



Credit: Gail Stott/Ya'axché Conservation Trust

“ To dwellers in a wood, almost every species of tree has its voice as well as its feature ”

Thomas Hardy,
Under the Greenwood Tree

Introduction

Conservation strategies that target one or more individual tree species can only be truly effective if those species are correctly identified in the first place. However, if your team has limited botanical training or experience, species identification can be extremely challenging. Another approach is to send information about an observed tree to a botanist for later identification. This brief provides guidance on what information to collect and how to present it.

Who is this guidance for?

This brief is aimed at non-specialists with limited experience in plant identification but who nonetheless are involved with the conservation of particular tree species. The focus of this guidance is trees, but the principles can be applied to many types of plants.



 This Brief was written by Steven Brewer

Unless stated otherwise all photos are by Steven Brewer

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Before you start

If you are planning to carry out a tree conservation project you will already appreciate the importance of accurately identifying trees to species level.

However, you may find yourself in a situation where you:

- can't be absolutely sure you have correctly identified the species
- don't have a botanist in your team or
- are unable to return with a botanist to your unidentified tree.

In these cases identification can be confirmed at a later date by **collecting detailed information about the tree** and sending it to an experienced botanist.

Knowing how to communicate relevant information in the correct botanical terms is vital. Before you collect information on species in the field it is useful to understand some basic terminology on plant structure.

Basic Plant Structure

Plants are composed of two major organ systems: **shoots** and **roots**. The shoot is the above-ground portion, which is key to identifying a given plant.

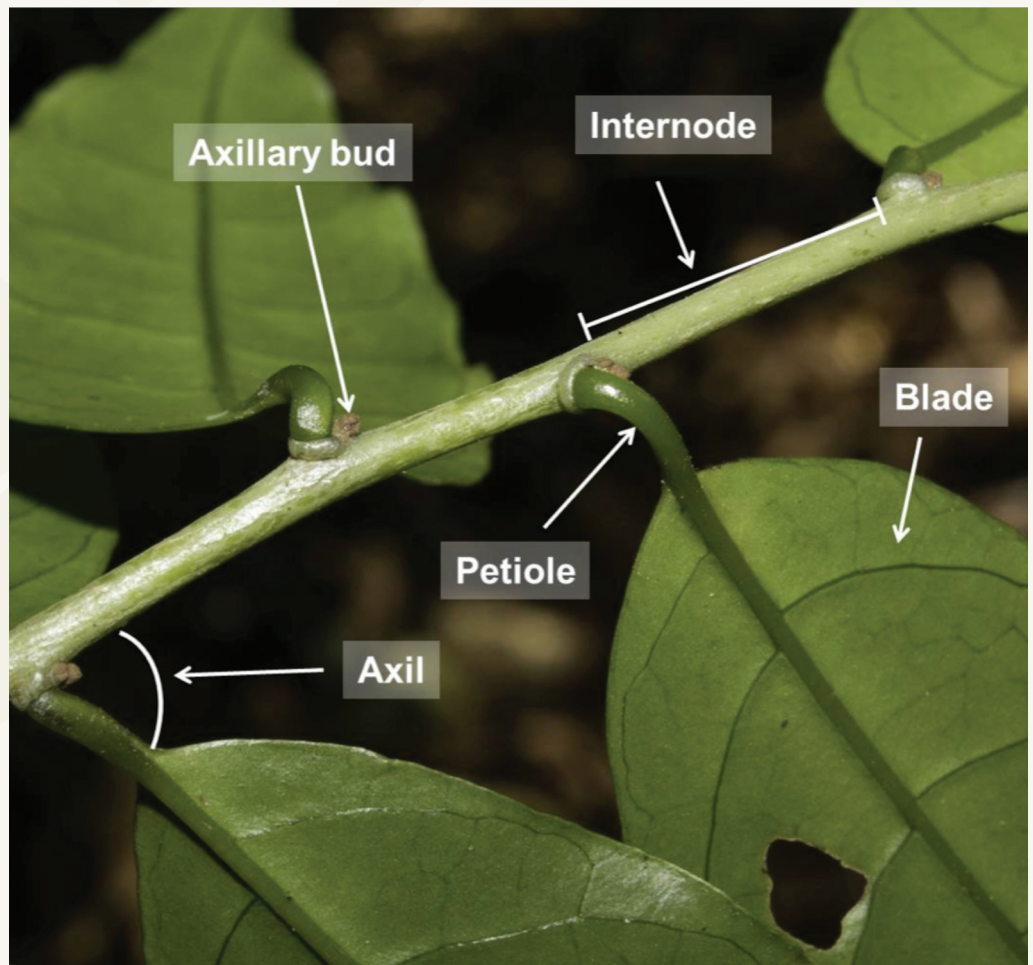
Stems are the main parts of the shoot and are composed of repeating units. Each of these units is comprised of **nodes** (where leaves and buds attach to the stem) and **internodes** (the part of the stem between nodes).

