THE DEVELOPMENT OF A RESTORATION RATING SYSTEM FOR THE CONSISTENT EVALUATION OF RESTORATION PROJECTS.

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Abstract

I*n many developments, it is claimed that a landscaped site has been restored to a natural state or that only indigenous plants have been used during implementation. There is always tacitly implied that some kind of ecosystem was created. However, there is no industry standard against which it can be assessed. A rating system for use in landscape restoration projects is therefore proposed based on vegetation composition and structure. The evaluation system will also include process as one of the parameters to assess. To determine composition, it is proposed that the Vegetation Units described by Mucina and Rutherford is used (Mucina and Rutherford, 2006). Structure could ultimately be linked to ecology and that finally, the rating system be process driven and based on the principles followed in the classification of water resources as described in the National Water Act (Act 36 of 1998).*

Such a rating system could provide a benchmark against which landscape restoration can be measured but will also provide a framework for the design of rehabilitation projects. The intention is that the landscape restoration system develops into an industry standard for all developments where it is applicable. For instance, this rating system can be implemented by developers, landscape architects as well as local authorities or any site where landscape restoration is required.

Keywords: Restoration, vegetation unit, bioregion, restoration rating system, structure, composition, process, classification.

INTRODUCTION

Our society relies heavily on rating systems to indicate to what level a goal has been achieved. This even applies to the training of Landscape Architects. To some degree, it is also reflected in the annual ILASA merit rewards.

So why a rating system for landscape restoration projects?

During the last decade, it has almost become the norm for new housing estates to only allow indigenous plants to be used for landscaping and gardening. The challenge is that “indigenous” in this context is not clearly defined. There is also no system in place that can be used to assess the success of this approach. Without a means of assessment, it remains a marketing ploy and quite often not a very successful one at that. Eventually many of the developers deviate from the initial requirement simply because there is no proper guideline that defines “indigenous”.

The same applies for degraded areas such as wetlands and riverine habitats, to name a few. However, the same principles can also be applied to other industrial sites and parks.

The benefit of a rating system is that it recognizes that a restored ecosystem is much more than just plants and much less of a liability from a maintenance perspective. In South Africa where water is a scarce resource and with climate change in mind, it can only be beneficial if landscape restoration projects are less dependent on external inputs for maintenance and at the same time add value to the development.

EXISTING RATING SYSTEMS

No rating system pertaining to this proposal could be identified in the literature that was scrutinized. There are many guidelines regarding the best way to restore a disturbed site (Allen, Brown, and Allen, 2001, The SITES v2 Rating System, 2014 and Perow and Davy, 2002) but none on the topic of rating.

Other industries do have rating systems, such as the building industry and that will be touched upon below.

The building industry

In many countries, a rating system is already in place for the building industry. The focus here is on good building practices, incorporating energy-saving technologies. For instance, the Australian Green Star rating system is summarised as follows (The Green Building Council of Australia n.d.):

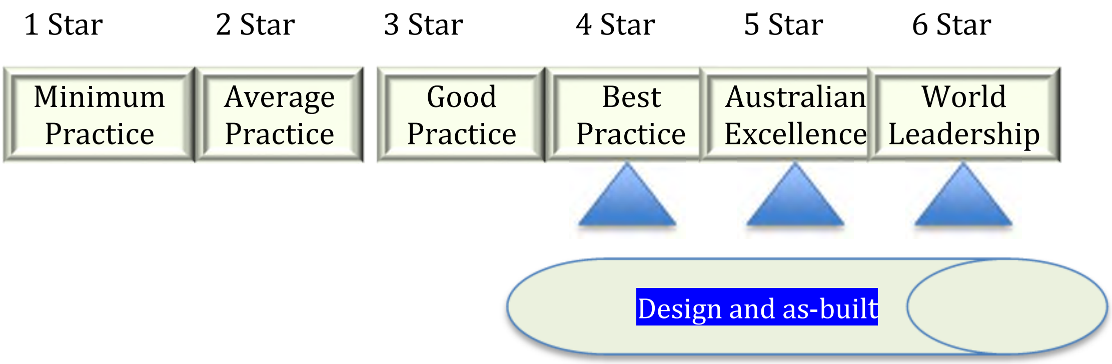


Figure 1. *The Green Star Rating System as implemented in Australia* (*The Green Building Council of Australia n.d.)*

