Australian Collaborative Rangeland Information System, Reporting Change in the Rangelands – 2007

New South Wales Information for the National Report

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SUMMARY

This document integrates reports provided by the New South Wales Department of Environment & Climate Change (formerly Natural Resources) that contribute to NSW's reporting of change in Australia's rangelands for the period 1992 to 2005. A national synthesis has been compiled from relevant jurisdictional and national data by the Australian Collaborative Rangeland Information System (ACRIS). The national report will be published in early 2008.

Reporting is by bioregion (IBRA v6.1).

Information in this (NSW) report relates to:

- Change in landscape function from site-based data collected through the Range Assessment Program (RAP),
- Change in critical stock forage (compiled from RAP data relating to those palatable perennial grasses that are the mainstay of livestock production),
- Change in diversity of native plant species (i.e. count of species) at RAP sites,
- Recent changes in woody cover due to clearing, and
- Change in typical property value for selected locations.

The ACRIS Biodiversity Working Group has compiled data and information for the 2007 report based on ten indicators. Information for NSW was scant. NSW information that was compiled is not included in this report because it was not part of the contractual arrangements for delivery of NSW information.

ACKNOWLEDGEMENTS

Richard Hicks as the NSW representative on the ACRIS Management Committee provided general guidance of the work reported here. Rob Richards (Clear Horizons) contributed to some of the data analysis and report writing. Andy Taylor provided the clearing data. We thank these people for their input.

Vanessa Chewings (CSIRO, Alice Springs) produced the site seasonal quality scores and provided general GIS support and advice. Again, our thanks to Vanessa for her valuable contribution.

Members of the ACRIS Management Committee provided more general direction and guidance with jurisdictional contributions to the 2007 national report.

NSW reporting was supported by Natural Heritage Trust funding administered by the Desert Knowledge CRC. We thank the DK-CRC Secretariat, and Ange Vincent in particular, for their contribution by way of implementing and managing contractual arrangements.

INTRODUCTION

The Australian Collaborative Rangeland Information System (ACRIS) is in the final stages of compiling its national report of change in the rangelands for the period 1992 to 2005. This report will be published by the Australian Government in the early part of 2008. The national report has been compiled from available jurisdictional and national datasets and this report describes the datasets and information contributed by NSW agencies. Reporting is by bioregion (IBRA v 6.1).

The national report is based on a number of biophysical and socio-economic themes and related products. NSW contributions to these themes include:

Theme	Product	Datasets
Landscape function	Landscape function	RAP monitoring program
Sustainable management	Critical stock forage Species diversity [1]	RAP monitoring program
Biodiversity	Clearing	Landsat satellite imagery and analysis
Socio-economic	Land values	Web-based reporting of typical property values
Supporting information	Photos	Time-series photos of selected rangeland sites

[1] Species diversity data reported here under 'biodiversity' but subsequently used in the national report as a component of the Sustainable Management theme.

The ACRIS Biodiversity Working Group has compiled data and information for the biodiversity theme of the 2007 report based on ten indicators. Information for NSW is scant. Information that was compiled is not included in this report because it was not a required deliverable of the DK-CRC contract with the NSW Department of Environment & Climate Change.

Reporting Area

NSW is reporting by each bioregion (IBRA version 6.1) of the rangelands. The rangelands make up about 57% of NSW, mostly as semi-arid rangelands within and adjacent to the Western Division. Bioregions are shown in Figure 1.

Method of Reporting

The NSW Department of Environment and Climate Change (formerly Department of Natural Resources) was contracted by the Desert Knowledge Cooperative Research Centre (DK-CRC) to collate, analyse and report on available data for the landscape function, sustainable management and biodiversity (species diversity) themes. This information comes from the NSW Rangeland Assessment Program (RAP). Russell Grant did most of this work. Russell is now employed by the Western Catchment Management Authority.

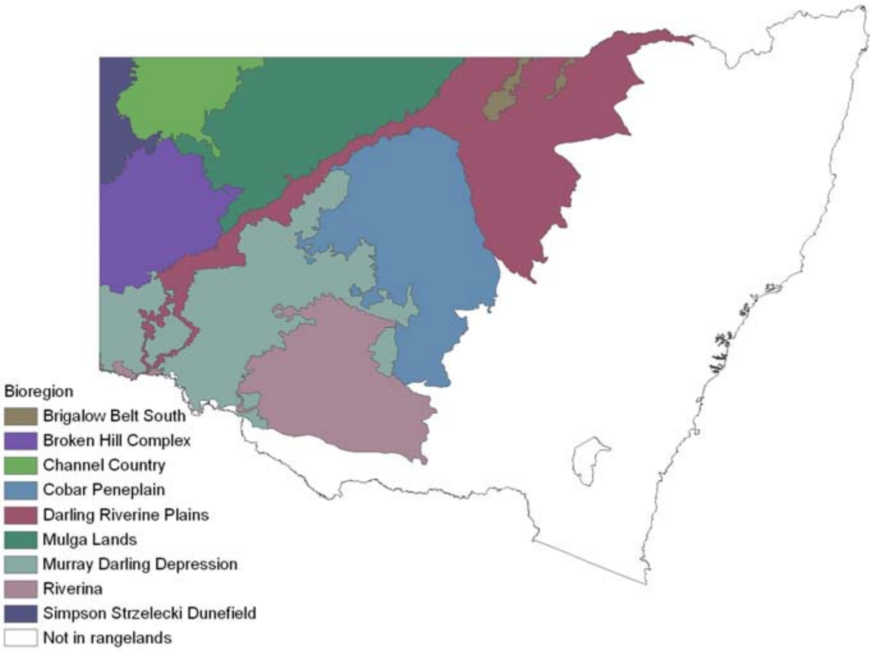

Figure 1. Bioregions in the NSW rangelands.

RANGELANDS ASSESSMENT PROGRAM

NSW rangelands have been monitored annually since 1985 at 350 representative sites (Fig. 2) as part of the Rangeland Assessment Program (RAP). This program is part of the Department of Environment and Climate Change (DECC). RAP sites were selected to be representative of the numerous range types in NSW and also have a strong correlation with the IBRA regions reported on in this ACRIS project.

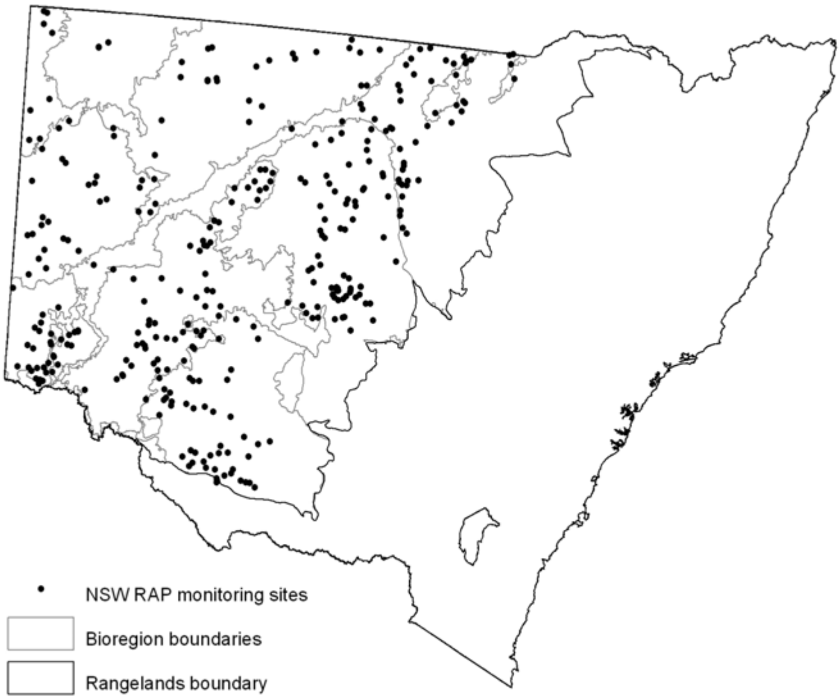

Figure 2. Location of RAP monitoring sites in the NSW rangelands.

Method

RAP field methods are described in Green *et al.* (1994). Each RAP site consists of four 300-m marked transects. Pasture species composition (using the dry weight rank method) and yield are estimated from 52 half square-metre quadrats along the transect. Perennial bush densities are estimated using a belt transect method and canopy cover is measured by a step point technique along the same transects.

RAP techniques were originally selected to provide a consistent methodology and standards across numerous observers working throughout western NSW and over a decadal time span. Methods were based on “best practice” identified at project inception in 1989 when they were assessed as minimising error between and “within” operators.

The original methodologies have been preserved over time (since 1989). Trends in the data over the ACRIS reporting period are therefore readily apparent, as there are no discontinuities due to changes in techniques.

RAP data limitations

RAP data trends are presented in this report mainly as simple line graphs showing the mean and standard error of site data by bioregion for each year. The averaged annual data illustrate general trends over the reporting period. Averages hide the variability inherent in site-based natural-resource data sourced across a range of local influences including landform, soil type, vegetation community, management regime and local seasonal circumstance. For this reason, the averaged information should be interpreted only in the context of identifying broad regional change.

RAP data have been collected by a number of assessors over a decade-long time span. Various sources of error are potentially present within the dataset, but all care has been taken to identify and minimise these. Consequently, while the integrity of the data is good, it cannot be guaranteed as being error-free.

SEASONAL QUALITY

Rainfall (amount, timing and follow-up) is the principal driver of vegetation change. In some areas, fire (or its absence) may also affect the vegetation. It is necessary that ACRIS filters the effect of prior seasonal conditions on change recorded at monitoring sites (to the extent possible) so that the effects of grazing management are better understood. ACRIS is using the phrase 'seasonal quality' to represent seasonal conditions.

Seasonal quality is defined as the relative value of recent climate (principally, rainfall) on biological functioning. Relative value (quality) is judged with reference to the available longer term record. 'Biological functioning' is a wide-ranging term but for the purpose of ACRIS reporting themes, broadly means vegetation growth as the basic resource for livestock production, for the maintenance or improvement of ecosystem / landscape function and as an important component of biodiversity.

Method

ACRIS partners, assisted by the Management Unit, have used the following procedure to produce an index of seasonal quality to assist interpretation of change:

1. Monthly SILO gridded rainfall was used as the input data set (see http://www.bom.gov.au/silo/). Rainfall data were extracted for the 0.05 degree grid cell (~5-km by ~5-km) corresponding with the location of each RAP site.
2. Monthly rainfall data were summed into seasonal totals. Summer (northern wet season) months are nominally November to April inclusive and winter (southern wet season) months are nominally May to October inclusive. Note that there is some latitude amongst jurisdictions in assigning months to seasons. For example, in WA winter is defined as April to September and summer as October to March.
3. Seasonal totals were then ranked as a tercile (upper, middle or lower third) against the long term record (1890 to 2005). This equates with a particular site having experienced above-average, average or below-average rainfall for a particular season, compared with the long-term record.

In NSW where RAP sites are assessed annually, the separate summer and winter terciles within each 12-month period were weighted and then used to calculate a (final) combined tercile score (based on similar weightings applied to all years of data in the rainfall record). In northern NSW, summer rainfall is more beneficial for plant growth than winter rain and summer rainfall was thus weighted preferentially. In southern NSW, the reverse applies and winter rainfall was weighted above summer rainfall.

Filtering seasonal effects

Where appropriate, seasonal effects on reported change have been filtered from those that may be attributable to grazing management using the "quality of prior seasons" by "direction of change" matrix (see Fig. 3).

Seasonal quality is based on the ranked amount of rainfall in the growth season(s) prior to the monitoring period compared with the long-term record and is calculated as described above.

Columns report the percentage of monitoring sites where reported attributes of vegetation (or landscape) declined, were unchanged or increased.

Seasonal Quality	Change in Reported Attribute		
	Decline	No change	Improvement
Above average	XX	X	~
Average	X	~	√
Below average	~	√	√√

Figure 3. Matrix for filtering seasonal effects on change.

√√ shows improvement although seasonal conditions were below average. XX is of concern because sites declined when seasonal conditions indicated no change or improvement.

The value of this matrix for reporting change is increased where vegetation data are selected that either enhance management effects or further dampen seasonal influences. For example, focussing on longer-lived perennial species filters many ephemeral species that are directly affected by timing of rainfall. Grazing effects, both positive and negative, are sharpened by reporting change for those species known to decline with heavy and prolonged grazing. This assumes that seasonal conditions alone have the same impact on species that decrease, increase or are unaffected by grazing.

THEME: LANDSCAPE FUNCTION

Product: Richards-Green Index

Description

Landscape function describes the capacity of landscapes to regulate (i.e. capture and retain, not leak) rainwater and nutrients, the vital resources for plant growth (Ludwig *et al*. 1997). Functional landscapes have a good cover and arrangement of persistent vegetation patches (typically perennial vegetation) for their type. This means that much of the rain that falls soaks into the soil and is available for plant growth. There is generally minimal runoff and so there is limited loss of plant nutrients in transported sediment. Reduced overland flow also limits loss of organic matter (litter) and seeds. Similarly, a good cover and arrangement of vegetation patches minimises wind erosion and loss of nutrients in dust.

Change in the functionality of landscapes provides a sound basis from which to judge the effects of management on the rangelands. Functional landscapes are likely to recover quickly from disturbance (e.g. grazing, fire or drought), and to maintain a consistent vegetation cover through variable seasonal conditions. Dysfunctional landscapes may not recover, take longer to recover or change to a less desirable vegetation state.

Method

An index of landscape function has been derived from the frequency and cover of perennial herbage species. This is a modified form of the Richards-Green Index.

Data source

Rangeland Assessment Program, NSW Department of Natural Resources.

Data collection

See Green *et al*. (1994). Assessment of site vegetation cover is based on annual ranking of the three dominant cover categories within 52 quadrats across four 300-m transects. Frequency is based on annual recording of ground stratum floristics (presence of species) within 52 quadrats across four 300-m transects. ‘Perenniality’ is based on the Flora of New South Wales (Harding GJ ed, V4 1993) and excludes facultative or opportunistic perennial species.

Analysis

Site vegetation cover and the average perennial frequency data have each been indexed on a 1-10 scale and added to indicate an annual value of landscape function (Tables 1 & 2). Index scores were then averaged for all sites within each bioregion. The standard error of the mean was also calculated.

Table 1. Cover categories adopted to assign cover values to the modified Richards-Green index.

% cover	Cover index*
<10	1
10-20	2
20-30	3
30-40	4
40-50	5
50-60	6
60-70	7
70-80	8
80-90	9
90-100	10

* Maximum recorded cover was 98%

Table 2. Perennial frequency categories adopted to assign perenniality values to the modified Richards-Green index.

% Perennial Frequency	Perenniality Index
0-10	2
10-20	4
20-30	6
30-40	8
40-50	9
50-60	10

Comments on data

The intent of the index is to provide a common product across bioregions and states with differing capacities to report on landscape function. Formal landscape function data have yet to be collected through the NSW Rangeland Assessment Program. A modified form of the Richards-Green Index is being used to provide some measure of the combined effects of two key parameters, vegetation cover and perennial plant abundance, on surface processes at RAP sites. Note that all perennial groundcover species are included in the latter category, not just pastorally productive species.

Reporting change

The following graphs and 'cause' tables show change in the landscape function index for each bioregion. In each cause table, the red cell reports the percentage of site-times where landscape function declined following above-average seasonal quality (increase expected at this time). Correspondingly, the green cell shows the percentage of site-times where landscape function increased following below-average seasonal quality (decrease expected at this time).

LANDSCAPE FUNCTION TRENDS BY BIOREGIONS

Brigalow Belt South Bioregion

Number of sites

Data from 4 sites have been extracted. These sites have consistent monitoring histories over the period 1989-2002.

Results

Temporal trend graph

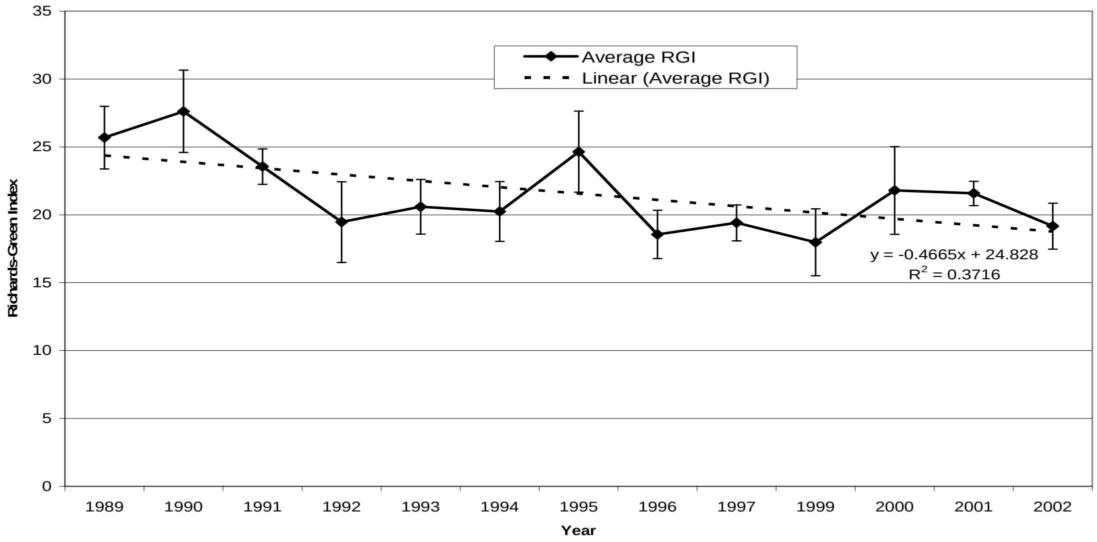

Figure 4. Change in values of the modified Richards-Green index for the Brigalow Belt South Bioregion.

