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Australian Journal of Experimental Agriculture

Volume 37, 1997

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CSIRO PUBLISHING
in co-operation with the
Standing Committee on Agriculture and Resource Management (SCARM)

Australian Journal of Experimental Agriculture, 1997, **37**, 279–86

A comparison of once- and twice-yearly weaning of an extensive herd in northern Australia 1. Cow liveweights, mortalities and fertility

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Summary. In northern Australia, many cows conceive only after their calves are weaned. The subsequent calves are born in the late wet or early dry season. Where producers wean once a year these late calves stay with the cows with resultant increased risk of cow mortality. A second weaning may reduce this risk.

From June 1985 to June 1990 we recorded cow liveweights, mortalities and reproductive rates from a herd of 500 *Bos indicus–Bos taurus*-cross cows at Kidman Springs, Northern Territory. The herd grazed native pastures, and was continuously mated and unsupplemented. Calves were weaned if they weighed 100 kg or more at muster in June (W1) or in either of June and October (W2).

In both groups (W1 and W2), 75% of calves were weaned at the June muster, and a further 14% were weaned at the October muster (W2 group). There was no difference in liveweight change, mortality or branding rates between the 2 groups. Overall productivity was low, probably due to poor nutrition during both dry and wet seasons. For example, average branding and mortality rates were 51.8 and 11.8%. Forty-seven percent of all cows were pregnant at the June muster but a quarter of these failed to rear a calf.

The low proportion of calves suitable for weaning in October indicated that the weaning times were too close together, and did not allow enough late calves to reach the target liveweight for weaning. Consequently, the benefit of the second weaning was reduced. Weaning times for continuously mated herds should be determined by the time taken for calves born late in the wet season to reach target liveweights for weaning at the second weaning round. Effectively, this means the first weaning should be earlier, perhaps in April, since high temperatures and the increased likelihood of rain make mustering after October difficult.

Introduction

Sullivan *et al.* (1992) reported the effect of once-yearly weaning on liveweight, mortality and conception rate of cows in an extensive herd in northern Australia. Weaning in June reduced cow mortality by 67% (5 *v.* 14%) and increased the annual conception rate by 25% (94 *v.* 74%) compared with no weaning. However, in the following year there was an alteration of the calving pattern due to weaning. The traditional cycle of conception in the wet season, for calving before or during the next wet season, is expected when cows are continuously mated and calves are not weaned (Andrews 1976; Robertson 1979; Winks 1984). However, when cows are weaned, lactational demands are removed and cows may start cycling during the dry season (Winks 1984) and calve 'out-of-season' (Sullivan *et al.* 1992). These out-of-season calves are too small to wean at the annual muster and stay with the herd, increasing the mortality risk for cows.

Out-of-season conceptions could be prevented by removal of bulls for 3–4 months. This is difficult and costly in extensive areas because of the need for 100% clean musters, transport and retention of bulls in secure paddocks, and redistribution of bulls to breeding paddocks when mating is to recommence. Oestrus-suppressing drugs have not proven satisfactory for temporary control of cow fertility (D'Occhio *et al.* 1992; MacDonald 1994) but may be cost effective if proven reliable. If dry season conception is not prevented, supplementary feeding can reduce weight loss and mortality in cows calving out-of-season (Fordyce *et al.* 1990). However, the expense of purchasing, transporting and delivering supplements, and the extra management required to identify and segregate target animals may be prohibitive for some producers.

While weaning in April would allow more cows to conceive before June and calve the following wet season

10.1071/EA95097

(Holroyd *et al*. 1988), we selected a June muster because early mustering in the Victoria River District is often devoted to turnoff of sale cattle. Also, the mid dry season (June–August) is the time of greatest mustering activity and the time when weaning is likely to occur. We considered that the growth rate of unweaned calves during the dry season would make the introduction of a second mustering round worthwhile, and allow out-of-season calves to be weaned. O'Rourke *et al*. (1992) reported 95% of northern Australian beef properties conducted ≥2 annual musters. In the Northern Territory and Western Australian regions surveyed, the total was around 60%, much higher than Robertson's (1982) report for the Victorian River District, where 3% of properties practiced 2 rounds. The increase was partly due to the Brucellosis and Tuberculosis Eradication Campaign (BTEC) requirement for regular mustering and testing. With the BTEC largely completed, producers may find it easier to revert to a single muster and weaning system, unless there are production and economic benefits from a second weaning.