The South African Green Building Industry has also developed a similar rating system for South Africa. The aim is on best building practices and energy saving to name only two aspects. However, landscape restoration *per se* is not part of the extensive rating tools that have been developed in South Africa (Green Building Council of South Africa. n.d.). It is briefly mentioned in the following categories listed in Tables 1 and 2:

Table 1. *Land Use and Ecology Category.(* Green Building Council of South Africa. n. d.)

Land Use and Ecology Category		
EB-Eco-1	**Groundskeeping Practices**	To encourage environmentally sensitive landscape, hard surfaces and building exterior maintenance practices that reduce the environmental impact and improve ecological value.

Table 2. *Innovation Category. (*Green Building Council of South Africa. n. d.)

Innovation Category		
EB-Inn-1	**Innovative Strategies & Technologies**	To encourage and recognise pioneering initiatives, processes or strategies in sustainable building management and operations.
EB-Inn-2	**Exceeding Green Star SA Benchmarks**	To encourage and recognise projects that achieve environmental benefits in excess of the current Green Star SA benchmarks.
EB-Inn-3	**Environmental Initiatives**	To encourage and recognise sustainable building initiatives, processes or strategies that are currently outside of the scope of this Green Star SA rating tool but which have a substantial or significant environmental benefit.

SITES™

The University of Texas at Austin in the US developed a document called The SITES v2 Rating System (*SITES v2 Rating System For Sustainable Land Design and Development, 2014)* that is aimed at sustainable land design and development. Although it does not propose a rating system, many of the issues addressed in the document are relevant to this discussion.

To quote from the above document: "T*he Sustainable Sites Initiative™ (SITES™) is a program based on the understanding that land is a crucial component of the built environment and can be planned, designed, developed, and maintained to avoid, mitigate, and even reverse these detrimental impacts. Sustainable landscapes create ecologically resilient communities better able to withstand and recover from episodic floods, droughts, wildfires, and other catastrophic events. They benefit the environment, property owners, and local and regional communities and economies.*"(page iv).

Other rating systems in South Africa.

Other possible rating systems were also investigated where the emphasis is more on ecology rather than "brick and mortar". One that followed the principles advocated in this presentation was the Classification System for water resources (Dollar, Nicolson, Brown, Turpie, Joubert, Turton., Grobler, Pienaar, Ewart-Smith and Manyaka. 2010) as defined in the National Water Act of South Africa (Act No. 36, 1998) (NWA).

With the introduction of the NWA in 1998, water became a public good. Water use was now subjected to a water use license.

In order to determine the amount of water that can be allocated from a resource through water use licenses without detrimentally affecting the sustainability of the water resource, the NWA makes provision for the concept of the Reserve; water allocated to the Reserve must ensure that sufficient water remains in the resource to allow the long-term use of the resource.

However, the NWA does not stipulate that the resource should be in a pristine condition. The Reserve can refer to different levels of protection, depending on the use of the resource.

To quantify different levels of Reserve protection, the concept of Classification was introduced. The ~~C~~lassification of a resource will determine the requirements that must be met for that particular level of Reserve protection.

The Classification categories are listed in Table 3:

Table3. *Resource classification based on the NWA (Dollar et. al. 2010.*)

Class	Description
A	Reference condition. Unmodified, natural.
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	Critically modified: An almost complete loss of natural habitat, biota and ecosystem functioning. In the worst cases, the changes are irreversible.

In all cases, the natural habitat is the reference condition. The presence and diversity of the biota is the indicator. For example, to maintain a Class A, virtually all the water in the resource will have to be allocated to the Reserve and none for use. This applies to most of the mountainous catchments where our rivers originate. At the other extreme, a channeled river, for instance the Apies River in Pretoria, would be classified as class F.

From the Classification System an amount of water is reserved in the resource (spatially and temporally) to ensure that the resource maintains its class while being utilised. Many indicators have been developed to quantify the class of a resource and most are based on ecology.

