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Impacts of grazing management options on pasture and animal productivity in a *Heteropogon contortus* (black speargrass) pasture in central Queensland. 3. Diet composition in autumn

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Abstract. The diet selected in autumn by steers fistulated at the oesophageous was studied in a subset of treatments in an extensive grazing study conducted in a *Heteropogon contortus* pasture in central Queensland between 1988 and 2001. These treatments were a factorial array of three stocking rates (4, 3 and 2 ha/steer) and three pasture types (native pasture, legume-oversown native pasture and animal diet supplement/spring-burning native pasture). Seasonal rainfall throughout this study was below the long-term mean and mean annual pasture utilisation ranged from 30 to 61%. Steers consistently selected *H. contortus* with levels decreasing from 47 to 18% of the diet as stocking rate increased from 4 ha/steer to 2 ha/steer. *Stylosanthes scabra* cv. Seca was always selected in legume-oversown pastures with diet composition varying from 35 to 66% despite its plant density increasing from 7 to 65 plants/m^2 and pasture composition from 20 to 50%. Steers also selected a diet containing *Chrysopogon fallax*, forbs and sedges in higher proportions than they were present in the pasture. Greater availability of the intermediate grasses *Chloris divaricata* and *Eragrostis* spp. was associated with increased stocking rates. *Bothriochloa bladhii* was seldom selected in the diet, especially when other palatable species were present in the pasture, despite *B. bladhii* often being the major contributor to total pasture yield. It was concluded that a stocking rate of 4 ha/steer will maintain the availability of *H. contortus* in the pasture.

Additional keywords: burning, *Heteropogon contortus* pastures, legume oversowing, oesophageal fistula, selection indices, stocking rate.

Introduction

In earlier papers, Orr *et al.* (2010*a*, 2010*b*) reported the impacts of stocking rate, legume oversowing and supplements/burning on pasture yield, composition and plant dynamics whereas Burrows *et al.* (2010) reported the impacts of these treatments on steer liveweight gains in a *Heteropogon contortus* pasture in central Queensland. Increasing stocking rate reduced total pasture yield, increased the occurrence of a range of intermediate species and reduced steer liveweight gain. Stocking rate was more influential than pasture type in effecting these changes although legume oversowing consistently increased steer liveweight gain compared with native pasture.

Grass, legume and forb composition of the diet of steers grazing *H. contortus* pastures has not been widely studied although such information would be useful in designing sustainable grazing management practices. Diet composition estimated from extrusa collected from animals fitted with oesophageal fistulae has been used to represent the diet of non-fistulated animals of similar history (Holechek *et al*. 1982; Forbes and Beattie 1987). Furthermore, Hall and Hamilton (1975) and Hamilton and Hall (1975) developed a microscope point technique to establish botanical composition of extrusa as representative of the diet consumed despite variation due to the degree of mastication. However, more recently, both Coates *et al*. (1987) and Jones and Lascano (1992) have reported biased estimates of diet legume composition by fistulated steers grazing sown pastures. Despite this limitation, diet composition determined from extrusa collected using oesophageal fistulae remains a valid method and continues to be used to estimate diet composition (e.g. Volesky *et al*. 2007). This paper reports the diet composition in autumn of steers fitted with oesophageal fistulae grazing native pasture, native pasture with legume oversown and burnt native pasture treatments at three stocking rates between 1992 and 2000.

Materials and methods

Grazing study

A study was conducted between 1988 and 2001 in a *H. contortus* pasture at Galloway Plains, Calliope (24°10′S, 150°57′E) in central Queensland. The original design was a randomised block with two replications of treatments: five stocking rates (8, 5, 4, 3 and 2 ha/steer) in native pasture and three stocking rates (4, 3 and 2 ha/steer) in both native pasture oversown with introduced legumes plus a diet phosphorous supplement and native pasture with dry season protein supplement to the

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animals (Table 1). The two predominant soil types were a low fertility duplex (Dy3) and a grey clay (Ug5) with the study designed so that one replicate block was located on each of these two dominant soil types. Five *Bos indicus* crossbred steers grazed each treatment with paddock sizes from 10 to 40 ha to achieve the designated stocking rates although 6 steers were included in the 1992–93, 1995–96, 1999–2000 and 2000–01 drafts in order to accelerate stocking rate effects. Steers were replaced annually. The legumes *Stylosanthes scabra* cv. Scabra, *S. hamata* cv. Verano and *Chamaecrista rotundifolia* cv. Wynn were surface sown in October 1987 and *C. rotundifolia* cv. Wynn was resown into cultivated strips in August 1988. In 1992, the original dry season supplement treatments were replaced by spring-burning treatments although reduced pasture yields combined with below average rainfall, particularly at 2 and 3 ha/steer, reduced the opportunity to burn and burning occurred only in 1992 and 1999 (further details are provided in Orr *et al*. 2010*a*).