Leaves are organs composed of a **petiole** (the 'stalk' of the leaf) and the **lamina** (commonly known as the blade).

The space between the point where a leaf attaches to the petiole and the next node up on the stem (or out and away from the main stem) is called an **axil**.

A **bud** is an embryonic shoot that, under the right conditions, grows into another shoot or a collection of flowers (inflorescence) and fruits (infructescence).

Buds may be found in the axil (**axillary buds**) or at the tips of shoots/stems (**terminal buds**) and they typically are covered in scales and/or hairs to protect the tissue inside.



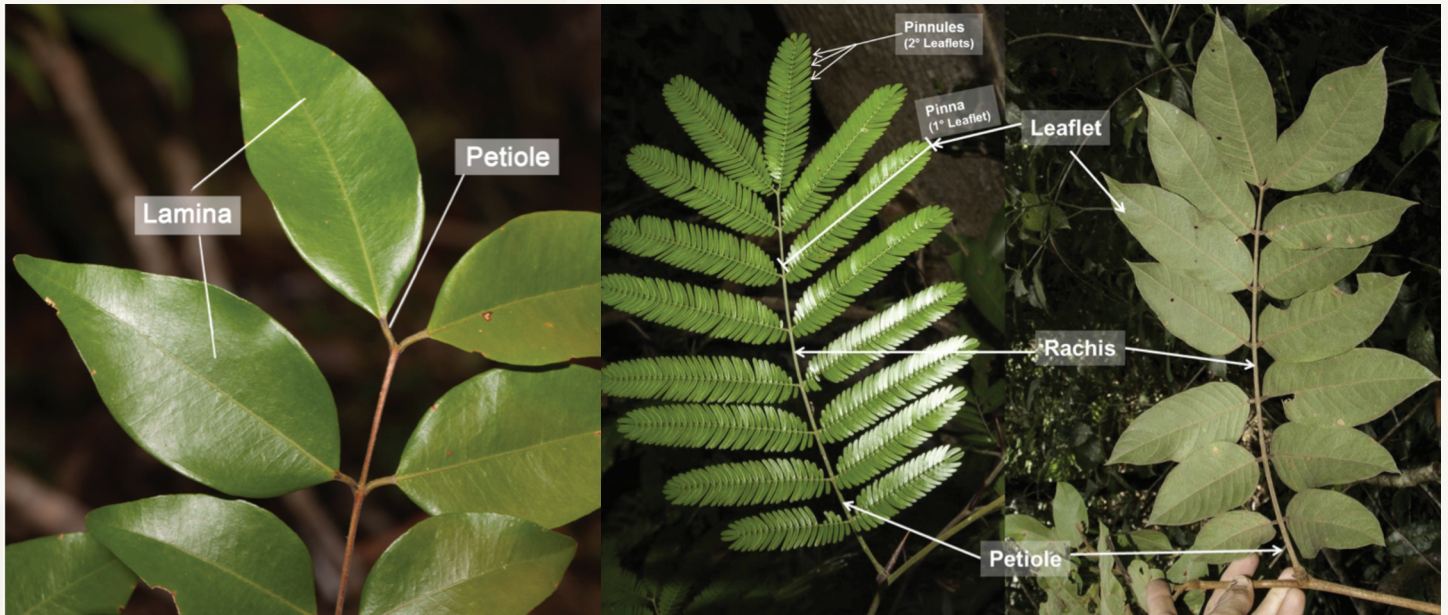
Compound vs. simple leaves

A leaf is **simple** if it is composed of one continuous blade.

