Vegetation status in grazed woodlands ('forest' country)

Bill Burrows, TBC, Rockhampton

How certain can we be that the vegetation present in today's woodlands is representative (e.g. in structure, composition, density) of what was 'originally' present in the defined community prior to management changes wrought by Europeans? The following extracts from scientific papers/reports for a wide geographic area are instructive:-

(a) A continental perspective

(i) ***Lunt (1998 a, b)*** – Southern Victoria

"Post settlement changes in vegetation and land use were examined in a reputedly undisturbed woodland remnant at Ocean Grove, southern Victoria, the site of earlier ecological studies. The vegetation has passed through at least three structural phases since European colonisation: an open grassy woodland dominated by Allocasuarina and Eucalyptus species and Banksia marginata with few shrubs; an open scrub of Acacia pycnantha; and a closed scrub of Allocasuarina littoralis which now dominates the reserve. Tree and shrub density has steadily increased from perhaps less than 20 trees/ha in the early 1800's to over 3000 trees/ha in 1996.…… Vegetation changes in the past 200 years can be attributed to the long-term absence of fire. The abundant recruitment of Acacia species in the mid-to late 1800's may have been a rapid response to the curtailment of Aboriginal burning, and the more recent invasion of A. littoralis a longer-term response to fire exclusion" (Lunt 1998*a*). *"The dramatic increase in the density of A. littoralis from 911 trees/ha in 1971 to 3565 trees/ha in 1996 was associated with a continued decline in the once dominant eucalypts, especially E. ovata"* (Lunt 1998*b*).

(ii) ***Fensham and Fairfax 1996*** – Bunya Mountains, Queensland

"The physical setting of 61 grassy bolds on the Bunya Mountains in south-eastern Queensland was surveyed during 1995, and a further 73 balds were assessed from aerial photographs taken in 1951 and 1991. About 26% of the area of balds existing in 1951 had been invaded by forest in 1991. The extent of the invasion was generally higher for balds surrounded by eucalypt forest than balds surrounded by eucalypt and rainforest or rainforest only."

(iii) ***Hopkins et al. (1996)*** – Daintree, north Queensland

"The identification and radiocarbon dating of charcoal collected under tropical rainforest indicated that sclerophyll forests dominated by Eucalyptus occupied parts of the wet tropical lowlands in the Daintree region of North Queensland at least intermittently from 12000 year BP (before present) until very recently.…… The process of eucalypt forest replacement by rainforest may have accelerated since the arrival of Europeans and the concomitant decrease in Aboriginal management."
[Also see: Harrington & Sanderson (1994)]

(iv) ***Neldner et al. (1997)*** – Cape York Peninsula, far north Queensland

"Data are provided that demonstrate the conversion of some grassland types to woodlands in the last 30 years, and it seems probable that the change is a result of altered fire regimes. Even if adequately reserved, appropriate fire management is required to maintain the grasslands of Cape York Peninsula."

(v): Crowley and Garnett (1998) -- Cape York Peninsula, far north Queensland

"The vegetation of 64 grassland and grassy woodland sites in east-central Cape York Peninsula, surveyed by CSIRO in 1966, was re-surveyed in 1995. While the original vegetation had persisted at most sites, a change in species dominance was recorded at 14% of sites. Melaleuca viridiflora (ti-tree) had invaded eight sites, and increased in abundance in at least 16 of the 35 sites in which it occurred in 1966. This had led to four of 13 grassland sites, and three out of four mixed evergreen sites being re-classified as ti-tree woodlands. Analysis of aerial photographs covering 415 km^2 showed a 10% net loss of grasslands between 1969 and 1988. These changes are attributed to a reduction in the use of fire as a management tool since European settlement."

(vi) Jacklyn (1998) – Victoria River District, N.T.