Diet in autumn

The diet composition in autumn was measured by steers fitted with an oesophageal fistula on a subset of treatments, the nested 3 by 3 factorial of three stocking rates (4, 3 and 2 ha/steer) by 3 pasture types (native pasture, legume-oversown native pasture, supplement/burnt native pasture). Throughout this paper, the supplement/burnt native pasture treatments will be referred to as 'burnt' because no diet sampling was conducted during the time that the dry season supplement was fed. Oesophageal-fistulated Brahman cross steers, separate to the intact steers, sampled pastures annually in autumn (February–April) between 1992 and 1996 and in 1998 and 2000. Twelve steers were used in 1992–95 and nine steers in 1996, 1998 and 2000. At each sampling period, the steers were randomly allocated to three groups and each group randomly allocated to a stocking rate treatment. A group was then used to sample their allocated stocking rate treatment across replicates and pasture type for that year. Each group of steers grazed the treatment paddock for 6 days before extrusa collection which occurred during 1 day in each treatment. When sampling, fistulated steers were restricted to an area which represented the pasture yield and composition of the overall paddock as determined by pasture sampling which is described under 'Selection indices' below.

Steers were fasted overnight before sampling. At each sampling, two extrusa samples were obtained from each fistulated steer following 30 min grazing the allocated paddock and samples frozen. Immediately before botanical analysis, extrusa samples were thawed and plant species identification determined using a microscope point hit technique measuring 200 points per sample (Hamilton and Hall 1975). The proportion of green leaf, dead leaf, green stem and dead stem was assessed for each species in the diet.

Table 1. Experimental design for stocking rate and pasture type treatments at Galloway Plains between 1988 and 2001

Stocking rate (ha/steer)	Native pasture	Native pasture with legume	Native pasture with dry season supplement/ burning
8	+[A]	–	–
5	+	–	+[B]
4	+	+	+
3	+	+	+
2	+	+	+

[A] Treatment conducted between 1988 and 1996.

[B] Treatment conducted between 1996 and 2001.

Selection indices

For each diet sampling, diet selection indices (SI) for individual species were calculated using the formula:

$$\text{Selection index} = \frac{\dfrac{\text{Component A in diet}}{\text{Component A in pasture}}}{\dfrac{\text{Component A in diet}}{\text{Component A in pasture}} + \dfrac{\text{Component B in diet}}{\text{Component B in pasture}}} \qquad (1)$$

where A is the percentage of an individual species in the diet or pasture and B is the percentage of the remaining species in the pasture or diet (John Hodgson, pers. comm.). SI values vary from 0 to 1 with high values indicating preference for that species while low values indicate preference against that species.

Pasture yield and composition for individual species was determined annually using Botanal (Tothill *et al*. 1992) conducted in autumn as close as possible to the time that the fistulated steers sampled the treatment paddocks (further details are provided in Orr *et al*. 2010*a*). Species were classified into three groups on the basis of maximum recorded yields: major (>1000 kg/ha), intermediate (<1000 kg/ha) and minor (<100 kg/ha) as per Orr *et al*. (2010*a*).

The pasture yield of each species at the time of each fistula sampling was plotted against the corresponding SI with the relationship between SI and pasture yield indicated by a fitted trend line. Only SI data for major and intermediate species recorded in the diet are presented as low and highly variable pasture yields of minor species are likely to bias the calculated SI value for these minor species.

Statistical analyses

Since a group of steers sampled all paddocks of a given stocking rate in any sampling time, stocking rate was confounded with sample group. Further, as steers within a group were not necessarily the same at each sample time, the groups across sample times were considered as independent (i.e. as if unique groups). Also, data were unbalanced and contained multi-strata, so data were analysed by residual maximum likelihood using GENSTAT (2002). Data included the proportion of green leaf, total green material (sum of green leaf and green stem) and total material (sum of green and dead leaf and stem) for: major species (*H. contortus*, *Bothriochloa bladhii*, *S. scabra* cv. Seca and *Aristida* spp.), intermediate species (*Chrysopogon fallax*, *Chloris divaricata* and *Eragrostis* spp.), and minor species ['other grasses' (grasses of minor occurrence including *Bothriochloa decipiens*)], forbs (aggregate of broad leaf species) and sedge (mainly *Fimbristylis* spp.).

To determine changes in diet composition across years, data for all seven autumn samplings for each species were analysed using a model that included the random effects of replicate × group, pasture type, animal and sample and the fixed effects of stocking rate, pasture type and year (sample time). As Seca stylo was present in the legume-oversown pasture only, the pasture type was removed from the model for this species. Data were angular-transformed [ang (p) = 180/π × arcsin ($\sqrt{}$(p/100)) where 0 < *P* <100] before analysis to satisfy normality and variance assumptions. Means were back-transformed for presentation in figures. Results presented in this paper are limited to those diet compositions where treatment differences were significant (*P* < 0.05). For those diet compositions where no results are presented, treatment differences were not significant (*P* > 0.05).