A leaf is **compound** if the blade is divided into pieces that look like leaves. These are called **leaflets** and they attach to a **rachis** (similar in appearance to the stem which leaves attach to).

For compound leaves, each leaflet has a stalk called a **petiolule**.

In **bipinnately compound** leaves, each leaflet is further divided into secondary leaflets (see below). Primary leaflets are called **pinna** and secondary leaflets are referred to as **pinnules**.



Examples of (a) simple leaves; (b) a bi-pinnately compound leaf and (c) a pinnately compound leaf. For (b) and (c) each leaflet is one part of the larger leaf.

How do you tell if you're looking at a simple leaf or the leaflet of a compound leaf?

The best way to tell these apart is to look where what looks like the "leaf" attaches to what looks like a stem.

If an axillary bud is present, or if there is a branch or flower in the axil, then the leaf is simple.

If there is nothing in the axil then you are looking at one leaflet (i.e. one part of the compound leaf). Follow the **rachis** (a structure like a stem where the individual leaflets attach) towards the next largest branch until you find an axillary bud. This is where the petiole of the entire compound leaf joins the main stem.

TOP TIP

Sometimes the axillary bud is just a small "bump" that is very hard to see. Another way to tell the difference between leaf types is that leaflets of a compound leaf spread in the same plane whereas leaves often spread in different planes around a branch.

Also, the rachis and petiole of compound leaves and petiole of simple leaves tend to be lighter green and softer than the branches they attach to. This is especially true where leaves attach to older branches (e.g. ones closer to the trunk/main stem) in woody plants.

Finally, if axillary buds are not conspicuous, look for a terminal bud. Because leaves do not have terminal buds, if you can see one it means you are looking at the end of a stem (with leaves) and not at a compound leaf (comprised of leaflets).

Alternate vs. opposite leaves

When two leaves attach at the same node they are said to be **opposite** each other. When only one leaf attaches to each node the leaves are **alternate** along the stem.



Opposite simple leaves. attached along a stem.



Alternate simple leaves. attached along a stem.

Less commonly, 3-4 leaves will attach at one node and are therefore **whorled**. Occasionally, many leaves will be **clustered** in an area of the stem where the nodes are very close together, usually on very short branches from a stem.



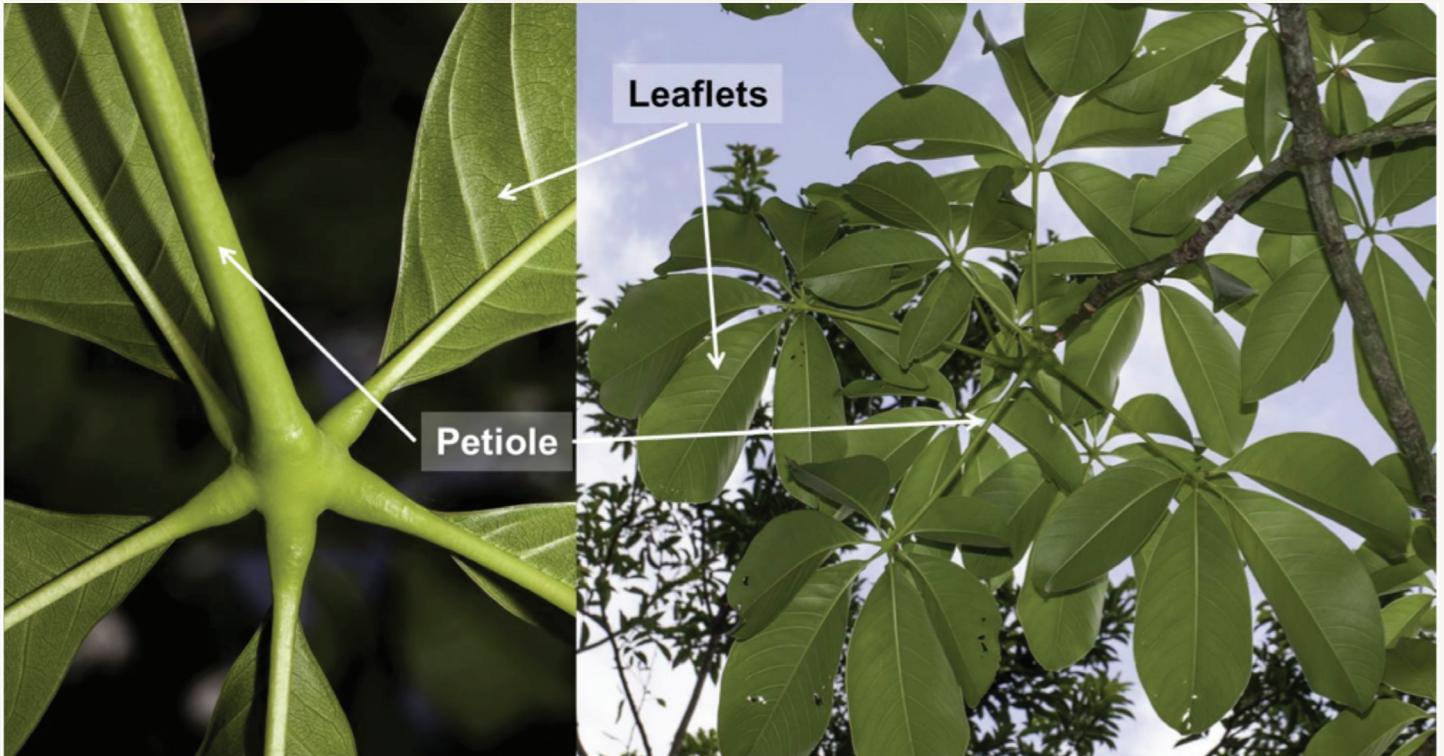
Whorled simple leaves.