This approach is getting closer to the aims of a rating system for landscape restoration projects.

The wetland classification/assessment approach uses something similar that is based on the Classification as listed in Table 3. They make use of an Ecological Classification tool, which includes a process known as the Present Ecological State (PES). The latter is used to describe the current state of a wetland based on an assessment against various criteria. The wetland is then given a rating from A (near natural) to F (critically modified). This is largely an expression of the health of the river or wetland (Furniss, 2016).

PROPOSED LANDSCAPE RESTORATION RATING SYSTEM

Before this concept can be taken further, some terminology needs to be highlighted:

Rehabilitation can be viewed as the process of stabilizing soil conditions on a site by reshaping the site and planting up without taking ecology formally into account. A limited number of plants are normally used and aesthetics is usually important. It also entails erosion control after stabilization has been achieved. To borrow from a well-known contractor it is the process of "*healing the scars of progress.*" This is quite often the case during the closure of mines or on road cuttings. On many sites, this is the only option or requirement stipulated.

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society for Ecological Restoration, n.d.). It is an intentional activity that initiates or accelerates ecosystem recovery with respect to its health (functional processes), integrity (species composition and community structure), and sustainability (resistance to disturbance and resilience).

For the purposes of this discussion, ecological restoration is defined as a practical management strategy that restores ecological processes to maintain ecosystem composition, structure and process (Apfelbaum, S.I. and Chapman, K.A., n.d.) as demonstrated in Figures 2 to 5.

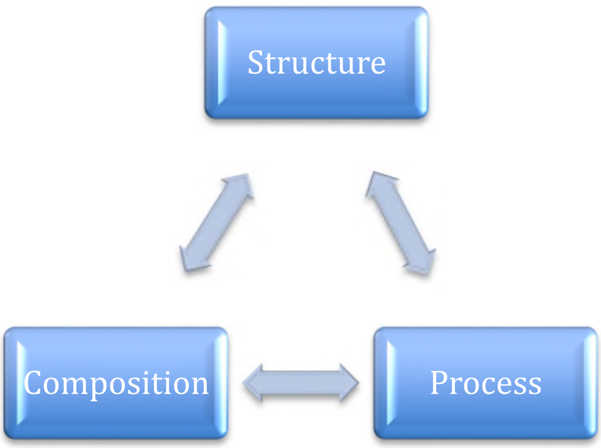


Figure 2*. The 3 elements to consider during a restoration activity (by the authors).*

These three elements, namely structure, composition and process will now be discussed in more detail.

Firstly, the **structure** must be in place (Figure 3). Structure involves the variety of habitat elements or ecosystems and their patterns as well as topography, soil and aspect of a site.

That is achieved through reshaping the site (where applicable) to ensure all the elements are in place where different habitats can potentially be established. Structure should also ensure site stability e.g. prevention of soil erosion.

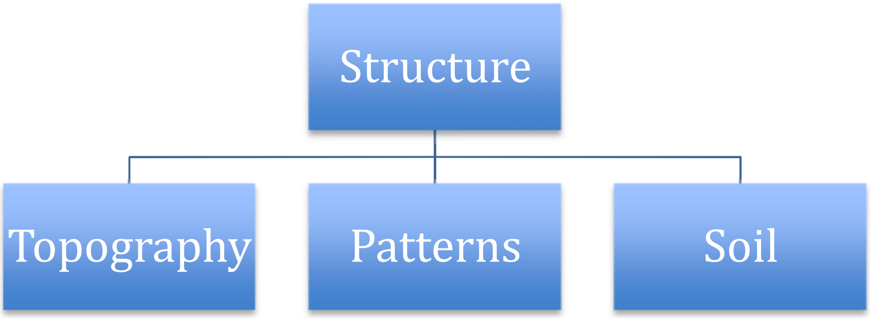


Figure 3. *Components of structure (by the authors).*

Secondly, the plant communities must be established through the correct **composition** (Figure 4). That involves plant diversity and abundance of species in the ecosystem, and the different types of communities present. This entails that a particular site created during the structural process are now vegetated in such a way that it can develop into an ecosystem, e.g. a rock outcrop or a grassland, etc. For example, trees would be established first since they provide the framework that can be utilized by other species (shade, frost protection). This should be followed by planting pioneer species that is easy to establish. Again, the aim is two-fold: to cover the area as quickly as possible to prevent erosion or compaction and to provide habitat for climax species to develop.