Results

Rainfall

Trends in the 5-year moving average summer (October–March) rainfall for Calliope Station (20 km from Galloway Plains) indicate that the experiment was conducted through the driest period of the last 100 years in this district. Summer rainfall in some years, for example 1990–91 and 1996–97, approached the long-term mean rainfall while other years, for example 1992–93 and 1994–95, were very much below the long-term mean (further details are provided in Orr *et al*. 2010*a*).

Pasture utilisation

Mean annual pasture utilisation increased with increasing stocking rate in the three native pasture treatments from 30% at 4 ha/steer to 61% at 2 ha/steer (Orr *et al*. 2010*a*). Utilisation was consistently higher on the texture contrast soil than on the grey clay reflecting higher pasture yields on the grey clay than on the texture contrast soil.

Selection indices

Pasture yields

Between 1992 and 2000 when this diet composition study was conducted, total pasture yields reached 3200 kg/ha at 4 ha/steer but were reduced with increasing stocking rate and in the burnt native pasture where total pasture yields were generally lower than the other two pasture types due to the impact of burning (Table 2). Yields of *H. contortus* and *B. bladhii* were reduced with increasing stocking rate and were lower in the legume treatments than in both native pasture and burning treatments. Yields of *C. fallax* were highest at light stocking rates while yields of *C. divaricata* increased with increasing stocking rate and yields of *Eragrostis* spp. tended to vary between stocking rates and pasture types.

Selection indices

A SI across all treatments of 0.69 ± 0.02 (mean ± s.e.) for *H. contortus* indicated that it was preferred while an average SI for *B. bladhii* of 0.30 ± 0.02 indicated that it was not preferred (Fig. 1*a, b*). For *H. contortus*, there was a clear trend line among pasture types with SI means for native pasture (0.72 ± 0.03) and burnt native pasture (0.73 ± 0.03) being higher than that for the legume-oversown pasture (0.62 ± 0.03) reflecting the preference for *S. scabra* cv. Seca in the legume-oversown pasture and supported by the SI for *S. scabra* cv. Seca averaging 0.67 ± 0.02 (Fig. 1*c*). For all three major species (*H. contortus*, *B. bladhii* and *S. scabra* cv. Seca), SI declined as pasture availability increased. No data are presented for *Aristida* spp., the other major species, because the overall SI was low (<0.10).

SI for the intermediate species *C. fallax* was 0.70 ± 0.02 indicating selection for this species although SI values were highest at low pasture availability and declined steeply with increasing pasture availability (Fig. 1*d*). For *C. divaricata* and *Eragrostis* spp., SI were 0.48 ± 0.03 and 0.49 ± 0.03 with a declining trend as pasture availability increased (Fig. 1*e, f*).

Diet composition

Major species

A pasture type × stocking rate interaction for all three plant components (green leaf, total green and total composition) for both *H. contortus* and *B. bladhii* was significant (*P* < 0.05) (Fig. 2). However, because all three components responded similarly to grazing treatments, data for total composition only is presented. In native pasture, the *H. contortus* composition decreased from 47 to 18% as stocking rate increased from 4 to 2 ha/steer. In the burnt pasture, a similar decline in *H. contortus* composition occurred from 45% at 4 ha/steer to 27% at 3 ha/steer, however, *H. contortus* composition increased again to 38% at 2 ha/steer. In the legume-oversown pasture, *H. contortus* composition was less than 20% irrespective of stocking rate. In native pasture, *B. bladhii* composition increased from 17 to 25% with increasing stocking rate from 4 to 2 ha/steer whereas the highest levels of 35% were recorded at 3 ha/steer in the burnt pasture. Composition of *B. bladhii* in

Table 2. Mean species and total pasture yields (kg/ha) for three stocking rates in three pasture types between 1992 and 2000 at Galloway Plains
M and I indicate major and intermediate species as described in the text

	Native pasture			Legume oversown			Burning		
Stocking rate (ha/steer)	4	3	2	4	3	2	4	3	2
Heteropogon contortus (M)	630	535	330	365	280	225	620	260	230
Bothriochloa bladhii (M)	1710	1005	570	1000	925	410	1285	1245	514
Stylo	0	0	0	1295	855	735	0	0	0
Chrysopogon fallax (I)	85	50	70	75	35	25	75	50	55
Chloris divaricata (I)	95	110	185	40	65	85	60	120	180
Eragrostis spp. (I)	50	50	60	45	30	35	70	60	65
Total	3355	2540	1620	3245	3100	1900	2395	2130	1365

