

A review of the comparative ecology of Red and Western Grey Kangaroo in Australian Rangelands.

**An evaluation of the likely impact on
the vegetation at
Hattah-Kulkyne National Park.**



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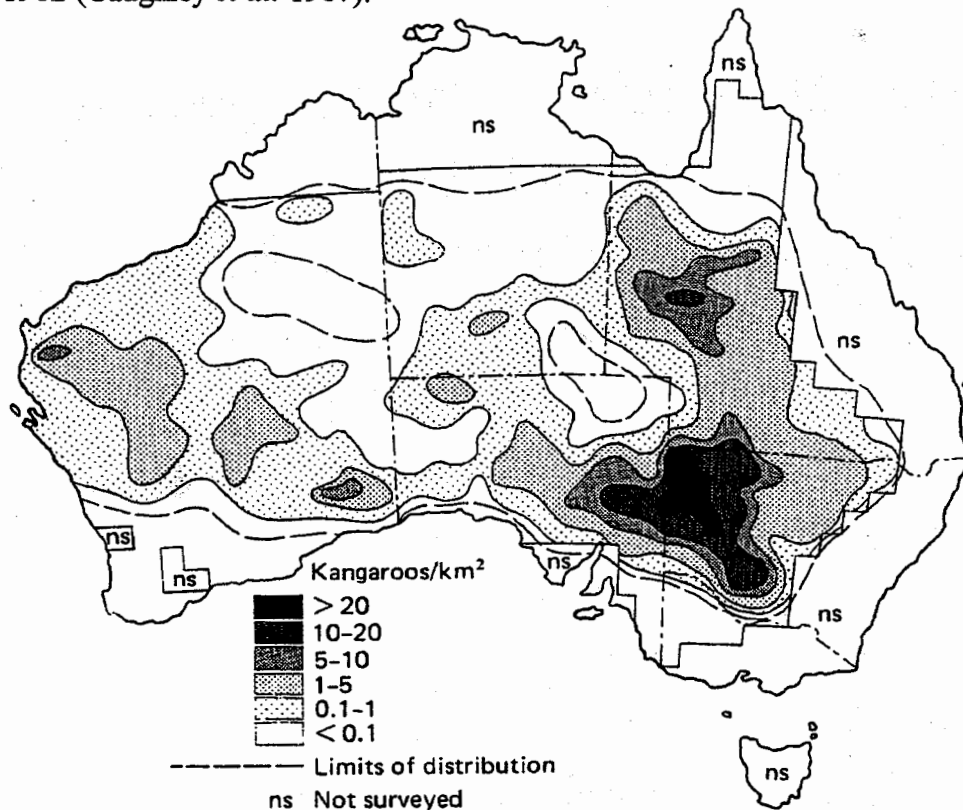
Introduction

This paper examines the existing research that compares and contrasts the ecology and ecological interactions of the Red Kangaroo (*Macropus rufus*) and Western Grey Kangaroos (*Macropus fuliginosus*) in the semi-arid and arid rangelands of Australia. Where possible reference to their respective ecologies within Hattah-Kulkyne National Park (HKNP) or at nearby Kinchega National Park (NSW) is made. The purpose of this paper is to provide a background to the future management of these species within HKNP.

Distribution, Abundance and Climatic Determinants

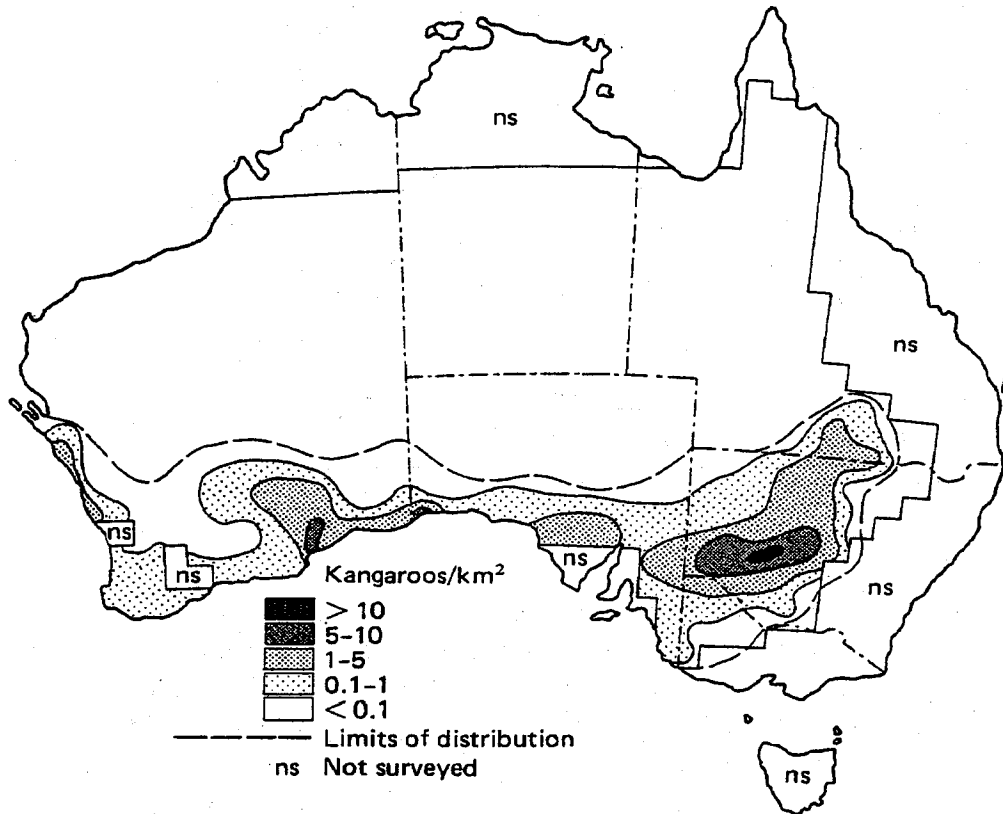
Red Kangaroos (RK) are the most common and widely distributed large macropod in Australia (Caughley *et al.* 1983) with a natural distribution (see Figure 1) that includes all mainland states and territories with the exception of the A.C.T. Highest densities (>10 animals/km²) are recorded in the arid and semi-arid sheep rangelands of western New South Wales, with generally low densities (<5 animals/km²) outside this area (Caughley *et al.* 1983)

Figure 1 Density and distribution of the Red Kangaroo, from aerial surveys 1980-1982 (Caughley *et al.* 1987).



