9 Coolibah - Black Box Woodlands, south-eastern Australia

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Classification

International: Currently not classified.
National: Nationally and within New South Wales, Coolibah - Black Box Woodlands are classified as an Endangered Ecological Community (TSSC 2011; NSW Scientific Committee 2004; 2008). In Queensland, the ecosystem includes: RE 11.3.3 Eucalyptus coolabah woodland on alluvial plains; RE 11.3.15 Eucalyptus coolabah, Acacia stenophylla, Muehlenbeckia florulenta fringing woodland on alluvial plains; RE 11.3.16 Eucalyptus largiflorens, ± Acacia cambagei ± A. harpophylla woodland to low open woodland on alluvial plains; RE 11.3.28 Eucalyptus coolabah ± Casuarina cristata open woodland on alluvial plains; and RE 11.3.37 Eucalyptus coolabah fringing woodland on alluvial plains. In New South Wales, the ecos ystem belongs to the North-west Floodplain Woodlands vegetation class (Keith 2004) and includes: ID 37 – Black Box woodland on floodplains of the NSW central and northern wheatbelt including the Darling Riverine Plains Bioregion; ID 39 – Coolibah – River Coobah – Lignum woodland of frequently flooded channels mainly of the Darling Riverine Plains Bioregion; and ID 40 – Coolibah open woodland with chenopod/grassy ground cover on grey and brown cla y floodplains (Benson et al. 2006). These units all fall within the Northwest Floodplain Woodlands vegetation class (Keith 2004).
IUCN Habitats Classification Scheme (Version 3.0): 2. Savanna / 2.1 Dry savanna.
Key references: TSSC 2011; NSW Scientific Committee 2004; 2008; Benson et al. 2006.

Ecosystem description

Characteristic native biota

In its mature state, Coolibah – Black Box Woodland has an open structure with widely scattered trees, a variable cover of shrubs and grassy groundlayer. In its regeneration phase, it may include dense stands of saplings with limited understorey and ground layer development. *Eucalyptus coolabah* is most frequently occurring tree species, with other species including *Eucalyptus largiflorens*, *Eucalyptus camaldulensis*, *Eucalyptus populnea* subsp. *bimbil*, *Acacia stenophylla*, *A. salicina*, *Casuarina cristata* and *Eremophila bignoniiflora*. Common shrubs species include *Muehlenbeckia florulenta* and *Rhagodia spinescens*, while the ground layer comprises a diverse suite of grasses including species of grasses such as *Astrebla*, *Chloris*, Dichanthium, Enteropogon, Panicum, Paspalidium and Sporobolus.

The characteristic vertebrate fauna includes diverse assemblages of woodland and wetland bird species, many of which depend on tree hollows, other features of large trees or standing water for breeding and or foraging (see NSW Scientific Committee, 2004; 2008 for a full description). Regionally, the ecosystem is distinguished compositionally from other woodlands, which lack E. coolibah and the diverse grassy ground layer, and structurally from grasslands and shrublands, which lack trees and many of the characteristic woody species. Further west, floodplains are more limited in extent and experience less inundation, with ephemeral plants replacing many of the perennial plant species.

Figure S9. 1. Examples of Coolobah - Black Box Woodland in mature state (left, near Moree, NSW, Australia) and regeneration phase (right, Culgoa National Park, NSW, Australia). Both sites show effects of grazing by feral herbivores.

Abiotic environment

Coolibah - Black Box Woodland occurs on level floodplains dissected by meandering river channels. The plain has deep alluvial clay and silt soils, which are periodically inundated by overbank flows and may remain waterlogged for extended periods. The climate is subtropical and semi-arid, with summer-dominant rainfall, declining from an average of about 600 mm per annum in the east to less than 350 mm per annum in the western part of the distribution.

Distribution

Coolabah - Black Box Woodland occurs on the floodplain of the upper Darling River and its tributaries, within latitudes 28 - 31° S and 146 - 150° E, about 400 km southwest of Brisbane in southeastern Australia. (Figure 2).