Seasonal change matrix

Insufficient number of sites to allow reporting.

Discussion

There are insufficient sites to provide a robust assessment of trends in landscape function and response to seasonal change.

However, the available data suggests that there was relative stability in landscape function despite fluctuating seasonal conditions. Overall there was a slight downward trend in the modified Richards Green index.

Broken Hill Complex Bioregion

Number of sites

Data from 24 sites have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Results

Temporal trend graph

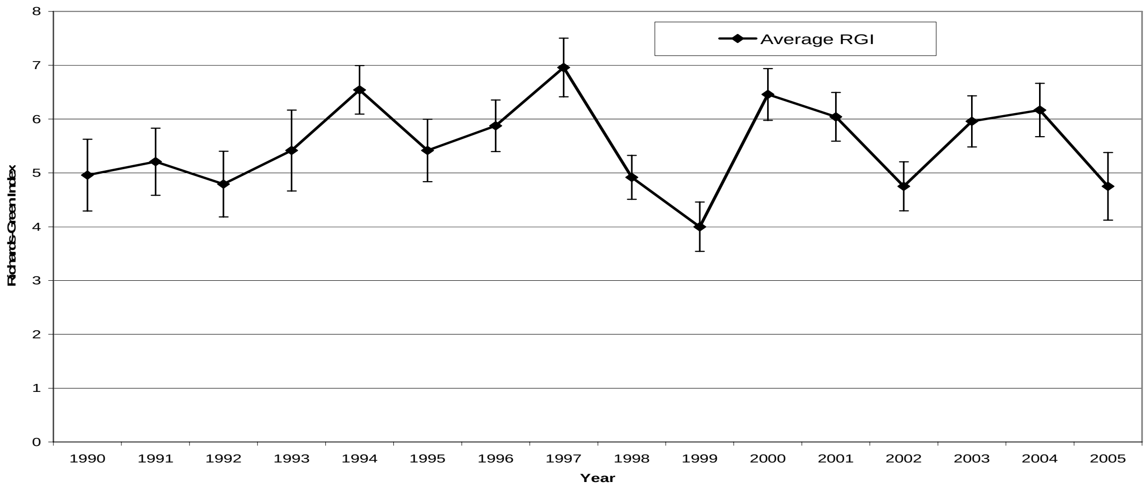

Figure 5. Change in values of the modified Richards-Green index for the Broken Hill Complex Bioregion.

Seasonal change matrix

Table 3. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Broken Hill Complex bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	120	13	72	15
Average	144	4	83	13
Below average	72	10	80	10

Discussion

- There were short periods with considerable year-to-year variation in the landscape function index, particularly between 1997 and 2000. Most of this change was probably seasonal.

- The best seasonal conditions occurred in 1993, 1996-97 and 2000 and were driven by summer rainfall. Peaks in the value of the modified Richards Green Index generally occurred in the year after each of these peaks. The lowest summer rainfalls occurred in 1992, 1995, 1999 and 2002, which accord with declines in derived landscape function.
- Many sites measured have saltbush cover or gravely surfaces which will influence landscape function. The bush cover was included in the cover component of the modified Richards Green index, but the role of gravel cover was not measured although having an appreciable role in surface hydrology.
- The seasonal component dominates site-level trends. There was greater responsiveness to above average conditions than poor seasons.

Channel Country Bioregion

Number of sites:

Data from 3 sites have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Results

Temporal trend graph

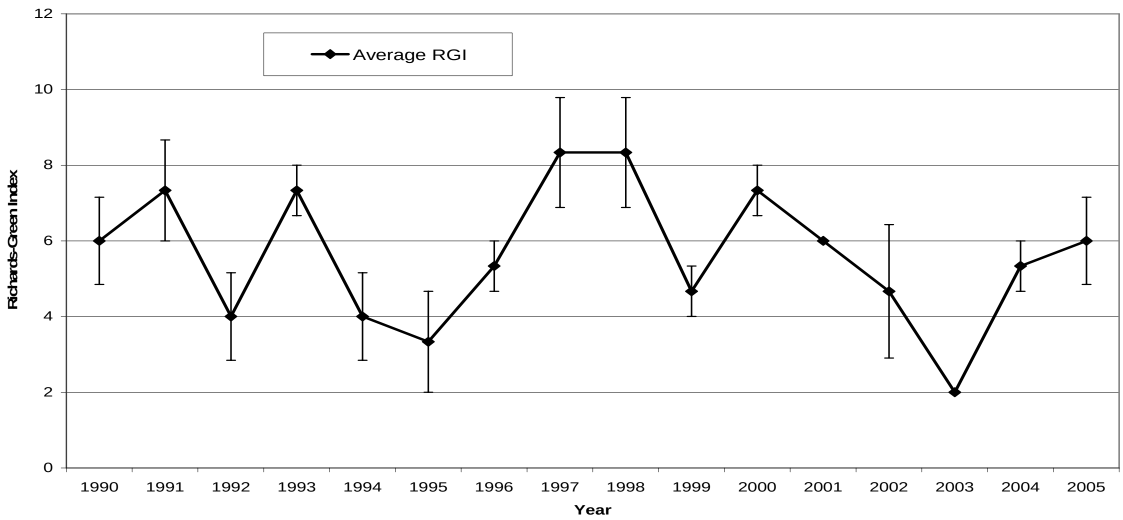

Figure 6. Change in values of the modified Richards-Green index for the Channel Country Bioregion.

Seasonal change matrix

Insufficient number of sites to reliably report change.

Discussion

- There are insufficient data to draw robust conclusions on landscape function.
- All sites consist of gilgaied gibber plain with perennial plants (mainly Mitchell grass) confined to the crabhole depressions. Consequently the absolute abundance of perennial groundcover plants was low and this is reflected in the relatively low values of the modified Richards Green index.
- The average index tracks changes in seasonal quality. The bioregion comprises one of the driest environments in western NSW, so seasonal rainfall (and quality) is highly variable.

Cobar Peneplain Bioregion

Number of sites

Data from 30 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2005.

Results

Temporal trend graph

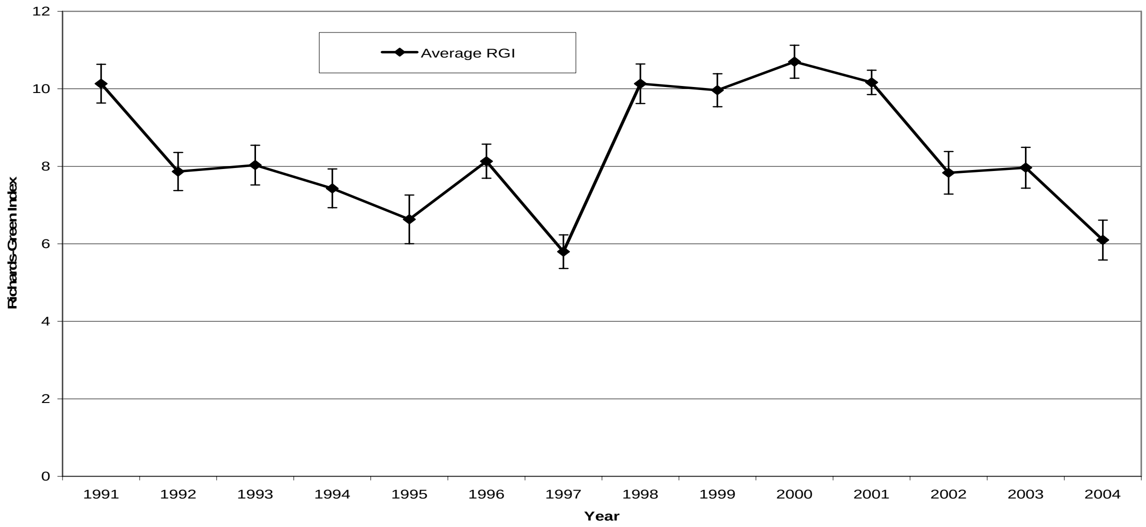

Figure 7. Change in values of the modified Richards-Green index for the Cobar Peneplain Bioregion.

Seasonal change matrix

Table 4. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Cobar Peneplain bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	150	6	83	11
Average	120	12	85	3
Below average	60	5	92	3

Discussion

- Values for the modified Richards Green index are more dynamic than in other NSW rangeland bioregions. A declining trend was evident from 1991 to 1997. This was followed by a return to the 1991 index level from 1998 until 2001 then decline till 2004.

- To some degree these changes accord with seasonal quality weighted for both summer and winter rainfalls. High summer rainfalls occurred in 1993 and 2000. Winter rainfall peaked in 1990 and 1999. Drought developed from 2001 onwards.
- In this bioregion, perennial grasses are both autumn-winter-growing (*Austrostipa spp*) and summer-growing (*Thyridolepis and Monochather spp*), so cover and perennial frequency can respond to year-round rainfalls. Most sites are assessed in spring, which would pick up autumn-winter responses better than summer rainfall growth.
- In any particular year, few sites responded in the opposite direction to the seasonal context. Landscape function improved at only 3% of sites in below average years.
- Values of the modified Richards Green index strongly reflect vegetative cover trends for this bioregion.

Darling Riverine Plains Bioregion

Number of sites

Data from 32 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2003 with the exception of 1998-99 when numerous sites were not assessed. 1998-99 data have therefore been excluded from the series.

Results

Temporal trend graph

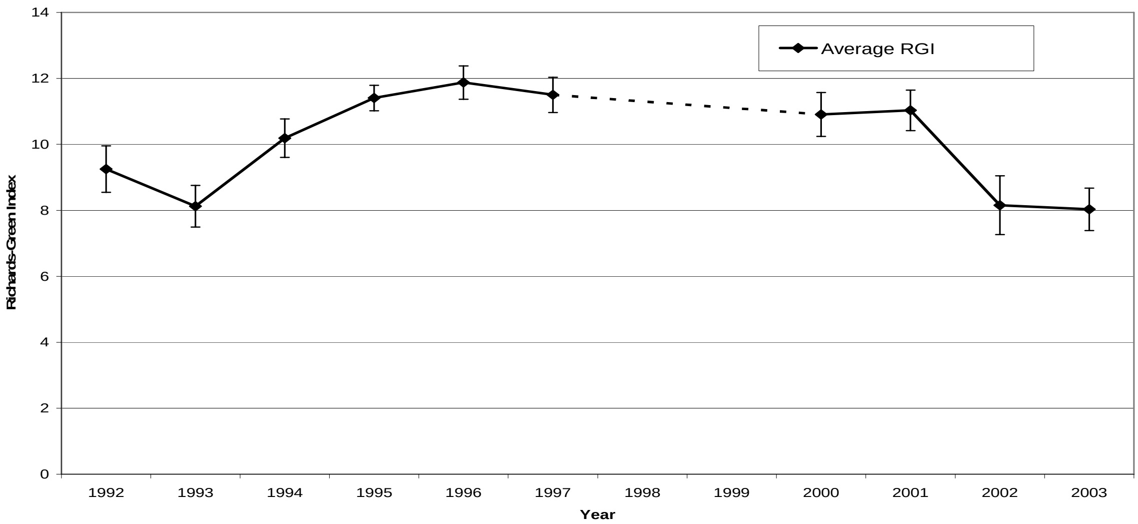

Figure 8. Change in values of the modified Richards-Green index for the Darling Riverine Plains Bioregion.

Seasonal change matrix

Table 5. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Darling Riverine Plains bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	62	2	90	8
Average	62	5	92	3
Below average	93	20	57	23

Discussion

- Values for the modified Richards Green index for the Darling Riverine Plains bioregion exhibit a different pattern to adjacent bioregions. Index values were suppressed during 1992-94, and again from 2002-03. In the intervening years, the index appeared stable, although data are missing for 1998 and 1999.
- The bioregion has a summer growth response and sites are assessed in autumn. Site assessments are therefore highly sensitive to the presence of perennial summer growing grasses such as *Astrebla lappacea*.
- The index behaves generally in accordance with the summer rainfall pattern, which was relatively stable from 1993 till 1999, peaking in 2000 before declining rapidly in 2002-03.
- The change ('cause') table indicates that 23% of sites improved in a shift to below average seasons, although 2% of sites declined in a shift to better seasons. This suggests that the impact of management during drought is often positive.

Mulga Lands Bioregion

Number of sites

Data from 19 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2004 with the exception of 1999 when five sites were not assessed. The 1999 data have therefore been excluded from the series.

Results

Temporal trend graph

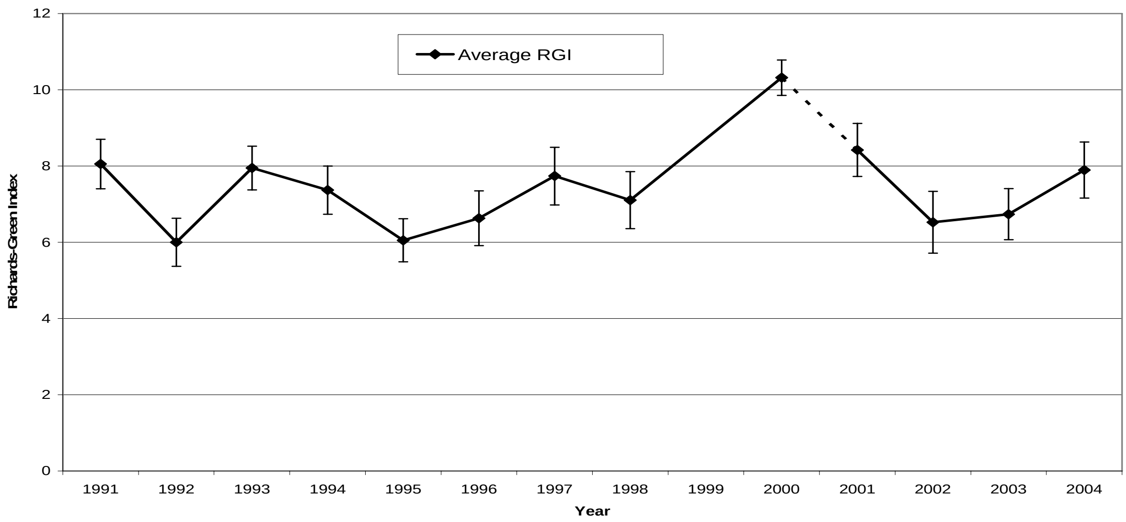

Figure 9. Change in values of the modified Richards-Green index for the Mulga Lands Bioregion.

Seasonal change matrix

Table 6. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Mulga Lands bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	59	3	65	32
Average	114	11	81	8
Below average	76	12	83	5

Discussion

- The Mulga Lands Bioregion had relatively stable values for the modified Richards Green index irrespective of its characteristic fluctuating seasonal quality.
- The region experienced a peak in summer rainfall in 2000 and the index responded accordingly. However the robust index value in 1991 may be a consequence of good winter rains in the preceding year.
- The predominant perennial pasture species are summer growing, so cover and abundance are most likely to respond to warm season rains.
- At 5% of sites, the index improved with a shift to below average seasons, and 3% of sites declined with the onset of above average conditions.

Murray Darling Depression Bioregion

Number of sites

Data from 67 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2004.

Results

Temporal trend graph

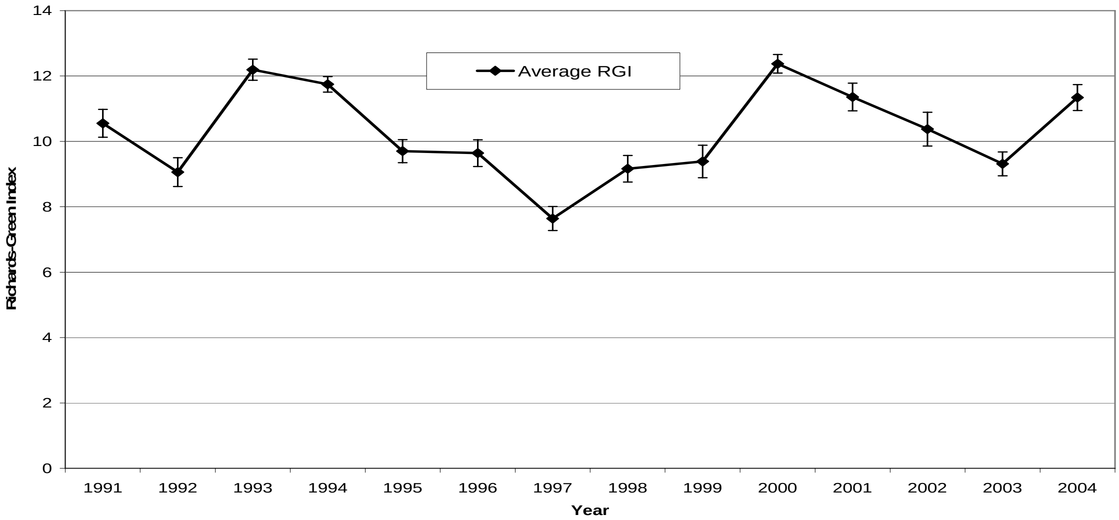

Figure 10. Change in values of the modified Richards-Green index for the Murray Darling Depression Bioregion.