Western Grey Kangaroos (WGK) are distributed across southern Australia with the highest densities (>5 animals /km²) within the semi-arid rangelands of south western New South Wales (see Figure 2). The two species occur sympatrically in those southern semi-arid and sub-humid parts of Australia where rainfall is either winter biased or is approximately equally distributed between winter and summer (Caughley *et al.* 1987).

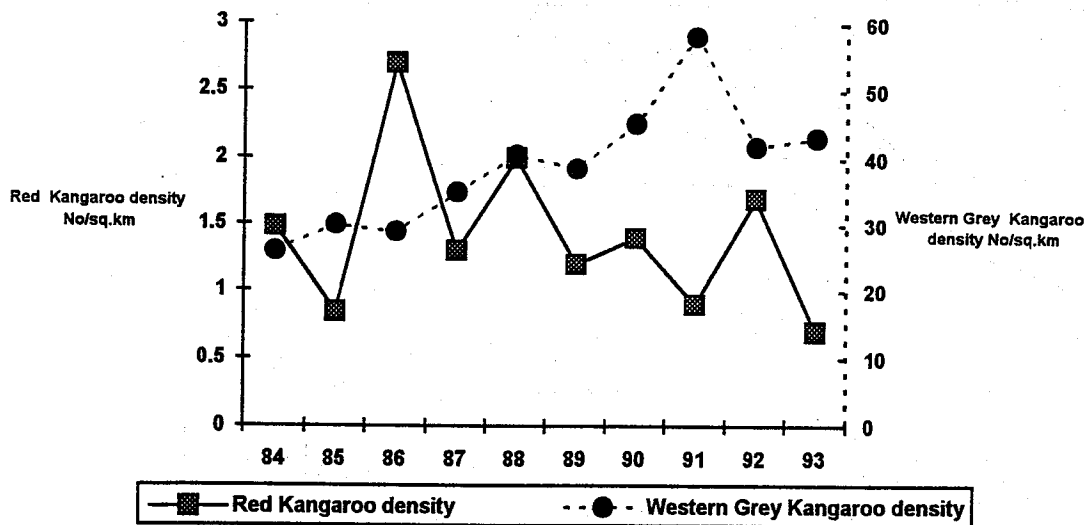
Figure 2 Density and distribution of Western Grey Kangaroo, from aerial surveys 1980-82. Density estimates are conservative (Caughley *et al.* 1987).



Census work subsequent to the broadscale aerial surveys of Caughley *et al.* (1983) have indicated that both species are capable of increasing relatively quickly following major droughts such as the one which afflicted southern Australia in 1982/83. At HKNP for instance, annual parkwide censuses (Morgan 1993) have seen WGK more than double their densities from an average of 25 animals/km² in 1983 to an average of 53 animals/km² in 1991 (see Figure 3). This, as will be explained later, may be partly due to more intensive rabbit control within the park, although increases post 1983 and pre 1986 before the major phase of rabbit control, serve to illustrate the kangaroos' post-drought response.

This localised abundance of WGK at HKNP is the highest density recorded for mainland Australia (Coulson 1990). Conversely RK densities at HKNP over the past ten years (see Figure 3) have generally been < 2 animal/km², a figure which closely reflects the situation for North West Victoria both immediately prior to European settlement (Barker and Caughley 1992) and subsequently (Caughley *et al.* 1983).

Figure 3 Kangaroo densities outside Mournpall June 1984 to June 1993



North west Victoria lies only 300 km south of rangelands containing the highest densities of RK recorded for Australia. This core location for the species has undoubtedly shifted with changes in semi-arid and arid zone climates throughout the Holocene (Ash and Wasson 1983, Luly in press) and can be anticipated to shift again under an Enhanced Greenhouse Scenario (CSIRO 1990).

If the predictions for north west Victoria (see Appendix 1) are accurate the area will become drier with reduced effective rainfall with a summer rainfall bias. Under such a scenario it is reasonable to anticipate that RK will increase in abundance in North West Victoria relatively quickly (eg within the next 50 years). Such an increase would be greatly assisted by changes to the Australian rangelands brought about subsequent to European settlement (eg an increased number of watering points, altered vegetation structure and increased weediness) which have generally made this area more suitable to habitation by large macropods such as RK and WGK.

It is possible that RK densities of approximately 4 animals/km² which occur at present within north west Murray-Sunset National Park (Morgan 1993) may reflect the beginnings of such a trend and elevates the importance of maintaining a long-term kangaroo monitoring program within the Victorian mallee.

Landform and Soil Characterization

The overwhelming diagnostic feature of the Australian rangelands is that they comprise predominately low-lying plains with relief over 350 m the exception. Soil types and landforms vary across the country with Western Australia dominated by granitic and limestone plains interspersed with palaeo-floodplains and wind-blown sand (Robertson *et al.* 1987). In North West Victoria, South Australia, New South Wales and Queensland landforms comprise an admixture of depositional floodplains, sandplains, dunefields and erosional surfaces. The influence of the inland discharging streams originating in the Great Dividing Range (eg Murray-Darling Basin rivers and associated water bodies) throughout the Tertiary to the present has led to the increase in the heterogeneity and productivity of the eastern Australian rangelands. This is a

major factor explaining the highest Australian densities for each of RK, WGK and Eastern Grey Kangaroo (*Macropus giganteus*) in eastern Australia .

The soils of Australian rangelands include calcareous earths, red and yellow earths, cracking clays, red sands, clayey sands and lithosols (Robertson *et al.* 1987). Within the rangelands of North West Victoria and western New South Wales, the first three of these predominate. At locations such as Kinchega National Park where the CSIRO conducted a major research program on kangaroos in the early 1980s and at HKNP where research by CNR and Melbourne University is ongoing, grey cracking clays of the current floodplains and calcareous earths and dune sands are the dominant soils.