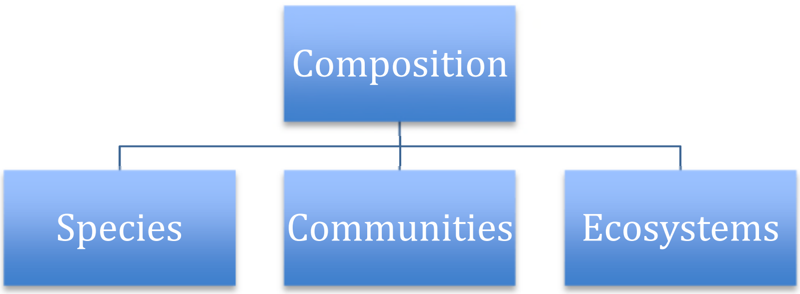


Figure 4. *Components of composition (by the authors).*

If the structure and composition have been addressed adequately, the system should start to function ecologically and various **processes** will be activated (Figure 5). This could involve nesting sites for birds, pollination and seed dispersal, water infiltration, regeneration of plant species and accumulation of debris. The ecosystem will be in a continuous state of flux that emanates from the interaction of the different elements and should happen with the minimum external inputs.

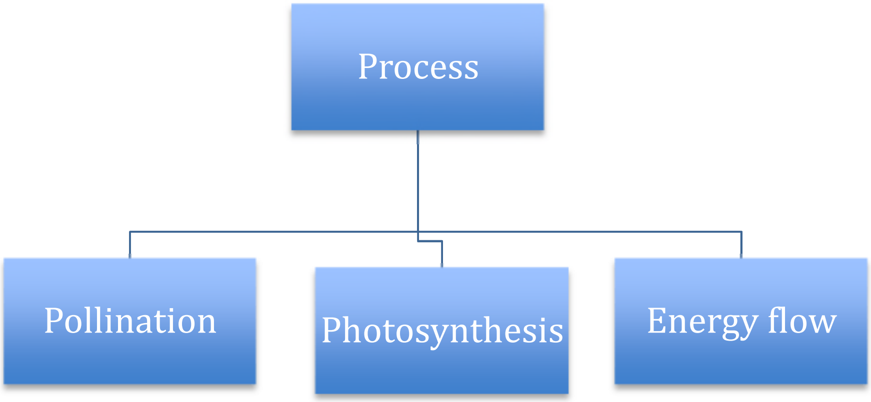


Figure 5. *Components of process (by the authors).*

In summary, rehabilitation stabilizes a site but restoration activates ecological processes that ensure the sustainability of the site.

The restored site could emulate a known existing ecosystem or it could be a combination of various known ecosystems. What is important is that the created ecosystem should function as anticipated.

To assess this ecosystem, it is proposed to develop a rating system that could quantify the level of restoration that has been achieved.

Development of a rating system.

A consistent rating system should address the three components that will ensure a stable and functioning ecosystem, namely structure, composition and process; although the three are intimately linked, they will be discussed separately.

It is crucial that the landscape designer must address the components of composition adequately and holistically to ensure that the concomitant biodiversity will underpin process and resilience on the site.

Rating system based on structure.

Structure refers to components of the physical state of the site and is the first to be addressed during the planning phase of the site.

In structure, the following must be addressed:

- Soil properties i.e. structure, texture, chemical composition, organic content, amelioration
- Soil stability i.e. erosion control
- Habitat creation i.e. nesting sites for birds, shelter amongst rocks for small mammals where they can hide and breed.
- Habitat connectivity i.e. différent rock outcrops be connected in such a way that inhabitants can move around without feeling threatened.
- Habitat diversity i.e. rock outcrops, tall grass, shrubs and trees as well as proper mulch.
- Topography i.e. stormwater management.