This study reports a comparison of once- and twice-yearly weaning on cow liveweights, mortalities and fertility in an extensively managed herd in the Victoria River District.

Materials and methods

Site details

The study was conducted on the Victoria River Research Station, 'Kidman Springs' (16º7'S, 130º57'E), 220 km south-west of Katherine in the Victoria River District. The climate is hot and seasonally dry with 80% of annual rainfall falling between December and March (Table 1). Mean maximum and minimum temperatures at Victoria River Downs Station (40 km south) are 37 and 25ºC in January, and 29 and 11ºC in July.

The land systems, soils and native vegetation at Kidman Springs have previously been described in detail (Stewart *et al*. 1970; Forster and Laity 1972; Foran *et al*. 1986; Sullivan *et al*. 1992). Briefly, the area contains 3 main soil types: cracking clays, calcareous red earths, and sandy red earths. The soils are neutral to slightly alkaline with low fertility (<5 µg/g phosphorus). The pastures are predominantly native species; *Chrysopogon fallax*, *Iseilema* spp., *Enneapogon* spp., *Heteropogon contortus* and *Sehima nervosum* are the major grasses.

Experimental design

The experiment, run for 5 years from July 1985, was a completely randomised design with 2 breeding herd treatments: (i) once-yearly weaning (W1) where calves ≥100 kg liveweight were weaned in June; and (ii) twice-yearly weaning (W2) where calves ≥100 kg liveweight were weaned in June and October. Cows were randomly allocated to treatment groups W1 and W2 in July 1985 and remained in their allocated group for the duration of the experiment.

Grazing management

The cow groups (W1 and W2) grazed separate paddocks during the experiment. In 1985–86 and 1986–87, each group was put into an ungrazed paddock in June at 7–10 ha/cow and remained in the paddock for a year. After June 1987, cows from each group were allocated to 2 paddocks at stocking rates of 14–16 ha/cow and cows remained in their allocated paddocks until the end of the experiment. Paddocks were spelled when not grazed by experimental animals and were not burnt.

Animals and their management

The treatment groups of 250 *Bos indicus–Bos taurus* (predominantly Droughtmaster type)-cross cows were mustered each June and calves ≥100 kg weaned (except in 1988 when calves were weaned in April due to low wet season rainfall). In October, both groups were mustered but only calves ≥100 kg from W2 group were weaned. Unweaned calves remained with the cow groups until the next weaning muster. This allowed some animals to reach 15 months of age before being weaned. Most husbandry activity took place in June: non-pregnant cows were culled if they had failed to rear a calf for 2 consecutive years or were ≥12 years of age; all calves were branded, marked and identified with eartags and firebrand; and unweaned yearling progeny were removed.

Table 1. Monthly rainfall (mm) from July 1984 to June 1991, and 23-year monthly and mean, annual rainfall (mm) at Kidman Springs

	No. of rain days	June	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1984–85	53	0	0	6	20	45	118	66	119	160	265	0	5	804
1985–86	35	0	0	0	4	56	126	159	138	9	14	0	0	506
1986–87	41	38	0	0	3	1	77	176	281	11	0	0	0	587
1987–88	47	0	0	0	22	30	95	35	101	63	7	0	0	353
1988–89	78	0	0	2	5	137	170	17	73	190	36	7	0	637
1989–90	58	0	0	1	27	67	97	124	102	48	7	48	0	521
1990–91	67	0	0	0	20	38	114	264	347	47	14	0	0	844
Mean	58	4	0	4	23	56	109	149	171	126	25	4	1	672

All cows were subject to culling for injury, physical unsoundness and bad temperament throughout the year.

Droughtmaster bulls (1 per 13 cows) were run with the cows continuously except for 3–4 weeks after the June muster. Bulls were examined each June for reproductive soundness, scrotal circumference and reproductive diseases (trichomoniasis and vibriosis), and culled for age and physical unsoundness. Replacement heifers entered the breeding groups between December and February at about 2 years of age, and were culled if they failed to conceive by 3.5 years of age. Animals were not supplemented or treated against internal parasites but were treated against ticks by plunge dipping (0.1 g cypermethrin/L and 0.6 g chlorfenvinphos/L) in June each year except 1989, and vaccinated annually against botulism.