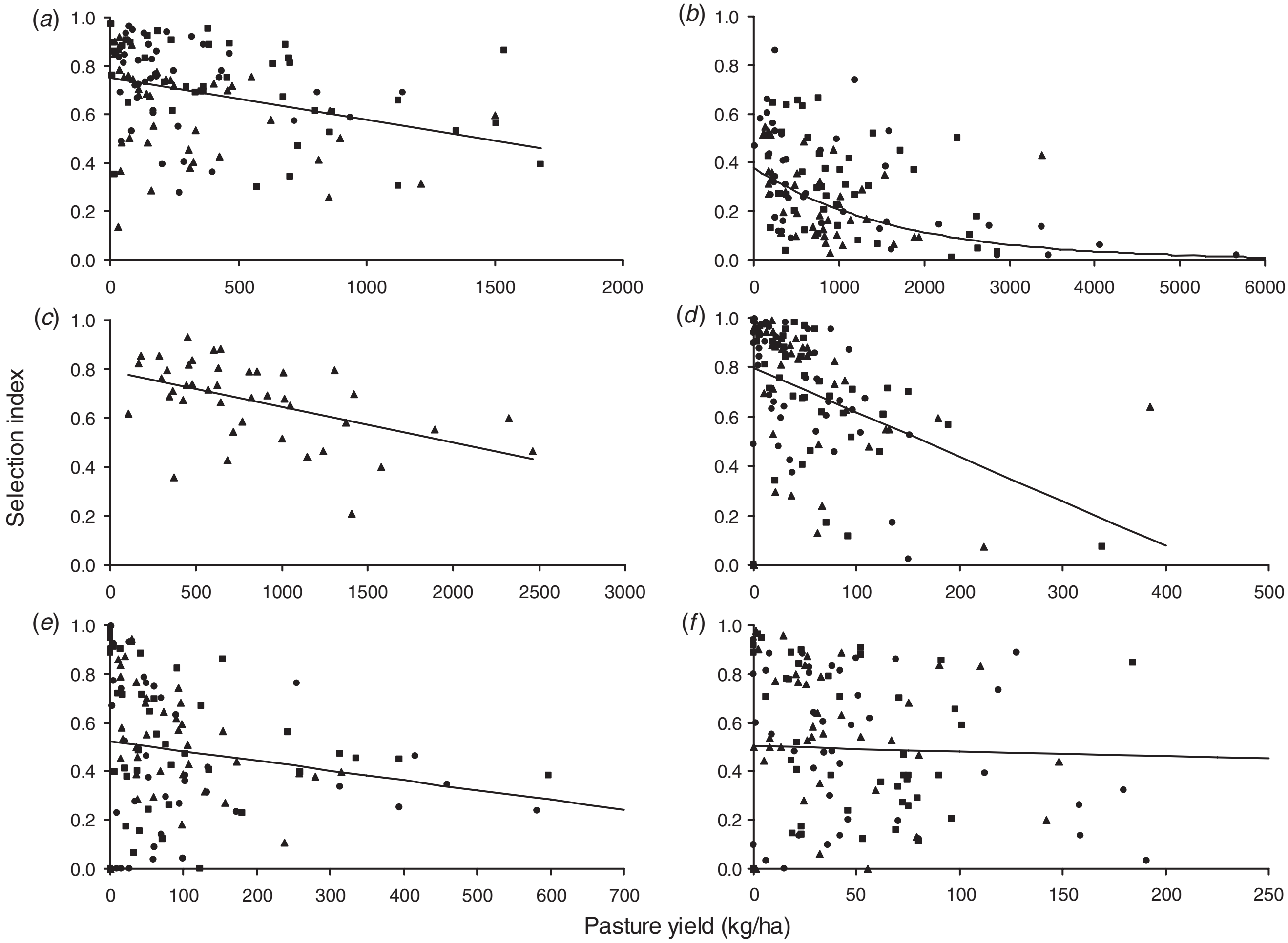

Fig. 1. Relationship between selection indices (SI) and pasture yield (showing individual replicate SI and pasture yields) for seven samplings across pasture types (native pasture ■, legume-oversown native pasture ▲ and supplemented/burnt native pasture ●) and stocking rates for (*a*) *Heteropogon contortus*, (*b*) *Bothriochloa bladhii*, (*c*) *Stylosanthes scabra* cv. Seca, (*d*) *Chrysopogon fallax*, (*e*) *Chloris divaricata* and (*f*) *Eragrostis* spp. in *H. contortus* between 1992 and 2000. Note differences in pasture yield scales.

legume-oversown pastures was less than 12% with little variation due to stocking rate.

The total diet composition of Seca stylo varied ($P < 0.05$) with years from 35% in 1992 to 66% in 1995 (Fig. 3). The occurrence of *Aristida* spp. was influenced ($P < 0.05$) by both year and pasture type. For the year effect, *Aristida* spp. composition was 2% in 1994 compared with less than 0.5% in other years while it reached 0.5% in the legume treatment compared with 0.2% in both native pasture and burnt treatments (data not presented). There was no effect ($P > 0.05$) of stocking rate.