Clustered simple leaves.

Other leaf types

Palmately compound leaves have leaflets that attach at one point to the end of the petiole, like fingers of the palm of a hand.



Flowers and Fruits

Flowering plants (over 300,000 species worldwide) have evolved thousands of types and modifications of flowers and fruits of all shapes and size. Therefore reproductive structure in plants is a topic too broad and

complex to cover in this brief (see references for some websites devoted to general botany).

Nevertheless, it is important to be observant, paying special attention to axils and tips of younger stems, when collecting or photographing unfamiliar plants: reproductive structures are often small and inconspicuous!

Don't forget to look on the ground (and in the leaf litter!) underneath a tree in question for old flowers and/or fruits that may have fallen previously from the tree. Although the tree may currently appear to be "sterile", you might have only just missed its flowering or fruiting seasons.

Fruits can be placed in a paper bag and dried in the sun, and flowers can be pressed (or placed in a paper bag if already quite dry). Note on the collection label when such material is collected from the ground.



Collecting Voucher Specimens

Unless you are a botanist familiar with the flora of your area, sending a voucher specimen to a botanist is the best way to accurately identify a plant to species.

A voucher specimen is a pressed and dried plant sample that is labeled, mounted and stored (usually in a herbarium) for future reference.

Typically the specimen is mounted on a sheet of special, stiff paper that is 28 cm x 43 cm (11" X 17").

The voucher is used to identify or verify the identity of a specific plant found in the field and for comparing against other specimens of other individual plants. It serves as an official record of the occurrence of a species in the locality where it was found.



How to Collect Voucher Specimens

The details of collecting plant specimens are far more numerous and subtle than space allows here, so the reader is referred to reference documents and websites (see 'References and Further Guidance' on Page 12) where this process is explained in more detail.

This following section summarizes the basic essentials of voucher specimen collection.

STEP 1: Acquire equipment

Collecting and processing a representative sample from most trees requires certain tools and supplies:

- Binoculars
- Collecting pole
- Hand pruner
- Plastic bags
- Newspaper
- Plant press including corrugates and blotters
- Price tags/Jeweler's tags
- Pencil, permanent marker, notebook



STEP 2: Collect a representative piece/pieces of the plant

Although small herbaceous plants can be collected in their entirety, voucher specimens for trees and woody plants are represented by a branch.

- Collect a branch that has fertile material if possible (i.e. with fruits, flowers, flower buds). However, identification can often be made using sterile material.
- Make sure that the branch you collect has at least one young and one older portion. The younger portion will be the outer-/tip-most portion of the branch and will often be green or greenish and smoother than the portion closer to the trunk of the tree, which will have thicker bark.

