

# ...Degree Celsius Field Guide...

## Carbon and Biodiversity Assessment

### 1 Preliminary preparation

**Policy: work in pairs or teams – never work in the field alone. Visits to properties to meet owners can be done alone.**

**Before going into the field ensure that you have considered the following:**

- ? Have you confirmed with the landholder that it is fine for you to visit their property on that date?
- ? Have you obtained a copy of the aerial photographs of the property and had a preliminary look at the nature of the revegetation?
- ? Have you prepared a check-list of questions that you would like to cover with the landholder if you have the opportunity?
- ? Have you got all the equipment you need (see Box 1)?
- ? Is your mobile phone charged enough to last you the whole day?
- ? Have you told someone where you are going, when you'll return, and what to do if you don't return when expected?
- ? Have you checked the weather forecast and made any necessary allowances for weather conditions (packed sun screen, hat, umbrella, spare clothes etc.)

#### Box 1: Checklist of things to take into the field

- |  |  |
|--|--|
| <input type="checkbox"/> Data sheets (waterproof)  | <input type="checkbox"/> Pencils, clutch or with sharpener |
| <input type="checkbox"/> Aerial photograph/s of property (printed on waterproof paper)                         | <input type="checkbox"/> GPS                               |
| <input type="checkbox"/> Any additional information available on the property (protected in waterproof folder) | <input type="checkbox"/> Compass                           |
| <input type="checkbox"/> 50 metre tape   | <input type="checkbox"/> Clinometer                        |
| <input type="checkbox"/> DBH tape  | <input type="checkbox"/> Camera                            |
| <input type="checkbox"/> 3 m ranging pole (extendable) <b>or</b>   | <input type="checkbox"/> Flagging tape (pink if possible)  |
| <input type="checkbox"/> 3m PVC pipe marked at 10cm lengths  | <input type="checkbox"/> Spray paint (pink if possible)    |
| <input type="checkbox"/> Aluminium tree labels & tie wires   | <input type="checkbox"/> Extra batteries                   |
| <input type="checkbox"/> Lump Hammer   | <input type="checkbox"/> Pocket knife and/or secateurs     |
| <input type="checkbox"/> Forestry Nails / wires  | <input type="checkbox"/> 2 steel posts per transect        |
| <input type="checkbox"/> Clipboard   | <input type="checkbox"/> <b>Water</b>                      |
|  | <input type="checkbox"/> Sunscreen                         |
|  | <input type="checkbox"/> Hat                               |

### ***Summary of survey method steps:***

- Pre-determine the number and location of sites and transect location from aerial photographs and discussions with landholder
- Survey the area for the location of required minimum 2 transects, using pre-determined locations as a guide
- Select the actual transect locations on the ground as near as possible to the pre-selected sites, and selecting for representativeness and uniformity of slope, vegetation type and density as much as possible
- Mark the entry point into the site and describe the distance and bearing from entry to the beginning of the transect.
- Lay out 50 m tape in straight or near-straight line
- Record compass bearing in degrees from the origin to the end marker
- Record GPS location for each end in Lat/Long
- Measure slope down the line of fall, and record slope in degrees. If slope is less than 6 degrees, it is only necessary to note  $<6^{\circ}$ , as anything less than this is not significant for the carbon calculations.
- Photograph the vegetation in direction of transect from origin using normal setting, not zoom, and looking back along the transect from the end.
- Install steel posts and/or other permanent markers at each end of the transect and label
- Walk the transect along the left hand side (LHS), recording all stems above 2.5 cm dbh within a 3 metre wide path left of the centre line, and all stems  $>20$  cm out to 5 metres left of centre line. Measure dead stems in dbh size classes and note DEAD.
- At the end of the transect, turn around and walk the opposite side (the right hand side from origin) back to the transect start, recording stems above 10 cm dbh within a 3 m wide path from the centre line, and all stems  $> 20$  cm out to 5 m from the centre line. Tally dead stems in dbh size classes.
- For each stem, measure where it lies both along the transect (reading from 50 metre tape) and out from the centreline in metres to 0.1 m (i.e. 10cm) (reading from the 3 metre measuring pole) and dbh in cm.
- At 5, 25 and 45 metres along the transect line, visually estimate a 5 m radius and record canopy height, canopy cover and the presence/absence of the variety of life forms.
- At 5, 25 and 45 metres, within a 1x1 m quadrat around the point, estimate the % of ground cover falling within each of the required categories.
- While winding up the tape, count the number of times the tape intersects with wood debris in a range of diameter size classes.

## 2 Site identification and transect placement

### *Identify and demarcate sites on aerial photographs*

Using the aerial photographs and through discussions with the landholders and review of any relevant documentation, identify the number of **sites** that exist in the property, locating and demarcating them on the aerial photographs. A **site** should be relatively homogenous in terms of the age of the planting, species mix and general vegetation condition (see Box 2). Differences in the nature and condition of the vegetation will often appear as differences in texture and tone on the photographs, and boundaries between different sites will usually be visually evident. In cases where this is not the case, discussions with landholders and review of maps or information they may have on their planting may assist in defining the boundary between one site and another.