Mustering was carried out on horseback, with helicopter assistance to ensure clean musters.

Measurements

Liveweights (after overnight curfew) of all animals, and pregnancy and lactation status of cows were recorded in April, June and October each year. Mortalities were recorded either by positive carcass identification during paddock inspections, or assumed if animals were absent for 5 consecutive musters.

Data treatment and analyses

Data were analysed using the method of least squares for unequal subclass numbers (Harvey 1960, 1982). Pairwise differences between treatments were tested for significance using the protected l.s.d. procedure. Cow liveweights were adjusted for stage of pregnancy using the correction factors for *Bos indicus* genotypes from O'Rourke *et al*. (1991). Month of conception was interpolated from month of first reliable pregnancy diagnosis. Branding rate, as used here, was the number of calves branded as a percentage of cows in the herd after the muster in June the previous year. Lactation rate included cows rearing newly-branded calves as well as those with persisting lactations from unweaned yearling calves. Perinatal losses included all foetal and calf losses between pregnancy diagnosis and branding as a percentage of the number of cows pregnant during the year.

The statistical model included main effects for weaning treatment, year, cow age and pregnancy class and their relevant 2-factor interactions. Cow ages were divided into young (<5 years), mature (5–9 years) and old (>9 years) at the June recording beginning the 12-month annual cycle. Data from pregnant cows which reared the calf until the following June were divided into early (1–3 months; EP), mid (4–5 months; MP) and late (6–9 months; LP) stages at the June muster each year. Data from non-pregnant cows (NP) and those which were pregnant in June but failed to rear the calf (FTR) were included as separate pregnancy classes.

Results

Seasonal conditions

Monthly rainfall for Kidman Springs from July 1984 to June 1991 shows the clear seasonal pattern but considerable variation between seasons in amount and distribution of rainfall (Table 1). Pastures grew each wet season except 1987–88, but were not measured. Station records show very little pasture growth over the 1987–88 wet season.

Cow liveweights

Effect of weaning treatment and season. Overall, cows from W2 were heavier than those from W1

Table 2. Liveweights (kg) adjusted for stage of pregnancy, in June and annual and seasonal liveweight changes, for cows in groups weaned either once (W1) or twice (W2) per year and at various reproductive states

EP, 1–3 months pregnant and reared calf; MP, 4–5 months pregnant and reared calf; LP, 6–9 months pregnant and reared calf; NP, not pregnant; FTR, pregnant but failed to rear calf

Means within factors or within years followed by the same letter are not significantly different at $P = 0.05$

	No. of cows	Liveweight June	Liveweight change June–Oct.	Oct.–Apr.	Apr.–June	June–June
Mean (± s.d.)	2297	326 ± 44.0	–33 ± 24.8	24 ± 31.3	–9 ± 22.6	–19 ± 41.8
Group						
W1	1115	322b	–34a	25a	–11b	–20a
W2	1182	330a	–33a	23a	–8a	–18a
Pregnancy status in June						
EP	185	320c	–18a	4d	–16c	–29c
MP	303	336b	–32b	–9e	–14bc	–54d
LP	348	345a	–61c	11c	–10b	–60d
NP	1206	296d	–21a	64a	–10b	32a
FTR	255	332b	–36b	50b	2a	16b

(P<0.05) throughout the year, but seasonal changes were similar for both groups, resulting in the same annual liveweight gain (Table 2). There was substantial year by group interaction with strong departures from the main effect in all periods. Liveweight change in the early dry season (April–June) was most affected by year. Cows lost liveweight in 1986, 1987 and 1990 (–29, –18 and –21 kg respectively) and gained liveweight in 1988 and 1989 (4 and 16 kg respectively).

Effect of age. Initial liveweights of young, mature and aged cows were 304, 332 and 342 kg respectively (P<0.05). Liveweight changes throughout the year were similar for all age groups; annual liveweight changes were –19, –17 and –21 kg, respectively, and not significantly different.

Effect of pregnancy status. Liveweight in June increased with advancing pregnancy status and seasonal weight changes throughout the year varied with reproductive status (Table 2).