Include at least 3 nodes and both young and older buds if possible and be sure the branch has leaves on it.

If the tree is deciduous at the time of collection (without leaves on the branches), collect leaves from beneath the tree. Usually the most common and abundant leaves beneath the tree are the ones you should collect.

If you are unsure about which leaves on the ground came from the tree, scan the canopy with binoculars for leaves still hanging on to branches, then look for similar leaves on the ground.



A branch containing reproductive parts.



A branch containing both younger and older portions.

- Every collection needs a unique collection number to be used only once by the collector.

In the field, attach some sort of tag (e.g. jeweler's tag, price tag, piece of plastic flagging, duct tape, etc.) to the specimen with the collection number written in pencil or permanent ink before it is processed. Afterwards, place it carefully into a large trash bag until it can be processed and pressed.

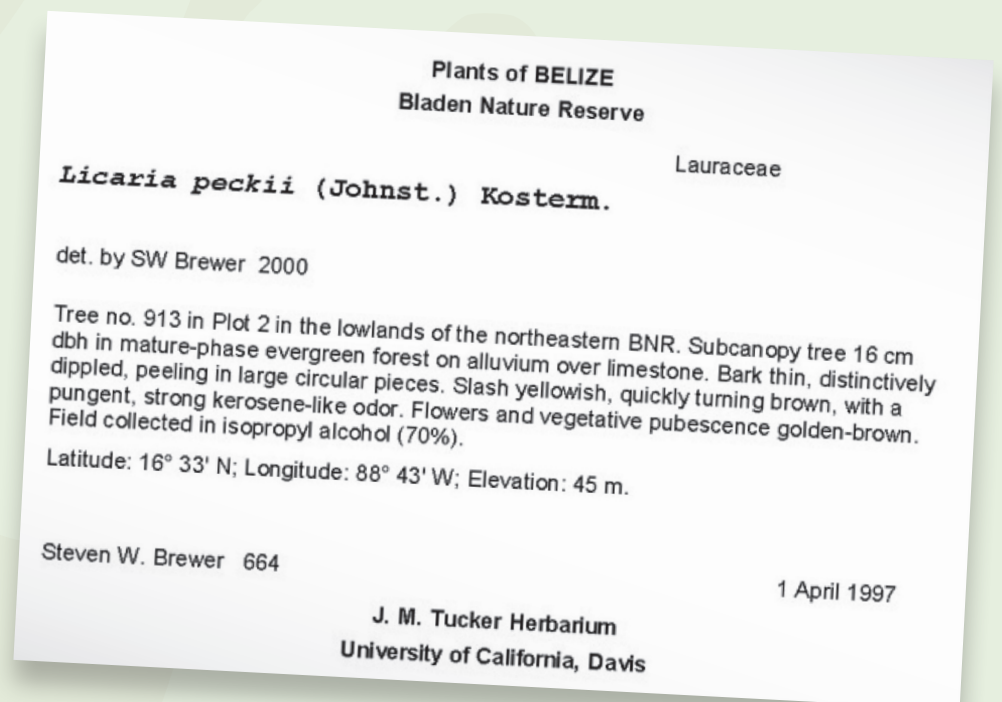
- Collect at least two copies ("duplicates") of each specimen – one to deposit in your country's herbarium and one to send to a specialist for identification.

STEP 3: Collect relevant information for a label

A label is essential and holds information about the plant that can't be represented by the specimen itself or, like colour of flowers, tends to be lost with age or specimen processing.

While collecting the specimen, write down your collection number in a notebook with as much information as possible about the tree that you collected. This should at least include:

- Collector and other collectors present.
- Collection date.
- Detailed location information: e.g. country, state / province / district / protected area. Also include a description of the location with reference to significant geographic points such as cities or towns, roads, physiographic features (mountain peaks or ranges, bodies of water, etc.), and preferably with GPS coordinates including map datum.
- Habitat type: a description of the major habitat (e.g. savanna, forest, scrub, etc.) and any topographic features (e.g. ridgetop or valley, slope, etc.).
- Habit: a description the type of plant form including herb, vine (usually mostly green and clings to other plants or rocks for most of its length), liana (a woody vine that hangs free for much or most of its length), shrub or tree, including height of the plant.
- Description of characteristics that cannot be captured with the specimen alone: e.g. presence of latex/colored sap, colours and odours (of sap, flowers, fruits, leaves, etc.), width of trunk, etc.