Intermediate species

Diet composition of *C. fallax* was influenced ($P < 0.05$) by a pasture type × year interaction and was highest at 27% in the native pasture in 1998 but was only 5% in 1995 also in the native pasture (Fig. 4).

Diet composition of *C. divaricata* and *Eragrostis* spp., was influenced ($P < 0.05$) by pasture type × stocking rate and pasture type × year interactions. For the pasture type × stocking rate interaction (Fig. 5), composition of *C. divaricata* was less than 2% at 4 ha/steer for all three pasture types and increased with stocking rate to be around 10% in native pasture at 2 ha/steer but was only 5% in the legume-oversown and burnt pastures. For *Eragrostis* spp., composition was negligible (<1%) irrespective of stocking rate or pasture type (Fig. 5).

For the pasture type × year interaction (Fig. 6), composition of *C. divaricata* varied between years and pasture types from 0.1 to 12% being highest in the burnt pasture in 1996. Similarly, the diet composition of *Eragrostis* spp. varied between years from 3% in the burnt pasture in 1996 and 0% in the legume-oversown pasture in 1995 and 1996 and burnt pasture in 1995.

Minor species

The composition of forbs in the diet was influenced ($P < 0.05$) by both year and pasture type (Fig. 7). Forbs composition varied with years to be highest at 7% in 1996 and

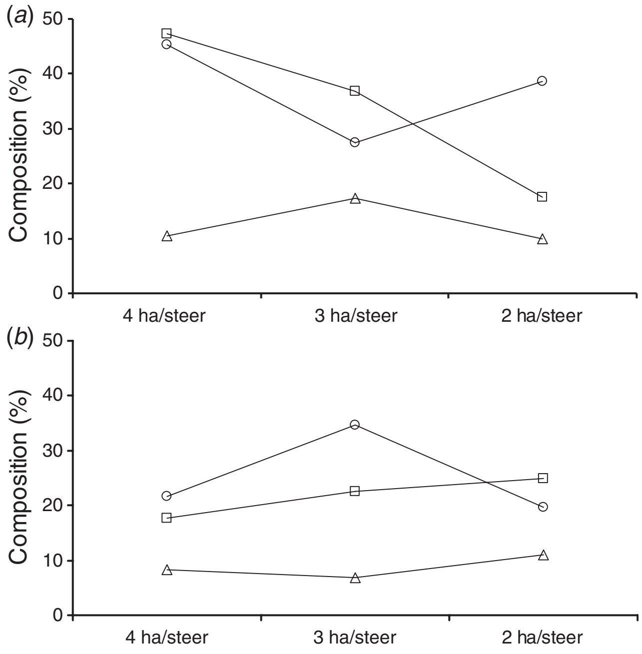

Fig. 2. Influence of pasture type (native pasture □, legume-oversown native pasture △ and supplemented/burnt native pasture ○) and stocking rate on the diet composition of (*a*) *Heteropogon contortus* and (*b*) *Bothriochloa bladhii* in *H. contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data.

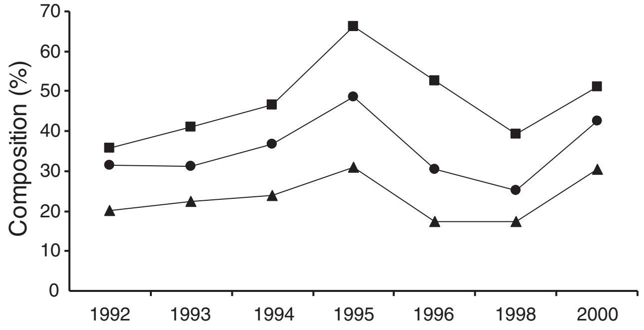

Fig. 3. Influence of year on the diet composition of Seca stylo for green leaf (▲), total green (●) and total composition (■) in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data.

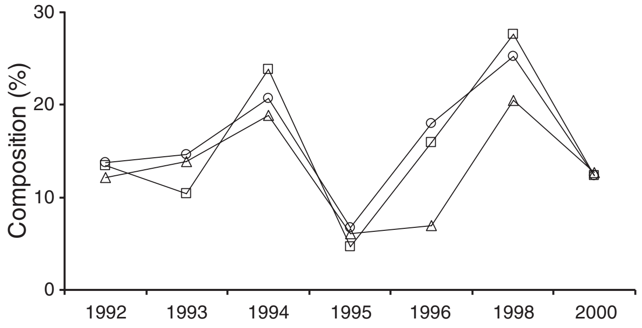

Fig. 4. Influence of pasture type (native pasture □, legume-oversown native pasture △ and supplemented/burnt native pasture ○) and year on the diet composition of *Chrysopogon fallax* in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data.

