

## Effects of Seasonal and Breed on Tie at Mating, Mating Number and Estrus in Bitches

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**Abstract:** This study was carried out in Gemlik Military Veterinary School and Training Center to investigate the some parameters (estrus, mating season, tie at mating) related to mating in bitches. In this study, one-hundred mating data of bitches obtained during 2 years (2004 and 2005) were used. In this study, average tie at mating in year 2004 and 2005 for German Shepherd Dog (GSD), Labrador Retriever Dog (LRD) and Belgian Malinois Dog (BMD) were 16.61-17.52, 13.78-15.51 and 14.27-15.13 min, respectively and differences between breeds were significant ( $p<0.05$ ). While mating season for LRD was at the end of the spring, it was in the beginning of the summer for GSD and BMD. Dates of mating in year 2004 and 2005 were on days 12.7-15, 13.1-14.7, 9.9-11.2 of estrus and average service numbers were 3.8-4.2, 3.9-4.9, 4.1-4.7 times for GSD, LRD and BMD, respectively. As phenotypical correlations, it was determined that there were significant positive correlations between mating age and mating season and between mating season and tie at mating of bitches ( $p<0.01$ ).

**Key words:** Bitch, coital, tie at mating, mating season, correlations

### INTRODUCTION

The average healthy bitch reaches sexual maturity well before 24 months of age and begins an estrous cycle once every 4.5-10 months (Feldman and Nelson, 2004). The average bitch cycles once every 4.5-10 months, with some specific breeds such as the German shepherd dog cycling more frequently usually without any associated infertility (Sokolowski *et al.*, 2001; Concannon *et al.*, 1989). In dogs, oestrus, breeding and whelping occur throughout the year. Because dogs are considered non-seasonal or mono-oestrus breeders, few studies have been carried out to investigate seasonal effects on reproductive performance in bitches. In the USA, a greater incidence of estrus periods is seen during late winter or early spring and again in the late summer or early autumn (Concannon, 1986). Some studies have shown a seasonal pattern of estrus in dog colonies or populations. For instance, in Quebec, Canada, more estrus periods were observed in domestic dogs during winter and summer (Bouchard *et al.*, 1991). Whereas in Britain more estrus periods were observed during the spring (Christie and Bell, 1971). In tropical regions such as Jaipur,

India, stray dogs are more commonly in estrus during late autumn and winter (Chawla and Reece, 2002).

The canine estrus cycle consists of four phases (proestrus, estrus, diestrus and anestrus). The average duration of proestrus in the bitch is 9 days. However, variations from 2-25 days are considered normal. The average duration of estrus is 5-9 days. During this phase of the estrus cycle, the female will permit the male to mount and breed (Feldman and Nelson, 2004; Johnston *et al.*, 2001). Ovulation usually occurs on the second day of estrus, it is highly effective to breed the bitch as soon as she is sexually receptive to the male dog and again two days later. The bitch is usually brought to the male dog for breeding.

The Copulatory pattern of the *Canidae* including the domestic dog is unlike that of any other carnivores in that it normally involves the establishment of a genital lock or tie between the male and female (Hart and Kitchell, 1965). Beagles have observed genital lock lasting from 1 min or less to 70 min. The average duration is approximately 25 min but individual differences between males and between pairs are pronounced (Beach and Le Boeuf, 1967). During normal mating male and female dogs

form a genital lock during which the penis is so swollen within the vagina that the pair cannot separate until detumescence begins. After a normal lock (15 min+) most males and females are relatively calm and inactive (Beach, 1970; Correa, 2002).

The studies carried out to investigate the main reproductive characters, such as mating season, tie at mating and estrus, in bitches are limited. This study was carried out to determine parameters, such as tie at mating, mating season and estrus and phenotypical correlations between these parameters in different purebred dogs trained in Gemlik Military Veterinary School and Training Center.

## MATERIALS AND METHODS

**Animals:** This study was carried out in Gemlik Military Veterinary School and Training Center, Dog Breeding and Training Battalion Commandership. In this study, the dogs of various breeds; German shepherd dog (number of males/number of females) (11/26), Labrador retriever (18/23) and Belgian malinois (7/10), were used. It was paid attention to be same age group for females. Male dogs were average 4.2 years old.