The photographic record was utilised *"to show that the vegetation has 'thickened up' on Bradshaw Station (Victoria River District, N.T.) since 1933. Interestingly, this trend is also seen in other similarly paired photographs assembled by Darrell (Lewis) from locations right across the VRD."*

(b) Western NSW

(i) Royal Commission (1901) – Cobar/Byrock

"Generally speaking it was originally open box-forest country with currajong and an occasional pine tree upon it. The overstocking of the country, coupled with the rabbits, prevented the growth of grass to anything like its former extent, and so causes a cessation of bush fires which formerly had occurred periodically. This afforded the noxious scrub a chance of making headway."

(ii) Eric Rolls (1981) – Pilliga Scrub

"The [Cypress] pines came up ten thousand to the hectare. 'One year the stockmen saw the little pines just up to the top of the horses 'hooves', one man told me. 'The next year the pine tops brushed their boots as they rode. And a year or two after that – those old stockmen used to ride at ten past ten, knees cocked up from the saddle like wings – well they had to jam their knees in hard behind the pads or the pines would have pushed them backwards out of the saddle. Soon they just mustered their stock and got out. There was no room for grass to grow'."
[**Also see:- Rolls (1999)**]

(c) Central/Western Queensland

(i) Walker et al. (1981) – Dirranbandi area

"Accounts of the poplar box region by early explorers indicate that the dominant trees had a spacing of between 50 and 100m with little understorey (Leichhardt 1847)" [Contrast with much higher poplar box densities present today].

(ii) Fensham (1998) – Fitzroy Basin, Central Queensland

"Preliminary analysis of the aerial photo comparison suggests substantial thickening has occurred in uncleared remnants in Central Queensland between the mean dates of the earliest photos (1955) and the mean date of the most recent photos". [Tree cover on 7 M ha had increased by > 20% - Rod Fensham pers. comm.].

(iii) Binnington (1997) – White Cypress Pine

"With current proposals to reserve 15% of the area of pre-European vegetation types there is concern about how to interpret the mixed cypress pine ecosystems – because of management changes white cypress pine forests currently cover a greater area than before European settlement."

(iv) Reynolds and Carter (1993) – Mitchell grassland/gidgee

"Surveyed an area aggregating 5.97 ha in Central Western Queensland (315 respondents). Major findings were:

- *11% of the area of affected properties had been "lost" due to the invasion of woody weeds.*
- *55% of respondents said their naturally timbered area had thickened up and this confirms the drift of grasslands towards woodlands."*

(v) McCallum (1998) – Moorrinya National Park, Aramac

"Extensive changes in the area of Mitchell grassland have occurred with the woody plant cover (boree, gidgee, blackwood) increasing by 31.8% over the period 1951-1998" [Based on aerial photo interpretation and ground measurements]