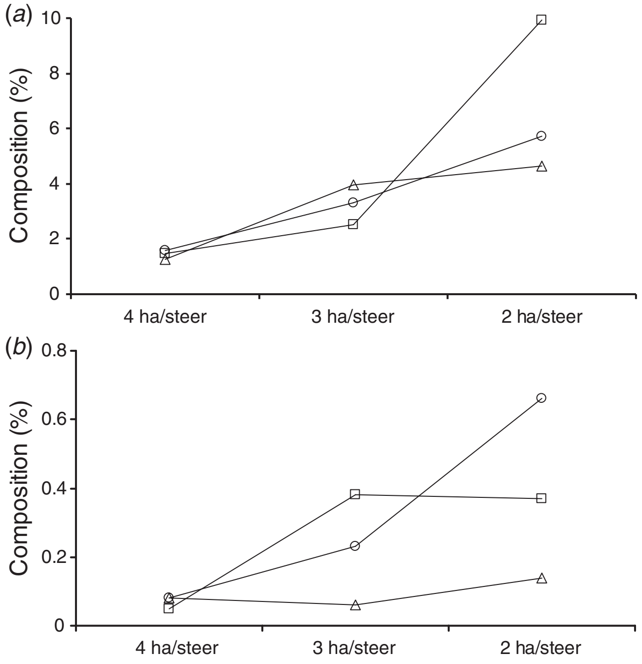

Fig. 5. Influence of pasture type (native pasture □, legume-oversown native pasture △ and supplemented/burnt native pasture ○) and stocking rate on the diet composition of (*a*) *Chloris divaricata* and (*b*) *Eragrostis* spp. in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data. Note differences in scales.

lowest at 2% in 1995 while, for the pasture type effect, forb composition was highest at 8% in native pasture and lowest at 1% in the legume-oversown pasture. Similarly, sedge composition varied ($P < 0.05$) with a pasture type × year interaction and was 14% in burnt pasture in 1998 and 2% in 1995 legume-oversown pasture (Fig. 8).

Discussion

Oesophageal-fistulated steers selected a diet with a consistently high proportion of *H. contortus* from the pasture in autumn. Steers also selected Seca stylo, *C. fallax*, forbs and sedges. Intermediate species, *C. divaricata* and *Eragrostis* spp., were neither preferred nor rejected whereas *B. bladhii* was seldom preferred despite it being a major contributor to total pasture yield (Orr *et al.* 2010*a*). Composition of the diet was influenced by stocking rate, pasture type and year and their interactions and the overall results were similar whether species composition was determined by green leaf, total green or total diet composition.

Selection for *H. contortus* at Galloway Plains is consistent with similar results recorded from a *H. contortus*/*B. bladhii* pasture on a clay soil near Gayndah, in southern Queensland (R. E. Hendricksen, unpubl. data). However, this preference for *H. contortus* contrasts with other studies where

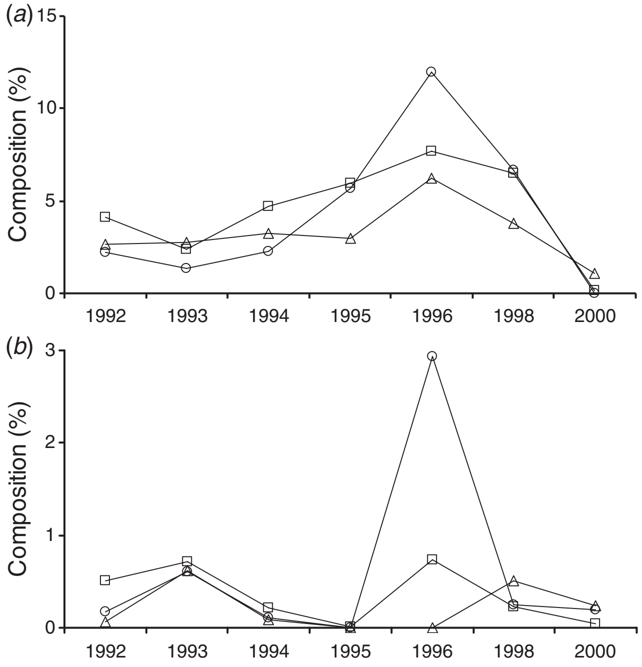

Fig. 6. Influence of pasture type (native pasture □, legume-oversown native pasture △ and supplemented/burnt native pasture ○) and year on the diet composition of (*a*) *Chloris divaricata* and (*b*) *Eragrostis* spp. in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data. Note differences in scales.

