Appendix 7

Data Specifications for predicting the Biodiversity Benefits of Vegetation Enhancement Activities

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Introduction

CSIRO has developed a draft framework or process for monitoring and assessing the biodiversity benefits of vegetation enhancement activities at a range of scales and attributes of biodiversity (Freudenberger and Harvey 2003). This draft framework has been developed for Australian Government Department of the Environment and Heritage (DEH) and the Biodiversity Benefits Task Group under the auspices of the Natural Resources Ministerial Council. This framework has the following four steps:

Step 1. Identify the most immediate threats to biodiversity that are likely to be causing the undesired status (condition or state of biodiversity) and decide on actions (e.g. vegetation enhancements) that could best reduce these threats.

Step 2. Identify the improvements to biodiversity that are expected to result from vegetation enhancement actions.

Step 3. Choose methods for monitoring the benefits that are expected.

Step 4. Monitor the actual changes that followed the actions, and compare them to the changes that were expected. Has various measures of biodiversity improved as expected?

Improving the status of biodiversity through vegetation enhancements will take a long time, centuries in the case of providing more tree hollows for the many species of dependent on hollows (Gibbons and Lindenmeyer 2002). Hence, it may take many years to obtain adequate results from applying this four-step process. In the interim, quite specific predictions of benefits can be made (Step 2). We have conducted Steps 1 and 2 for 7 case study regions across southern Australia. We have attempted to assess the potential benefits of on-ground works supported by the Natural Heritage Trust (Freudenberger and Harvey in prep). We have assessed potential benefits to biodiversity as a result of changes in:

- Native vegetation cover
- Patch sizes of remnant vegetation
- Isolation of remnants
- Condition or structural diversity of remnants

Changes in these patch and landscape scale biodiversity attributes are slowly occurring through public investments in programs such as the NHT and through private investments in agroforestry, shelterbelts, fencing of remnants, etc. These sorts of investments in vegetation enhancements can reduce some threatening processes that reduce biodiversity values. Vegetation enhancements can reduce the threats caused by loss of habitat, isolation of habitat and degradation of habitat. The possible biodiversity benefits of vegetation enhancements can be predicted if:

1. On-ground activities to enhance native vegetation have been mapped and entered into a geographical information system or spatially explicit database.

2. There is adequate research knowledge to predict changes in various biota or ecosystem processes following changes in broad spatial statistics like patch size, vegetation cover and patch isolation.

The following recommendations are in regards to the minimum data sets required to conduct the first step in a predictive assessment – mapped data. This minimum data set can also be used to assess progress towards spatially explicit vegetation enhancement targets (e.g. a minimum of 10 cover of each vegetation type).

Data specifications

Table 1 is a draft list of the minimum data fields for recording the details of on-ground activities. Table 2 is a list of additional fields that may prove useful for predicting biodiversity benefits. This minimum dataset is based on our assessment of seven case study project regions in southern Australia (Freudenberger and Harvey 2003b). Credit for developing these fields lies very much with the project officers and organizations involved in these case studies.

Table 1. Recommended minimum fields (attributes) needed to assess the potential biodiversity benefits of mapped on-ground works. This data is needed for every site (polygon) that has been mapped. Projects may have many more fields for data on inputs or outputs.

Suggested Field Name	**Description**
Site ID	A unique number needed for each mapped activity (polygon). This number should link to a file number and/or site number
Date	Date of on ground activity (year)
Objective 1	The primary purpose of the on-ground works (e.g. habitat conservation)
Objective 2	The secondary purpose of the on-ground works (e.g. protection of a threatened species)
Objective 3	Further purposes may include salinity or erosion control
Action 1	The primary action may be remnant protection (fencing) or revegetation (e.g. riparian)
Action2	The secondary action may include remnant enhancement (e.g. direct seeding of understory spp) (If this is only in part of the protected area then it meeds to be mapped separately)
Geomorphic position	Ridge, upper or lower slope of valley, drainage line, creek, etc
Width	Minimum width of shelterbelt or riparian strip.
Remnant vegetation type[1]	e.g. dry sclerophyll forest, riparian, open box woodland, grassland.
Revegetation type	e.g. multi-species habitat planting, single species agro-forestry, riparian planting or grassland
Condition[2] (site description)	e.g. intact remnant, scattered trees, exotic pasture, weed infested,
Input1	Fencing funded by the project (km)
Input2	Tube stock planted
Input3	Direct seeding (km or kg)
Input4	Weed removal, fire or other preparations
Planting origin	Local, non-local or exotic species
Planting life form	Trees, shrubs or grasses
Planting species	Dominant species (may be more fields here)
Landholder ID	This only needs to be a number (key) to link to the confidential information held elsewhere.

[1]Vegetation type should be by NVIS classification. Where possible this should be at NVIS Level V (vegetation association). See http://audit.ea.gov.au/ANRA/vegetation/vegetation_frame.cfm?region_type=AUS&region_code=AUS&info=NVIS_framework for more information.

