

## MILK PRODUCTION AND REPRODUCTION PERFORMANCE OF MURRAH BUFFALOES OF TAMIL NADU, INDIA

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### ABSTRACT

The data pertaining to variable production and reproduction traits of Murrah buffaloes (1980 lactation records of 698 Murrah buffaloes) were collected from the Central Cattle Breeding Farm, Alamadhi, Tamil Nadu, India. The overall least-squares means ( $\pm$  SE) for peak yield, days to attain peak yield, 305-day milk yield, lactation length, lactation milk yield, service period, calving interval and dry period were  $8.87 \pm 0.05$  kg,  $53.4 \pm 0.8$  days,  $1804.9 \pm 14.7$  kg,  $297.8 \pm 1.9$  days,  $1855.6 \pm 16.1$  kg,  $225.0 \pm 5.5$ ,  $532.8 \pm 5.5$  and  $230.2 \pm 4.9$  days, respectively. Period of calving had a highly significant ( $P < 0.01$ ) effect on all the traits studied except days to attain peak yield, where it had only a significant ( $P < 0.05$ ) effect. Season of calving had a significant ( $P < 0.05$ ) effect on peak yield and lactation milk yield and a highly significant ( $P < 0.01$ ) effect on days to attain peak yield, 305-day milk yield, milk yield per day of lactation and all the reproduction traits studied. The lowest calving interval was observed in south-west monsoon calvers, and they differed significantly ( $P < 0.05$ ) from winter and summer calvers. Parity had a highly significant effect ( $P < 0.01$ ) on all the traits studied. Pairwise comparison revealed that the lactation milk yield was lowest in first parity and differed significantly ( $P < 0.05$ ) from other parities. In general, the reproduction traits such

as service period, calving interval and dry period were slightly higher than those observed in the home tract of the Murrah buffalo and hence better breeding management and introduction of genetic evaluation programmes are needed for genetic improvement of these traits.

**Keywords:** coastal region, genetic parameters, Murrah buffaloes, production, reproduction

### INTRODUCTION

According to the 2003 livestock census, India possesses 185.2 million cattle and 97.9 million buffaloes, which is about 13.7 percent of the total cattle and 57.5 percent of the total buffalo population of the world. The dairy industry in India has made significant progress in the last few decades. Today, India is the largest producer of milk in the world. The milk production in the country has risen to about 88.1 million tonnes in 2003-2004 from 17.0 million tonnes in 1950-51. At present, India's contribution to the total world milk production is about 14.3 percent and the national per capita milk availability is 231 g/day. In India, although the proportion of buffaloes to cattle is 1:2, the buffaloes contribute 56.86 percent of the total milk obtained from cattle and buffaloes. Tamil Nadu with 9.14 million cattle and 1.66 million buffaloes

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produces an estimated quantity of 4.75 million tonnes of milk (Report, 2006). The Murrah breed is the finest genetic material of milk producing buffalo not only in India but also probably in the world. This breed has been used extensively throughout the country to upgrade the non-descript buffalo stock to improve milk production. The breeding policy of Tamil Nadu state is to use Murrah or Surti as the breeds of choice to improve non-descript buffaloes. As a result of these measures, the Murrah and graded Murrah population have been increased over the years. Although the water buffalo in the tropics out-produces other domestic animals, commercial milk production is adversely affected by a large number of detractive factors such as late age at first calving, seasonality of oestrus, and long calving interval and dry period. Therefore, it is necessary to evaluate the relative importance of various fixed environmental and physiological effects in influencing the milk production and reproduction traits in order to devise appropriate feeding and other managerial practices. From the literature reviewed, it was found that the bulk of scientific information on buffaloes has come from the analysis of records made available from institutional and government farms in northern India (Sethi and Khatkar, 1997; Dass and Sadana, 2000; Gogoi *et al.*, 2002; Kundu *et al.*, 2003a,b; Yadav *et al.*, 2007). Such information from the southern peninsular region, especially under hot and humid coastal regions of Tamil Nadu, is scanty. The home tract of Murrah buffaloes is a hot and dry climatic region in the north-western part of India. Breeding these buffaloes in the southern peninsular region of India, which is hot and humid, may affect their performance and adaptability. Hence, the present study has been made to understand the performance and the influence of various non-genetic factors affecting economic traits of Murrah

buffaloes in the coastal regions of Tamil Nadu to suggest suitable managerial practices, selection and breeding strategies for genetic improvement of Murrah buffaloes under hot and humid climatic conditions of India.

