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High Conservation Value in the Rangelands

Mark Stafford Smith
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A report prepared for the Australian Government Department of the Environment and Heritage by the Desert Knowledge Cooperative Research Centre

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Workshop, Adelaide, 22–23 November 2005

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Project report
for the Department of the Environment and Heritage

This document provides a short Final Report for Desert Knowledge CRC Project *Criteria for Defining Areas of High Conservation Value in the Rangelands*, a small project contracted by the Department of the Environment and Heritage (DEH) in late 2005 in the form of a workshop (see Appendix). The objective of the workshop was to draw on key ecological, management and policy expertise to define a state-of-the-art rationale for the mapping of high conservation value (HCV) areas in the rangelands, and, if necessary, to develop the approach required to test and implement this mapping.

Workshop rationale

For a number of years there have been concerns in various agencies that approaches to identifying areas of high conservation value used for other regions of Australia may not provide the best outcomes in the rangelands. In response to these concerns, the Australian Government DEH has sought to explore alternative approaches and this workshop was intended to bring together the thinking and expertise around the subject. Amongst other matters, a better basis for defining areas of high conservation value will assist priority-setting for public investment at a variety of scales, including both traditional activities such as reserve acquisition, as well as more contemporary issues such as regional plan accreditation, incentives and off-reserve conservation actions.

Key findings

The key points from the workshop were:

1. We conclude that a process for determining HCV areas cannot currently be operationalised fully in the same way in rangelands as in fragmented landscapes, because of some key distinguishing features of rangelands in practice (Box 1).
2. There are two classes of HCV areas in rangelands – (i) those that can be conserved by action in a specific locality or focal area, such as a national park or other off-reserve area, and (ii) those that are supported by maintaining certain diffuse ecosystem processes across large areas – such as genetic flow across landscapes, the integrity of water redistribution (potentially at local scale but with regional implications) and the spatio-temporal dynamics of disturbance regimes at large scales – which drive the maintenance of genetic diversity (α, β and γ) in semi-natural landscapes (see Box 2).
3. The same two classes probably apply in all land types, but in fragmented landscapes the importance of focal areas for conservation greatly outweighs the importance of diffuse processes (of course, diffuse processes remain important for production in fragmented landscapes). The significance of the two classes of HCV areas is relatively more even in rangelands.

4. We conclude that priority-setting for the first class – focal areas – can be handled in rangelands (as elsewhere) by the current tools of Systematic Conservation Planning (SCP) as applied under a conventional reserve design paradigm. However, the application of this approach in rangelands using tools such as Marxan or C-Plus may be constrained by issues to do with data types, data resolution and data availability, as identified at the workshop (Table 1).
5. By contrast, the second class – diffuse processes (Table 2) – requires an approach which is paradigmatically different from that of conventional reserve design techniques. We began outlining the features of this approach which, in practice in Australia, would be based around IBRAs[1] (or preferably sub-IBRAs[2]). It would take the form of (see Fig. 1):
   (a) identifying any differential intrinsic values represented by each IBRA in a pristine condition
   (b) identifying any differential values represented by each IBRA in their current condition
   (c) identifying what management interventions might be appropriate to maintaining the diffuse processes in that IBRA (and their costs)
   (d) identifying the degree of benefit to be achieved by making those management interventions.
6. Whilst we thought there are strong conceptual reasons to imagine that the intrinsic pristine differences between IBRAs exist (ie. step a)[3] , there is limited evidence for this at present, so we suggest initially valuing all IBRAs equally in terms of their pristine intrinsic value.[4] However, this assumption should be critically re-appraised in the future.
7. The current condition values of IBRAs (step b) would be assessed in terms of historical damage, both in terms of degree and, as importantly, longevity. Longevity of impact is important: although some processes that create local genetic diversity (Box 2) might be re-instated quite easily, if they have been absent for long enough, the diversity has been lost (as in many fragmented landscapes) and will not be re-instated until genetic drift is re-established, probably over centuries. In a general sense this type of description of many IBRAs has already been carried out by jurisdictional and other projects (e.g. see http://www.deh.gov.au/land/management/rangelands/processes.html and http://www.nrm.gov.au/monitoring/indicators/vegetation-condition/index.html) but not with a specific eye to these diffuse processes which support biodiversity.
8. The costs and benefits of conservation action (steps c and d) in terms of invasive species control, maintenance of water-remote areas, maintenance of landscape function in terms of water flows, re-establishment of wetland networks, etc, have also been summarised for many IBRAs, but again without a focus on diffuse processes – in general these have been discussed in terms of maintaining processes at the far less critical level required for production.

