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Ecosystem Research Infrastructure

Ecological Field Monitoring Protocols Manual

Using the Ecological Monitoring System Australia

Vegetation Mapping Module – PROCEDURE ONLY

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Version

Readers are advised that all modules of the Ecological Field Monitoring Protocols Manual regularly undergo revision. Readers should check the website emsa.tern.org.au/documents to ensure they are viewing the current version.

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Key components of this module were developed, written, and field tested by the TERN Ecosystem Surveillance team, including Beth Cox, Tamara Potter, Ellen Kilpatrick, Kate Matthews, Rhys Morgan, David Peacock, and Carly Steen. Technical components, including the development of the accompanying app, were developed by the team led by Andrew Tokmakoff, including Luke Derby, Matthew Barty, Jin Zhou, Ho Hai Huy Vo, Walid Al Naim, Muhummad Khan, and Michael Doroch. Aspects of the protocols that have been built on by this project are the result of the extensive and ongoing body of work conducted by the TERN Ecosystem Surveillance team, as part of TERN's field-based ecosystem monitoring program. A full list of team members who have contributed is available on the TERN eSupport Services website.

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The information contained in this document comprises information and instructions for implementing ecological monitoring field surveys. The reader is advised that TERN has made its best efforts to ensure instructions are comprehensive enough to fulfil the tasks required to the standards required at the time of publication. All field surveys must be carefully planned to ensure the safety of personnel is paramount and that the required scientific permits and wildlife licences are obtained from the appropriate jurisdictions and conditions strictly adhered to. Such requirements may go above and beyond those listed in this manual. TERN, including the project personnel, are excluded from all liability to any person for the consequences, including but not limited to all losses, damages, costs, expenses and any other compensation arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

Photographs presented in this report are provided by TERN unless otherwise indicated.

Main front cover photograph: Landscape view of vegetation, Central Plateau, Tasmania.

Version control

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The version history of this module is identified below. The version history of the Ecological Field Monitoring Protocols Manual, the methods and data implications, both historical, current and future interpretations of data, are available from the TERN website. Enquiries should be directed to tern@adelaide.edu.au.

Version	Date	Version update overview
1	20 November 2025	First published version

in the current dataset (Bell and Driscoll 2020).

1 Vegetation mapping protocol

1.1 Field collection

1.1.1 Pre-requisites

Pre-requisites for completing this protocol:

- This module is not dependent on other modules. Vegetation mapping is often undertaken at the start of a project, before other modules, to help inform the selection of plots, targeted survey locations, or the location of intervention activities.

1.1.2 Time requirements

Time estimates vary depending on the level of experience and whether voucher specimens are collected. The time required to traverse between vegetation mapping points will vary based on the size of the project area and the number of points required. As a general guide, allow:

- 5–15 minutes per vegetation mapping point to collect the required information.
- 5–15 minutes per vegetation mapping point to collect and prepare voucher specimens, attach voucher labels, and scan and enter details into the app.
- 10 minutes per plant press every 2–3 days, during and immediately after the field survey, to inspect and change newspaper as necessary, until specimens are dry.

1.1.3 Personnel requirements

- Vegetation mapping can be completed by one person but is easier with two, so one can make the observations and the other can record the data directly into the Monitor app.
- The surveyor making the observations is ideally familiar with vegetation attributes and experienced in identifying the vegetation within the area.
- Scientific permits are required if voucher specimens are collected. Additional permits may be required for collecting threatened plant species, check with the local authority. Land access permissions are required.

1.1.4 Equipment

- Mobile device pre-loaded with:
  - the Monitor app
  - a field GIS app (e.g. QField, ArcGIS Collector, Avenza Maps) with available layers (e.g. satellite imagery, project area boundaries, prospective vegetation mapping point and plot locations, vegetation mapping, landform features, access tracks, watercourses) (optional)
  - A suitable app for recording tree height, e.g. Tree Meter, Arboreal Tree Height (optional)
- GNSS, such as a Trimble R1 or DA2 receiver, a hand-held GPS or device built-in GPS (least preferred), capable of achieving <30 cm accuracy
- Backup hard copy maps with relevant spatial layers
- DSLR camera and micro SD card(s) (backup)
- Compass (or a suitable app)
- Plant identification guides
- Plant vouchering equipment (refer to the Floristics Module for a more detailed equipment list):
  - Secateurs
  - Paper bags (small)

- Envelopes (for storage of seeds and other small plant material)
- Plastics bags (large for storage and transport of plant specimens)
- Plant press and straps
- Newspaper (tabloid size) and cardboard (43.5 x 28.5 cm)
- Voucher barcode labels (see the Generating Voucher Barcode Labels for EMSA Specimens and Samples information sheet)

- Rangefinder (to measure tree height and to assist with homogeneity measure) (optional).