## MATERIALS AND METHODS

The study was based on the data pertaining to the Murrah buffaloes born and bred at the Central Cattle Breeding Farm, Alamadhi, Chennai, Tamil Nadu, India from 1979 to 2006 (28 years). This farm is located approximately at 13° N latitude and 80° E longitude at an altitude of about 20 metres above mean sea level. The climate is generally hot, humid and tropical in nature. The mean annual maximum and minimum temperatures were 33°C and 24.7°C, respectively, and the mean relative humidity ranged between 69.2 and 76.2%. The Murrah buffaloes were housed in permanent sheds with open type ventilation and maintained under stall-fed conditions. Roughage in the form of green fodder and paddy straw was provided. In addition, concentrate mixture was provided to all age groups as per the standard requirements. Cows were hand-milked twice daily in the morning and evening. Data on production and reproduction performance of Murrah buffaloes (1980 lactation records from 698 Murrah cows) were extracted from History and Pedigree Sheets. The traits studied were peak yield, days to attain peak yield, 305-day milk yield, lactation length, lactation milk yield, milk yield per day of lactation, service period, calving interval, dry period and number of services per conception. Period and season were the fixed environmental effects considered for all the traits studied. As the calvings were less in a year, year-season analysis was not done. To utilise all available data the entire

duration was divided into seven periods each with an interval of five years assuming that there would not be any major managerial changes within a period. Further each calendar year was sub-divided into four seasons, viz. winter (January and February), Summer (March to May), south-west monsoon (June to September) and north-east monsoon (October to December). LSMLMW and MIXMDL PC-2 VERSION computer programme of Harvey (1990) was used to study the effect of various non-genetic factors and the means were compared using Duncan's multiple range test. The model used for analysis was  $Y_{ijkl} = \mu + P_i + S_j + O_k + e_{ijkl}$ , where,  $Y_{ijkl}$  = the  $l^{\text{th}}$  observation in  $i^{\text{th}}$  period,  $j^{\text{th}}$  season and  $k^{\text{th}}$  parity,  $\mu$  = overall mean when equal subclass frequencies exist,  $P_i$  = effect of  $i^{\text{th}}$  period ( $i = 1$  to 7),  $S_j$  = effect of  $j^{\text{th}}$  season ( $j = 1$  to 4),  $O_k$  = effect of  $k^{\text{th}}$  parity ( $k = 1$  to 6) and  $e_{ijkl}$  = random errors NID ( $0, \sigma^2$ ).

## RESULTS AND DISCUSSION

### *Production Traits*

Least-squares means ( $\pm$ SE) of different production traits are presented in Table 1. Period of calving had a highly significant ( $P < 0.01$ ) effect on the variation of peak yield, 305-day milk yield, lactation length, lactation milk yield and milk yield per day of lactation and had only a significant ( $P < 0.05$ ) effect on days to attain peak yield. The highest peak yield, 305-day milk yield and lactation milk yield were observed in period 6 (1999 to 2002) and they differed significantly from rest of the periods, except with periods 5 and 7, where the differences were not significant. The lowest lactation length was observed in period 3 (1987 to 90) and this period differed significantly ( $P < 0.05$ ) from the rest of the periods except period 7 (2003

to 2006), where the difference was not significant. There was a steep increase in peak yield, 305-day milk yield and lactation milk yield from the second to the sixth periods and then a slight decline in period 7 (2003 to 2006); the values observed in period 2 differed significantly ( $P < 0.05$ ) from the rest of the periods.

