Observations on gestation length of European, Mesopotamian and hybrid fallow deer

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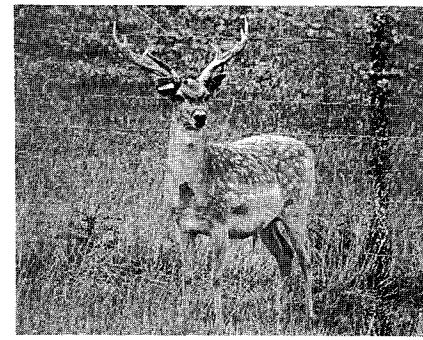

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Summary

Gestation length records for 930 fallow deer pregnancies across three properties, representing European (*Dama dama dama*) and part-Mesopotamian (*Dama dama mesopotamica*) genotypes, were analysed with respect to foetal genotype. Mean gestation lengths generally ranged from 232-235 days for all genotypes, although there was a significant farm x genotype interaction whereby F1 Mesopotamian hybrid fawns on a Texas property exhibited somewhat abbreviated gestation, with a mean of 228.1 days. Greatest variance in gestation length was observed for F1 hybrid fawns. This is discussed in relation to artificial insemination programmes.

Introduction

Gestation length, the interval from insemination (natural or artificial) to parturition, is genetically determined for each mammalian species, ranging from <30 days in marsupials and rodents to >500 days in elephants. Cervid species exhibit a wide range in species-specific gestation length from <200 days in small species (eg. mouse deer) to >280 days in large species (eg. Pere David's deer).

There is limited published information on gestation length of fallow deer (*Dama dama*). Chapman & Chapman (1975) indicated an average gestation of 229 days, but this was based on a very limited data set. More recently Asher (1986) calculated a mean (± s.d.) gestation length of 234.2±2.7 days (n=88 observations) with a range of 228-244 days. These later data were obtained following observation of mating and fawning of farmed European fallow does on the Ruakura Agricultural Centre in 1983 and 1984. An interval of around 234 days for European fallow deer has been confirmed from a number of studies involving artificial insemination (Asher *et al.*, 1988a; Mulley *et al.*, 1988).

Within the last 5-6 years there has been a rapid introduction of Mesopotamian fallow deer (*Dama dama mesopotamica*) genes into the international farmed fallow deer gene pool. This has mostly been achieved by artificial insemination using semen from purebred or hybrid sires based in New Zealand (Asher *et al.*, 1990, 1992; Mylrea *et al.*, 1991). From a very limited number of observations, Otway (1992) states a gestation length of 229 days for pure Mesopotamian fallow deer. The effect of hybridisation between Mesopotamian and European subspecies on gestation length has not been previously evaluated, although some farmers involved in artificial insemination programmes had indicated wide variation in gestation length for does carrying F1 hybrid fawns (Asher, 1992).

Differentiation of fawns born to artificial insemination (AI) from those conceived 21 days later to natural mating (ie. return-oestrus matings) is often based on birth date analysis, whereby those born 234 ±10 days from AI represent AI conceptions, while those born 255±10 days from AI represent return-oestrus conceptions (ie. failed AI). This system appears to work well for the European genotype, as gestation length lies within predictable and repeatable bounds. However, increased gestation length variability of hybrid fawns is reputed to confound interpretation based on birth date, as a degree of overlap exists between the birth date of AI conceived verses return-oestrus conceived fawns.

In this paper we have analysed gestation length data for a number of fawn genotypes, including European, F1 Mesopotamian hybrids and various

back-cross hybrids. These data include those of Asher (1986) as well as records from commercial and experimental AI programmes in which pregnancy to AI was confirmed by ultrasonography.

Materials and Methods

Gestation length (ie. interval between mating/insemination and parturition inclusive) data were obtained for 930 fallow deer fawns across three farms: (1) Ruakura Agricultural Centre, Hamilton, New Zealand (n=260 fawns); (2) Hazelhurst Fallow Deer Farm, Tirau, New Zealand (n=249 fawns); (3) Heart-Bar Deer Farm, Yancey, Texas, USA (n=421 fawns).