After returning from the field with tagged plant material, it will be time to make and fill out a label with any information collected in your notebook. These will then be attached to the specimens as you process them, press them and prepare them for storage.

STEP 4: Process the specimens in preparation for drying

In most situations pressing plants is not necessary during collection. Besides, carrying a plant press is cumbersome and pressing takes too much time. Instead, after all specimens are collected and tagged with a unique collection number, processing and pressing can take place at the end of the field day. However, note that specimens will deteriorate quite rapidly if they are not pressed and dried (or preserved in alcohol – see below) on the same day that you collected them.

To begin processing, place the specimen in between a folded sheet of newspaper. Trim and/or fold the newspaper to fit within an area slightly smaller than a sheet of 11" x 17" mounting paper (where the specimen will eventually end up being affixed in the herbarium), making sure to leave room for a label.

Write your initials and the collection number on the edge of the outside of the folded newspaper.

If you are far from your base of operations (e.g. your field office, research station, etc.) you can stack your specimens after placing them in labeled newspaper.

Stack specimens in order by collection number – this will help to reduce errors during the drying process (see STEP 5) – then place them in a heavy-duty plastic bag.

Sprinkle alcohol (70% isopropyl or ethyl alcohol, even strong liquors c. 50% alcohol such as rum will work) in the bag to keep them from molding/rotting and being eaten by insects. One litre of alcohol will usually preserve a stack of specimens about 35 cm tall for a few months.

Be sure to compress the specimens to remove the air from the bag, tie and/or tape the bag closed, and turn the package daily for the first few days to ensure the stack of specimens is completely penetrated by the alcohol.

Make sure the bag is securely taped or tied to ensure that specimens do not move around and avoid crushing the edges of the package.

When you return from the field, these specimens will be removed from the bag to be dried and eventually stored.



Credit: Gall Stott/Ya'axché Conservation Trust.

STEP 5: Press, dry and store the specimens

Specimens should be dried and stored as soon as practical. In summary this involves securing your specimens within a plant press, which is then placed on one long edge over a heat source.

To begin, each specimen is placed in its own newspaper (use a fresh one if the specimen has been preserved in alcohol and don't forget to label the fresh newspaper). Then place the newspaper between **two sheets of moisture-absorbing material** (preferably blotter paper or "blotters") and **two sheets of corrugated cardboard**.

The order is therefore: cardboard – blotter – specimen in newspaper – blotter – cardboard – blotter – specimen in newspaper 2 – blotter – cardboard – blotter – specimen in newspaper 3 and so on.

Specimens that are not bulky (e.g., herbs, fern leaves, small tree twigs, etc.) may share a blotter between them and stacked in 2's or 3's between two cardboards, if materials are in short supply and drying time is limited. When ready, the entire stack of specimens is secured within a plant press.



Plant specimens are placed inside newspaper, blotter paper and cardboard before being placed in a plant press.

Next, make a dryer (a container used to hold one or more plant presses above a heat source). The easiest dryer to make is a rectangular box lying on one long side – with an open top and bottom – that encloses one or more plant presses.

The inside walls of the box should be snug enough against the sides of the plant press to ensure that air moves through the corrugates rather than around the plant press. Attach wire mesh or metal rods inside the dryer to keep the plant press stable and then place the dryer about 50-75cm above a heat source (e.g. propane burner, camp stoves, kerosene stoves or incandescent light bulbs).

Most specimens will dry within 24-48 hours but **monitoring specimens regularly is essential:**

- Specimens should be dry but not brittle and some specimens will dry more quickly than others.
- Plant presses loosen as their specimens dry, which means they must be tightened periodically to prevent pieces of specimens from falling out.

TAKE CARE: Fire is a real danger. Newspapers too close to the heat source and falling plant material can catch fire.

Once dried, specimens should be removed from the plant press and then stacked and sealed in plastic bags or boxes before being stored or sent on to a herbarium or botanist for identification. To prevent insect infestations, one or two moth balls may be placed in each container of specimens.