Season of calving had no effect on lactation length; however, it had a significant ( $P < 0.05$ ) effect on peak yield and lactation milk yield and a highly significant ( $P < 0.01$ ) effect on days to attain peak yield, 305-day milk yield and milk yield per day of lactation. The peak yield of Murrah buffaloes calving in the south-west monsoon season was the highest and it differed significantly ( $P < 0.05$ ) from that of north-east monsoon calvers. However, there was no significant difference among the other seasons. On the other hand, the lowest 305-day milk yield, lactation milk yield and milk yield per day of lactation were observed in cows calving in the north-east monsoon season. Winter and summer calvers had higher 305-day milk yield and lactation milk yield than the monsoon calvers. The yields observed among winter, summer and south-west monsoon calvers were not significant but they differed significantly ( $P < 0.05$ ) from north-east monsoon calvers.

Parity had a highly significant ( $P < 0.01$ ) effect on all the traits studied. First lactation peak yield was significantly ( $P < 0.05$ ) lower than the rest. The yield increased from first to fourth parity and from there on it started declining. Whereas, the days to attain peak yield decreased from first to fifth parity followed by a moderate increase in sixth parity. The days to attain peak yield in first lactation was significantly ( $P < 0.05$ ) higher (60.9 days) than the rest. The 305-day milk yield and lactation milk yield increased up to third parity, was maintained at fourth parity, and declined

Table 1. Least-squares means ( $\pm$  SE) for different milk production traits of Murrah buffaloes