Seasonal change matrix

Table 7. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Murray Darling Depression bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	134	5	60	35
Average	469	12	73	15
Below average	201	19	80	1

Discussion

- In general terms values for the modified Richards Green index for the Murray Darling Depression bioregion exhibited stability. Index values showed two peaks, in 1993-94 and 2000-01, which correspond with years of high summer rainfall. Winter rainfall was relatively consistent over the recording period.

- Index values suggest that landscape function remained relatively stable over the reporting period, responding to high rainfall years but less impacted by relatively poor years such as 1994-95 and 2002.
- Index values declined at 5% of site-times with the onset of above average conditions, implying that either management had little adverse influence on landscape function, or that other factors were operating. Index values increased at 1% of site-times in good seasons.
- Since values of the index increased at only 1% with a shift to below average seasons, it appears that management was seldom able to counter adverse conditions.

Riverina Bioregion

Number of sites

Data from 18 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2003 with the exception of 1996 when three sites were not assessed. 1996 data have therefore been excluded from the series.

Results

Temporal trend graph

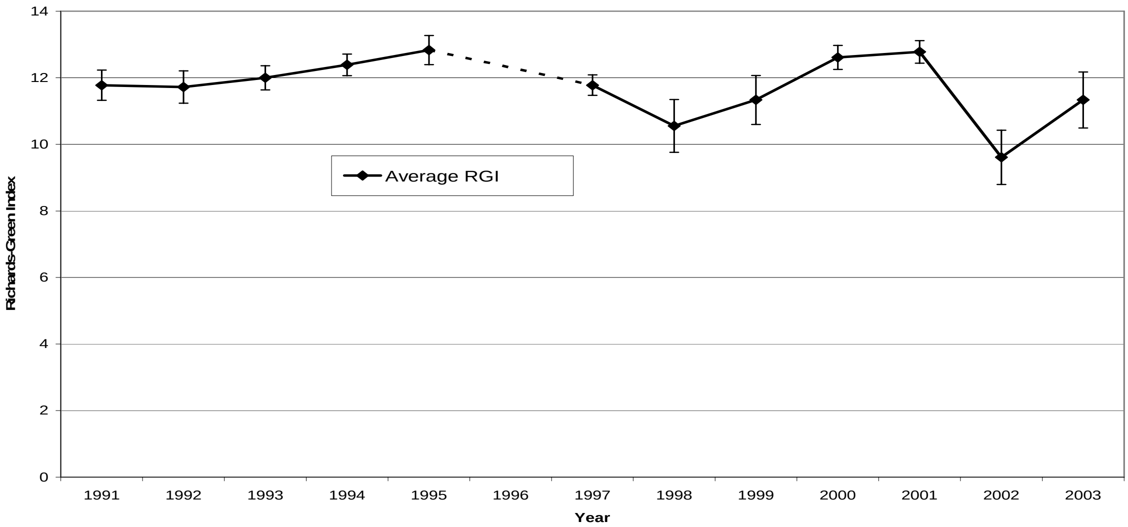

Figure 11. Change in values of the modified Richards-Green index for the Riverina Bioregion.

Seasonal change matrix

Table 8. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Riverina bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	57	7	89	4
Average	72	6	86	8
Below average	54	5	89	6

Discussion

- The Riverina bioregion had relatively stable values of the modified Richards Green index with the exception of 1998 and 2002. This was in spite of substantial variability in seasonal quality.
- The bioregion receives the highest annual rainfall of the NSW rangeland bioregions and generally supports the highest cover levels. This probably aids stability in landscape function.
- In this bioregion, pasture growth and the development of cover generally occur in response to cool-season rainfalls. Winter rainfalls had a slightly declining trend over the reporting period, with minimums in 1994 and 2002. High summer rainfalls fell in 1993-94 and 2000.
- Vegetation cover declined over the reporting period, possibly reflecting the decline of cool-season rainfall.

Simpson Strzelecki Dunefields Bioregion

Number of sites:

Data from eight sites have been extracted. These sites had consistent monitoring histories over the period 1990-2005 with the exception of 1993 when only one site was assessed.

Results

Temporal trend graph

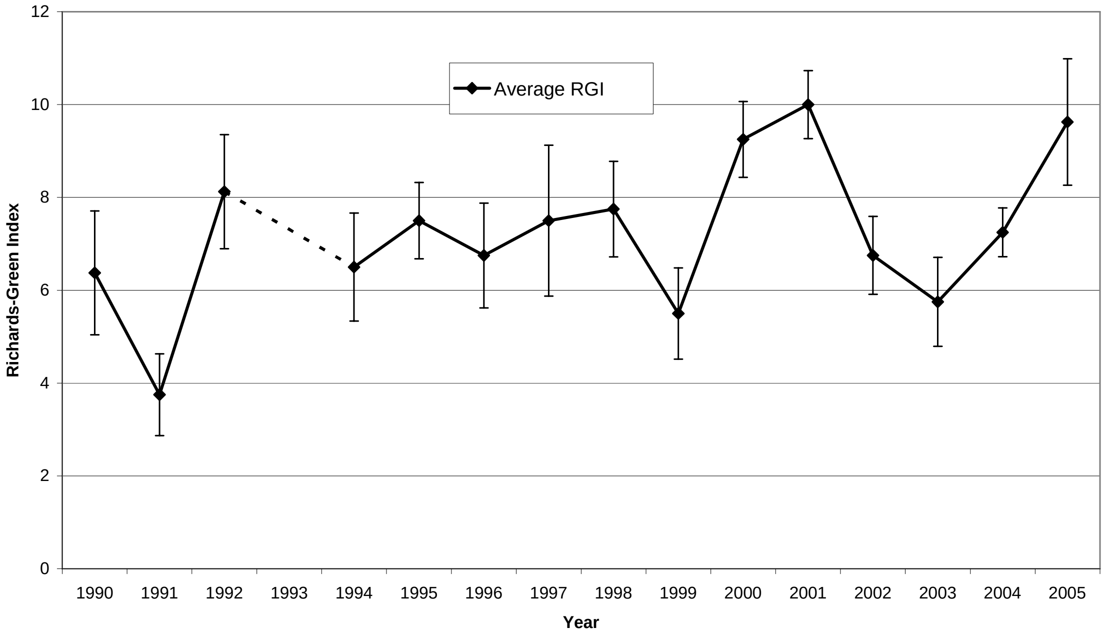

Figure 12. Change in values of the modified Richards-Green index for the Simpson Strzelecki Dunefields bioregion.

Seasonal change matrix

Table 9. Seasonally interpreted change in values of the modified Richards-Green index for site-by-year reassessments in the Simpson Strzelecki Dunefields bioregion.

		Change in Landscape Function		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decr in index	**Stable**	**Increase** >4 incr in index
Above average	40	20	55	25
Average	48	4	77	19
Below average	32	31	44	25

Discussion

- The Simpson-Strzelecki Dunefields Bioregion has highly variable summer-dominant rainfall, more-so than the other NSW rangeland bioregions.
- The trend in values of the modified Richards Green index broadly follows the summer rainfall pattern until 2003. The bioregion supports many summer growing species, although autumn-winter responsive *Astrostipa spp* is also prevalent.
- Index values declined at 20% of sites in high rainfall years and improved at 25% of sites in below-average years. This suggests that management responses were quite diverse, although eight sites provides only a small sample to report change for the entire bioregion.

THEME: SUSTAINABLE MANAGEMENT, CRITICAL STOCK FORAGE

Product: Frequency of Palatable Perennial Grasses

Method

Reporting change in critical stock forage is based on the frequency of selected palatable and perennial (2P) grasses recorded at RAP sites.

Data source

Rangeland Assessment Program, NSW Department of Environment and Climate Change.

Data collection

See Green *et al*. (1994). Annual recording of ground stratum floristics (presence of species) within 52 quadrats across four 300-m transects at permanently marked RAP sites. Frequency is based on the percentage of 52 quadrats recording an individual species. Perenniality criterion is based on the Flora of New South Wales (Harding GJ ed, V4 1993) and excludes facultative or opportunistic perennial species.

Analysis

RAP frequency data are collected on a species basis only and it is not feasible to calculate the frequency of species groupings such as “palatable perennial grasses”. The information presented here consists of site-based frequency data for the principal palatable perennial grass within each bioregion. Site data for each year have been averaged and the standard error also calculated.

The trend data only include values from those sites on which a particular species has been recorded at some stage during the reporting period. It was considered that this approach had greater validity than averaging values over all sites, some of which may not be capable of supporting a particular species.

The grass species selected for presentation are those most widespread and abundant within each bioregion and also known to respond to grazing use.

Comments on data

Generally the species selected for data presentation is persistent in the landscape under varying seasonal conditions.

Reporting change

The following graphs and ‘cause’ tables show change in critical stock forage for selected 2P grasses in each bioregion. In each cause table, the red cell reports the percentage of site-times where the 2P grass frequency declined following above-average seasonal quality (increase expected at this time). Correspondingly, the green cell shows the percentage of site-times where the 2P grass frequency increased following below-average seasonal quality (decrease expected at this time).

CRITICAL STOCK FORAGE TRENDS BY BIOREGIONS

Brigalow Belt South Bioregion

Number of sites

Data from the four sites within this bioregion have been extracted. These sites have consistent monitoring histories over the period 1989-2002.

Comments on data

Thyridolepis mitchelliana is the most common palatable perennial (2P) grass in this bioregion. Other 2P grasses have been recorded at sites but to a limited extent. *Stipa spp* is also presented as it is a major component of pastures despite its relatively low grazing value and response to grazing.

Results

Temporal trend graph

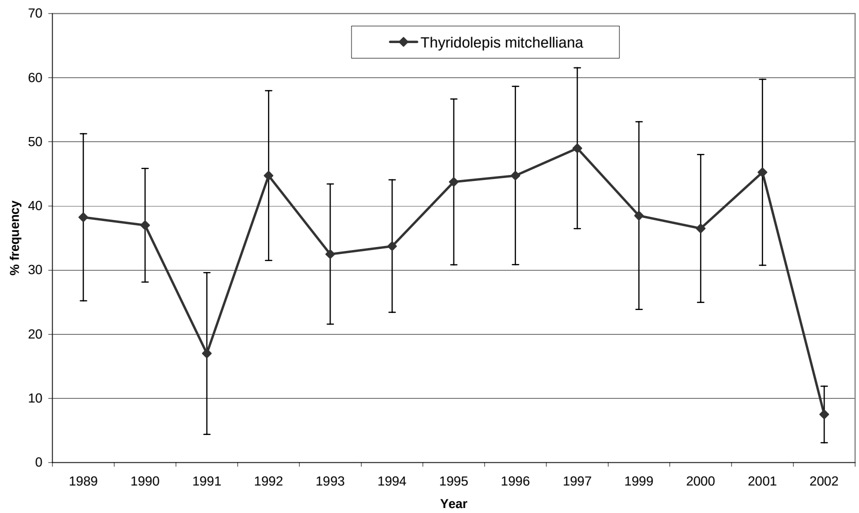

Figure 13. Change in frequency of the 2P grass *Thyridolepis mitchelliana* in the Brigalow Belt South Bioregion.

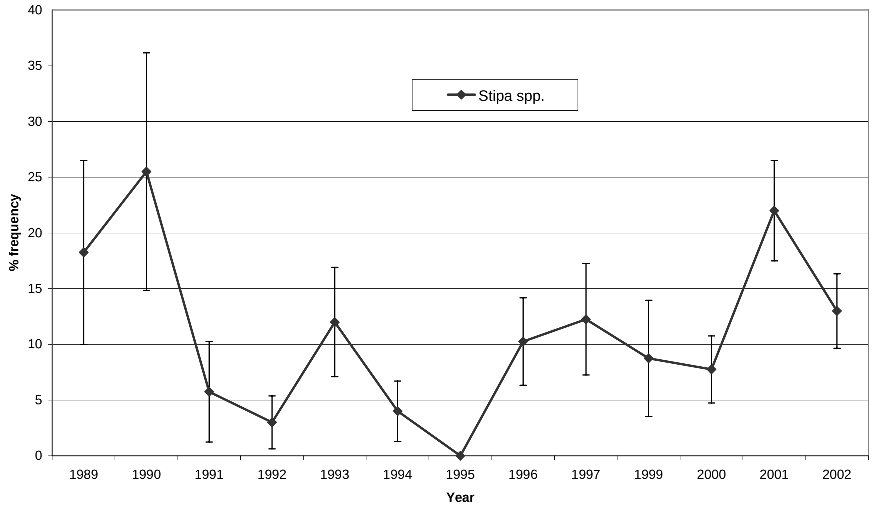

Figure 14. Change in frequency of the 2P grass *Stipa spp* in the Brigalow Belt South Bioregion.

Seasonal change matrix

Insufficient number of sites to report for the bioregion.

Discussion

- The bioregion experiences summer dominant rainfall. This favours *Thyridolepis* spp over *Stipa* spp as the latter responds best to cool-season rainfall.
- The relatively high frequency of *Thyridolepis* is a reflection of the relatively high rainfall and productivity of this bioregion over the other rangeland regions. Frequency of occurrence of this grass was relatively constant with the exception of 1991 and 2002, both years of low summer and low winter rainfall.
- *Stipa* spp appears to have responded to high winter rainfall in 1990 and high summer rainfall in 2001, possibly leading to good soil moisture levels during its growth period in the cooler months.

Broken Hill Complex Bioregion

Number of sites

Data from 24 sites have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Comments on data

The more common perennial grasses were selected for presentation. Data have been averaged only from those sites where the particular species has been recorded (i.e. *Astrebla lappacea*, 6 sites; *Eragrostis eriopoda*, 6 sites; *Stipa spp*, 23 sites; and *Panicum decompositum*, 14 sites). *Astrebla lappacea* is the most productive palatable perennial grass present within the bioregion. Although *Eragrostis eriopoda* is considered unresponsive to grazing in many areas of the rangelands, it is well regarded as a fodder plant in western NSW and also responsive to grazing pressure. *Stipa spp* is included as it is the most widespread and abundant grass in many situations. *Panicum decompositum* is a valuable perennial grass but generally of limited abundance and distribution in pastures.

Results

Temporal trend graph

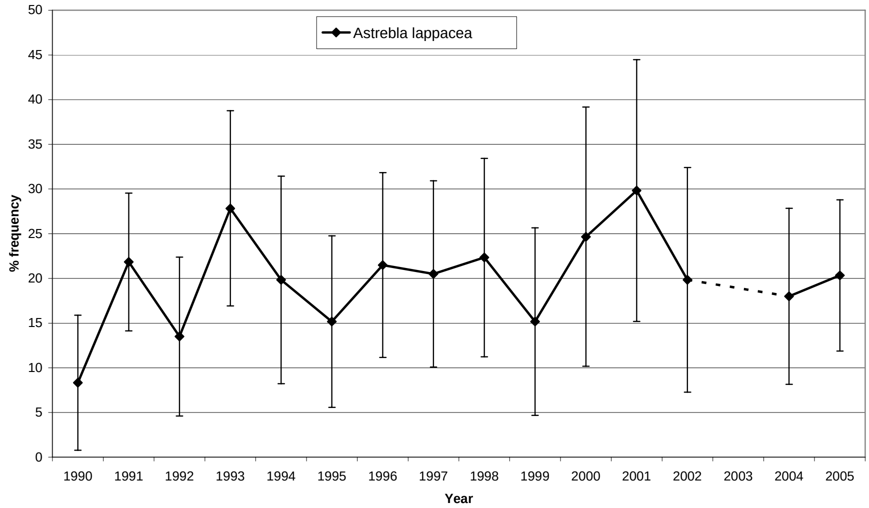

Figure 15. Change in frequency of the 2P grass *Astrebla lappacea* in the Broken Hill Complex Bioregion.

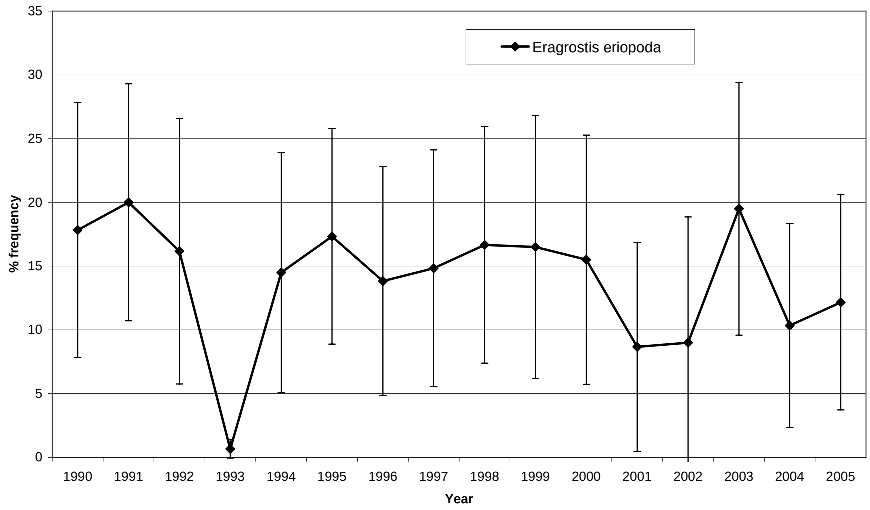

Figure 16. Change in frequency of the 2P grass *Eragrostis eriopoda* in the Broken Hill Complex Bioregion.