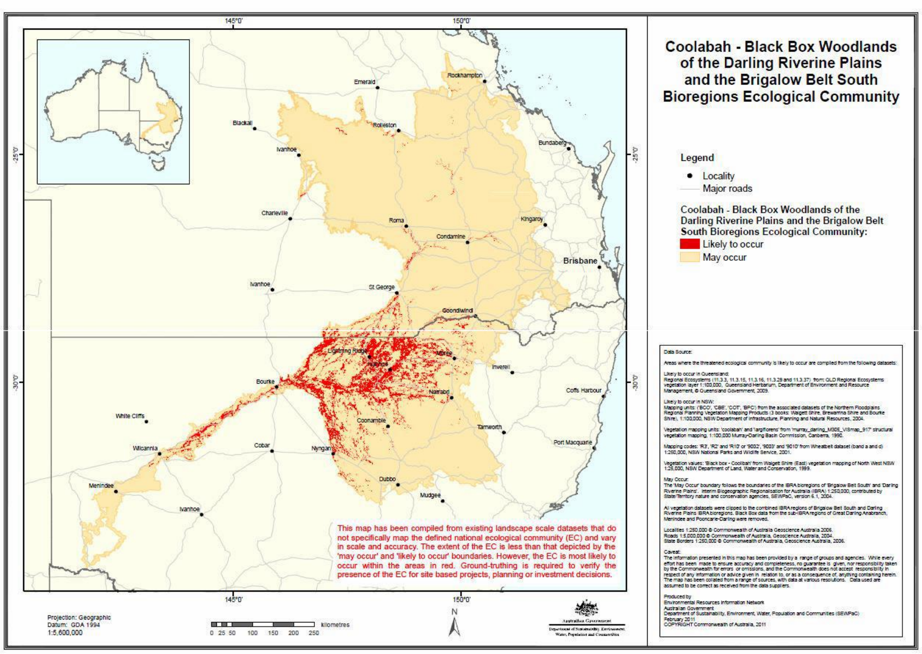

Figure S9. 2. Distribution of Coolibah - Black Box Woodland. Source: Australian Government Department of Sustainability, Environment, Water, Population and Community (http://www.environment.gov.au/biodiversity/threatened/communities/maps/pubs/66-map.pdf) compiled from data supplied by the NSW Office of Environment and Heritage and Queensland Department of Environment and Resource Management.

Key processes and interactions

Water regimes are a key driver of ecosystem dynamics in Coolibah - Black Box Woodland. Major floods may trigger periodic tree recruitment from which dense stands of saplings may develop and self- thin over time, eventually resulting in a sparser cover of large trees (Roberts 1993; Good et al. 2011). Extended dry periods are associated with episodes of tree mortalit y, which accelerate the thinning process. Different plant species apparently have different recruitment responses to floods of varying magnitude and duration and also different tolerances to droughts of varying severit y and duration (Roberts and Marston 2000; Capon 2003; Capon et al. 2009). The composition and structure of overstorey and understorey therefore varies spatially and temporally, depending on soil moisture and local flood regimes (Reid et al. 2011). For example, Eucalyptus camaldulensis and E. populnea subsp. bimbil occur, respectively, on lower and upper parts of the floodplain characterised by contrasting water regimes. Muehlenbeckia florulenta, Cyperus, Marsilea and Sporobolis mitchellii tend to dominate the woodland understorey at sites where soil moisture is sustained, while grasses and chenopod shrubs dominate in less frequently moist locations (Reid et al. 2011). The water regime also profoundly influences the dynamics of fauna assemblages, with breeding cycles of waterbirds, amphibians and many invertebrates cued to major floods associated with high resource levels (Lee and Mercer 1967; Boulton and Lloyd 1992; Kingsford and Auld 2005). Floods also mediate the movement of nutrients, organic matter, water and biota by periodically connecting rivers, wetlands and floodplains, which are otherwise isolated under dry conditions (Humphries et al. 1999; Thoms 2003).

