differences	Suppose you have used the RFK to try to identify a specimen, and at the end of the keying session several species remain. One way of trying to decide which of these is correct would be to access the information (photographs, leaf images & fact sheets) associated with the species. This may allow you to discriminate the remaining species further. An alternative way may be to view a list of features that differ between the species. You can access such a list by clicking the **Differences** button on the toolbar, which opens the Differences window. These will open the Differences window. The Differences window has two panels. The upper panel lists all features that differ (that is, are not scored the same) for the remaining entities. When you click on a specific feature, the lower panel shows how the species are scored for the listed features. Differences in the upper panel are sorted by their utility for separating the species, therefore it is recommended you review the differences from the top down.
	Why discarded	To determine why a species was discarded, select it from the Entities Discarded window then click on the **Why Discarded** button on the toolbar. The Why Discarded dialog which opens displays the list of chosen features that do not match the selected entity. For each feature, the list of states that you chose from the feature are displayed, along with the list of states present for the entity in the key. If an entity is discarded that you believe should still be present, the Why Discarded function allows you to quickly compare your selections with the features present for the entity in the key
	Help	Links you to Lucid help notes.
	View enlarged image	You'll find this icon associated with thumbnails in the listing of features. Clicking it opens a full size image of the thumbnail you've selected.

7.3 What if no taxa remain?

This will happen sooner or later in one of your Lucid sessions. If no taxa are listed, then it simply means that no taxa in the database match the selection of states you have made. Several explanations are possible, but the most common are:

- You may have made an error in one or more states that you have selected. This is the most likely cause.
- The taxon may be a new species (unlikely), or not present in the key. In this case Lucid cannot identify the specimen because its features are not represented in the key's data tables.
- The key author may have made an error when constructing the key. If, after carefully checking all the features and states and checking that the specimen should be in the key, then you may conclude a key construction error may be present.

7.4 What if several taxa remain?

Never assume that you will end up with one taxon remaining. Some species may be very hard to differentiate, except when using difficult or obscure features. Sometimes, after you have addressed all the features you may have a short list of species remaining instead of just one. If Lucid features such as the Shortcuts or Best options don't help, you may then have to carefully check the specimen against associated information (*e.g.* Additional Features, leaf images).

7.5 Confirm your choice.

Once you have made a preliminary identification, check the information provided within the key for the taxon. Getting a possible name for a species is not the end point – you may have made errors, or you may have a taxon that is not in the key. In these cases, the key may have provided you with the wrong answer. By reviewing the associated information in the key, descriptions/images of the species published in other locations, and comparing with known specimens held in herbaria, you can check your identification.

7.6 What if I still can't identify the species?

Unfortunately, no key will give you an answer every time. Sometimes you may have insufficient material to successfully identify the species, other times there may be shortcomings in the key. Experience and practice will increase your success rate, but there will always be specimens that can't be identified.

8 Introduction to plant morphology

8.1 Key objectives

- Describe plant morphology using the correct terminology

8.2 What is plant morphology

As with any technical discipline, botany comes with its fair share of jargon. In the same way that you can't fix your car without knowing the difference between a carburettor and a distributor, plant identification is going to be quite challenging without learning a few terms. The following pages are designed to introduce you to some botanical terms and concepts used in the Weed Key and the Rainforest Key.

Time doesn't allow us to cover the full range of features utilised in the key, however, we're going to look at a subset of features that will enable you to identify most commonly encountered species.

Plant morphology is the study of plant form and structure. Typically, the flowering plant form comprises three basic organs – roots, stems and leaves (Figure 6). Note that this list doesn't include flowers – they are actually highly modified stem and leaf structures. Roots, stems and leaves are usually immediately recognisable on any plant, however there is a vast range of variation on the basic themes illustrated below.

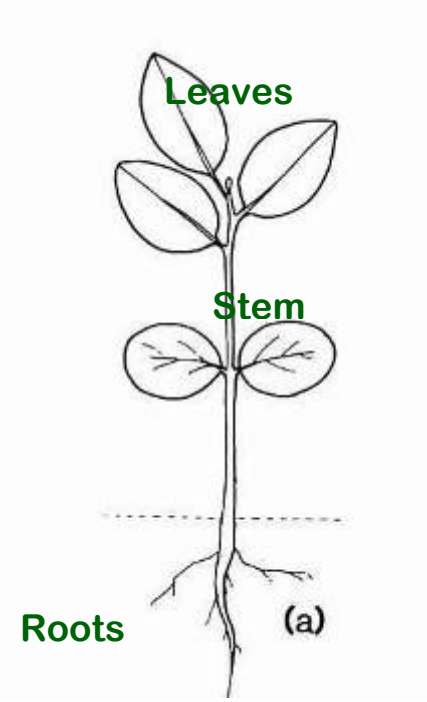


Figure 6 Basic plant structure, showing leaves, stem and roots

8.2.1 Roots

Roots anchor the plant firmly to their substrate and absorb minerals and water. They also produce hormones that regulate plant growth. They are distinguished from underground stems by the internal arrangement of their veins.

8.2.2 Stems

Stems provide support for the plant, and conduct water and nutrients from roots to leaves. Sugars move from the leaves to other parts of the plant through veins in the stems. Stems often display indeterminate growth, which means they keep on growing in length and width throughout the life of the plant.

As stems age, they develop a thick protective external layer of dead tissue – the bark. Bark on mature trees is often a useful feature for identification.

8.2.3 Simple leaves

The **leaf** is usually the most prominent feature of any plant. Leaves are usually flat, thin and demonstrate determinate growth (*i.e.* they stop growing when mature).

The main function of the leaf is photosynthesis – the process by which plants catch sunlight energy and use it to construct sugar out of water and carbon dioxide from the air. Each true leaf has a bud at the base of the leaf stem.

A typical leaf comprises a leaf blade , or lamina, and the leaf stalk, or petiole (Figure). The point where the leaf stem meets the branch is called the axil, and in that axil you will find a bud, which may one day

grow into a flower or another branch. Sometimes the bud may be hidden and can only be revealed by dissection, for example in Eucalyptus.

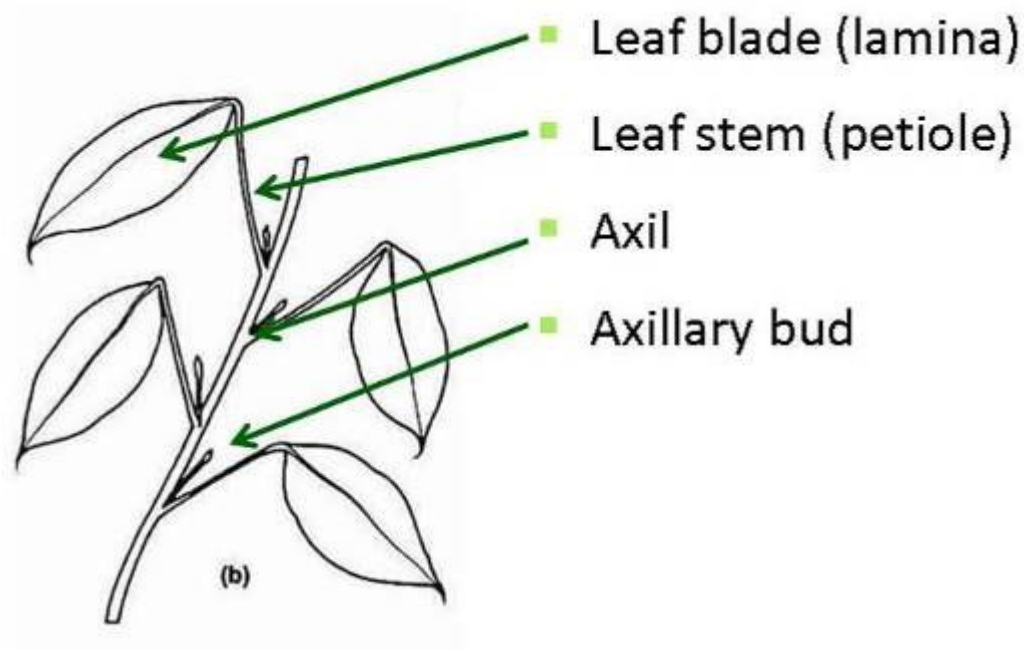


Figure 6 **Structure of a typical leafy stem**

Most leaves are flat, green structures borne on the branches of plants. As these pictures show (**Figure**), and as your experience should illustrate, they are immensely variable in size, shape and arrangement. However, they can be divided into two main types – simple and compound. A simple leaf comprises only one leaf blade, whilst a compound leaf contains from two to hundreds of individual leaflets.

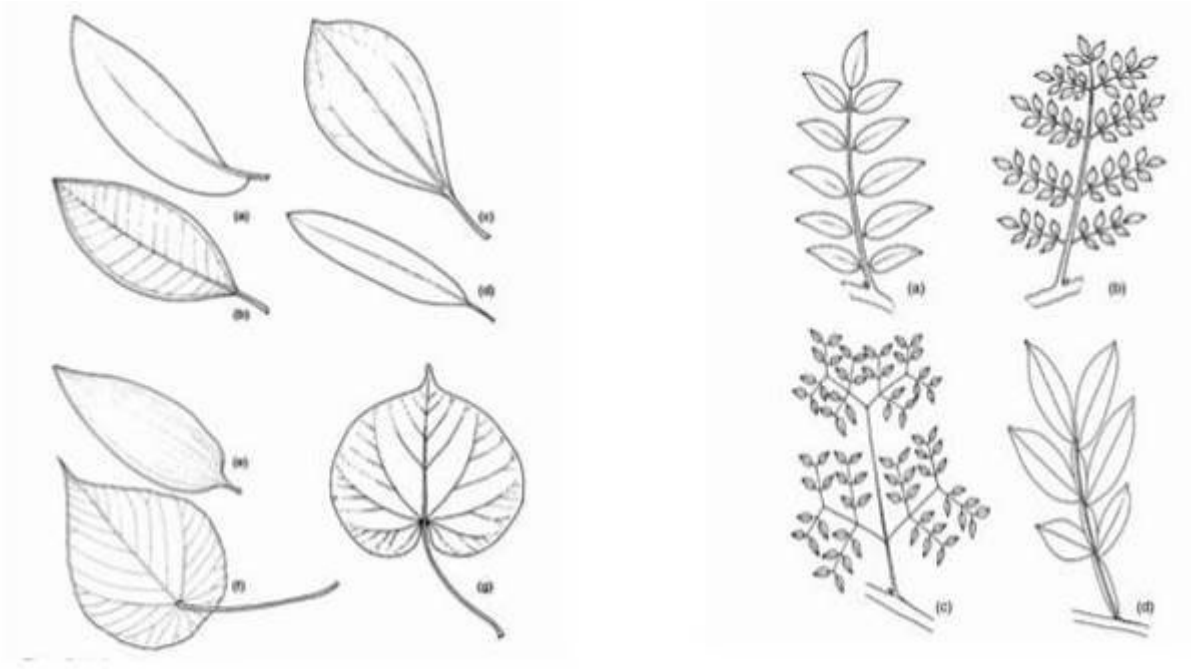


Figure 7 **Variation in leaf form, showing both simple (left) and compound leaves (right)**

8.2.4 Compound leaves

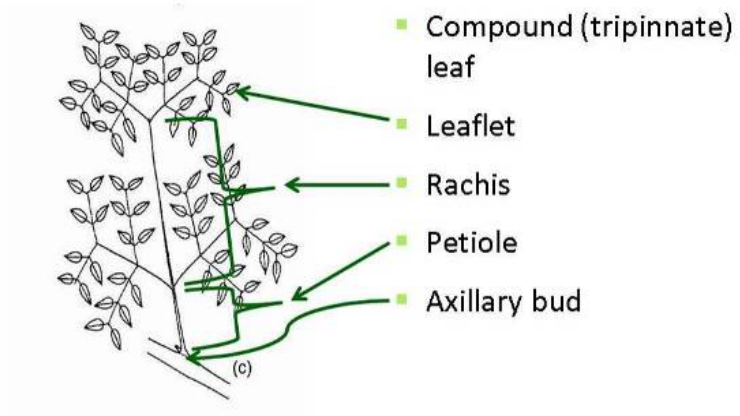


Figure 8 Compound leaf structure

Compound leaves are composed of many leaflets on a common stalk. They often look like leafy branches, but like a simple leaf a compound leaf is defined by the presence of an axillary bud where the petiole joins the branch (**Figure**). The individual leaflets within the compound leaf will not have any axillary buds associated with their stalks. In a compound leaf, the petiole only extends as far as the first leaflet or branching. Beyond this point, the stalk is called a rachis.