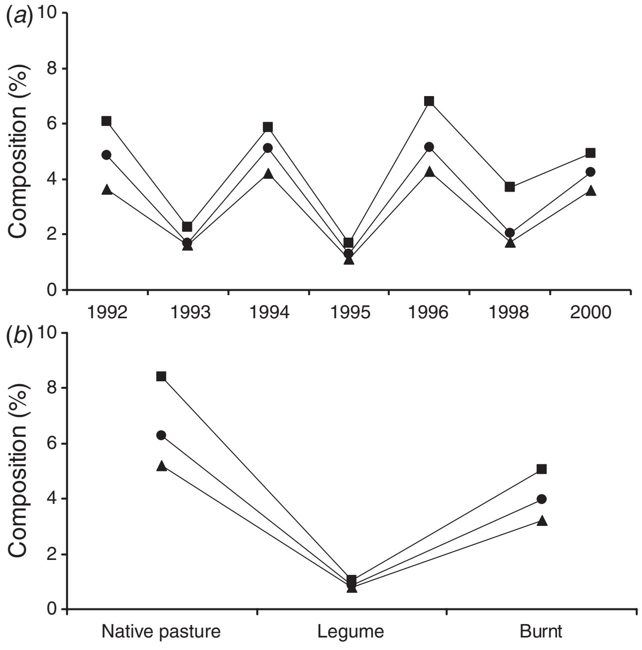

Fig. 7. Influence of (*a*) year and (*b*) pasture type on green leaf (▲), total green (●) and total composition (■) (%) of forbs in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data.

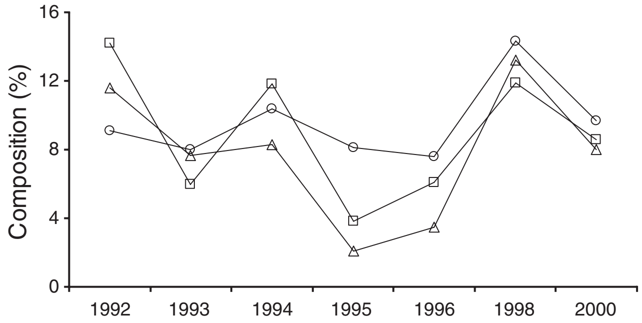

Fig. 8. Influence of pasture type (native pasture □, legume-oversown native pasture △ and supplemented/burnt native pasture ○) and year on the diet composition of sedge in *Heteropogon contortus* pasture between 1992 and 2000. Analyses performed on angular-transformed data.

H. contortus was present in the pasture. For example, *H. contortus* was ranked as an intermediate species on a coarse textured soil at Glenwood in southern Queensland (R. W. McLean, unpubl. data), had a low preference ranking near Charters Towers (McIvor 2007) and was the least preferred species in a *Themeda* veld in Zimbabwe (Gammon and Roberts 1978). Similarly, in northern Queensland, *H. contortus* was preferred only at the start of the wet season (Hendricksen *et al*. 1999).

The major impact of increasing stocking rate was to reduce total pasture yield and the availability of preferred species, particularly *H. contortus* (Orr *et al*. 2010*a*). For example, between 1992 and 2000 in native pasture, total pasture yields were 3355 and 1620 kg/ha and *H. contortus* yields were 630 and 330 kg/ha at 4 and 2 ha/steer, respectively. Thus, this reduced availability of *H. contortus* probably resulted in steers selecting a range of other, less preferred species. For example, increasing stocking rate increased the availability of the intermediate species, *C. divaricata* and *Eragrostis* spp. (Orr *et al*. 2010*a*) with the result that these species were increasingly selected in the diet in similar proportion to their availability in the pasture. Thus, these species were neither preferred nor rejected. Anderson (1993) suggested that *C. divaricata* is moderately palatable when young but is low yielding and is, therefore, not highly valued as a grazing species while *E. sororia* is relatively insignificant because of its low yield compared with other native grasses.

Pasture type influenced the availability of some species in the pasture. Generally, most grass species were less available in legume-oversown pasture compared with the other two pasture types. For example, the lower *H. contortus* and diet composition in legume-oversown pasture reflects the fact that steers were selecting a diet that contained 20–60% of Seca stylo as well as the lower availability of *H. contortus*. This relatively high composition of Seca stylo in autumn is consistent with findings from other studies in legume-oversown pastures (Coates 1996) indicating that dietary Seca composition peaks in the late wet or early dry season.

The composition of the diet selected by fistulated steers also varied among years. This probably reflects the influence of rainfall on species availability – especially of lower yielding forbs and sedges. However, the year effect on Seca stylo content of the diet probably reflects not only seasonal rainfall conditions but also the increasing preference for the legume towards the end of the wet season (Coates 1996). Interestingly, the levels of Seca stylo in the diet in autumn between 1992 and

2000 failed to reflect the large increase in Seca composition in the pasture. Seca stylo plant density increased from 7 plants/m^2 in 1992 to 65 plants/m^2 in 2000 and this increase was associated with an increase from 20 to 50% of the pasture composition (Orr *et al*. 2010*a*). This finding suggests that a density of seven mature plants/m^2 and 20% pasture composition in autumn 1992 may represent a 'threshold' composition whereby animals are able to select a satisfactory level of Seca in their diet. However, the evidence for what constitutes a suitable Seca pasture composition for both pasture stability and animal productivity is conflicting. McIvor *et al*. (1996) highlighted the ecological problems associated with high Seca composition in pastures. In contrast, the increasing animal liveweight advantage for steers grazing legume-oversown pastures with time and, consequently, increasing pasture composition in this study (Burrows *et al*. 2010) suggest that this 'threshold' pasture composition may be higher than this 20%.