Data are from pregnancies to either observed natural mating or artificial insemination between the years 1983 and 1992. Genotypes represented include: (1) 100% European fallow deer (ie. sires and dams from *Dama dama dama* stock in New Zealand and USA; n=439); (2) 50% (F1) Mesopotamian fallow deer (ie. *Dama dama mesopotamica* sire x European dam; n=176); (3) 50% Mesopotamian fallow deer (ie. 75% Mesopotamian sire x 25% Mesopotamian dam; n=50); (4) 37.5% Mesopotamian fallow deer (ie. 75% Mesopotamian sire X European dam; n=95); (5) 25% Mesopotamian fallow deer (ie. F1 Mesopotamian hybrid sire X European dam; n=116).

Gestation length (days) was determined as the interval between observed mating and parturition inclusive, for does in which conception was confirmed by either plasma progesterone profiles or rectal ultrasonography between days 38 and 50 from mating/insemination. Gestation lengths of does conceiving to intravaginal or intracervical artificial insemination, performed 48-54 hours after removal of intravaginal CIDR devices (ie. approximate time of onset of oestrus), were calculated as for natural mating. Gestation lengths of does conceiving to laparoscopic intra-uterine inseminations, performed 68-72 hours after removal of CIDR devices (ie. approximately 24 hours after the onset of oestrus), have an additional day added to the interval between insemination and parturition.

Data collected on the day of fawn birth included birth date, fawn sex, sire, dam genotype and, in most cases, birth weight and specific dam identification (Asher & Adam, 1985). Gestation length data were analysed using the REML procedure in Genstat 5 (Lawes Agricultural Trust, Rothamstead, UK) with fawn genotype as the fixed effect and using farm, year, fawn sex and birth weight as investigative variables.

Results

The frequency distribution of gestation lengths are presented in Figure 1 for the European (*Dama dama dama*) genotype, and in Figure 2 for fawns containing varying proportions of Mesopotamian (*Dama dama mesopotamica*) genes. Mean gestation length by fawn genotype, for data pooled across farms/years (Table 1), generally ranged from 233 to 235 days. However, the mean gestation length of F1 Mesopotamian hybrid fawns was, at 229.7 days, notably shorter. Furthermore, the F1 hybrids exhibited the greatest variance (Table 1).

Table 1: Mean gestation length of fallow deer by fawn genotype (pooled across farms/years)

Fawn genotype	No of observations	Mean gestation length (days)	Standard deviation	S.E.M.
European	493	233.4	3.02	0.14
50% Meso (F1)	176	229.7	4.45	0.34
50% Meso (interbreed)	50	235.4	3.76	0.53
37.5% Meso	95	235.2	2.91	0.30
25% Meso	116	234.2	2.99	0.28

Table 2: Fawn genotype x farm adjusted mean gestation length (adjustments by covariance for effects of birth weight, fawn sex and year)

Fawn genotype	Ruakura	Hazelhurst	Heart-Bar	S.E.D.
European	234.2	237.3	231.1	0.66
50% Meso (F1)	232.2	235.4	228.1	1.11
50% Meso (interbreed)	-	235.1	-	-
37.5% Meso	234.8	234.8	-	0.45
25% Meso	-	234.8	233.4	0.98

Analysis of variance indicates a highly significant farm x genotype interaction ($P<0.001$), with F1 hybrid fawns on Heart-Bar Deer Farms having notably shorter gestation lengths than either F1 hybrid fawns on other farms or other genotypes on Heart-Bar. This, in fact, accounts for most of the deviation in mean gestation length for F1 hybrid fawns in Table 1.

There were also other significant interaction effects on gestation length; namely, farm x birth weight, genotype x birth weight and fawn sex x birth weight ($P<0.05$). Following considerable covariate

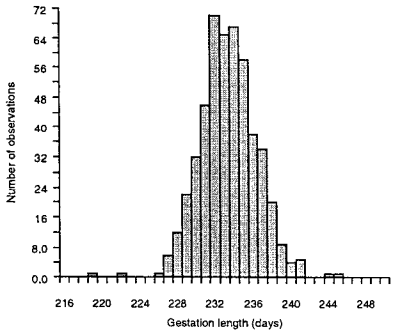

Figure 1: Frequency histogram of gestation length of European fallow deer (*Dama dama dama*) (n=493 observations).

adjustments (REML), fawn genotype x farm adjusted means were calculated (Table 2). These data clearly show that much of the deviation in overall mean gestation length of F1 Mesopotamian hybrid fawns originate from the noteably abbreviated gestation of this genotype on Heart-Bar Deer Farms. There was also a tendancy for European fawns on the Hazelhurst properly to exhibit a slightly, but significantly ($P<0.05$) longer gestation interval of 237.3 days (adjusted mean).