Familiar examples of compound leaves can be seen in palms and ferns.

8.2.5 When is a leaf not a leaf? Leaf modifications and leaflike-structures.

Most of the time, what appears to be a leaf attached to a stem is just that. However, there are exceptions to this rule. Leaves can be modified to the point of being unrecognizable, for example the spines on a cactus, the pitchers on a pitcher plant, or the tendrils on a grape vine. On other plants, such as Casuarina, leaves can be reduced or absent. The simple leaves of *Acacia* (**Figure 7**) are actually modified, flattened petioles (perhaps a modification to reduce water loss in Australia's dry environment), however, for the purposes of the RFK and the Weed Key, they are treated as leaves. Finally, there are some plants which lack leaves altogether, but the stems have become modified to form leaf like structures called cladodes. A familiar example of this is *Asparagus* (**Figure 7**) and cacti.

Asparagus racemosus has no leaves, but stems are modified to form leaf-like structures. Copyright A. Ford and F. Goulter

The simple leaves of many acacias are modified petioles called phyllodes. Shown here is *Acacia oraria*. Copyright CSIRO

The leaves of *Opuntia ficus-indica* are reduced to spines, with photosynthesis occurring in modified stems. Forest & Starr (Wikimedia Commons).

Figure 7 Examples of leaf and stem modifications

9 Using the *Environmental Weeds of Australia* key

9.1 Leaf characters

Traditionally, plant identification has been reliant on flowers and fruit features. However, these reproductive structures are not always accessible. In the rainforest, leaves and stem features are often the only features available for plant identification. So, to start off things we'll focus on leaf features, as they're the most useful and easily obtained part of the plant. Some weed species can be identified in just a few steps with leaf features.

9.1.1 Selecting leaves for use in identification

Always use healthy, fully expanded leaves; where possible from a mature plant (*i.e.* a plant with flowers or fruits). When collecting herbs, especially weedy herbs, don't be afraid to pull up the whole plant. Be aware that leaves from young plants can be a completely different shape or colour to those from reproductively mature plants – this is particularly noticeable in the daisy family (Asteraceae). Also, if you are looking at weedy trees, leaves taken from the shade can often be much larger than those in the canopy of the tree. Ideally, leaves should be collected from the crown of the tree. Leaves from coppice shoots and epicormic shoots should not be used, as they may differ substantially from the leaves in the crown of the tree (not always possible).

Determine at the outset whether the leaves are simple or compound, otherwise all subsequent observations will be incorrect. Features should be assessed using the naked eye unless directions specify otherwise.

USING A HAND LENS

Some of the plant features discussed on the following pages require magnfication, and we've provided hand lenses for that purpose. Using a hand lens can take a bit of getting used to. Always remember, hold the hand lens close to your eye, and move the specimen in and out until it comes into focus. Best results are obtained if the specimen is well lit.

Photo: Adamantios (Wikimedia Commons)

9.1.2 Examining your specimen

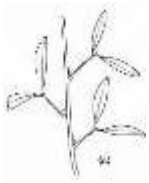
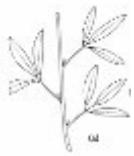
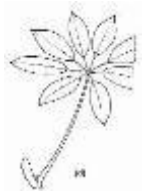
You will get lots of hands-on experience using the key during the workshop. The following basic steps might lead you to a final identification.

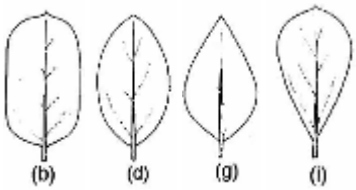
- 'Undress' the specimen
- Choose relevant feature sets, such as flower characters, fruit characters or distribution characters
- Select features

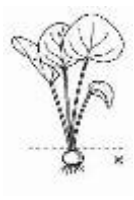
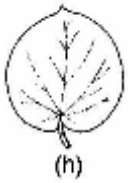
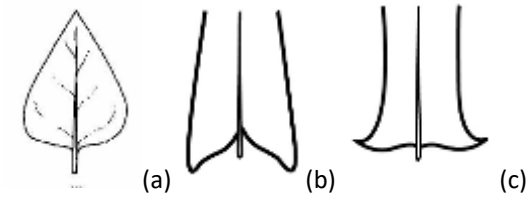
- Inspect remaining species
- See additional information on remaining taxa
- Make final selection of the most appropriate species.

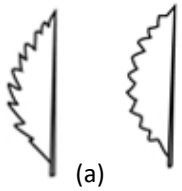
Always remember: if in doubt about a feature, leave it out!!!

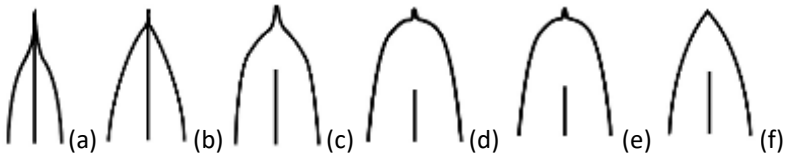
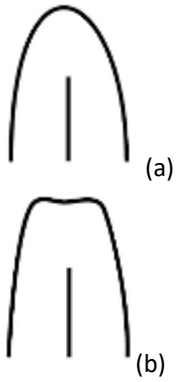
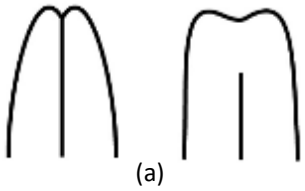
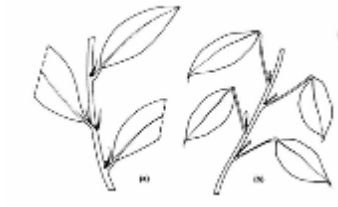
Table 4 Leaf characters from the Weed Key

Characters from the Weed Key	Notes
LEAF TYPE	
Simple	
Once-compound with two leaflets (bifoliate)	
Once-compound with three leaflets (trifoliate)	
Once compound with leaflets radiating from a single point (palmate)	
Once compound with leaflets arrranged along an axis (pinnate)	

Characters from the Weed Key	Notes
Twice compound with three lots of three leaflets (biternate)	 *Moringa pterygosperma* MORINGACEAE. © CSIRO
Otherwise twice compound (bipinnate)	
Absent or inconspicuous	This is a very rare character. Examples of this are shown in Figure 7 (*Asparagus racemosus* and *Opuntia*)
LEAF SIZE	
Leaf size small (less than 5 cm long)	 Leaf size refers to the length from the base of the leaf stalk to the tip of the leaf blade, or to the tip of the furthermost leaflet on a compound leaf.
Leaf size medium (5 cm to 20 cm long)	
Leaf size large (>20 cm)	
LEAF OR LEAFLET SHAPE	
Regular (ovate, obovate, oblong or elliptic	 Oblong - leaf broadly oblong in shape, with more or less parallel sides (b). Elliptic - leaf broadly oval in outline, with the widest part of the leaf in the middle (d). Ovate - egg shaped. The widest part of the leaf is in the lower half, towards the petiole (g). Obovate or oblanceolate - leaf lance-shaped or egg-shaped, but with the widest part towards the leaf tip (i).
Long and narrow (elongated or linear)	 Linear - thread-like (filiform), needle-like (acicular). Leaf long and narrow with more or less parallel sides.
Cylindrical (terete)	Leaves that are round or roundish in cross section, *e.g.* the leaves of Pinus caribaea.

Characters from the Weed Key	Notes
Kidney shaped (reniform)	 Leaf blade kidney shaped in outline.
Round (orbicular)	 Circular or almost circular in outline.
Arrowhead-shaped (triangular, hastate or sagittate)	 Triangular. Leaf triangular in outline (a). Shaped like the head of an arrow; narrow and pointed but gradually enlarged at base into two straight lobes directed downwards; may refer only to the base of a leaf with such lobes. *e.g.* Alocasia brisbanensis. Compare hastate. Hastate. Narrow and pointed but abruptly enlarged at the base into two acute diverging lobes; may refer only to the base of a leaf with such lobes. *e.g.* Cirsium vulgare. Compare sagittate.
Heart shaped (cordate or obcordate)	 Cordate - leaf heart shaped, with the petiole attached at the cleft.In obcordate leaves, the petiole is attached to the pointed end of the heart, the cleft is at the top of the leaf.
Lobed (including pinnatifid)	 © CSIRO
Divided into fingers (palmately lobed)	 Palmatifid leaves have lobes arranged palmately, with lobe length less than half the distance from the leaf edge to the midrib. Palmatisect leaves have the leaf blade very deeply lobed, with the lobes extending more than half the distance from the leaf edge to the midrib.

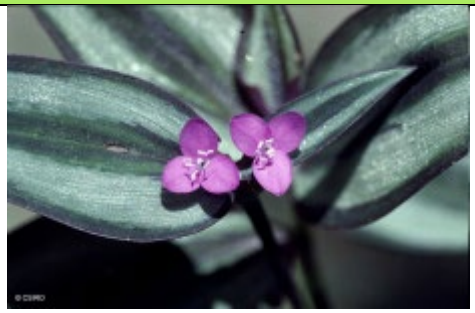
Characters from the Weed Key	Notes	
Deeply divided (dissected or pinnatisect)	 © CSIRO	Deeply divided refers to leaves that are so heavily divided into segments (*i.e.* dissected) that they have no particular leaf shape in outline. It also includes leaves that have their margins cut half-way (*i.e.* pinnatifid) or nearly entirely (*i.e.* pinnatisect) to their centre (*i.e.* midrib). Pinnatisect leaves have the leaf blade very deeply lobed (the lobes extend more than half the distance from the leaf edge to the midrib). The individual lobes do not form leaflets.
LEAF OR LEAFLET MARGIN		
Entire (including wavy)		
Bluntly tooted (crenate or sinuate)		Margins toothed, but the teeth are rounded.
Sharply toothed (serrate or dentate)	 (a) (b)	Serrate (a) – teeth point forward. Dentate (b) – teeth are symmetrical.
Lobed (including pinnatifid)		Pinnatifid leaves have lobes arranged pinnately, with lobe length less than half the distance from the leaf edge to the midrib.

