# Jerrabomberra Grassland Reserves

The Monaro Highway heading south from Canberra divides the East (99 ha) and West (260 ha) Jerrabomberra Nature Reserves, which together constitute one of the largest areas of Natural Temperate Grassland in the ACT. The reserves are managed by the ACT Government for the protection and conservation of the grassland and its resident flora and fauna. The place is a stronghold of the critically endangered Grassland Earless Dragon, while also holding populations of the Striped Legless Lizard, Pink-tailed Worm-lizard, Golden Sun Moth and Perunga Grasshopper, all of which are listed species.

## Jerrabomberra Grasslands Nature Reserve: a case study of grassland reserves management in the ACT

Maree Gilbert
ACT Parks and Conservation Service

Established in 2008, the Jerrabomberra Grasslands are among the few remaining strongholds for the endangered Grassland Earless Dragon *Tympanocryptis pinguicolla*. Formerly rural lease land, the Reserves also have a range of other ecological values and a host of management challenges.

From preliminary planning and set up, to day-to-day management and long-term habitat enhancement projects, ACT Parks and Conservation Service has prioritised the Grassland Earless Dragon in an effort to secure the future of populations in the Reserve.

In addition to pest plants and animals, urban infrastructure projects, roads and fire, biomass has emerged as a significant management issue. In association with Conservation Planning and Research (ACT Government) and the University of Canberra, ACT Parks and Conservation have experimented with burning, grazing, slashing and exclusion fences to manage biomass and maintain habitat structure for the Grassland Earless Dragon.

Maree Gilbert is a Senior Ranger with Canberra Nature Park. Having established the Jerrabomberra Grassland Reserves over 6 years ago, Maree has specialised in the planning and management of remnant urban grassland reserves throughout Canberra.

## Insects in grasslands

Kim Pullen
CSIRO

Invertebrates play a crucial role in the healthy functioning of ecosystems, yet their importance is often overlooked. On a global level, they dominate in terms of diversity and abundance. In some environments they even dominate in total biomass. The invertebrates most familiar to Australians are the shellfish and crustaceans that we eat, and the insects that torment us and eat our plants.

In native grasslands, insects are not always obvious, but are always present and diverse. They live within the soil, in decaying vegetation on the soil surface, or in the above-ground vegetation, and may move between these micro-environments daily or seasonally. They may take to the air to disperse or mate. Their food might be another animal (perhaps another insect), or a microorganism, plant or fungus, and they may eat its live tissue – if they are predators, parasites and 'grazers' – or dead tissue – if they are saprophages and scavengers.

As Australian temperate native grasslands have become reduced and fragmented, their insect fauna has suffered. Two grassland insect species are listed as threatened in the ACT: the Golden Sun Moth and the Perunga Grasshopper. Other species known to have declined are the Canberra Raspy Cricket, Lewis's Laxabilla Grasshopper and Key's Matchstick Grasshopper.

Insect conservation is impeded by lack of public awareness and appreciation of the insects themselves, in turn leading to a lack of political action, and a lack of scientific knowledge of their ecology, distribution and abundance. Even identifying insects can be difficult, with few experts and little in the way of scientific and popular literature to help.

Kim Pullen first became interested in insects as a teenager growing up in Canberra, and formed a collection of beetles over the following 20 years. He has carried out entomological work for the ANU, CSIRO and the Queensland Government in the fields of ecology, cytogenetics, biological control of weeds, orchard pest control and biodiversity inventory. He is currently compiling a list of the insects of the ACT.

## Assessing grassland site condition using the Floristic Value Scoring method

Rainer Rehwinkel

Assessing grassland sites using a numerically sound method is required for a number of reasons. For example, a repeatable method is required for NSW regulatory purposes and for assessment under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Since the Floristic Value Scoring (FVS) method was developed in 2007, a number of changes to the NSW legislation and EPBC Act listing of Natural Temperate Grassland have been in train. Additionally, a new way of scoring to derive a FVS has been developed. This presentation will discuss these legislative requirements and will demonstrate the basic method.

(*The talk and paper given in the field in 2014 have since been superseded. The updated method,* 'A Revised Floristic Value Scoring Method to Assess Grassland Condition', October 2015, *is included below as an addendum to this proceedings.*)

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Rainer Rehwinkel is a Senior Threatened Species Officer at the NSW Office of Environment and Heritage (OEH). He works on the conservation of grassy ecosystems and their species, including working on policy issues, recovery and rehabilitation of sites and community engagement programs. He is currently Chair of the Executive Committee of the Kosciuszko to Coast Partnership and is a co-author of *Grassland Flora*.
(*This bio was current at November 2014. Rainer retired from NSW OEH in 2015.*).

*Addendum, next page*

# A Revised Floristic Value Scoring Method to assess grassland condition

Rainer Rehwinkel

October 2015

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Floristic Value Score spreadsheet tools exist for these regions:

- South Eastern Highlands Monaro,
- South Eastern Highlands Excluding Monaro,
- Brigalow Belt South, and
- Riverina.

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*Note:* This method is published here only as a record of the information presented at the forum. The information published in these proceedings has *not* been peer-reviewed.

# A Revised Floristic Value Scoring Method to assess grassland condition

This document presents a quantitative method to assess the relative condition of natural grasslands and secondary grasslands. The methodology assigns a Floristic Value Score (FVS) to a grassland site by using significance ratings of the native species occurring at the site.

The methodology presented in this document is a revised version of Rehwinkel (2007), which was developed for use in the Southern Tablelands of NSW. That document was produced for the Australian Government as part of the actions identified in the *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): An Endangered Ecological Community* (Environment ACT 2005). This revised methodology scores all native plant species present, in contrast to the former method that only scored so-called 'significant species'. By scoring all species present, the resultant score is more comprehensive and better represents the relative value of a site. The revised methodology was produced in response to two processes that require a quantitative condition assessment method for grasslands. The first is a revision of the listing of Natural Temperate Grassland endangered ecological community by the Australian Government; the second is for use under NSW legislative requirements.

As with the Rehwinkel (2007) method, this method is specifically designed for use in the following broad vegetation types:

- Natural grasslands, including those that fall under the definitions of Natural Temperate Grassland of the Southern Tablelands (NSW and ACT), a listed threatened ecological community under the Commonwealth *Environmental Protection and Biodiversity Conservation Act (1999)* (EPBC Act); and
- Secondary grasslands derived from grassy woodlands, including:
    - 'White Box Yellow Box Blakely's Red Gum Woodland (Box–Gum Woodland)', a listed endangered ecological community (EEC) under the NSW *Threatened Species Conservation Act (1995)*, and its EPBC-listed equivalent 'White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands'; and
    - 'Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions (Tablelands Snow Gum Grassy Woodland)', a listed endangered ecological community (EEC) under the NSW *Threatened Species Conservation Act (1995)*.

This method can also be used in the following broad vegetation types:

- the grassy groundlayer of grassy woodlands, including the above-listed woodland endangered ecological communities; and
- grassy groundlayers of other regionally declining vegetation types; and
- derived or secondary grasslands that have been derived from woody vegetation types, including woodland, forest or heathlands, where the original vegetation type cannot be identified.