The composition of ground layer vegetation depends on past and present grazing pressure as well as the water regime (Capon 2003, 2005; Reid et al. 2011). Feral herbivores and domestic livestock are the most abundant herbivores in the s ystem, and their effects probably overshadow those of native macropods whose abundance depends on inter-annual rainfall variation.

Threatening processes

Four main processes threaten the persistence of this ecosystem (NSW Scientific Committee 2004; 2008). First, expansion and intensification of agricultural land use has replaced large areas of woodland with crops and pastures in recent decades (Keith et al. 2009). Second, extraction of water from rivers for irrigation has altered flood regimes and their spatial extent (Thoms & Sheldon 2000; Thoms 2003), reducing opportunities for reproduction and dispersal of characteristic flora and fauna (Kingsford and Thomas 1995; Kingsford and Johnson 1998; Sims 2004; Kingsford and Auld 2005). Future climate change may also affect the spatial and temporal availability of water in the system (Hennessy et al. 2004). Third, invasive plants have spread with agricultural intensification and are reducing the diversity and abundance of native biota. Invasion of the mat-forming forb, Phyla canescens, reduces the diversity of native ground layer plants by (Taylor and Ganf 2005; Price et al. 2010; 2011a,b,c). This species has spread rapidly, in response to altered water regimes and persistent heavy livestock grazing (McCosker 1999; Earl 2003). Finally, overgrazing by feral goats and rabbits and domestic livestock has altered the composition and structure of the woodland vegetation, through slective consumption of palatable native ground layer plants and seedlings of trees and shrubs, with effects most marked beneath trees where livestock concentrate their grazoing activities (Robertson & Rowling 2000; Reid et al. 2011).

Ecosystem collapse

For assessment of criteria A and B, this ecosystem assumed to have collapsed when its mapped distribution has declined to zero as a consequence of clearing for agriculture. Because water regimes are a key driver of ecosystem dynamics and water diversion for irrigation is a major threat in Coolibah - Black Box Woodland, median daily river flow was identified as a suitable variable for assessing environmental degradation under criterion C. Conservatively, it was assumed that the ecosyst em would collapse if median flow declined to 0 - 10% of unregulated levels.

ASSESSMENT

Summary

Criterion	A	B	C	D	E	overall
subcriterion 1	VU(VU-EN)	LC LC	EN DD	DD DD	DD	EN
subcriterion 2	DD	LC	VU	DD		
subcriterion 3	VU(VU-EN)					

Criterion A

Current decline: Annual rates of decline in the distribution of Coolibah - Black Box Woodland were estimated from a time series of maps compiled from base maps described by Cox et al. (2000), Metcalfe et al. (2003) and NFRPC (2004a,b,c) and interpretation of subsequent Landsat imagery (Keith et al. 2009). These maps cover almost 90% of the distribution in New South Wales (TSSC 2011). It was assumed that rates of clearing were similar in the remaining 12% of the distribution occurring in Queensland, which seems reasonable given similar economic development and conservation regulations. Keith et al. (2009) estimated that the area of the ecosystem declined on average by 0.79% per year between c. 1984 and 2004. Rates of decline varied within this period, for example, averaging 1.72±0.30% between 1998 and 2004 (Keith et al. 2009). Rates of clearing have not been assessed for the periods before c. 1984 and after 2004. There is evidence that clearing activit y commenced after 1900, and accelerated between 1940 and 1969 due to increasing deplo yment of heavy farm machiner y and development of river regulation infrastructure, which made more water available for irrigation (Bedward et al. 2007). Cropping data suggest that rates of clearing continued at similar rates after 2004, at least up until 2007 (Keith et al. 2009), although may have slowed subsequently due to prolonged drought and compliance actions under clearing legislation. For assessment, it was assumed that the rate of decline in distribution during 50 years 1960-2010 was at least 0.8% and at most 1.7% per year, with an intermediate scenario of 0.8% per year for the past 25 years and 1.7% per year for the preceding 25 years. Under these scenarios, the distribution of the community was estimated to have declined by $100\times(1-0.008)^{50}$ = 33%, $100\times(1-0.008)^{25} \times (1-0.017)^{25}$ = 47%, $100\times(1-0.008)^{50}$ = 58%, respectively. A bounded estimate of decline in distribution for the past 50 years is therefore 47% (plausible bounds 33-58%). The status of the ecosystem is therefore Endangered (plausible range Vulnerable-Endangered) under A1.