Vegetation

The vegetation of the rangelands consists of a mosaic of open forests, woodlands, shrublands and grasslands with a wide overlap in the composition of the pasture layer (Robertson *et al.* 1987). In southeast Australian rangelands at key study sites such as Kinchega National Park, HKNP and Murray-Sunset National Park, open forest is mostly restricted to the banks of major rivers, anabranches and billabongs and is dominated by River Red Gum (*Eucalyptus camaldulensis*). Woodlands occur in more elevated dryland situations characterized by Cypress-pine (*Callitris* spp) with or without False Sandalwood (*Myoporum platycarpum*) and she-oaks such as Belah (*Casuarina pauper*) and Buloke (*Allocasuarina luehmannii*). Also present in these dry woodland types are Cattlebush (*Alectryon oleifolius*) and smaller shrubs from genera such as *Eremophila*, *Dodonaea*, *Senna*, *Maireana* and *Acacia*. Floodplain woodlands are dominated by Black Box (*Eucalyptus largiflorens*) with an understory comprising lignum (*Muehlenbeckia florulenta*) and/or chenopod shrubs and sub-shrubs along with perennial grasses such as *Danthonia* spp and *Stipa* spp.

Low shrublands up to 1.5m in height are dominated by Black Bluebush (*Maireana pyramidata*) and Pearl Bluebush (*Maireana sedifolia*) with an understory of *Atriplex* shrubs and sub-shrubs. Such communities are restricted within southeast Australian rangelands and scarcely occur at HKNP, but are widespread throughout the rest of Australia's rangelands. Tall and tall open shrublands (2-8 metres in height) which occur extensively outside the semi-arid southeastern Australian rangelands are dominated by *Acacia* spp. (eg *A.aneura*, *A.cabbagei*, *A.sowdenii*) with understory representatives from the genera *Eremophila*, *Hakea*, *Myoporum*, *Senna*, and *Dodonaea*. Another tall open shrubland which occurs extensively in the semi-arid rangelands of southeastern Australia is mallee. This community type is dominated by multi-stemmed *Eucalyptus* spp. up to 12 metres in height often in association with *Eremophila*, *Senna* and/or hummock grassland of *Triodia* spp.

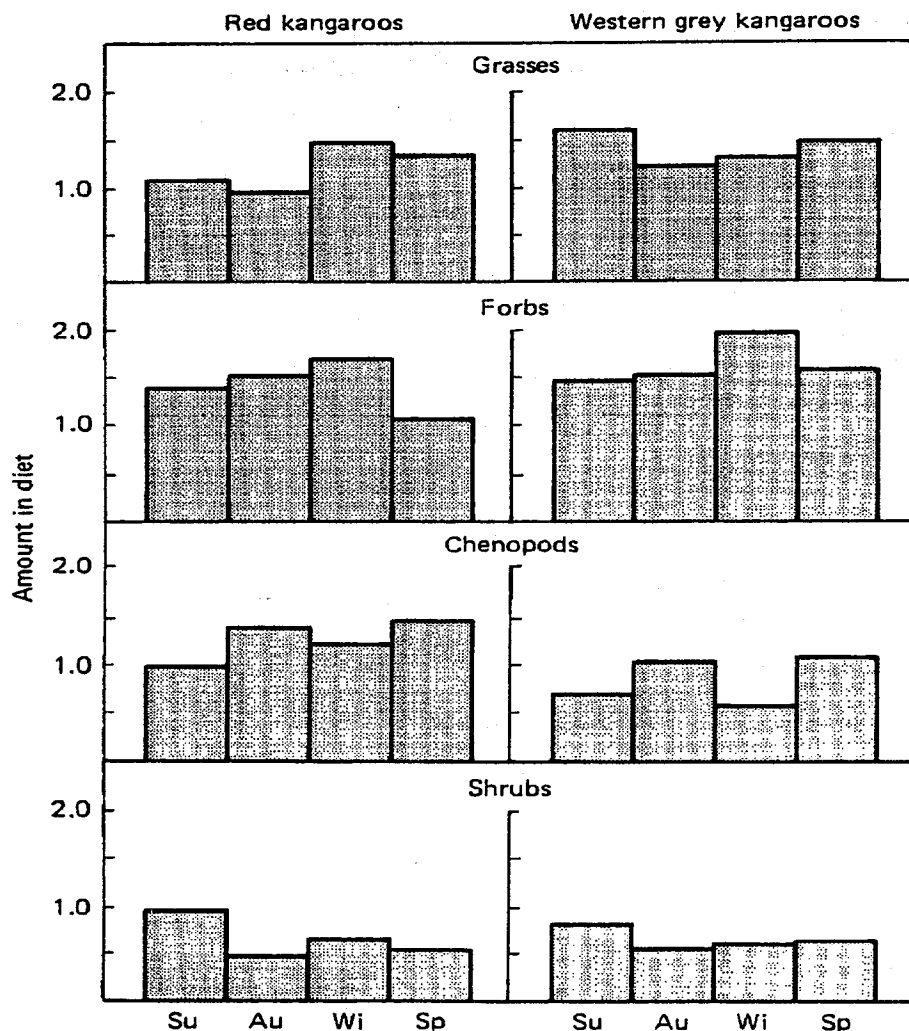
The vegetation is far from pristine however. Postulated changes since the introduction of domestic stock and the European Rabbit, (*Oryctolagus corniculus*) include the reduction in density of small trees and shrubs in low open chenopod shrublands (Robertson *et al.* 1987), an increase in the incidence of woody shrubs unpalatable to stock (Harrington *et al.* 1979), the introduction of exotic species (Dixon 1982, Moore 1959) and the failure of long-lived tree species to regenerate despite favourable climatic sequences for germination and establishment (Lange and Purdie 1976).

These changes have all substantially manifested themselves at HKNP where the major changes have occurred within dune woodland vegetation. Tree densities are now markedly reduced with Slender Cypress Pine (*Callitris preissii*) and *Allocasuarina luehmannii* occasionally represented by remnants on dunes which are dominated by pastures of introduced herbaceous annuals, unpalatable native annuals, short-lived perennials and/or the native woody perennial shrub Hopbush (*Dodonaea viscosa* ssp *angustissima*). Floodplain vegetation too is now grossly changed with tree densities of Black Box reduced through past logging within the area and ground floras characterized by herbs and unpalatable natives at low pasture biomass levels.