While the Rehwinkel (2007) method was developed specifically for native grasslands on the Southern Tablelands of NSW, including the Monaro region, with adequate field-based quantitative data and review by relevant experts, this methodology is applicable to natural and secondary native grasslands in other regions of NSW.

The method relies on developing a 'significance rating' for each plant species found within grassy ecosystems within a particular region. This process has been completed for the Monaro region, a geo-political region within the South Eastern Highlands IBRA* bioregion, and another region that includes the South Eastern Highlands bioregion excluding the Monaro. Species lists and significance ratings have been developed for the Riverina and the Brigalow Belt South IBRA regions. The method is being considered for other IBRA regions in NSW

* IBRA = Interim Biogeographic Regionalisation for Australia

(see 'Regionalisation', below). For alignment with Australian Government needs, separate lists are also required for the ACT and the parts of the South Eastern Highlands that occur in Victoria, into which the proposed revised listing of Natural Temperate Grassland will extend.

Determining which regions or sub-regions this method is being applied to is based on a demonstrated prior need for such a method. For example, grassland conservation is of particular concern in the Monaro and Riverina regions. Development of slightly different approaches and adaptations of the basic methodology are determined based on bioregional differences, and in some cases, on sub-regional differences, in the responses of the grasslands, their component species, or particular land-use pressures within and between the regions and sub-regions.

To satisfy the requirements of both the Australian and NSW Governments' requirements, various threshold levels have been developed along the continuum of grassland condition values between low and high. Under these requirements, the minimum accepted threshold used to consider a grassland as being native vegetation is the requirement that greater than 50% of the groundlayer cover is of native species. In grassland assessment the key defining characteristic for a site to be considered as a Natural Temperate Grassland under the EPBC Act is that an area of grassland needs to be '… dominated by native grasses and/or native forbs (more than 50% total vegetative cover, excluding introduced annuals)' (p. 18, *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): An Endangered Ecological Community;* Environment ACT 2005). Thus, if a grassland has greater than 50% of its groundlayer cover composed of exotic perennial species, it is not considered to be native vegetation. Above this minimum threshold lies a continuum of grasslands that vary from having low to extremely high conservation values.

It is to be noted that under the assessment rules being developed by the processes discussed above, various criteria are being developed to ensure that grasslands with special values other than the site's floristic condition are likely to be protected, even if they are assigned a low FVS. Other identified values need to be considered separately, and the method presented in this document is only part of the assessment process.

Thus, according to this method, a grassland with a FVS of between 0 and 4.99 is considered to be of 'Low Conservation Value' or 'Low Condition Value' in this component of the conservation assessment. This threshold has been agreed for use in south-eastern NSW by relevant grassland and pasture experts and agency staff in both NSW and Australian Government agencies, and is based on examination of data from more than 500 grassland plots from the region (R. Rehwinkel, unpublished data).

A second class of grasslands is in a 'Moderate to High Conservation Value' or 'Moderate to High Condition Value'. Grasslands with a FVS of between 5.00 and 6.49 are in this class. Finally, grasslands with a FVS of 6.50 or greater are considered to be of 'High to Very High Conservation Value' or 'High to Very High Condition Value'.

To ensure that all regions use a standard methodology, minimum FVS threshold scores to define the three classes (Low Conservation Value, Moderate to High, and High to Very High Conservation Value) have been determined by defining the 'significance ratings' for each of the grassy ecosystem species found in that particular region and then testing the method against plot data in each of those regions.

It should be noted that the method, as described in Rehwinkel (2007) has been widely adopted by ecological consultants in south-eastern NSW and the ACT to assess the relative values of grasslands in project planning and impact assessments. The method has also been used to monitor grassland values, with up to four years of data now collected and analysed in some grassland sites in the ACT, where the impacts of kangaroos on grassland flora are being assessed (Greg Baines and Emma Cook, pers. comm.), and in assessing floristic changes due to biomass control and weed control treatments in some NSW grassland reserves (Rowan Watts, pers. comm.; Susannah Power, pers. comm.). A CSIRO researcher has also used this method to monitor changes in grassland floristics (Ken Hodgkinson, pers. comm.).

Spreadsheet tools have been developed for calculation of Floristic Value Scores for grassland sites (see 'The process to determine a site's Floristic Value Score', below).

## The significant species concept

The method was developed using data collected since the early 1990s (see 'Acknowledgments') in site surveys of grassland and grassy woodland throughout the Southern Tablelands in NSW and ACT. The method is based upon the 'significant species concept', which relies on the application of a 'significance rating' to most of the 700 or so species that have been recorded in grassland and grassy woodland surveys within the Southern Tablelands. Briefly, native plant species of grassy ecosystems have been assigned a 'significance rating' based on their rarity or commonness in the regional data. The categories are:

- A = 'indicator species, level A': species that are uncommon in the region, and where they occur, generally indicate grassland sites of high to very high value; such species occur very rarely or in very low numbers in grasslands that have been subject to intense, frequent, long-term or sometimes even one-off disturbances, such as ploughing, heavy stock grazing pressures or application of fertilisers. Some of these species are also inherently rare. This category includes all threatened flora species that are listed under the NSW and Australian Government Acts;
- B = 'indicator species, level B': species that are more common in grassland sites, relative to 'level A' species. They generally occur less frequently in highly disturbed sites, though some persist with intermediate levels of disturbance; and
- C = 'common or increaser species, level C': species that are thought to be 'disturbance-tolerant', 'disturbance responding' or 'increaser' species. Increasers respond positively to various disturbances and are thus most commonly recorded in disturbed or degraded sites.

While most species have been assigned to a category based on analysis of data for the Southern Tablelands of NSW (R. Rehwinkel, unpublished data), there are some species that, although apparently rare in the datasets, are thought to be 'disturbance-tolerant', 'disturbance responding' or 'increaser' species and are observed frequently, and often in high densities in the most disturbed and degraded sites. This is based on observations and expert opinion of grassland experts, including David Eddy and Sarah Sharp, assisting in the review of this unpublished analysis.

More information on the development of the method is in the documentation of the original version of this methodology (Rehwinkel 2007). Further references on declining species of grassy ecosystems is are provided below as Further Reading.

## Grassland assessment

Traditionally, grasslands have been difficult to assess because of their inherent variability. Before the European settlement of south-eastern Australia, there were extensive grassy plains, as well as smaller areas of grassland within a mosaic of woodlands (Thomas et al. 2000; Environment ACT 2005; Armstrong et al. 2013). Now relatively few sites of these vegetation types remain in a state that resembles the former grasslands. The same applies to grassy woodlands (Thomas et al. 2000; Armstrong et al. 2013). This is principally because grasslands and grassy woodlands occur in landscapes that were, and continue to be, heavily favoured for agricultural purposes and more recently, in many areas, for urban, peri-urban and infrastructure development. More recently, wind-farm and solar farm developments have focussed on grassland areas, and establishment of pine plantations has also been a major threat. Despite this, in some regions, large areas of native grassland are retained that are variously described as native pasture or degraded or highly modified native grassland (Langford et al. 2004; Environment ACT 2005). Across the Southern Tablelands, these areas vary in their extent according to the climate, soil types and land-use histories. This pattern is repeated in other regions of NSW, with varying extent of natural or secondary grasslands remaining.