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1. Interim Biogeographic Regions of Australia as originally proposed by Thackway and Cresswell (1995), and subsequently extensively revised as shown recently (version 5.1) in NLWRA (2002).
2. In practice any large regional unit could legitimately be used, but this report uses IBRAs as the pragmatic most likely approach, and as shorthand for any other regionalisation. The key issue is that the units must be large enough to encompass regional ($\sim10^{3-6}$ km^2) scale diffuse processes.
3. Because each of the examples of diffuse processes in Box 2 could be expected to be more significant in some IBRAs than others.
4. Whilst we acknowledge that conservation management is generally about maintaining or changing the current state, there are circumstances where the aspiration to restore or conserve a 'pristine state' may be a viable option, so it is important to include this consideration. The unconstrained flooding systems of some parts of the Lake Eyre Basin might be an example.

9. It is worth noting that the reality of thresholds and change in critical slow processes means that there may often be a good case for intervening in an IBRA which is no longer in particularly good condition before some additional threshold is crossed. Nonetheless, it is likely that, as the condition of a rangeland IBRA deteriorates and, in particular, becomes more fragmented, it will converge on the situation for fragmented agricultural landscapes where the conservation of focal areas becomes a higher priority.
10. Although the approach to prioritising for diffuse processes has some parallels to current reserve design methodologies, it is conceptualised at a far larger scale of geographic unit (not generally amenable to excision), and the issues of representativeness, geographic relationships and perhaps irreplaceability are not so meaningful. Complementarity remains important, as may a fourth basic element (perhaps 'synergy' or 'additionality'?) – the degree to which the protection of focal areas in a reserve network add up to reduce the costs of maintaining sufficient functioning processes across the remainder of an IBRA. Development of data or indicators to represent these diffuse processes requires a different conceptual approach to the way data is used for reserve design planning. Hence using the standard software such as Marxan and C-Plus is probably not the appropriate methodology.[5] It is likely that some form of Multi-Criteria Analysis (MCA) would handle the diverse values and weightings adequately; the use of these types of approach to incorporate more ecological processes in conservation planning is beginning to be explored in the SCP community.[6]
11. We spent inadequate time debating the question of how one might judge the relative balance of resources to put into the two classes of HCV areas in rangelands.

Future workplan options

This analysis leads to a number of future steps for DEH to consider:

(i) Commission a systematic review of the IBRAs with a view to establishing the datasets for steps (b–d) above in Key Point 5, at least in some qualitative form. This would review the current descriptions of the IBRAs with a specific focus on diffuse processes for maintaining genetic diversity values (specifically within- and between-species diversity at a $10^{2\text{-}5}$ km^2 type of scale) as opposed to production values (which might require some further debate on the precise list of these); the study would then send the summaries out to regional experts to complete the review.

Potential cost (assume a coordinating contractor @50k plus collaboration from each jurisdiction @40k each, using an ACRIS-type model): $250k

(ii) The current efforts to apply SCP to focal areas prioritisation nationally, including rangelands, should proceed, but take account of the data issues raised for rangelands, and potentially draw further rangelands skills into the project steering team.

Potential cost: drawing the expertise in should require negligible extra cost; however, there may be significant data management costs not included in the current project which cannot be estimated here.