Mortalities and culling

Effect of weaning treatment and season. Average annual mortalities and seasonal trends were the same for both weaning treatments. Mean annual mortality, culling and wastage (mortality plus culling) rates were 13.8, 8.0 and 21.7% respectively, however, these are least square means and tend to give undue weighting to aged cows. The simple means for the whole herd were 11.8, 4.9 and 16.7% respectively. The seasonal pattern of mortalities was: June–October, 3.3%; October–April, 9.1%; April–June, 1.4%. Annual culling rates were similar for W1 and W2 (8.1 *v*. 7.8%). Hence, cow wastage was similar for both treatments overall (22.4 *v*. 21.1%).

Effect of age. More (P<0.05) aged cows died (22.2%) each year than young or mature cows (10.1 and 8.9% respectively) and generally the difference occurred between the October and April recordings (16.3 *v*. 5.2 and 5.8%). Differences between young and mature cows were minor. Culling rates were low (3.1 and 1.4% respectively) for young and mature cows but high (19.4%) for aged cows (P<0.05). Aged cows had higher (P<0.05) wastage rates (41.6%), than young cows (13.3%) and mature cows (10.3%).

Effect of reproductive status. Seventy-five percent of cow deaths occurred in late pregnancy, around calving or while rearing a calf, and 10% in the period following weaning (Table 3). Of the remaining 36 deaths among non-pregnant cows or early pregnant cows that were not rearing a calf, 8 were associated with calving in the previous period, 19 with weaning a calf in the previous June but dying after the October muster, and 9 were unspecified. Hence, a total of 51 cows died without recovering from the stress of rearing a calf even though the calf had been weaned. Less young cows died during late pregnancy or lactation than older cows (69.4 *v*. 82.7%). Late-pregnant cows that died were heavier (P<0.05) than the other reproductive classes at the previous recording (298 *v*. 269 kg). Mean liveweight of all dead cows at the previous muster was 278 ± 44.9 kg.

Reproduction

Reproductive data is presented for 2 different stages of the annual production cycle. Data from all cows (including newly-mated heifers but excluding culled cows) present in June at the beginning of the annual cycle are shown in Table 4. Table 5 shows the lactation rates and cumulative pregnancy rates for cows which survived the previous 12-month period ending in June. Overall, lactation rate was higher at the end of the year than at the beginning.

Timing of weaning. The number of calves weaned in June as a proportion of the total branded for the year did not differ between treatments [72.8% (W1) *v.* 75.5% (W2)]. At the October muster 14.4% of W2 calves were weaned, leaving 27.2% of W1 and 10.1% of W2 calves unweaned until the following June.

Effect of age. Young cows had lower (P<0.05) lactation and pregnancy rates than mature and aged cows at the beginning of the annual cycle (Table 4). Lactation

Table 3. Distribution of cow deaths (%) by reproductive status at previous muster for different seasons and cow ages

	Lactating	Mid–late pregnant	Non or early pregnant	Weaned calf	Total no. of deaths
Season					
June–Oct.	14.3	41.7	9.5	34.5	84
Oct.–Apr.	40.3	44.4	13.8	1.5	196
Apr.–June	76.7	20.0	3.3	0	30
Cow age at death					
<5 years	32.4	37.0	14.8	15.7	108
5–9 years	43.0	38.0	9.0	10.0	100
>9 years	35.3	49.0	10.8	4.9	102
Whole herd	36.8	41.3	11.6	10.3	310

Table 4. Lactation and pregnancy rates in June for all cows commencing an annual cycle and weaned once (W1)- or twice (W2)-yearly, for 5 years and 3 cow age groups

Number of cows represents those at the beginning of the year including those animals which died during the next year

Lactation rate includes cows rearing yearling calves

Means within factors followed by the same letter are not significantly different at $P = 0.05$

	No. of cows	Lactation rate (%)	Pregnancy rate (%)		
			Overall	Lactating	Non lactating
Mean (± s.d.)	2628	53.5 ± 48.6	51.7 ± 36.1	17.2 ± 36.2	86.7 ± 35.7
Group					
W1	1286	53.8a	52.6a	17.6a	87.8a
W2	1342	53.3a	50.9a	16.8a	85.7a
Year					
1985	537	55.7ab	60.1a	28.9a	91.8a
1986	554	58.1a	46.4c	9.0c	84.4bc
1987	514	47.5c	44.2c	7.3c	81.0c
1988	516	55.9ab	56.0ab	23.7ab	89.0ab
1989	507	50.5bc	52.1b	17.1b	87.5abc
Age					
<5 years	1063	39.6b	42.8b	9.4b	76.6b
5–9 years	1124	60.3a	56.3a	20.9a	92.5a
>9 years	441	60.7a	56.1a	21.3a	91.1a

rate at the end of the 12-month cycle was lower ($P<0.05$) for young compared with mature and aged cows. Mature cows had a higher ($P<0.05$) cumulative conception rate than young or aged cows.