Within any particular region, remnant grasslands and grassy woodlands exist along a continuum of site condition. At one end of this continuum, there are the rare sites that retain a very high degree of integrity (i.e. very high floristic diversity, varied structure that provides habitat for a diverse fauna, and low or absent cover of exotic plants). It needs to be noted that there are exceptions, such as the sites that are apparently relatively undisturbed, but inherently have a low species richness, such as some sites that are dominated by Plains Grass (*Austrostipa aristiglumis*) in northern NSW, or some long-ungrazed grassland sites dominated by Kangaroo Grass (*Themeda australis*) throughout the state. At the other end of the continuum are the more extensive areas of native pasture and degraded or highly modified grassland. Such grasslands usually have very low native plant diversity, limited fauna habitat values, and often, a high cover and diversity of exotic plant species, many of which are either introduced pasture species, or agricultural or environmental weeds. As has been noted above, the extent of unmodified native grassland varies from region to region.

Some regions, including parts of the Riverina, retain extensive areas of grassland in high condition (Damon Oliver pers. comm.). The pattern in the Riverina is complicated by the fact that some of the grasslands of the Hay Plains, which are now dominated by wallaby grasses *(Rytidosperma caespitosum* and *R. setaceum*) and Corkscrew-grass (*Austrostipa scabra*) are considered to be derived from Chenopod Shrublands or even Boree Woodlands. In the case of the former shrublands, *Atriplex* spp. and *Maireana* spp. have been largely grazed out, leaving grass and forb species that are tolerant of grazing. These grasslands now provide habitat for rare species, including the Plains-wanderer (*Pedionomus torquatus*), which prefers an open structured grassland rather than shrubland.

Because grassland and woodland sites occur in all states, from those with the highest integrity to those that are severely degraded, it has traditionally been difficult to draw a line between marginal sites that fall between those that clearly have conservation value and those which are less important for conservation.

Assessment of vegetation without trees has been particularly problematic under the processes in the NSW legislation. Most significantly, current processes lack an adequate definition for low conservation value grasslands. Currently, the definition for low conservation value grasslands is the same as that for non-native vegetation. Further, the method that underpins the NSW *BioMetric* process, which assigns condition values to patches of vegetation, fails to adequately address the values of natural or secondary grassland sites. This is because *BioMetric* calculates the condition of the site in relation to a set of benchmark values of a number of site attributes for that vegetation type. For patches of woody vegetation there are multiple benchmark values, including cover of upper-, mid- and ground-layer strata, total length of fallen timber, number of trees with hollows and total species richness. In grasslands, most of these benchmark figures are not relevant (grasslands do not have relevant upper- and mid-layer benchmark values, and fallen timber and tree hollows are similarly irrelevant because these features are typically absent). Assessment of the remaining values (cover variables and species richness values) do not adequately capture the value of native grassland sites, because not considered is the inherent variability of grasslands, including seasonal or within-year, year-to-year and within-site spatial variation, and the fact that some important sites may not be inherently species-rich (because some vegetation types tend not to be species-rich, or species richness can be masked by a build-up of biomass). Importantly, and counter-intuitively, as mentioned above, some grassland sites that have undergone disturbances may actually have higher native species richness than sites with little recent disturbance. There are many species that increase with disturbances (the 'level C' species, above), and such sites may have a temporarily high species richness that may mask their true value.

In response to the issues outlined above, and to the action defined in Environment ACT (2005), it was found necessary to develop a methodology to determine those grassland sites that should be considered to be of conservation significance. The approach presented in this document provides a robust, transparent and repeatable process that has been applied across south-eastern NSW, to determine the conservation significance of any grassland and secondary grassland site assessed.

## The process to determine a site's Floristic Value Score

Assessment of grassland condition is achieved by the collection of species and cover data from within a standard 20 m x 20 m (0.04 ha) plot. These data are entered into a spreadsheet tool, which produces a Floristic Value Score based on the species present and their abundance within the plot. Sites attaining a score of 5.00 or higher are considered to have conservation significance. Sites with a FVS below 5.00 effectively fall within the 'Low Conservation Value' category, as long as other assessment values have been considered and dismissed.

Using this methodology, each native species receives a minimum score of 0.10. Those native species that are classified as indicator species 'level A' or 'level B' are given a higher score, and each species present is also given a weighting depending on their abundance at the site. The weightings for species at each level and each abundance class band are shown in Table 1 of Appendix 1. The score generated by the spreadsheet tool is generally not linear in relation to the species richness present. Data from many sites have been tested and sites with no 'level A' or 'level B' species will generally return a score of less than 5.00. Sites in which there is a presence of 'level A' or 'level B' species in low densities or low numbers may similarly return a score below 5.00. Where there is an increasing abundance of 'level A' species, even if they are at low densities at the sites, the scores for such sites are increasingly greater than 5.00.

### Secondary grasslands

Grasslands vary in their pre-European settlement origin. This has the potential to create confusion, especially in parts of the landscape that are heavily cleared and it is difficult to determine whether a site is a natural or a 'secondary' grassland (i.e. grassland that results from the clearing of trees and shrubs in a woodland, heathland or forest).

Secondary grasslands have a range of values. They may be floristically diverse in their own right and thus be worthy of conservation. They may provide habitat for grassland fauna rather that the woodland or forest fauna formerly occupying the site. They may be important as sites for rehabilitation of the former woody vegetation types that were present before clearing. They may have connectivity value as grassland, or if scattered trees are retained, for woodland or forest fauna.

This document provides guidance in cases where it is difficult to determine whether a grassland is natural or secondary. Note, the terms 'secondary' and 'derived' are interchangeable (see Box 1).

This methodology could be applied to secondary grasslands where it is impossible to determine the pre-existing vegetation type. Where there is little or no evidence of the site being a secondary or derived grassland, the site should be accepted as natural grassland.

**Box 1. Identifying secondary or derived grassland**

Firstly, it is important to remember that some, if not all grassland vegetation types may have a very low cover of trees as natural components of those types. However, if one or more of the following signs are evident, the site may be a 'secondary grassland' or 'derived grassland' (i.e., a grassland that results from the clearing of woodland or forest trees, or even heathland shrubs).

Is there any evidence of trees formerly occupying the site? For example, are there stumps, regularly spaced depressions in the ground that were once occupied by tree stumps and that may or may not retain pieces of dead timber, or significant amounts of fallen timber, presence of seedlings or saplings of tree species and/or are there trees of grassy woodland or forest tree species in a woodland or forest formation adjacent to or near the site on similar topographical positions and geological substrates?

The terms 'secondary grassland' or 'derived grassland' are interchangeable, and make no distinction as to what vegetation type (VT) was present before the tree and/or shrub layers were removed. If it is possible to define the VT that was present prior to tree clearing, the current NSW processes requires that the site be assessed as per the relevant VT. However, if it is impossible to define what VT is present, it would be appropriate to use the Floristic Value Score methodology along with any required assessment of other attributes, in assessing a site's value.

