

# **NFI METHODOLOGY – BOTANICAL SPECIMENS COLLECTIONS**

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## **1. Number of botanists for NFI**

Number of botany personal in a the NFI team must be at least three, this will be comprised of 1 botanist, 1 support staff (para taxonomist) and a local assistant. The roles will be 1 - botanist to confirm identifications of plants using identification tools (books, tablets, dictionary etc.); 1- para taxonomist to assist botanists in identifications and collections and preservation of plant specimens; 1- local assistant to assist the botanists in collections of samples and also to give local names and traditional uses of plants for NTFP.

## **2. Field collections and numbering of specimens within plots**

All specimens collected will be tagged using watch makers tags and labelled. The labels on the tag will include date, locality, cluster number, plot number and tree number. Number of samples of plants to be collected for each species will be two. Specimens will be preserved in the field and sent to Lae National Herbarium for further confirmation of species and reporting. All plant specimens collected will be pictured using digital cameras. The images taken will include the plant specimen with its numbering on the tag corresponding to the species number recorded in the plot data sheet. Any other necessary images will be taken to assist botanists in species identification.

### *a. Tree samples*

Every standing Tree assessed in the plots for dbh and heights will be marked by a flagging tag for botanists to name. On the flagging tags, the tree number will be written. The tree data sheet will be used to enter the species names to the corresponding numbers.

### *b. Lower plants and other plant groups.*

Samples of lower plants and other plant groups such as palms, grasses, bamboos, pandanus, gingers, aroids, ferns, lianas, etc. also be collected if assessed. The samples will be tagged and labelled as in tree samples. Different plant groups have different collecting methods for good botanical specimens so each will be collected according to their respective specifications.

### 3. Botanical collecting tools and equipments

Sufficient tools and equipment will enable the botany team to make good specimens for botanists to make accurate identifications to the plant species collected. Botany teams must have following tools and equipments for good plant specimen collections as in figure 1. (a, b, c)

Figure 1. Botanical collecting equipments

*a. Delicate collecting equipments*



1. Binoculars
2. Camera
3. GPS
4. Tape measure
5. Dissecting kit
6. Hand lens (X 10 / 12)
7. Field book
8. Pencils

*b. Tree species collecting equipments*



1. Sling shot (Catapult – Locally made)
2. Hand gloves
3. Fishing line reels (L)
4. Fishing line reels (M)
5. Nylon twine (4mm thick x 150m long)
6. Fishing line (21 lbs x 150 m long)
7. Sinker (0.1kg lead)

*c. General plant collecting & preservation equipments*



1. Pruner
2. Bush knife
3. Secateurs
4. Safety helmet
5. Silica gel
6. Sticky tapes
7. Old news papers
8. Polythene tubes (plastic)
9. Plant presses (wooden) & straps
10. Card boards
11. Ethanol (95%)

## 5. Sample collection and preservation

It is important to note that different plant groups (Angiosperms, gymnosperms, monocotyledons, pteridophytes, bryophytes etc.) will have different collection methods for good and accurate species identifications by the botanists later in the herbarium.

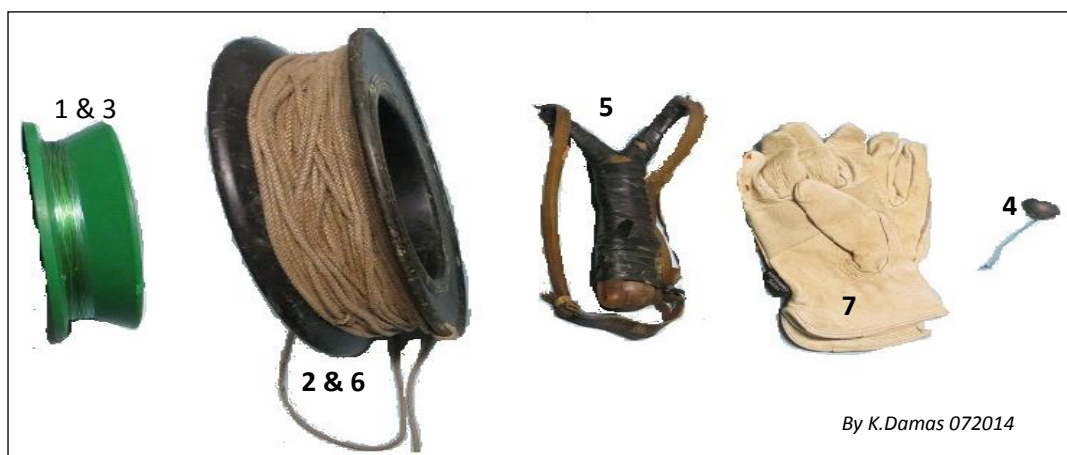
### a. Tree species collection method

Specimens from very tall trees will be collected using sling shot or catapult method. The sling shot or catapult method is a use of lead (sinker) being tied to one end of a fishing line ( approx. 21lbs) and is shot up to a tree branch with good specimens (flower/fruit). The sinker goes over the desired branch, it is lowered down to the ground then the sinker is removed from the string. The string is tied to a nylon twine and is pulled up over the branch until that end of the nylon twine reaches the ground, string is removed and both ends of the nylon twine are held together and pulled until the branch breaks. The samples will be collected and processed as shown in figure 3 & 4.

The catapult or a sling shot method will have the following components (see Figure 2.)

- i. 21 lbs fishing line approximately 150 m long.
- ii. Fishing line reel (large size)
- iii. Fishing line reel (medium size)
- iv. Sinkers (lead)
- v. Sling shot (Catapult) locally made
- vi. Nylon twine ( 4mm thick and 150 m long)
- vii. Hand gloves

Figure 2. Catapult (sling shot ) components



Samples collected be based on botanical specimen collection specifications and will be preserved in 95% ethanol. The botanical specimen collection specifications include getting specimens large enough to fit in between a page of a daily news paper (National or Post

Courier), 40 x 29 cm so that later in the herbarium can be mounted on a standard herbarium sheet 43.5 x 28 cm. If the plant parts are too big they can be cut into sections and when brought to the herbarium they can be mounted on several sheets.

The specimens placed between the newspapers will be pressed together between wooden frames and left overnight (12 hours) then placed into the plastic bags (polythene tubes). The specimens in the plastic bags will be preserved in 95% ethanol (Figure 4). The 95% ethanol will be diluted with water at a ratio of 2-3 cups ethanol, 1 cup water and poured onto the specimens in the plastic bags and sealed off with scotch tape.

Figure 3. Flowering plant specimen collection



Lower plants such as palms, pandanus, grasses, gingers, aroids, ferns, bananas, lianas etc have their own collection methods. General rule for good botanical specimen is that a

sample must always be fertile. In flowering plants, either flower or fruit or both must be present on the sample collected. Exceptions are given to plant groups that have the natural habit of not flowering and fruiting for long period of time. Palms, pandanus, gingers, bananas, aroids and some grasses are difficult to collect because of their sizes, only certain parts of the plants will be useful for collecting so long as their distinguishable features are present for identification. Example, the palms are too big and bulky so the fronds will be measured and several sections will be discarded and only the selected sections be maintained as samples. The inflorescence will be quiet bulky so only several sections will be selected and rest will be discarded.

Figure 4. Plant sample preservation



Long and narrow specimens such as grasses and sedges can be folded once, twice or even three times at the time of pressing. In this way a plant of up to 1.6 metres high may be pressed onto a single sheet. For very small plants, a number of individuals may be placed on each sheet.

## References

1. Womersley, J.S. 1976 Plant collecting for Anthropologists Geographers and Ecologists in Papua New Guinea. Botany Bulletin No.2
2. Jones, D.L. and Clemesha, S.C. 1976 Australian Ferns and Fern Allies
3. Harrington, H.D. 1993 Collecting and pressing plants in How to identify plants. Swallow press, Athens.
4. Barfod, A.S. , Banka, R. & Dowe, J. L 2001 Field Guide to Palms in Papua New Guinea. ANU Reports 40.
5. Anderson, P.J. 2011. *Identifying Commonly Cultivated Palms*. In *A Resource for Pests and Diseases of Cultivated Palms*. Florida Department of Agriculture and Consumer Service, Division of Plant Industry and Identification Technology Program, CPHST, PPQ, APHIS, USDA; Fort Collins, CO.
6. Queensland Herbarium, (2013) *Collection and preserving plant specimens, a manual*. Department of Science, Information Technology, Innovation and the Arts.

## Appendix 1: Collection methods of different plant groups

### 1. Bananas (Musaceae)

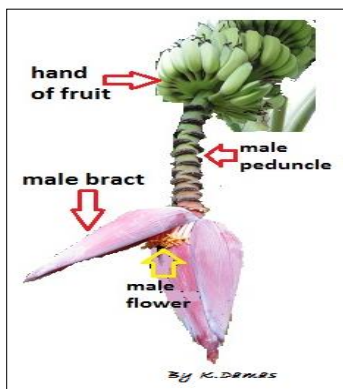
A good collection of a banana (*Musa* sp.) comprises herbarium sheets of pressed material, written notes, spirit material and photographs (whole plant, pseudo-stem (to show colour), whole inflorescence, bracts and male flowers). Measurements to be taken include total height of the plant, diameter of the stem, total leaf length and with, length of petiole, size of fruit and seed etc.

Figure 1 Banana plant



- a. Parts to be collected include half lamina base + midrib
- b. Upper section of petiole (Junction between lamina and petiole should form the middle of the herbarium sheet).
- c. Cut off the top of the leaf
- d. Cut off the bottom of the petiole
- e. Remove petiole very close to stem (petiole base).
- f. Split petiole in half, longitudinally
- g. Cut off one side of the lamina leaving the midrib intact so that what remains will fit onto a herbarium sheet.

Figure 2 Fruit and male flower



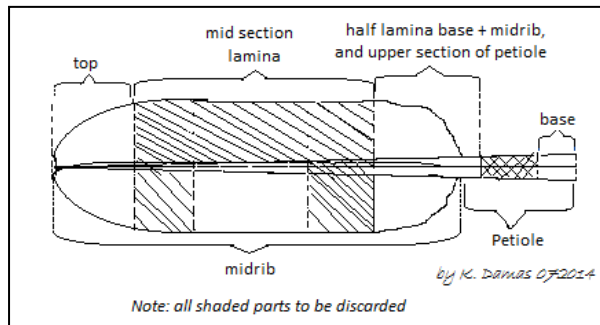
- a. Cut one 'hand' of fruits.
- b. Include one fruit cut in longitudinal section
- c. Cut one cluster of male flowers, attached to the subtending bract
- d. portion of the male peduncle (the hanging 'tail' between bunch and male flowers).

*Things to note on the specimen label :*

Plants suckering freely or hardly suckering at all, colour of sap in suckers (watery, or red to violet, or milky), colour of pseudo-stem; older bracts strongly revolute or scarcely revolute, inflorescence erect or pendulous, total length of lamina and petiole, colour of fruit, colour of male flowers.

*Portions to include in spirit material:* use a large screw-top glass jar. Include some male flowers, some female flowers, some fruits and a bract.

Figure 3. Banana (Musa) leaf showing sections for collection



It is recommended that the leaf specimen must be collected from the fourth-last fully developed leaf below the inflorescence.

## 1. Cycads (Cycadaceae)

Cycads are mistaken for palm or a tree fern because of their morphology especially the leaves (fronds) and their stems which almost resemble palms and tree ferns. However the inflorescence differ from palms and ferns as they are cone bearing plants. Palms bear flowers while the ferns produce spores.

Figure 4 . Cycas tree leaves, fruits and cones



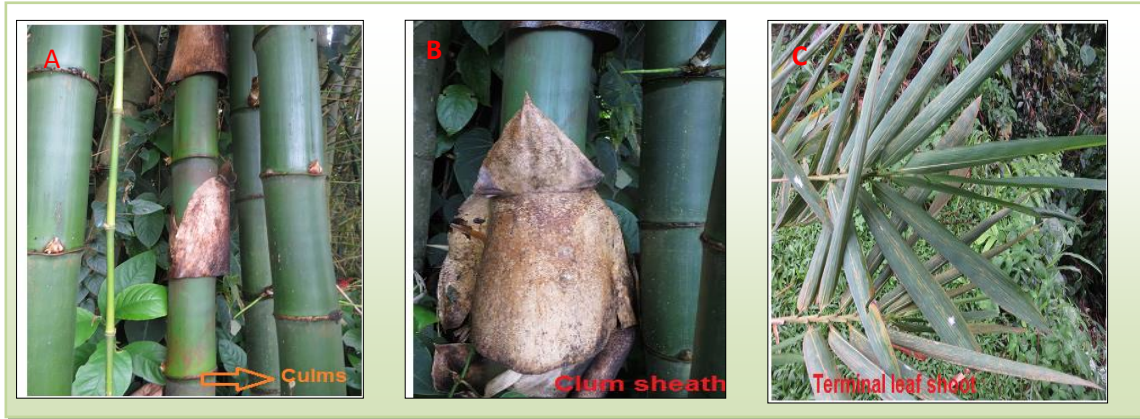
Procedures in collecting cycas specimens:

- Take pictures of whole plant, leaf (frond), flowers (cones) and fruit.
- Measurements to be taken include total height of the plant, diameter of the stem, total leaf length and width, length of petiole, size of fruit and seed etc.
- Specimens will include a cone or at least a number of the sporophylls (scales) that make up a cone. Also include an entire leaf (i.e. the entire "frond", not just an individual pinnule (leaflet)) Leaf may be cut into c. 30 cm lengths for ease of handling.
- Record the total number of leaf present in the crown of the plant.

## 2. Bamboos (Poaceae)

Bamboos comprise a section of the very large grass family Poaceae. Many species are in excess of 5 metres tall and some can reach 30 metres or more. One of the characteristics of most bamboos is that they rarely produce flowers, and so when you collect a specimen, the chances are that only sterile material will be available.

Figure 5. Picture showing bamboo culms



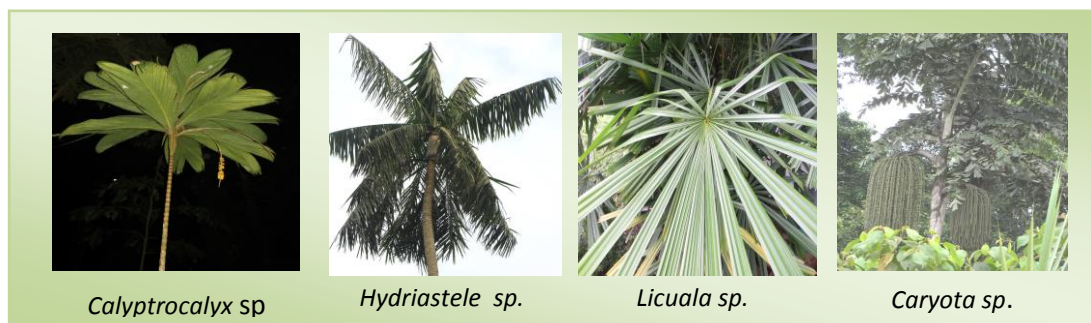
You will need to collect the following:

- Photograph the plant and each entire part before sectioning. Place a common object such as a pencil in the photograph to provide scale.
- leafy sample from a terminal shoot.
- A sample of the stem or culm about 30cm long (you will probably need a small saw to remove this), and one or more culm sheaths.
- Collect flowering sprigs if the flowers are present.
- Record whether the species is tightly clumping, or 'running'; the stem colour and any striping, overall height, and the branching pattern at the nodes. Also note from which part of the plant you collected the stem section and the culm sheaths.

## 3. Palms (Arecaceae)

Palms habits and forms vary in many ways particularly the leaf structures and architectures are somewhat complex that making specimens are always tedious, time consuming and often it is bulky. It is recommended that the parts that are useful for distinguishing species must be observed and collected carefully as in all the other plant species.

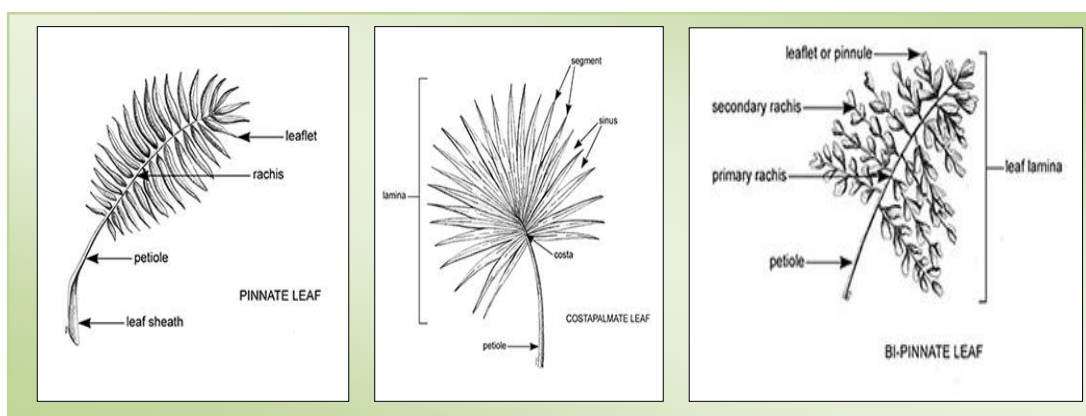
Figure 6. Pictures showing different species leaf structures



Procedures in making palm specimens:

1. Photograph the plant and each entire part before sectioning. Place a common object such as a pencil in the photograph to provide scale.
2. Leaves
  - a. Measure the petiole, blade, rachis and leaflet lengths of pinnate leaves, the petiole and blade length of palmate (segments radiating from a single point) leaves and the petiole, blade and rib lengths of costa palmate (leaf stalk extending into leaf blade - rib) leaves. If leaves are small, keep and press whole leaf. For large leaves divide the petiole into mounting paper size pieces. Number the pieces on the tags to keep them in order of cutting.

Figure 7. Palm leaf types



Source: Anderson, P.J. 2011. *Identifying Commonly Cultivated Palms*. Florida department of Agriculture

- i. Pinnate leaf. Take several pieces from the blade, include tip. For each piece, apart from the tip, cut the rachis into a mounting sheet size length, remove the leaflets on one side leaving the stubs near the rachis. Fold the other side back and forth to fit the mounting sheet.
  - ii. Palmate leaf or costa palmate leaf, keep the point of attachment to the petiole and ensure that the hastula is showing. Cut off one side of the blade, part of the other side and fold several times to fit the mounting sheet and press.
- b. Inflorescence
- i. If the flower cluster is small, fold and press all of it. If it is large, keep several portions including the base and also showing the origin of the side branches in successive order. If applicable try to keep an entire inflorescence main stem with the side branches removed. Selected side branches from noted positions should be kept and pressed.
  - ii. All of the spathe should be kept, cutting it into sections if necessary. Some flowers may be preserved in ethanol (spirit). Fruits should be treated as for flowers. The cupule (or cup) at the base of the fruit should be kept. Large fruits may be dried quickly if cut in half.

(Refer to Field Guide to Palms in Papua New Guinea)

#### 4. Gingers (Zingiberaceae)

Gingers are small to large plants, The gingers according to their inflorescence (flowering and fruiting) habits, generally comprised of two different groups. One group possessing terminal and axillary inflorescence while the other group bearing basal inflorescence. In Papua New Guinea the genera bearing terminal or axillary inflorescence include *Alpinia*, *Ridelia*, *Tapeinochilus*, *Boesenbergia*, *Pleuranthodium*, *Curcuma*. The other group with basal inflorescence include *Amomum*, *Hornstedtia* and *Etingera*

Figure 8 Different ginger genera showing their inflorescence arrangements



Procedures in making ginger specimens:

- Photograph the plant and each entire part before sectioning. Place a common object such as a pencil in the photograph to provide scale.
- Select the best fertile (flowers and fruit) sample of a species, and clear the base
- For species with inflorescence attached to rhizome, dig the base carefully to avoid breaking any attached inflorescence, flowers or fruits.
- The rhizome dug out from the ground be clean off the mud from the roots with water. Remove soil with care to avoid breaking the flowers.
- Specimen collection will include rhizome (split in halves), flowers, fruits, middle leaf and top leaf attached to the pseudo stem

Figure 9. Ginger collections

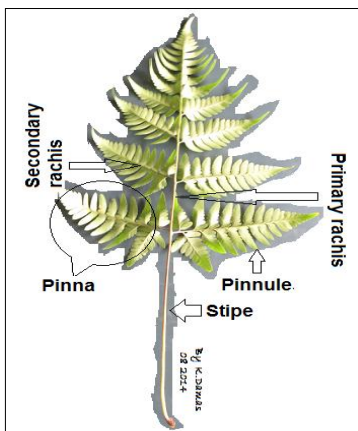


- For species with terminal and axillary inflorescences carefully prepare the specimen to fit in between news paper page
- The leaves specimen should include top section, mid section and the lower section of the pseudostem.

- h. *Things to note on the specimen label:*
- i. Life form (terrestrial /epiphyte ),
- ii. Plant in clumps or spreading
- iii. Length of pseudo stem and diameter, leaf sheath, single leaf blade ( Length and width.)  
Length and width of the fruits
- iv. Describe colours and shape of all parts, no. of leaves per shoot, Position of the fruit (subterranean - below the ground, embedded in soil or above ground), number and shape of individual fruits
- v. Measure distance between directly connected peduncle.

## 5. Ferns and fern allies (Pteridophytes)

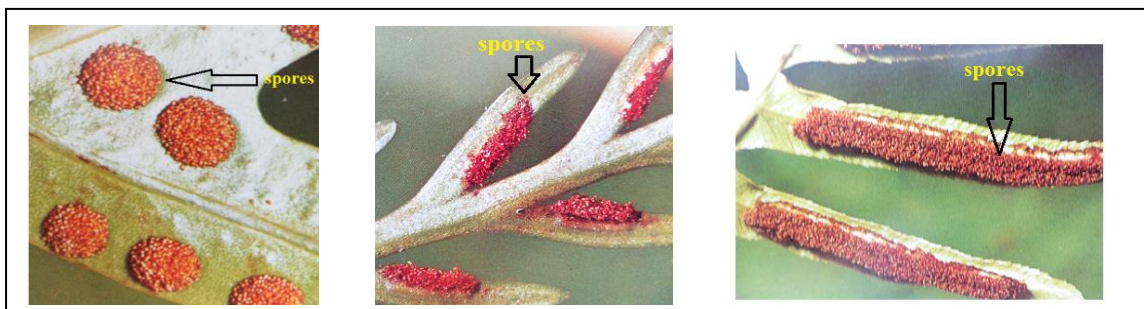
Figure 10. Fern leaf (frond)



Ferns are small to large, mostly medium-sized plants. Their habits range from small terrestrial or epiphytic herb or shrubby looking, climbing and erect medium size trees. They are non flower bearing plants unlike other vascular plants. They produce spores on the under surface of the fronds (leaves). The spores are borne in sporangia and sporangia can be borne in groups called sori or situated along the leaf veins and margins. They can be rounded or elongated. When making fern specimens, the presence and location of spores must be noted and collected.

The techniques of collecting preparing and mounting on to herbarium sheets are much the same as for other vascular plants. Large specimens must be trimmed to fit in between a daily newspaper (Post Courier, National News paper etc.) page. The longest pinnae of the fronds can be folded in zigzag paterm 3 – 4 times so it fits in between the newspaper page. Long and large stipes from tree ferns and others must be trimmed, always keeping the base, then mid section and the upper section with the first pinnae and placed in separate newspaper. The rest of the frond including the primary, secondary or tertiary rachis can also be sectioned and trimmed to fit into the news paper pages and later glued on a separate mounting sheet in the herbarium.

Figure 11. Different spore arrangements on fern leaves



Things to note on specimen label:

- a. Habit (terrestrial, epiphyte, tree fern, fern allies)
- b. Rhizome (stem) type (tufted, short creeping, medium creeping, long creeping)
- c. Leaves (fronds) simple, pinnate, pinnatifid, palmatifid etc.
- d. Stipe length, grooved or ungrooved, scaly or smooth, thorny, spiky
- e. Spores presence

Figure 12. Rhizome type