Characters from the Weed Key	Notes
LEAF OR LEAFLET TIP	
Pointed (acute, acuminate or mucronate)	 (a) (b) (c) (d) (e) (f) Acuminate – tapering gradually to a point (c) Mucronate – Terminating in a short sharp point (d) Acute - Pointed; converging edges making an angle of less than 90° (f). Compare obtuse.
Rounded (obtuse or truncate)	 (a) (b) Obtuse - Blunt or rounded at the tip or apex; converging edges making an angle of more than 90° (a). Compare acute. Truncate – cut off squarely (b).
Notched (retuse or emarginate)	 (a) (b) Retuse - with a blunt (obtuse) and slightly notched apex. Emarginate - notched at apex (notch usually broad and shallow).
LEAF ARRANGEMENT	
Opposite	 Leaves arise at a point on the stem called a node. In an opposite leaf arrangement, two leaves arise from opposite sides of the node.
Alternate	 Most plants have only one leaf per node, usually alternating from one side of the stem to the next, or spirally arranged up the stem.

Characters from the Weed Key	Notes
Whorled (verticillate)	 Three or more leaves per node. Includes psuedowhorled leaves, where nodes are bunched up together, so that a tight spiral of leaves actually looks like a whorl.
In a basal rosette (rosulate)	 Usually refers to herbs, where all leaves are tightly clustered and arise from once central point.
Tufted (caespitose)	Usually refers to grasses, sedges and rushes, where all leaves arise in tight clusters or tufts, and are generally held erect.
Grouped or clustered	This state describes where several leaves arise from the same point at the tip of a small branch. It is distinct from a whorl of leaves in that the leaves are not arranged around the stem along its length. This rare form of leaf arrangement is present mostly in pines.
LEAF ATTACHMENT	
Stalkless (sessile)	Careful! When considering the petiole of compound leaves, the RFK refers to the petiole of the leaflet (properly called a petiolule). The Environmental Weeds of Australia key refers to the true petiole, the petiole of the compound leaf.
Stalked (petiolate)	Careful! When considering the petiole of compound leaves, the RFK refers to the petiole of the leaflet (properly called a petiolule). The Environmental Weeds of Australia key refers to the true petiole, the petiole of the compound leaf.
Sheathed	This refers to a leaf that has two sections; a leaf sheath that is attached to the stem and usually partly or entirely wrapped around it, and a leaf blade.
LEAF HAIRS ON UPPER LEAF SURFACE	
Present	Select this feature state if hairs are visible to the naked eye.
Absent	

LEAF HAIRS ON LOWER LEAF SURFACE	
Present	Select this feature state if hairs are visible to the naked eye. The undersurface is clothed in hairs or short sharp prickles which give the undersurface a rough texture. (The minimum requirement for a hairy undersurface is that the midrib and all the main lateral veins are either hairy or prickly.) TIP: Use adult leaves only. Many species have hairs on young leaves which are lost as leaves mature. If in doubt, use a hand lens to check, or rub the leaf against your lips.

Characters from the Weed Key	Notes
Absent	
LEAF HAIRS ON LEAF MARGINS	
Present	Select this feature state if hairs are visible to the naked eye.
Absent	
LEAF SPINES OR PRICKLES	
Present	 © CSIRO This is asking whether or not there are any spines or prickles on either leaf surface. The leaf illustrated here is from *Cirsium vulgare* (spear thistle). The thistles are a group well known for their spiny leaves.
Absent	
LEAF TENDRILS	
Present	 Careful! The RFK refers to any form of tendril that is used for climbing. The Environmental Weeds of Australia key refers only to leaves that have tendrils (see illustration).
Absent	

Characters from the Weed Key	Notes
LEAF VARIEGATION	
Present	 © CSIRO Variegated leaves have leaf blades marked with patches of colour. This feature doesn't include colours in dying or juvenile leaves, or colours along veins.
Absent	

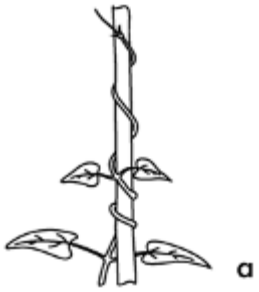
9.2 Habit or growth form

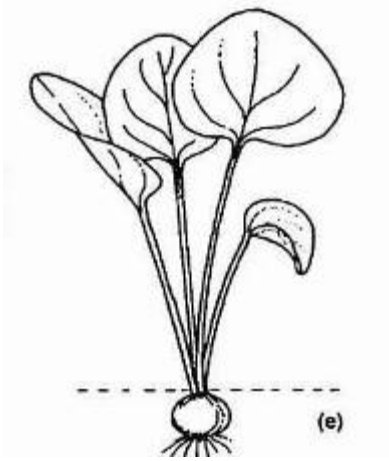
This feature set asks you about the general growth form of the plant you've collected. In the Weed Key, the plant form character is very powerful and useful and is a good starting point for your identification. It is an easy character to use and is basically asking what type of plant the weed is (*i.e.* is it a tree, shrub, vine, etc.). The only time it might not be useful is if you are given a specimen of a weed that someone else has collected and you have to identify it without ever seeing what the entire plant looks like.

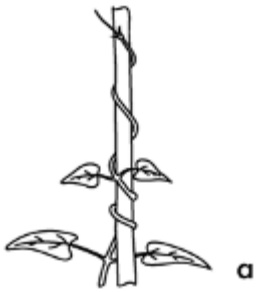
The Weed Key lists features of plant habit and plant growth form under the heading 'Plant Characters'. The RFK lists these features under 'Plant Features'. The character should only be used with reproductively mature plants.

As with the leaf features, we'll review the various aspects of plant habit with reference to the Weed Key, and then discuss comparable features in the rainforest key.

Table 5 Plant habit features from the Weed Key

Characters from the Weed Key	Notes
PLANT CHARACTERS - PLANT FORM	
Tree	In the Weed Key, the term tree refers to a large woody plant that reaches greater than 3m in height when fully grown. Trees usually have a single main trunk. In the RFK a tree is defined as a single stemmed plant greater than 6 m tall, whilst a shrub is defined as a single or multi-stemmed plant, more than 1 m but less than 6 m tall, which flowers and fruits within that size range. This definition overlaps with the 'Tree' definition in the Weed Key. Note: Tree seedlings can often appear similar to herbaceous plants, and care needs to be taken not to confuse them. Even when in the seedling stage a degree of woodiness is usually present in the stems of trees.
Shrub	The Weed Key defines a shrub is a woody plant that rarely reaches greater than 3m in height when fully grown. Shrub usually have several woody stems which branch close to ground level. As noted above, the RFK defines a shrub as a mature single or multi-stemmed plant between 1 and 6 m tall.
Vine	 a A vine is defined as a single- or multi-stemmed plant usually more than 1 m long or high which relies on other objects (often other plants) to support it as its own stem lacks the rigidity to hold it in an upright position. Vines may or may not have structures along the stem (*e.g.* tendrils and hooks) which help them to attach to such objects.

Characters from the Weed Key	Notes	
Floating or submerged	 *Pistia stratioides* ARACEAE Source: Wikimedia Commons	This refers to plants that float on the surface of water and are not permanently attached to the ground by any means (*i.e.* free-floating), and also to plants that are wholly or partly covered (*i.e.* submerged) in water.
Grass or grass-like	 Copyright CSIRO. *Thoracostachyum sumatranum,* CYPERACEAE	This plant form refers to grasses or plants that are grass-like in appearance (*e.g.* sedges, rushes, some lilies or lily-like species etc.). Grasses and grass-like plants (*i.e.* graminoids) generally have thin strap-like leaves with a sheath that wraps around the stem. They also usually have small or inconspicuous flowers that are clustered into larger inflorescences and often form tussocks.
Fern	 *Blechnum spicant,* BLECHNACEAE. Source: Wikimedia Commons	Ferns are members of the Phylum Pteridophyta, and hence they do not have flowers like most other plants. Instead they possess sporocarps or sporangia, structures that produce vast numbers of spores. The 'leaf' of a fern is referred to as a frond, and fronds uncurl from the base upward as they grow. Ferns often also reproduce by fibrous underground stems called rhizomes. Only a few weed species are ferns.
Herbaceous or other		This state refers to all of the herbaceous plants and also to those that do not fit easily into any of the other Plant Form states. A herb is a small non-woody flowering plant that rarely reaches greater than 2 m in height. The majority of weeds are herbaceous. The definition includes plants that normally grow in the ground, but excludes species that are normally lithophytic or epiphytic.

Characters from the Weed Key	Notes
PLANT CHARACTERS – PLANT HABIT	
Upright (erect or ascending)	The plant is growing in an upright or mostly upright manner. This includes two botanical types of growth habit - erect and ascending. Erect plants are totally vertical in growth habit while plants with an ascending growth habit grow on a slant or close to the ground at first but quickly become upright. This character can apply to herbs, shrubs or trees.
Creeping (prostrate or decumbent)	The plant is growing in an creeping manner (*i.e.* close to the ground surface). This includes two botanical types of growth habit - prostrate and decumbent. Prostrate plants are horizontal in growth habit while plants with a decumbent growth habit grow close to the ground at first but eventually turn upright near their tips.
Climbing or twining	 a This growth habit refers to plants with long trailing stems that climb up or twine around other plants or objects. Climbing plants often have structures along their stems (*e.g.* tendrils and hooks) which help them to attach to such objects (*i.e.* they provide support).
Floating or submerged	This feature is defined above.
In a rosette (rosulate)	 *Taraxacum officianale* ASTERACEAE. Source: Adam Retchless (Wikimedia Commons). This describes a growth habit where all the leaves of a plant radiate from a central point or crown near the ground surface. These leaves also usually lie flat, or close to the ground surface. In some species this leaf arrangement is only temporary, during the early stages of the life cycle, while in others it exists throughout the weeds lifespan. Note: this form of growth habit is particularly common in members of the 'daisy' plant family (*i.e.* Asteraceae).

9.3 Flower characters

Since the time of Linnaeus, floral structure has provided the basis for plant identification. An understanding of the arrangement and numbers of floral parts, and the nature of the resulting fruit (discussed in the next section) is critical for revealing a plant's identity and relationships with other species.

9.3.1 Overview of floral structure

Flowers are grouped in an **inflorescence** arising from one stem. An inflorescence can comprise just one flower, or an intricately branched panicle containing many flowers, or a head of many flowers that is so densely packed it appears to be a single flower.

Typically, flowers are made up of separate whorls of parts, starting with the calyx (the sepals), the corolla (the petals), the androecium (the stamens) and the gynoecium (the stigma and ovary). In this introductory course, we shall look only at the most prominent part of the flower: the petals, or corolla, and the flower's location on the plant.