Effect of treatment. Branding rates, as the number of calves per cow in the herd the previous June, for W1 and W2 were 51.9 and 51.8%, respectively, and not significantly different. There was no difference between treatments in either lactation or pregnancy rate in June at the beginning of the annual cycle. However, of the cows which survived until the following June, more ($P<0.05$) W1 cows were lactating (Table 5). There was no difference in lactation rate between groups for cows which survived the year and had been dry the previous June [74.1% (W1) *v.* 72.5% (W2)], however, of the cows which were lactating the previous June, 49.8% of W1 and 37.0% of W2 were lactating 12 months later. More ($P<0.05$) W1 cows conceived over the 12 months than W2 (Table 5). This resulted from different conception patterns among pregnancy classes during the first year of the experiment and a higher cumulative pregnancy rate for W1 among FTR cows (86.7 *v.* 74.3%). Conception rates between treatments were similar for pregnant cows that reared a calf (15.8 *v.* 15.9%) and NP cows (84.8 *v.* 86.4%). Average time to conception was the same for both treatments in all years except 1987–88 when W1 cows took longer ($P<0.05$) to conceive than W2 cows (7.3 *v.* 6.0 months). Perinatal losses excluding cow deaths averaged 8.6% of pregnant cows and were similar for W1 and W2. When cow deaths were included perinatal losses averaged 16.7%. Overall, of cows surviving the whole year, 47% were pregnant in June but 23% of these cows did not rear this calf to the following June.

Effect of year. There was no interaction between treatments and years for lactation and pregnancy rate at the beginning of the year. There were significant

Table 5. Lactation rate (%) in June, and the cumulative conception rate (%) from the previous June for cows surviving a 12 month cycle and weaned once (W1)- or twice (W2)-yearly, for 5 years and 3 cow age groups

Numbers of cows represents those surviving for the 12-month period ending in June

Means within factors followed by the same letter are not significantly different at $P = 0.05$

	No. of cows	Lactation rate	Conception rate over 12 months
Mean (± s.d.)	2296	58.3 ± 46.5	60.6 ± 35.4
Group			
W1	1114	61.9a	62.5a
W2	1182	54.8b	58.8b
Year			
1985–86	505	65.8a	59.8b
1986–87	465	52.2c	48.7c
1987–88	450	54.6bc	65.0ab
1988–89	446	60.0ab	65.4a
1989–90	430	59.2b	64.3ab
Age			
<5 years	949	51.3b	57.9b
5–9 years	1011	61.7a	67.7a
>9 years	336	62.1a	56.3b

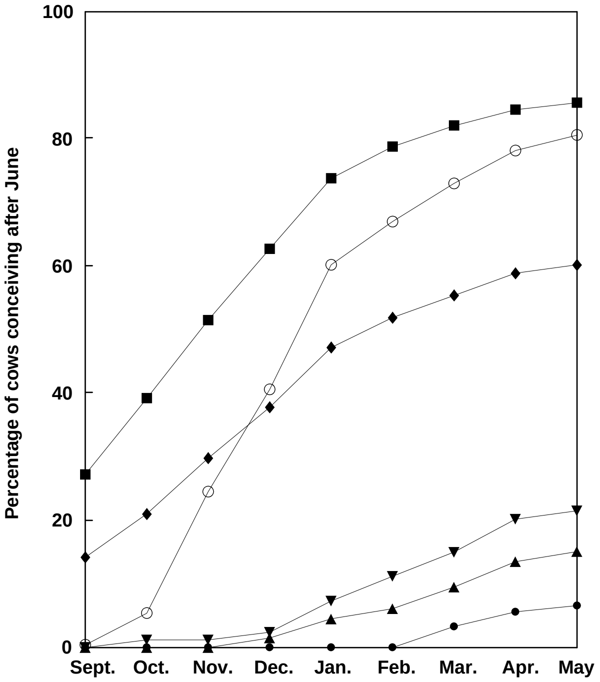

Figure 1. Cumulative conception rates of cows in different pregnancy classes at Kidman Springs after an annual muster in June. Monthly points were interpolated from month of first reliable pregnancy diagnosis. ● 1–3 months pregnant in June and reared calf; ▲ 4–5 months pregnant in June and reared calf; ▼ 6–9 months pregnant in June and reared calf; ■ not pregnant in June; ○ pregnant in June but failed to rear calf; ◆ whole herd.