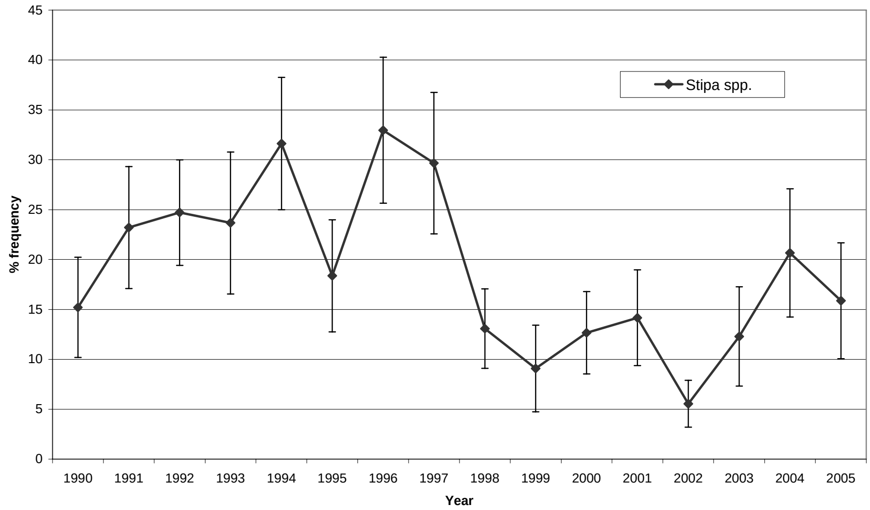

Figure 17. Change in frequency of the 2P grass *Stipa spp* in the Broken Hill Complex Bioregion.

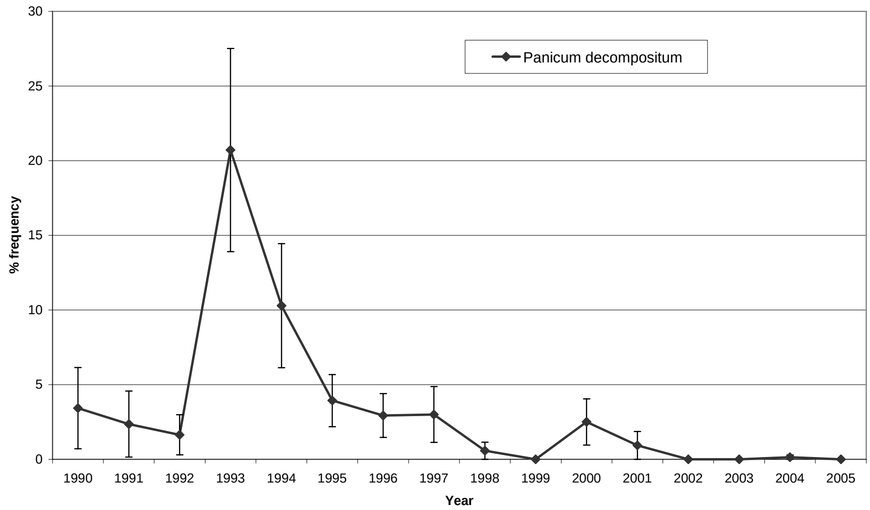

Figure 18. Change in frequency of the 2P grass *Panicum decompositum* in the Broken Hill Complex Bioregion.

Seasonal change matrix

Table 10. Seasonally adjusted change in frequency of the 2P grass *Astrebla lappacea* in the Broken Hill Complex Bioregion.

Astrebla lappacea

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >13 decrease in freq	**Stable**	**Increase** >14 increase in freq
Above average	30	17	63	20
Average	42	7	74	19
Below average	18	22	78	0

Discussion

- *Astrebla lappaceae* was a persistent grass in the landscape maintaining a frequency of occurrence within quadrats of 15 to 30% at most sites through most of the reporting period. This persistence is supported by the stability shown in the Seasonal Change matrix (i.e. cause table) although its frequency decreased appreciably at 17% of site-time assessments following below-average seasonal quality.
- There was considerable variation amongst sites in the frequency of occurrence of 2P grasses, illustrated by the very large standard errors about the mean for most species in most years.
- Some identification errors may occur between *Stipa* and *Eragrostis eriopoda*.
- An above-average summer in 1992 was the driver for peaks in the frequency of grasses such as *Panicum decompositum.*
- *Eragrostis eriopoda* behaves as a “decreaser” species in western NSW, where it is actively grazed by sheep, goats and macropods. This is contrary to its perceived value in some other areas of the Australian rangelands.

Channel Country Bioregion

Number of sites

Data from the 3 sites within the bioregion have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Comments on data

Curly Mitchell grass (*Astrebla lappacea*) was the most significant perennial grass on the Channel Country sites.

Results

Temporal trend graph

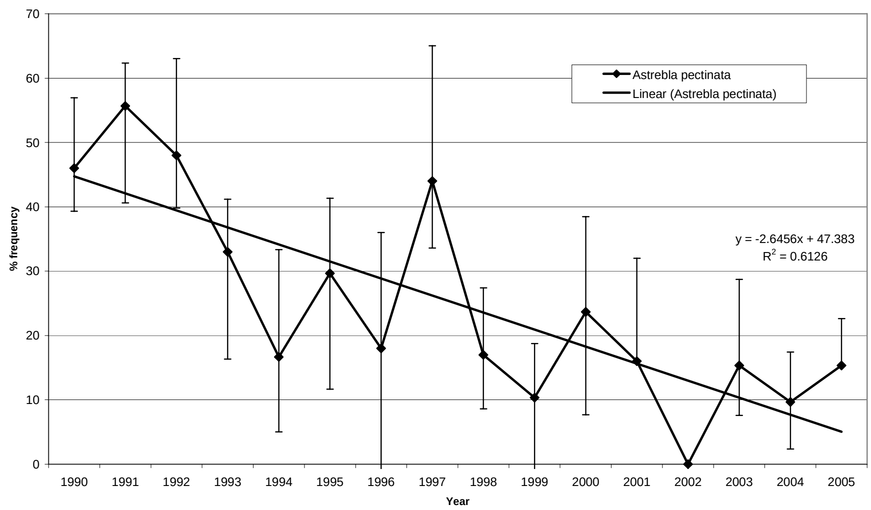

Figure 19. Change in frequency of the 2P grass *Astrebla lappacea* in the Channel Country Bioregion.

Seasonal change matrix

There are insufficient sites to accurately report change for the Channel Country.

Discussion

- This assessment is based on data from only three sites. However, these are quite consistent in land type, with two located on a National Park and one on pastoral lease.
- There is clearly a declining trend in *Astrebla* frequency over the reporting period. This is possibly in accord with an apparent slight negative trend in seasonal quality.

Cobar Peneplain Bioregion

Number of sites

Data from 18 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2003 with the exception of 1996 when three sites were not assessed. 1999 data have therefore been excluded from the series for some species. Data from 1990 and 2004-05 are also incomplete and have been selectively presented.

Comments on data

Common palatable perennial grasses have been selected for presentation. *Thyridolepis mitchelliana* and *Monochather paradoxa* are the most widespread species present within the bioregion, but are seldom abundant. *Austrodanthonia caespitosa* is generally present in low abundance in the more southerly parts of the bioregion, while *Eragrostis eriopoda* is more typical of northern areas.

Results

Temporal trend graph

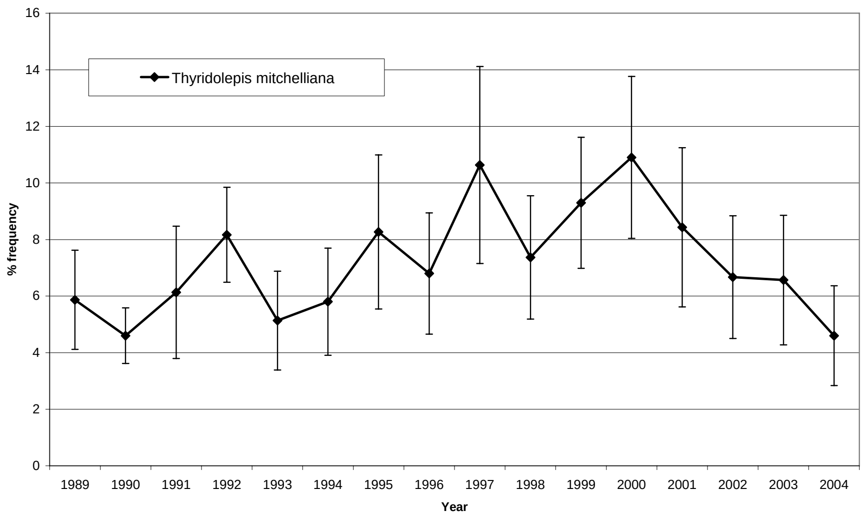

Figure 20. Change in frequency of the 2P grass *Thyridolepis mitchelliana* in the Cobar Peneplain Bioregion.

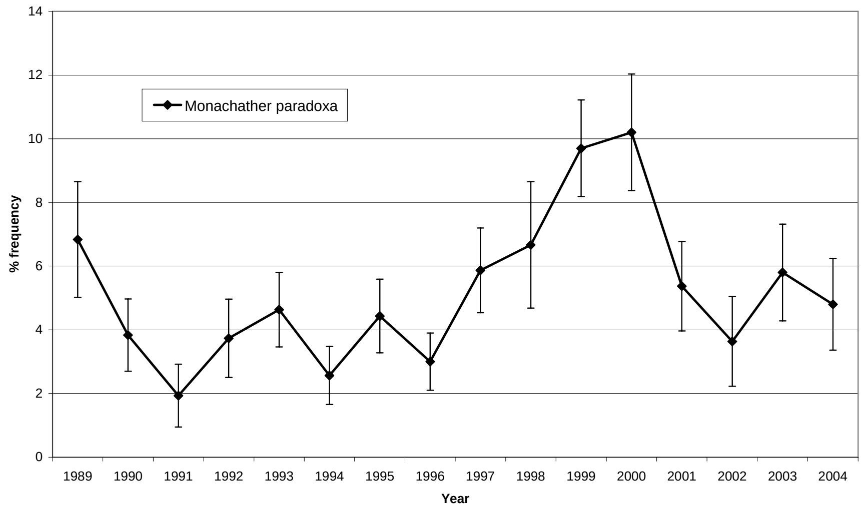

Figure 21. Change in frequency of the 2P grass *Monachather paradoxa* in the Cobar Peneplain Bioregion.

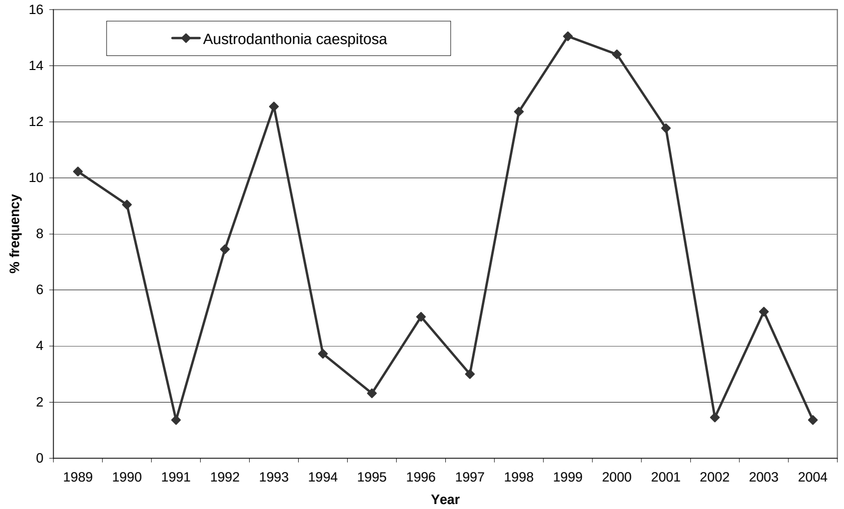

Figure 22. Change in frequency of the 2P grass *Austodanthonia caespitosa* in the Cobar Peneplain Bioregion.

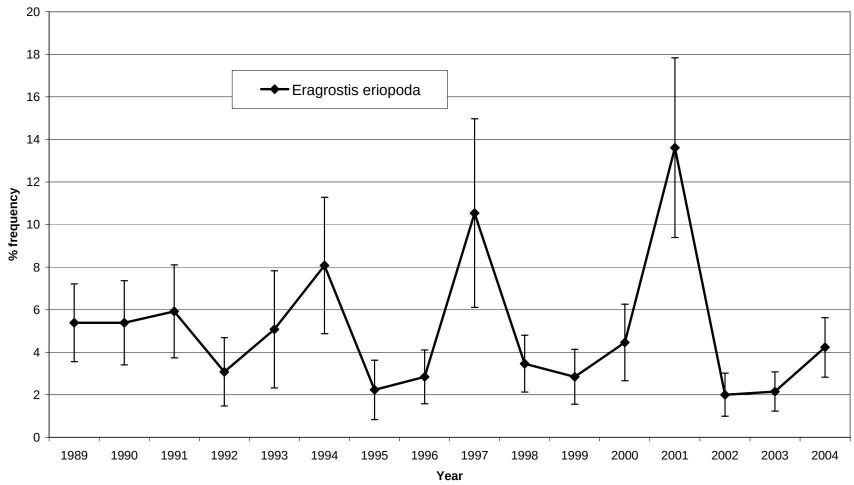

Figure 23. Change in frequency of the 2P grass *Eragrostis eriopoda* in the Cobar Peneplain Bioregion.

Seasonal change matrix

Table 11. Seasonally adjusted change in frequency of the 2P grass *Monachather paradoxa* in the Cobar Peneplain bioregion.

Monachather paradoxa

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >4 decrease in freq	**Stable**	**Increase** >4 increase in freq
Above average	150	7	84	9
Average	120	19	62	19
Below average	90	18	64	18

Discussion

- There was a general increasing trend in the percentage frequency for *Monachather paradoxa*, *Thyridolepis mitchelliana*, *Austodanthonia caespitosa* and *Eragrostis eriopoda* from the early 1990s up until 2001. This is consistent with the summer seasonal conditions up until 2002 when very dry conditions became prevalent.
- Both *Monachather paradoxa* and *Thyridolepis mitchelliana* are persistent grasses in the landscape indicated by their stability during a range of seasonal conditions.
- Peaks in the percentage frequency in 2000 for both *Monachather paradoxa* and *Thyridolepis mitchelliana* are consistent with above-average summer rainfall in the 1999/2000 summer.
- *Monachather paradoxa* is quite drought resistant and when grazed heavily can continue to produce flowering heads which lie on the soil surface. It rarely dominates the pasture, tending to grow as scattered plants. These factors explain its stability during below-average and average seasons.

Darling Riverine Plains Bioregion

Number of sites

Data from 18 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2003 with the exception of 1998-99 when numerous sites were not assessed. 1998-99 data have therefore been excluded from the series.

Comments on data

Astrebla lappacea is the most widespread 2P species within the bioregion and data have been extracted from 23 sites. *Astrebla elymoides* has high productive value but limited extent and data have been extracted from 14 sites. *Eragrostis setifolia,* considered an increaser species on productive soils elsewhere in the Australian rangelands, is often the predominant perennial grass on the soils of this bioregion and behaves as a decreaser. Data have been used from 32 sites. Data for *Sporobolus mitchelli* have been extracted from 16 sites.

Results

Temporal trend graph

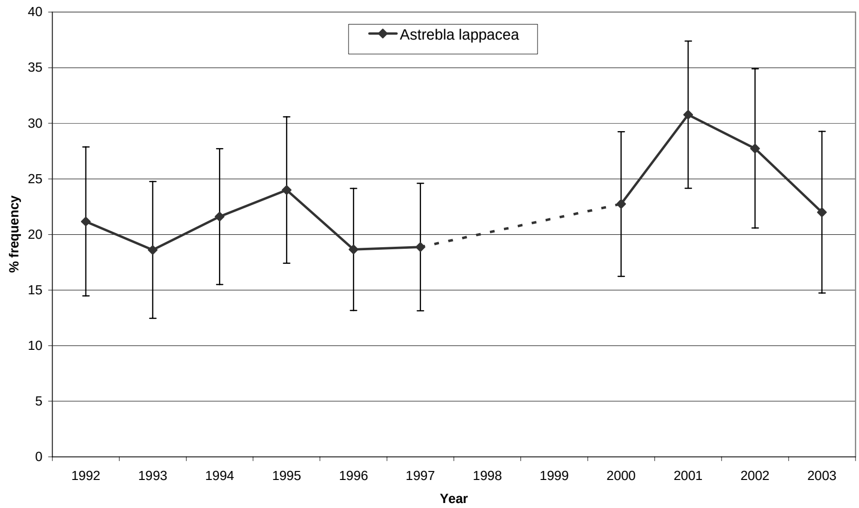

Figure 24. Change in frequency of the 2P grass *Astrebla lappacea* in the Darling Riverine Plain Bioregion.

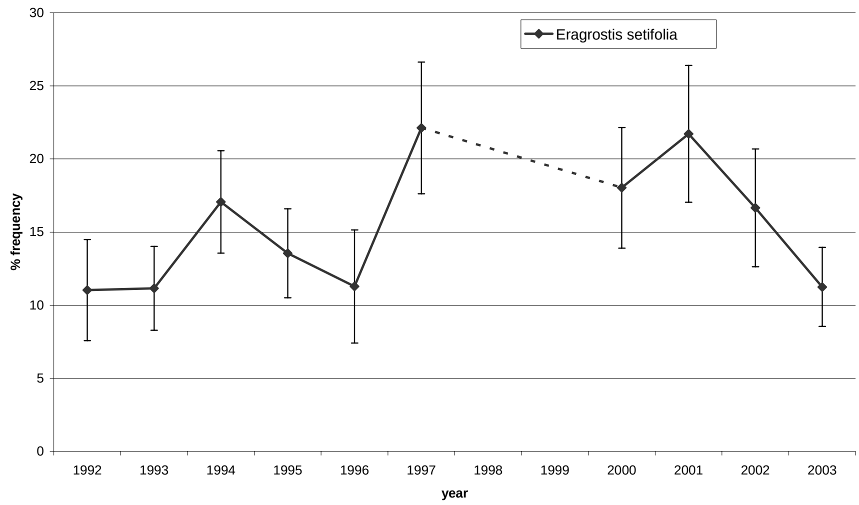

Figure 25. Change in frequency of the 2P grass *Eragrostis setifolia* in the Darling Riverine Plain Bioregion.

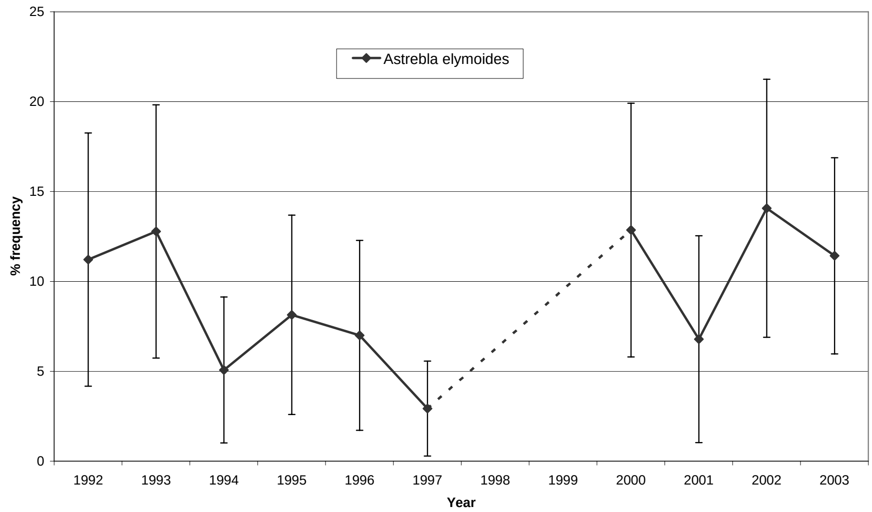

Figure 26. Change in frequency of the 2P grass *Astrebla elymoides* in the Darling Riverine Plain Bioregion.

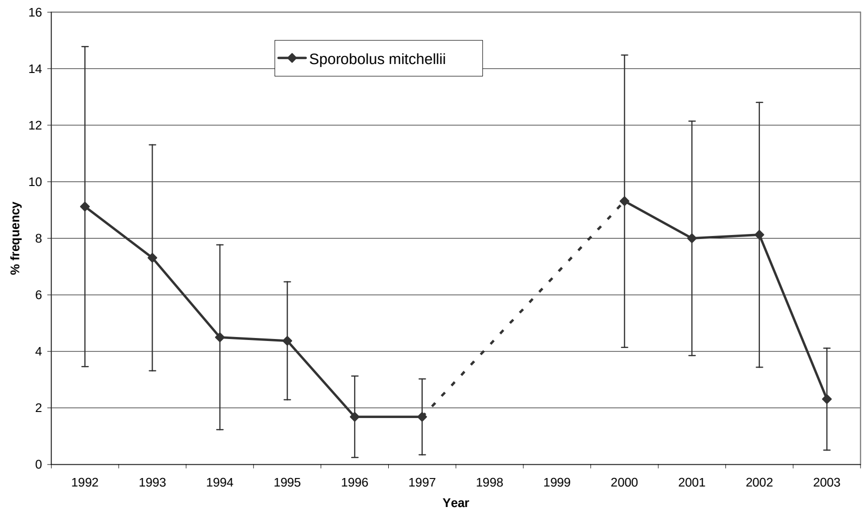

Figure 27. Change in frequency of the 2P grass *Sporobolus mitchelli* in the Darling Riverine Plain Bioregion.

Seasonal change matrix

Table 12. Seasonally adjusted change in frequency of the 2P grass *Astrebla lappacea* in the Darling Riverine Plain bioregion.

Astrebla lappacea

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >11 decrease in freq	**Stable**	**Increase** >12 increase in freq
Above average	69	17	71	12
Average	46	17	65	17
Below average	69	9	83	9

Discussion

- *Eragrostis setifolia* behaves as a "decreaser" species in western NSW, where it is actively grazed by sheep, goats and macropods. This is contrary to its perceived value in some other areas of the Australian rangelands.
- There was an increasing trend in the percentage frequency of *Astrebla lappacea* and *Eragrostis setifolia* in the reporting period until 2001. This is consistent with average or above-average winter rainfall with the exception of 1994.
- The sharp decline in percentage frequency for *Astrebla lappacea* and *Eragrostis setifolia* after 2001 is due to the below-average winter seasons in 2002 and 2003.
- *Astrebla lappacea* and *Eragrostis setifolia* appear to be quite stable in the landscape even though they are both highly palatable.

Mulga Lands Bioregion

Number of sites

Data from 18 sites have been extracted. These sites have consistent monitoring histories over the period 1991-2004 with the exception of 1999 when five sites were not assessed. 1999 data have therefore been excluded from the time series for some 2P species.

Comments on data

Common palatable perennial grasses have been selected for presentation in this report. Data for *Thyridolepis mitchelliana* have been extracted from 15 sites, *Monochather paradoxa* 14 sites and *Eragrostis eriopoda* 15 sites.

Results

Temporal trend graph

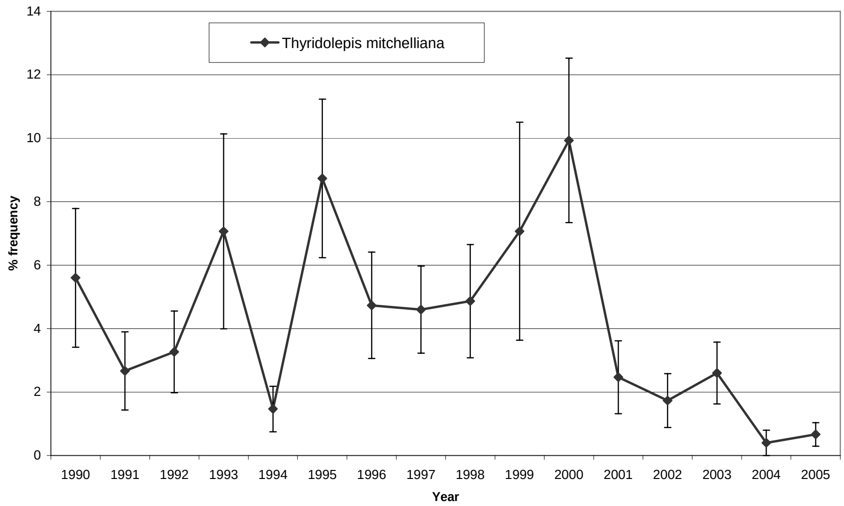

Figure 28. Change in frequency of the 2P grass *Thyridolepis mitchelliana* in the Mulga Lands Bioregion.

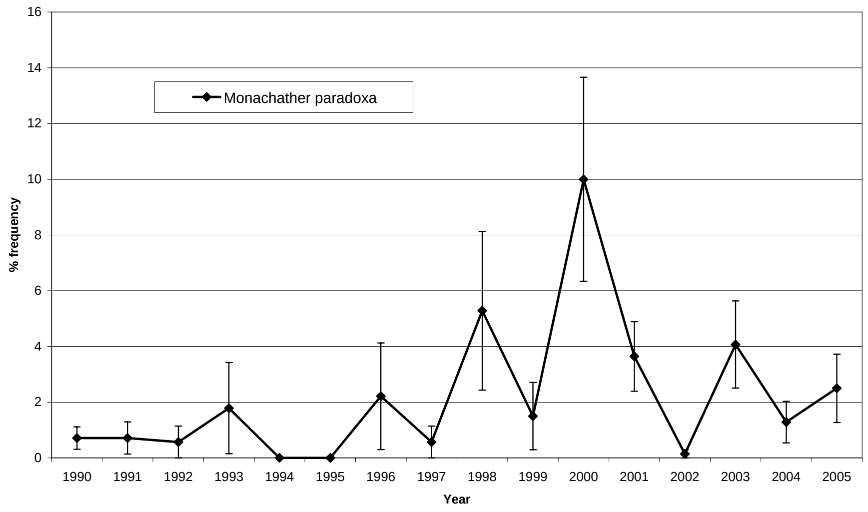

Figure 29. Change in frequency of the 2P grass *Monochather paradoxa* in the Mulga Lands Bioregion.

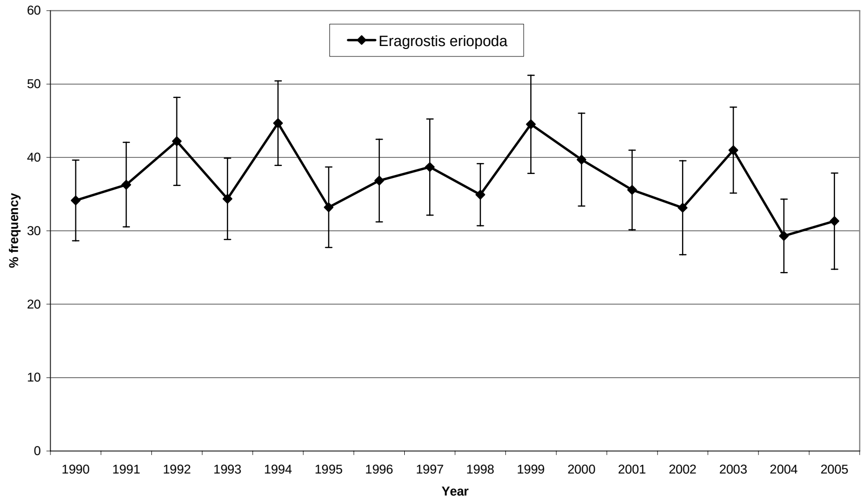

Figure 30. Change in frequency of the 2P grass *Eragrostis eriopoda* in the Mulga Lands Bioregion.

Seasonal change matrix

Table 13. Seasonally adjusted change in frequency of the 2P grass *Thyridolepis mitchelliana* in the Mulga Lands bioregion.

Thyridolepis mitchelliana		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >6 decrease in freq	**Stable**	**Increase** >4 increase in freq
Above average	42	0	100	0
Average	84	11	76	13
Below average	84	27	50	23

Discussion

- Above-average seasons in the late 1990s and then below average seasons after 2001 explain most of the increasing trend and then crash of *Thyridolepis mitchelliana* in the bioregion. This grass is generally persistent in the landscape even under below-average seasonal conditions.
- *Eragrostis eriopoda* showed a general decrease in percentage frequency over the reporting period. Although persistent in the landscape, this species is reported to be very slow to re-establish. This downward trend may be due to slow recovery as a result of below-average seasons in the mid 1990s and early 2000s coupled with high stocking rates including goats in the late 1990s.
- There was virtually no response of increased percentage frequency of *Eragrostis eriopoda* to above-average or average seasonal conditions during the reporting period.

Murray Darling Depression Bioregion

Number of sites

Data were potentially available from 67 sites. Most sites had consistent monitoring histories.

Comments on data

The palatable perennial grasses selected for this report are *Austrodanthonia caespitosa* (39 sites) along with *Danthonia spp* (42 sites), *Stipa spp* (69 sites) and *Eragrostis eriopoda* (nine sites). *Stipa spp*, while not a highly palatable species, is the mainstay of many pastures within the bioregion. *Eragrostis eriopoda* is important in a relatively discrete area in the north of the bioregion.

Results

Temporal trend graph

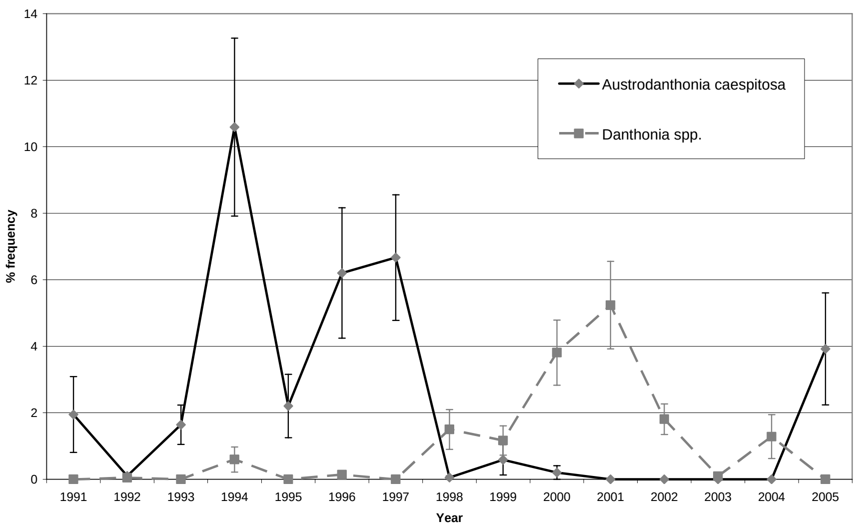

Figure 31. Change in frequency of the 2P grass *Austrodanthonia caespitosa* in the Murray Darling Depression Bioregion.

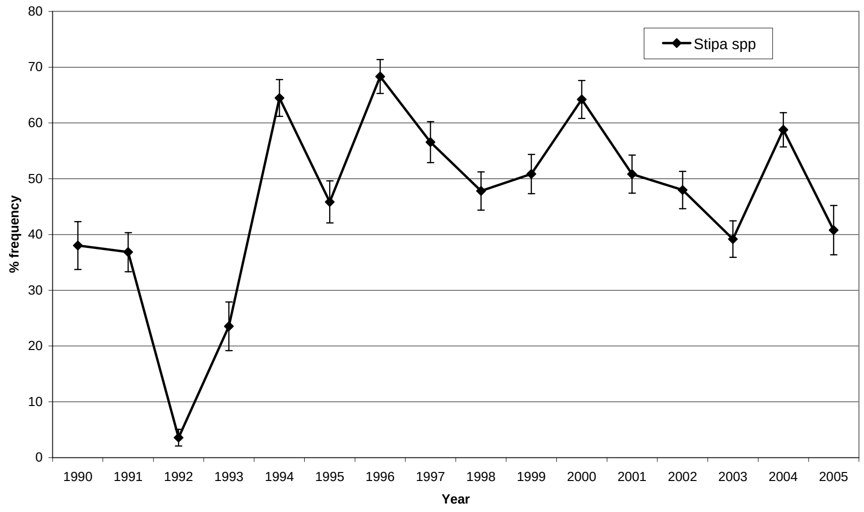

Figure 32. Change in frequency of the 2P grass *Stipa spp* in the Murray Darling Depression Bioregion.

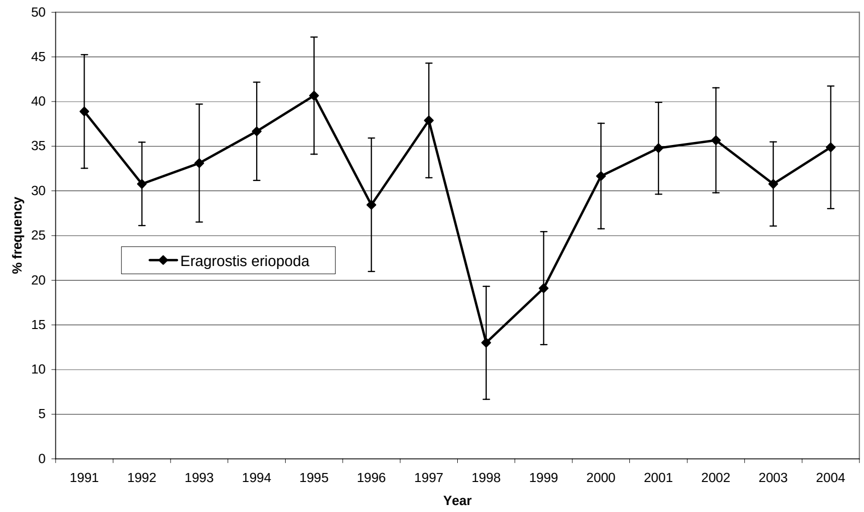

Figure 33. Change in frequency of the 2P grass *Eragrostis eriopoda* in the Murray Darling Depression Bioregion.

Seasonal change matrix

Table 14. Seasonally adjusted change in frequency of the 2P grass *Stipa spp* in the Murray Darling Depression bioregion.

Stipa sp

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >29 decrease in freq	**Stable**	**Increase** >33 increase in freq
Above average	138	2	68	30
Average	621	16	69	15
Below average	207	18	76	6

Discussion

- *Stipa spp* was a persistent grass at high percentage frequency at sites in this bioregion throughout the reporting period.
- The sharp decline in its frequency in 1992 was associated with below-average winter rainfall.
- Growth of *Stipa spp* may be stimulated by winter or summer rainfall helping to explain its persistence in the landscape.
- The trend for *Eragrostis eriopoda* is derived from a discrete group of sites in the northern portion of the bioregion. The species is uncommon throughout the remainder of the region.

Riverina Bioregion

Number of sites

Data from 18 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2003 with the exception of 1996 when three sites were not assessed (1996 data presented below though).

Comments on data

The trend for *Austrodanthonia caespitosa* is presented based on the data from 17 sites.

Results

Temporal trend graph

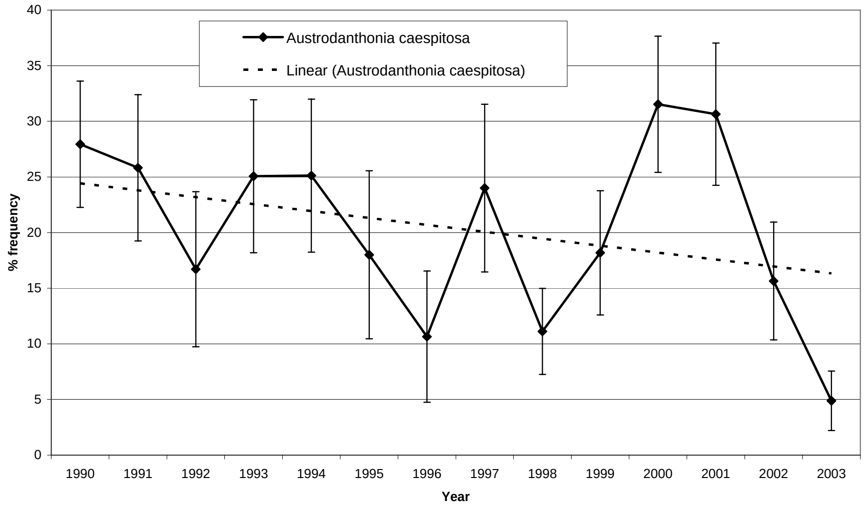

Figure 34. Change in frequency of the 2P grass *Austrodanthonia caespitosa* in the Riverina Bioregion.

Seasonal change matrix

Table 15. Seasonally adjusted change in frequency of the 2P grass *Austodanthonia spp* in the Riverina bioregion.

Austodanthonia sp

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >18 decrease in freq	**Stable**	**Increase** >13 increase in freq
Above average	68	13	72	15
Average	102	13	66	21
Below average	51	22	78	0

Discussion

- There was a high degree of fluctuation of the percentage frequency of *Austodanthonia s*p at sites throughout the reporting period. *Austodanthonia spp*, although quite persistent in the landscape, retracts back to small butts that may easily be hidden (when assessing RAP sites) by large autumn flushes of annuals such as barley grass and rye grass.
- Significant growth of *Austodanthonia spp* often occurs at the end of winter and early summer. This growth (as frequency of occurrence) may not be correctly detected at the time of autumn site monitoring.
- There is a strong relationship evident between seasonal condition and the proportion of sites with increased and decreased percentage frequency of this species. A declining trend in abundance is evident from 1990 till 1999 and this broadly reflects the pattern of winter rainfall.

Simpson Strzelecki Dunefields Bioregion

Number of sites

Data from eight sites have been extracted. These sites had consistent monitoring histories over the period 1990-2005 with the exception of 1993 when only one site was assessed.

Comments on data

The trend for *Eragrostis eriopoda* is presented based on the data from eight sites. Within this bioregion, this species is the principal perennial grass.

Results

Temporal trend graph

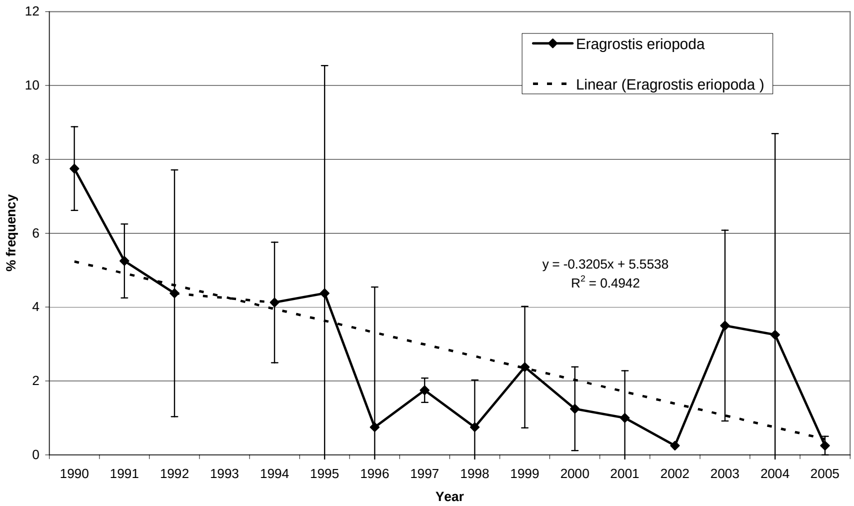

Figure 35. Change in frequency of the 2P grass *Eragrostis eriopoda* in the Simpson Strzelecki Dunefields Bioregion.

Seasonal change matrix

Table 16. Seasonally adjusted change in frequency of the 2P grass *Eragrostis eriopoda* in the Simpson Strzelecki Dunefields bioregion.

Eragrostis eriopoda

		Change in Critical Stock Forage		
Seasonal Quality	**# site by year combinations**	**Decrease** >3 decrease in freq	**Stable**	**Increase** >2 increase in freq
Above average	32	9	78	13
Average	48	23	67	10
Below average	24	8	75	17

Discussion

- There was a strong downward trend in the percentage frequency of *Eragrostis eriopoda* over the reporting period.
- Only 13% of sites had an increased frequency of this grass following above average seasonal conditions.
- Woody weed thickening and increasing grazing pressure due to the improving commercial value of goats during the late 1990s may have contributed to the downward trend.

THEME: BIODIVERSITY CHANGE

Product: Change in Plant Species Diversity

Method

This narrow aspect of biodiversity change is indicated by the count of native perennial and annual herbage species at RAP sites.

Data source

Rangeland Assessment Program, NSW Department of Natural Resources.

Data collection

See Green *et al*. (1994). Annual recording of ground stratum floristics within 52 quadrats across four 300-m transects at permanently marked Rangeland Assessment Program sites.

Analysis

Site data have been averaged. Species diversity has been determined for total, exotic, annual and perennial plant categories.

Comments on data

Species diversity is based on the count of species recorded at sites each year. Assessments are undertaken before the dominant growing season (spring in the north, autumn in the south) and capture the worst-case situation. The principal source of error is where observers have recorded groups of species to the genus level only, thereby underestimating species diversity.

It should be noted that the timing of site readings is designed to be at the end of the growing season and hence focus on the residual perennial component of the pasture rather than the annual flux. The site reading methods however do aim to detect all species present at the site including annuals. Many annuals at the end of the growing season are often very perished, grazed or partially broken down and hence difficult to identify. For this reason some generic codes are assigned in order to at least record if an annual species was present. It therefore needs to be considered that annual species diversity will vary according to the use of these codes by the operator and the capacity of the operator to identify annual pasture species.

Reporting change

The following graphs and 'cause' tables show change in plant species diversity in each bioregion. In each cause table, the red cell reports the percentage of site-times where native species diversity declined following above-average seasonal quality (increase expected at this time). Correspondingly, the green cell shows the percentage of site-times where native species diversity increased following below-average seasonal quality (decrease expected at this time).

PLANT SPECIES DIVERSITY BY BIOREGION

Brigalow Belt South Bioregion

Number of sites

Data from four sites have been extracted. These sites have consistent monitoring histories over the period 1989-2002.

Results

Temporal trend graph

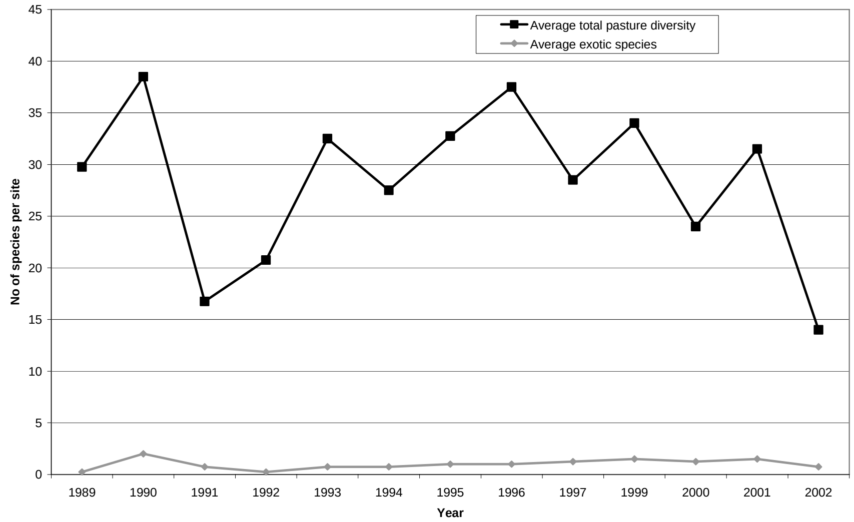

Figure 36. Change in species diversity of all pasture species and exotic species for the Brigalow Belt South bioregion.

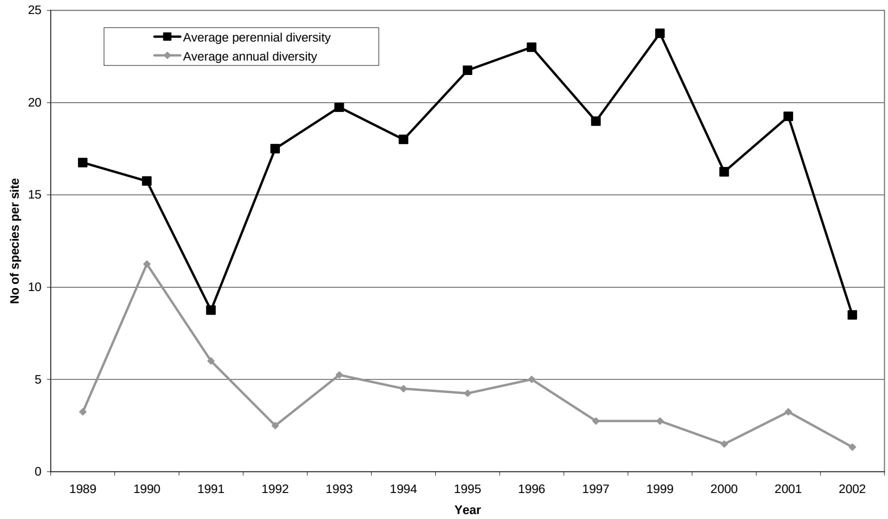

Figure 37. Change in species diversity of perennial and annual plants for the Brigalow Belt South bioregion.

Seasonal change matrix

There are insufficient sites to interpret seasonal change in native plant species diversity.

Discussion

- The trend in species diversity broadly follows seasonal quality, which was depressed in 1991-92 and 2002. In both these periods both summer and winter rains were low.
- There was a low number of exotic species recorded at these sites.
- The perennial species trend mirrors total diversity. Perennials appear to be the major component of variation in year to year diversity.
- Annual species numbers were relatively low. They peaked in 1992 coinciding with high winter rainfall in that year.
- There was a decrease in species diversity at the majority of sites during below-average seasons whilst relative stability occurred during above-average seasons.

Broken Hill Complex Bioregion

Number of sites

Data from 24 sites have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Results

Temporal trend graph

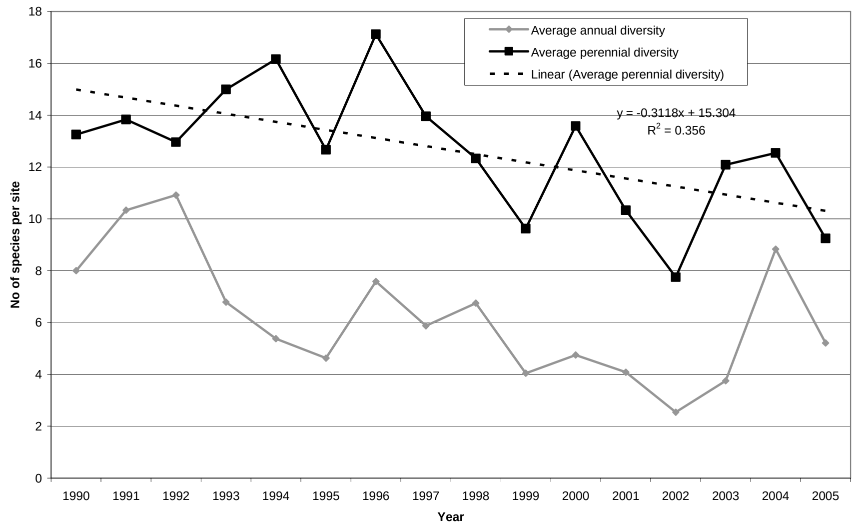

Figure 38. Change in species diversity of perennial and annual plants for the Broken Hill Complex bioregion.

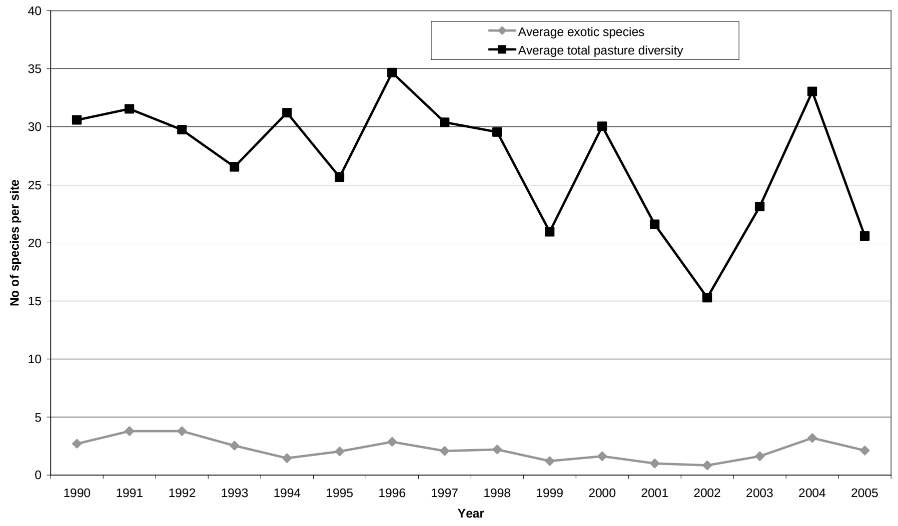

Figure 39. Change in species diversity of all pasture species and exotic species for the Broken Hill Complex bioregion.

Seasonal change matrix

Table 17. Seasonally interpreted change in native species diversity for the Broken Hill Complex bioregion.

Seasonal Quality	# site by year combinations	Change in Species Diversity: Decrease >14 decr in no. spp	Stable	Increase >14 incr in no. spp
Above average	120	23	63	14
Average	168	11	73	15
Below average	72	8	76	16

Discussion

- There was an overall downward trend in species diversity for the reporting period.
- Trend of annual diversity mirrored that of perennial diversity.
- Peaks in perennial diversity for 1992/93 and 1999/2000 coincided with above average summer rainfall for the IBRA.
- There was a relatively minor, and stable, number of exotic species present.
- There is a strong correlation with increased species diversity and above-average seasons and a good correlation between decreased species diversity and below-average seasons.
- Generally, species diversity was stable during below-average seasons.

Channel Country Bioregion

Number of sites

Data from three sites have been extracted. These sites have consistent monitoring histories over the period 1990-2005.

Results

Temporal trend graph

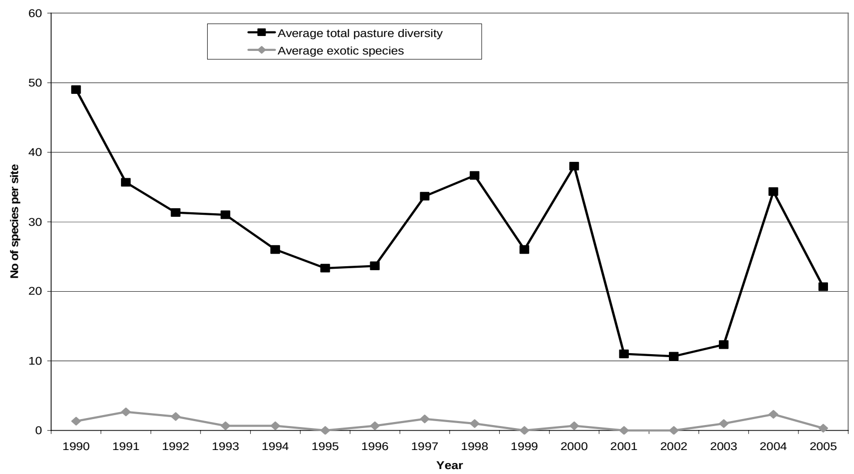

Figure 40. Change in species diversity of all pasture species and exotic species for the Channel Country bioregion.

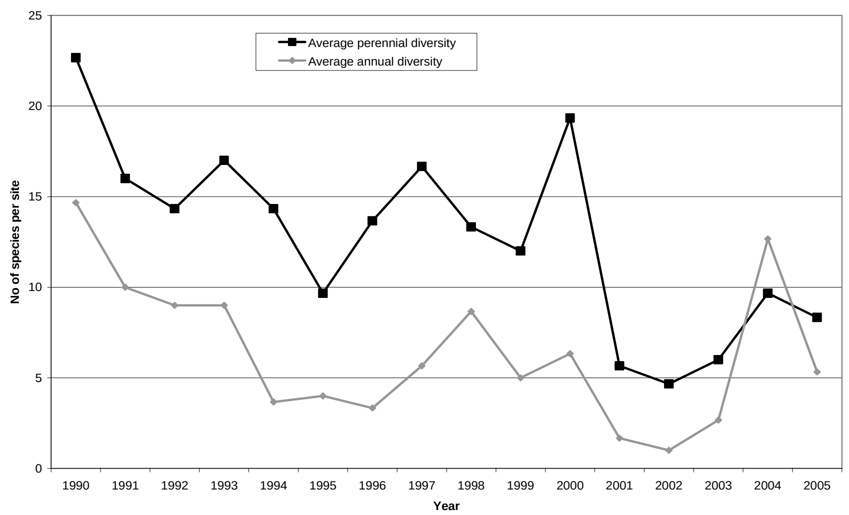

Figure 41. Change in species diversity of perennial and annual plants for the Channel Country bioregion.

Seasonal change matrix

There are insufficient sites to interpret seasonal change in native plant species diversity.

Discussion

- The sample size is too small to make any confident conclusions from the data. Notably, the sites are on quite similar land types: two are located within a National Park and one is close by on an adjacent pastoral lease.
- Peaks in total diversity and perennial diversity coincide with above-average summer rainfall in 1999/2000 and 2003/04.

Cobar Peneplain Bioregion

Number of sites

Data from 30 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2005.

Results

Temporal trend graph

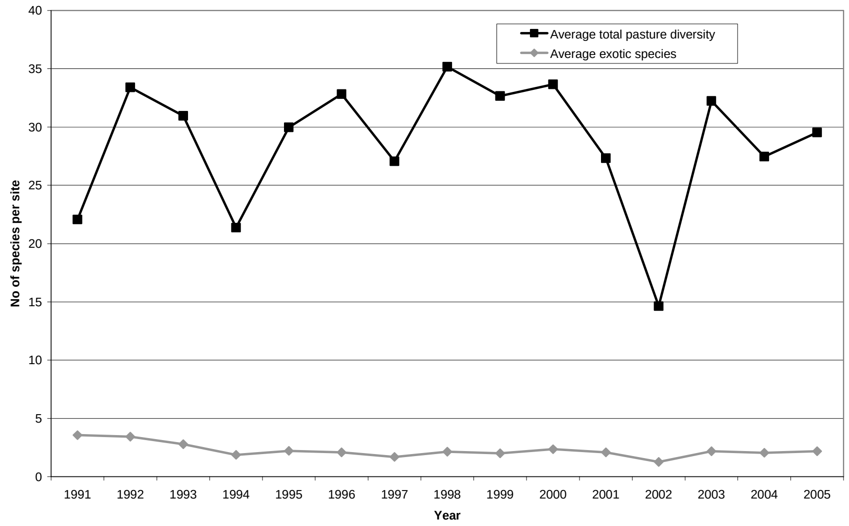

Figure 42. Change in species diversity of all pasture species and exotic species for the Cobar Peneplain bioregion

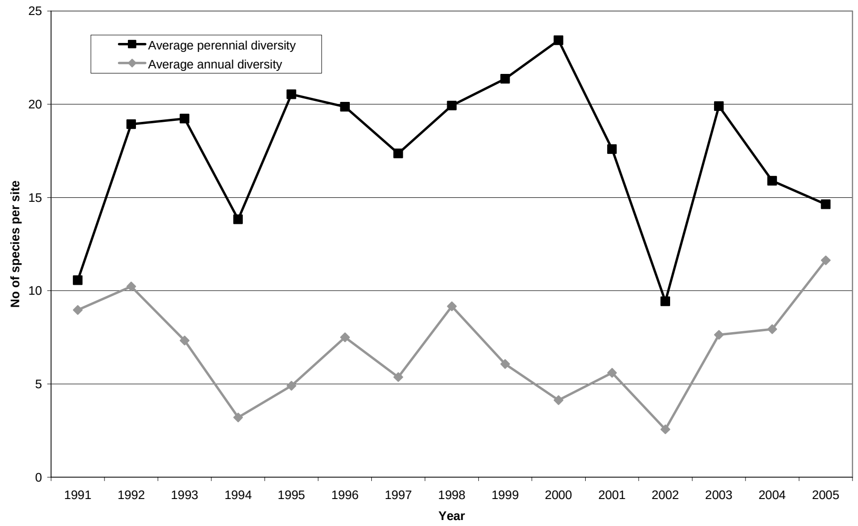

Figure 43. Change in species diversity of perennial and annual plants for the Cobar Peneplain bioregion.

Seasonal change matrix

Table 18. Seasonally interpreted change in native species diversity for the Cobar Peneplain bioregion.

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >11 decr in no. spp	**Stable**	**Increase** >15 incr in no. spp
Above average	150	12	77	11
Average	123	15	63	22
Below average	90	40	59	1

Discussion

- Peaks in total species diversity coincided with above-average seasons in the summer of 1992/93, winter 1998 and summer 1999/2000.
- A high diversity of summer annuals was apparent with above-average summer rainfall in 1992/1993.
- A peak in perennial species was associated with above-average rainfall in summer 1999/2000. Perennials had the greatest influence on the trend in total diversity.
- The lowest perennial, annual and total pasture diversity scores were associated with well below-average seasons in 2002.
- Pasture diversity appeared to remain fairly constant during above-average and average seasons but decreased significantly during below-average seasons.

Darling Riverine Plains Bioregion

Number of sites

Data from 34 sites have been extracted. These sites had consistent monitoring histories over the period 1992-2003 with the exception of 1998-99 when a number of sites were not assessed. 1998-99 data has therefore been excluded from the series.

Results

Temporal trend graph

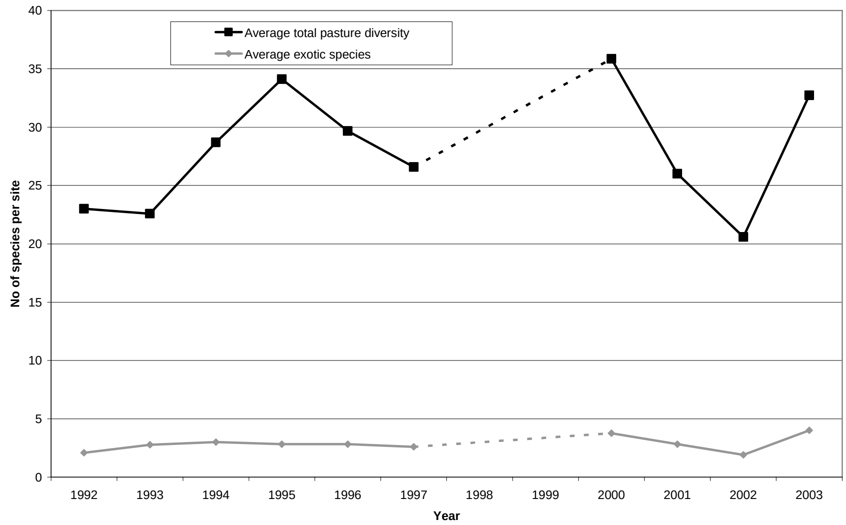

Figure 44. Change in species diversity of all pasture species and exotic species for the Darling Riverine Plains bioregion.

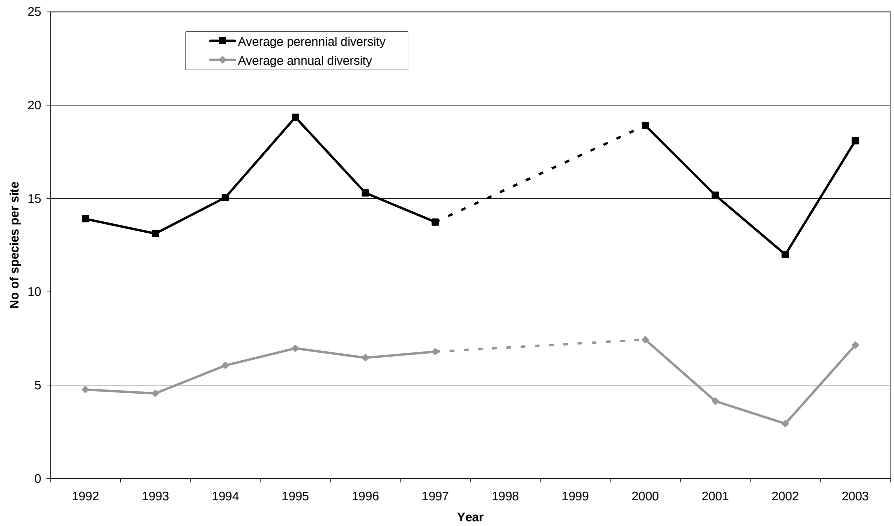

Figure 45. Change in species diversity of perennial and annual plants for the Darling Riverine Plains bioregion

Seasonal change matrix

Table 19. Seasonally interpreted change in native species diversity for the Darling Riverine Plains bioregion.

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >12 decr in no. spp	**Stable**	**Increase** >15 incr in no. spp
Above average	102	11	77	12
Average	68	24	75	1
Below average	102	11	66	23

Discussion

- Peaks in total pasture diversity were associated with above-average seasons in summer 1994/95 and summer 2000. The 1994/95 summer was preceded by an above-average winter in 1993. The 2000 summer was preceded by an above-average winter in 1998.
- An increase in pasture diversity was evident with above-average seasons.
- Summer rainfall drives pasture diversity on sites of the northern floodplains of this IBRA.
- Pasture diversity appeared to stay quite static during below-average seasons.

Mulga Lands Bioregion

Number of sites

Data from 17 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2004 with the exception of 1999 when five sites were not assessed. 1999 data have therefore been excluded from the series. Data points from 1990 and 2005 have been included in the series but in both cases, data are unavailable for two sites.

Results

Temporal trend graph

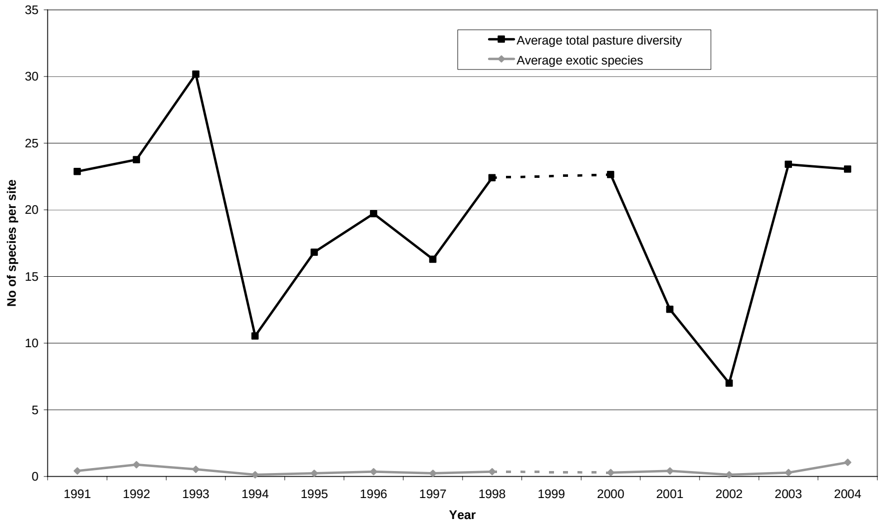

Figure 46. Change in species diversity of all pasture species and exotic species for the Mulga Lands bioregion.

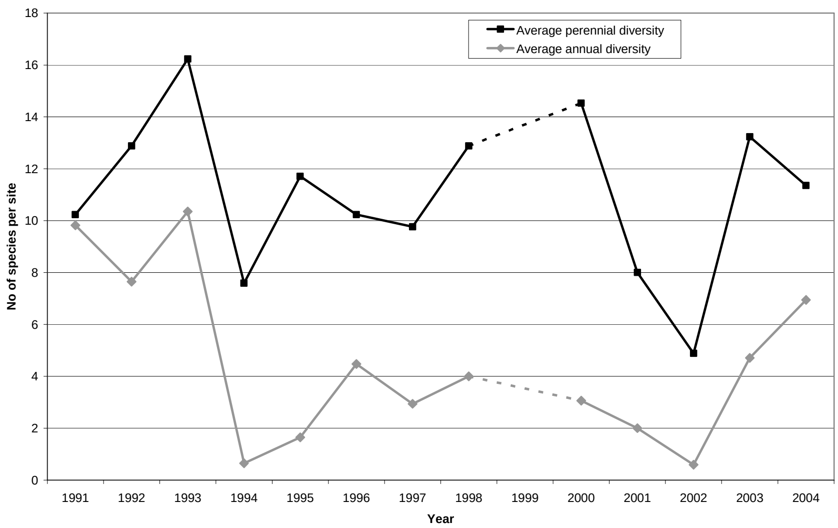

Figure 47. Change in species diversity of perennial and annual plants for the Mulga Lands bioregion.

Seasonal change matrix

Table 20. Seasonally interpreted change in native species diversity for the Mulga Lands bioregion.

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >12 decr in no. spp	**Stable**	**Increase** >15 incr in no. spp
Above average	34	0	79	21
Average	85	8	84	8
Below average	68	25	56	19

Discussion

- Very few exotic pasture species were recorded during the reporting period. This was a consistent trend towards the north-west of NSW.
- Peaks in total pasture diversity were associated with above-average summer rainfall in 1992/93, 1999/2000 and 2003/04.
- Low total pasture species diversity was associated with below-average rainfall in the summer of 2002/03.
- Pasture species diversity was generally stable under above-average and average seasons with an expected decrease during below-average seasons.

Murray Darling Depression Bioregion

Number of sites

Data from 71 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2005.

Results

Temporal trend graph

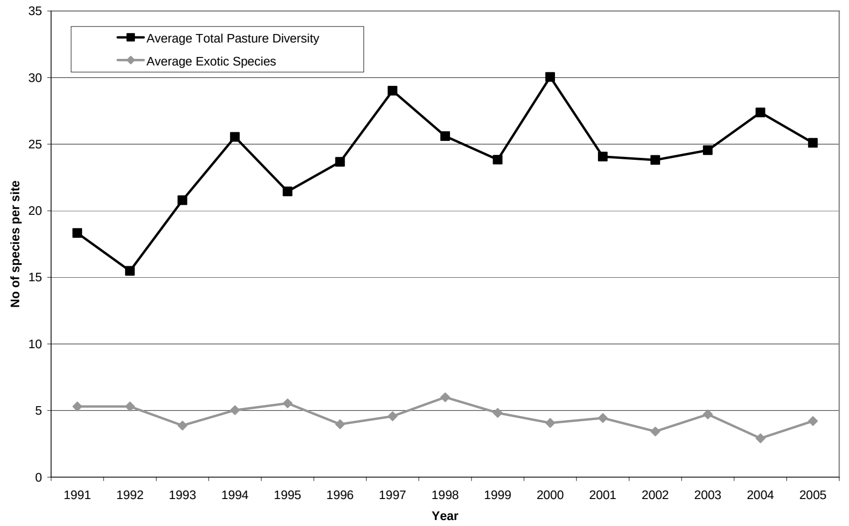

Figure 48. Change in species diversity of all pasture species and exotic species for the Murray Darling Depression bioregion.