5. Note: the current reserve design tools such as Marxan can be used *within* a region to determine where to support management with incentives, etc (eg. the maintenance of water-remote areas, cf. James et al. 1999, Biograze 2000, Landsberg et al. 2002); however this should not be confused with establishing the priority of how much to invest in doing that action in this particular IBRA as opposed to other actions and in other IBRAs.
6. New developments such as MarZone from UQ take up this challenge.

(iii) In the light of (i), an initial attempt at an actual prioritisation process would be commissioned.

Potential cost (assume a small project team developing and applying an MCA-type approach over 9 months, to data that is assumed already collated under (i)): $110k

(iv) Some further discussion may be needed as to how to balance the effort put into focal areas as opposed to diffuse processes from the conservation point of view in rangelands.

Potential cost: this could be added on to work in the existing project or under (iii), or could be the subject of perhaps 2 teleconferences with appropriate participants for negligible cost ($2k if carried out formally?)

(v) As a more theoretical question, a review of whether there is any literature which could justify differential values for IBRAs in pristine states (step a in Key Point 5 above) is needed. It seems to us likely that regions with different degrees of spatio-temporal variability might logically have different degrees of landscape-based genetic diversity; and there may be criteria by which to judge what regions play the most important roles in connecting this diversity at large scales. Elucidating ideas about this requires an initial review but could also lead to important basic research eventually.

Potential cost (for review only, assuming a post graduate or equivalent undertook a 4 week literature review assisted by an expert steering group through 2 teleconferences and email review, and one bout of consultative air travel): $15k

[further resulting research if required could be promoted through an ARC Linkage Grant or equivalent]

Further details of the discussion during the workshop are provided informally in the unpublished Workshop Record, available from the authors on request, and a more detailed rationale for the findings is being drafted in a separate short journal paper.

Box 1: What are the unique characteristics of rangelands?

It is important to assess whether approaches typically used in systematic conservation planning for the intensive-use zone of Australia are equally applicable to the rangelands. We argue that rangelands are characterised by a unique set of attributes, due both to inherent ecological characteristics, and to pragmatic factors such as current land use regimes. In practice, the availability and adequacy of data useful for conservation planning is also an issue, as in other data-scarce areas.

1. *The rangelands comprise very extensive areas of natural or semi-natural vegetation.* In contrast to much of the mesic zone, rangelands remain relatively intact, which provides opportunities to undertake conservation planning across whole landscapes, and to make a genuine attempt to conserve genetic diversity (both in species with very broad distributions and those with high levels of within-species genetic variability across smaller ranges and within habitats) (Morton et al. 1995).

2. *High variability in space and time is a key feature of many ecological and landscape processes in rangelands.* In particular, the major drivers of rainfall and disturbance (notably fire and grazing) are highly variable both spatially and temporally. This variability is evident at a variety of spatial (e.g. hillslope, sub-catchment, catchment and regional scales for movement of water, nutrients and sediments) and temporal (within-year, between years and decadal or century-scale cycles) scales and may be highly unpredictable (Stafford Smith and Morton 1990). Consequently, patterning of biota is dynamic and even basic attributes such as local species richness are difficult to define or measure.

Two other features of rangelands are related to this high level of spatial and temporal variability:

3. *Landscape-scale processes are as significant (for conservation planning) as local richness or similar biodiversity attributes*. Concentration of conservation planning on localised areas can only ever protect some proportion of the biota. The maintenance of broadscale, diffuse ecosystem processes is necessary for conservation of many components. As rangelands comprise extensive areas of (semi-)natural vegetation this may still be achieved (Morton et al. 1995). Such processes either never operated at broad scales in the more productive mesic country or, following fragmentation, are no longer as important to conservation planning which concentrates on identifying and conserving remnants. For examples of diffuse processes, see Box 2.

4. *Some organisms operate over large to very large spatial scales*. Mobile organisms track variable resources or preferred habitat over space and time (eg. waterbirds moving between ephemeral wetlands (Roshier et al. 2001a, Roshier et al. 2001b); honeyeaters following intermittent flowering of nectarivorous plants). Even in some sedentary organisms, the persistence of regional populations may depend on the maintenance of habitat heterogeneity over very large areas (eg. species dependent on juxtaposition of particular seral stages after fire).