[2]Where ever possible, an explicit and repeatable measure of condition should be used, e.g. "Habitat Hectares", Parkes et al. 2003).

The objectives of a vegetation enhancement activity should be derived from of the project or farm plans. Objectives can include remnant protection, enhancement and or enlargement, revegetation for a wildlife corridor, salinity control, erosion control, shelterbelt or timber production. An activity may have secondary objectives. For example, a shelterbelt, if wide enough and consisting of local species, may act as a wildlife corridor, or a plantation may also help control salinity. Similarly there may be more than one action applied to a site; e.g. fencing, weeding, planting of tube stock and/or direct seeding. Details of numbers and species can be entered into the 'Inputs' and 'Planting species' fields. Often the objective and actions get combined in a database or are not entered at all, making assessments against overall aims difficult.

Table 2. Optional or additional fields may be obtained for describing the nature and extent of site-based activities. Additional fields can be held within GIS software or held in linked relational databases. If the data is linked, the SiteID is the "key" between databases.

Optional fields	**Description**
Funding	Source of funding – primary and secondary
Project ID	e.g. NHT project number
Area (ha)	The area of on ground works can be calculated by a GIS, but this field can be a useful check against the GIS
Coordinates	Coordinates for each polygon can be calculated from a GIS, but coordinates from a GPS can be a useful cross-check
Datum	The datum used to obtain the GPS coordinates is needed, datums can differ by up to 100 m.
Photo point	Digital photos can be linked to each site (polygon) within some GIS software
Output1	Survival of plantings (e.g. number surviving per 100 planted)
Output2	Regeneration (e.g. seedlings/10 m)
Output3	Link to wildlife survey data
Comment1	Field notes from landholders, eg. Drought, flooding, grazing, weed encroachment, etc
Comment2	

In addition to these fields needed to adequately describe each mapped activity (polygon), the following data layers (e.g. shape files) are needed to assess potential biodiversity benefits:

1. Mapped on-ground works (including new fencing vs. existing fences)
2. Broad vegetation types or more specific at the finest resolution available
3. Imagery (satellite image or aerial photos)
4. Streams and roads
5. Elevation contours
6. Project boundary
7. Crown land (e.g. conservation reserves, state forests)

A vegetation layer is needed to calculate changes in vegetation cover, patch size and isolation. Some useful assessments can be made even if the vegetation data is woody vs. non-woody cover. However, classes of vegetation cover are far more informative. Composition data allows for the analysis of how well the revegetation or remnant protection was targeted and whether the remnant fencing was restricted to only a few well-represented vegetation classes, or whether it was associated with a diversity of classes or mainly highly cleared classes.

Practical vegetation mapping cannot map down to individual trees or shrubs. Imagery such as aerial photos or high-resolution satellite images is needed to assess the type of cleared land that has been revegetated. In some cases the presence of scattered old trees or signs of recent cultivation can be identified.

Broad elevation contours are needed to assess whether remnant enhancements have been biased towards the higher, drier and often less fertile parts of a project area, or preferentially targeted to highly cleared lower parts of the subcatchment or project area. Related to this, a defined project area is needed in the GIS. We were surprised how difficult it was to define the boundaries of some of the case study projects we assessed. A GIS layer of crown land classified by landuse (e.g. commercial forestry vs. conservation reserve) is needed to assess how on-farm vegetation enhancements may contribute to a regional conservation network.

The following additional data layers can help in assessing potential biodiversity benefits of recent vegetation enhancements:

1. Mapped weed invasion;
2. Known locations of threatened species or mapped habitat;
3. Previous vegetation enhancement works e.g. older shelterbelts, agroforestry, remnant fencing;
4. Salinity risk or saline out-breaks;
5. Forms of erosion;
6. Vegetation condition.

A number of the case studies that we assessed included significant woody weed removal. We were not able to assess the potential benefits of this removal because 1) the areas treated were not mapped and 2) the areas affected by the targeted weed were not mapped. If we had these two data layers we could have assessed progress towards some weed control target such as eradication from a particular subcatchment.

Other case study projects aimed to conserve threatened species and their habitat. However we were not able to assess potential benefits of on-ground activities because mapped data of known location or potential habitat of threatened species were not available.

Only one of the case studies we assessed (Holbrook Landcare) is in the process of mapping all revegetation activities regardless of project origin whilst all the other case studies only mapped on-ground works specifically supported by the project funding the mapping. Hence our assessment of likely changes in vegetation extent, configuration and condition did not include older plantings unless that had been captured by formal vegetation mapping programs. Neither were we able to assess the true extent, configuration or composition of remnants fenced and protected from continuous grazing. All we could do was assume that privately held remnants not fenced by the project remained unprotected from continuous grazing.

One of the challenges of assessing mapped data is the degree to which it is accurate and current. Recent remotely sensed data can be used to assess accuracy, but won't detect recent plantings or fencing that has not had a chance to change enough to be detected on the imagery. The accuracy of 'presence' data is probably reasonable. That is, sites (polygons) of on-ground works have a high probability of existing. Whereas 'absences' of on-ground works are likely to be much less accurate since revegetation or remnant protection often occurs without of project support.