#### **Box 2... What is a *site* ???**

It is important when sampling, that the area you sample is reasonably similar to the whole area that it represents. In some cases, the area that landholders have planted will be very homogenous – it will all have been planted in the same year, using the same species mix and planting layout, and will have all grown at approximately the same rate and be in a similar condition in general. In this case, the whole revegetation area would be considered one single **site**.

In other cases, where there is significant difference in the revegetation on a landholder's property, it will need to be divided into a number of **sites**. This is called **stratified sampling** – where in advance, through the use of information such as aerial photographs and discussions with landholders, you divide – or stratify – the area into a number of different sections, each of which appear to have characteristics similar to each other.

This may be the case if they have planted in stages – e.g. one area in 1998, another in 2001, and another in 2003. These **sites** are likely to differ in their total growth, and will contain differing levels of carbon per hectare. In other cases, landholders may have planted one area under the CRRP scheme, and another as a purely environmental planting along their creek. The species and planting layout in these cases will differ, and the sites are therefore likely to vary in terms of both their carbon content and biodiversity values. In some cases, areas that were planted at the same time with the same species mix may differ due to a climatic event – e.g. a lower part of the planting may have been severely affected by frost while the upper area remained unaffected. In all of the above cases, the revegetation will be divided into more than one site, and the first task is to determine the number and location of these sites.

Once the area has been **stratified** into a number of sites, the location of sampling transects is then chosen semi-randomly within each of these stratified sites. The data from these sites will be analysed separately.

### *Determine ideal location of transects on aerial photographs*

For small plantings of below 2 hectares, each site must contain at least **two 50 metre transects**. In some cases, where the site is large, more than 2 transects will be required to ensure that the area has been well sampled and any variation within the site captured. The actual number of transects is not a fixed relationship, and depends on the variability within the site. In general, better results will be obtained from more transects. Likewise, the transects may need to be shorter or longer than the standard 50 metres, depending on site configuration, or on the density of vegetation. Sparse plantings

may require, for instance, 100 m transects, smaller clumped areas may require four 25m transects rather than two 50m transects. Providing that the logic is well explained within the data sheets, flexibility in transect placement is acceptable.

The transects should be chosen randomly within the sites, using the aerial photographs. It is important that the transects are placed in such a way that they are as representative of the site as possible. So if the site has an area which is flat, transitioning into an area which is on a slope, both the flat and sloped area must be represented in one or both of the transects. Where possible, the orientation of the transects should be either along the contour or down the slope, and traverse a consistent slope. Where this is not possible, an average slope may need to be estimated by taking several slope measurements

The transects should be spaced from each other by a minimum of 50 m where possible. In some smaller sites, this may not be possible and in such cases, the transects should be spaced as far apart as possible. It is advisable to locate transects in areas where the beginning is relatively easily re-located. In many revegetation sites this is easy, as they are either small, or long and thin (e.g. following a riparian area). If the area is large, it may be necessary to locate a transect in the middle of the site. Once in the field, clear directions from a distinct place outside the site to the transect start must be recorded on the data sheets.

Draw as accurately as possible, the transect location on the aerial photograph, and using the compass, determine the proposed bearing that the transect will follow. Actual transect locations and bearings may have to be refined on the ground, due to site constraints which were not detectable from aerial photo or satellite image interpretation. These may include topography which is too steep to access safely or efficiently, or vegetation which is too dense to access without destruction of the vegetation and injury to survey personnel. From the aerial photographs, determine the exact compass bearing of the transect.

### 3 Laying out the transect

#### *Locate and lay out the transect*

Using the aerial photographs as a guide, in the field locate the beginning of the transect. **Record details on where the transect begins on the data sheet** (including distances and compass bearing direction). Ensure enough detail is provided, particularly if reaching the transect requires moving some distance from the edge of the site. To complement the description on the data sheet, mark the point at which the site is entered, preferably by marking a permanent feature (e.g. corner fence post, large tree, existing star picket) with marker paint or flagging tape.

Lay out the 50m tape in a straight line according to the compass bearing taken from the aerial photographs – with the bearing describing the direction of the transect line if looking from the starting point to the finishing point. Secure the tape at the beginning point using a stick. Try to ensure that there is minimal slack in the line when demarcating the end point of the transect. Secure the end point with a stick if necessary. In some cases, you may need to slightly alter the compass bearing from that determined from the aerial photographs. **Record exact bearing of transect on data sheet.**

Take a GPS reading at both the beginning and end of the transect, recording them as waypoints. Use of Lat/Long coordinates is best to avoid problems with zones in UTM coordinates. Check that the GPS datum is set up as GDA 94, or if not an option on your GPS, then WGS 84. **Record both the GPS Waypoint and the actual GPS coordinates on the data sheet.**