Future decline: Projections of future declines in distribution can be made by assuming similar rates of land conversion continue into the future (Keith et al. 2009). There is little impediment to continued clearing imposed by protected area land tenure (the ecosystem occurs mostly on freehold or leasehold land used for agriculture) and declaration of dominant trees under 'invasive native scrub' regulations promotes clearing of the ecosystem when in the juvenile thicket phase (Fensham 2008). However, clearing of native vegetation and availability of water for irrigation are regulated by permit under legislation. These opposing influences, together with uncertainties in future trends of water extraction and impacts of climate change on the water regime, create complex future scenarios that are yet to be modelled. The status of the ecosystem under criterion A2 is therefore Data Deficient.

Historic decline: Keith et al. (2009), using maps constructed from simple habitat suitabilit y models and field reconnaissance, estimated that the historic distribution of Coolibah - Black Box Woodland in NSW had declined by 61% (plausible bounds 50-67%). Similar mapping in Queensland produced an estimated historic decline of 82% (Queensland Herbarium 2009). The combined data suggest an overall historic decline of 65% (TSSC 2011), with a plausible lower bound above 50% and upper bound likely to be marginally above 70%. The status of the ecosystem is therefore Vulnerable under criterion A3.

Criterion B

Approximately 1.3 million ha of Coolibah - Black Box Woodland have been mapped from recent aerial photography and Landsat imagery (Fig. 2, TSSC 2011). The swamps occur naturally in small patches, with approximately 42% of mapped swamps covering less than 1 ha, and making up about 6% of the total mapped area.

Extent of occurrence: A minimum convex polygon enclosing all mapped occurrences of Coolibah - Black Box Wooland has an area of 266,400 (130,200 - 437,300) km^2 (best estimate based on Fig. 3, lower bound excludes putative occurrences north of 28°S and west of 145°30'E, upper bound based onfull extent in Fig. 2). Although there is evidence of continuing decline in distribution and continuing environmental degradation, the status of the ecosystem under criterion B1 is Least Concern because the estimated extent of occurrence exceeds the thresholds for all threatened categories.