For a definition of 'derived community' as used in the NSW processes, see under the heading "Derived vegetation communities" at: http://www.environment.nsw.gov.au/projects/biometrictool.htm

## Regionalisation

The original version of this method (Rehwinkel 2007) divided the region that was then relevant (the Southern Tablelands) into broad sub-regions, as recognised in the *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW & ACT)* (Environment ACT 2005). The current methodology now recognises only two regions within the South Eastern Highlands IBRA bioregion (or three if the ACT is considered as a separate region). The two NSW regions are:

- Monaro region: the geo-political region as defined by the three local government areas of Cooma–Monaro, Snowy River and Bombala; and
- South Eastern Highlands excluding the Monaro: the areas within the IBRA South Eastern Highlands bioregion excluding the Monaro region.

These two regions each have different floras, manifested in the differences in the forb, shrub and tree species (Armstrong et al. 2013). These areas also have distinctive land-use patterns. Much of the Monaro region retains its native grasslands, including secondary grasslands that are either part of the 'Tablelands Snow Gum Grassy Woodland EEC' or other vegetation types, though only relatively small areas retain moderate to high floristic values. In contrast, while there were formerly substantial areas of natural grassland and Box–Gum Woodland in the South Eastern Highlands, excluding the Monaro region, very few areas remain because grasslands and woodlands in this region have suffered extensive modification for pasture development and cropping, as well as urban development and, more recently, development of rural sub-divisions. These differences are stark when areas of the northern parts of the South Eastern Highlands Bioregion are considered. The districts surrounding Orange and Bathurst were amongst the very earliest of the tablelands country to be opened up for pastoralism and now little of the pre-European grassland remains (R. Rehwinkel, unpublished data).

The floristic and land-use differences between the regions are reflected in the differences in the species lists and the associated significance ratings used for assessment in this method for each region (see the species lists that are part of the spreadsheet tool for each region).

Spreadsheet tools with relevant species lists and draft significance ratings have been developed for other regions in NSW, namely:

- Riverina IBRA region; and
- Brigalow Belt South IBRA region.

Other regions or vegetation types that require the development of spreadsheet tools with species lists and significance ratings include:

- Darling Riverine Plain IBRA region;
- NSW South-western Slopes IBRA region;
- Nandewar IBRA region;
- New England Tablelands IBRA region;
- The Hunter region;
- The NSW North and South Coastal regions;
- *Poa*-dominated sub-alpine grasslands along the ranges of NSW; and
- Grasslands derived from the Cumberland Plains vegetation communities of western Sydney.

The draft species lists in the spreadsheet tools for the above-listed NSW regions require development and careful review by the relevant regional grassy ecosystems experts. This requires production of significance ratings for each species in each regional list, along with the development of lists of other assessable attributes for each region.

## Other grassland values

The Floristic Value Score method presented in this document provides a way to assess natural grasslands and secondary grasslands only on their floristic values. It is important to note that other values exist, including the following:

- a known site for threatened fauna or flora species;
- presence of fauna habitat, as assessed by the vegetation type, and particularly as habitat for threatened species;
- presence of fauna microhabitat attributes, including the presence of rocky outcrops, loose surface rocks, exposed earth banks, standing dead timber, or structural elements provided by certain plant species such as shrubs and tall tussocks. Note that if a secondary grassland site has coarse woody debris and a low cover of remnant trees, along with tree hollows, it may be adequately covered by current NSW *BioMetric* benchmarks for the relevant plant vegetation types and may be assessable by other methods;
- landscape values, such as creek-beds, drainage lines, wetlands, etc., that should be retained for reasons beyond the site's particular grassland values; i.e. because these features are important for catchment control, amenity or other landscape values;
- size of site, with large sites (>50 ha) being particularly important;
- connectivity values, whether the grassland is adjacent to or nearby other grasslands, or to some other vegetation type;
- buffer values, either as a buffer to a higher quality grassland or to a remnant of another vegetation type;
- sampling a rare grassland type; this will be dependent on its regional or sub-regional context; and
- cover of weeds, with sites that have a high cover of perennial weed species generally having a lesser value than those without weeds. Note that the extent of cover of weeds is usually strongly correlated with presence or absence or declining grassland forb species.

The above, and any additional values, may need to be considered in conjunction with this method. Such attributes either need to be assessed first, before the application of the Floristic Value Score method at a site, or in addition to the values that the method identifies.

To aid in assessment of weeds at a site, the exotic species in the plot are scored in a similar way to the native species. The following categories are defined for exotic species:

- X = 'level X' species: these are the high-impact species, such as Phalaris (*Phalaris aquatica*), African Love-grass (*Eragrostis curvula*), the exotic stipoid grasses, Serrated Tussock (*Nassella trichotoma*) and Chilean Needle-grass (*N. neesiana*) and Coolatai Grass (*Hyparrhenia hirta*). They are often, though not in every region, declared noxious weeds, and are the most intractable species, and if occurring over a large proportion of the site, may render the site's value to be low, despite its other inherent values, as they are difficult, time-consuming and costly to remove without also severely impacting on the native species at the site;
- Y = 'level Y' species: these are less significant, though still quite persistent species, mostly either perennial, or biennial, and sometimes woody. They include species such as Cootamundra Wattle (*Acacia baileyana*), Sweet Briar (*Rosa rubiginosa*), St John's Wort (*Hypericum perforatum*) Cat's-ear (*Hypochaeris radicata*) and Goat's-beard (*Tragopogon* spp.). These species can usually be easily removed, even if occurring in high cover over a site, but are generally not as important to control as the 'level X' species; and
- Z = 'level Z' species: these include the common, though low-impact, mostly annual weeds, such as, hair-grasses (*Aira* spp.), Red Bartsia (*Parentucellia latifolia*) or Pelisser's Toadflax (*Linaria pelisseriana*); they generally have little impact on a grassland's value.

By running the presence and cover of exotic species through the same process as is required for deriving a site's native species' FVS, a resultant 'Weed Value Score' (WVS) can be derived. This can be used to assess the management needs of a site and it provides a guide to any recovery strategies that could be applied. Analysis of this component in the scoring method has now been undertaken for the South Eastern Highlands regions (Monaro and non-Monaro), Brigalow Belt South and Riverina region datasets. This method needs to be further developed for all regions.

Additional components can be scored for some 'level X' weeds occurring at high densities, in a similar way that cover of some grass species generates a higher score at high densities under the current scoring system (see 'Additional scoring rules', below). This part of the methodology will require more work, including a consultation process.

Finally, a 'level X' weed species cover value can be added. It is proposed that this cover value only be calculated for the 'level X' species. A proposed method of deriving this value would be by scoring the total cover of the plants in this category using a step-point transect. In undertaking a step-point transect, the values to be collected are as follows:

1. percentage cover of native species – includes all species, whether grasses or forbs, perennial or annual;
2. percentage cover of exotic species – and for these data, the following details also need to be recorded:
   (a) annual vs. perennial species,
   (b) status as a 'level X' species.