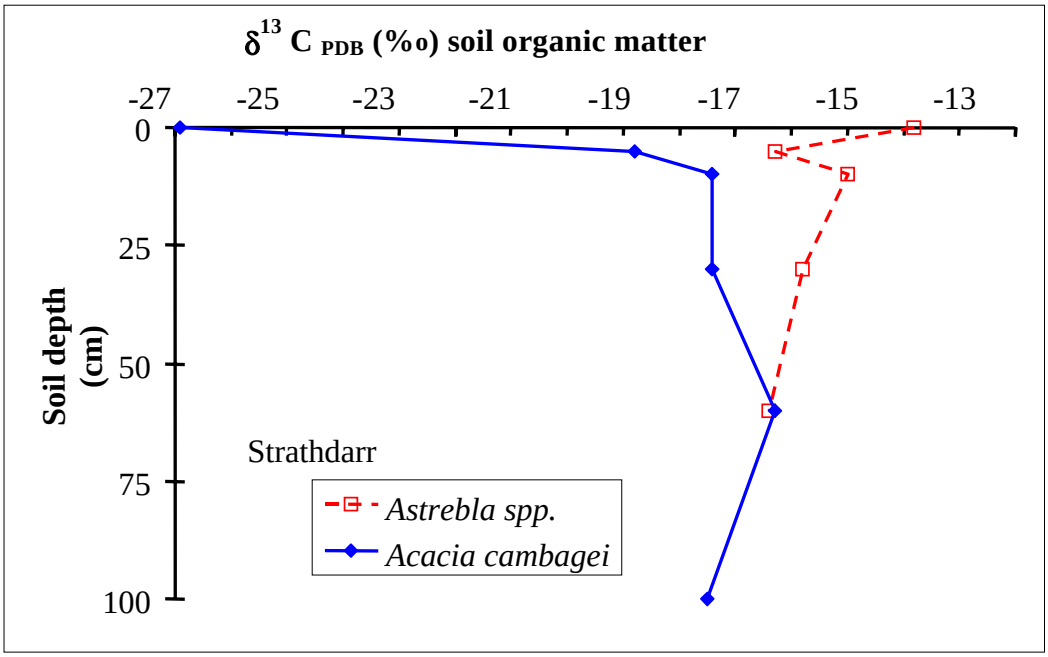
(vi) Burrows (1996) – Gidgee, Longreach

Compared $\delta^{13}C$ values in surface litter and soil organic matter in two adjacent soil profiles (a) under Mitchell grass (Astrebla spp.) grassland and (b) gidgee (Acacia cambagei) juveniles at Strathdarr, Longreach [see Box 1 next page]. *The $\delta^{13}C$ values at depth in (b) reflect that of the soil in the open grassland, supportive of grazier contention that gidgee has 'recently' invaded.*
[cf. (v) above]

Box 1

Mitchell Grassland (*Astrebla* spp.)

Gidgee (*Acacia cambagei*) invasion of grassland



Carbon Isotope Ratios

The ratios of $^{13}C/^{12}C$ (expressed as $\delta^{13}C$) provide diagnostic signatures which can be used to differentiate organic C derived from C_3 and C_4 plants (Tieszen and Archer 1990). Woody plants possess the C_3 photosynthetic pathway ($\delta^{13}C$ range = -27 to -32‰, whereas vegetation of tropical grass dominated zones is characterised by grasses with the C_4 pathway ($\delta^{13}C$ range = -13 to -17‰).

If woody plants have been long term constituents of the landscape the $\delta^{13}C$ signature of the soils beneath them should reflect this and fall within the -27 to -32‰ range. However if C_3 trees and shrubs had displaced C_4 grasses;-

(i) the soil $\delta^{13}C$ value would be less negative than -27 to -32‰

(ii) the degree of departure from the expected ratio would decrease as time of site habitation by woody plants increases, and

(iii) the soil $\delta^{13}C$ values would become less negative with depth along the chronosequence (Tieszen and Archer 1990)

(vii) Burrows et al. (1998) – Eucalypt woodlands, inland Queensland

> *"Historical, anecdotal and $\delta^{13}C$ data, along with permanent transect records together provide convincing evidence of woody plant thickening (increases in number and size) in the grazed woodlands of north-eastern Australia. In both Australia and elsewhere in the tropics/sub-tropics the woodlands (savannas) were maintained as a fire mediated sub-climax prior to the introduction of domestic livestock. The prime agent changing the structure of these woodlands has been the conversion of land use from hunter-gathering or nomadism to the raising of sheep and cattle – a practice which has often been associated with increased grazing pressure, reduced fuel loads and the containment of fire."*

(viii) Purdie 1985 – Queensland's Mulga region

> *"Because of the widespread pastoral usage, ecosystems in virtually all areas of the mulga region have been affected to some degree by introduced stock and feral animals, and by specific land management practices such as the use of mulga for drought feed, and the thinning or clearing of mulga and other communities to encourage more herbage growth. Such disturbances have been more severe in the eastern part of the region, where there has been widespread introduction of non native pasture species …..… or the complete removal of the native vegetation to allow agriculture cropping. As a result of this land use, the mulga region ecosystems can in no way be described as 'pristine' i.e. identical with their pre-Aboriginal or pre-European settlement state."*

The extracts canvassed here are but a small representation of a much wider Australian and international literature that conclusively demonstrates that the vegetation present in to-day's grazed woodland/savanna communities is very different to that existing at the time domestic livestock were first introduced.