Taking Photographs

For accurate identification of plants, there is no substitute for collecting specimens from living plant material, but collecting plants in the field requires equipment and can be time consuming.

Photographs can be a relatively quick and less expensive means of identification. Presenting a good set of photographs to a botanist can often lead to identification at least to family and may lead to species identification.

Following these general guidelines for photographing trees will enhance the possibility of species identification:

1 General photographs of the tree

- The bole (trunk) including the base of the tree.
- A shot from below into the canopy (if visible).
- A shot of a branch showing older (inner) and younger (outer) portions of a stem.

2 Leaf

- A shot of the underside of a whole leaf (including petiole) and a close-up (macro) shot of the underside from the base of the blade to about the middle of the blade.
- A shot of the upper side of the whole leaf.
- For compound leaves, also include a macro shot of the upper surface of the entire petiole and upper surface of the apical (towards the tip) 1/3 of the rachis. Include shots as above but for individual leaflets instead of the entire leaf.

3 Stem

- A macro shot of the tip of a young stem that includes the apical (tip of stem) bud, surface of the stem and if possible where a petiole attaches to the stem.
- A shot of 2-3 nodes each on a younger portion of stem (showing the base of petioles attached, if possible) and an older portion of stem (without leaves). Be sure to show any axillary buds and hairs or other surface features (scales, thorns, or anything that looks unusual) and the upper and lower sides of the stem.

4 Fertile parts

- Photo flowers and flower buds with macro shots from the side, bottom of the flower and top (looking down into the flower).
- Photo whole fruits and (if possible) cut a fruit lengthwise and cross-wise (across the shortest side) and photo the cut surfaces. Photo individual seeds if available from multiple angles.

Selected references and further guidance

References and further guidance on some of the methods described in this brief are provided below.

General botany and botany lists

Internet Directory for Botany: http://bit.ly/gtc_ref_2ai

University of Illinois – Plant Systematics Database: http://bit.ly/gtc_ref_2b

University of Oklahoma – Scott’s Botanical Links: http://bit.ly/gtc_ref_2c

Wayne’s World – Plant Taxonomy Lists: http://bit.ly/gtc_ref_2d

Databases (focused on tropics)

The Field Museum – Useful Links for Neotropical Flowering Plant Identification: http://bit.ly/gtc_ref_2e

The Field Museum – Neotropical Herbarium Specimens: http://bit.ly/gtc_ref_2f

Missouri Botanic Gardens – Tropicos: http://bit.ly/gtc_ref_2g

Missouri Botanic Gardens – Tropicos – Flora Mesoamericana: http://bit.ly/gtc_ref_2h

New York Botanical Garden – C. V. Starr Virtual Herbarium: http://bit.ly/gtc_ref_2i

Royal Botanic Gardens Kew – Neotropikey: http://bit.ly/gtc_ref_2j

Singapore Botanic Gardens – Online Herbarium: http://bit.ly/gtc_ref_2k

Smithsonian Tropical Research Institute – Center for Tropical Forest Science: http://bit.ly/gtc_ref_2l

Southern Africa Plants – a Photo Guide: http://bit.ly/gtc_ref_2m

West African Plants – a Photo Guide: http://bit.ly/gtc_ref_2n

Collecting and processing plant specimens

Missouri Botanic Gardens – Field Techniques: http://bit.ly/gtc_ref_2o

Royal Botanic Garden Sydney & the Domain Trust – Processing Plant Specimens: http://bit.ly/gtc_ref_2p

Bowles, J.M. (2004). Guide to Plant Collection and Identification: http://bit.ly/gtc_ref_2q

Province of British Columbia, Ministry of Forests Research Program (1996). Techniques and Procedures for Collecting, Preserving, Processing, and Storing Botanical Specimens: http://bit.ly/gtc_ref_2r

Queensland Herbarium (2013). Collection and preserving plant specimens, a manual. Department of Science, Information Technology, Innovation and the Arts: http://bit.ly/gtc_ref_2s

Botanical & other field supplies

Ben Meadows: http://bit.ly/gtc_ref_2t

Forestry Suppliers: http://bit.ly/gtc_ref_2v

Herbarium Supply Co: http://bit.ly/gtc_ref_2u

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