Effect	n	Peak yield (kg)	Days to attain peak yield (days)	305-day milk yield (kg)	Lactation length (days)	Lactation milk yield (kg)	Mil yield per day of lactation (kg)
<b>Overall mean (<math>\mu</math>)</b>	<b>1980</b>	<b>8.87 <math>\pm</math> 0.05</b>	<b>53.4 <math>\pm</math> 0.8</b>	<b>1804.9 <math>\pm</math> 14.7</b>	<b>297.8 <math>\pm</math> 1.9</b>	<b>1855.6 <math>\pm</math> 16.1</b>	<b>6.16 <math>\pm</math> 0.04</b>
<b>Period of calving</b>		**	*	**	**	**	**
P <sub>1</sub> (1979-82)	268	8.47 $\pm$ 0.12 <sup>b</sup>	50.7 $\pm$ 1.7 <sup>ad</sup>	1670.2 $\pm$ 32.6 <sup>b</sup>	295.6 $\pm$ 4.2 <sup>b</sup>	1706.2 $\pm$ 35.8 <sup>a</sup>	5.74 $\pm$ 0.08 <sup>b</sup>
P <sub>2</sub> (1983-86)	491	7.96 $\pm$ 0.09 <sup>a</sup>	54.9 $\pm$ 1.3 <sup>bc</sup>	1584.2 $\pm$ 23.6 <sup>a</sup>	300.2 $\pm$ 3.1 <sup>b</sup>	1629.9 $\pm$ 25.8 <sup>a</sup>	5.38 $\pm$ 0.06 <sup>a</sup>
P <sub>3</sub> (1987-90)	430	8.30 $\pm$ 0.08 <sup>b</sup>	52.0 $\pm$ 1.3 <sup>ab</sup>	1632.0 $\pm$ 23.4 <sup>ab</sup>	285.1 $\pm$ 3.0 <sup>a</sup>	1658.5 $\pm$ 25.6 <sup>a</sup>	5.72 $\pm$ 0.06 <sup>b</sup>
P <sub>4</sub> (1991-94)	265	9.16 $\pm$ 0.11 <sup>c</sup>	52.2 $\pm$ 1.6 <sup>abc</sup>	1872.9 $\pm$ 29.8 <sup>c</sup>	298.3 $\pm$ 3.9 <sup>b</sup>	1925.2 $\pm$ 32.7 <sup>b</sup>	6.43 $\pm$ 0.07 <sup>c</sup>
P <sub>5</sub> (1995-98)	171	9.47 $\pm$ 0.13 <sup>ce</sup>	57.2 $\pm$ 1.9 <sup>c</sup>	1947.2 $\pm$ 36.1 <sup>cd</sup>	307.2 $\pm$ 4.7 <sup>b</sup>	2030.3 $\pm$ 39.6 <sup>c</sup>	6.55 $\pm$ 0.09 <sup>c</sup>
P <sub>6</sub> (1999-2002)	236	9.52 $\pm$ 0.11 <sup>c</sup>	51.4 $\pm$ 1.7 <sup>ab</sup>	1974.1 $\pm$ 31.1 <sup>d</sup>	305.8 $\pm$ 4.1 <sup>b</sup>	2055.6 $\pm$ 34.1 <sup>c</sup>	6.66 $\pm$ 0.08 <sup>c</sup>
P <sub>7</sub> (2003-2006)	119	9.18 $\pm$ 0.16 <sup>ce</sup>	55.0 $\pm$ 2.3 <sup>bcd</sup>	1953.7 $\pm$ 43.2 <sup>cd</sup>	292.5 $\pm$ 5.6 <sup>ab</sup>	1983.2 $\pm$ 47.4 <sup>bc</sup>	6.66 $\pm$ 0.11 <sup>c</sup>
<b>Season of calving</b>		*	**	**		*	**
Winter (Jan.-Feb.)	276	8.81 $\pm$ 0.10 <sup>ab</sup>	53.0 $\pm$ 1.5 <sup>b</sup>	1839.0 $\pm$ 28.6 <sup>b</sup>	301.8 $\pm$ 3.7	1888.6 $\pm$ 31.4 <sup>b</sup>	6.19 $\pm$ 0.07 <sup>b</sup>
Summer (Mar.-May)	150	8.84 $\pm$ 0.14 <sup>ab</sup>	57.9 $\pm$ 2.0 <sup>b</sup>	1853.8 $\pm$ 38.1 <sup>b</sup>	293.3 $\pm$ 5.0	1882.4 $\pm$ 41.8 <sup>b</sup>	6.34 $\pm$ 0.09 <sup>b</sup>
South-west monsoon (Jun.- Sep.)	724	9.03 $\pm$ 0.07 <sup>b</sup>	54.1 $\pm$ 1.1 <sup>b</sup>	1793.1 $\pm$ 19.8 <sup>b</sup>	298.8 $\pm$ 2.6	1849.6 $\pm$ 21.8 <sup>b</sup>	6.14 $\pm$ 0.05 <sup>b</sup>
North-east monsoon (Oct.- Dec.)	830	8.79 $\pm$ 0.06 <sup>a</sup>	48.3 $\pm$ 0.9 <sup>a</sup>	1733.8 $\pm$ 17.7 <sup>a</sup>	297.4 $\pm$ 2.3	1801.6 $\pm$ 19.4 <sup>a</sup>	5.99 $\pm$ 0.04 <sup>a</sup>
<b>Parity</b>		**	**	**	**	**	**
First	645	7.73 $\pm$ 0.08 <sup>a</sup>	60.9 $\pm$ 1.2 <sup>b</sup>	1619.7 $\pm$ 22.6 <sup>a</sup>	310.4 $\pm$ 2.9 <sup>c</sup>	1687.6 $\pm$ 24.8 <sup>a</sup>	5.38 $\pm$ 0.05 <sup>a</sup>
Second	457	8.85 $\pm$ 0.09 <sup>b</sup>	54.0 $\pm$ 1.3 <sup>a</sup>	1832.8 $\pm$ 23.5 <sup>c</sup>	301.1 $\pm$ 3.1 <sup>b</sup>	1894.5 $\pm$ 25.7 <sup>cd</sup>	6.22 $\pm$ 0.06 <sup>b</sup>
Third	311	9.37 $\pm$ 0.10 <sup>cd</sup>	51.1 $\pm$ 1.5 <sup>a</sup>	1913.9 $\pm$ 27.7 <sup>d</sup>	302.3 $\pm$ 3.6 <sup>bc</sup>	1967.3 $\pm$ 30.4 <sup>c</sup>	6.45 $\pm$ 0.07 <sup>c</sup>
Fourth	224	9.54 $\pm$ 0.12 <sup>d</sup>	50.6 $\pm$ 1.7 <sup>a</sup>	1910.4 $\pm$ 32.3 <sup>d</sup>	299.0 $\pm$ 4.2 <sup>bd</sup>	1966.5 $\pm$ 35.5 <sup>de</sup>	6.50 $\pm$ 0.08 <sup>c</sup>
Fifth	150	8.98 $\pm$ 0.14 <sup>b</sup>	50.0 $\pm$ 2.1 <sup>a</sup>	1823.4 $\pm$ 38.7 <sup>c</sup>	289.8 $\pm$ 5.0 <sup>abd</sup>	1853.7 $\pm$ 42.4 <sup>bc</sup>	6.33 $\pm$ 0.09 <sup>bc</sup>
Sixth and above	193	8.74 $\pm$ 0.13 <sup>b</sup>	53.5 $\pm$ 1.9 <sup>a</sup>	1729.1 $\pm$ 35.1 <sup>b</sup>	284.3 $\pm$ 4.6 <sup>a</sup>	1763.8 $\pm$ 38.5 <sup>ab</sup>	6.09 $\pm$ 0.09 <sup>b</sup>