Using the clinometer, determine the average slope of the transect, which is the natural fall of the slope – don't measure across the slope (which will be horizontal at worst), but down what looks to be the steepest part. If the transect slope is greater than 6 degrees (~10%) it must be recorded, in **degrees** (*not* %). Slopes above 6° have an effect on the surface area measured on the ground when transferred to a planar map, and if slope is not taken into account, considerable underestimates of the standing forest biomass may be made. If the slope varies considerably along the transect, several slope measurements are taken and an average determined. **Record the average slope on the data sheet.**

Take photographs of the transect line, (using standard focal length – usually 50 mm), capturing the view both from the start looking forward, as well as back down the transect line from the finish. If vegetation is dense and visibility is difficult, photographs may also be taken looking both ways from the 25 metre point along the transect line. **Record the photograph numbers on the data sheet.**

### ***Demarcate the transect***

The transects must be identifiable in the field with permanent markers. The most usual permanent markers are steel posts (star pickets). If you have these available, they should be used to demarcate both the exact beginning and end of the transect. If steel posts are not available for some reason, a tree should be temporarily demarcated as the beginning of the transect. This tree should always be counted as **INSIDE** the transect for consistency. At the end of the transect, the nearest tree should be demarcated, and a description included in the data sheets about the distance and direction of this tree from the exact transect end.

Demarcate the beginning and end of the transect with a post/tree tag with the following information etched onto the tag:

- Landholder name
- Site name
- Transect number
- Either S for start of transect, or F for finish of transect
- Date

Hammer the tag into the tree just below average eye height, facing the direction at which one would walk when moving towards the transect. If a metal post is used, attach the tag with a wire. In addition to a permanent tag, attach flagging tape to the marker posts or trees to attract attention to the transect beginning and end.

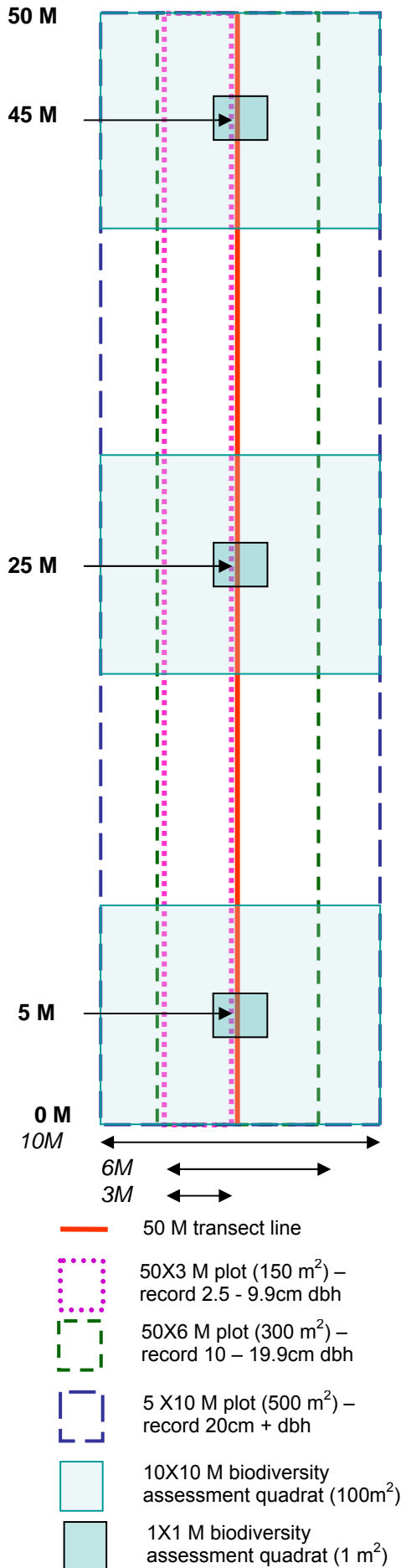
A summary of the dimensions and layout of the transect is provided in **Box 3**.

### Box 3: Overview of Transect Layout, Dimensions and Components

The field transect method consists of the following components:

**Central 50m transect line** along which the following survey components are recorded;

- DBH Nested plot 1:** 150 m<sup>2</sup> (3X50m) plot extending 3 metres on the LEFT hand side (LHS) of transect line and following the entire 50 metre length – the dbh of stems between 2.5 cm dbh and 9.9 cm are recorded within this area; stems under 2.5cm dbh but over 1metre high are tallied.
- DBH Nested plot 2:** 300 m<sup>2</sup> (6X50m) plot extending 3 metres on BOTH sides (LHS + RHS) of the transect line and following the entire 50 metre length; the dbh of all stems between 10 and 19.9 cm dbh are recorded within this area for the entire 50 metre length. Dead trees between 10 and 19.9 dm dbh tallied.
- DBH Nested plot 3:** 500 m<sup>2</sup> (10X50m) plot extending 5 metres on BOTH sides of the transect line and following the entire 50 metre length; the dbh of all stems 20 cm dbh and above recorded for the entire 50 metre length. Dead trees over 20cm dbh tallied.
- Biodiversity Assessment quadrats - large:** total of ~300 m<sup>2</sup> in 3 10X10 m quadrats (often estimated as 5 m radius) – with central points at 5, 25 and 45 metres along the transect; Presence/absence of life forms and canopy cover recorded.
- Biodiversity Assessment quadrats – small:** total size of 3m<sup>2</sup> in 3 1X1 m quadrats – with central points at 5, 25 and 45 metres along the transect; ground cover recorded.
- Woody debris assessment:** along the entire 50 metres, tally recording of woody debris that the transect tape intersects in size classes.