5. *Highest diversity of many organisms occurs in less fertile lands*. While restricted patches with relatively high productivity may be important for certain taxa, such as mammals and birds, many groups, such as lizards, termites, ants and gryllacridids, reach their greatest diversity in infertile habitats (Morton and James 1988, Stafford Smith and Morton 1990, James and Shine 2000). It is therefore unlikely that these taxa can be captured within a relatively small selection of biodiversity ‘hotspots’, nor is it likely to be possible to identify areas of high diversity through (easily mapped) surrogates such as primary productivity or vegetation types (even if it were possible to map them at high resolution, which is in fact unrealistic). This is further exacerbated by species complexes in

which high levels of unspeciated genetic diversity (eg. Kearney 2003, Ladiges et al. 2006) may be masked by lumping into superficially single species records.

6. *Environmental and biodiversity data are generally sparse or have coarse spatial resolution for most rangeland regions*. Moreover, environmental and biotic variation is often subtle and patterns are difficult to resolve or map at finer scales. Over much of the Australian rangelands, environmental mapping is available at scales of 1:250000 or poorer. Moreover, state- or continental-scale vegetation mapping typically shows rangelands to have relatively few very extensive map units. Such mapping does not adequately represent the often subtle variation in many rangeland environments and the well-known biotic patterning associated with them (for example, most rangelands are very flat, but slopes of a fraction of a degree are significant for landscape processes) (eg. Pickup 1985, Tongway and Ludwig 1994). Consequently, such mapping does not allow adequate assessment of representativeness, complementarity or irreplaceability in conventional conservation planning processes.

While high-quality data relating to species distribution is available for a few taxa and some localised areas, such point data is generally sparse and geographically highly biased. Some of this data also has to be interpreted cautiously – for example, records may show irruptive species to be widespread but their non-irruptive distribution may be very limited but most important to conservation planning.

Poor availability of data in the rangelands has led to the search for appropriate indicators of biodiversity at plot and landscape scales and to the use of remotely sensed vegetation and soil attributes as surrogates for habitat condition and biodiversity (Smyth and James 2004). The challenge with this approach is to identify indicators that will adequately represent biodiversity trends.

7. A related issue is that understanding the *spatial distribution of the condition of vegetation units may be particularly important* to conservation planning in rangelands. Again, differences in condition may be subtle and/or difficult to determine, and available spatial data is particularly poor. This issue is important in fragmented landscapes too, but is usually overwhelmed by the dramatic differences between land-uses, such as cropping and remnants (in whatever condition). By contrast in rangelands it is the major axis of variation within the extensive land uses (Morton et al. 1995).

Box 2: Diffuse processes in rangelands

Examples of diffuse processes include:

- maintenance of pollination processes – clearly, these are important everywhere
- supporting recruitment and migration, including management of the matrix between refugia, etc – these processes are important everywhere but they occur at large scales [eg. with waterbirds (Roshier et al. 2001a, Roshier et al. 2001b), rock wallabies (Pearson 1992)] in rangelands, and are more likely to be still occurring in the general landscape here than in fragmented landscapes
- ensuring there is continued opportunity for the intersection of multiple patchy processes (fire, grazing, rain, etc) at large scales – this will require maintaining diversity of grazing and fire regimes at landscape and regional scales to maintain species diversity, but more importantly within species genetic diversity. Low species diversity associated with species complexes and reticulate evolution in (eg.) *Senna artemisiodes* and various *Acacia* sp may in fact be masking regions with high genetic diversity (Stafford Smith et al. 1996, Kearney 2003 and references therein);
- large scale landscape function processes such as sustained flows in major river systems (eg. Sheldon et al. 2002).