n= Number of observations. \* P<0.05, \*\* P<0.01. Means bearing same superscript within classes do not differ significantly (P>0.05).

thereafter. Pairwise comparison revealed that the 305-day and lactation milk yields observed in first parity differed significantly ( $P < 0.05$ ) from other parities. Similar to days to attain peak yield, the lactation length decreased with the advancement of parity. There was an initial sharp reduction (3.09 percent) in lactation length in the second parity followed by gradual decline later. The reduction in lactation length between first and second parities was statistically significant ( $P < 0.05$ ). The milk yield per day of lactation increased linearly with the advancement of parity up to 4<sup>th</sup> parity and then declined; the values observed in first parity differed significantly ( $P < 0.05$ ) from the rest of the parities.

The average peak yield obtained in the present investigation was higher than the value reported by a few earlier workers (Rao and Rao, 1994; Kundu *et al.*, 2003b). However, Chhikara *et al.* (1998) and Suresh *et al.* (2004) reported higher values for Murrah buffaloes than those observed in the present study. The days to reach peak yield in the present study was substantially higher than those reported for Murrah buffaloes at different places in India (Kundu *et al.*, 2003b; Suresh *et al.*, 2004). Lactation milk yield of cattle and buffaloes up to 305-days of lactation is the criterion most commonly used for the selection of dairy animals and a study of the performance of this trait is of paramount importance for carrying out selection. The overall 305-day milk yield obtained for Murrah buffaloes in this investigation was comparable to the value reported by Ulaganathan *et al.* (1983) and higher than the values reported by other researchers (Kandasamy, 1987; Suresh *et al.*, 2004). The overall least-squares means of lactation milk yield obtained was higher than those observed by Ulaganathan *et al.* (1984) and Patnaik (1988) in the same herd and lower than the present estimate was also reported by Kandasamy (1987) and Suresh

*et al.* (2004). Differences in the estimates might be due to sampling errors, genetic constitution of the herds, agroclimatic variations and managerial conditions. In general, the performance in terms of the first lactation milk yield of Murrah buffaloes at the Central Cattle Breeding Farm, Alamadhi is quite similar (Sethi and Khatkar, 1997; Kumar *et al.*, 2002) to those herds in Haryana indicating that there might not be any appreciable genotype x environment interaction.

#### *Reproduction Traits*

Least-squares means ( $\pm$ SE) of different reproduction traits are set out in Table 2. Analyses of variance revealed that the period of calving influenced service period, calving interval, dry period and number of services per conception in a highly significant ( $P < 0.01$ ) manner although there was no consistent trend over the periods. Period 3 (1987 to 90) had the lowest service period, calving interval and number of services per conception, and these differed significantly ( $P < 0.05$ ) from other periods except period 1 (1979 to 1982). Whereas, the lowest and the highest dry periods were observed in period 1 and period 5, respectively, and the dry period observed in period 5 was significantly ( $P < 0.05$ ) different from periods 1, 3 and 4.

Season of calving also influenced all the reproduction traits in a highly significant manner ( $P < 0.01$ ). Murrah buffalo heifers freshening in the south-west monsoon had significantly ( $P < 0.05$ ) shorter service period, calving interval, dry period and number of services per conception than those calving in other seasons. The highest service period, calving interval and number of services per conception were observed in winter season calvers. The service period and calving interval observed in south-west monsoon calvers differed significantly ( $P < 0.05$ ) from other seasons except with north-east

Table 2. Least-squares means ( $\pm$  SE) for different reproduction traits of Murrah buffaloes.