## 4 Surveying the transect

*Note: The survey results in 6 core data components which are summarized in Box 3. For ease of collection, the following method enables data from all the components to be collected at the same time. Data should not be 'nested' during collection. When entering the data into the computer, the data sheet will automatically sort each recording into its appropriate size class for analysis.*

### **Measuring stems down the Left Hand Side (LHS)**

Beginning at 0 metres, move down the **LHS** of the transect line and record the following:

- 1) For **EVERY** tree **over 2.5cm** dbh that falls within **3m** of the transect line record:
  - How far **ALONG** the transect it is located (recording distance from the 50m tape);
  - How far **OUT** from the transect line it is located (recording distance out from 3m pole); and
  - Its **DBH** (see Box 4 for more details on what to measure and how).
- 2) For additional trees that are  $\geq 20\text{cm}$  dbh and fall within **5m** of the transect line record exactly the same information as above.
- 3) For every tree **below 2.5cm** dbh but above 1 metre high that falls within **3m** of the transect line, record a tally.

For all dead trees over 2.5cm within 3 metres, and additional 20cm+ within 5 metres, record a tally in the relevant size class.

#### **Box 4: What to measure... how to measure**

In order to ensure consistency across all survey teams, and also ensure that our methods meet the international standards required, the following 'rules' have been adopted.

- In addition to **all trees**, record the dbh of both palms and tree ferns, but **CLEARLY IDENTIFY** each of these with either **TF** or **P**. Do not measure scramblers, vines or shrubs;
- DBH (diameter at breast height) refers to the diameter of the stem at 1.3 metres from the ground;
- If the stem is located on sloping land, the measurement is taken at the highest point of ground;
- Bumps and other distortions of trunks should be avoided by moving the tape to above or below the profusion, by 30 cm above and below, and averaging 2 measurements;
- If the trunk is buttressed significantly, measure above buttress termination – if that's too high to reach, estimate the diameter of the main trunk as if the buttress was absent\*;
- If the stem/trunk of a tree branches at between 1m and 1.3m, the measurement is taken just below the point at which the trunk/stem thickens into branching;
- If a tree branches into a number of stems below 1m, **ONLY** those stems that are 2.5cm or over are recorded. Stems which are  $< 2.5\text{cm}$  dbh are not measured, but included in the tally. This is considered a multi-stemmed tree. In this case, include all stem measurements in the same line, separating individual stem measurements clearly with a comma (not a slash as this can look like the number 1);
- If the tree is growing horizontally or at an angle, the dbh measurement is taken at 1.3m along the trunk;
- If a main trunk has broken off not far above 1.3m and there is resulting regeneration, the dbh of the main broken stem is not to be recorded. Only regenerating stems that are  $\geq 2.5\text{cm}$  dbh are to be recorded in this instance;
- When there is a vine around the tree trunk, endeavour to pass the tape measure under the vine;
- Trees which are large and potentially remnant are to be measured and recorded with an 'R'. If they are too large to be measured, indicating a size class (e.g. 50-60cm dbh) together with an 'R' will be sufficient. Ensure that their **ALONG** and **OUT** location in the plot is recorded;
- A tree is considered 'in the plot' when half or more of its trunk lies within the transect;
- The start marker tree is always considered in the plot.
- When a marker tree falls within the plot, note on the data sheet 'Marker' when recording its dbh.

\*Rice A. H., Pyle E. H., Saleska S. R., Hutyra L., Palace M., Keller M., Camargo P. B. d., Portilho K., Marques D. F. & Wofsy S. C. (2004) Carbon Balance and Vegetation Dynamics in an Old-Growth Amazonian Forest. *Ecological Applications* 14: S55-S71.

### **Measuring stems down the Right Hand Side (RHS)**

Beginning at 50 metres, move down the other side of the transect line and record the following (this is the RHS if looking from 0 towards the end of the transect):

Prep by N Preece & P Scott 2007-2008; v13 ndp 13Feb09

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- 1) For **EVERY** tree **over 10 cm** dbh that falls within **3m** of the transect line record:
  - Its **DBH**;
  - How far **ALONG** the transect it is located (recording distance from the 50m tape); and
  - How far **OUT** from the transect line it is located (recording distance out using the 3 metre pole or pvc pipe).
- 2) For additional trees that are **20cm+** dbh and fall within **5m** of the transect line record exactly the same information as above.
- 3) For all dead trees over **10cm** within **3** metres, and additional **20cm+** within **5** metres, record a tally in the relevant size class.