Discussion

In most mammalian species it is the foetus that initiates the endocrine events leading to parturition. Therefore, foetal genotype is the major determinant of gestation length, this being particularly pronounced when parental breeds/subspecies differ in their specific gestation intervals. In cervids, this has been most notably demonstrated in the hybridisation between red deer (*Cervus elaphus*; gestation = 234 days) and Pere David's deer (*Elaphurus davidianus*; gestation = 280 days), whereby F1 hybrid calves exhibit gestation lengths of 245-265 days (Asher *et al.*, 1988b; Fennessy *et al.*, 1991).

In the case of the genus *Dama*, which consists of only two subspecies, there appears to be relatively little difference in the gestation interval between the European and Mesopotamian genotypes. This is reflected in the fact that hybrids, in general, exhibit similar mean gestation lengths of between 232 and 235 days. The little available data on gestation length of 75% (3/4) and 87.5% (7/8) Mesopotamian hybrids lends support to this (W. Otway, pers. comm.).

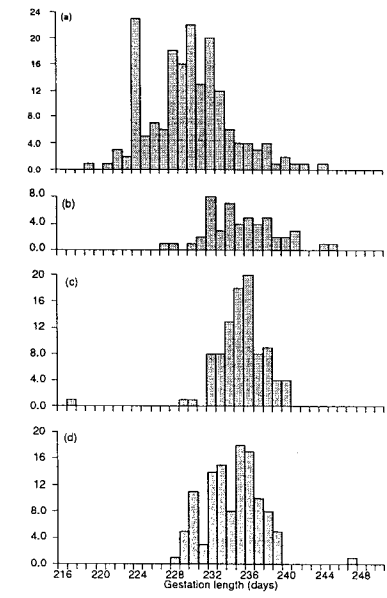

Figure 2: Frequency histograms of gestation length of (a) 50% F1 Mesopotamian hybrids (n=176), (b) 50% interbreed Mesopotamian hybrids (n=50), (c) 37.5% Mesopotamian hybrids (n=95), and (d) 25% Mesopotamian hybrids (n=116).

The fact the F1 Mesopotamian hybrids exhibited considerable between-farm variation in mean gestation length (eg. 235.4 days for Hazelhurst vs 228.1 days for Heart-Bar, Table 2) indicates the possibility of environmental influences on the initiation of parturition for this genotype. While specific environmental factors cannot be readily identified in the present study, it should be noted that the shorter gestation length of F1 hybrids on Heart-Bar may in some way reflect the hot, arid environment of south Texas, USA verses the cooler, moist environment of the Waikato region, New Zealand. It is now known that for some camelid species such as alpaca and llama, the dam can exert some control over the actual timing of parturition in order to avoid inclement weather (G.H. Davis, pers. comm.). This is perhaps also implicated in the anomalies observed for European does carrying F1 hybrid fawns - this is purely speculation at this stage.

The contention of some farmers that initial hybridisation between European and Mesopotamian

subspecies (ie. the production of F1 hybrids) results in increased variation in gestation length receives some support from these data. Indeed, the variance is such that overlap in parturition dates may occur between fawns conceived to artificial insemination and those conceived 21 days later to return-oestrus matings. This may result in a "zone of confusion", although the vast majority (95%) of fawns will be born close to the expected parturition date. In the case of F1 hybrid fawns, these can be readily blood-typed to confirm genotype (Tate, 1989).

In conclusion, the average gestation length of fallow deer of various genotypes generally ranges within the predictable bounds of 232-235 days. However, occasional anomalies occur; particularly abbreviated gestation of F1 Mesopotamian hybrid fawns on some occasions. Greatest variation in gestation length was also observed for does carrying F1 hybrid fawns.

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