Dietary Preference

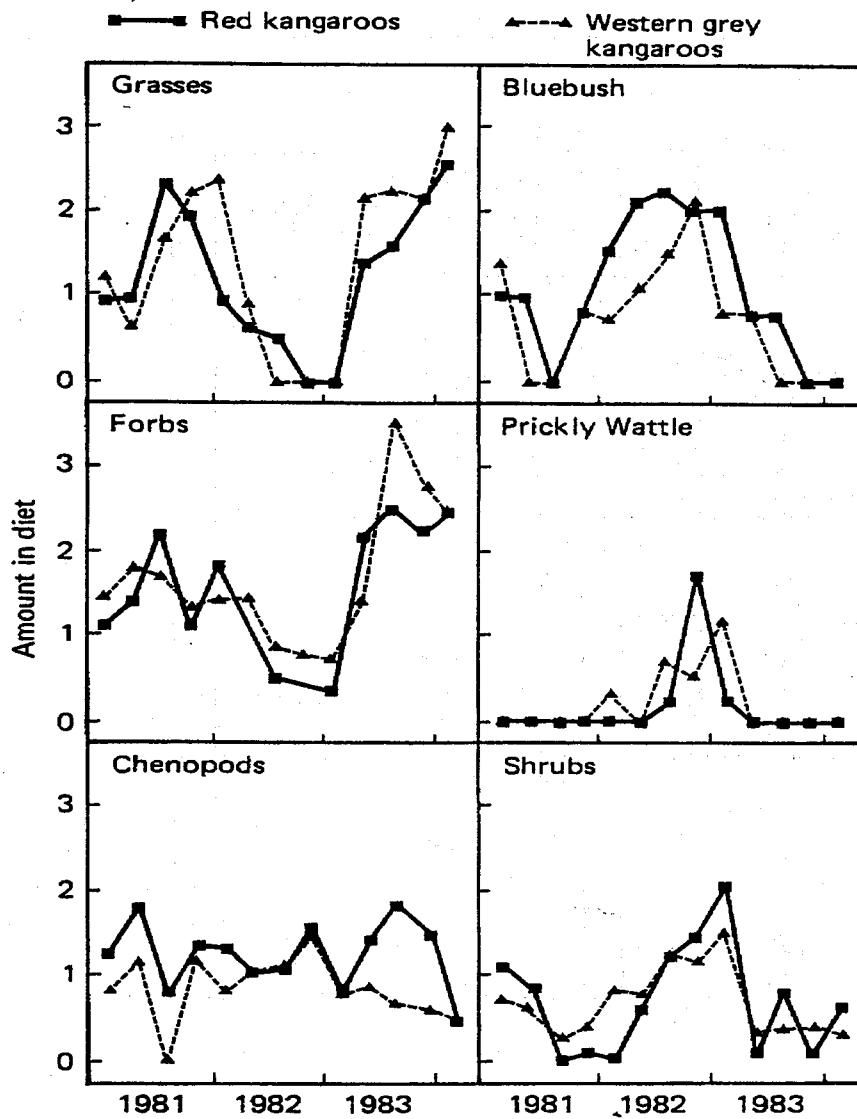
The only study to directly compare the dietary preference of WGK and RK at the same site was conducted at Kincheha National Park (Barker 1987). That study found that the diet of both species was fundamentally affected by the type of food on offer and that importantly few differences were evident between the two species at higher pasture biomass levels. This relationship is summarized in Figure 4 where the mean seasonal contributions of grasses, forbs, chenopods and shrubs to the diet of RK and WGK over the period from 1981-1984 is portrayed. The only differences between the two species' dietary preferences over the study period was a tendency for WGK to consume a slightly greater proportion of grasses and forbs than RK whilst the latter tended to consume a greater proportion of chenopods (excluding bluebush, *Maireana* spp.) than the former.

Figure 4 The mean of the scoring of the amount of grasses, forbs, chenopods and shrubs in the diet of Red and Western Grey Kangaroos for each season at Kinchega National Park (Barker 1987).



Averaging of the figures, however, was shown to mask the importance of the 1982 drought which affected southern Australia and manifested itself at Kinchega National Park in a drastic reduction in total standing biomass as well altering the relative contributions of the above categories of pasture to the diets of the kangaroos (see Figure 5). Barker (1987) was able to demonstrate that at times of low pasture biomass both species switched their dietary preferences. As grasses and forbs (the major dietary components for both species) diminished with the intensification of the drought through 1982, RK greatly increased their intake of bluebush shrubs (particularly *Maireana pyramidata*) whilst WGK tended to consume a relatively larger proportion of shrubs such as *Acacia* spp *Eremophila* spp and *Dodonaea* spp.

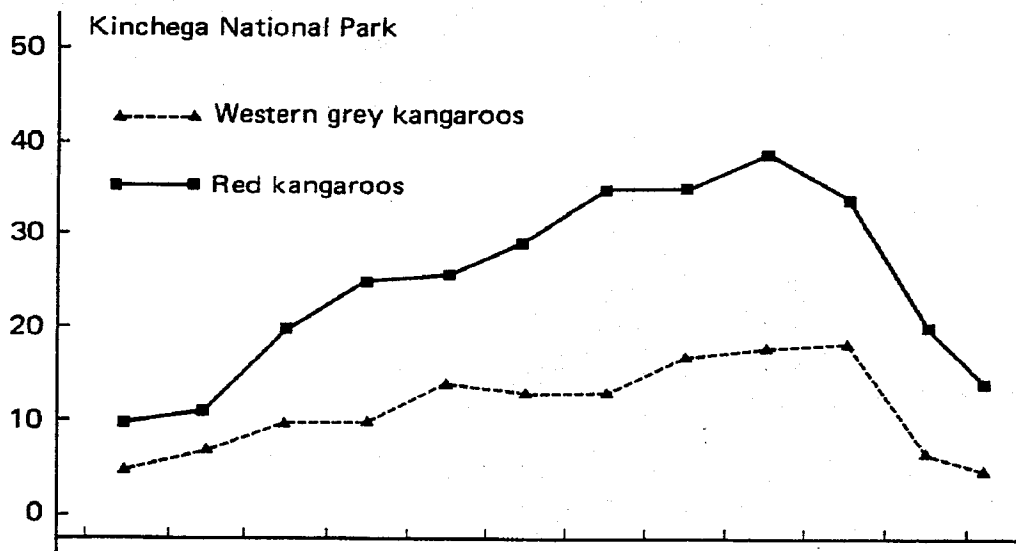
Figure 5 The change in the amount of grass, forbs, shrubs, prickly wattle and bluebush in the diets of Red and Western Grey Kangaroos at Kinchega National Park, 1981-1984. The vertical axis 1, 2 and 3 refer to "a little", "some" and "a lot" respectively (Barker 1987).