**NB:** *If there are no stems on either side of the plot, note this on the data sheet. This is particularly the case for the RHS, there may be no stems over 10cm DBH (e.g. younger plantings).*

### **Biodiversity Assessment Quadrats** <sup>1</sup>

The biodiversity assessment can be undertaken when surveying either the LHS or RHS of the transect line. It is generally easier to do this on the return journey down the RHS, as there are fewer stems to record. However, providing the information is recorded in the correct part of the data sheet, the survey team can determine when these measurements are made.

At 3 points along the transect (5m, 25m and 45m) undertake an assessment of both a 10X10 quadrat, and a central 1X1 quadrat for data required for assessing vegetation structure as a surrogate for biodiversity value.

Visually estimate a 5m distance either side of the transect line. The area within this distance, and extending to 10m along the tape is the **10mX10m quadrat**. In this quadrat, record the following information:

- **Foliage Cover:** Record the projective cover of vegetation >2 m above ground level (shade cast by foliage and stems, if the sun was overhead, assessed for the entire 10m x 10m quadrat around each point. It can be estimated by eye (although this can be very subjective) or from a photo. Both methods are preferred. Record as a percentage.
- **Special life forms:** Record presence ('1') of life forms in each 10 m x 10 m quadrat centred on the 5 m, 25 m and 45 m points. If life forms are present on site, but not inside quadrats, record in last column. Do not record abundance. Categories include (see Box 5 for descriptions):
 

<ul style="list-style-type: none"> <li>- strangler figs,</li> <li>- hemi-epiphytes,</li> <li>- vines</li> <li>- vine towers and vine tangles</li> <li>- thorny scramblers</li> <li>- clumping epiphytic ferns</li> <li>- other epiphytes</li> </ul>	<ul style="list-style-type: none"> <li>- tree ferns and ground ferns,</li> <li>- palm trees and understorey palms,</li> <li>- cordylines,</li> <li>- herbs with long, wide leaves,</li> <li>- herbs with strap leaves, cycads</li> <li>- pandanus, or</li> <li>- other (describe)</li> </ul>
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- **Canopy Height:** Record the average height of trees forming the canopy in the 10m x 10m quadrat around each point. The canopy is the layer of foliage forming the 'roof' of the forest. The canopy may be broken by gaps or incomplete. In some sites and forest types, it may be necessary to distinguish canopy trees from emergent trees (i.e., trees projecting well above the canopy, with crowns exposed on all sides). *Note: Estimating height is difficult. Use a clinometer and tape measure, or range finder if available. Alternatively, place the 3m ranging*

<sup>1</sup> Information in this section extracted and adapted from Kanowski, J. and Catterall, C. P. (2007) *Monitoring Revegetation Projects for Biodiversity in Rainforest Landscapes. Toolkit Version 1, Revision 2.* Marine and Tropical Science Research Facility, Cairns.

*pole or PVC pipe against a tree which approximates the canopy height, and standing at a distance, estimate height in multiples of 3 m.*

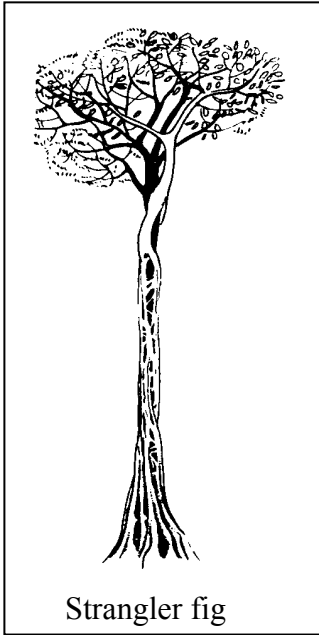
At the 5 m, 25 m and 45 m points along the transect line, define a **1mX1m quadrat**, using the unextended ranging rod. Alternatively, each field officer stands either side of the tape, approximately 0.5m away from the tape with legs 1m apart. The area framed by the legs should be approximately 1mX1m.

- **Ground Cover:** Looking down at the quadrat from 1m, **record the proportion of ground cover** according to the following categories; (total must add up to 100%)
  - (a) vegetation within 1 m of ground (grass, herbs, ferns, vines and scramblers, trees and shrubs, moss),
  - (b) leaf litter and fine woody debris,
  - (c) coarse woody debris,
  - (d) rock,
  - (e) soil, or
  - (f) other.