Andrew (1986) and Ash and Corfield (1998) both reported that steers grazing native pasture near Katherine in northern Australia generally reject *C. fallax*. At Glenwood in southern Queensland, *C. fallax* was preferred in the diet of steers grazing mown but not unmown pasture and this was attributed to an increase in the amount of leaf in mown pasture (R. W. McLean, unpubl. data). However, at Galloway Plains steers actively selected *C. fallax* as indicated by a selection index of 0.70 ± 0.02 and 18% composition in the diet compared with only 2% composition in the pasture. Similarly, McIvor (2007) reported *C. fallax* to have the highest selection index of eight perennial grasses, both native and introduced, near Charters Towers and suggests that the differences in preference for *C. fallax* between Charters Towers and Katherine may reflect differences in growth habit with plants at Katherine being larger and more fibrous than plants at Charters Towers. Wandera *et al*. (1993) classified *C. fallax* as undesirable on coarse-textured soils at Glenwood, southern Queensland because it forms dense patches which exclude the growth of other, more productive pasture species in otherwise *H. contortus*-dominant pastures.

Forbs comprised 2–8% of the diet but always constituted less than 1% of pasture yield and this preference is consistent with similar data from Glenwood in southern Queensland where forbs were consistently preferred (R. W. McLean, unpubl. data). This preference for forbs is consistent with similar reports of their usefulness to sheep in both *Astrebla* (Mitchell grass) grassland and *Acacia aneura* (mulga) woodland (McMeniman *et al*. 1986). In those studies, forb selection was associated with increased nitrogen and mineral nutrition while Ash *et al*. (1995) suggested the higher protein nutrition of animals grazing a partially degraded monsoon tallgrass pasture was associated with a higher C_3 (i.e. forbs) diet content compared with pasture that was not degraded.

Sedges were often preferred as indicated by the 14% composition of the diet despite being always less than 1% of the pasture. Reasons for the pasture × year interaction are not clear. The frequency of sedges was increased in burnt pastures particularly after 1998 (Orr *et al*. 2010*a*), however, this increased frequency was not reflected in higher diet composition in this pasture type.

Steers did not prefer *B. bladhii* as indicated by a selection index of 0.30 ± 0.02 even though it comprised up to 30% of the diet. This non-selection of *B. bladhii* was most noticeable in wet years when more species were available in the pasture and, consequently, steers had a greater opportunity to select those more palatable species. This low preference for *B. bladhii* occurred in all years and across all treatments despite the fact that it contributed up to 50% of the total pasture yield. Similarly, steer diets measured across early, mid and late summer over the 1995–96 summer at Galloway Plains indicated that that *B. bladhii* was not preferred when palatable species, notably *H. contortus*, were available in the pasture (R. E. Hendricksen, unpubl. data). Similarly, steers rejected *Themeda triandra* in tropical tall grass pastures near Mareeba even though this species contributed ~50% of pasture yield (Hendricksen *et al*. 1999). This lack of preference for *B. bladhii* supports the suggestion that *B. bladhii* may replace *H. contortus* under long-term, heavy grazing especially in the absence of burning (Orr *et al*. 1999).

Levels of *Aristida* spp. in the diet were usually less than 1% and, although these levels did increase to 2% in 1994, they were low compared with its availability in the pasture (Orr *et al*. 2010*a*). Reasons for the increased *Aristida* spp. diet content in legume-oversown pastures compared with the other two pasture types are not clear. Nevertheless, these low levels of *Aristida* spp. in the diet are consistent with this species being regarded as unpalatable (R. W. McLean, unpubl. data; McIvor 2007). The highest pasture yields of *Aristida* spp. occurred at light stocking rate (Orr et al. 2010*a*); however, results from this diet composition study indicated that the diet composition of *Aristida* spp. was not influenced by stocking rate.

Conclusions

This diet study indicates clearly that steers consistently select *H. contortus* when it is available in autumn. Steers also preferentially select Seca stylo, *C. fallax*, forbs and sedges when they are available. Except for *H. contortus* and Seca stylo, these species are minor components of the pasture. As increasing stocking rates reduced the availability of *H. contortus*, the availability of intermediate species such as *C. divaricata* and *Eragrostis* spp. increase and steers increasingly grazed these species. Across all treatments and seasons, cattle failed to select *B. bladhii* when other, more palatable species were available in the pasture despite *B. bladhii* contributing up to 50% of total pasture yield.

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