Structure must allow all plants selected under composition to be accommodated on the site.

Rating of structure can be based on the number and diversity of plants that can be accommodated and the number and diversity of habitats created. The ultimate rating will only be fully evaluated once composition has been introduced and the ecological functioning of the site can be assessed. However, it would be more meaningful to base the rating on ecology after structure and composition have been addressed.

Rating system based on composition.

For a system to be ecologically and structurally sound, the obvious choice for composition would be to look at local flora. However, it is conceded that the environment that needs restoration may contain constructed habitats that is not present in the immediate natural environment and that the concept of using only local plants may not be entirely feasible. It is, however, important to retain local genetics wherever possible.

It is proposed that the Vegetation Units as defined by Mucina and Rutherford (2006) be used as the default framework for defining a rating system during the planning phase in terms of **composition**. The plants listed for each Vegetation Unit is certainly not exhaustive, but currently it is the only national dataset on plant occurrence within Vegetation Units.

Mucina and Rutherford (2006) consider a location that harbours 75% of possible species for a particular Vegetation Unit as pristine. This approach was followed when they assessed the extent of pristine areas within a particular Vegetation Unit. This is probably based on the fact that a particular Vegetation Unit may have smaller sub-units where some of these plants may occur. An example is the presence of a riverine habitat within a broader Grassland Unit.

For the purpose of a rating system, it is proposed that a five-star rating be defined as an area that harbours 75% of the 75% of all listed species. This figure could be rounded to 60% of the species listed by Mucina and Rutherford. (Pristine refers at least to the entire species listed by Mucina and Rutherford for a particular Vegetation Unit).

The five star rating percentages was selected as examples and could have different values for different habitats.

In Table 4, a rating system based only on composition is proposed, based on the discussion above:

Table 4. *Proposed five star rating system based on composition.*

Rating	% of Pristine
*****	60
****	45
***	30
**	20
*	10

A challenge is that many of these species may not be commercially available when planning and implementing a landscape restoration project.

If that is the case, the species that occur in the Bioregion as described by Mucina and Rutherford (2006) can be considered or species from published documents pertaining to that site or environment. For example, a regional wildflower guide or an Environmental Impact Assessment Report (EIA) can also be used to identify relevant species.

Another source is SANBI (http://newposa.sanbi.org/) where plant lists can be downloaded on a quarter degree basis. SANBI is currently busy with an upgrade of the site and the reference supplied may change. This site has the potential to become the reference site for plant species lists. Currently the data cannot be downloaded per Vegetation Unit.

Cowling, Richardson and Pierce (1997) provide a very holistic view regarding the vegetation of South Africa. As already mentioned, other sources based on regional vegetation than Mucina and Rutherford can (and should) be consulted when available.

Case studies.

The following case studies focus only on the grasses (as an example) and will illustrate the practical application of the rating system based on composition. For example, note the difference in species quantities as obtained from the Vegetation Unit or the Bioregion as described by Mucina and Rutherford (2006) or from Van Oudtshoorn (2014).

Carletonville Dolomite Grasslands

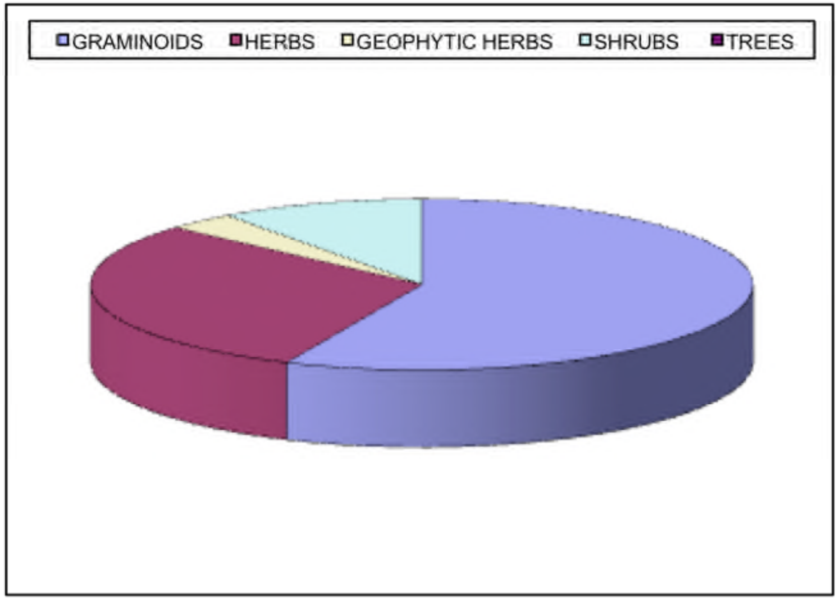
Figure 6*. Chert outcrop in the Carltonville Dolomite Grassland Vegetation Unit. (by the author).*