Effect	N	Service period (days)	Calving interval (days)	Dry period (days)	Number of services per conception
<b>Overall mean (<math>\mu</math>)</b>	<b>1550</b>	<b>225.0 <math>\pm</math> 5.5</b>	<b>532.8 <math>\pm</math> 5.5</b>	<b>230.2 <math>\pm</math> 4.9</b>	<b>2.31 <math>\pm</math> 0.05</b>
<b>Period of calving</b>		**	**	**	**
P <sub>1</sub> (1979-82)	220	182.8 $\pm$ 11.4 <sup>af</sup>	488.8 $\pm$ 11.4 <sup>a</sup>	181.6 $\pm$ 10.2 <sup>a</sup>	1.92 $\pm$ 0.11 <sup>ad</sup>
P <sub>2</sub> (1983-86)	423	241.3 $\pm$ 8.1 <sup>bc</sup>	548.2 $\pm$ 8.2 <sup>bc</sup>	242.6 $\pm$ 7.3 <sup>bc</sup>	2.45 $\pm$ 0.08 <sup>b</sup>
P <sub>3</sub> (1987-90)	316	176.1 $\pm$ 8.5 <sup>a</sup>	481.9 $\pm$ 8.5 <sup>a</sup>	191.5 $\pm$ 7.6 <sup>a</sup>	1.87 $\pm$ 0.08 <sup>ad</sup>
P <sub>4</sub> (1991-94)	210	218.9 $\pm$ 10.4 <sup>b</sup>	527.7 $\pm$ 10.4 <sup>b</sup>	228.6 $\pm$ 9.3 <sup>b</sup>	2.29 $\pm$ 0.10 <sup>b</sup>
P <sub>5</sub> (1995-98)	114	272.8 $\pm$ 14.0 <sup>cd</sup>	580.8 $\pm$ 14.0 <sup>cd</sup>	268.7 $\pm$ 12.5 <sup>c</sup>	2.82 $\pm$ 0.13 <sup>c</sup>
P <sub>6</sub> (1999-2002)	199	252.9 $\pm$ 10.7 <sup>cde</sup>	559.7 $\pm$ 10.7 <sup>cde</sup>	253.3 $\pm$ 9.6 <sup>bc</sup>	2.55 $\pm$ 0.10 <sup>bc</sup>
P <sub>7</sub> (2003-2006)	68	230.5 $\pm$ 17.6 <sup>def</sup>	542.4 $\pm$ 17.7 <sup>bd</sup>	245.1 $\pm$ 15.8 <sup>bc</sup>	2.30 $\pm$ 0.16 <sup>bcd</sup>
<b>Season of calving</b>		**	**	**	**
Winter (Jan.-Feb.)	211	246.8 $\pm$ 10.3 <sup>b</sup>	554.4 $\pm$ 10.3 <sup>b</sup>	248.0 $\pm$ 9.2 <sup>c</sup>	2.56 $\pm$ 0.10 <sup>c</sup>
Summer (Mar.-May)	109	245.2 $\pm$ 14.0 <sup>b</sup>	553.4 $\pm$ 14.0 <sup>b</sup>	254.1 $\pm$ 12.5 <sup>c</sup>	2.44 $\pm$ 0.13 <sup>bc</sup>
South-west monsoon (Jun.- Sep.)	587	197.5 $\pm$ 7.2 <sup>a</sup>	505.5 $\pm$ 7.2 <sup>a</sup>	201.5 $\pm$ 6.4 <sup>a</sup>	2.02 $\pm$ 0.07 <sup>a</sup>
North-east monsoon (Oct.- Dec.)	643	210.6 $\pm$ 6.4 <sup>a</sup>	517.9 $\pm$ 6.5 <sup>a</sup>	217.1 $\pm$ 5.8 <sup>b</sup>	2.24 $\pm$ 0.06 <sup>b</sup>
<b>Parity</b>		**	**	**	**
First	513	280.1 $\pm$ 8.0 <sup>c</sup>	586.6 $\pm$ 8.1 <sup>c</sup>	274.1 $\pm$ 7.2 <sup>c</sup>	2.82 $\pm$ 0.08 <sup>c</sup>
Second	367	237.1 $\pm$ 8.3 <sup>b</sup>	544.9 $\pm$ 8.3 <sup>b</sup>	240.3 $\pm$ 7.4 <sup>b</sup>	2.40 $\pm$ 0.08 <sup>b</sup>
Third	259	218.4 $\pm$ 9.6 <sup>ab</sup>	526.4 $\pm$ 9.6 <sup>ab</sup>	220.9 $\pm$ 8.6 <sup>ab</sup>	2.24 $\pm$ 0.09 <sup>ab</sup>
Fourth	175	205.9 $\pm$ 11.6 <sup>a</sup>	512.7 $\pm$ 11.6 <sup>a</sup>	207.9 $\pm$ 10.4 <sup>a</sup>	2.19 $\pm$ 0.11 <sup>ab</sup>
Fifth	118	187.4 $\pm$ 13.7 <sup>a</sup>	495.5 $\pm$ 13.7 <sup>a</sup>	201.2 $\pm$ 12.2 <sup>a</sup>	2.00 $\pm$ 0.13 <sup>a</sup>
Sixth and above	118	221.2 $\pm$ 14.0 <sup>ab</sup>	530.8 $\pm$ 14.1 <sup>ab</sup>	236.8 $\pm$ 12.6 <sup>ab</sup>	2.24 $\pm$ 0.13 <sup>ab</sup>