With the breaking of the drought in the autumn of 1983 the grasses and forbs responded almost immediately with WGK proving relatively more adept at taking advantage of these newly increased components of the biomass.

Comparisons of the Kinchega study with those results from HKNP are difficult to make for a number of reasons, however. Firstly RK are the dominant macropod at Kinchega National Park with a normal ratio of 2 RK : 1 WGK (see Figure 6). Secondly HKNP receives on average, approximately 80 mm more rainfall per year than Kinchega (320 mm Vs 236 mm with a lower co-efficient of variation (cv 31 vs cv 47). Moreover at Kinchega there is no bias toward either summer or winter falls whereas at HKNP, there is a slight although clear winter spring bias in rainfall. Thirdly although the major vegetation types are broadly similar, Kinchega National Park lacks large areas of mallee shrubland as occur at HKNP whilst the latter area lacks extensive areas of low open bluebush shrublands

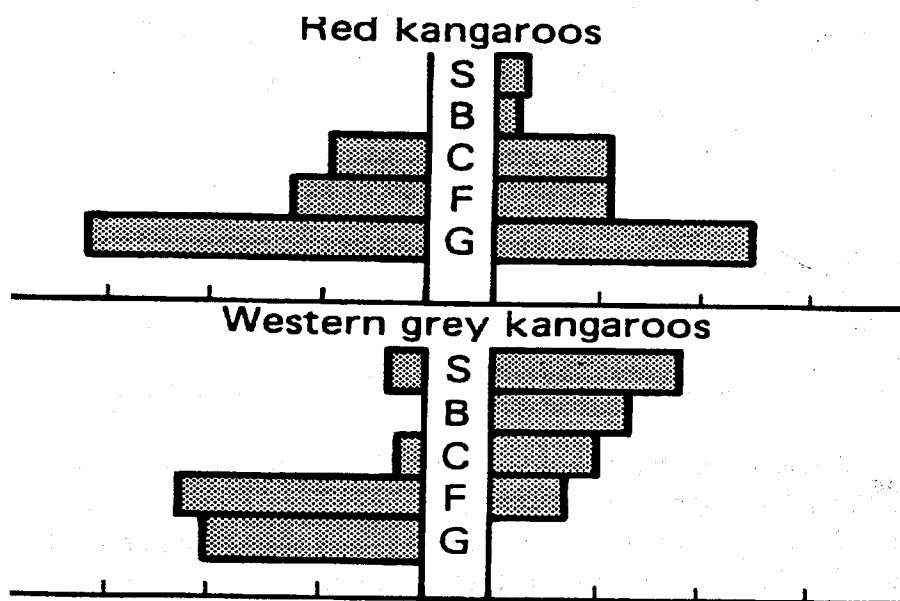
Figure 6 The yearly trend in Red and Western Grey Kangaroo densities at Kinchega National Park (1973 to 1984) (Bayliss 1985).



Despite this, in a study conducted on the diet of WGK at HKNP a similar preference for grasses in all vegetation types at all times of the year was revealed (Norbury 1988 Coulson and Norbury 1988). Only when grass biomass was reduced to levels of <math><400\text{ kg dry weight / ha}^2</math> did WGK adopt alternative feeding strategies such as a greater selection of forbs and shrubs. Such low biomass scenarios however, are the norm at HKNP rather than the extreme. Indeed high grazing pressure combined with the near absence of native perennial grass cover for most of the year means that the Park experiences "pseudo-drought" conditions at most times. Consequently damage to perennial vegetation at HKNP will persist as long as WGK numbers remain high. In addition such damage will similarly continue if large populations of WGK are replaced by RK.

Studies from elsewhere in the eastern Australian rangelands summarized by Barker (1987) (see Figure 7) tends to support the above findings, although most authors report that in dry or drought times RK maintain their favoured diet and browse only sparingly whereas WGK switch dramatically from grazing grass and forbs to browsing chenopods and other shrub species.

Figure 7 Diet of Red and Western Grey Kangaroos in good and dry times. The data are summarised from studies in western New South Wales and southern Queensland. G-grasses F-forbs C-chenopds sub-shrubs, B-chenopod shrubs S-shrubs Graphs on the left represent good times and graphs on right represent dry times (Barker,R.D. 1987).



Mobility

Understanding the mobility and habitat utilization of kangaroos plays a key role in their management. It is important to know whether the individuals of a population are confined to a home range or whether they are nomadic. Scientific evidence conflicts with the anecdotal view that kangaroos are nomadic. There are records of individual animals traveling distances in excess of 200 km in times of drought (Bailey 1971, Denny 1982). The majority of studies, however suggest both RK and WGK are confined to a circumscribed area or home range (Frith 1964, Bailey 1971, Denny 1982, Priddel 1983 and Coulson 1991).

Bailey (1971) concluded there was a spectrum of mobility types in the kangaroo population studied ranging from highly mobile animals to sedentary animals. Other observations are consistent with this conclusion (Denny 1982, Coulson 1991 and Priddel 1983). Denny (1982) and Norbury *et al.* (1994) found wide-ranging kangaroos to be predominately young males, suggesting that this particular sex and age class may be the means for long range dispersal of the species.

Studies by Priddel (1983) at Kinchega National Park suggest that : (1) on average RK had a larger home range than WGK (7.7 km² and 6.9 km² respectively) ; and (2) males had larger home ranges than females (8.1 and 6.5 km² respectively). Similarly no WGK has been recorded moving as far as 5 km in HKNP (Coulson 1990).Coulson (1993) reports that at HKNP home ranges of WGK ranged from 2.2 km² to 4.6 km² each encompassing three or four habitat types, and there was extensive spatial and temporal overlap between individuals. In a study from a more arid site in the Gascoyne region of Western Australia, Norbury *et al.*(1994) measured home range

sizes in RK of 18.4 km² for females and 36.1 km² for males. These large home ranges being attributed to inherently poor vegetation production and the occurrence of drought.