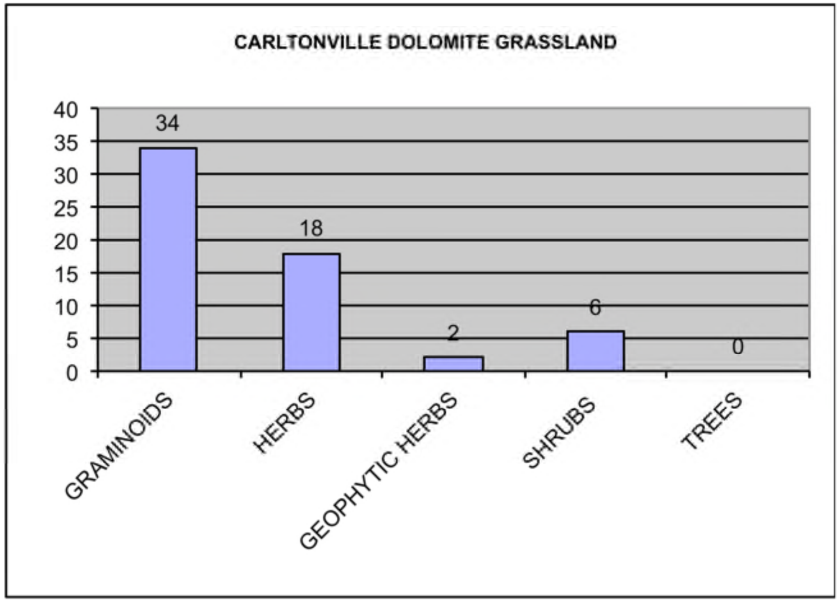
In the Vegetation Unit, "Carltonville Dolomite Grasslands", the species listed by Mucina and Rutherford were counted and grouped as indicated in Table 5. In this instance, 34 grasses were identified. This constitutes 57% of all the species.

For a site that is restored to a five-star rating, 60% of 34 grass species must be planted, i.e. 20 grass species (the other plant species that occur in this Vegetation Unit-are not considered for this case study, mainly to simplify the discussion). If these grasses are not available, the Dry Highveld Grassland Bioregion of which the Carletonville Dolomite Grassland is a subset, can be consulted where 47 species are recorded. If species listed in Grasses of South Africa (Van Oudtshoorn, 2014) are added, the number of grass species rises to 74. This case study illustrates that enough data is available to make a meaningful selection. In this illustration, no importance was attached to particular grass species while in practice, the grasses may have to be rated in terms of ecological importance.

Table 5. *Graphical presentation of plant composition in the Carltonville Dolomite Grassland Vegetation Unit (by the authors).*

VEGETATION UNIT	GRAMINOIDS	HERBS	GEOPHYTIC HERBS	SHRUBS	TREES	TOTAL
CARLTONVILLE DOLOMITE GRASSLAND	34	18	2	6	0	**60**
PERCENTAGE	**57%**	**30%**	**3%**	**10%**	**0%**	**100%**
DRY HIGHVELD GRASSLAND (DHG)	47					
DHG plus Van Oudtshoorn (2014)	71					





Central Sandy Bushveld.