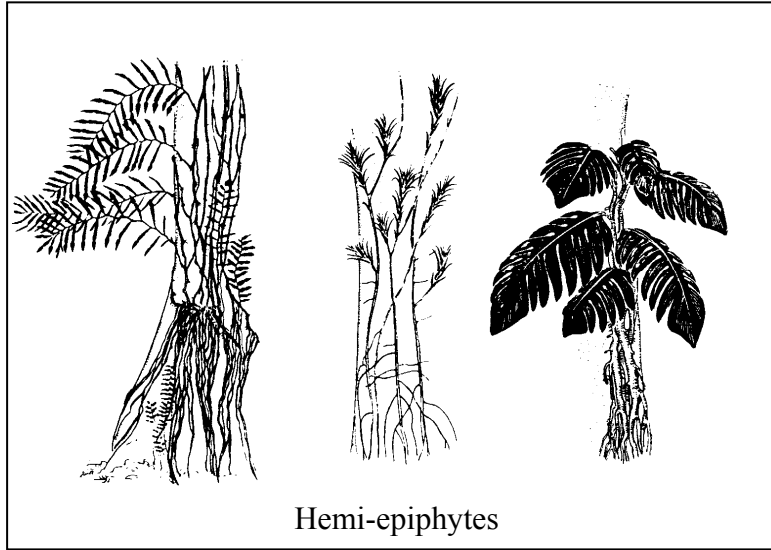
**Woody Debris:** When winding up the 50 metre tape, tally the number of fallen logs/ branches, lying on or within 1 m of the ground intersected by the tape. This debris is tallied by diameter size classes 2.5-5 cm, 5-10 cm, 10-20 cm, 20-30 cm, 30-40 cm, 40-50 cm, 50-75 cm, 75-100 cm, >100 cm. **Record tally totals on data sheet.**

**After data collection is complete at each transect, cross-check data sheets to ensure that all the required information is recorded and all sections of the data sheet are complete.**

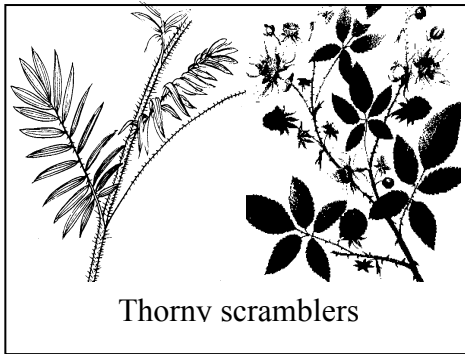
**Box 5: Examples of different life forms**



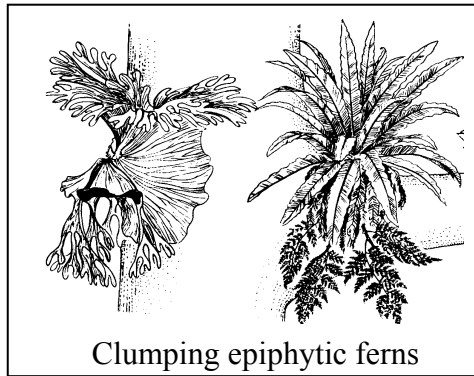
Strangler fig



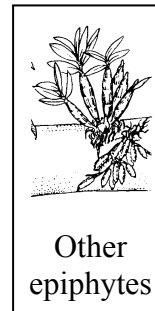
Hemi-epiphytes



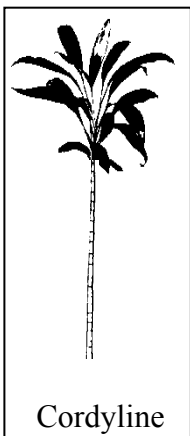
Thorny scramblers



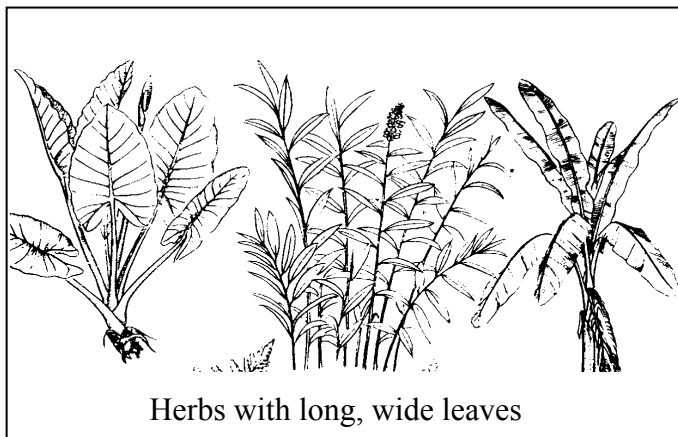
Clumping epiphytic ferns



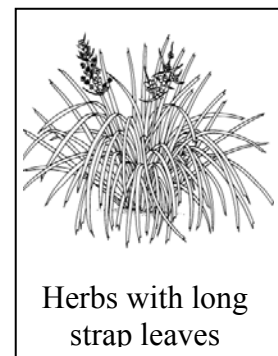
Other epiphytes



Cordyline



Herbs with long, wide leaves



Herbs with long strap leaves

Extract from Kanowski, J. and Catterall, C. P. (2007) *Monitoring Revegetation Projects for Biodiversity in Rainforest Landscapes. Toolkit Version 1, Revision 2.* Marine and Tropical Science Research Facility, Cairns

**Terminology**

**Site:** a parcel of vegetation which has been planted by or for the landholder for the purposes of environmental services including carbon sequestration, biodiversity habitat enhancement and environmental protection – by CCB and VCS standards, sites must be at least 0.05 ha in area.