**Study area:** The study was conducted at the Gemlik Military Veterinary School and Training Center. Gemlik is a city of Bursa province in Turkey located between 40 longitude and 29 parallel of latitude. In general, Gemlik has a mild climate and hottest months are July-August-September and coldest months are January-February-March. Yearly average amount of fall of rain was 706 mm and average relative humidity was 69% during 52 years of observation.

**Method:** Data were obtained from the number of mating and estrus of female dogs recorded individually during 2 years. In this study, data from 100 mating and estrus of 59 female dogs of 3 various breeds (26 GSD, 23 LRD and 10 BMD) during 2 years were investigated. Number of mating recorded for GSD, LRD and BMD in 2004 were 23, 19, 11 and in 2005 were 27, 10, 10, respectively. Males and females used for breeding were housed individually. Spring, summer, autumn and winter seasons of the study area coincide with March-April-May, June-July-August, September-October-November and December-January-February, respectively.

Estrus in female dogs were monitored under natural conditions without any drug or hormone treatment. Boxes of females were inspected every morning to record menstruation before daily cleaning. Females had menstruation were recorded to check book and controlling of estrus were done daily from the beginning

of 5th day of menstruation. Following 5th day of proestrus, smear samples were collected from vagina every other day or suspected day to determine the period of estrus cycle and appropriate time for mating (Allen, 1992). Estrus were also examined by vaginoscopy and the inspection of outer genital organs. Female had estrus was assigned into mating boxes with a breeding male every other day and was monitored whether to mate or not. Female were mated at least 3 times one day interval following the date of mating. During the study, penis-vagina genital lock duration between females and males were recorded. Parameters investigated in the study are:

**Service number:** Mating of females 3-6 times one day interval in the estrus females accepted males for mating.

**Dates of mating (day):** Average of first and other date of mating of females in estrus.

**Mating age of bitches:** Average age of females in 2004 and 2005.

**Mating season:** Mating season of dogs mated.

**Tie at mating (min):** The lock duration (beginning to finishing) of penis and vagina during mating.

**Statistical analysis:** The statistical analyses of data were conducted by using (SPSS, 1999). In this model, the effect of breed and year on some reproductive characteristics were investigated. Data obtained in 2004 and 2005 were analysed separately to determinate the mating characteristics. Breed×year interaction was removed from the model due to it was not significant. In the study, variance analysis and Duncan's test were used to determinate the significance of mating characteristics according to years. Numbers-1, 2, 3, 4 were used to describe the statistical data related to seasons-Spring, Summer, Autumn, Winter, respectively. Coefficients of phenotypical correlations were designated to determinate the interactions between mating characteristics. Also, Principal Component Analysis (PCA) were done for determination of the proportions of characteristics and factors, considered as effective on these characteristics, in variation. Following statistical model was used for all characteristics investigated:

$$Y_{ij} = \mu + a_i + b_j + e_{ijk}$$

$Y_{ijk}$  = Phenotypical means of mating characteristics.

$\mu$  = General mean.

$a_i$  = Proportion of effect relating to years ( $i$  = 2004, 2005).

$b_j$  = Proportion of effects relating to breeds ( $j$ : 1. German Shepherd dog, 2. Labrador Retriever dog, 3. Belgian Malinois dog).

$e_{ijk}$  = Mean 0, variance  $\sigma^2$  error term.