Figure 8. *Typical Central Sandy Bushveld vegetation (by the author).*

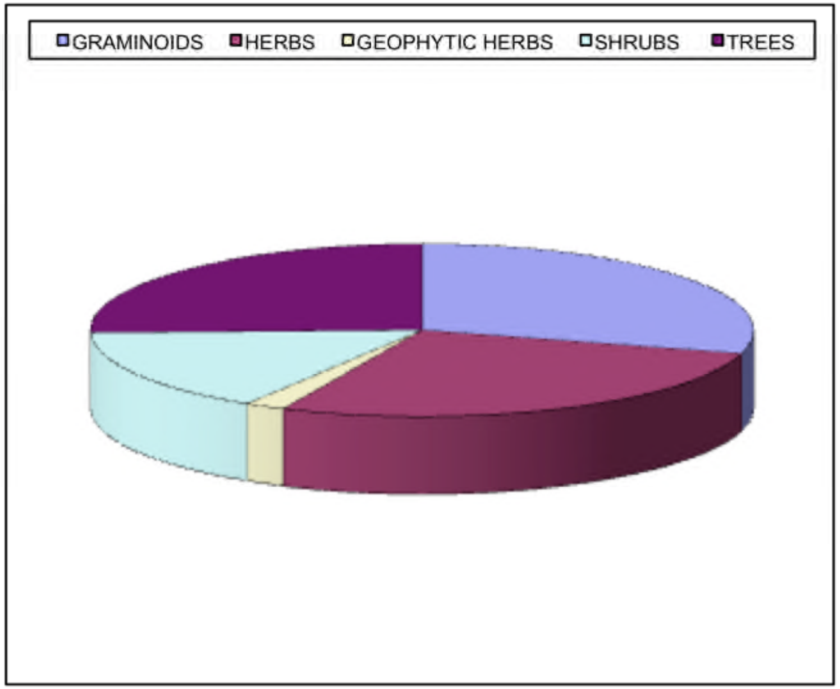
In the Central Sandy Bushveld, the vegetation composition is completely different from the Carltonville Dolomite Grassland as can be seen from Table 6.

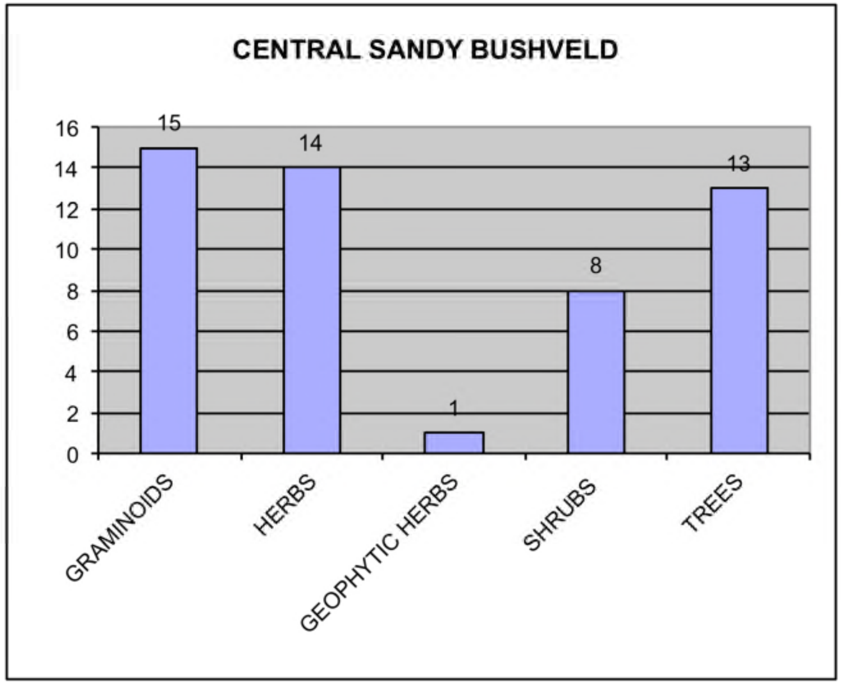
Only 15 grass species are listed for this Vegetation Unit. The number of grass species required would be 60% of 15, i.e. nine species.