1.1.5 Instructions and procedures

Pre-survey planning (desktop component)

1. Review existing data, available aerial/satellite imagery, and NVIS/vegetation mapping for the area of interest and surrounds. This will provide an indication of the likely extent of native vegetation cover and the vegetation types to be expected, and whether any threatened species and threatened ecological communities have been recorded in or around the area, to assist with project area level stratification for vegetation mapping/survey purposes and help to determine the potential number of vegetation mapping points required. Refer to the Plot Selection and Layout Module for key sources of information to review.
2. Determine if vegetation mapping is necessary and at what scale, depending on the:
    - Scale, aims, requirements and budget of the project
    - Availability, scale and accuracy (spatial and classification) of existing mapping
    - Changes to the project area since the previous vegetation survey/mapping was undertaken.
3. Assess if vegetation mapping points are required. If the project area is small (e.g. <5 ha) and the range of visually distinct vegetation associations is already represented within survey plots, vegetation mapping points may not be required.
4. Determine what needs to be classified and mapped based on the scope of the project (i.e. all of the project area or only areas to be impacted or managed).
5. Determine if a reconnaissance survey is necessary to:
    - Verify the accuracy of existing information
    - Confirm if nationally threatened species/threatened ecological communities are present
    - Stratify the project area based on visual interpretation
    - Refine the proposed location of plots.
6. Determine how many vegetation mapping points are required and how they are spread across the project area. There is no set standard, however, consider the:
    - Project aims, requirements and budget
    - Size of the project area/vegetation associations
    - Number and complexity of vegetation associations
    - Site access/practicalities
    - Desired scale of mapping (the more points, the more accurate the output)
    - Coverage already provided by proposed survey plots
    - Environmental impact assessment requirements (e.g. sampling intensity, representation of areas of different condition, and proximity to proposed development footprint)
    - State/Territory level survey requirements.

Field survey

1. If using an external GNSS to record location, connect it to the mobile device and allow time for the accuracy to drop to sub-metre.
2. Select a suitable location for a vegetation mapping point:
    - Ensure you are located within homogeneous vegetation
    - Avoid shrubs or trees in the foreground when facing south, so the photo is unobscured.
3. Open the Monitor app and then the Vegetation Mapping Module.
4. The survey *start date time* (yyyy-mm-dd hh:mm:ss) is automatically recorded but may be edited if neccessary.
5. Save the vegetation mapping survey (start) component. The first vegetation mapping point observation will open.
6. The *date* and *time* of the observation are automatically recorded but can be edited if necessary.
7. A unique sequential *vegetation mapping point* ID is automatically assigned to the record.
8. Assign a *field ID* (optional). This is additional to the automatically generated ID, to assist field-based stratification of the project area, visual mapping and reporting (e.g. VA1, VA2, VA2b).
9. The *location* of the observation is automatically recorded. To change the location, select 'choose on map' or enter specific coordinates.
10. Record the *homogeneity measure* (in metres), being a visual estimate of the shortest distance from the vegetation mapping point to a vegetation association different to the one that you are sampling (see diagram in Appendix 2).
11. Take a landscape orientated photo (where possible, facing south to minimise the effect of shadow) by pressing the *camera* button. Record the photo *direction*. Provide a photo *comment* (optional).
12. Consider a virtual assessment area centred around the vegetation mapping point; the size of which will vary depending on the height of the vegetation. A 20 x 20 m area is typical however a smaller assessment area may be appropriate in grassland and heathland, and a larger area may be more appropriate in open woody communities (Hnatiuk *et al.* 2009a; Sivertsen 2009).
13. Record the:
    - *vegetation growth stage* (refer to Appendix 4 and Appendix 5)
    - *site disturbance* (refer to Appendix 5)
    - *land-use history* (refer to Appendix 5)
    - *fire history* (unknown or known with *known fire date*)
    - *comment* (optional) (e.g. impact of weed species, overgrazing, mass flowering event etc.).
14. Collect vegetation information to *NVIS Level 5* (association level). For each of the three vegetation strata (Upper [U], Mid [M], Ground [G]) nominate in descending order the dominant species (up to 3 species per stratum with ≥5% foliage projective cover), where present. For each species, record:
    - *stratum*
    - *species* (using the search function and drop-down list, or manually enter a descriptive *field name* if identification is uncertain, see Additional guidelines)
    - dominant *growth form* (refer to Appendix 6)
    - *average height* (m)
    - visual estimate of *foliage projective cover* to the nearest 1% (refer to Appendix 3)
    - *photo/s* (optional, e.g. if species identification is uncertain) (refer to Appendix 7)
    - a *voucher barcode*, *voucher type* and *voucher comment* (if a voucher specimen is collected; optional). Tag each voucher specimen securely with a unique voucher barcode label. Place the label on stems or away from any plant parts that will need to be examined for identification purposes.

15. Save the vegetation mapping point observation. Select the back button at the top of page to return to the project page.
16. Record additional vegetation mapping points by selecting the Vegetation Mapping Module and then the edit button and add observation button. A new vegetation mapping point observation will open. The next unique sequential *vegetation mapping point* ID is automatically assigned to the record. Repeat steps 6–15.
17. Transfer the voucher specimens to a plant press whilst in the field, ideally after each vegetation mapping point.
18. At the end of the survey, complete the vegetation mapping ovservation component and then record the *end date time* (yyyy-mm-dd hh:mm:ss) of the vegetation mapping survey. Check the summary of the data and queue the collection for submission.