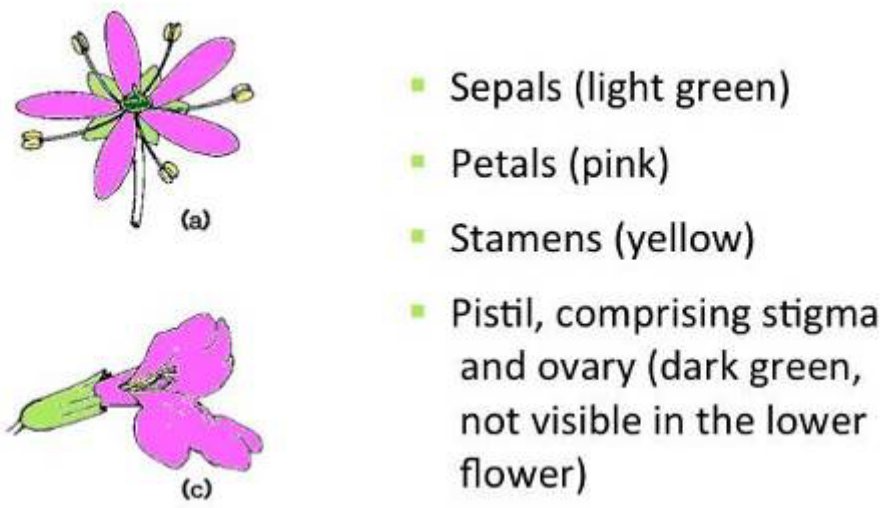


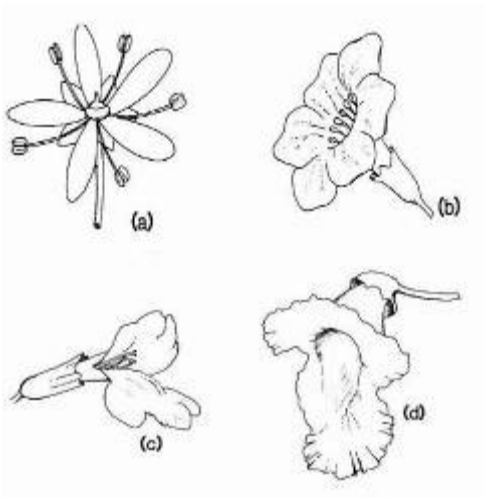
Figure 9 Floral structure, showing the same features in two different flowers.

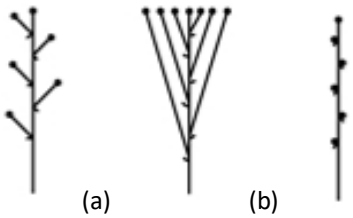
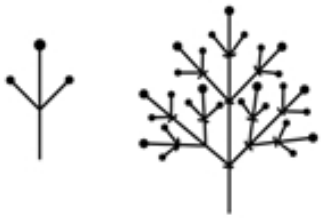
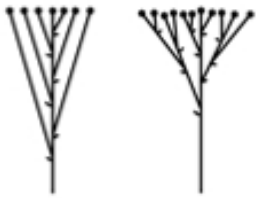
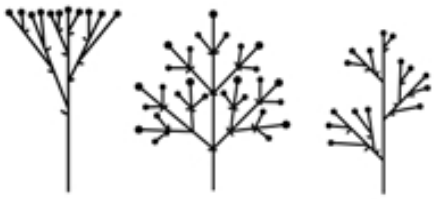
Flowers are immensely variable, and may have many petals or none at all. Flowers such as Eupomatia have no petals, but instead have petal-like stamens. Orchids have three sepals and three petals, but for the purpose of the key, the two whorls are treated as one. Often petals are fused into trumpet-like flower structures (morning glory - Convolvulus) is a good example. The flowers shown in Figure 7 both have five petals – however in the lower flower these are fused. With so much variability in flowers, take care when counting flower parts. As always, if in doubt leave it out.

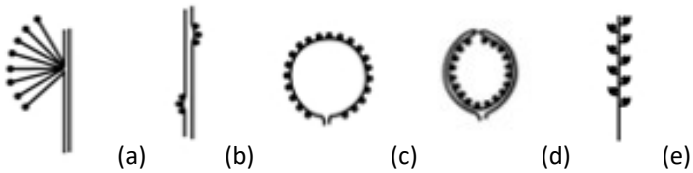
The following table introduces some floral features that are useful for in identifying rainforest weeds, namely inflorescence type and numbers of petals.

Table 6 Selected inflorescence and flower features from the Weed Key

Characters from the Weed Key	Notes
FLOWER CHARACTERS – NUMBER OF PETALS OR RAYS	
One or two	
Three	

Characters from the Weed Key	Notes
Four Five Six Many	 This character refers to the number of petals the flower has, or the number of petal lobes that are present if it is a tubular flower (*i.e.* with fused petals). Even on well-developed flowers, counting petals can be problematic. Flower (a) to the right clearly has 5 petals, flower (b) has 6 fused petals. However, flower (c) could be seen as having two petals, but is more likely to have five (two petals/lobes in the upper lip of the flower, three petals/lobes in the lower lip of the flower). In flower (d) the number of petals is difficult to determine, and it might be safest to skip the character for this individual. Rays (*i.e.* ray florets or ligulate florets) are present on some flower-heads from the daisy plant family (*i.e.* Asteraceae). They resemble petals but are actually tiny flowers that are part of a larger compound flower-head. Because they can be easily confused for petals, they are treated as such in the Weed Key, but not in the RFK.
INFLORESCENCE TYPE	
Solitary flower or solitary flower head	In the Weed Key, this feature refers to flowers or flower heads that are borne singly, either at the tips of the branches or in the upper leaf forks. A flower head is a tight cluster of flowers borne together on one stem, such as in acacia or daisies.
Axillary cluster	 Photo: Stuart Worboys *Geniostoma rupestre*, LOGANIACEAE. Axillary inflorescences are produced on the twigs or branches but back from the tip and in the axils of the leaves. Includes inflorescences that lie between leaves. Axillary is the most common position for inflorescences. Basal inflorescences are usually seen in herbs, where flowers arise from near the base of the plant stem.

Characters from the Weed Key	Notes
Spike or raceme	 (a) (b) (c) In a raceme (a, b), the flowers are arranged on a single axis, with each flower stalked. In a spike (c), the flowers are arranged on a single axis, however individual flowers lack stalks.
Coiled (boragoid)	This is a special type of spike or raceme, where the flowers are arranged only along one side of the stem. The stem is also coiled at first, and proceeds to uncurl as it matures. This is the typical flower cluster (*i.e.* inflorescence type) of the borage plant family (*i.e.* Boraginaceae).
Cyme	 Flowers produced so that a flower terminates each branch of the inflorescence and additional flowers can only be produced by the production of floral branches below the terminal flower.
Corymb	 Flowers arranged so that they are on the same level more or less in the same plane.
Umbel	 Flowers arising from one point at the apex of a stalk, each flower on its own stalk. (Two and three flowered umbels are included in this category.)
Panicle	 Flowers produced in much branched complex structures resembling the branching pattern of a tree. It is important to realize that panicles can incorporate other basic inflorescence patterns such as umbels and cymes.

Characters from the Weed Key	Notes
Other	 (a) (b) (c) (d) (e) In the Weed Key, this character refers to all other types of flower clusters not specifically described (*e.g.* spadix, thyrse, synconium, etc.). This definition includes inflorescence types specifically described in the RFK, including: Fascicle - Flowers arising from one point on a twig or branch, each flower with or without a stalk (a, b). Head - Flowers produced in definite structures where the flowers (often without stalks) are densely packed in various ways without any obvious branching pattern *e.g.* acacia, daisies, *Syngonium*, figs (c, d) Cone - A seed-bearing structure, usually woody, ovoid to globular, including scales, bracts or bracteoles arranged around a central axis, *e.g.* in gymnosperms, especially conifers and Casuarina (e)

9.4 Grass characters

9.4.1 The grass flower.

Grasses have strongly simplified flowers which may present different arrangements but usually follow a similar basic structure. The fundamental unit of a grass reproductive structures is the spikelet (inflorescence). Typically, spikelet contain one or two glumes, and one or many florets (flowers). We will learn more about them later.

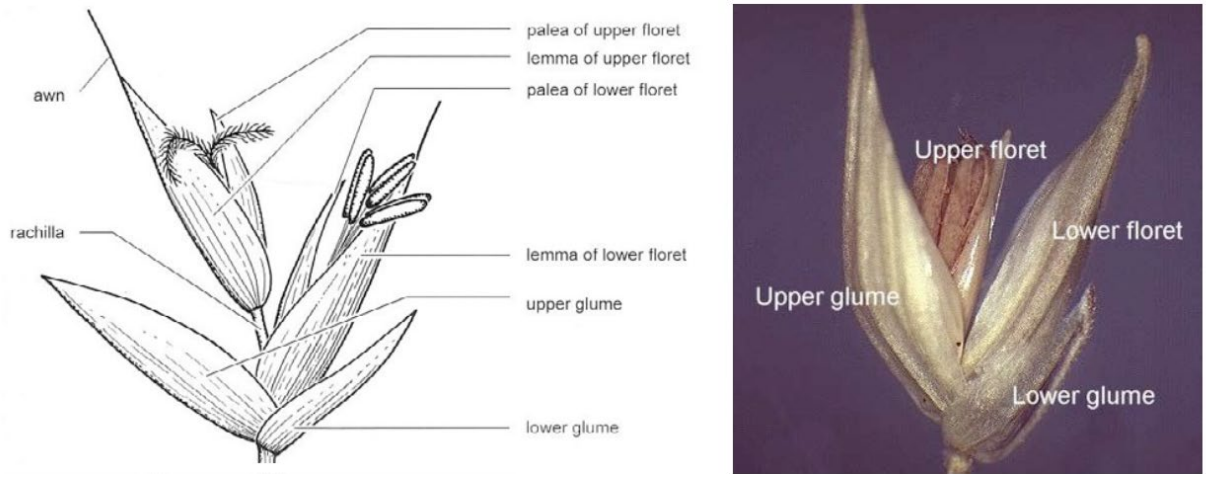
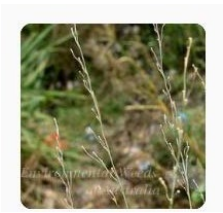
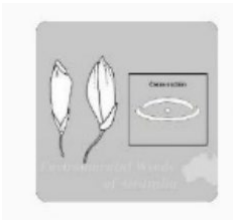
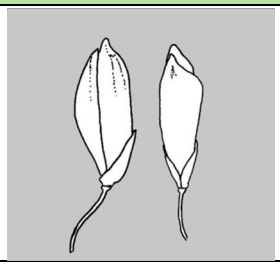
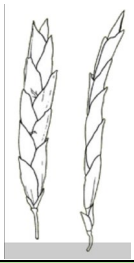
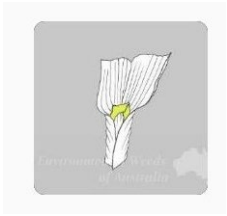


Figure 10 **Image from: Hooker & Gardiner (2012) *Grass Genera in Townsville*. JCU, Townsville.**

Table 7: Selected grass inflorescence and flower characters from the Weed Key.

Characters from the Weed Key	Notes
GRASS TRAITS – INFLORESCENCE TYPE	
Spike or spike-like (spiciform)	
Digitate or sub-digitate	
Panicle of racemes or spikes	
Open panicle	
Other	
SPIKLET DISARTICULATION	
Above the glumes (breaking up)	
Below the glumes (falling entire)	
SPIKLET COMPRESSION	

Characters from the Weed Key	Notes
Lateral	
Dorsal	
Not readily apparent	
FLORETS PER SPIKLET	
One or two	
Three or more	
LIGULE	
Inconspicuous or absent	

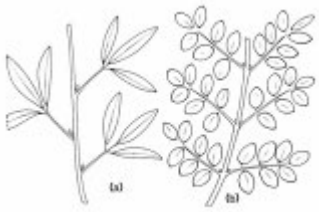
Characters from the Weed Key	Notes
Line of hairs (ciliate)	
Membranous flap (eciliate membrane)	
Membrane topped with haris (ciliate membrane)	

10 Using the *Australian Tropical Rainforest Plants* key

The Rainforest Key includes over 200 exotic species, which makes it a very useful tool for identifying rainforest weeds in tropical north Queensland. The features used in the RFK cover a much greater range of plant features, and include some that require detailed technical knowledge. Nevertheless, most plants can easily be identified using the simple characters described below. These characters are much the same as those used in the Weeds Key.