Subsequent discussions[7] have suggested that these might be loosely categorised into the following groups, with examples and possible approaches:

Functional categories of processes	Example reasons (should be exhaustive; needs ecological justification!)	Possible surrogates (that need ecological justification!)	Possible selection strategy
1. Large scale quasi-universal/ spatially-continuous processes	*1a. Undetected genetic diversity (eg places with substantial reticulate evolution, etc)*	• *Degree of variance in spatio-temporal disturbance regimes (fire, rainfall, etc)* • *Variance in GPP*	*Select reasonable geographic spread but also zone at regional scale for lower level investment in maintenance of landscape function*
	1b. Maintenance of dispersal (including directional dispersal, eg. as needed in response to climate change)	• *Connectivity of regions* • *Preferential orientation (eg. with respect to climate gradients) of connectivity if directional*	
2. Processes focused on small areas but spread across large (~$10^{2\text{-}3}$km) spatial scales	*2a. Focused on fixed localities, but with linkages among sites crucial for survival (eg. fish in permanent waterholes)*	• *Migration routes* • *Spatially-fixed high production spots in GPP* • *Permanent waterholes*	*Maintenance of connected network (maybe select geographically spread sets, but also zone regions with lower investment maintenance of the matrix)*
	2b. Focused on varying localities of which some need to be linked accessibly at any time (eg. fire patch edges for organisms needing both recent and old patches – but larger-scale examples??)	• *Regions with high incidence of high production spots in GPP at any time (but not fixed in space)*	

7. Notes by Mark Stafford Smith after Spatial Prioritisation workshop, 9th Nov 2006

Table 1: Attributes of focal places and implications for SCP and data use.

This table summarises the types of attributes that would contribute to defining high conservation value for focal places, and the issues that might need special consideration in finding and using surrogates for these in rangelands (compared to other regions – ie. generic problems are generally not noted). [From the workshop.]

Attributes	What's important in Rangelands	Data layers/Indicators	Implications for planning and data in rangelands
COMPOSITION			
Rare species	*Sparse data; definitional issues (irruptives, etc)*	*Species distributions*	*Should distinguish genuinely rare species from species that irrupt that may appear as common but are rare most of the time – consider treating refugia in non-irruptive phases as key focal points*
Threatened species	*Nil*	*Species distributions*	*Distinguish species that are localised and threatened from those that are widespread but threatened (localised ones have higher priority for focal conservation action; the latter require diffuse process management and less emphasis on specific point records)*
Species richness	*Richness in different taxa to non-rangelands often*	*Species distributions*	*Subdivide to major taxa, so that the comparative dominance of different taxa in rangelands doesn't distort outcomes (eg. reptiles, ants, etc)*
Endemic species	*Dispersed and patchy species under-represented*	*Species distributions – Number of species in spatial selection cells*	*Scale dependence of issue interacts with poorer spatial data resolution in rangelands (sensitivity analysis for this?)* [Possibly *less attention to appropriate levels of species classification in rangelands]*
Species of restricted distribution	*Some species are in restricted patches but very widely spread (eg. Xanthorrhea thorntoni)*		*Occurs elsewhere but here over geographic scale that is larger than would be considered in non-rangelands environments*
Habitats of restricted distribution	*Larger spatial scales and habitats with little connection except during extreme events (eg wet periods)*	*Vegetation, landsystem, soil types, geological types wetlands*	*[eg. mound springs, mountain gorges/seepages, etc]* *Possible issue of occurring at smaller scale than the coarser vegetation mapping that is common in rangelands*
Condition and intactness in relation to species complement	*Nil*	*Productivity, remoteness from watering points and stocking rates*	*Important criterion for choosing between alternatives within one vegetation type in rangelands. Differences likely to be more in understorey state rather than woody structure. Could use cover (ACRIS) dataset; also water remoteness as key indicator. Ideally should recognise areas that have avoided grazing by chance but this generally needs local knowledge.*
STRUCTURE			
Condition and intactness in relation to age structure and recruitment	*Mapping not resolved enough (i.e. subtlety of gradients)*	*Productivity, remoteness from watering points and stocking rates*	*As above.* *Plus fire and rabbits important in driving this in rangelands woody vegetation.* *Some woody thickening may be detectable in AGO change data; still a question of whether this makes any difference to conservation value.* *Clearing is an issue in rangelands margins.*
Complexity of assemblages and temporal variation in this	*High temporal variability*	*Lack of knowledge of assemblages*	*See above*