**Transect:** a linear survey area consisting of several sub-transects and imbedded plots

**Plot:** an area within the *Transect* in which specific tree mensuration data are recorded.

**Quadrat:** a square area within the *Transect* from which specific data are recorded, in the case of this methodology these data relate to vegetation structural characteristics.

**DBH:** diameter at breast height; the diameter measured at 1.3 metres from the highest ground point at the base of the tree.

**Stratified sampling:** where a sample area, such as a property, is purposefully divided into a number of sections, each with similar characteristics, such as age of planting, species mix, or density or height of trees. Each section is then considered a separate *stratum* and assessed and analysed separately. This approach ensures that the inherent variation within an area is more effectively taken into account in the data collection process. Data from one site within the stratified sample is extrapolated according to the area of that particular site, not the entire planted area.

## **Additional notes and references**

Transects are based on the TRAPS Savanna Monitoring approach, with transect methods following Burrows *et al.* 2000, 2002, and Blake *et al.* 1997; TRAPS modified to allow nesting in accordance with LULUCF Guidelines to account for stem size classes; Plots and quadrats shape and size were originally based on Kanowski & Catterall (2007) Monitoring Toolkit areas for biodiversity monitoring, of 150m<sup>2</sup>, and 300m<sup>2</sup>; resulting areas of each of the three nested plots in the Data Entry Sheet 2 plots were based on a combination of the two methods, replacing the 3 square quadrats of the latter paper with a long narrow plot measuring the same dimensions for the purposes of stem measurements, but retaining these quadrats for the purposes of vegetation structure assessment.

### **References**

Pearson T., Walker S. & Brown S. (2005) *Sourcebook for Land Use, Land-Use Change and Forestry Projects*. BioCarbon Fund of the World Bank & Winrock International.

Rice A. H., Pyle E. H., Saleska S. R., Hutyra L., Palace M., Keller M., Camargo P. B. d., Portilho K., Marques D. F. & Wofsy S. C. (2004) Carbon Balance and Vegetation Dynamics in an Old-Growth Amazonian Forest. *Ecological Applications* 14: S55-S71.







### GROUND COVER, CANOPY COVER and CANOPY HEIGHT

For each survey Transect, lay out a 50 m transect. Then, mark out and survey quadrats centred on the 5 m, 25 m and 45 m points (see Figure 3).

**Ground Cover** = proportion of ground covered by (a) vegetation within 1 m of ground (various categories), (b) leaf litter and fine woody debris, (c) coarse woody debris, d) rock, (e) soil, or (f) other. Note: total must add to 100%.

At the 5 m, 25 m and 45 m points, define a 1 m x 1 m quadrat, using four 1 m sticks. Looking down at the quadrat from 1 m, estimate the % of ground covered by each type (i.e., as would be seen on a photo of the ground cover).

Ground Cover	Transect 1			Transect 2		
Location of quadrat:	5 m	25 m	45 m	5 m	25 m	45 m
a) <b>Vegetation within 1 m of the ground</b>						
<b>Grass</b> (and sedges)	%	%	%	%	%	%
<b>Herbs</b> (soft-stemmed plants)	%	%	%	%	%	%
<b>Ferns</b>	%	%	%	%	%	%
<b>Vines &amp; scramblers</b>	%	%	%	%	%	%
<b>Tree seedlings &amp; shrubs</b>	%	%	%	%	%	%
<b>Moss</b> (and liverworts and lichens)	%	%	%	%	%	%
b) <b>Leaf litter</b> and fine woody debris <10 cm diameter	%	%	%	%	%	%
c) <b>Coarse woody debris</b> >10 cm diameter	%	%	%	%	%	%
d) <b>Rock</b>	%	%	%	%	%	%
e) <b>Soil</b>	%	%	%	%	%	%
f) <b>Other</b> (including tree trunks, roots, etc.)	%	%	%	%	%	%
<b>TOTAL</b> (must add up to 100%)	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Foliage Cover** = projective cover of vegetation >2 m above ground level (shade cast by foliage and stems, if the sun was overhead, assessed for the entire 10 m x 10 m quadrat around each point. It can be estimated by eye (although this can be very subjective) or from a photo. We suggest using both methods.

1. Estimate foliage cover visually, e.g., by comparison with reference photos (see Appendix 1).
2. Take a wide-angled digital photo looking up from the centre of each 10 x 10 m quadrat, and use to calculate foliage cover (see Appendix 2). Record the number of each photo for later reference.