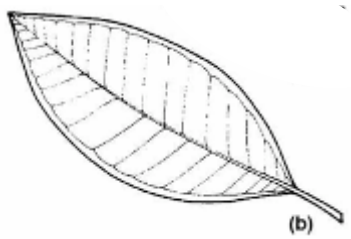
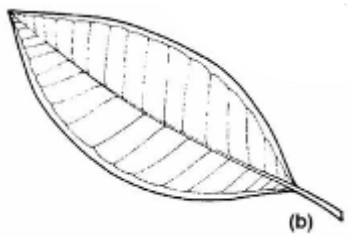
10.1 Leaf characters

Table 8 RFK general leaf features

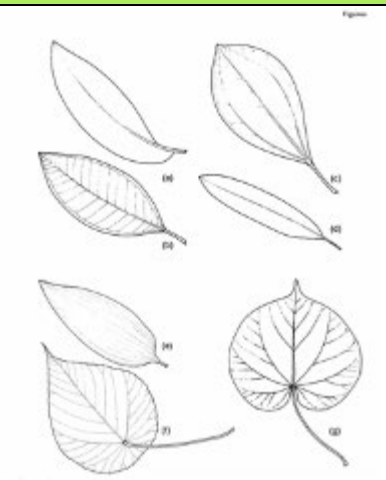
RFK Code	Feature description	Notes
LEAVES PRESENT OR NOT ON ADULT PLANT		
L1	**Leaves present** Some trees, such as figs, shed their leaves for a short time in the dry season. These trees are considered to have leaves present. To help with identification, you can collect fallen leaves from the ground if you're sure that they've fallen from the leafless tree above.	
L2	**Leaves reduced to scales or apparently never present**. Examples of this situation are shown in Error! Reference source not found. (*Asparagus racemosus* and *Casuarina*)	
LEAF SIMPLE OR COMPOUND		
L3	**Leaves simple**	
L4	**Leaves compound** Compound leaves are made up of many leaflets. Palm leaves are compound leaves.	
LEAF ARRANGEMENT (OF SIMPLE OR COMPOUND LEAVES)		
L5	**Leaves alternately or spirally arranged** The point where the leaf arises is called the node. Most plants have only one leaf per node, usually alternating from one side of the stem to the next, or spirally arranged up the stem.	

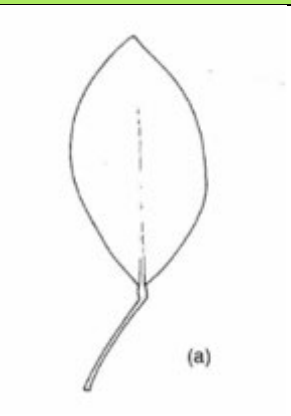
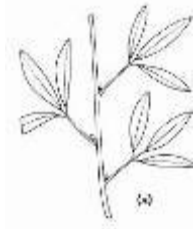
RFK Code	Feature description	Notes
L6	**Leaves opposite** Two leaves per node, arising on opposite sides of the stem.	
L7	**Leaves whorled** Three or more leaves per node. Includes *psuedowhorled* leaves, where nodes are bunched up together, so that a tight spiral of leaves actually looks like a whorl.	
L8	**Leaves basal or radical**	
STIPULES OR STIPULAR SCARS		
L9	**Stipules or stipular scars present** Stipules are outgrowths of the stem that protect the delicate young developing leaf bud. When they fall, they can leave a scar. They are often very small and difficult to see. If you're unsure if they're present, leave this feature out.	 Copyright Zolly Florian & Betsy Jackes *Hodgkinsonia ovatiflora*, RUBIACEAE
L10	**Stipules or stipular scars absent.**	
OIL DOTS VISIBLE (IN LEAVES, OR LEAFLETS IN COMPOUND LEAVES)		
L11	**Oil dots visible to the naked eye** To see oil dots, hold up the leaf to a strong light and look closely. Oil dots are small, regularly arranged dots that are visible in the lamina of some leaves. In some cases, they are very small and can only be seen with a hand lens. They often contain compounds such as resins or aromatic oils that serve to protect the leaf against predators. In the genera *Myrsine, Ardisia, Embelia* and *Tapeinosperma*, the oil dots can be black, red, yellow, or be oval or sausage-shaped. TIP: Always check both sides of the leaf when looking for oil dots. Sometimes they're only visible on one side of the leaf.	 Copyright Zolly Florian & Betsy Jackes *Halfordia kendack*: RUTACEAE
L12	**Oil dots visible with a lens**	

RFK Code	Feature description	Notes
L13	**Oil dots absent**	

LEAF OR LEAFLET LENGTH/BREADTH RATIO (LEAFLET IN COMPOUND LEAVES)		
L14	**Leaf length/breadth ratio less than 1.5** Select a typical sized leaf from your specimen. Measure the length of the leaf and divide this number by the width measurement. The answer is the length/breadth ratio. TIP: If you don't have a ruler handy, you can select two equal sized leaves from the specimen and measure out the length of the first leaf with the width of the second leaf.	
L15	**Leaf length/breadth ratio 1.5-4**	
L16	**Leaf length/breadth ratio more than 4**	
LEAF OR LEAFLET MARGIN (LEAFLET IN COMPOUND LEAVES)		
L17	**Leaf margins smooth** The margin is neither toothed nor lobed but when the leaf blade is held horizontally at eye level waves may be apparent along the edge.	
L18	**Leaf margin toothed** Teeth are small lobes on the edge of the leaf blade and may be either sharp or rounded.	
L19	**Leaf margin lobed** Lobes are large projections or indentations on the blade margin. TIP: As this feature only refers to mature leaves, it does not include the lobed leaves of juvenile silky oaks (Proteaceae).	
LEAF OR LEAFLET INTRAMARGINAL VEIN (LEAFLET IN COMPOUND LEAVES)		
L20	**Intramarginal vein present** An intramarginal vein is a vein of constant thickness (much thinner than the midrib) just inside the margin and extends from the base to the apex. Lateral veins run from the midrib to the intramarginal vein. To be classed as an intramarginal vein rather than looping lateral veins there should not be any major bends. However, slight indentations may occur at the junction with the main lateral veins. An intramarginal vein is a common feature in the MYRTACEAE family.	

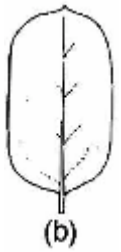
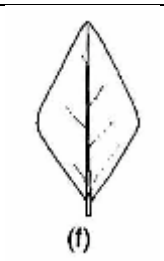
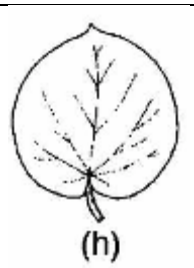
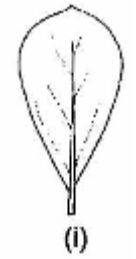
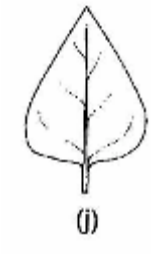
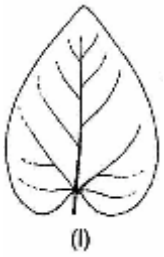
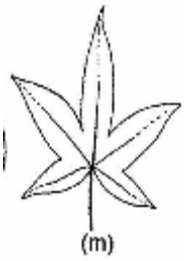
RFK Code	Feature description	Notes
L21	Intramarginal vein absent	

LEAF THREE-VEINED		
L22	**Leaf three-veined** The leaf has a midrib or main central longitudinal vein and two main veins (of similar thickness) running more or less parallel to the margin of the leaf blade but some distance from it. The two main lateral veins may approximate the midrib in thickness and extend halfway up the leaf blade or approach the apex.	
LATERAL VEIN NUMBER (LEAFLET IN COMPOUND LEAVES)		
L23	**No lateral veins either side of the midrib**	
L24	**Up to 7 lateral veins on each side of the midrib** TIP: Major veins only should be considered, *i.e.* the veins which extend from the midrib to the outer margin of the leaf blade.	
L25	**8-20 lateral veins on each side of the midrib**	
L26	**More than 20 veins on each side of the midrib**	
L27	**Leaves with longitudinally parallel venation**	
L28	**Other types of venation**	
MIDRIB APPEARANCE ON UPPER SURFACE (LEAFLET IN COMPOUND LEAVES)		
L29	**Midrib distinctly raised on the upper surface** TIP: Be careful with this feature. It can vary with the age of the plant. It's best to leave it out unless you're absolutely certain of its nature.	
L30	**Midrib distinctly depressed on the upper surface**	
L31	**Midrib more or less flush with the upper surface**	
PETIOLE WINGED OR OTHERWISE (LEAFLET STALK IN COMPOUND LEAVES)		
L44	**Petiole distinctly winged** This feature can overlap with the character L83 Leaf base attenuate.	
L45	**Petiole not winged**	

RFK Code	Feature description	Notes
PULVINUS		
L46	Pulvinus present In the RFK, pulvini are defined as fleshy swellings on the petiole at its junction with the leaf blade. They are often associated with an angle or change in direction of the petiole. Swellings at the junction of the petiole and the twig are not regarded a pulvini. In the case of compound leaves, swellings at the junction of the leaflet stalk and leaflet blade are regarded as pulvini. Other authors define a pulvinus as the swelling at the junction of the petiole and stem. This definition is not used in the RFK. Pulvini are common in the families ELAEOCARPACEAE and EUPHORBIACEAE.	
L47	**Pulvinus absent**	
COMPOUND LEAF TYPE		
L48	**Compound leaves with three leaflets**	
L49	**Compound leaves palmate/digitate** Palmate or digitate means all leaves arise from one central point, illustrated to the right.	
L50	**Compound leaves pinnate (with as few as two leaflets)**	

RFK Code	Feature description	Notes
L51	**Compound leaves bipinnate or tripinnate** Bipinnate describes a pinnate leaf in which the leaflets themselves are further subdivided in a pinnate fashion (illustrated to the right). Tripinnate leaves are subdivided once more.	
TERMINAL LEAFLET IN COMPOUND LEAVES (PINNATE, BIPINNATE OR TRIPINNATE)		
L52	**Terminal leaflet present** Determining the presence of absence of a terminal leaflet can be problematic. In some specimens, the terminal leaflet of older leaves may be missing. Alternatively, in juvenile SAPINDACEAE the terminal leaflet, normally absent, may be present. Be careful to examine several compound leaves on the plant you're sampling, and make sure the compound leaf you're working on is typical for the plant.	See illustrations for L50 and L51
L53	**Terminal leaflet absent**	
LEAFLET ARRANGEMENT IN PINNATE LEAVES		
L54	**Leaflets opposite**	See illustration for L50 and L51
L55	**Leaflets alternate**	See illustrations for L53
LEAFLET NUMBER IN COMPOUND LEAVES		
L56	**Up to 7 leaflets in the compound leaf** Doesn't apply to species that typically have trifoliate leaves, these are covered at L48.	
L57	**8-20 leaflets in the compound leaf**	
L58	**More than 20 leaflets in the compound leaf**	
LEAF RACHIS IN COMPOUND LEAVES		
L59	**Rachis distinctly winged** The rachis is the stem of the compound leaf above the first leaflet. Technically, the part of the stem below the first leaflet is called the petiole, however for the purposes of this key, the petiole refers to the leaflet stem.	
L60	**Rachis not winged**	

Table 7 RFK Leaf or leaflet shape

LEAF OR LEAFLET SHAPE			
			
L61 Linear , thread-like (filiform), needle-like (acicular) Leaf long and narrow with more or less parallel sides.	**L62 Oblong** Leaf broadly oblong in shape, with more or less parallel sides.	**L63 Lanceolate** Leaf lance shaped, narrow and tapering at both ends. The widest part of the leaf is in the lower half, towards the petiole.	**L64 Elliptic** Leaf broadly oval in outline, with the widest part of the leaf in the middle.
			