Table 1: Reproductive parameters ( mean  $\pm$ sd) of bitches by breeds

	German shepherd dog		Labrador retriever dog		Belgian malinois dog		
Parameters	X	SD	X	SD	X	SD	Mean
2004 year							
Number of mating bitches (n)	23		19		11		53
Mating age of bitches	4.24 <sup>a</sup>	1.65	3.78 <sup>a</sup>	1.75	4.00 <sup>a</sup>	1.24	4.00
Service number	4.25 <sup>b</sup>	1.11	3.90 <sup>a</sup>	1.19	4.73 <sup>c</sup>	1.38	4.29
Dates of mating	15.00 <sup>b</sup>	7.28	14.70 <sup>b</sup>	5.00	11.28 <sup>a</sup>	5.05	13.66
Tie at mating (min.)	16.61 <sup>b</sup>	6.02	13.78 <sup>a</sup>	5.63	15.13 <sup>b</sup>	5.03	15.17
Mating season	2.12 <sup>b</sup>	1.23	1.76 <sup>a</sup>	0.92	2.39 <sup>b</sup>	1.14	2.09
2005 year							
Number of mating bitches (n)	27		10		10		47
Mating age of bitches	4.82 <sup>a</sup>	1.98	5.05 <sup>a</sup>	2.42	4.75 <sup>a</sup>	1.62	4.87
Service number	3.82 <sup>a</sup>	1.06	4.94 <sup>b</sup>	2.05	4.16 <sup>a</sup>	1.29	4.30
Dates of mating	12.73 <sup>b</sup>	4.00	13.18 <sup>b</sup>	3.87	9.94 <sup>a</sup>	3.18	11.95
Tie at mating (min)	17.52 <sup>b</sup>	9.57	15.51 <sup>a</sup>	4.97	14.27 <sup>a</sup>	3.87	15.76
Mating season	2.23 <sup>b</sup>	1.14	1.56 <sup>a</sup>	1.11	1.41 <sup>a</sup>	0.50	1.73

a,b,c: Means within a row with different superscripts differ ( $p < 0.05$ )

Table 2: Phenotypical correlations related to some characteristics

	Mating age of bitches	Service number	Mating season	Dates of mating	Tie at mating
Mating age of bitches		0.090	0.200**	-0.098	0.048
Service number			-0.101	0.016	0.050
Mating season				0.029	0.207**
Dates of mating					0.082

\*:  $p < 0.05$ , \*\*:  $p < 0.01$

## RESULTS

Descriptive statistics related to mating characteristics in bitches were shown in Table 1. Average mating age of bitches in 2004 for German Shepherd dog (GSD), Labrador Retriever dog (LRD) and Belgian Malinois dog (BMD) were 4.24, 3.78 and 4.00 years, respectively. BMD had higher (4.73) and LRD had lower (3.90) average service number in 2004 and the difference between these breeds for service numbers were statistically significant ( $p < 0.05$ ). When average dates of mating were compared, it was observed that BMD mated in the earliest period of estrus (11.28th day) and GSD had the latest date of mating (15th day). Tie at mating, an other important parameter in this study, was shortest in LRD (13.78 min) and was longest in GSD (16.61 min). While the mating season in 2004 year was the end of the spring season for LRD, it coincided with the beginning of the summer season for GSD and BMD. In this study, differences between all parameters investigated in 2004 were significant ( $p < 0.05$ ).

According to data recorded in 2005, mating ages of bitches for GSD, LRD and BMD were 4.82, 5.05 and 4.75 years, respectively. Service number was in favour of LRD (4.94 times) and the difference was found more significant than those of other two breeds. From the point of view of the average dates of mating, it was determined as latest for LRD (13.18th day of estrus) and earliest for BMD (9.94th day of estrus). Tie at mating of bitches for GSD, LRD and BMD were 17.52, 15.51 and 14.27 min,

Table 3: The results of PCA (Principal Component Analysis) related to characteristics

	Component axis		
	C1	C2	C3
Commentary ratio of variation (%)	21.34	17.86	15.77
Cumulative ratio of variation (%)	21.34	39.20	54.97
<b>Variables</b>			
Service number	-0.647	0.679	0.465
Mating season	0.685	0.631	0.730
Tie at mating	0.689	0.499	0.465
Mating age of bitches	-0.040	0.594	0.120
Dates of mating	0.224	0.344	-0.536

respectively. While the mating season was the spring season for BMD and LRD, it was the beginning of the summer season for GSD. Also, the average mating season was determined as the end of the spring and the beginning of the summer season.

Data of phenotypical correlation of parameters investigated in this study were presented in Table 2. It was determined that there was significant positive correlation between mating age of bitches and mating season and between mating season and tie at mating ( $p < 0.01$ ).