When gathering data from a step-point transect, all 'hits' are recorded along regular intervals, say 10 cm, along a 50 m or 100 m transect. This is best done using a tape and a thin straight wire to record the 'hits'. Totalling the 'hits' of each species in group 2b (the 'level X' species), above, and dividing that by the sum of the group 1 and and group 2b species (i.e. the total number of 'hits'), and then multiplying the result by 100 then results in a percentage value for the cover of the 'level X' species. The 'level X' species' percentage can be added to the spreadsheet tool as an additional assessment value. The resultant percentage cover value of the 'level X' weed species may then be used for further analysis of the site's conservation value or condition. For example, it is suggested that should a site have greater than a certain percentage cover of 'level X' species, it may be beyond any meaningful or effective management intervention, regardless of its Floristic Value Score, and thus it may be regarded as having a low conservation value (i.e. a value equivalent to a FVS of below 5). Further work is required to test this part of the assessment method.

Additional values or attributes that occur in the grassland or grassy groundlayer of a woodland or forest may have data collected to provide inputs for assessment of a site. With the exception of the cryptogam cover, these data do not contribute to the site's Floristic Value Score. The following data attributes can be collected along a step-point transect, with the exception of those marked with an asterisk (*). These attributes are consistent with the requirements of the data collection processes under NSW Vegetation Information Standards:

1. Litter (cover %); this may help in determination of biomass build-up (in grassland), or whether a site is in, or surrounded by, woodland or forest.
2. Bare ground (% cover); may help in determining if the site has a history of soil disturbance.
3. Cryptogam (% cover); generally, an increase of cover of mosses, soil algal crusts, and lichens indicate a recovering or mature ecosystem, in improving or good condition (i.e. lacking disturbance history).
4. Rocks (cover %); rocks may indicate presence of habitat, particularly for invertebrates and reptiles. Note, to provide more meaningful data, especially in relation to fauna habitat, data on cover of rocks can be sub-divided into:
   (a) surface (more suitable for reptiles); and
   (b) outcropping.
5. Number of trees with hollows*; an indicator of habitat quality.
6. Woody debris (linear m)*; an indicator of habitat quality.
7. Woody regeneration (number of species)*; may be indicating a trend towards regeneration towards a former woodland or forest condition.
8. Woody regeneration (abundance – count of stems)*; may also be an indication of a return to woodland or forest.

The important value of the presence of cryptogam cover is scored directly onto the spreadsheet tool. This is achieved by adding a score of 0.33 if cryptogams are in a cover range less than 2%; 0.40 if the cover range is between 2 and <10%; or 1.00 if cryptogam cover is greater than 10%. This value is added into the appropriate field in the spreadsheet tool and a calculation is carried out within the spreadsheet tool by adding the cryptogam score value to the FVS.

To ensure conformity with Australian Government processes being developed for a new EPBC listing for 'Natural Temperate Grassland EEC', covering grasslands in the NSW South Eastern Highlands bioregion, additional data on the number of 'indicator species' and non-grass species recorded in each plot are required. Grasslands in this region are considered to meet the EPBC listing criteria and to be in the 'Moderate to High' condition threshold category if they satisfy at least the essential criteria as discussed below and at least one of the following:

- there are at least 8 non-grass native species present in the plot (see note, below),

*or*

- there are at least 2 'indicator species' present in the plot (see note, below).

*or*

- the plot returns a floristic value score (FVS) of at least 5.

Note: non-grass species include forbs and herbs (including lilies, orchids, and members of the genus *Lomandra*) and shrubs. They do not include trees, or sedges and rushes in the families *Cyperaceae* or *Juncaceae*. 'Indicator species' in this phase of the assessment only include 'level A' species.

Grasslands in this region are considered to meet the EPBC listing criteria and to be in the 'High to Very High' condition threshold category if they satisfy at least the essential criteria as discussed below and at least one of the following:

- there are at least 12 non-grass native species present in the plot (see note, above),

*or*

- there are at least 3 'indicator species' present in the plot (see note, above),

*or*

- the plot returns a floristic value score (FVS) of at least 6.5.

The essential criteria for the EPBC listing are that a grassland will satisfy the 'Moderate to High' condition threshold category if one of the following are present:

1. the patch is characterised by at least 50% foliage cover of the ground of *Themeda australis*;
2. the patch is characterised by at least 50% foliage cover of the ground of *Poa labillardierei* and is in a drainage line of associated flats; this condition is applicable in the South Eastern Highlands bioregion; and
3. the patch is characterised by at least 50% foliage cover of the ground of *Carex bichenoviana*, or at least 50 tussocks for every 100 $m^2$.

In the case of the EPBC-listed 'Natural Grasslands of the Murray Valley Plains EEC', amongst other criteria, a certain number of flora species need to be present for the grassland to be considered to belong to this EEC. The species criteria have been built into the spreadsheet tool for the Riverina region. Other Australian Government listed EECs with clearly defined species criteria can be developed for the appropriate regional spreadsheet tools.

## The Floristic Value Scoring Method

It is important to note that this method is applied at the Keith Class vegetation classification level rather than at the vegetation type level. However, it needs to be recognised that there are several relevant vegetation types within the Keith Classes in each region. For example, an analysis of associations found within natural grasslands of the Southern Tablelands has defined eight vegetation types within the Montane Grassland Keith Class (OEH 2011; Armstrong et al. 2013). Thomas et al. (2000), Tindall et al. (2006) and Armstrong et al. (2013) have defined a number of grassy woodland vegetation types within the South Eastern Highlands.

The method presented in this document treats all grassland and the ground-layers of woodland vegetation types of the two regions in the South Eastern Highlands bioregion as a single entity, with no reference to the differences found between the variously identified types. The method has been specifically designed to be broad enough to capture all samples of the different vegetation types that have been identified within the grassy ecosystems of a region. However, several now rare grassland types in some of the regions are special cases that are catered for in this method by application of rules to ensure that high value sites are given an adequate floristic score regardless of whether they have high diversity. This is done by giving higher weightings to their dominant grass species if they reach a certain cover value. Examples in the South Eastern Highlands are those grasslands or secondary grasslands naturally dominated by Kangaroo Grass (*Themeda australis*), the types in which River Tussock (*Poa labillardierei*) naturally occur in drainage lines and associated flats, and a wetland or wetland-associated type in which Curly Sedge (*Carex bichenoviana*) dominates.

Sites with such vegetation types, according to the region, and that are in good condition are particularly rare, but for a number of reasons they often have a low forb diversity. For example, many sites in the South Eastern Highlands IBRA bioregion that are dominated by *T. australis*, especially long-ungrazed examples, and associations dominated by *P. labillardierei* in drainage lines and associated flats have a high cover of native perennial grasses, so sites in which the cover is dominated by the native species of the particular vegetation type have conservation value, regardless of whether a diversity of forbs is present or not. Similar rules, but with different triggering species, are being identified in the other regions. For example, grasslands in the Brigalow Belt South bioregion that are dominated by species including Barbed-wire Grass (*Cymbopogon refractus*), Curly Windmill Grass (*Enteropogon ramosus*) and Queensland Bluegrass (*Dichanthium sericeum*), warrant a higher weighting if they have a high cover of these native grasses, regardless of whether they contain forbs or not.