Habitat Utilisation

The major factors affecting dispersion are water and pasture quality. Studies at Kinchega National Park explained shifts in habitat utilisation as a response to shifts in pasture productivity, with RK in particular consistently seeking out areas of green pasture (Johnson and Bayliss 1981).

Priddel (1983) similarly established that the dispersion of kangaroos changed substantially depending upon conditions. Usually kangaroos were widely dispersed, but during dry times when pastures were otherwise scarce both RK and WGK aggregated in depressions and along the edges of receding lakes and creeks, where they would generally find remnants of palatable pasture still available. Pastures on these alluvial soils stayed palatable longer than those on the aeolian soils of the sandplains, especially in areas adjacent to creeks, billabongs and depressions. Although floodplains appeared to be refuges for kangaroos when conditions were dry, vegetation on these heavy textured soils did not regenerate as rapidly or as profusely following light rain as that on the lighter-textured soils. Consequently, kangaroos moved onto the sandplains after rain to take advantage of the rapid growth of pasture there. Priddel (1987) showed that the RK responded to rain by moving to the sand plains to take advantage of new growth whereas WGK moved from two to ten weeks later.

The above observations, however, are generally only valid for movements within a home range. When pasture becomes scarce RK and WGK will not become nomadic in search of fresh pasture, but rather tend to remain and die within their home range (Priddel 1987). In times of drought kangaroos have depleted fat reserves and poor body condition. Priddel (1987) has suggested that by moving hundreds of kilometres in search of green pasture the additional demands on these reserves results in an increased probability of premature death than the alternative strategy of remaining sedentary and waiting for the drought to break. RK do, however, show an increase in home range with increased aridity (Norbury *et al.* 1994), while increases in WGK home range are best correlated to decreasing pasture biomass (Caughley *et al.* 1987).

Kangaroo Population Dynamics

Bayliss (1987) concluded that there is no important difference in population dynamics between RK and WGK. Both species appear to share the same food supply and the differences in survival and fecundity between the species are likely to be trivial.

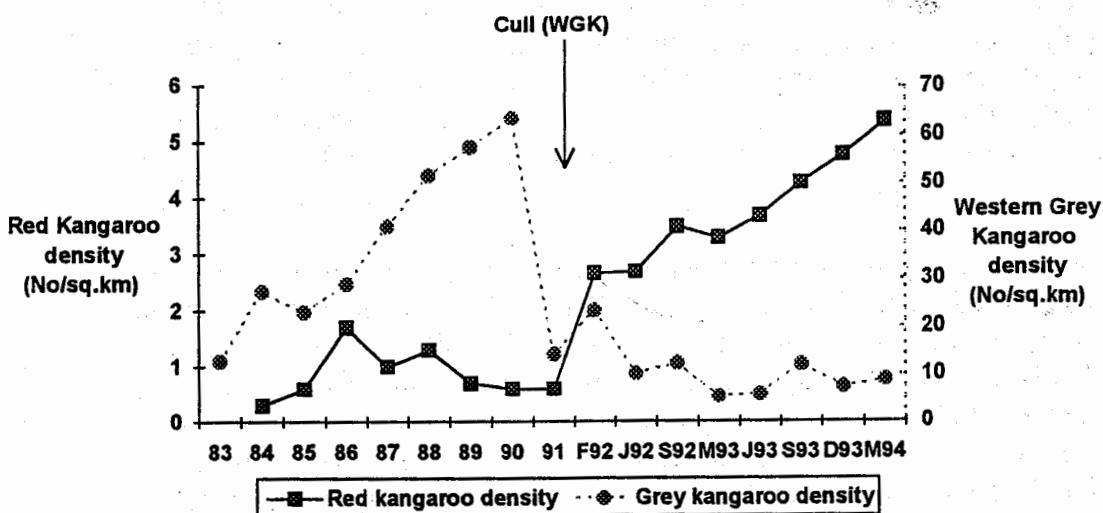
Bayliss (1987) stated that RK bred continuously in favourable conditions. Norbury *et al.* (1988) similarly showed that WGK at HKNP bred continuously with births concentrated in spring and summer with a peak in November in good seasons. RK mature sexually at ages between about 18 months and 24 months (Sharman and Calaby 1964) and female WGK usually mature at 18-34 months old (Poole and Catling 1974). A slight difference does exist in fecundity however. A healthy adult female RK can rear a maximum of 3 young every 2.5 years in good seasons. WGK young however

occupy the pouch for approximately 10 months so that the peak spring-summer breeding season would be followed by permanent pouch vacation the following spring (Norbury *et al.* 1988)

The major environmental factors affecting kangaroo population dynamics are rainfall and food availability. The average time lag between rainfall and a detected response in kangaroo populations is 6 months (Bayliss 1985, Caughley *et al.* 1985) and this short reaction time implies a survival response not a breeding response. The greatest mortality of kangaroos in times of food shortages is in pouch young during advanced lactation (Newsome 1965, 1966, Kirkpatrick and McEvoy 1966, Poole 1973 and Russell 1974). If rainfall is high and food abundant, juvenile survival is high and is detected as a positive change in rate of population increase six months later.

The overwhelming conclusion for co-habiting populations of RK and WGK therefore, as expressed by Caughley *et al.* (1987) is that "an artificial reduction in the density of one would be compensated to some extent by an increase in the other." This predicted outcome has occurred recently in the Mournpall Block of HKNP (see Figure 8).

Figure 8 Red and Western Grey Kangaroo density Mournpall Block 1983 to 1993



Since the commencement of WGK culling within the Mournpall Block in October 1990 there has been a reduction in their density from in excess of 60 animals/km² to <10 animals/km². With the reduction of WGK, RK have increased from 50 animals (1.4 animals/km²) in 1991 to 305 animals (5.4 animals/km²) in March 1994. Despite maintenance culling of WGK to numbers approaching the target figure of 300, a near equivalent and increasing number of RK has seen the total grazing pressure in the block maintained at over 600 or alternatively > 10 animals/km² for the past 3.5 years. All available evidence suggests that whilst the population of WGK in the Mournpall Block is held at not more than 300 individuals, the population of RK will continue to increase. It is not possible to predict at what level the RK population will stabilise.