L65 Falcate Sickle-shaped	**L66 Rhomboid** Diamond shaped.	**L67 Ovate** Egg shaped. The widest part of the leaf is in the lower half, towards the petiole.	**L68 Orbicular** Circular or almost circular in outline.
			
L69 Obovate or oblanceolate Leaf lance-shaped or egg-shaped, but with the widest part towards the leaf tip.	**L70 Triangular** Leaf triangular in outline.	**L70 Cordate** Leaf heart shaped, with the petiole attached at the cleft.	**L70 Palmate** With segments or lobes radiating from a central point, resembling a fan.

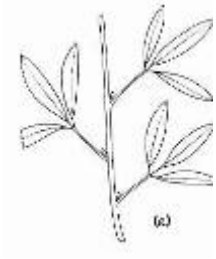
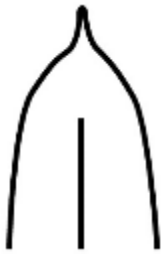
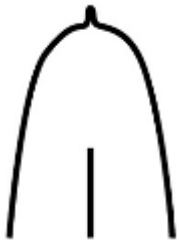
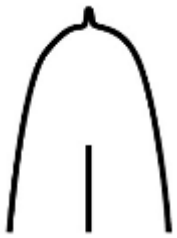
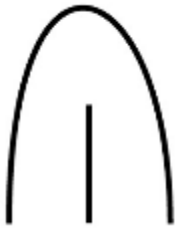
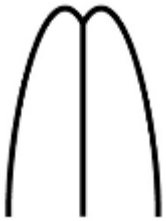
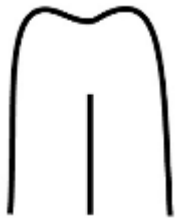
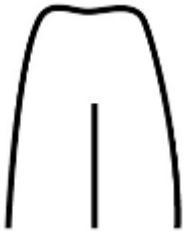
LEAF OR LEAFLET SHAPE			
			
L71 Cuneate Wedge shaped, with the widest part towards the leaf tip.	**L48 Compound leaf with three leaflets.** Most leaves on the specimen are trifoliate.	**L51 Leaves bipinnate** Compound leaf divided twice. Do not select this feature and L48 Compound leaf with three leaflets.	**L41 Leaves tripinnate** Compound leaf divided three times. Do not select this feature and **L48** Compound leaf with three leaflets.

Table 8 Shape of leaf or leaflet apex

LEAF APEX SHAPE – Can be difficult to interpret. Refer to the RFK help notes for more information. If in doubt, leave it out. Definitions adapted from Anonymous (2010)[20].			
			
L72 Subulate Narrow and tapering gradually to a fine, often soft point. *e.g. Araucaria cunninghamii*	**L73 Aristate** With a stiff, bristle-like tip. *e.g. Pollia crispata*	**L74 Acuminate** Tapering gradually to a point (sometimes called a drip-tip) *e.g. Pilidiostigma tropicum*	**L75 Mucronate** Terminating in a short, sharp point. Compare **apiculate**. *e.g. Cycas media*
			
L76 Apiculate Terminating in a short sharp flexible point; less abrupt than **mucronate**. *e.g. Acacia holosericea*	**L77 Acute** Pointed; converging edges making an angle of less than 90°. *e.g. Pilidiostigma tropicum*. Compare **obtuse**.	**L78 Obtuse** Blunt or rounded at the tip or apex; converging edges making an angle of more than 90°. *e.g. Dillenia alata*. Compare **acute**	**L79 Retuse** With a blunt (obtuse) and slightly notched apex. *e.g. Palaquium galactoxylum*

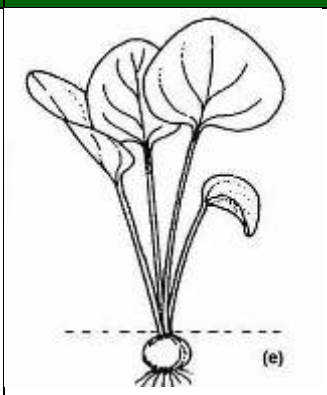
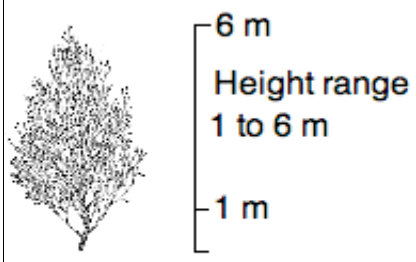
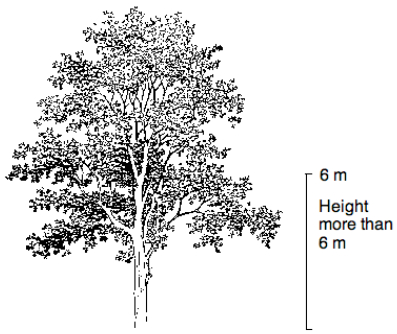
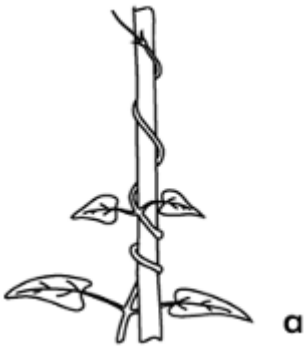
[20] Anonymous (2010) Glossary of Botanical Terms. In: Wikipedia The Free Encyclopaedia. http://en.wikipedia.org/wiki/Glossary_of_botanical_terms#S. (Date reviewed 3 August 2010).

LEAF APEX SHAPE – Can be difficult to interpret. Refer to the RFK help notes for more information. If in doubt, leave it out. Definitions adapted from Anonymous (2010)[20].			
 **L80 Emarginate** Notched at apex (notch usually broad and shallow). *e.g. Vandesina retusa*	 **L81 Truncate** Cut off squarely. *e.g. Terminalia arenicola.*		

10.2 Habit or growth form

Table 9 RFK plant habit features

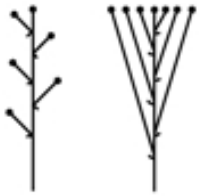
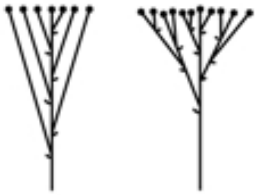
Characters from theRFK	Notes
Epiphyte	An epiphyte is defined as a plant that typically grows in the branches of trees. Some epiphytes obtain nutrients from its host plant (*i.e.* they are parasites). They do not have any connection with the ground.
Grass, sedge or rush	 A plant, typically with a tufted (all leaves arising from one point) growth form. Leaves are long and narrow, with parallel venation. Photo: Copyright CSIRO. *Thoracostachyum sumatranum*: CYPERACEAE
Palm or pandan	 Any plant that is a member of the palm family (ARECACEAE) or pandan family (PANDANACEAE). Photo: Copyright CSIRO. *Pandanus tectorius,* PANDANACEAE

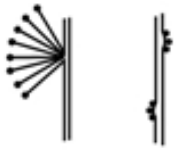
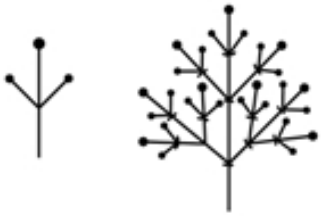
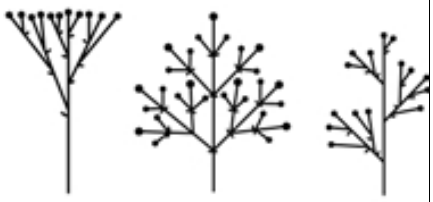
Characters from theRFK	Notes
Small shrub or herb (under 1 m tall)	 A herb is defined a single or multi-stemmed flowering plant that is less than 1 m tall, and flowers and fruits within this size range. Herbs may be erect or consist of a ground-hugging rosette of leaves. The definition includes plants that normally grow in the ground, but excludes species that are normally lithophytic or epiphytic.
Tall shrub or herb (1-6 m tall).	 A shrub is defined as a single or multi-stemmed plant, more than 1 m but less than 6 m tall, which flowers and fruits within that size range. Shrubs should be growing within the rain forest, or on the edge.
Tree.	 A tree is defined a usually single-stemmed woody plant, more than 6 m tall, with a stem encased in living bark. Does not include palms or pandans.
Vine.	 A vine is defined as a single- or multi-stemmed plant usually more than 1 m long or high which relies on other objects (often other plants) to support it as its own stem lacks the rigidity to hold it in an upright position.

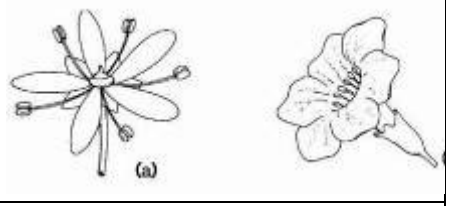
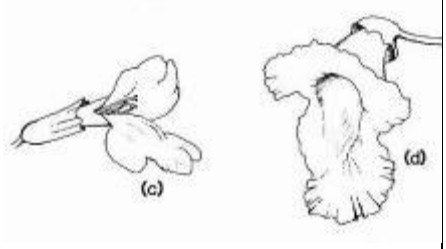
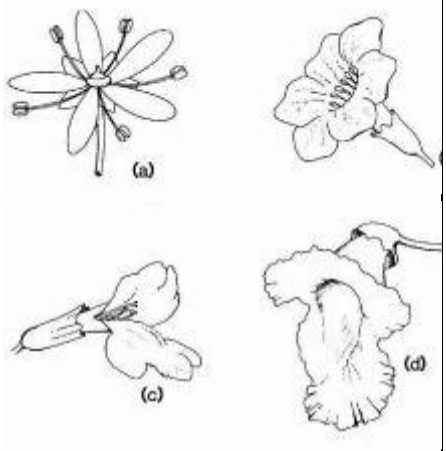
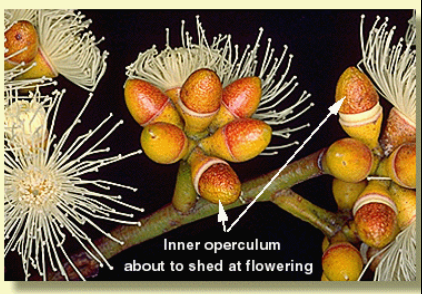
10.3 Flower characters