Additional information

Our case study assessments of potential benefits using our four-step process required documentation in the form of catchment plans, project proposals, funding guidelines etc. We gleaned plans for the following key information:

- Quantified objectives or targets (e.g. 6000 ha of remnant protection below 300 m elevation or increase vegetation cover to 10);
- The status of various biodiversity attributes (e.g. threatened species or communities);
- Details of threatening processes that are reducing compositional, structural or functional attributes of biodiversity;
- Project inputs (e.g. funding, cash and in-kind);
- Regionally specific models or benefits expected from on-ground activities.

We were seeking information to fill in the matrix that summarises the issues that need to be addressed in Step 1 of the Freudenberger and Harvey (2003) assessment framework (Table 3).

Table 3. An example of the information gleaned from the Tasmanian Bushweb Project documentation in order to address the issues involved in Step 1 of the assessment on the biodiversity benefits framework of Freudenberger and Harvey (2003).

Scale	Biodiversity Status			Threatening processes causing the status		Management action(s)	
	Composition	**Structure**	**Function**	**Modification**	**Removal**	**Vegetation enhancement**	**(Other) ***
Patch	Low diversity and abundance of woodland birds, rare and threatened plants, weeds	Simple habitat structure	Dryland salinity, poor water quality	Grazing and agricultural intensification	Historical clearing	Remnant fencing & revegetation	e.g. feral predators
Landscape (subcatchment)	Declining populations of native flora and fauna species and loss of grassy dry woodlands	Small patch size & low connectivity	Poor water quality	Grazing and agricultural intensification on the most fertile soils	Historical clearing of most fertile soils on lower slopes	Remnant fencing & revegetation	

*The 'other' column can include management actions other than vegetation enhancement that can also change biodiversity status

Assessing potential benefits is improved if the conservation status of each mapped vegetation type or class is known. Potentially revegetation can increase the cover of severely depleted vegetation classes or can merely add onto a well represented class. Predictive mapping of 'pre-1750' vegetation or more appropriately termed 'potential vegetation in the absence of clearing' can greatly assist in the assessment of the benefits likely to result from fencing, revegetation or understory enhancement.

Predicting benefits

Our recommendations are only for the data required to predict changes in vegetation cover, configuration and condition. In order to assess the likely benefits of changes in these landscape attributes, models or relationships between these changes and various species or processes (e.g. hydrology) are needed. This predictive understanding is generally lacking for most regions in Australia. For example, there are only a few studies in just a few regions that have examined the benefits of fencing off remnants (Cluff and Semple 1994; Pettit et al. 1995; Prober and Thiele 1995; Yates *et. al*. 2000a & b; and Spooner et al. 2002). There have been no studies in Australia that have experimentally demonstrated the benefits of reducing isolation through revegetation of corridors or 'stepping stones'.

Predicting biodiversity benefits from mapped on-ground works is no substitute to choosing suitable monitoring methods (Step 3), implementing these methods in a rigorous fashion and assessing against the predicted benefits (Step 4 of the Freudenberger and Harvey (2003) draft framework). We know far too little about the responses of biota to vegetation enhancements to rely on assessments of mapped activities. Assessing mapping is only a starting point and a means of focussing efforts on further monitoring and evaluation.

Monitoring and Evaluation

The above specifications for data fields and data layers are only those required to assess potential benefits to a few attributes or measures of biodiversity. The minimum data fields listed in Table 1 capture some but not all project inputs. These data specifications are only one part of a much broader system needed to conduct a comprehensive monitoring and evaluation of the social, economic and environmental benefits of regional scale initiatives aimed at improving natural resource management. Organisations such as Sustainability and Environment Victoria and Greening Australia have developed or are trialling comprehensive monitoring and evaluation systems (e.g. CAMS and Catchment Scorecard™). We have made some recommendations regarding monitoring and assessing just the biodiversity component of a much larger system needed to monitor and evaluate improvements in a diversity of regional outcomes.

Regional Data Managers

Developing, maintaining and using a GIS database of mapped on-ground works to support the planning and evaluation of natural resource management is not a trivial exercise. It requires, at minimum, a full-time staff member with competent GIS and database skills to develop a project or region specific GIS database. This development process probably requires at least six months to develop such a system from scratch, less if an existing system such as Catchment Scorecard™ is used. Just as importantly, such a GIS database requires a dedicated ‘data manager’ to maintain, update and deliver outputs from the database. A data manager can be a part time, though specialised position once the system is up and running.

An effective and continuously updated database requires long-term institutional support from regional organisations such councils, catchment management authorities, or non-governmental organisations with a stable funding base. Finally, such a GIS system requires stakeholders that desire and expect regular updates and analyses. GIS databases of regularly registered updated inputs of on-ground activities should be a part of annual reporting to the institutions and the stakeholders that support such a system.

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