Figure 1 provides a decision tree to determine whether the grassy vegetation of a site meets criteria as a native grassland and whether the assessment process in this document is appropriate for that site. Figure 2 enables identification of grasslands that have high values regardless of their FVS. The steps outlined in Figures 1 and 2 (next page) will enable the identification of grassland sites for which the FVS needs to be determined. Note that Figure 1 and Figure 2 are specifically designed for use in the South Eastern Highlands IBRA bioregion. Different criteria need to be developed for other regions.

## Data collection and analysis to determine a site's Floristic Value Score (FVS)

This analysis requires a number of steps:

1. Determine the region you are in (see 'Regionalisation', above) and use the appropriate species list, significance ratings and spreadsheet tools, as required.
2. Determine how many plots are required (see 'Stratification', below).
3. Set up the plot(s) and collect the required data; see 'The field method' and 'Field data collection', below.
4. Analyse the data using the appropriate spreadsheet tool; the methodology is outlined below; if desired the FVS can be calculated manually (see Appendix 1).

## How to gather data: stratification, sampling effort and data collection

### *Stratification*

A preliminary inspection of the site should be undertaken to assess the homogeneity of the grassland and condition classes present. Within-site differences may relate to the following:

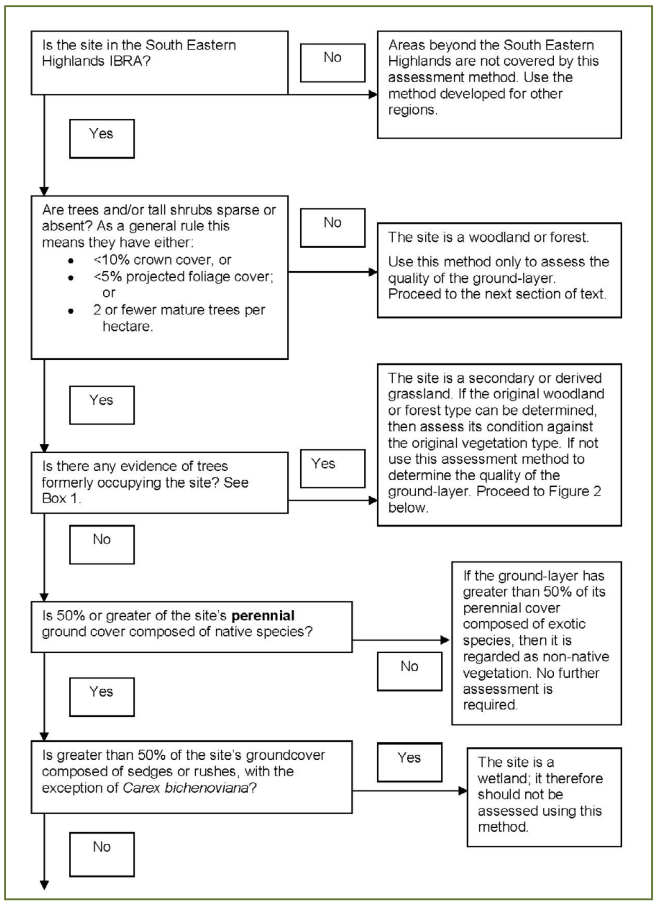
(a) vegetation types (i.e. there may be different grassland types present);

(b) topographical position (e.g. upper slopes may differ from footslopes or flats because of different drainage or fertility patterns);

(c) past or current management effects (e.g. grazing or ploughing history, or stock camps or other patches of disturbance); or

(d) combinations of the above.

Figure 1 (right). Decision tree for assessing a grassland site in the South Eastern Highlands IBRA Bioregion (Monaro and non-Monaro)



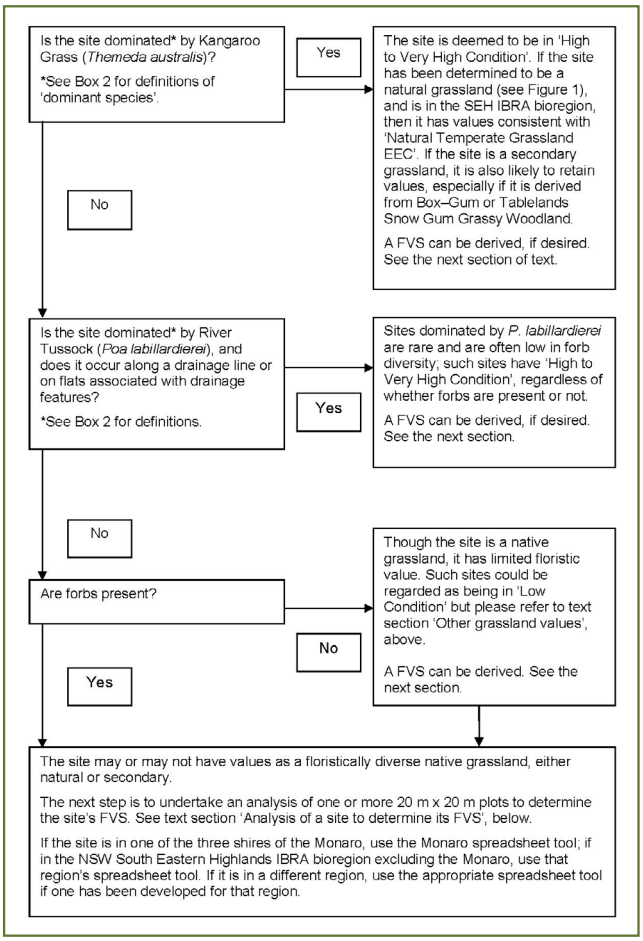




Figure 2 (left). Decision tree for identifying grassland sites in the South Eastern Highlands IBRA Bioregion (Monaro and non-Monaro) that should be regarded as having a high value, regardless of the site's FVS.

**Box 2. Definition of 'dominant species'**

A dominant species is one that makes up a large proportion of community biomass or numbers (see: http://www.blackwellpublishing.com/townsend/)

A map could be produced that defines the boundaries of the different vegetation zones (or stratification units), and brief notes could be made of each unit's attributes, outlining why each is regarded as distinct from others and internally relatively homogenous.

A number of plots will be required in each vegetation zone to calculate the FVS of each unit. The number of plots depends on the size of each vegetation zone. The following levels of survey effort provide a guide to how many plots should be set up:

- 1 plot per vegetation zone of 2 ha or less
- 4 plots per vegetation zone of between 2 and 50 ha, and
- 10 plots per vegetation zone of between 51 and 250 ha.

***The field method***

The predetermined number of 20 m x 20 m plots should be located within each vegetation zone. For linear-shaped units (e.g. road or rail reserves or other narrow sites) the shape of the plot may be varied (e.g. 10 m x 40 m or even 5 m x 80 m), but the area of the plots must remain the same (400 $m^2$ or 0.04 ha). Plots in grasslands along drainage lines may be of the rectangular or linear shape, rather than being square, to ensure that only that vegetation type is sampled.

Plots should be placed away from environmental boundaries such as major soil and slope changes and changes in vegetation type or condition. They should be placed in areas with homogenous representative vegetation. Plots should avoid areas of unrepresentative local disturbance (e.g. roads, vehicle or animal tracks, fence-lines and dam edges).