Foliage Cover	Transect 1			Transect 2		
Location of quadrat:	5 m	25 m	45 m	5 m	25 m	45 m
<b>Visual estimate of foliage cover</b>	%	%	%	%	%	%
<b>Foliage cover photo</b> (record number for reference)						
<b>Foliage cover calculated from photograph</b>	%	%	%	%	%	%

**Canopy Height** = the average height of trees forming the canopy in the 10 m x 10 m quadrat around each point. The canopy is the layer of foliage forming the 'roof' of the forest. The canopy may be broken by gaps or incomplete.

In some sites and forest types, it may be necessary to distinguish canopy trees from emergent trees (i.e., trees projecting well above the canopy, with crowns exposed on all sides).

Note: Estimating height is difficult. Use a clinometer and tape measure, or range finder if available. Alternatively, place a 2.5 m stick or length of pipe against a tree, and standing at a distance, estimate height in multiples of 2.5 m.

Canopy Height	Transect 1			Transect 2		
Location of quadrat:	5 m	25 m	45 m	5 m	25 m	45 m
<b>Average height of canopy trees</b>	m	m	m	m	m	m
<b>Height of emergent trees</b> (if present)	m	m	m	m	m	m

**SPECIAL LIFE FORMS** Record *presence* (✓) of life forms in each 10 m x 10 m quadrat centred on the 5 m, 25 m and 45 m points. If life forms are present on site, but not in quadrats, record in last column. Do not record abundance.

Special Life Forms (see also diagrams following proforma)	Transect 1			Transect 2			On site?
	5 m	25 m	45 m	5 m	25 m	45 m	
Location of quadrat:							
<b>Strangler figs</b> Figs with network of roots around stem of host tree, rooted in ground							
<b>Hemi-epiphytes</b> Climbing plants adhering to tree trunks, rooted in ground, e.g. <i>Pothos</i> , climbing pandanus							
<b>Vines</b> Climbing woody-stemmed plants dependent on trees for support, and rooted in the ground	<b>Slender</b> (stem <5 cm diam.)						
	<b>Robust</b> (stem >5 cm diam.)						
<b>Vine towers</b> Dense columns of vines growing over and smothering tree crowns and stems							
<b>Vine tangles</b> Dense masses of interwoven vine stems in understorey or midstorey							
<b>Thorny scramblers</b> Thicket-forming spiny vines or shrubs, e.g. <i>Calamus</i> , lantana, cockspur, raspberry	<b>Individual</b> plants present						
	<b>Thickets</b> present						
<b>Palm trees</b> Palms with stems >2 m high							
<b>Understorey palms</b> with stems <2 m high, e.g., walking stick palms (also includes juvenile palm trees)							
<b>Tree ferns</b> Ferns with stems usually >0.5 m high							
<b>Ground ferns</b> Ferns or fern-like plants without stems, growing on the ground							
<b>Clumping epiphytic ferns</b> Growing on trees, e.g. staghorns, elkhorns, basket ferns							
<b>Other epiphytes</b> Growing on trees, e.g. trailing ferns, orchids, not rooted on ground							
<b>Cordylines</b> 'Palm-lilies': shrubs to 5 m high, occasionally branched, with long leaves							
<b>Herbs with long wide leaves</b> e.g., ginger, cunjevoi, bananas							
<b>Herbs with long strap-like leaves</b> e.g. lilies, mat-rush ( <i>Lomandra</i> )							
<b>Cycads</b> Plants with leathery palm-like foliage borne on stout stems or growing on ground (subterranean stems)	Stout stems, e.g. <i>Lepidozamia</i>						
	Ground cycads, e.g. <i>Bowenia</i>						
<b>Pandanus</b> (shrub / tree form) Small tree with prickly strap-like leaves in spirals on the end of trunks, often with prop roots							
<b>Other life forms:</b> describe... (record <u>species</u> of plants or weeds on next page, <u>not</u> here)							

**Woody debris** = fallen logs & branches lying on or within 1 m of the ground.

Tally the number of times logs are intercepted by each 50 m transect, by diameter class at the point of intersection. If a log is intercepted by the transect more than once, it is tallied each time, by the diameter class at the point of intersection

Tally	Fine woody debris <10 cm dia		Coarse woody debris (CWD) > 10 cm diameter						
	2.5-5 cm	5-10 cm	10-20	20-30	30-40	40-50	50-75	75-100	>100
<b>Transect 1</b> 50 m transect									
<b>Transect 2</b> 50 m transect									

**GENERAL COMMENTS** on the structure and composition of vegetation at the site (e.g., dominant or notable structural features and/or plant species, variation in these factors across the site): record by strata as follows:

**Canopy:**

**Midstorey:**

**Ground cover:**

**RECRUITMENT:** What plants are recruiting to the site (e.g., natives, exotics)? How abundant are they?

Does this site have any **WEED** or **MAINTENANCE ISSUES** that need attention?

**Any other comments on the site?** Mark an 'X' here \_\_\_\_\_ and add extra page(s) as required