Again, note the increase in grass species if the Bioregion is taken into account or if publications other than Mucina and Rutherford (2006) are consulted.

Table 6. *Graphical presentation of plant composition in the Central Sandy Bushveld Vegetation Unit* (by the author).

VEGETATION UNIT	GRAMINOIDS	HERBS	GEOPHYTIC HERBS	SHRUBS	TREES	TOTAL
CENTRAL SANDY BUSHVELD	15	14	1	8	13	51
PERCENTAGE	23%	17%	5%	23%	32%	100%
CENTRAL BUSHVELD (CB)	34					
CB plus Van Oudtshoorn (2014)	83					





The publication by Mucina and Rutherford (2006) provides a dataset for the whole country and by following this approach, all practitioners could use their datasets per Vegetation Unit as a baseline. As already mentioned, other sources can (and should) be consulted when available.

Rating system based on process.

In establishing a rating system based on process, the following must be considered:

- Ecological functioning i.e. seed production, habitat for fauna, debris accumulation.
- Self generation i.e. to what extent will vegetation maintains itself.
- Resilience.
- Natural progression towards a climax state i.e. to what extent will the composition progress naturally.

Although the factors that could impact on the individual components considered for the rating system, it must be pointed out that the rating system proposed should be based on all three components.

Rating system based on Structure, Composition and Process.

The three elements of the rating system can only be rated *post facto* and a rating system should address all three aspects in a holistic way.

It is proposed that a rating system for landscape restoration projects rather be approached from an ecological perspective modeled on Classification of Water Resources as defined in the National Water Act (1998). It is assumed that plant composition and diversity of the site comply with the guidelines as set out previously. A rating system for landscape restoration projects that is based on all three components is proposed in Table 7.

Table 7*. Proposed rating system for landscape restoration projects*.

Rating	Description
*****	Site has been restored to the original condition and functionality. Species composition reflects 60% of the species in the pristine landscape.
****	Site has been restored largely to a natural system with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. Species composition reflects 45% of the species in the pristine landscape.
***	The site has been moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged. Species composition reflects 30% of the species in the pristine landscape.
**	The site has been largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. Species composition reflects 20% of the species in the pristine landscape.
*	The site has been modified to such an extent that the loss of natural habitat, biota and basic ecosystem functions is extensive. Species

	composition reflects 10% of the species in the pristine landscape.

The proposed rating system is in line with the attributes of a restored ecosystem that are listed by the Society for Ecological Restoration (n.d.) The rating system based on ecological outputs rather than "brick and mortar" outputs of the building industry does not imply that the two rating systems are mutually exclusive; there could be significant interaction between the two rating systems, depending on the site. For example, plants can be utilised to cool a building, or filtering grey- and runoff water in ecosystem maintenance, etc.

The evaluation of the restored site in terms of its success and implied rating is a complex process and will require the inputs of other specialists as well. Ecological indicators can be a very cost effective way of achieving this. However, the following is envisaged in terms of the impact of rating category on the relevant site:

Table 8*. Broad description of the rating system*

Rating	Broad description
*****	RESTORATION
****	RESTORATION
***	REHABILITATION
**	REHABILITATION
*	SOIL STABILISATION

Issues that have not been addressed are natural succession and what potential role that can play on a site. A very detailed management plan will also be required. If Grasslands, for example, are not managed properly they could easily revert to Savannah with a significant loss in species diversity.

The requirements of inhabitants may also differ from what the immediate Vegetation Unit can offer. A case in point is the paucity of tree species in the Grassland Biome.

In conclusion

It must be borne in mind that the whole aim of this rating system is to quantify the level of landscape restoration that was achieved on a particular site as per specification and to set an industry standard against which the level of landscape restoration can be measured.

The proposed rating system as discussed in this presentation, presents the views of the authors based on many years of experience in their respective fields. A rating system can add great value to projects by quantifying the goals in an objective way. It can also foster awareness amongst the inhabitants about the importance of sustainable living since the restored site is a living proof of what can be achieved.

However, this concept should be expanded upon by other professionals, notably landscape architects and ecologists, to ensure that it is scientifically sound and implementable.

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