Particular care needs to be taken to sample from the highest quality areas of each vegetation zone. This can be determined prior to sampling, and then plots can be placed in locations where there are higher than background concentrations of 'level A' and 'level B' species. Familiarity with these species can be gained by referring to the regional species lists.

***Field data collection***

Data should be entered into a field notebook, or onto a datasheet (for an example, see Appendix 2). Alternatively, use the datasheet developed for the NSW Native Vegetation Interim Type Standard at http://www.environment.nsw.gov.au/resources/nativeveg/10060nvinttypestand.pdf. Record all plant species. Other attributes can be collected for a richer data set (see 'Other grassland values', above).

Cover-abundance (C/A) scores for each species need to be collected as per the NSW Native Vegetation Interim Type Standard, but for the purposes of deriving a Floristic Value Score, the cover/abundance data can be converted to the codes as follows:

| C/A Score | Explanation |
|---|---|
| 1 | < 5% cover and solitary (<4 individuals) |
| 2 | < 5% cover and few (4–15 individuals) |
| 3 | < 5% cover and numerous/scattered (>15 individuals) |
| 4 | 5% – <25% cover |
| 5 | 25% – <50% cover |
| 6 | 50% – <75% cover |
| 7 | 75% cover and greater. |

The above codes are equivalent to a modified Braun–Blanquet scale. This is the format currently accepted by the spreadsheet tools.

The location of the centre of each plot could be recorded on the site datasheet, preferably using a GPS, and marked on a map showing the vegetation zones. Each plot should be given a unique plot number.

***Additional scoring rules***

In the South Eastern Highlands regions, where a site is a River Tussock Grassland (i.e. grassland dominated by *Poa labillardierei* and where the site is along a drainage line or on flats associated with drainage features), or it is a site in the South Eastern Highlands Monaro region and is dominated by Kangaroo Grass (*Themeda australis*), these species are regarded as 'indicator species, level A' for the purposes of the determination of a site's FVS, but only if the cover of these species is 25% or greater. Conversely, if the cover of Kangaroo Grass, or of River Tussock, where the grassland site is along a drainage line or on flats associated with drainage features, is less than 25%, River Tussock is regarded as a 'level C' species, and Kangaroo Grass is regarded as a 'level B' species. Where River Tussock occurs in high cover classes in mid- or upper-slope situations, it is not to be regarded as a 'level A' species. In grasslands with correspondingly high cover values of Curly Sedge (*Carex bichenoviana*), where these occur in the South Eastern Highlands region, this species is treated the same as Kangaroo Grass is in the Monaro region.

In the South Eastern Highlands regions, where a site is a River Tussock Grassland (i.e. grassland and has a cover of 75% or greater of *Poa labillardierei* and where the site is along a drainage line or on flats associated with drainage features), or it has a greater than 75% cover of Kangaroo Grass or Curly Sedge, an additional score of 1 is added in a special field in the FVS spreadsheet tool.

Rule sets similar to those in the above two paragraphs are in the process of development, or have been added, for the other NSW regions, as appropriate to those regions.

***Timing of survey***

As a general rule, natural and secondary grasslands should only be assessed using this method when the diversity is likely to be most evident. For most sites in the South Eastern Highlands, this will be during late spring to early summer. This method may be rendered ineffective if the site has been heavily grazed, because grazing animals will have targeted many of the forbs and they may not be readily detectable. Similarly, drought conditions will mask a site's diversity. Conversely, in years of heavy late summer or early autumn rains, it may be possible to assess a site in autumn, although not all species may be evident, particularly the spring-flowering orchids and 'lilies' that tend not to flower in response to summer and autumn rains.

Timing rules are in development, or have been added for the other regions, as appropriate.

## Data analysis to derive a Floristic Value Score for a plot

Appendix 1 of this document shows, by a worked example, how to manually derive a FVS.

Spreadsheet tools to enable rapid analysis have been developed, or are in the process of development, with one spreadsheet tool for each appropriate region or sub-region. The tools include detailed instructions for their use. The following summarises how the spreadsheet tools are to be used.

The worksheet entitled 'Explanation' provides general instructions for use of the tool, including how new species can be added to the tool, if required. The worksheet entitled 'VEGETATION' is the active worksheet into which site and species data (name of species and cover within the plot using a cover/abundance code) are entered. The red cells on this worksheet have detailed instructions; it is important to follow these carefully. Pale blue or grey cells are those into which data are entered. The active cells into which species names (in codes – see below) are to be added are immediately below the row-heading 'Species code' and 'C/A code'.

Special additional scoring boxes have been added as, for example, where cover of *Poa labillardierei, Themeda australis* or *Carex bichenoviana* is greater than 75%, in the spreadsheet tools developed for the South Eastern Highlands. Such additional scoring boxes have been added or can be added, as required for the other NSW regions.

The spreadsheet tool automatically calculates the FVS. Additionally, a Weed Value Score is calculated. The yellow cells display information that the tool calculates, including number of non-grass species and number of indicators, in the case of the tools developed for the South

Eastern Highlands bioregion. For other regions, other indicators may need to be added; for example, in the Riverina spreadsheet tool, the number of indicator species that are required for a grassland to be considered as the EPBC-listed 'Natural Grasslands of the Murray Valley Plains EEC' are displayed.

The third worksheet on the spreadsheet tool, titled 'Sp_score_ref' contains the reference species list and significance ratings for each species for that tool. In the case of the tools developed for the South Eastern Highlands bioregion, it also includes notation for non-grass species and notation for 'level A' species (EPBC indicators for that EEC), and in the case of the Riverina tool, notation for indicator species of the 'Natural Grasslands of the Murray Valley Plains EEC' is included. Note that a different species list is used for each region, and hence, spreadsheet tools need to be tailored specifically for each region.

When entering plot data into the spreadsheet tool, the species list in the 'Sp_score_ref' worksheet should be referred to for the appropriate codes for each species. This code is then entered into the 'VEGETATION' worksheet. Most species will be entered using a so-called '4 + 4' species code (e.g. 'arth mill' is entered for *Arthropodium milleflorum*). For some taxa that are difficult to identify to species level, it is only necessary to enter a genus name, for example 'wahlenbergia' for any *Wahlenbergia* species. In many cases, all species in such a group will have the same significance rating, for example, all *Vittadinia* spp. in the BBS are listed as 'level C', so an unidentified *Vittadinia* sp. is assigned a significance rating of 'level C'. Note, however, that in some genera there is a mixture of easy- and more difficult-to-identify taxa as well as native and exotic species. For example, in the genus *Rytidosperma*, where a taxon is only identified to genus, entering 'rytidosperma' will returns an asterisk (*), in this case because there are species with differing significance ratings. In cases such as these it is important to correctly identify to species level. In cases where identification to species is impossible and there is a variety of significance ratings within the genus, in order that a score is returned for that species, it may be useful to manually enter a significance rating into the 'Sp_score_ref' worksheet for that assessment, giving that taxon entry the lower significance rating (i.e. 'level C' rather than 'level B'), with an accompanying note to record that this has been done. In another type of example, *Geranium* spp. such as *G. retrorsum* and *G. solanderi* are difficult to identify without appropriate material and in these cases an entry using the code 'gera spn' can be used if there is certainty that the species is either not an exotic species, or is not *Geranium antrorsum*, which is more easily identified in the field and which incidentally has a different significance rating to the other native species. If the species is clearly an exotic one, the code 'gera spe' can be entered.