The results of PCA (Principal Component Analysis) were presented in Table 3. In this study, the variations of characteristics related to mating and estrus have explained 54% of total variation with three principal components. The results from PCA showed that there were positive correlations in component 1 and negative correlations in component 2 and 3 between the relevant characteristics.

Particularly, there were intense and significant relationships between service number, mating season and tie at mating. According to PCA of mating characteristics of bitches, especially mating season and tie at mating were in component 1 axis as same directed and equal length. Similarly, mating age of bitches and service number were also same directed and equal length.

## DISCUSSION

Conception in the bitch depends on the health of the male and female and appropriate management of the environment and breeding. This study is one of the very few researches carried out to determinate the tie at mating and factors affecting some parameters related to mating in different dog breeds. These results had presented important data to clarify the mating characteristics in bitches. The highest average tie at mating was determined in GSD (between 16.6-17.5 min) and it was between 13.7-15.5 min in LRD and BMD. These findings were lower than that obtained by Beach (1970). Beach (1970) reported that tie at mating in male dogs were variable between 13.75-44.81 min. However, it was reported in a study carried out with male dogs and maquette bitches (phantom) that phantom lock time was between 2.92-14.25 min (Beach, 1970). Beach and Le Boeuf (1967) reported that tie at mating during copulation of male and female dogs was between 10-15 min. In a study conducted by Correa (2002), it was observed that tie at mating was on the vast range (5-60 min). Moreover, average tie at mating was reported as 20.53 min for German shepherd dog, 21 min (Gönül, 1996) and 19.08 min. Tepeli and Çetin (2000) for Anatolian shepherd dog (Kangal dog). Although tie at mating that was reported between 16.61-17.52 min for GSD in this study was a little bit lower than that reported by Gönül (1996) and Tepeli and Çetin (2000) this founding was agree with their results.

The most suitable date of mating for domestic bitches is 2nd or 3th day of estrus period (heat) or 10th and 14th day of pro-oestrus bleeding (Allen, 1992; Christiansen, 1984; Concannon *et al.*, 1989). In this study, dates of mating for GSD, LRD and BMD were determined on days 12.7-15, 13.1-14.7 and 9.9-11.2 of estrus period, respectively. These results showed that dates of mating for GSD and LRD were similar and BMD had capability for mating at the early period estrus (heat). Several researchers reported that male and female dogs mated between 10th and 14th day of estrus period (Grundy *et al.*, 2002; Tsutsui, 1989).

It is known that estrus occurs twice a year, first one in the spring season and second one in the autumn season, in the bitches (Christiansen, 1984; Lofstedt, 2001). In this study, mating seasons in both 2004 and 2005 for LRD and GSD were the spring and the summer season,

respectively, however, it was the middle of the summer season in 2004 for BMD and the spring season in 2005 for BMD. Bouchard *et al.* (1991) reported that estrus period in the bitches occurred frequently in the winter and summer seasons than the other seasons. Ortega-Pacheco *et al.* (2007), determined that the distribution of oestrus period in the bitches did not depend on any factor (season, age, body weight...etc.). Similarly, in a study carried out with GSD and LRD under tropical condition in the military dog center in Thailand, although the estrus incidence increased on the months of the summer season, it was reported that there was no significant effect of season on the distribution of estrus incidence (Chatdarong *et al.*, 2007). This report was similar to the result related to estrus period that was obtained in the spring and the summer season in this study.

## CONCLUSION

The present study showed that the shortest (13.78 min) and the longest (17.52 min) tie at mating were determined for LRD and GSD, respectively. In this study, estrus periods were determined more frequently in the spring and the summer seasons. Also, it was determined that there was a significant positive correlation between the mating season and the tie at mating.