Table 10RFK Inflorescence features

RFK Code	Feature description	Notes
INFLORESCENCE POSITION **You don't need flowers to ascertain the position of the inflorescence. If flowers, buds or fruits are present, this feature should be easy to determine.**		
FL1	**Inflorescence terminal.** Inflorescences produced on the ends of the twigs or branches.	 Photo: Stuart Worboys *Plectranthus sp*: LAMIACEAE
FL2	**Inflorescence axillary or basal.** Axillary inflorescences are produced on the twigs or branches but back from the tip and in the axils of the leaves. Includes inflorescences that lie between leaves. Axillary is the most common position for inflorescences. Basal inflorescences are usually seen in herbs, where flowers arise from near the base of the plant stem.	 Photo: Stuart Worboys. *Geniostoma rupestre*: LOGANIACEAE.
FL3	**Inflorescence cauliflorous** Inflorescences produced on the main stem of the plant. This is a distinctive and rare feature, occurring in only 2.4% of rainforest plants.	 Photo: Ethel Aardvark (Wikimedia Commons). *Ficus racemosa*: MORACEAE
FL4	**Inflorescence ramiflorous** Inflorescences produced on the branches of the plant well back from the leaves.	 Photo: S. Worboys, *Tecomanthe sp:* BIGNONIACEAE

RFK Code	Feature description	Notes
INFLORESCENCE TYPE **This is the arrangement in which the flowers are borne on the plant.**		
FL5	**Solitary flower**	
FL6	**Raceme** Flowers arranged on a single axis, each flower stalked.	
FL7	**Spike** Flowers arranged on a single axis, individual flowers lacking stalks.	
FL8	**Corymb** Flowers arranged so that they are on the same level more or less in the same plane.	
FL9	**Umbel** Flowers arising from one point at the apex of a stalk, each flower on its own stalk. (Two and three flowered umbels are included in this category.)	
INFLORESCENCE TYPE **This is the arrangement in which the flowers are borne on the plant.**		

RFK Code	Feature description	Notes
L10	**Fascicle** Flowers arising from one point on a twig or branch, each flower with or without a stalk.	
FL11	**Cyme** Flowers produced so that a flower terminates each branch of the inflorescence and additional flowers can only be produced by the production of floral branches below the terminal flower.	
FL12	**Panicle** Flowers produced in much branched complex structures resembling the branching pattern of a tree. It is important to realize that panicles can incorporate other basic inflorescence patterns such as umbels and cymes.	
FL13	**Head** Flowers produced in definite structures where the flowers (often without stalks) are densely packed in various ways without any obvious branching pattern.	
FL14	**Cone** A seed-bearing structure, usually woody, ovoid to globular, including scales, bracts or bracteoles arranged around a central axis, *e.g.* in gymnosperms, especially conifers and Casuarina.	
FLOWER SIZE **This feature refers to the size of flowers when fully developed and open.**		
FL19	**Flowers small (less than 10 mm diameter)**	
FL20	**Flowers large (more than 10 mm diameter)**	
FLOWER SYMMETRY **Flower symmetry refers to the basic symmetry of the flower when cut longitudinally and radially. Where there is doubt, normally only the corolla is assessed.**		

RFK Code	Feature description	Notes
FL31	**Flowers actinomorphic (regular)** Flower parts are arranged equally around a central point. This means, if you cut the flower in half through the centre, each side will be a mirror image of the other, no matter which way you cut.	
FL32	**Flowers slightly zygomorphic (bilateral)**	
FL33	**Flowers markedly zygomorphic (bilateral)** Flowers whose longitudinal image varies substantially according to the angle of the section in relation to the perianth parts.	
COROLLA PARTS		
FL62	**Corolla none. No petals or petal-like structures** Even on well-developed flowers, counting petals can be problematic. Flower (a) to the right clearly has 5 petals, flower (b) has 6 fused petals. However, flower (c) could be seen as having two petals, but is more likely to have five (two petals/lobes in the upper lip of the flower, three petals/lobes in the lower lip of the flower). In flower (d) the number of petals is difficult to determine, and it might be safest to skip the character for this individual.	
FL63	**Corolla of one petal**	
FL64	**Corolla of two petals**	
FL65	**Corolla of three petals**	
FL66	**Corolla of four petals**	
FL67	**Corolla of five petals**	
FL68	**Corolla of six or more petals**	
FL69	Corolla calyptrate, petals fused to form an operculum Calyptrate means the petals are fused into a cap-like operculum, which falls when the flower opens. In such flowers, stamens are often prominent. The most well known example of this feature is the flower of *Eucalyptus*.	 Copyright CSIRO (Euclid 2nd Edition). *Eucalyptus sp.*

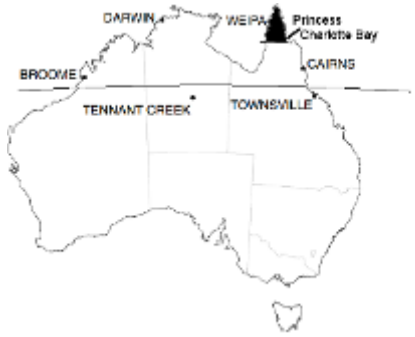
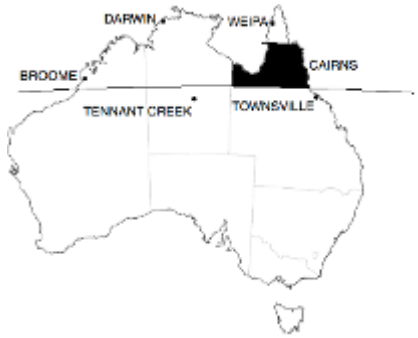
10.4 Geography and distribution

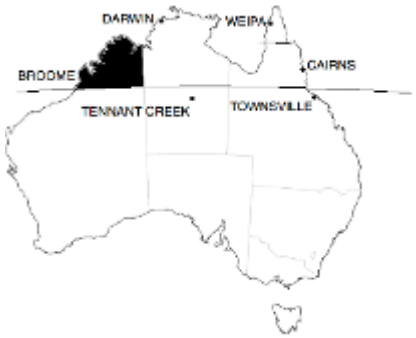
The geography/distribtution feature set asks where the specimen was collected, assuming it was collected in the wild and not cultivated.

The geographic coverage of the Weed Key is clearly defined in terms of state boundaries and major climatic regions, and does not need to be described further.

The geographic coverage of the Rainforest Key is limited to Australian mainland and offshore island rainforest communities north of latitude 19° S, which roughly corresponds to a line between Broome and Townsville. For the key, this geographic area is broken into four regions, defined below.

Table 11 RFK geographic features

RFK distribution features	Notes
Cape York Peninsula (CYP) The northern part of Cape York Peninsula, north of Princess Charlotte Bay (14.5° S).	
North east Queensland (NEQ) North eastern Queensland from Townsville to Princess Charlotte Bay.	
Northern Territory (NT) This area is the 'Top End' of the Northern Territory extending from the border with Western Australia to the Queensland border.	

RFK distribution features	Notes
Western Australia (WA) This is the Kimberley Region of Western Australia extending from Broome in the west to the Northern Territory border.	

Appendix A Collect and preserve plant specimens

There are numerous reasons for collecting plant specimens. Usually, a collection is made of a species that you want identified. You make the collection, send it to the Queensland Herbarium or the Australian Tropical Herbarium, and you eventually receive a formal identification. This identification may be necessary if:

- You suspect you have a rare species that requires special protection.
- You believe you have a significant weed, and accurate identification is required so you can determine the best means of control.
- To confirm your own identification.

Other reasons for collecting and pressing plants may be to create your own reference collection, or to contribute specimens that constitute extensions to the known range of species, or additional collections of poorly collected species.

Information in the following section is adapted from Centre for Plant Biodiversity Research's Plant Collection Procedures and Specimen Preservation (CPBR 2006) and

A.1 Before you collect

The key to accurate identification of your collection is to supply the botanist with good quality specimens and sufficient information about the plant, including the ecological conditions in which it was collected. Photographs of the plant in its habitat can help this.

Inadequate or poorly preserved and presented specimens will often not be accepted for identification. If sufficient material is available, and can be collected ethically, obtain several sets of the same specimen so that you can keep a specimen for your own reference. Specimens sent to the herbarium will not be returned: often they are incorporated into the herbarium's own collection.

A.2 Equipment

Fortunately, collection of herbarium specimens is not a hi-tech enterprise, and good specimens can be obtained with a minimum of equipment. For successful plant collecting, you'll need:

- For herbs, use a gardening trowel or mattock to ease plant specimens from the soil, leaving the roots and other underground organs intact. Never pull plants from the soil.
- Secateurs and/or small saw for removing small branches from trees and shrubs
- Large, heavy duty, thick plastic bags, rubber bands and 'Esky' if weather is hot OR newspaper and a portable plant press
- Pencil or permanent marker,
- Jewellers tags for labelling individual specimens
- Notebook for recording details
- Camera for recording plants in position in their habitat before you collect them

- A GPS unit is the best way to accurately determine the location of the specimen you are collecting. If this is not available then a topographic map or Google Earth may be used

Collecting difficult specimens

In addition to the equipment mentioned previously, you may wish to collect specimens that are a bit more challenging. Species that might require more than the usual effort include:

- Stinging plants, such as *Urtica* spp. (nettles), *Dendrocnide* spp. (stinging trees) and *Tragia*;
- Plants with irritant sap such as *Semecarpus* (tar tree);
- Plants with delicate flowers, such as *Hibbertia* (guinea flowers) or *Ipomoea* (morning glory);
- Thorny plants such as *Calamus* spp. (wait-a-while), *Rubus* spp. (native raspberries) or Cactaceae;
- Plants with very large leaves such as palms, pandans and cycads;
- Plants with fleshy, water-rich stems, leaves or roots, such as Cactaceae, *Drynaria* spp. (basket ferns), *Crinum* spp. (lilies).
- Tall plants, where the best specimens are high up in the canopy.

If it seems likely you'll be collecting difficult specimens, you will need to give more thought to the equipment to carry into the field. This might include:

- A throwing rope, comprising venetian blind cord and heavy lead weight, can be used to throw over and pull down inaccessible branches (note, for some rainforest trees and vines with strong timber, this method may not work)
- 70% ethanol is useful for preserving the delicate structures of small soft flowers. It's important to record the colour of the flower before placing it in alcohol.
- Paper bags are used for drying and storing large bulky fruit.
- Gloves should be used when handling prickly plant material or plants with corrosive sap.

A.3 Collecting

Before taking anything from a native plant, consider the ethics of that collection: can you collect the plant and not affect its overall health, or its reproductive output? What impact will you have on the surrounding environment?

A.4 What to collect

The specimens you collect will ultimately be mounted on A3 (*i.e.* 290 x 420 mm) herbarium sheets. Collect sufficient material to fill this space. Plants too large for a single sheet (*e.g.* a palm leaf) may be divided and pressed as a series of sheets.

It is often not possible to confidently identify plants from leaves alone. Therefore it is important to supply different parts of the plant for correct identification, particularly flowers and fruits/seedpods. Collect additional flowers and/or fruit for identification purposes

Select vigorous, healthy specimens that are typical of the species.

For plants with separate male and female flowers (e.g members of the cucumber family CUCURBITACEAE or the EUPHORBIACEAE), collect both sets of flowers.

Sometimes flower-bearing stems have few, or poorly-formed, leaves, and it may be necessary to collect an additional leafy specimen to provide a complete picture of the plant's features. Include a description of the bark if relevant.

Collecting herbs

When collecting small herbs, remember you need to fill and A3 sheets. It's therefore normal practice to collect several specimens from the same population. If the leaves of the herb form a basal rosette, collect at least some of these. With some herbs, you may need to collect roots or tubers or other underground parts.