(P<0.05) differences between years for lactation and pregnancy rate at both the start and end of the year (Table 5). In 1986–87, cows conceived later (January; P<0.05) on average than in other years (December).

Effect of pregnancy class. Non-pregnant cows had significantly (P<0.05) higher conception rates throughout the year compared with all other classes except FTR cows (Fig. 1). Conception rates were similar for all pregnant cow classes until October while FTR cows had higher (P<0.05) conception rates from November onwards. Differences in conception rate between EP and LP cows were not significant (P<0.05) until January, and differences between EP and MP, MP and LP cows were only significant (P<0.05) in April and May. Average times to conception for NP, FTR and all pregnant cows which reared a calf were 4.7, 6.7 and 8.3 months respectively (P<0.05).

Reproductive diseases

Trichomoniasis was detected during 1987, 1988 and 1989 in 15, 3 and 9% of bulls respectively. Vibriosis was not detected.

Discussion

The results of this study show no benefit from a second weaning of a continuously mated herd run under extensive conditions. However, we consider that the timing of weaning treatments and poor nutrition in our study confounded any effects of the second weaning. In northern beef herds the first mustering round usually commences in April and lasts until July (Winks 1984; Holroyd *et al*. 1988). The second round finishes by November (Winks 1984) when high temperatures and poor condition of cattle prevent further work. The weaning rounds in this study fell within these times, and we believed a 4-month period between musters would allow enough time for all out-of-season calves to reach weaning weight (100 kg) at the October muster. Clearly, a longer time between musters is needed. Seasonal conditions in this environment give more scope for an earlier first weaning than a later second weaning. Benefits from earlier weaning include earlier conception and greater likelihood of wet season calving (Arthur and Mayer 1975; Schottler and Williams 1975; Holroyd *et al.* 1988). Changing to an April weaning would shift weaning of some calves from the first round to the second round in the first year. Pregnancies triggered by the April weaning would probably be earlier in the dry season and the resultant calves born during the subsequent wet season. If these calves were too young to wean at an April muster they would be likely to reach weaning size by October. Changes to annual mustering programs to allow the earlier weaning would be required.

Pregnancy status in June and timing of subsequent calving was a major influence on liveweight and survival of cows. This agrees with the study of Fordyce *et al.* (1990) where cows in advanced pregnancy and poor body condition at the start of a drought year were less likely to survive. Initial liveweight in June was closely linked to stage of pregnancy even after liveweights were adjusted for weight of the conceptus. However, cows which calved during the dry season (MP, LP and FTR) lost more liveweight and were more likely to die. Poor quality pastures and lack of digestible energy during the dry season are well recognised throughout northern Australia. The increased energy requirements of cows in advancing stages of pregnancy and lactation probably exceeded that available from the pasture on offer. The low liveweight gains and low conception rates of lactating cows during the wet season as well, indicate year round nutritional problems at Kidman Springs which weaning alone is unlikely to overcome. The results of this study agree with those of Holroyd *et al.* (1988) where weaning did not improve lactating cow pregnancy rates.

There was considerable variation from year to year in amount of liveweight gain or loss, particularly for the early dry season with losses in 3 of the 5 years and gains in the other 2. The highest early dry season gains occurred in 1988–89 when significant March rainfall was recorded compared with other years. The slight gain between April and June in 1987–88 is probably the result of earlier than usual weaning and is similar to the liveweight advantage of early-weaned cows reported by Holroyd *et al.* (1988). Rainfall in that season was the lowest at Kidman Springs in 23 years of records and little if any pasture growth occurred. Standing dry feed remaining from the previous year and edible shrub species, such as conkerberry (*Carissa lanceolata*) and rosewood (*Terminalia volucris*), may have provided sufficient nutrition for weight gain once weaning had occurred.