References

Binnington, K. (1997). Australian Forest Profiles 6. White Cypress Pine. (National Forest Inventory – BRS, Canberra). 12 pp.

Burrows, W.H. (1996). Queensland's grazed woodlands – an enormous anthropogenic carbon sink demanding recognition. Technical Report 'Vegetation Thickening' Workshop. (DEST International Panel Review: Canberra). October 1996.

Burrows, W.H., Compton, J.F. and Hoffmann, M.B. (1998). Vegetation thickening and carbon sinks in the grazed woodlands of north-east Australia. *Proceedings Australian Forest Growers Conference,* Lismore, NSW. pp. 305-316.

Crowley, G.M. and Garnett, S.T. (1998). Vegetation change in the grasslands and grassy woodlands of east-central Cape York Peninsula, Australia. *Pacific Conservation Biology* **4**: 132-148.

Fensham, R.J. (1998). Resolving biomass fluxes in Queensland woodlands. *Climate Change Newsletter* **10**: 13-15.

Fensham, R.J. and Fairfax, R.J. (1996). The disappearing grassy balds of the Bunya Mountains, south-eastern Queensland. *Australian Journal of Botany* **44**: 543-558.

Harrington, G.N. and Sanderson, K.D. (1994). Recent contraction of wet sclerophyll forest in the wet tropics of Queensland due to invasion by rainforest. *Pacific Conservation Biology* **1**: 319-327.

Hopkins, M.S., Head, J., Ash, J.E., Hewett, R.K. and Graham, A.W. (1996). Evidence of a Holocene and continuing recent expansion of lowland rainforest in humid, tropical North Queensland. *Journal of Biogeography* **23**: 737-745.

Jacklyn, P. (1998). Understanding effects of fire in northern savannas. *In:* "Exploring CRC Research" (ed. D.Alcock) p.8 (CRC Association Inc.: Canberra).

Lunt, I.D. (1998a). Two hundred years of land use and vegetation change in a remnant coastal woodland in southern Australia. *Australian Journal of Botany* **46**: 629-647.

Lunt, I.D. (1998b). *Allocasuarina* (Casuarinaceae) invasion of an unburnt coastal woodland at Ocean Grove, Victoria: Structural changes 1971-1996. *Australian Journal of Botany* **46**: 649-656.

McCallum, B.S. (1998). "An investigation of native tree incursion into native grassland at Moorrinya National Park, North Queensland" Unpublished B. App. Sci. Hons thesis, JCU, Townsville.

Neldner, V.J., Fensham, R.J., Clarkson, J.R. and Stanton, J.P. (1997). The natural grasslands of Cape York Peninsula, Australia. Description, distribution and conservation status. *Biological Conservation* **81**: 121-136.

Purdie, R.W. (185). Development of a National Park System for Queensland's mulga region. *In*: "The Mulga Lands" (ed. P.S. Sattler) pp. 122-127 (Royal Society of Queensland: Brisbane).

Reynolds, J.A. and Carter, J.O. (1993). What landholders reckon about woody weeds in Central Western Queensland. (QDPI Project Report RQL93001: Longreach).

Rolls, E.C. (1981). A Million Wild Acres. (Nelson: Melbourne).

Rolls, E.C. (1999). Land of grass: the loss of Australia's grasslands. *Australian Geographical Studies* **37**: 197-213.

Royal Commission (1901). Royal Commission to Inquire into the Conditions of Crown Tenants – Western Division of NSW. (Govt. Printer: Sydney).

Walker, J., Moore, R.M., and Robertson, J.A. (1972). Herbage response to tree and shrub thinning in *Ecualyptus populnea* shrub woodlands. *Australian Journal of Agricultural Research* **23**: 405-410.