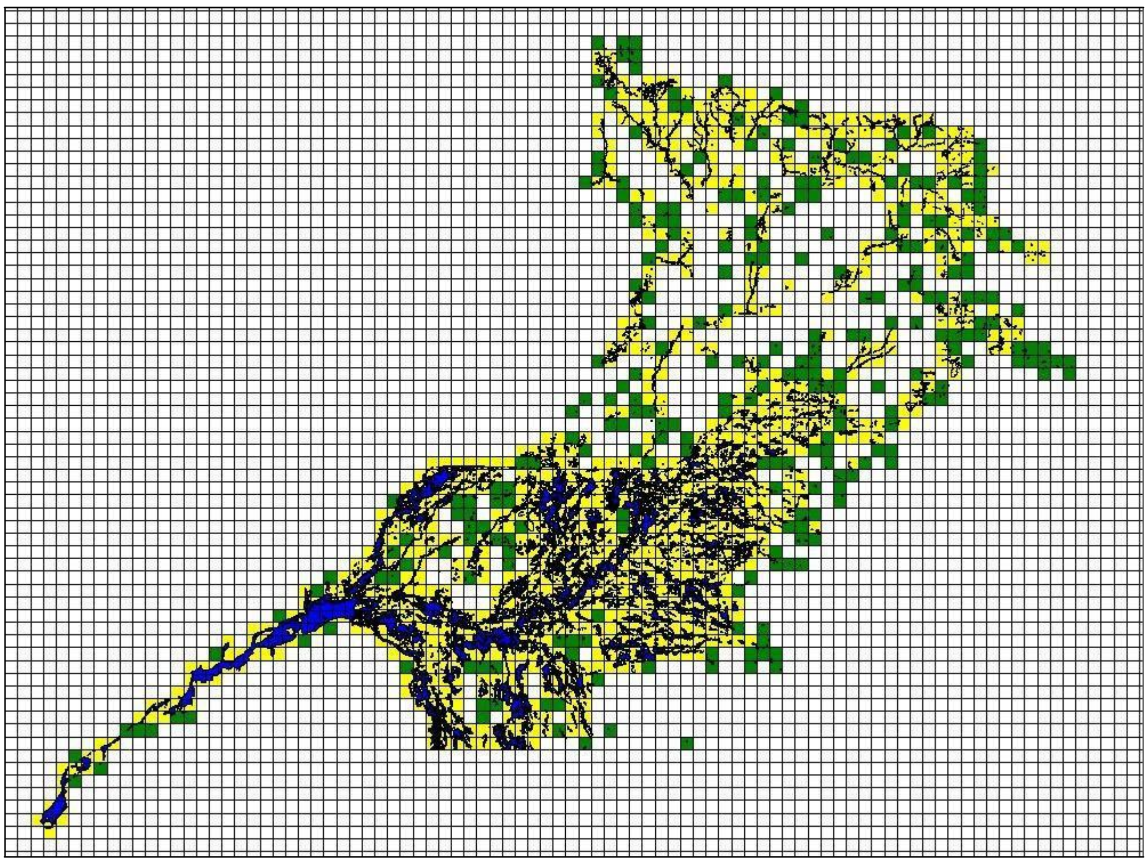

Figure S9. 3. Mapped distribution of Coolibah - Black Box Woodland (blue) showing occupied 10 × 10 km grid cells (Area of occupancy) in New South Wales (data from Keith et al. 2009, Queensland Environment Protection Authority 2009). Yellow- cells with more than 1% of cell area occupied. Green- additional occupied cells with less than 1% of cell area occupied.

Area of occurrence: Superimposing a 10 km grid over the mapped polygons of Coolibah - Black Box Woodland (Figure 3) indicates that they are present within 1193 grid cells (752 within New South Wales). Of these, 283 grid cells (92 in NSW) contain less than 1 km^2 of the ecosystem (i.e. <1% of the area of a grid cell). Excluding these small occurrences, the swamps are therefore estimated to occupy 910 10 × 10 km grid cells (shaded yellow in Fig. 3), exceeding the threshold for Vulnerable by a substantial margin. Assessments of B2 subcriteria are identical to those for criterion B1 (see Extent of occurrence, above). The status of the ecosystem is therefore Least Concern under criteria B2b and B2c.

Number of locations: The most serious plausible threats to Coolibah - Black Box Woodland are land clearing and changes to water regimes. Spatial patterns of land clearing show a high degree of contagion, with the best predictor of future clearing being the proximity of a patch to land parcels already cleared of native vegetation (Bedward et al. 2007). A broad interpretation of 'locations' under criterion B3 would be three jurisdictional zones with different regulatory controls on land clearing: the leasehold western Division of NSW; the freehold Central Division of New South Wales; and Queensland. A more narrow interpretation of locations based on neighbourhoods of contagion would produce an estimate of more than five. Small protected areas are excluded from these locations, as they are not threatened by land clearing. These areas were assessed by considering the next most serious plausible threat, changes to water regimes. As protected areas are located in at least two different subcatchments with different water management infrastructure, there are at least two further locations. Hence the most precautionary interpretation produces an estimate of five locations, although it is likely that there are more. Based on current rates of depletion due to land clearing (see criterion A1) and current rates of environmental degradation due to changes in water regime (see criterion C1), the ecosystem is unlikely to collapse or become Critically Endangered within the near future (c. 20 years). The status of the ecosystem is therefore Least Concern under criteria B3.