Attributes	What's important in Rangelands	Data layers/Indicators	Implications for planning and data in rangelands
FUNCTION			
Richness of habitat types, including local landscape diversity	*More subtle variation and low resolution mapping*	*Vegetation, landsystem, soil types, geological types, geomorphic types*	*General absence of fine scale mapping – could use remote sensing to provide some indicator of spectral diversity (more sophisticated semi-variograms/local spatial autocorrelation measures?)*
Specific ecological processes	*e.g. wetlands for bird breeding; mound springs*	*Directory of important wetlands and RAMSAR wetlands and Dave Roshier layers*	*Breeding areas, etc. not generally apparent from available data layers. Include inventories of wetlands where possible.*
Condition and intactness in relation to functioning processes		*Productivity, remoteness from watering points and stocking rates Hydro-ecological processes, topographic diversity*	*See diffuse processes, but also indicators from previous condition entries above*
Spatial unit area (km sq)	*Rangelands of lower productivity per unit area*	*Use built-in aggregation rules in Marxan*	*Consider whether appropriate sizes need to be different in rangelands due to scale of ecological processes (and management efficiency)*

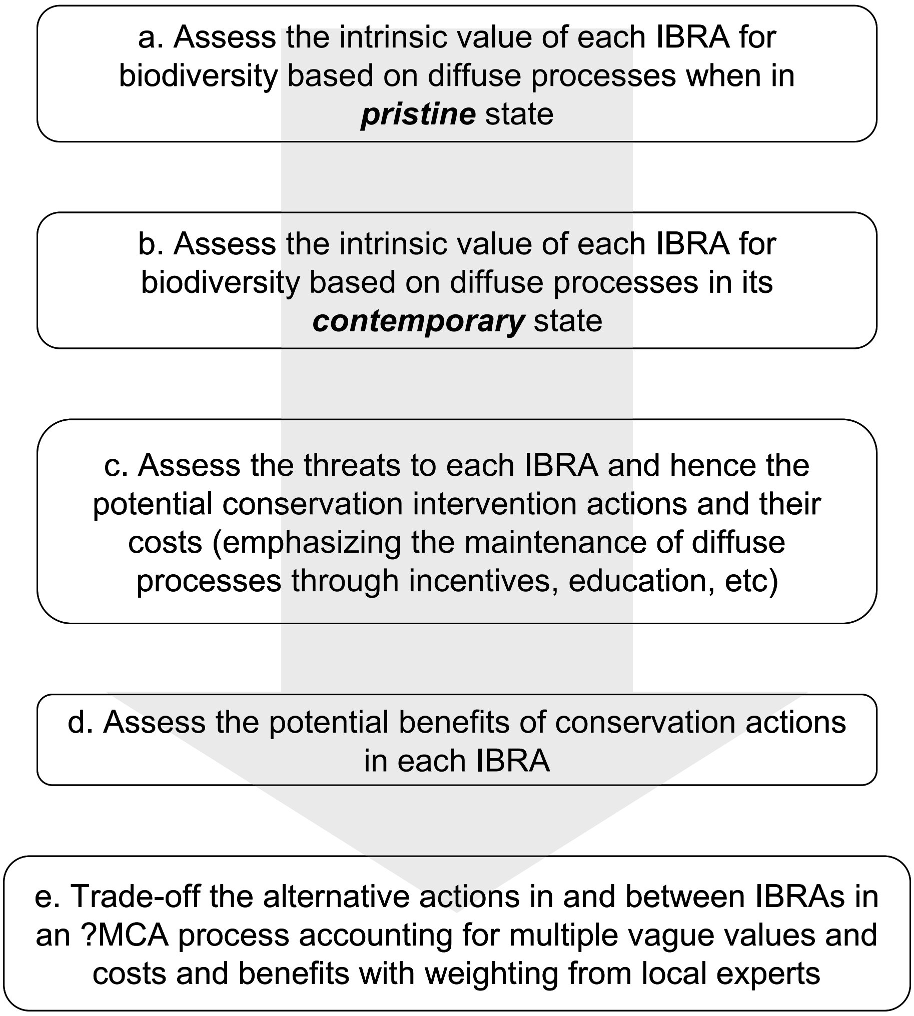
- Priorities at holistic level: a fundamental consideration of SCP is complementarity (the selection of sets of priority areas that maximise biodiversity when assessed collectively, vs. hotspots which are areas of importance individually), for which there may be implications of environmental mapping being relatively coarser in rangelands; aggregation rules might need to favour larger areas where possible.
- Threat maps are not included here – weeds and ferals (both fairly coarse and often inconsistent across boundaries; some point data).
- There is a particular opportunity in rangelands to draw on better quality state-level databases rather than poorer national ones.