Collecting Eucalyptus and Corymbia

Eucalyptus and Corymbia are a diverse group with many similar species. Always collect gumnuts and provide a detailed description of the bark on the trunk and main branches. You may need to scratch around on the ground to find last year's gumnut crop. Flower buds are often necessary for a positive identification in this group. You must also record as much information about the tree as possible, for instance:

- Is the bark a stringybark, box bark, gum bark, ironbark or bloodwood?
- Does the trunk bark extend to the main branches, or are they smooth?
- Are there coppice shoots on the plant? How do the juvenile leaves on the coppice shoot differ from the adult leaf?

Collecting acacias

As with Eucalyptus and Corymbia, acacias are a diverse group with many similar species. It's very important to collect pods, even if you have to scratch around on the ground. With many species, bark texture is also an important feature to record. If flowers are present, record their colour – for example, pale yellow, lemon yellow, golden yellow.

A.5 Pressing and Care of Specimens

Specimens should be pressed as quickly as possible after collection. If this is not possible, specimens may be stored in plastic bags, preferably wrapped in damp (but not wet) papers. Bags should not be packed tightly, and should be kept cool (or refrigerated) and moist. Make sure that each bag is correctly labelled for locality.

Remember the specimen has to fit on an A3-size herbarium mounting sheet. Trim the specimen to a suitable size (as shown in Figure 8). Bush specimens should have excess branches pruned so that they sit better in the press. Place each specimen, with numbered tie-on tag attached, in a fold of several sheets of newspaper, and place in the press (Figure 8). If necessary, occasionally add a sheet of corrugated cardboard to act as a ventilator. As you fill the press, try to keep it level to allow even distribution of pressure. This may mean the use of alternate corners of the fold for bulky roots and other parts, or packing around a bulky specimen with foam. Close the press and exert pressure with the straps.

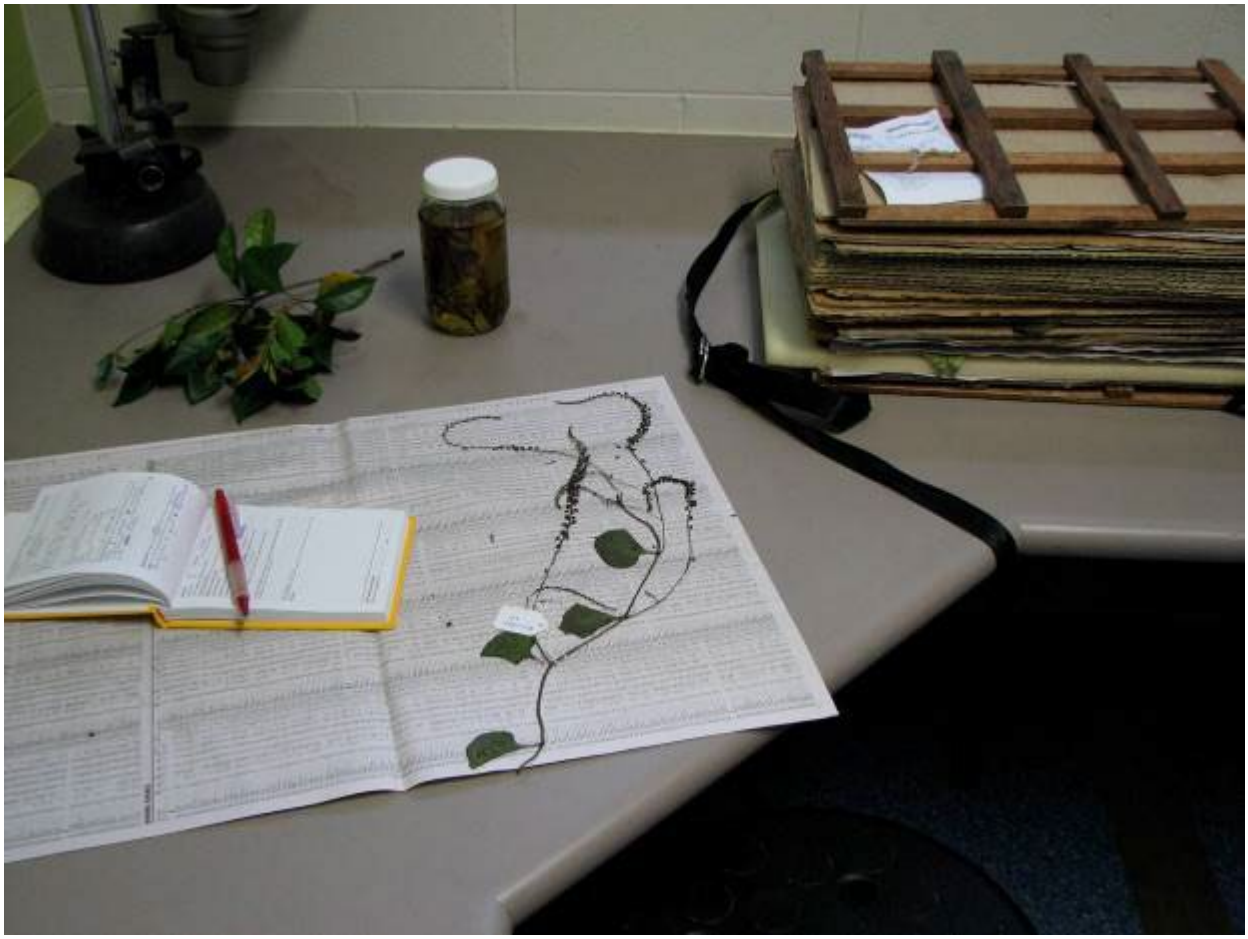


Figure 81 Equipment you'll need for pressing and recording specimens. Shown here are notebook and pencil, newspaper, tagged specimen, jar with specimen preserved in 70% ethanol, and plant press.

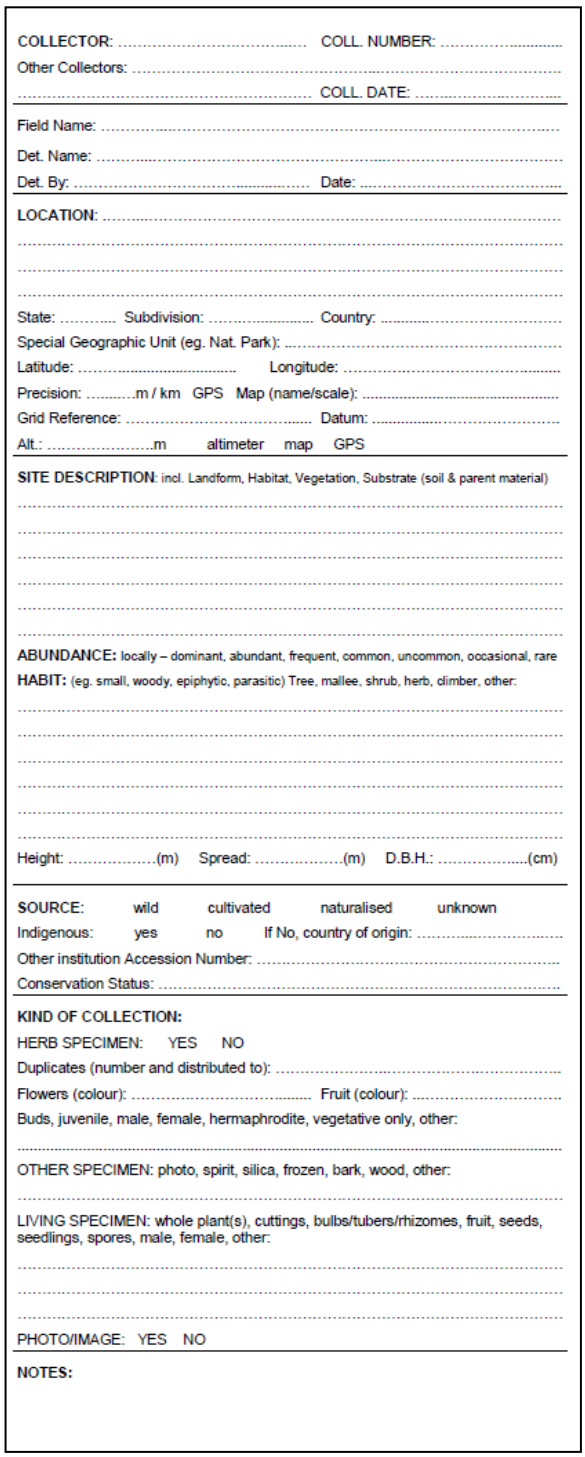
The plants in the press should be dried fairly quickly, in a warm airy place if possible. The specimens must not be left in damp papers or they will go mouldy – especially in the humid tropics. It's a good idea to change papers on a daily basis until the plants are dry. Delicate plants and petals may be lost in changing and should be kept in tissue-paper folders throughout changes. A properly dried plant specimen is brittle.

A.6 Field Notes

At the time of collection, a numbered tag should be tied on to the specimen. If you don't have a tag, write (carefully) on a leaf, or attach a piece of paper to the specimen. The number of the specimen should be unique, and may incorporate your name, for instance John Smith 22. Each number should refer to the collections taken from one plant on a particular date. You may take several specimens from one plant (these are called duplicates), with each duplicate bearing the same number.

Details of the collection are recorded in the field notebook, an example of which is shown to the right. As much as possible of the following data should be included:

- Your name and collection number.
- Collection date.
- Exact locality - a good plain language description, and latitude and longitude.
- Altitude.
- Site description, including - type of soil, topography, slope, aspect, associated species and vegetation type.
- A description of the plant itself - record features which will not be evident from the pressed specimen *e.g.* whether it is a tree or shrub, height, branching, notes on root system, odour, etc., as well as those features which may be lost on drying *e.g.* flower colour and odour.



COLLECTOR: ..... COLL. NUMBER: .....
Other Collectors: .....
..... COLL. DATE: .....

Field Name: .....
Det. Name: .....
Det. By: ..... Date: .....

LOCATION: .....
.....
.....
.....

State: ..... Subdivision: ..... Country: .....
Special Geographic Unit (eg. Nat. Park): .....
Latitude: ..... Longitude: .....
Precision: .....m / km GPS Map (name/scale): .....
Grid Reference: ..... Datum: .....
Alt.: .....m altimeter map GPS

SITE DESCRIPTION: incl. Landform, Habitat, Vegetation, Substrate (soil & parent material)
.....
.....
.....
.....
.....
.....

ABUNDANCE: locally – dominant, abundant, frequent, common, uncommon, occasional, rare
HABIT: (eg. small, woody, epiphytic, parasitic) Tree, mallee, shrub, herb, climber, other:
.....
.....
.....
.....
.....
.....

Height: .....(m) Spread: .....(m) D.B.H.: .....(cm)

SOURCE: wild cultivated naturalised unknown
Indigenous: yes no If No, country of origin: .....
Other institution Accession Number: .....
Conservation Status: .....

KIND OF COLLECTION:
HERB SPECIMEN: YES NO
Duplicates (number and distributed to): .....
Flowers (colour): ..... Fruit (colour): .....
Buds, juvenile, male, female, hermaphrodite, vegetative only, other:
.....
OTHER SPECIMEN: photo, spirit, silica, frozen, bark, wood, other:
.....
LIVING SPECIMEN: whole plant(s), cuttings, bulbs/tubers/rhizomes, fruit, seeds, seedlings, spores, male, female, other:
.....
.....
.....
PHOTO/IMAGE: YES NO

NOTES: