



Australia's National
Science Agency

DRAFT Monitoring Protocols Manual for the MER Pilot Network

Vegetation Composition and Structure Module

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Contributions

J. Hodgson led the coordination, drafting and editing of this document. She also led the field trials and contributed to the design of the protocols. S. Prober, B. Sparrow and L. Broadhurst led the design of the protocols and provided revisions. L. Broadhurst also assisted in conducting field trials. N. Gellie and the TERN protocols team provided drafts, revisions and conducted field trials of the protocols. J. Carwardine and S. Nicol provided revisions.

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Introduction

Vegetation composition and structure was deemed extremely important by ecological experts and practitioners at the MER Network consultation workshops, hence the core data streams collected by the Fire and Weeds Pilot MER Network will focus on vegetation monitoring.

This Vegetation composition and structure module details three protocols, each a related but independent survey, to gather information on various aspects of the vegetation community such as species presence, cover and structure. These protocols are a modification of the TERN AusPlots protocols thus enabling consistency with ecological monitoring data streams collected across Australia by TERN (White et al. 2012).

Part One of this module describes the Floristic survey. The Floristic survey informs upon the species composition of an area. It involves the collection of voucher specimens of all species present in the first year of survey and any new unidentifiable (in the field) species in subsequent years. For the most accurate data, all voucher specimens will be forwarded onto the relevant Herbarium for professional identification.

Part Two of this module describes the Cover survey. The Cover survey uses the point-intercept method to collect repeatable measures of vegetation and substrate cover to NVIS level 5. Cover is defined by Bonham (2013) as the percentage of vertical projection of the vegetation or substrate present.

Part Three of this module describes the Basal wedge survey. The Basal wedge is a handheld device that measures Basal area in the surrounding area. This method informs on community structure by estimating biomass of the dominant tree and shrub species of the plot and surrounds.

It is assumed that the plot set up has been completed and tapes have been laid out prior to completing these modules.

For each Module the standard survey procedure is described however an adapted procedure for more complex vegetation types i.e. rainforest, are provided in the Appendices.

Glossary

Term	Definition
Site	A site is a cluster of one set of plots. These may occur in a single reserve or property or be spread across areas with differing tenures.
Plot	Plots are a defined sampling area within sites and each plot falls into one of the three experimental treatments.
Blocks (Triplets or Pairs)	Within a site, all plots are grouped into either a Triplet or a Pair (depending on whether two or three treatment types exist for the Site). One plot in each Triplet (or Pair) represents one of the treatment groups. Also referred to as a 'Block.'
Quadrat	A defined sampling area within a plot used for collecting vegetation and/or soil
Transect	A transect is a defined linear collection area within a plot. All MER Network plots have the same transect setup defined by a tape measure and have length (e.g. 10m, 25m) direction (e.g. north, south, east and west) and sequence (e.g. South 1, South 2, South 3 etc.). This information (set-up) is important for all MER Network protocols.
Protocol	The standard procedure used to monitor a MER Network Plot.
Adapted protocol	The adapted procedure used to monitor a MER Network Plot in rainforest and dense closed woodlands (see Appendix 5.1, 5.2)
Voucher	A voucher is a pressed plant sample and associated information (e.g. location) that is required for herbarium identification and for future reference. The voucher should include the best on offer mature foliage along with diagnostic features (e.g. seed, flowers, bark and roots) where possible. Furthermore, as a voucher may be kept by herbarium and used for genetic work it needs to be taken from a single plant species specimen.
GRS Densimeter	A densimeter is a survey device used to observe vertical line of sight canopy intercepts for the cover module that are taller than the surveyor. The vertical line of sight is obtained by levelling both of the densimeter bubble-levels and then looking through the instrument so that the sighting marks (cross hairs and circle) are aligned.

Part I Floristics

A floristic survey enables the collation of information on the species composition and richness of an area. When collected in nested plots of increasing size, a species richness curve can be calculated and species richness is more easily compared between sites that use different plot sizes. Regardless of plot size in your vegetation type, the first step is to set the plot up. Species will first be recorded within 10 m x 10 m quadrats, then in the remainder of the plot if your plot size is 25 m x 25 m. It is important to note that the plot size varies across the MER Pilot Network according to community type. They are usually 25 m x 25 m, and for logistical reasons are sometimes 10 x 10 m.



1 Floristics Protocol

1.1 Equipment

- Mobile device (tablet) and google play email registered with the MER AuScribe App and Fulcrum App. Currently the AuScribe app is not publicly available so this will be provided on loan to you by your trainer (speak to your MER contact). No iOS version available
- Survey tapes
- Secateurs
- Hand trowel
- Paper bags and envelopes for temporary storage of plant specimens at the plots
- Large heavy duty plastic bags for storage and transport of plant specimens at the plots whilst collecting
- Plant presses (minimum x2) and compression straps or sash cord (see instructions for construction of plant press in Appendix 5.3)
- Newspaper and cardboard (tabloid size)
- MER/DAWE barcoded voucher labels that are regionally specific (speak to your MER contact).
- Flora reference keys, guides and apps for the region
- Hand lens (10 x magnification)
- Hi-vis pin flags and/or pegs (to mark start and end of transects)
- Flagging tape
- Pen/permanent marker
- Notepad and pencil
- Notebook or ring folder with papers (plus sticky tape) or camera for specimen diary
- Personal Protective Equipment (e.g. hat, sunscreen, protective clothing and gloves)

1.2 Plot Setup

In most cases regional MER Network liaison staff would have visited your site and stratified it by selecting plots according to the experimental design (e.g. Figure 1.1a). During this process SW, NW, NE, and SE corner posts will have been installed which orientate the plot for survey visits. Plots are usually 25 x 25 m, but some are 10 x 10 m.

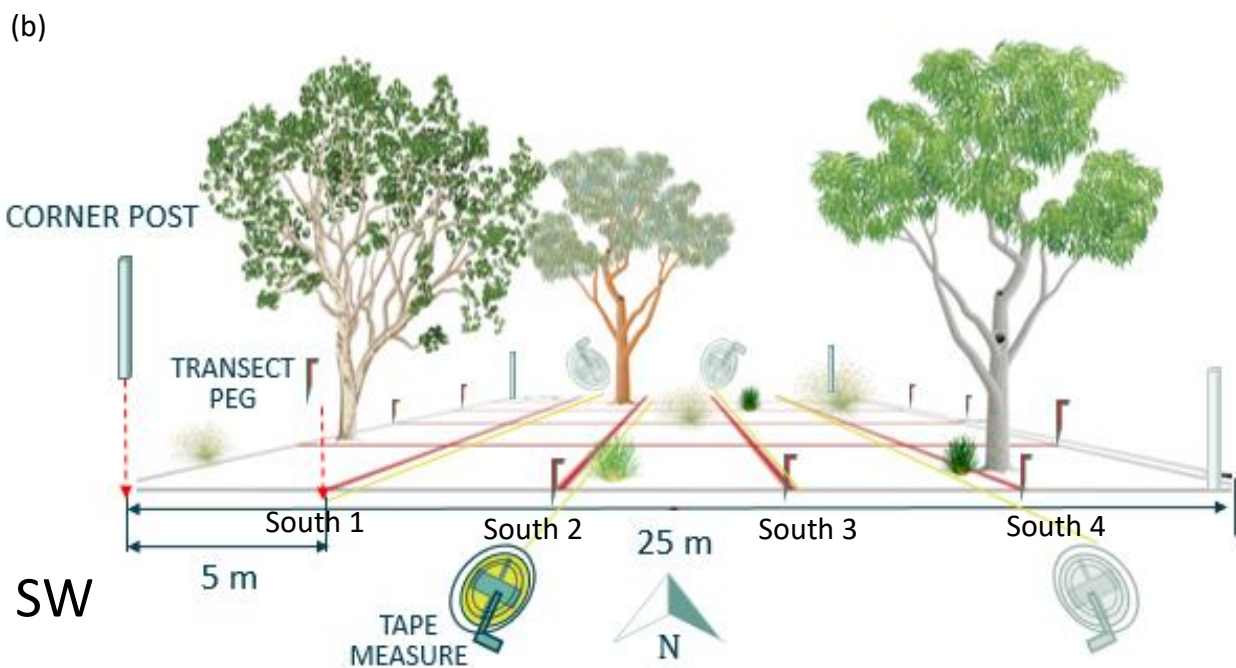
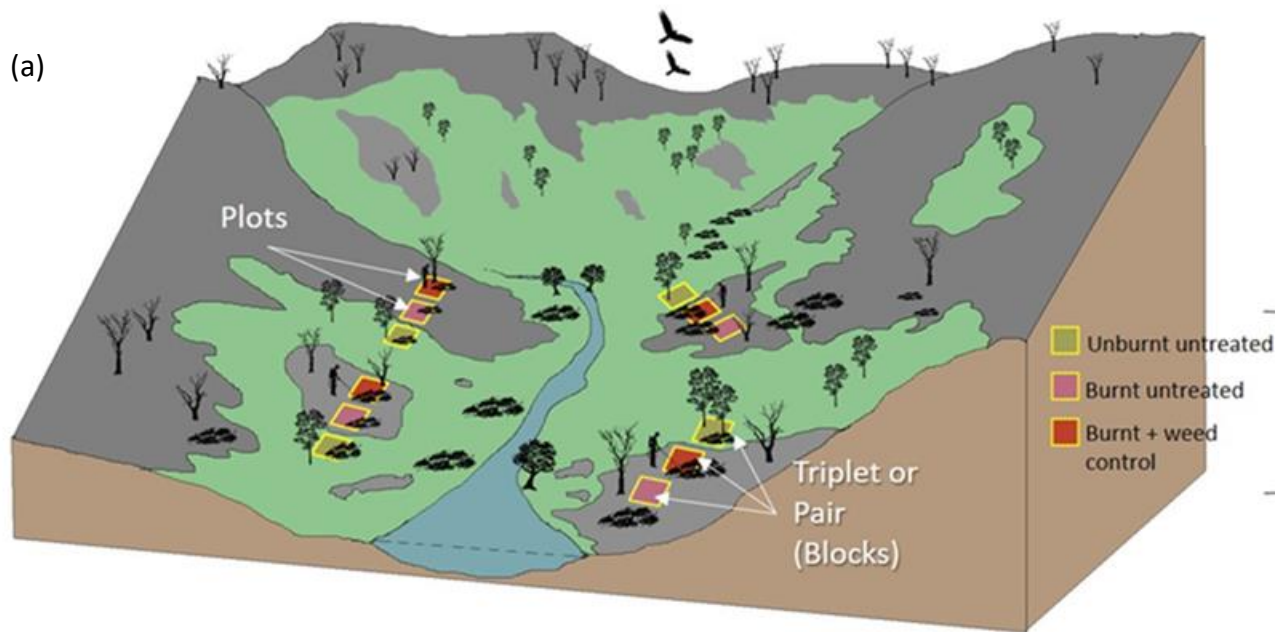


Figure 1.1 MER Network Site and plot orientation (a) MER Network Site (b) MER Network Plot for the 25 m x 25 m variant (for 10 x 10 m plots, distance between transects is 2 m instead of 5 m).

- All protocols begin at the South West corner **SW**.
- On arrival to the site the first job is to peg the end of the transects which occur at **5 m intervals** along all the edges of 25 m x 25 m plots (see Figure 1.1b) or 2 m intervals for 10 m x 10 m plots. Hi-vis pin flags or tent pegs are useful for this.
- The tape measures will be used to lay out the transects. Transects have length (e.g. 10 m, 25 m) direction (e.g. north, south, east and west) and sequence (e.g. South 1, South 2, South 3 etc; Figure 1.1b). This information is important for the Cover Protocol detailed in Part II.

Figure 1.3. Overhead view of a 25 x 25 m MER Network Plot shown in Figure 1.1b with the two floristic sampling areas of a 25m x 25m plot (e.g. 10m x 10m quadrat (blue) and remainder (yellow)). For 10 x 10 m plots allow 2 m between transects, and there are no nested quadrats.

2. One surveyor who is botanically skilled searches each quadrat for plant species, beginning at the smallest size using enough collection bags to separate the plants found in different quadrats.

TIP: The same skilled person should lead the species list documentation and cover survey across all plots within a site, to maximise consistency of species' recognition, field names and data.

3. Only one voucher specimen is necessary for each species occurring at the MER Network site. In your first plot of a site, collect voucher specimens for every plant species present in the 10 x 10 quadrat, taking enough material to cover an A3 herbarium sheet (See 1.4.3 Collecting Vouchers). For 25 x 25 m plots, move to the remainder of the 25 x 25 m quadrat and collect every plant species that was not in the 10 m x 10 m quadrat of the same plot. Separate the plant samples in quadrat bags until pressed, and clearly label field names of delicate plants and material (e.g. seeds and flowers etc) in a paper bag or envelope to protect them.
4. It is unlikely you will encounter all species present at the site in the first plot. Therefore, in subsequent plots and subsequent years of monitoring at the same site, only collect a voucher specimen for *new* species not previously recorded in any of your plots, or if you are uncertain about the plant identity. All species collected at the site (their field name) will appear as red for new plots or plots previously sampled. Click on those that you observe in the new or repeat plot to add them to the master plant list for that plot (turning the button green).
5. When quadrats within the plot are complete (i.e. when you have spent about 10 minutes without finding any new species), return to the field vehicle or an area where all the equipment is available to process the specimens.
6. Select and open the 'Vegetation vouchering' module in the MER Auscribe App.
7. For each specimen, assign a field name and enter this name in AuScribe. Where you are confident of the identification, the field name should be a definitive Latin species name. Where the identification is unknown, it should be given a known common name or a descriptive name (e.g. *Eremophila* 'red flower' or 'yellow daisy flower shrub'). The field name given during this step will be carried through and used as the field name for the point-intercept data collection every time that species is encountered at the site (see the Cover module).

TIP: We strongly recommend that site leads maintain a local herbarium or photographic diary of each species to assist with recognition across plots and sampling years. This could be done, for instance, using a book or ring folder with labelled small specimens, or a photo app.

8. Label each specimen securely with a unique regional voucher barcode label provided by MER/DAWE. Place the label on stems or away from any plant parts that will need to be examined for identification purposes. If the specimen is too small for the barcode (e.g. a very small herb that is still likely to be identifiable), place the barcode on the envelope and press the plant in the envelope.
9. For each specimen, scan the voucher barcode label into the App by pressing the 'Scan a voucher' button. Once scanned, the App will ask for a growth form and the quadrat size that the specimen was collected from. A drop-down list of growth forms and quadrat size (10 m x 10 m, 25 m x 25 m) to select from. If there is a second growth form of a species (e.g. shrub and tree) select this to distinguish the 'Growth Form #2' drop-down list.
10. Once scanned place the vouchered plant in the plant press.
11. Press the 'Save' button to save the species record and begin recording the next species and its metadata. Once all species have been recorded and their voucher barcode scanned, press the 'Complete Module' button to return to the 'Module Selection' screen.
12. After labelling and scanning each specimen, place larger specimens directly into a plastic

1.4 Additional guidelines

1.4.1 Searching for species

- A single, botanically skilled surveyor should be able to survey a typical 25 x 25 m plot in 30-60 mins.
- Surveys may be faster in sparse or low diversity environments.
- Surveys may take longer in dense or highly diverse environments, and this is accounted for in funding. DAWE and CSIRO welcome your feedback to help understand survey time requirements in this pilot project.
- We recommend the following stopping rule: **if no new species are detected after 10 minutes the search can cease** (new species can still be added if found during the cover survey).
- Be sure to search all microhabitats within the plot, i.e. under shrubs/trees, near water, rocky areas)
- Other surveyors can help by communicating to the collector any uncommon or inconspicuous species observed while conducting the other survey modules.

1.4.2 Species field names

- Field names for voucher specimens need to make sense to the surveyor because they will be used in subsequent modules. For example, we recommend that the surveyor that conducts the *Floristic* module also performs the *Cover* survey as the field names need to be consistent. Also note that Herbarium staff will have access to your field names, so if you know and use the Latin names it will make their work faster (and costs lower).
- Avoid using field names such as '*Acacia* sp.'. Include a descriptive word (e.g. *Acacia* sp. Tall prickly) to help avoid confusion regarding whether it was a genuine species in a non-identifiable form or not.
- The Australian Plant Census <https://www.anbg.gov.au/chah/apc/about-APC.html> guides current published plant names.

1.4.3 Collecting vouchers

- Permits are required to collect flora voucher specimens and all MER specimens must be collected in accordance with the conditions and guidelines outlined for each jurisdictional permit.
- **The voucher should include the best on offer mature foliage along with diagnostic features (e.g. seed, flowers, bark and roots) where possible.** Even dried-up flowers or fruits can be useful if no fresh ones are available.
- When pressing, use one folded tabloid sized newspaper sheet for each specimen and use cardboard dividers frequently – to a maximum of one cardboard between every fifth specimen or more frequently for bulky and moist specimens.
- Air the press in the sun and change the newspaper regularly to prevent specimens becoming mouldy. Frequent changes will be necessary if specimens were damp when collected or you are in humid conditions.
- Ideally specimens should be placed into the plant press before leaving each plot. However, as a minimum requirement, press specimens by the end of each day's field work making sure to label correctly which plot specimens were found. Pressing plants in the field ensures that none are lost or mis-recorded and speeds up the identification process as diagnostic characters will be better preserved soon after collection.
- A photo may be useful to assist in the accurate identification of a species, particularly for species where colour is important to identification but may not be preserved in the dried specimen
- Curation, naming convention and data integrity is the responsibility of the primary surveyor. We recommend that field notes are curated locally so they can brief additional personnel (who may not be the primary surveyor) for subsequent surveys. This may include the addition of voice recordings annotated photos or field notebook and herbaria (see Figure 1.4).



Figure 1.4. MER Network Site records need to have transferability between surveyors and between visits

TIPS for collecting or pressing different types of species

- Flora vouchers of rare, threatened or endangered species should only be made when such actions would not jeopardise the continued existence of the population. Collection of threatened species may also require additional information to be obtained to fulfil permitting conditions requirements.
- If collecting a voucher specimen would jeopardise the continued existence of a rare, threatened or endangered flora population, the following can serve as a proxy for the voucher (listed in decreasing order of preference):
 - Portion of fertile plant without the root.
 - Photos of plant in conjunction with piece of fertile plant or plant parts (leaves and flowers or fruits).
 - Photos of fertile plant in conjunction with sterile plant specimen.
 - Sterile plant specimen only, or photos only.
- For small species, collect the whole plant, including the basal material and roots, particularly for *Poaceae* (grasses), *Cyperaceae* (sedges) and *Juncaceae* (rushes).
- For wet specimens, wrap them in newspaper and place them in a small snap-lock bag or paper bag until ready for pressing
- We recommend keeping succulent plants in a separate press to facilitate more frequent changing of papers and reduce the risk of damaging other specimens. Succulent plants are difficult to dry and can be frozen overnight (either in the field or on return to the office) to fracture the cell walls enabling the moisture to escape. Once frozen, the specimen can be

transferred to newspaper and cardboard in the press for the plot which it was recorded from.

1.5 Post-field survey tasks

- Inspect the pressed specimens for moisture and mould and change newspaper until completely dry.
- Arrange specimens for delivery of the specimens to local herbarium, contractor or MER contact. Please contact one of the CSIRO MER team for up-to-date information on where to send them.
- The procedures for lodging specimens for identification with each herbarium will be covered by agreements with each herbarium and Council of the Heads of Australasian Herbaria. At a minimum, plant vouchers should be sorted into strata (e.g. overstorey, midstorey and understorey) for each plot, and a note with the metadata of site, project and collector included when lodging the voucher (see Figure 1.5).

MER006001 MER Network 26/10/2022 burnt
Dodonaea viscosa subsp. angustissima
Calperum Station South Australia 38.4 km north of
Wentworth Road on Oak BoreTrack -33.76879484
140.608357278503
Nick Gellie, Rebecca Arnold, ALC
Mixed Eucalyptus open woodland (burnt and unburnt).
Overstorey (E. socialis, E. gracilis and E. dumosa).
Midstorey of Dodonaea sp, Goodenia sp, Daviesia sp.
Groundstorey is predominantly Triodia and Austrostipa
sp.

Figure 1.5. An example of a herbaria metadata label that needs to be attached to MER Network voucher

- As of April 2022, agreements that relate to the delivery of samples to herbarium are in the process of being negotiated and confirmed. Further details will be provided when available.

Part II Cover

The point-intercept method is used to estimate cover of plant species, total vegetation cover and cover of the substrates such as leaf litter, bare ground, or rock etc. This protocol also records the height and range of strata (e.g. layers of vegetation). In the protocol, points are arranged along linear transects. At each point along the transect (of designated distance), the species and substrate type that is present is recorded as a 'hit' and its height class is recorded. Total cover and cumulative cover can then be calculated based on the number of hits for each species or substrate over all transects.



2 Cover Protocol

2.1 Equipment list

- Mobile device (tablet) and google play email registered with the MER AusScribe App as noted above (speak to your MER contact)
- Survey staff which combines a graduated head height staff with 10cm increments, a GRS Densimeter™ with ability to be mounted on top of staff and a Laser pointer. See Figure 2.1 and Appendix 5.4. and separate instructions for assembling the staff (email your MER network contact if you don't have the instructions)
- Additional laser batteries
- Pegs or pin flags to mark ends of transects and hold tape in place
- Flagging tape
- Tape measures
- Pen/permanent marker
- Notepad and pencil
- Personal Protective Equipment (e.g. hat, sunscreen, protective clothing and gloves)



Figure 2.1. Cover survey staff with densimeter (A) and laser pointer (B) attached to a graduated staff (TERN image)

2.2 Procedure

1. As per plot layout guidelines, 8 transects will be surveyed, four each in a North to South and then four in an East to West orientation. See Section 1.2 for plot set up.
2. Start at the south-west (SW) corner and proceed to “South 1” point of the plot then select the Point Intercept module in the Auscribe MER App. This transect is called South 1 to North 1 in the App and should be chosen to begin the survey.
3. Once selected all vouchered plants found in plot will appear in the survey screen (Figure 2.2).

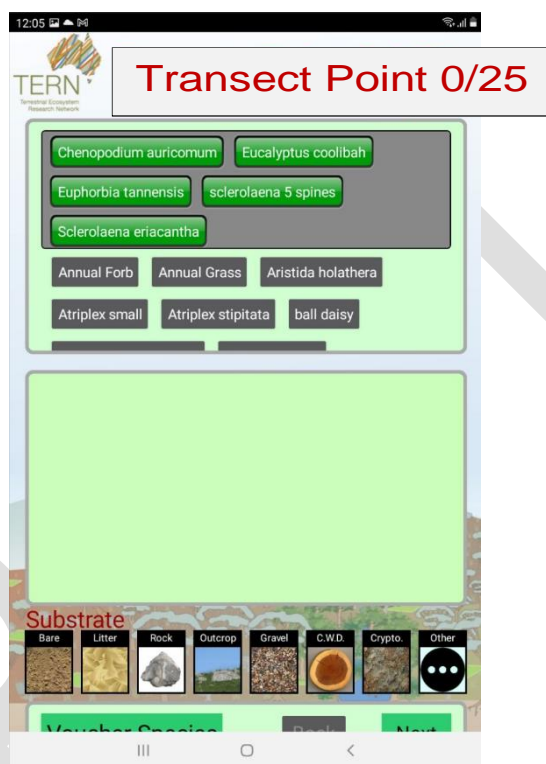


Figure 2.2. Cover surveying page with quick choice vouchered plant appearing in the top window

4. The sequence of recording point intercept data is as follows. First look above eye level (densiometer view = species + height) then touching staff (between densiometer and the laser mount = species + height), below laser (laser point= species + height) and finally substrate (laser point = 1 of 10 substrates).

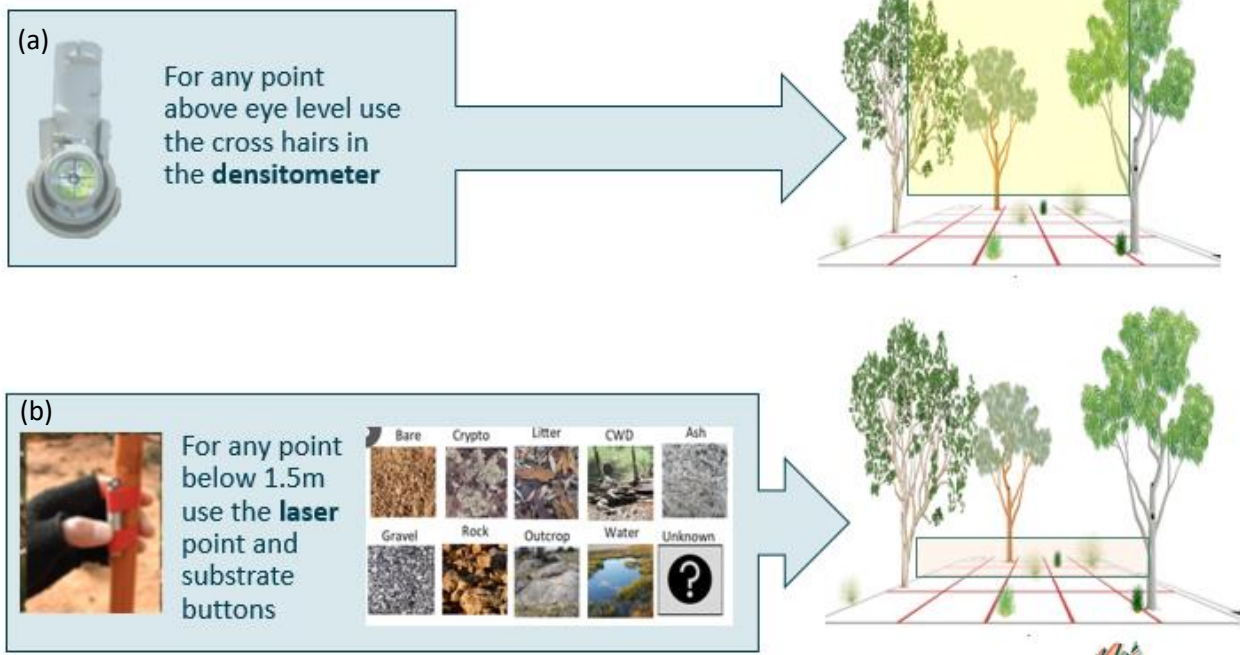


Figure 2.3. Cover surveying zones (a) eye level and above is a densitometer record yellow (b) below this is a laser record shaded orange. Note sometimes there will be foliage touching the staff in between the laser and densitometer which is also recorded. Also note the meter (point) you are recording in the App will only advance to the next meter (point) once you have recorded one of 10 substrates

5. Use the graduated staff, with the laser pointer and densitometer attached (see Figure 2.1, 2.3), begin your point intercept at the 0 m mark of the first tape measure (transect).
6. Place the bottom of the staff at the 0 m mark of the tape measure. Ensure the staff is vertical, level and the laser pointer is pointing downward so the laser beam will intercept the plant or ground near the base of the staff. Observations from the point (i.e. hits through the densitometer or laser beam, Figure 2.4) are added to the app and give a single point record of species/no species, strata, height and substrate. See 2.4.3 for treatment of dead plants and 2.4.4 for more detail on recording from the densitometer.
7. For time efficiency in the MER project, the height of any species is entered on first encounter as the visually estimated average height of that species across the plot. Subsequent hits of the same species can use the default (initial) score. These height estimates should only be used to provide approximate vegetation structural summaries.

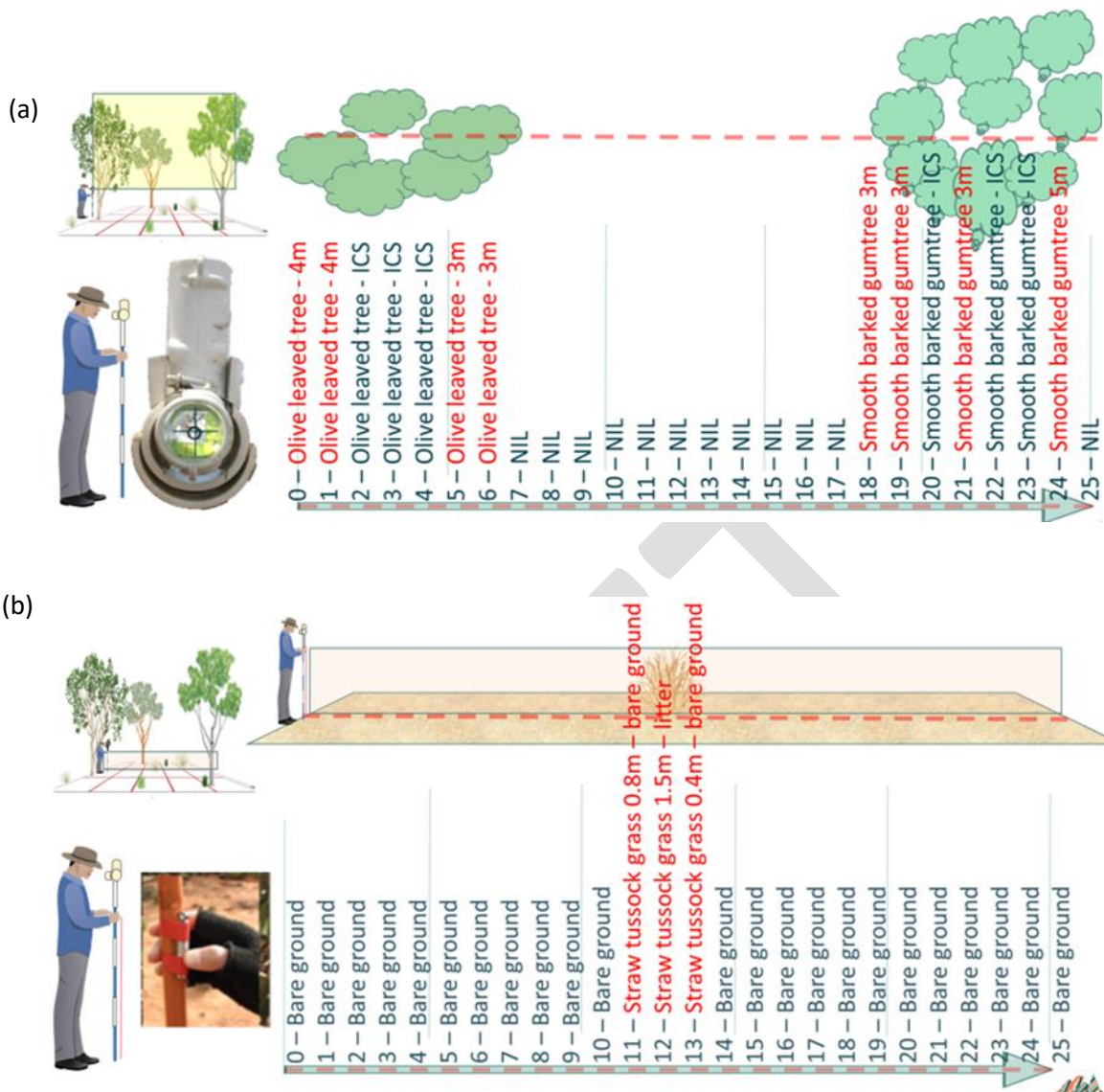


Figure 2.4. Records as they would be entered into App (a) eye level and above (using densiometer) (b) below eye level/densiometer using laser or pole. Note in (a) If no part of the foliage or branches are sighted in the cross hairs but the vertical line is still within the canopy boundary, record as 'In Canopy Sky' (ICS)

8. Note the metre (point) you are recording in the App will only advance to the next metre (point) once you have recorded one of 10 substrates. Substrates have specific buttons and are defined as such
 - i. Bare ground (no biological material present)
 - ii. Crypto (cryptogam, i.e. any lichen, moss, algae, biological crust, etc. present on the soil surface).
 - iii. Litter (dried vegetation not attached and not identifiable; if litter is attached and identifiable as a plant, it should be recorded as this species but flagged as being dried).
 - iv. CWD (coarse woody debris detached from source and greater than 10 cm diameter at point of intercept; woody debris less than 10 cm at point of intercept should be recorded as 'Litter').

- v. Gravel (between 2 mm and 2 cm).
 - vi. Rock (greater than 2 cm).
 - vii. Outcrop (continuous rock without soil matrix).
 - viii. Water.
 - ix. Ash (fire residue of litter, CWD or vegetation).
 - x. Unknown (undefined substrate e.g. man-made structure)
9. Where a species is encountered that has not already been identified within the plot you can add them to the species list. If the species has not been collected at the site yet, press a new voucher specimen to register it on the app collect the specimen and attach a barcode as explained in previous section (see 1.4.3 Collecting Vouchers)
 10. Repeat for each transect
 11. At the completion of the point-intercept data collection, select 'Finish Point-intercept'.

2.3 Number of points

See Section 1.2 for general guide to plot layout. Note the number of point intercepts scales with plot size.

- 10 x 10 m plot: **8 transects**, 4 x N-S and 4 x E-W, point frequency every **1m** beginning each transect at 0 m point and ending at 10 m equals **88** points. Each transect starts **2nd, 4th, 6th, 8thm** along plot edges
- 25 x 25 m plot: **8 transects**, 4 x N-S and 4x E-W, point frequency every **1m** beginning each transect at 0 m point and ending at 25 m point equals **208** points. Each transect starts at the **5th, 10th, 15th and 20thm**.

2.4 Additional guidelines

2.4.1 Efficiency

- This point intercept module for estimating Cover is best completed when with two surveyors, one using the staff and determining the point-intercept reading (surveyor), and the other entering the data directly into the App (scribe).
- Accuracy and speed of collecting point intercept data improves with experience. Laying out a set of tape measures along all the transects, or a set of transects (i.e. all the N–S transects, then all the E–W transects) as noted in Section 1.2, rather than just one transect at a time, is more efficient. This is particularly the case if the survey team comprises more generalist surveyors and/or volunteers who can lay out the tapes while the vegetation specialist commences the species lists.

2.4.2 Using the laser pointer

- Using the laser pointer takes the guess work out of what is (and what is not) a hit. If you cannot see the laser beam on the ground, try one of the following tips:
 - If the laser is in the sun – rotate the staff so the laser is in a shadow.

- If the laser beam hits vegetation before it hits the substrate – temporarily and gently move the vegetation out of the way.
- If you still cannot see the beam, estimate where it would be using the staff.
- If the battery is flat – change the battery (always carry spare batteries and/or a spare laser pointer).

2.4.3 Rules for determining what is a ‘hit’

- If part of a tree or shrub intersects the vertical line of sight through the densiometer, this is recorded as a hit.
- If you intercept a dead plant and can determine what the species is, this is recorded as hit for that species but flagged as ‘dead’.
- If you intercept a dead plant but you cannot determine what the species is, this is recorded as an ‘annual forb’, ‘annual grass’ or ‘shrub/tree’ (pre-recorded field names) and flagged as ‘dead’.
- Only one hit should be recorded for a species of each growth form at a point. For example, a part of a tree of the same species may be touching the laser pointer and also be visible through the densiometer, but should only be scored once. This rule holds true for multiple intercepts of the same species and growth form along the laser beam.

2.4.4 Estimating overhead ‘hits’ using the GRS Densiometer™

- Ensure the graduated staff is adjusted so that the densiometer is at eye-level.
- Level both of the densiometer bubble-levels and then look through the instrument so that the sighting marks (cross hairs and circle) are aligned.
- If working in bright sunlight, a piece of coloured cellophane can be placed over the top of the densiometer and secured with a rubber band to reduce glare.
- Where the vertical line of sight through the densiometer projects onto bare sky that is not within a canopy, nothing is recorded for the upper stratum.
- Where the vertical line of sight through the densiometer projects onto leaves, a canopy hit is recorded (e.g. Figure 2.4a).
- Where the vertical line of sight through the densiometer projects onto bare sky that is within a canopy, ‘In Canopy Sky’ (ICS) is recorded (e.g. Figure 2.4a).
- Where the vertical line of sight through the densiometer projects onto bare sky that is within the canopy of a dead tree and can determine what the species is, ICS is recorded for that species but flagged as ‘dead’.
- Where the vertical line of sight through the densiometer projects onto bare sky that is within the canopy of a dead tree, but you cannot determine what the species is, ICS is recorded for a ‘shrub/tree’ (pre-recorded field name) and flagged as ‘dead’.

- The canopy perimeter (from an aerial or vertical perspective) is the extent of the outer layer of leaves of an individual tree or shrub.

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Part III Basal area

Basal area is the cross-sectional area of trees and shrubs at a defined height (1.3 m). It is used to inform upon vegetation structure and can be used to calculate biomass. The basal wedge method provides a rapid and simple estimate of the basal area of dominant trees and shrubs. It is also plotless therefore provides a representation of the broader vegetation community where the community is homogenous beyond the plot area. In the MER network, there may be instances where the area is not homogenous beyond the plot area i.e., there is a fire scar nearby or your plots may be very close to each other. It's important the basal area survey is conducted for the proportion of your 360° sweep that is homogenous to the plot of interest only. Please see point 8 of the protocol below for how to adapt the method when faced with heterogenous environments.



3 Basal area Protocol

3.1 Determining if basal area should be measured at your plot

Is there a dominant growth form of tree, shrub, or mallee?

- No – Do not use the basal wedge
- Yes – Are there enough live and/or dead trees to record at least seven hits (see point 5 below) for any of the basal wedge apertures at any of the point sampling locations?
 - Yes – Use the basal wedge at the plot
 - No – Do not use the basal wedge at the plot

3.2 Equipment List

- Basal Wedge with attached string knotted at 50 cm from the wedge
- Mobile device with the Fulcrum App downloaded, accessible and synced ready for commencing.

3.3 Procedure

Basal wedge measures are taken at each of the four sampling locations throughout the quadrat, i.e. the NW, NE, SE, and SW points around the perimeter of the plot (see Point Sampling Locations in the plot layout diagram in Section 3.4 below).

1. Determine if use of the basal wedge is warranted at the plot (see Section 3.1), i.e. are there sufficient stems of live and/or dead trees or tall shrubs that are large enough to produce greater than seven “hits” for any species (see point 5).
2. Stand at one of the four sampling locations (see Section 3.4).

TIP: If your view of trees is substantially blocked from a sampling point (e.g. it is in the middle of a tall dense shrub), move a minimum number of steps away from the obstructing shrub or tree (or other) until visibility is achieved. Note the location (e.g. 1 m north of SW corner) and if possible mark with a pin flag so it can be repeated from the same spot next time.

3. Hold the end knot of the 50 cm length of string attached to the wedge on your cheek below one eye. Close the other eye.
4. Hold the wedge so that the string is taut.
5. Establish which of the six wedge apertures (0.1, 0.25, 0.5, 0.75, 1 and 2) to use for live trees then dead trees (Figure 3.1). This is determined by undertaking a brief sweep across the site to determine the largest of the apertures that will achieve greater than 7 “hits” for a

species. A hit is achieved when a stem or trunk, at breast height (1.3 m, or nearest point above if there is a deformity at 1.3 m), is wider than the chosen aperture. A minimum of 7 hits is needed for the results to be meaningful. Selecting the largest suitable aperture increases efficiency as it reduces the number of hits likely to be recorded.

6. Once you have chosen the appropriate wedge aperture, at a sampling point rotate through a complete 360° sweep and, looking through the eye above the string, count the number of stems or trunks of that species, at breast height, **that are wider than the chosen aperture as a hit**. Using the same wedge aperture, **where the stem or trunk is exactly the same width as the aperture, count this as half a hit**.
7. Using the same wedge aperture, where the trunk is narrower than the aperture, this is not counted as a hit. It is more efficient if the same wedge factor is used for a species at all sampling locations (and for all species), however this is not always practicable.
8. If the area around your Plot is heterogenous, i.e. you can see neighbouring survey plots nearby, you are abutting a different vegetation type or there is a fire scar surrounding your plot then **only conduct the sweep for the proportion of 360° that IS homogenous** to your survey plot.

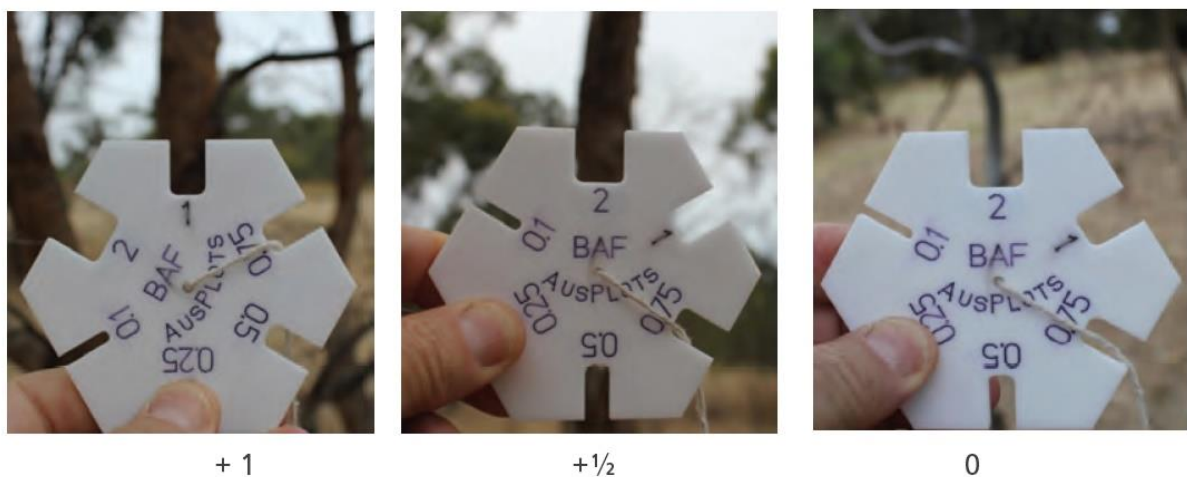


Figure 3.1. These three photographs illustrate stem widths relative to wedge apertures – to be included in a 360° sweep the aperture used to score a species would need to be consistent. Record the number of “hits” per species and the wedge factor (aperture size) at each point sampling location. Image credit: TERN.

3.4 Point layout

The basal wedge survey is carried out at 4 points of the plot for each of live and dead trees, as shown in Figure 3.2 below.

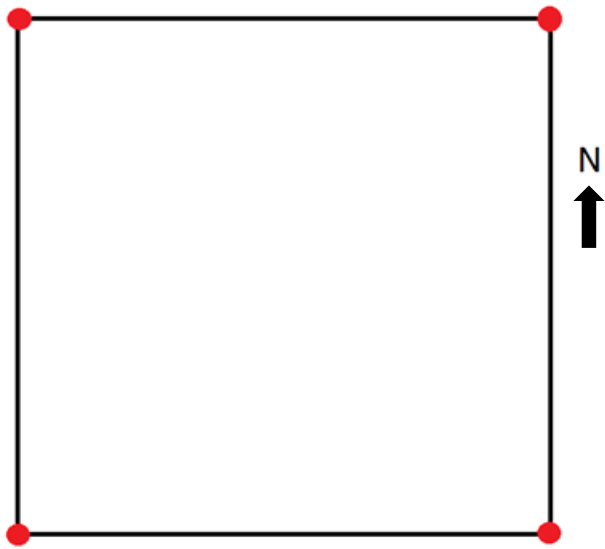


Figure 3.2. Red points show where measurements should be taken for the Basal wedge survey in the 10 x 10 m or 25 x 25 m survey plot.

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Part IV Submitting data and plant specimens



4 Submitting your data and samples

4.1 Submitting data

This section describes how to deposit your data into the MER database. It includes information for submitting all digital data collected (i.e. from all the MER network monitoring protocols).

AuScribe data

At the end of your monitoring, you will need to submit the data from AuScribe to CSIRO for incorporation into the MER networks database. To do this (see also Figure 4.3):

- 1) Press and hold the TERN logo in the top left hand side of the AuScribe app. This will open the Settings menu
- 2) Press the “Dump Local DB to sd-card and also email it” button. This will open a set of options to share the data dump. Select gmail (you will need to set up gmail on your tablet if it is not already installed)
- 3) A blank email will open with the data attached. You will need to change a couple of defaults to ensure that your data is sent to the right location:
 - a. In the “To” field, replace `ausplotsdata@gmail.com` with `MERPilot@csiro.au`.
 - b. In the “cc” field, replace `andrew.tokmakoff@adelaide.edu.au` and `emrys.leitch@adelaide.edu.au` with `sam.nicol@csiro.au`
- 4) You can add any explanatory text to the email body if you would like to, but this is not required. When you are finished, send the email.

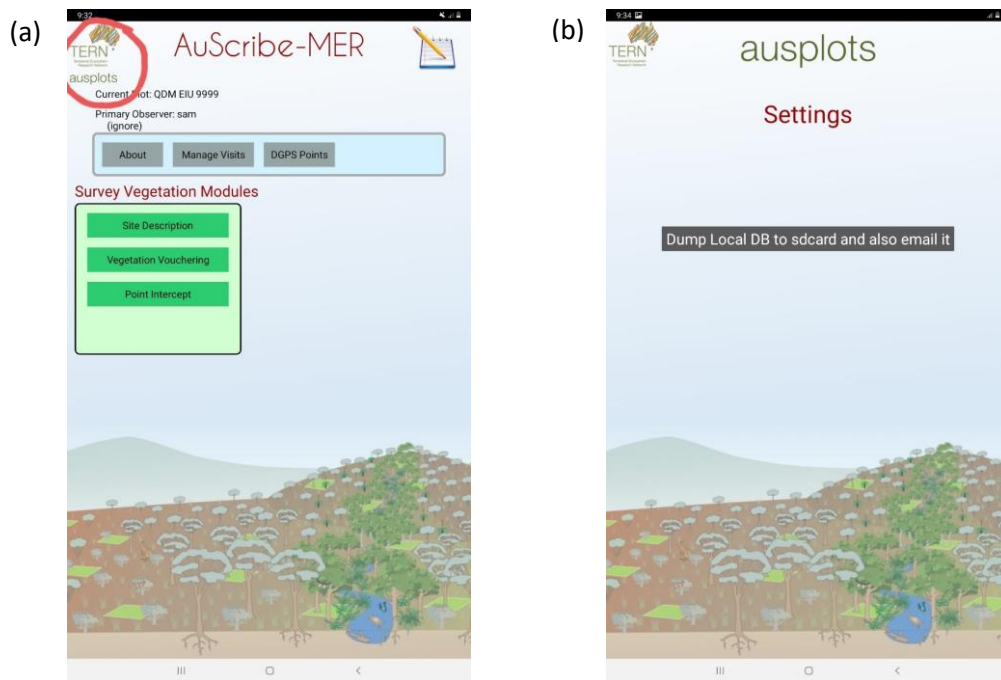


Figure 4.1: Screenshot of the AuScribe app showing (a) where to click and hold to open the settings menu (circled in red); and (b) the Settings menu.

Fulcrum data

To send the Fulcrum data, simply open the app in a location where you have internet access and click the 'sync' logo (two arrows forming a circle) in the top right hand corner. This will upload your data to the MER Fulcrum database. Confirm that you have recorded data for all the apps, including both the MER Pilot Plot Monitoring Module and the MER Pilot Site Description Module.

If you have any questions about the data submission process or want to check that it has been received, please contact sam.nicol@csiro.au.

4.2 Submitting plant specimens

Arrangements are being made for specimens to be identified in State herbaria. Please contact your local MER contact for instructions on where to send or deliver your samples once they are dried and sorted.

Part V Appendices

5.1: Adapted Floristics protocol for rainforest communities

5.2: Adapted Cover protocol for rainforest communities.

5.3: How to make 4 standard plant presses.

5.4: How to make the point intercept staff



5 Appendices

5.1 Adapted Floristics Protocol

The high diversity of and difficulty of collecting specimens in rainforests and vine thickets may make the standard floristics and cover protocols difficult or too time consuming to apply, hence some adaptations are suggested in both the Floristics and Cover protocols. Note we describe only the permitted changes to the standard here; please refer to the main protocols for full methods.

5.1.1 Equipment

As for standard protocol plus;

- any special equipment that may be needed to collect rainforest species that are unknown to the botanist

5.1.2 Procedure

As for Standard protocol with the following variation:

- Due to the challenge of collecting flowering or fruiting specimens of rainforest species, and the high diversity of some rainforests, the amended protocol requires collection of fewer voucher specimens. Instead of collecting a specimen of every species at a site, it is expected that an expert botanist familiar with the rainforest species at the site is hired, and will be able to identify the majority of species present *in situ* to genus and species. Therefore, ONLY uncertain or unknown species need to be collected for later identification by the local herbarium.

Specific steps:

1. Set up quadrats for recording plant species according to plot size. A 10 m x 10 m plot needs only a 10 m x 10 m quadrat. For 25 m x 25 m plots, establish a nested 10 m x 10 m quadrat within the 25 m x 25 m plot/quadrat). This plot set up follows the standard plot layout protocol (Section 1.2), except that the number of transects in 25 m x 25 m plots is reduced from 8 to 4 (see details in 5.2 Adapted Cover Protocol).
2. One surveyor who is botanically skilled searches each quadrat for plant species, beginning at the smallest size.
3. Record all plant species detected in the plot using the AuScribe App (see step 5), providing the scientific name for the species. If the surveyor is confident of the species ID, it is sufficient to enter the species into the app without collecting a voucher specimen. **If the plant CAN be confidently identified in the field:**
 - a. If not already open, select the 'Vegetation vouchering' module in the App
 - b. Assign the field name using the definitive Latin species name.

- c. At present it is still necessary to scan a barcode to enter a new species into the app. Thus, use the same barcoding procedure as 1.3, but without an actual plant specimen. Instead, stick the barcodes in a notebook or on pages in a ring folder with plot, species name, notes, and if available, any leaf or other material to help you remember what they are. Any species only needs to be entered with a barcode once for a site.
- d. Press the 'OK' button to save the species record and begin recording the next species

4. If a plant cannot be identified or the scientific name is not known:

- a. Collect a voucher specimen of the plant species and process as per the standard protocol (Section 1.3). Remember only a single specimen per species is required for each site.

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5.2 Adapted Cover protocol

Due to the high diversity and/or density of some rainforests and vine thickets the standard protocol has been revised to maximise monitoring efficiency. Under the standard Cover protocol, a typical 25 x25 m plot encompasses 208 points, with sampling every 1 m across 8 transects. In the adapted protocol, for a 25 x 25 m plot, it is recommended to halve the number of points by measuring cover every 1 m across 4 transects (26 points per transect). For a plot of 10 x10 m, 88 points divided among 8 transects are still recommended (11 points per transect) hence the cover protocol is unchanged.

Again, it is critical and expected that an expert local botanist is contracted to perform the Vegetation Structure and Community protocol because an expert botanist will be capable of identifying the majority of species present rapidly and without collecting as many specimens. See more information below in the procedure.

5.2.1 Equipment list

As per Standard Protocol

5.2.2 Procedure

As per standard protocol with the following variations;

- In a 25 x 25 m plot the number of points required is half that for the standard protocol. Thus, for plots of size 25 x 25 m only 4 transects (rather than 8) are needed. We recommend 4 transects be established in a North to South orientation, so that distance between tapes remains 5 m and East-West tapes are excluded.
- in a 10 x10 m plot the number of points remains unchanged from the standard protocol to ensure a sufficiently large number of points for analysis.

If hazardous plants such as stinging trees prevent identification of cover at the point we suggest estimating point intercepts from an appropriate safe distance.

5.2.3 Number of points

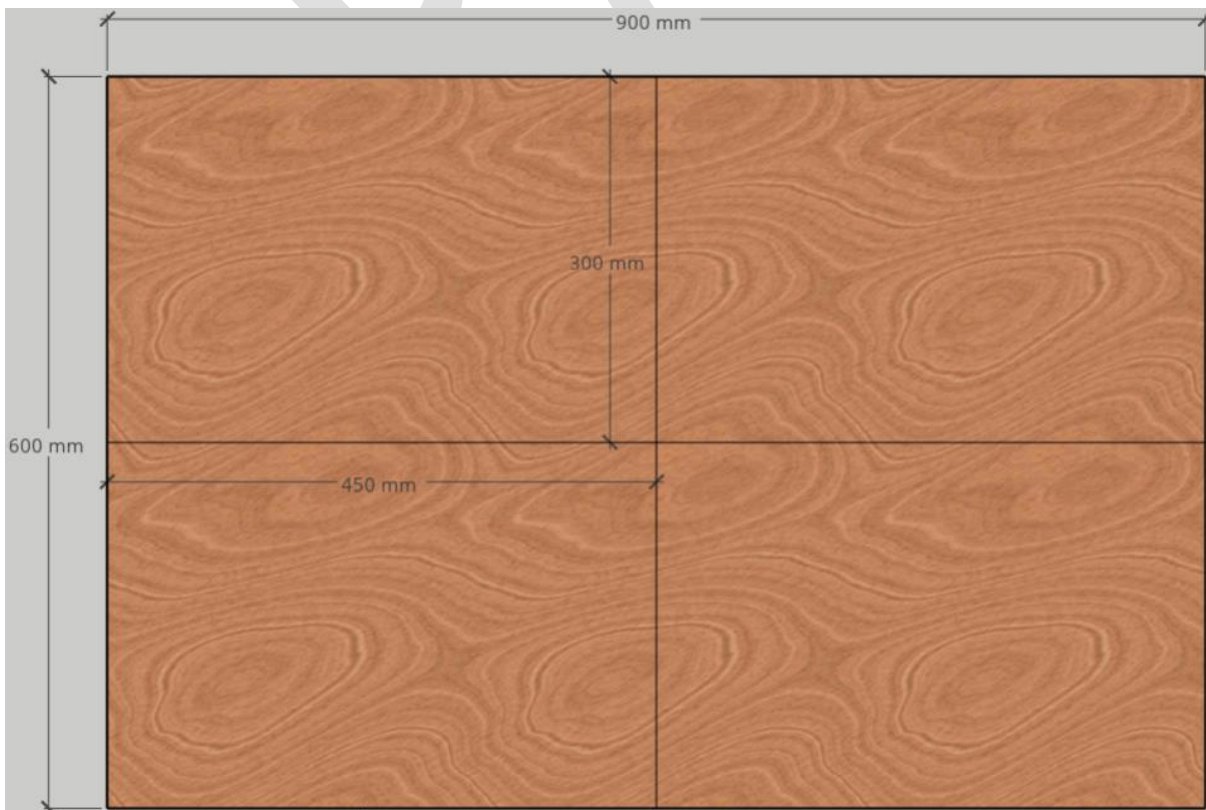
The number of point intercepts scales with plot size.

- 10 x 10 m plot. Same as standard protocol: **8 transects**, 4 x N-S and 4 x E-W, point frequency every **1m** beginning each transect at 0 m point and ending at 10 m equals **88** points. Each transect starts **2nd, 4th, 6th, 8thm** along plot edges
- 25 x 25 m plot: Half the number of transects as standard protocol, i.e. **4 N-S transects only**, point frequency every **1m** beginning each transect at 0 m point and ending at 25 m point equals **104** points. Each transect starts at the **5th, 10th, 15th and 20thm** as for N-S transects in the **standard protocol (see Figure 1.1b)**.

5.3 How to make 4 standard plant presses

1. **Plywood.** Head on down to Bunnings or similar and get two of these sheets of plywood. They are 897 x 600 x 12mm and when cut in half, both ways, to leave 4 pieces of ply, each 300mm x 450mm (the correct size for the press). So two sheets produce four presses (or one sheet for 2 presses). If you think you will only need two presses, just start with one sheet.
2. **Cutting.** Most Bunnings stores offer a cutting service for a small fee, <https://www.workshop.bunnings.com.au/t5/Garage-and-Shed/Does-Bunnings-cut-wood-to-size/td-p/59927>
We recommend getting your sheet cut as you buy if your local hardware or timber supply store has a cut shop.

Hint: Don't do this on Saturday morning, head down at 10:30 on a weekday and take this diagram with you to ensure you get what you want.



3. **Straps.** You'll then need 8 of these straps for 4 presses, they are 2m long each and easy to secure tightly. You could get away with one per press, but two works better. An alternative to the straps is to use sash cord, each 1.5-2m long.
4. **Aeration holes.** We highly recommend drilling aeration holes in your press boards (not shown in images). If you have a drill, get a kit like this and drill 8 x 44mm holes in each face. This is especially important if you think you'll be collecting fleshy, high moisture plants.
5. **Filling the press.** Then you'll need lots of corrugated cardboard (to be provided by the MER project) and newspapers to press the plants between. It's typical to use one piece of newspaper per specimen and 3-4+ specimens per cardboard.

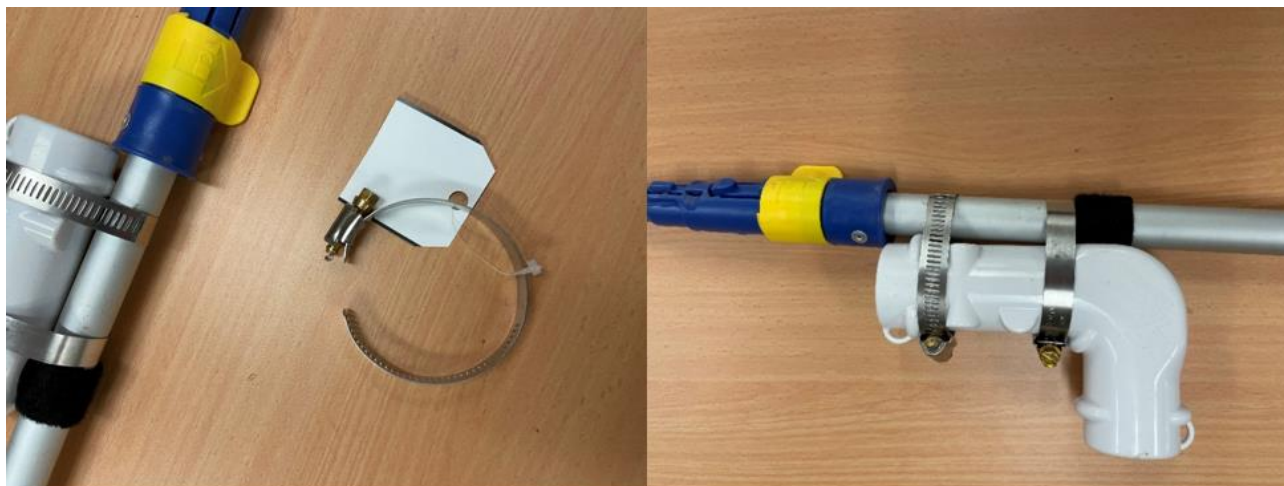


5.4 How to make the point intercept staff

1. **The painters pole.** Get the painters pole with a continuous height adjustment from Bunnings or similar.
2. **Remove sticker.** Remove the branding sticker with a blade and discard.
3. **Height increments.** With a tape measure and a sharpie, mark the pole at 10cm increments from the base to the adjustable section, and label with height.



- Attach Densiometer.** Using two 33-57 Toledo hose clamps, attach the long edge of Densiometer to pole on the upper section which is adjustable. You may need to open the hose clamp completely, then feed it back it to fasten. Use a strip of Velcro wrapped around the pole to block the lower end of the densiometer out, if desired.



- Attach laser pointer.** Laser pointer of choice can be attached using a combination of adhesive Velcro and elastic bands. Ensure the Velcro is at the lower edge so it directs its beam slightly away from the pole. Attach at the highest point you can on the base pole.
- When ready to use, adjust the height of the densiometer to the user's eye height using the twist mechanism. Around midday you may sometimes have difficulty looking into the sun. In this case you can use one or two layers of green cellophane to cover the top of the viewer (attach with rubber bands) – or take a lunch break!

References

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White, A., Sparrow, B., Leitch, E., Foulkes, J., Flitton, R., Lowe, A.J. and Caddy-Retalic, S., (2012). AUSPLOTS rangelands survey protocols manual.

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