Note the special cases in the South Eastern Highlands bioregion, where *Themeda australis*, *Poa labillardierei* or *Carex bichenoviana* occur and different scores are returned according to the cover values of the species within the plot and, in the case of *P. labillardiere*i, the topographic location of the site. Values are added according to these codes:

| | |
|---|---|
| them aust (cover of less than 25%) | If cover less than 25% (C/A score of 4 or lower) |
| them aust (cover of 25% or greater) | If cover of 25% or greater (C/A score of 5 or higher) |
| poa labi (cover of less than 25%) | If cover of less than 25% (C/A score of 4 or lower), and the site is in drainage line or on a flat associated with a drainage line |
| poa labi (cover of 25% or greater) | If cover of 25% or greater (C/A score of 5 or higher), and the site is in drainage line or on a flat associated with a drainage line |

In the South Eastern Highlands *Carex bichenoviana* is coded in the same way as *Themeda australis*. Species that warrant such treatment in other regions have similar codes assigned (in the case of Brigalow Belt South and Riverina IBRAs) and similar codes will need to be applied in other regions. Entering these species data is best done by copying the appropriate codes from the 'Sp_score_ref' worksheet and pasting them into the 'VEGETATION' worksheet.

Upon completion of the analysis, the 'VEGETATION' worksheet can be saved or printed out for future reference.

If grassland data is accompanied by reliable location details and species identifications, as well as the additional attribute data as suggested in 'Other grassland values', above, it would be appropriate to input such data to NSW BioNet, the website for the Atlas of NSW Wildlife (http://bionet.nsw.gov.au/). A minimal amount of additional site data could be collected to make it compatible with the requirements of BioNet.

### Data analysis to derive a Floristic Value Score for a site

The floristic value score (FVS) reflects the value of each of the sampled plots. It is intended that this sampling should represent the FVS of the site as well. For example, if a number of plots have been taken from a vegetation zone, and they all fall within a similar range of FVSs (e.g. all above 6.50, or all within the range 5.00 – 6.49), then an average FVS can be calculated for that unit. If, however, a number of plots reveal a range of values between say 0 and 10.00 across a site, this would indicate a potential problem with the stratification. For example, if out of a sample of 10 plots, three have a FVS of between 0 and 4.99 (i.e. low conservation value), three plots have values between 5.00 and 6.49 (moderate conservation value), and the remainder have values greater than 6.50 (high value), this would suggest the stratification needs to be revised. Under such circumstances the unit boundaries (vegetation zones) should be redrawn to encompass the three condition classes that have been identified by the plot analysis and calculation of the FVS. On the other hand, if, for example, a unit of 10 plots was analysed, and nine had a high FVS (i.e. significantly greater than 6.50) and one plot had a particularly low value, the low value plot may just represent a very small area of low diversity within a larger area of high quality grassland. It would be valid to calculate an average FVS for that site by either including that 'outlier' plot, or to exclude that plot if the area in low condition was too small to warrant creating an additional zone to be assessed separately. Clearly, some judgement will be required when determining FVSs within any assessment site, particularly for sites that contain a complex mosaic of vegetation condition.

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Finally, I express my gratitude to David Wong for painstakingly developing the first version of the spreadsheet tool.

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Grassland with a high floristic value score (FVS), at Gidleigh Lane Travelling Stock Reserve, Bungendore, NSW. Photo: Rainer Rehwinkel.

## Appendix 1. Manual calculation of the Floristic Value Score

Each species recorded in a plot contributes a value to the overall Floristic Value Score (FVS) for that plot. Calculation of the score can easily be done manually. Each of the species in a region's list is assigned a significance rating and there is a value attributed to each significance rating according to how frequently or rarely the species occurs in each plot.

Table 1 shows the values for each significance rating, according to its abundance in the plot. The example in Table 2 demonstrates the calculation that manually derives a site's FVS, using the information in Table 1. Species data (column 1) are accompanied by the species' Braun–Blanquet Score (Column 2) and the species' significance rating in Column 3. Significance ratings for each species are found in the appropriate region's spreadsheet tool. Column 4 contains the relevant value component, according to the species' abundance in the plot, as shown in Table 1. Totalling the values in Column 4 at the base of the table produces the plot's FVS.

Appendix 2 is a datasheet suitable for field data collection and calculation of the FVS for a plot.

**Table 1. The weighted values (a proportion of the plot's total FVS) assigned to each species according to its significance rating and abundance in a plot**

| Significance rating | C/A score of 1 | C/A score of 2 | C/A score of 3 to 7 |
|---|---|---|---|
| **Level C species** | 0.10 | 0.12 | 0.30 |
| **Level B species** | 0.33 | 0.40 | 1.00 |
| **Level A species** | 1.11 | 1.33 | 3.33 |

**Table 2. Example of raw data and calculation of a FVS (with this example showing the Monaro region's scoring)**

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Species name** | **Cover / abundance (C/A) score** | **Species' significance rating** | **Floristic value score component (see Table 1)** |
| *Themeda australis* | 7 | A | 3.33 |
| *Rytidosperma sp.* | 4 | C | 0.30 |
| *Austrostipa bigeniculata* | 4 | C | 0.30 |
| *Austrostipa scabra* | 4 | C | 0.30 |
| *Chrysocephalum apiculatum* | 3 | A | 3.33 |
| *Microlaena stipoides* | 3 | C | 0.30 |
| *Leptorhynchos squamatus* | 3 | A | 3.33 |
| *Rutidosis leiolepis* | 2 | A | 1.33 |
| *Asperula conferta* | 2 | C | 0.12 |
| *Goodenia pinnatifida* | 1 | A | 1.11 |
| *Lissanthe strigosa* | 1 | A | 1.11 |
| *Cryptandra amara* | 1 | A | 1.11 |
| *Calocephalus citreus* | 1 | A | 1.11 |
| *Cheilanthes sp.* | 1 | A | 1.11 |
| *Convolvulus angustissimus* | 1 | C | 0.10 |
| *Dianella longifolia* | 1 | A | 1.11 |
| *Euchiton sp.* | 1 | C | 0.10 |
| *Calotis glandulosa* | 1 | A | 1.11 |
| *Leucopogon fraseri* | 1 | A | 1.11 |
| *Swainsona sericea* | 1 | A | 1.11 |
| *Pimelea curviflora* | 1 | A | 1.11 |
| *Rhodanthe anthemoides* | 1 | A | 1.11 |
| *Bulbine bulbosa* | 1 | A | 1.11 |
| | | **This plot's FVS:** | **26.16** |

## Appendix 2. Field data and calculation sheet to determine FVS of grassland plot data

| **Date:** | **Easting:** | **Northing:** | **Observer:** |
|---|---|---|---|
| **Species name** | **Cover / abundance score** | **Species' significance rating** | **Floristic value score component** |
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| | | **This plot's FVS:** | |