Criterion C

The principal mechanism of environmental degradation is through declines in hydrological processes related to extraction of water from rivers than flow through the floodplains that support the woodland ecosystem. The changes to water regimes and their effects are complex. There is evidence from gauging stations and modelled scenarios that median and mean river flows have reduced, that flows during small floods (average return interval <2 years) have been reduced more than flows during larger flood, that flooding is sustained for shorter durations (i.e. more rapid recession of flood waters), and that flows are less temporally variable as peak extraction in summer months coincides with timing of peak flows (Thoms & Sheldon 2000). Changes in the extent and duration of floods are likely to be the most direct measure of te extent and severity of hydrological degradation, given the importance of overbank flows for ecosystem function (see above). A temporal analysis of flood extent and duration is not available, however stream flow data provide a summary of average hydrological changes in catchments upstream, and hence a suitable proxy for assessing the severity of degradation under criterion C. Data from a flow gauge on the Darling River at Bourke was selected for analysis because of its position at the bottom of a catchment that contains almost the entire distribution of Coolibah - Back Box Woodland. Median flows provide an overall summary of general water availability in the system.

Current decline: Thoms & Sheldon (2000) used a hydrological model to simulate current stream discharge (with water extraction) and 'natural' discharge (without extraction). The model was evaluated by comparing modelled current flows with observed flows at the Bourke stream gauge and close correspondence was confirmed. Black et al. (1997) present a full description and evaluation of the model). For assessing criterion C1, it can be assumed that the ratio of current to natural flow represents change in flow over the past 50 years. This is a reasonable assumption because the first major river regulation infrastructure in the catchment was constructed in 1961 (Keepit Dam) and water extraction is likely to have been negligible prior to that year.

The flow volume at which the ecosystem would collapse is uncertain, but collapse is likely to occur before median daily flow declines to zero at Bourke (i.e. zero flow on 50% of days). Conservatively, it was assumed that the ecosystem would collapse if median flow declined to 0 - 10% of 'natural' (unregulated) levels. Thoms & Sheldon (2000) estimated that median flow at Bourke declined from 2917 ML/day (natural) to 1342 ML/day (current). Applying range standardisation (see Fig. 6 in main paper) gives a relative severity between 100 × (2917 - 1342)/(2917 - 0) = 54% and 100 × (2917 - 1342)/(2917 - 291.7) = 60%. As the flow gauge at the bottom of the catchment is indicative of rangewide change in water regime, the extent of the decline is taken as 100%. The status of the ecosystem under criterion C1b is therefore Endangered.

Future decline: Future projections for flooding in the upper Darling catchment would need to take into account plausible scenarios of irrigation, environmental flows and climate change. No such projections are currently available. The status of the ecosystem is therefore Data Deficient under criterion C2.

Historic decline: As water extraction was assumed to be negligible prior to 1961, historic declines in the water regime are the same as current declines; with relative severity of 54 - 60 % over 100% extent. The status of the ecosystem is therefore Vulnerable under criterion C3.

Criterion D

Suitable variables for assessing declines in biotic interactions include vegetation responses to grazing, changes in structure due to tree thinning and ringbarking and the abundance of transformer invasive plants, particularly Phyla canescens. There are currently insufficient data available on these processes to assess the relative severity and extent of declines in biotic interactions under criterion D. The status of the community is Data Deficient under criteria D1, D2 and D3.

Criterion E

No quantitative analysis has been carried out to assess the risk of ecosystem collapse for Coolibah - Black Box Woodland. The status of the ecosystem is therefore Data Deficient under criterion E.

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