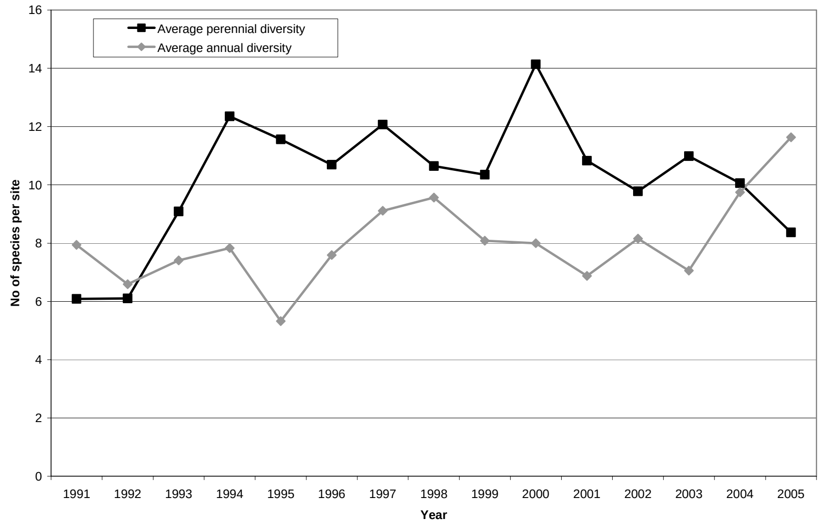

Figure 49. Change in species diversity of perennial and annual plants for the Murray Darling Depression bioregion.

Seasonal change matrix

Table 21 Seasonally interpreted change in native species diversity for the Murray Darling Depression bioregion

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >9 decr in no. spp	**Stable**	**Increase** >10 incr in no. spp
Above average	142	5	77	18
Average	639	15	72	13
Below average	213	16	76	8

Discussion

- A peak in total pasture diversity was associated with above-average rainfall during winter 1998 and summer 1999/2000.
- Generally these sites are dominated by perennial chenopods and the pasture diversity is relatively stable.
- There was a slight trend to improvement in total diversity across the reporting period. The component of exotic species was higher than in more northern bioregions.

Riverina Bioregion

Number of sites

Data from 15 sites have been extracted. These sites had consistent monitoring histories over the period 1991-2003.

Results

Temporal trend graph

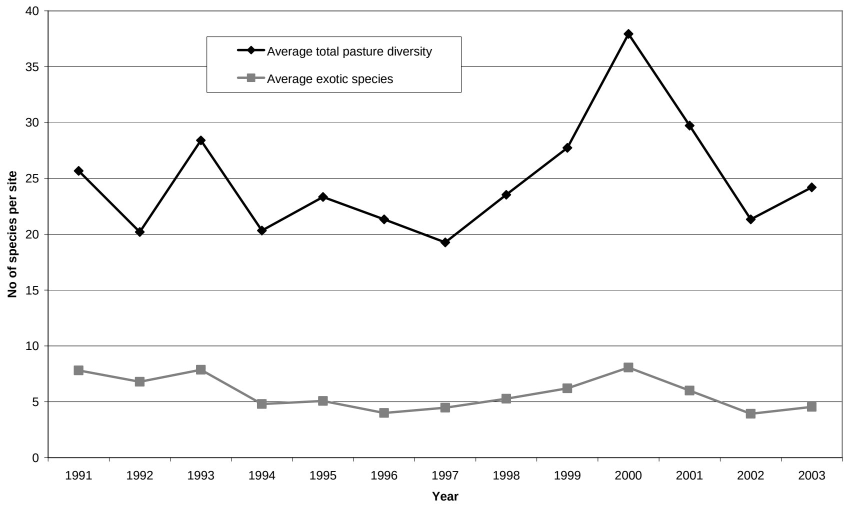

Figure 50. Change in species diversity of all pasture species and exotic species for the Riverina bioregion.

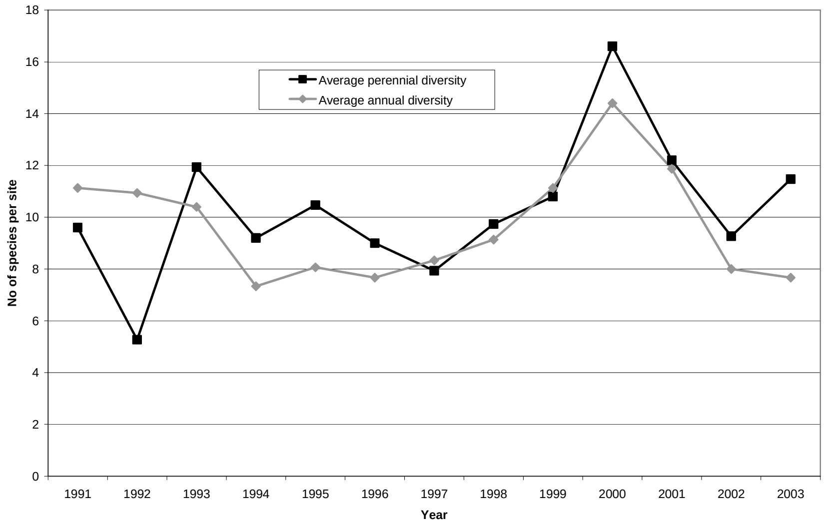

Figure 51. Change in species diversity of perennial and annual plants for the Riverina bioregion.

Seasonal change matrix

Table 22. Seasonally interpreted change in native species diversity for the Riverina bioregion.

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >11 decr in no. spp	**Stable**	**Increase** >9 incr in no. spp
Above average	60	18	72	10
Average	75	8	73	19
Below average	45	9	82	9

Discussion

- The peak in total pasture diversity in 2000 can be attributed to several above-average seasons in the winter of 1998, 1999 and 2000 in the Riverina IBRA.
- Trend in diversity of annuals mirrored that of perennials for the reporting period.
- The annual component of these pastures is winter dominant and important for grazing systems in the Riverina IBRA. A few pasture species such as barley grass, bromes, rye grass and medics may dominate winter pastures.
- An increase in pasture diversity at a high percentage of sites is associated with above-average seasons.
- An increase in pasture diversity during below-average seasons may be associated with the ability of the observer to detect more species when lower biomass is present.
- This bioregion has the highest diversity of exotic species.

Simpson Strzelecki Dunefields Bioregion

Number of sites

Data from eight sites have been extracted. These sites had consistent monitoring histories over the period 1990-2005 with the exception of 1993 when only one site was assessed. 1993 data have therefore been excluded from the series.

Results

Temporal trend graph

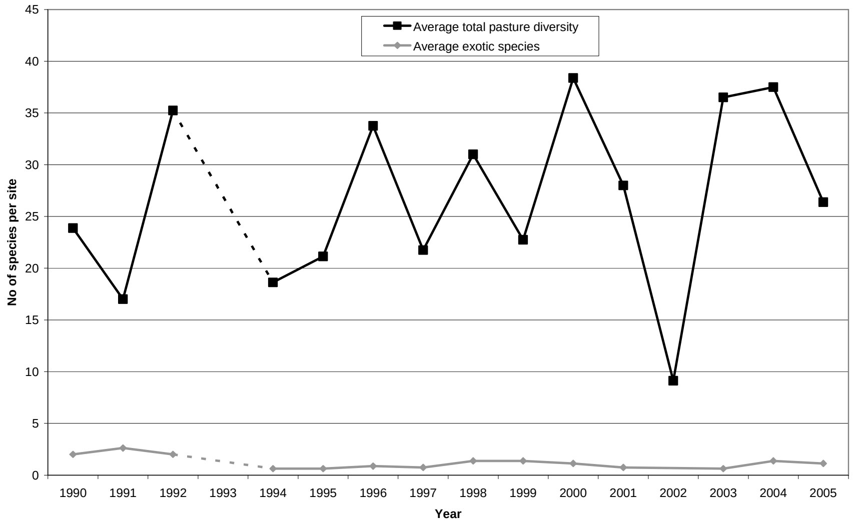

Figure 52. Change in species diversity of all pasture species and exotic species for the Simpson Strzelecki Dunefields bioregion.

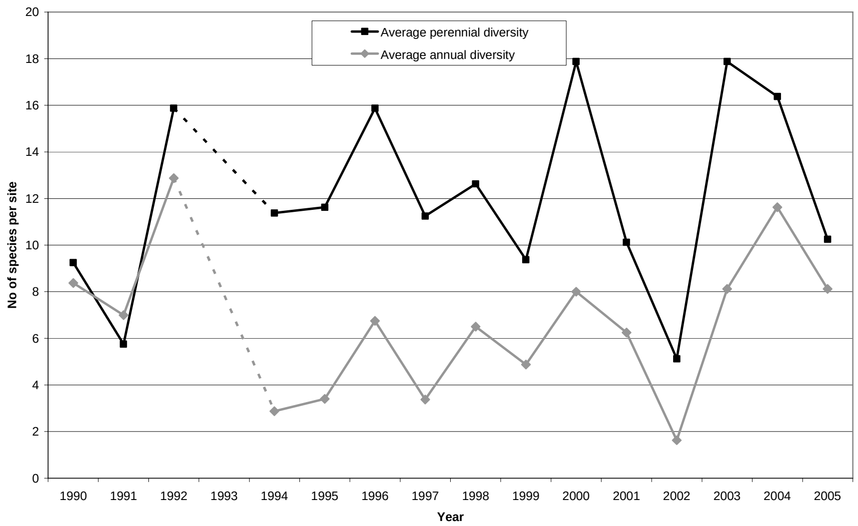

Figure 53. Change in species diversity of perennial and annual plants for the Simpson Strzelecki Dunefields bioregion.

Seasonal change matrix

Table 23. Seasonally interpreted change in native species diversity for the Simpson Strzelecki Dunefields bioregion.

		Change in Species Diversity		
Seasonal Quality	**# site by year combinations**	**Decrease** >18 decr in no. spp	**Stable**	**Increase** >18 incr in no. spp
Above average	40	20	57	23
Average	48	4	85	11
Below average	32	13	75	12

Discussion

- The system is driven by summer rainfall.
- Peaks in total pasture diversity were associated with above-average seasons in summer 19992/93 and 1999/2000.
- There was a low number of exotic species recorded during the reporting period.
- There was a low pasture diversity recorded for the well below-average summer of 2002/03.
- There was a significant decrease in the diversity of pasture species during average and below-average seasons.

HABITAT LOSS BY CLEARING

SLATS-type methods have also been applied to estimate change in woody cover due to clearing in the NSW rangelands. SLATS is the (Queensland) Statewide Landcover and Trees Study. It uses Landsat TM imagery to estimate the percentage of each sub-IBRA region (or other regionalisations as appropriate) cleared in Queensland (DNRM 2005).

For NSW, change is reported as the *annualised rate of woody vegetation change* between 2004 and 2006. Change data for rangeland bioregions are graphed in Fig. 54. Note that the most extensive clearing of woody vegetation occurred in the Cobar Peneplain. Lesser areas were cleared in the Murray-Darling Depression and the Darling Riverine Plains bioregions. For these SLATS-type analyses, woody vegetation was defined as:

> *woody communities with 20% crown cover or more (eg woodlands, open forests and closed forests) and taller than about 2 metres.*

'A*nnualised rates*' of clearing are defined as *annual rates of woody vegetation change*, which are largely due to *cropping, pasture and thinning* but also due to *rural and major infrastructure*, *fire scars* and *forestry* (DNR 2007), the latter in coastal and tableland regions of NSW.

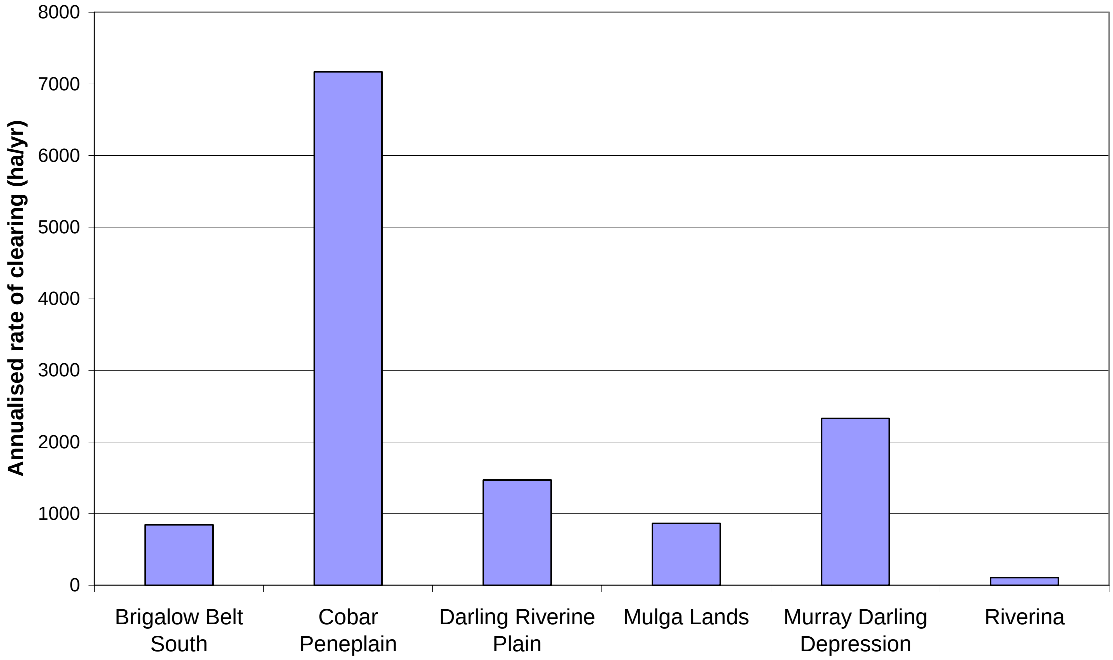

Figure 54 Annualised rate of woody vegetation change (ha/y) between 2004 and 2006 for rangeland bioregions in NSW.

Source: Andy Taylor, Science Services Division, Department of Environment and Climate Change, Dubbo NSW.

LAND VALUES

Land value information for NSW is sourced from the NSW Department of Lands. An indication of the value of selected NSW pastoral leases is available at http://www.lands.nsw.gov.au/valuation/nsw_land_values (Table 16 "Western Grazing"). This table provides the area, carrying capacity (DSE basis) and property market value (1996, then 2002 to 2006 on an annual basis) of a typical property from eight localities in the Western Division. Values were converted to $s/sq km and CPI adjusted to 2005 dollars (they could also be reported as $s/DSE but that has not been done here). Values are reported for the corresponding bioregion of each locality. Note that these are typical values, not the average value (or some other statistic) for the whole of each bioregion.

Values (CPI adjusted) of properties typical of various rangeland localities either declined or remained fairly constant between 1996 and 2002 (Table 24). Properties in the Cobar Peneplain bioregion (Cobar and Bourke) showed the biggest decreases. Property values also fell in the southern part of the NSW rangelands, i.e. Wentworth area (Murray Darling Depression) and Balranald (western Riverina). Properties in the Hay area were an exception at this time with their typical value increasing.

Table 24. Change in property market value for pastoral leases in different localities in the NSW rangelands.

Values are expressed in 2005 dollars. Note that values are for a typical property in each region, not the average of all properties.

Locality	Associated Bioregion	Property Market Value ($/km^2, 2005 $s)			Ratio of Change (1996 to 2005)
		1996	2002	2005	
Hay	Riverina	8,519	10,653	20,605	2.4
Brewarrina	Darling Riverine Plains	4,328	5,164	7,753	1.8
Bourke	Cobar Peneplain	468	375	774	1.7
Wilcannia	Mulga Lands	368	310	642	1.7
Lightning Ridge	Brigalow Belt South	3,241	3,685	4,935	1.5
Balranald	Riverina	3,374	2,322	3,966	1.2
Wentworth	Murray Darling Depression	2,080	1,428	2,537	1.2
Cobar	Cobar Peneplain	868	424	865	1.0
Average – Riverina		7,444	7,004	12,285	1.7
Average – Cobar Peneplain		836	431	820	1.0

Property values in all NSW localities have shown considerable growth between 2002 and 2005. There has been strong overall increase in property value in eastern parts of the NSW rangelands (Hay and Brewarrina) and lesser growth elsewhere (Bourke, Wilcannia and Lightning Ridge). Property value in the Cobar area recovered its earlier loss (1996 to 2002) to have a similar value in 2005 to that of 1996.

Probable reasons for the different regional changes in land values include:

- Initial declines in some localities in the early part of the reporting period due to continuing poorer seasonal quality through the 1990s and continuing marginal profitability for wool growers.

- Large gains in the eastern rangelands (Hay and Brewarrina districts) driven by opportunities for alternative agricultural enterprises (dryland and irrigated cropping in the Riverina, beef cattle and dryland cropping in the north eastern Darling Riverine Plains).
- The meat value of sheep has increased in recent years providing opportunities to cross Merinos with alternative meat-sheep breeds (including British-breed rams with first-cross lambs finished off-station).
- Continuing demand for goat meat as an alternative income stream for woolgrowers through either direct harvest or domestication of feral goats.
- Cattle prices have, in the main, remained strong and beef cattle are now a substantial component of livestock income on many pastoral leases.

However, increasing land values have generally been contrary to the general level of profitability of NSW rangeland enterprises. One reason for this is the increasing prices for prime agricultural land further east and the “ripple” effect as primary producers have progressively migrated their operations towards more marginal areas where land values are perceived to be better aligned with returns.

In some areas (e.g. the eastern Cobar Peneplain bioregion), relatively small properties rendered non-viable by woody thickening have been purchased for recreational pursuits, mainly hunting. These purchasers generally seek lower-value properties and are influenced by the perception of “bargain” prices for relatively large areas. Rather than being “lifestyle” blocks, these properties generally have absentee owners.

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