n= Number of observations.

\* P<0.05, \*\* P<0.01. Means bearing same superscript within classes do not differ significantly (P>0.05).

monsoon calvers. On the other hand, the dry period and number of services per conception observed in south-west monsoon season calvers differed significantly ( $P < 0.05$ ) from winter, summer and north-east monsoon season calvers. The differences of service period among parities were highly significant ( $P < 0.01$ ). The service period decreased with the order of lactation up to fifth parity and the lowest value of  $187.4 \pm 13.7$  days was observed at this parity. The reduction in service period in the second and third parities was rather sharp and further decline was gradual. In general, pairwise comparison revealed that the mean service periods of first and second parities differed significantly ( $P < 0.05$ ) from other parities as well as between them. Similarly the Murrah buffaloes calving for the first time had the longest calving interval and dry period, which declined thereafter. The calving interval and dry period observed in the first parity was significantly ( $P < 0.05$ ) different from second and later parities. In addition, the mean calving intervals and dry periods observed between the second and fourth and fifth parities differed significantly ( $P < 0.05$ ). The decline from third to fifth parities was gradual and the differences between means were not significant.

The mean service period, calving interval and dry period of Murrah buffaloes observed were in agreement with some research reports on Murrah buffaloes (Kandasamy, 1987; Patnaik, 1988; Kundu *et al.*, 2003b). However, studies on these traits in the Murrah breeding tract reported (Chhikara *et al.*, 1995a; Dass and Sadana, 2000; Banik and Tomer, 2003) much lower values than those observed in the herd under study. The mean number of services per conception observed ( $2.31 \pm 0.05$ ) was also much higher than that reported by Kumar *et al.* (2003). However, Dutt and Yadav (1988) and Chhikara *et al.* (1995b) found comparable estimates for Murrah

buffaloes maintained at the National Dairy Research Institute, Karnal and the Buffalo Research Centre, Hisar in India.

The main factor controlling variations in the calving interval is the service period, which in turn depends on post-partum oestrus days and number of services per conception. In addition, many other additional factors have been implicated in lengthened calving intervals, such as embryonic mortality, high milk production, seasonal and environmental factors, age of cow and sire used for service. The coefficient of variation obtained for service period (67.3 percent) in the present study indicates that the herd was more heterogeneous for this trait. This strongly suggests better opportunities for improvement through good breeding practices. Hence, every effort should be made to reduce the service period sufficiently to reduce the calving interval.