Table 2: Links between specific management interventions and the ultimate biodiversity conservation goals of maintaining diffuse processes at a regional scale. [From the workshop.]

Threats to diffuse processes	**Specific regional management interventions**	**Immediate (observable, measurable) diffuse processes being sustained**	**Ultimate (hard-to-measure) biodiversity assets being sustained**
Intensification (fragmentation from fencing, roads; water points; clearing) *Total Grazing Pressure* *Ecologically Significant Invasive Plants* *Altered Fire Regimes* *Water Diversion, Dams etc.*	*Fire management* *Grazing distributions and water point development intensity* *Regionally organised protection of water-remote areas* *Total grazing pressure* *Control of weed and feral animals*	*Fire regime diversity* *Grazing regime diversity* *Landscape connectivity at all scales* *Water flows at multiple scales* *Soil and microhabitat functioning with emergent regional implications* *Predation pressures*	*Local genetic diversity where dependent on cross-fertilisation or re-invasion (eg. rock wallabies), or on widespread local landscape function (eg. mulga groving, terminal lakes on large river systems), or on the diversity of landscape ephemeral patch outcomes which are not fixed in space or time (eg. intersection of burned patches with rainfall, chats)* *Local genetic diversity where this is dependent on continuous functioning landscapes*

Measures of current status of IBRAs include: Land Condition; History of intensification (Indicators: property size, water remoteness, distance to markets, time since settlement, ground cover, ACRIS collation [poor info on Indigenous lands]); Species status; Fire histories; Ecologically significant invasive species and ferals; Long-term climate history; Water diversion; Road/track network intensity?

Figure 1: Basic conceptualisation of the procedure for prioritising conservation actions across regions, aimed at diffuse processes and their influence on maintaining biodiversity assets. [From the workshop.]



Appendix: Workshop participants and agenda

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(A Western Australian invitee was ultimately unable to attend)

Workshop Agenda: Criteria for Defining Areas of High Conservation Value in the Rangelands	
Tuesday 22 November 2005, Adelaide	
9.00 am	*Introductions and Background – Mark Stafford Smith [MSS]*
9.30 am	*Discuss and clarify purpose of workshop and policy drivers for the question – 'value' for what, scale, intended uses of outputs, etc – Annemarie Watt, Andrew Ash*
11.00	*Identify alternative approaches to thinking about biodiversity value in the rangelands, and the consequent potential drivers – inputs from all [MSS]*
1.30–5.00 pm	*Define scientific and conceptual approaches to biodiversity value drivers, with ideal proximate causes – discussion groups*
Wednesday 23 November 2005	
9.00–1230	*Reflect on progress on the previous day [MSS/JM?]* *Review data and consequent options and limits to implementation – what data is there about or indicators of key proximate causes*
1.30–3.00 pm	*What would be necessary to test the proposals, and how could they be implemented in practice? – implementation plan(s)*
3.15–4.00 pm	*Wrap up and depart*

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