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## REFERENCES

- Allen, W.E., 1992. Fertility and Obstetrics in the Dog. Blackwell Scientific Publications, Oxford.
- Beach, F.A., 1970. Coital behavior in dogs. IX. Sequelae to "coitus interruptus" in males and females. *Physiol. Behav.*, 5: 263-268.
- Beach, F.A. and B.J. Le Boeuf, 1967. Coital behaviour in dogs: I. Preferential mating in the bitch. *Anim. Behav.*, 15: 546-558.
- Bouchard, G., R.S. Youngquist, D. Vaillancourt, G.F. Krause, P. Guay and M. Paradis, 1991. Seasonality and variability of the interestrus interval in the bitch. *Theriogenology*, 36(1): 41-50.
- Chatdarong, K., P. Tummaruk, S. Sirivaidyapong and S. Raksil, 2007. Seasonal and breed effects on reproductive parameters in bitches in the tropics: A retrospective study. *J. Small Anim. Pract.*, 48: 444-448.
- Chawla, S.K. and J.F. Reece, 2002. Timing of oestrus and reproductive behaviour in Indian street dogs. *Vet. Rec.*, 150: 451-452.

- Christiansen, I.B.J., 1984. Reproduction in the Dog and Cat. Bailliere Tindall, London.
- Christie, D.W. and E.T. Bell, 1971. Some observations on the seasonal incidence and frequency of oestrus in breeding bitches in Britain. *J. Small Anim. Pract.*, 12: 15-167.
- Concannon, P., J. McCann and M. Temple, 1989. Biology and endocrinology of ovulation, pregnancy and parturition in the dog. *J. Reprod. Fertil.*, 39: 3-25.
- Concannon, P.W., 1986. Canine Physiology of Reproduction. In: Burke, T.J. (Ed.) *Small Animal Reproduction and Fertility*, Lea and Febiger, Philadelphia, pp: 23-77.
- Correa, J.E., 2002. Canine Breeding and reproduction. Alabama Cooperative Extension System. Alabama A and M and Auburn Universities. UNP-52.
- Feldman, E.C. and R.W. Nelson, 2004. *Canine and Feline Endocrinology and Reproduction*. 3rd Edn. St. Louis, Missouri: Saunders.
- Gönlü, N., 1996. Gemlik Askeri Veteriner Okulu ve Eğitim Merkez Komutanlığı'nda yetiştirilen Türk çoban köpeği ve Alman çoban köpeğinin başlıca morfolojik özellikleri ile bu genotiplerin karşılaştırılmalı eğitim performansları. Uludağ Üniversitesi Sağlık Bilimleri Enstitüsü, yayınlanmamış Doktora Tezi.
- Grundey, S.A., E. Feldman and A. Davidson, 2002. Evaluation of Infertility in the Bitch. *Clin. Techniq. Small Anim. Pract.*, 17 (3): 108-115.
- Hart, B.L. and R.L. Kitchell, 1965. External morphology of the erect penis of the dog. *Anat. Rec.*, 152: 193-198.
- Johnston, J.H., M.V. Root Kustritz and P.N. Olson, 2001. *Canine and Feline Theriogenology*. Philadelphia, PA, Saunders.
- Lofstedt, R., 2001. Reproductive physiology of bitches and artificial insemination with fresh semen. Atlantic Veterinary College University of Prince Edward Island. P.E.I. Canada. C1A 4P3. <http://people.upei.ca/lofstedt/opence/2000carep.html>.
- Ortega-Pacheco, A., J.C. Segura-Correa, M. Jimenez-Coello and C. Linde Forsberg, 2007. Reproductive patterns and reproductive pathologies of stray bitches in the tropics. *Theriogenology*, 67: 382-390.
- Sokolowski, J.H., D.G. Stover and F. Van Ravensway, 2001. Seasonal incidence of estrus and interestrus interval for bitches of seven breeds. *Am. J. Vet. Res.*, 38: 1371-1376.
- SPSS INC., 1999. SPSS for Windows. Release 10.0.5 Standard Version. SPSS Inc. Headquarters, 233 S. Wacker Drive, 11th Floor Chicago, IL 60606.
- Tepeli, C. and O. Çetin, 2000. Determination of growth, some body measurements and reproductive traits of Kangal Turkish Shepherd Dogs. II. Reproductive traits. *Vet. Bil. Derg.*, 16 (1): 17-25.
- Tsutsui, T., 1989. Gamete physiology and timing of ovulation and fertilization in dogs. *J. Reprod. Fertil., Suppl.*, 39: 269-275.