The Vegetation Response to Kangaroo Culling at Hattah -Kulkyne National Park.

The maintenance of three different grazing regimes at HKNP over the past 3.5 years has facilitated a study of the vegetation response to kangaroo grazing at high (>50 animals/km²) = Outside Mournpall, moderate (approximately 10-15 animals/km²) = Mournpall Block, and nil grazing pressure (= Consplot). Biomass quantification in the two major non-Mallee vegetation associations at HKNP - in dunefields (Dune - see Figure 9) and riverine woodlands (Woodland - see Figure 10) reveals the following.

- 1) Dunefields support a higher level of biomass, especially for monocotyledons, under all grazing regimes than do Woodlands.
- 2) The Mournpall Block Dunes represent an intermediate position between high and nil grazing pressure, although in Woodlands they are in only marginally better condition than areas outside Mournpall despite supporting a significantly lower grazing pressure.
- 3) Monocotyledons (dominantly native perennial grasses) constitute by far the greatest (70-80%) proportion of biomass under grazing exclusion in dunefield areas. Under moderate grazing (Mournpall Block), grasses constitute on average approximately half of the biomass. In contrast, monocotyledons are poorly represented Outside Mournpall and are overwhelmingly comprised of Onion Weed (*Asphodelus fistulosus*).
- 4) Grazed Riverine woodland areas support very low biomass levels throughout the park and are especially depauperate of grasses.

To summarize vegetation recovery has occurred within the Mournpall Block of HKNP since the introduction of a culling program there in October 1990. Improvement has been most noticeable in the groundflora of dunefields which are now characterized mostly by native perennial grasses. Improvement has also occurred within riverine woodland areas although the overall result has been disappointing. The reasons for this are attributed to a) a higher than recommended total grazing pressure within the Mournpall Block (ie > 10 Kangaroos/km² instead of 5 Kangaroos/ km²), and b) vigilance on the part of the remaining kangaroos in their habitat preference for more wooded riverine areas.

Conclusion

It is clear that both RK and WGK show broad overlap in diet, habitat utilisation and breeding. This broad overlap indicates that regardless of the proportion of each of these two species, kangaroos at even moderately high numbers such as occur in the Mournpall Block of HKNP will jeopardise the vegetation rehabilitation program there. Consequently RK should be seen as part of the total grazing pressure within the Mournpall Block and included in any future kangaroo management programs.