1.2 Additional guidelines

1.2.1 Field collection

Vegetation

- Vegetation mapping points should be in areas of homogeneous vegetation and should cover the range of visually distinct vegetation associations present.
- As a guide, for a 1:50,000 mapping scale, a minimum of one vegetation mapping point is recommended in each visually distinct vegetation association per every 1 km^2 (Gunn et al. 1988). Refer to Appendix 1 for sampling intensity recommendations based on the desired mapping scale.
- It is recommended that vegetation mapping points are at least 100 m apart to avoid spatial auto-correlation.
- If the homogeneity measure is uncertain, it is best to be conservative and underestimate the distance to ensure homogeneity.
- The NVIS classification is derived from the species' cover, growth form and height data. Refer to Appendix 6 for the growth forms allowed for each stratum, height classes and cover codes.
- Emergent plant species (with foliage projective cover <5%) can be entered. A warning message will appear when the cover value is <5%. Select OK to proceed and the species will be marked as emergent and excluded for NVIS classification and mapping purposes.

Species identification

- If the taxonomic identification is uncertain when the observation is recorded, or if a lower taxonomic identification is possible with accompanying evidence (e.g. high-quality photos, physical voucher specimens), the record is given a descriptive field name. The descriptive field name must be used consistently across modules within a survey event.
- When assigning a descriptive field name, the field name must make sense to you. Avoid generic labels such as 'Acacia sp.'. Use a descriptive word instead of 'sp.' (e.g. Acacia spiky); this saves confusion later regarding whether it was an uncertain species or a species in a non-identifiable vegetative form.
- If the taxonomic identification is known after reviewing the accompanying evidence, edit the record, and select the species from the drop-down list.
- A plant photo voucher should be taken for unknown species that have been assigned a field name to help identify them when surveying other vegetation mapping points or completing other modules.

Taking plant photo vouchers

- Try to ensure you photograph a plant that has good vigour and is representative of the species within the area.
- Take a photo that shows the overall growth form of the plant (see Appendix 7), as the distinctions in growth form may not be apparent to the surveyor, but crucial to identification.

- A suitable photographic reference scale should be used depending on the species/features being photographed. If you do not have an actual reference scale, use something you have on hand to provide a reference (e.g. pen, pencil, compass).

Collecting plant voucher specimens

Refer to the Floristics Module for further information regarding the collection and preparation of plant voucher specimens. Also, refer to the advice provided by the local herbarium. Key information is provided below:

- Collection of plant voucher specimens as part of the Vegetation Mapping Module is optional and limited to the dominant three species (≥5% cover) in the dominant three strata. Plant voucher specimens are recommended for new, unknown, important, contentious and threatened species (see definitions in the Floristics Module). Specimens of threatened species should only be collected if permitted and if their collection will not jeopardise the population.
- The need to collect a voucher specimen will depend on the circumstances and the other modules undertaken (e.g. if a species of uncertain identification has already been assigned a field name and a suitable voucher specimen has already been collected within the same visit, then collecting a further voucher specimen may be unnecessary).
- The Opportune Module is used to record plant species of interest observed at vegetation mapping points that are not captured by the Vegetation Mapping Module (i.e. species of <5% cover).
- Herbaria typically require physical specimens for positive identification. Where possible, a voucher should include enough material to cover an A3 size herbarium sheet. For specimens that you anticipate herbaria will wish to lodge (e.g. species of interest to the herbaria determined from pre-survey consultation), a duplicate should be collected.
- To aid identification, each voucher should ideally include when available: flowers or buds, leaves, fruit, and bark (for trees). Try to minimise the number of individual specimens needed to represent each species by maximising the number of plant components (e.g. flowers, fruit, leaves) on each sample collected.
- Ideally, voucher specimens are pressed after each vegetation mapping point, but if this is not possible, press them before commencing another module, or at least by the end of each day's field work. Until pressed, place larger specimens in a plastic bag, and smaller specimens in paper bags within the plastic bag, and store them in an appropriate place to maintain their quality. To avoid confusion, it is best to place specimens from vegetation mapping points in a separate plant press to those obtained from plots and opportune sampling.

1.3 Post-field survey tasks

1.3.1 Sample curation

The following tasks should be completed after the field survey is completed:

- Inspect the pressed voucher specimens and change the newspaper where necessary until the vouchers are dry.
- Complete species identifications, and if required contact the local herbarium (or approved taxonomist) to assist with the identifications of any uncertain vouchers. Determine the procedures for lodging plant specimen vouchers for identification, and provide the required associated information.
- Once the species have been identified, update any assigned field names in the app.

We at TERN acknowledge the traditional owners and their custodianship of the lands on which TERN operates. We pay our respects to their ancestors and their descendants, who continue cultural and spiritual connections to country.

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