The proportion of branded calves weaned in June was similar for both treatments and liveweight change was similar between June and October. Differences in liveweight and mortality were expected after the second weaning for W2, in October. However, the percentage of calves weaned from W2 in October was probably insufficient to significantly affect cow liveweights or mortalities. Management and supervision were not sufficient to identify the specific cows which had calves weaned in October. Hence, liveweight change and mortality rates could not be separated from the levels for the whole treatment group.

Cow liveweight increased with age and differences between age groups were similar to those reported by Sullivan *et al.* (1992). Weight change throughout the year was the same for all age groups but aged cows had higher mortality rates. This is different from the liveweight changes reported by Sullivan *et al.* (1992), where aged cows lost more liveweight during the dry and failed to compensate during the wet. The cows in this experiment were previously part of the Sullivan *et al.* (1992) study and were up to 14 years old when the experiment commenced. Despite active culling (19.4%) of aged cows, some remained in the herd. The high mortality rate of these cows (22.2%) may have disguised the level of liveweight loss, as only data from cows surviving the whole year were included in the liveweight figures. Aged cow mortality patterns indicate culling should occur at 10 years in this environment (O'Rourke *et al.* 1995).

Differences in lactation rate between the beginning and end of the year were due to the inclusion of predominantly non-lactating heifers as replacements and the culling of lactating, aged cows, after weaning in June. A large proportion of each year's heifer crop was required to replace the herd wastage rate of 21.7% (Sullivan *et al.* 1997). Such a situation on a commercial property would make herd rebuilding after drought or disease eradication programs very slow. The higher lactation rate of surviving W1 cows at the end of the year was expected after the October weaning of W2. Conception patterns of cows rearing calves were similar to those reported by Sullivan *et al.* (1992) with only 15.9% of cows conceiving while lactating. There was no peak of conceptions for the herd as a whole. Rather, conceptions occurred at a consistent rate from September to January probably a result of cows, weaned in June, regaining cyclicity.

While weaning reduces liveweight loss or improves gain in cows (Arthur and Mayer 1975; Holroyd *et al.* 1988; Sullivan *et al.* 1992), weaning in June was too late for some cows in our study. Sixteen percent of mortalities were of cows that were weaned but failed to recover. Use of strategic or crisis supplements during the dry season can reduce weight loss and mortality of cows (Holroyd *et al.* 1977; Taylor *et al.* 1982). Supplementation is expensive (Fordyce *et al.* 1990), and where mortality rates are low, such as occurred in the studies of Holroyd *et al.* (1983, 1988), may be difficult to justify. However, in our study, where cows were calving and lactating throughout the year, supplements may have significantly reduced nutritional stress and hence mortalities. Late pregnant cows which died were <300 kg at the previous muster and were a high proportion of herd mortalities. Such animals would fit into the high supplement requirement group of Fordyce *et al.* (1990).

Reproductive losses were high even without the effect of cow mortalities. The 23% of surviving pregnant cows which failed to rear a calf to the following June is high compared with 11.7% reported by Holroyd (1987) for 1/2 and 3/4 Brahman cows. Calf loss during the perinatal period accounted for a third (8.6% of pregnant cows) of the losses. However, losses during other periods, particularly prenatal were harder to assess because of the infrequent musters. O'Rourke *et al.* (1995) examined data from 9 years at Kidman Springs and assigned an 11.5% loss from confirmed pregnancy to the first muster post-calving. Failure to brand accounted for an additional 9.3% out of a total loss of 20.8%. Seasonal nutritional conditions contributed to lactation failure (O'Rourke *et al.* 1995) with losses highest in the late dry–early wet period and lowest in the late wet period. Other possible reasons may include predation by dingoes, hyperthermia, trichomoniasis and other reproductive diseases which were not assessed, such as leptospirosis.

It is likely that a combination of earlier time for the first weaning round and wet and dry season supplementation is required to reduce liveweight loss and mortalities and to improve wet season conception rates of cows at Kidman Springs. Assessment of such a system for production and economic effects is warranted. This will assist cattle producers in north-western Australia to make better decisions for improved production and profitability.

Acknowledgments

The technical assistance of staff from Kidman Springs is gratefully acknowledged. The study was funded by the

Northern Territory Department of Primary Industry and Fisheries.

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Received 9 June 1995, accepted 13 February 1997