Figure 9 Biomass levels in dunes in three grazing regimes at HKNP

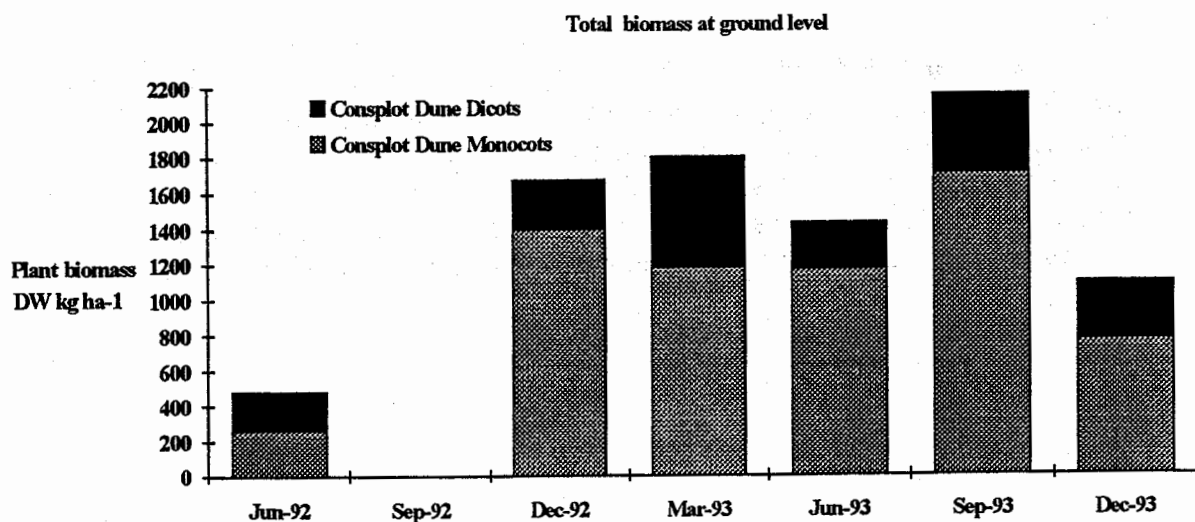
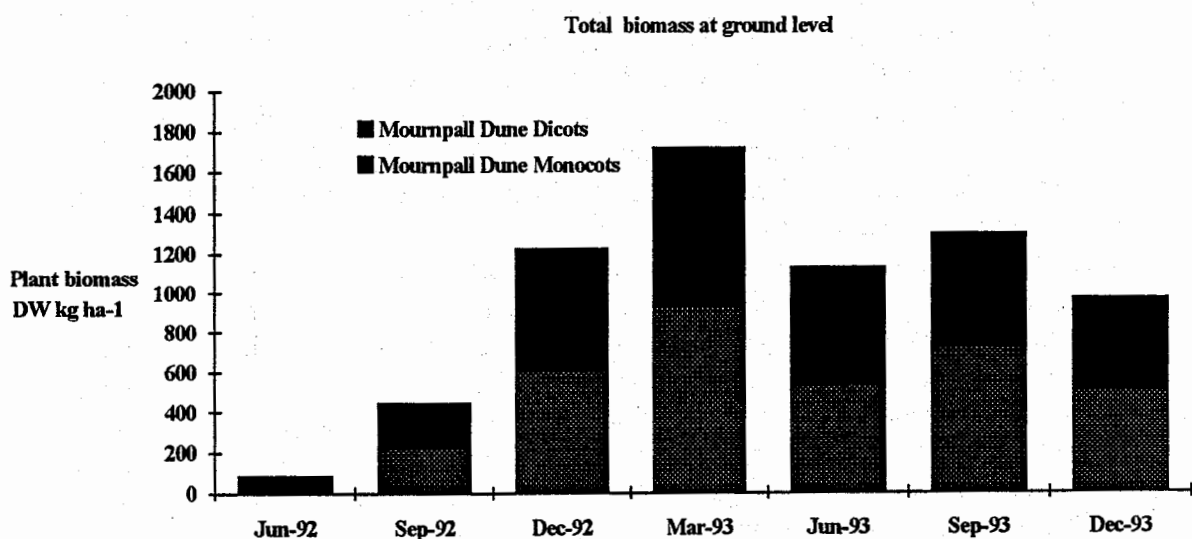
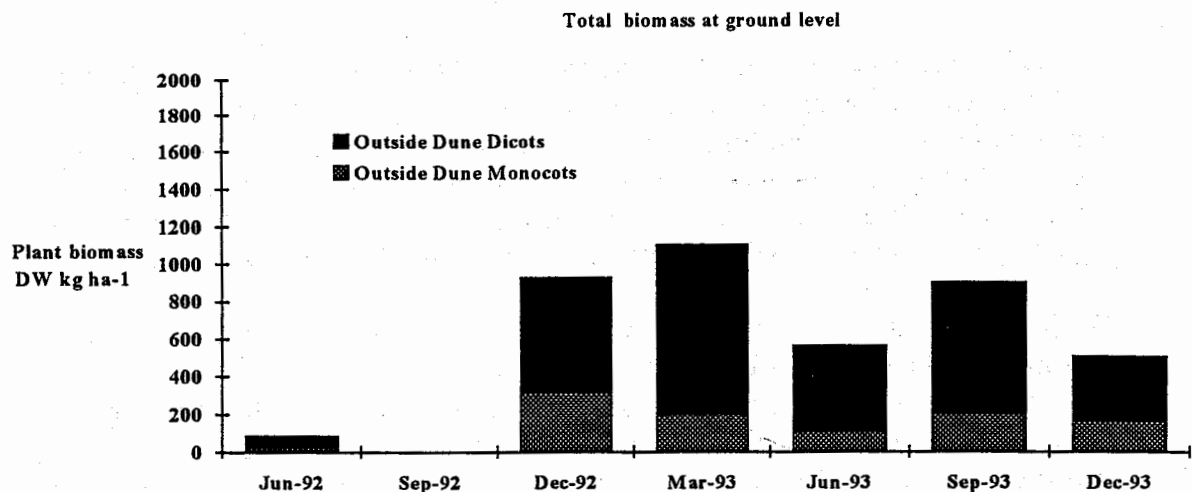
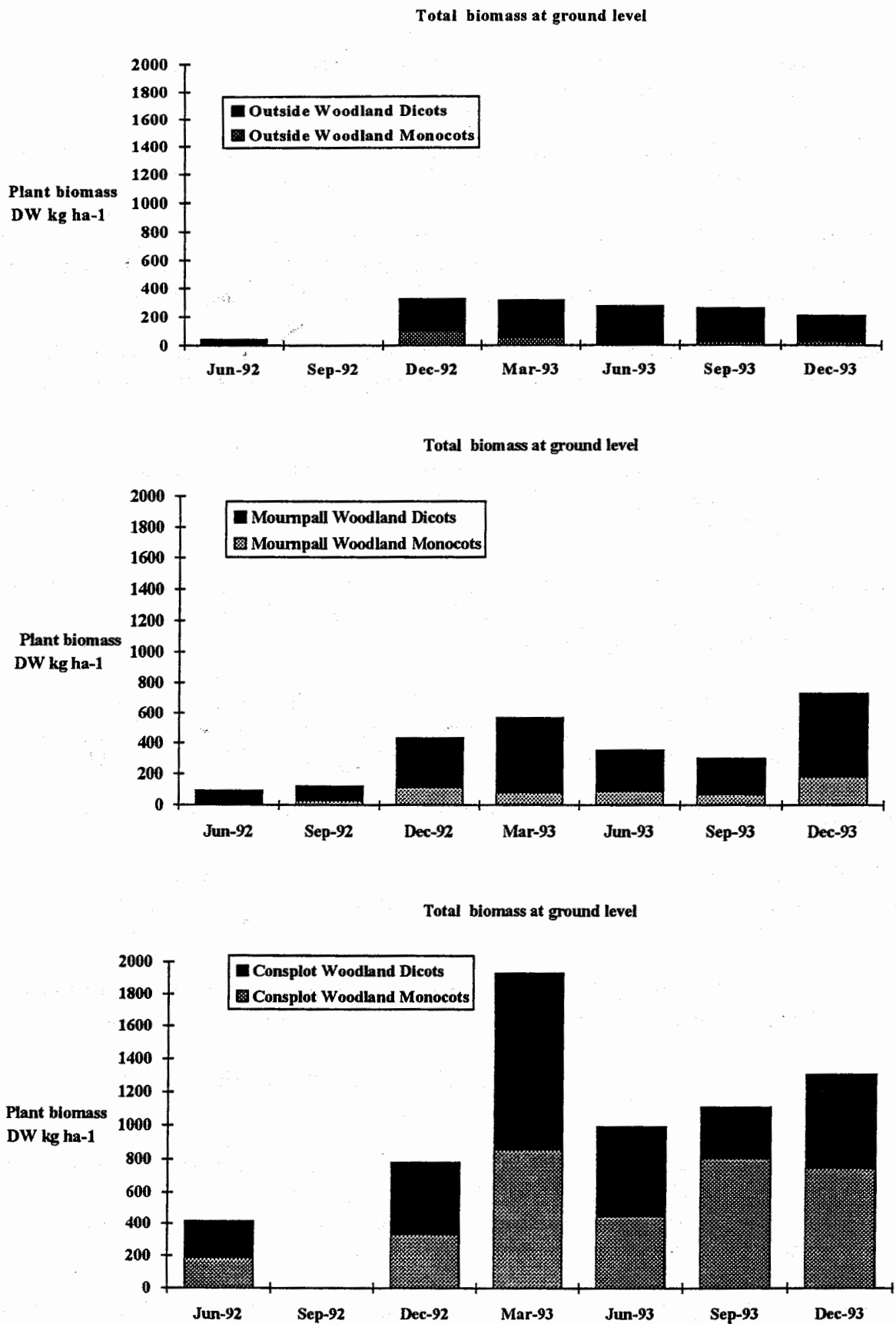


Figure 10 Biomass levels in woodlands in three grazing regimes at HKNP



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