The highly significant influence of period of calving observed in the present study on different production and reproduction traits was supported by similar findings on Murrah buffaloes maintained at different places in India (Kandasamy, 1987; Sethi and Khatkar, 1997; Suresh *et al.*, 2004; Yadav *et al.*, 2007). The difference in performance of the animals among different periods might be attributed to differences in management practices, sires used for breeding, environmental conditions such as ambient temperature, humidity, rainfall etc., and variations in feed and fodder availability.

The significant to highly significant effect of season of calving on different production traits corroborated with the findings of the earlier workers (Chhikara *et al.*, 1998; Dass and Sadana, 2000) and indicated that there was a pronounced seasonal influence on the traits under study. The buffaloes calving in the winter season had longer lactation length and higher lactation milk yield than those

calving in the rainy seasons. This confirms the findings in most of the earlier reports on Murrah buffaloes (Rao and Rao, 1994; Dass and Sadana, 2000; Gogoi *et al.*, 2002). The higher lactation milk yield in the winter and summer seasons might be due to the fact that the buffaloes calving in those periods were found to have less gestational stress due to longer service period and delayed conception and also that during their descending stage of lactation there was an abundant availability of fodders, since it falls on monsoon seasons. The lowest milk yield in monsoon calvers might be due to the fact that they suffered from hot humid stress and non-availability of quality fodder during the major part of the lactation period.

The significant effect of season of calving on service period and calving interval is in agreement with findings reported in the literature for Murrah buffaloes (Chhikara *et al.*, 1995b; Kumar *et al.*, 2003; Suresh *et al.*, 2004). It is generally observed that buffalo cows are seasonally polyoestrus during October to February and they breed regularly during these periods. This might be one of the reasons for shorter service period during monsoon seasons.

The higher number of services per conception in winter calvers observed in this study might be due to the fact that those animals calving in winter exhibit post-partum heat in summer months and hence there would be reduction in conception rate. Conception rate is related to oestrous behaviour, time of oestrus detection and insemination and site of semen deposition. Among the different factors, accurate detection of oestrus is of paramount importance in any reproductive management programmes; however, this is difficult in buffaloes during the summer season, since most of them exhibit silent oestrus. Thus accurate detection of oestrus and managerial interventions to ameliorate the effects of heat

load on conception rate should be implemented to reduce number of services per conception. This in turn will have a positive effect on service period and calving interval.

The significant influence of parity on different production and reproduction traits is in accordance with the results obtained by other researchers (Dass and Sadana, 2000; Kundu *et al.*, 2003b) on Murrah buffaloes. That the highest 305-day and lactation milk yields were obtained in the third parity indicates that lactational maturity is attained in the third lactation. These findings are similar to the reports of Ulaganathan *et al.* (1983) and Kandasamy (1987). The significant influence of calving sequence on service period and calving interval and longer first calving interval than the rest found in the present study concurred with the other reports on Murrah buffaloes (Kandasamy, 1987; Dass and Sadana, 2000; Kundu *et al.*, 2003a; Suresh *et al.*, 2004). The reduction in service period and calving interval over parities might be due to differences in age of the animals and periodic culling of buffalo cows with longer calving intervals. The other plausible reason is that following the first two calvings, the physiological rhythm may be maintained (i.e. reduced postpartum oestrus days and better conception) which results in shorter inter-calving periods in pluriparous buffalo cows. Similarly the highest dry period in the first parity and significant reduction in later parities might be due to the reduction of calving interval. The slight increase in reproduction traits from the fifth to sixth and above parities might be due to the lumping of all later records with the sixth parity.

## CONCLUSIONS

The study revealed that non-genetic factors

such as period and season of calving had highly significant effect on all the traits studied. In general, the milk production performance of the farmbred Murrah buffaloes at the Central Cattle Breeding Farm, Alamadhi was comparable to that of animals maintained in other government and institutional herds in India. However, the comparatively lower performance of Murrah buffaloes with respect to fitness traits indicates less adaptability of the breed to the hot and humid coastal region. Since temporary environmental factors play a major role on these fitness traits, better breeding management is needed for improvement. In addition, multi-trait evaluation with a combination of production and reproduction traits may be carried out for simultaneous improvement of production and reproduction performances of Murrah buffaloes in the herd. It is therefore imperative to emphasize improvements in husbandry practices and introduction of genetic evaluation programmes at the same time.

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