

Reproduction of Icelandic horses with special reference to seasonal sexual activity

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SUMMARY

The paper reports on a study, which began in 1979, of the attainment of puberty, seasonal sexual activity, gestation length and reproductive efficiency in Icelandic horses kept under free-range conditions. Puberty was attained by 70% and 90% of mares by two and three years of age, respectively. Stallions had generally reached this stage of sexual development by two years of age. However, some well-grown fillies and colts may breed successfully at one year of age. A seasonal breeding pattern was demonstrated with a distinct peak of sexual activity in May and June (spring). This may be modified by the reproductive status of the mare and the level of nutrition of both mares and stallions. Moreover, limited breeding activity may occur in all months outside the main season in spring and summer. A hypothesis is proposed relating seasonality of breeding of Icelandic horses with natural selection and photoperiod. The limited information available on the duration of gestation indicated a substantial variation of 315 to 390 days around an average of approximately 350 days. Generally, over 80% of free-ranging mares were found to produce live foals, indicating a high reproductive rate, and surprisingly almost 70% of twin foals born to a total of 16 mares survived. The need for more detailed research on several reproductive characteristics of Icelandic horses is emphasized.

Key words: breeding season, gestation, horses, puberty, reproduction, twinning.

YFIRLIT

Frjósemi íslenskra hrossa með sérstöku tilliti til árstíðabundinnar kynstarfsemi

Ritgerðin greinir frá niðurstöðum athugana sem hófust 1979 á kynþroska, árstíðabundnum fengitíma, meðgöngutíma og frjósemi íslenskra hrossa í hefðbundnum stóðbúskap. Um 70% hryssa höfðu náð kynþroska við tveggja vetra aldur og 90% þriggja vetra. Stóðhestar voru venjulega orðnir kynþroska tveggja vetra gamlir. Reyndar kom í ljós að þroskamikil tryppi, bæði hryssur og folar, geta náð kynþroska veturgömul. Niðurstöðurnar sýna að fengitíminn er árstíðabundinn og nær hann hámarki í maí og júní, þ.e. að vorlagi. Þættir svo sem fyrri frjósemi hryssa og næringarástand bæði hryssa og stóðhesta, geta haft áhrif á fengitímann. Einnig komu fram vísbendingar um minni háttar kynstarfsemi í öllum mánuðum utan hins eðlislæga fengitíma að vor- og sumarlagi. Sú tilgáta er sett fram að árstíðabundin afmörkun fengitíma íslenskra hrossa hafi mótast af náttúruúrvali og dagsbirtuskilyrðum. Þær takmörkuðu upplýsingar sem fyrir lágu um lengd meðgöngutíma benda til verulegs breytileika, þ.e. frá 315–390 daga með um 350 daga meðaltal. Almennt má reikna með að í hefðbundnum stóðbúskap héraendis kasti rúmlega 80% hryssa sem telst góð frjósemi hjá hrossum. Skráðar voru 16 tvíburafæðingar og er athyglisvert að nær 70% folaldanna lifðu. Lögð er áhersla á að gerðar verði ítarlegri rannsóknir á ýmsu er varðar frjósemi hrossa.

INTRODUCTION

Although a great deal of practical knowledge is available about reproduction of the Icelandic breed of horses there is a lack of documented information on most of its repro-

ductive characteristics. Apart from two studies on horse fertility (Hugason *et al.*, 1985; Sigurdsson and Árnason, 1990), and on artificial insemination (Björnsson, 1983), little attention has been paid to the recording of detailed data on several basic parameters such as the attainment of puberty, seasonal breeding activity and gestation length. This paper reports on the results of a survey where an attempt was made to gather such information, however, in the absence of facilities for controlled scientific research.

MATERIALS AND METHODS

The collection of data commenced in 1979 and the results presented here are based on the following three sources of information:

- 1) Survey conducted in 1979 by publishing enquiries in the Icelandic equine journals **Eiðfaxi** and **Hesturinn okkar** where breeders and owners of horses were asked to provide information on reproductive characteristics such as sexual development, seasonality of breeding, gestation length and the incidence of twin foal births. Twelve written and several telephone replies were received from horse breeders in various parts of the country, mostly in or soon after 1980.
- 2) Analysis of horse records covering mares born during the period 1936 to 1976 at **Lágafell Farm, Austur-Landeyjar Parish, S-Iceland**, where the traditional Icelandic free-range management system of horse keeping is practiced, i.e. grazing on natural pastures with or without supplementary feeding in winter. The stallions were kept with the mares and replacement fillies throughout the year.
- 3) Monitoring and recording of bits of information reported in journals and newspapers during the period 1980 to 1992 on individual cases of foaling out-of-season (winter) and on twin births in various parts of the country.

Table 1. Age at first foaling of mares at Lágafell Farm.

1. tafla. Aldur hryssa þegar þær kasta í fyrsta sinn á Lágafelli.

Age, years <i>Fjöldi, vetur</i>	Number <i>Fjöldi</i>	%
2	6	4.4
3	87	64.0
4	30	22.1
5	7	5.1
6	1	0.7
7	5	3.7
Total— <i>Samtals</i>	136	100.0

%=Percentage—*Hundraðshluti.*

In presenting the results information from the above sources has in most cases been combined in an attempt to improve the uniformity of the fragmentary data available.

RESULTS

Attainment of puberty

The age at first foaling of 136 mares at Lágafell Farm shown in Table 1 indicates that puberty was attained by approximately 70% and 90% of them by two and three years of age, respectively. A few mares had in fact reached this stage of sexual development by one year of age. This is in agreement with observations and general experience on other farms included in the survey. While several breeders stated that first oestrus was commonly experienced at two years of age they quoted examples of well nourished fillies being mated at one year of age. Similarly they referred to cases of well-grown colts on a high level of nutrition being able to mate at one year of age while stallions generally had attained puberty by two years of age.

Seasonal breeding activity

The seasonal distribution of 151 parturitions of mares aged two to 22 years during the period 1959 to 1979 at Lágafell Farm is shown in Table 2, firstly for mares foaling for the

Table 2. Seasonal distribution of foal births at Lágafell Farm.
2. tafla. Árstíðabundin dreifing fæðinga folalda á Lágafelli.

Mare category <i>Flokkur hryssa</i>		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total <i>Samtals</i>
A														
Foaling for the first time	n					12	11	5	2			1		31
<i>Að kasta í fyrsta skipti</i>	%					38.7	35.5	16.1	6.5			3.2		100.0
B														
Foaling in the previous year	n					16	16	7	3	5	1			48
<i>Köstuðu árið áður</i>	%					33.3	33.3	14.6	6.3	10.4	2.1			100.0
C														
Barren in the previous year, not foaling for the first time	n			1	1	47	16	6	1					72
<i>Geldar árið áður, ekki að kasta í fyrsta skipti</i>	%			1.4	1.4	65.3	22.2	8.3	1.4					100.0
Total	n			1	1	75	43	18	6	5	1	1		151
<i>Samtals</i>	%			0.7	0.7	49.6	28.5	11.9	3.9	3.3	0.7	0.7		100.0

n=Number—*Fjöldi*. %=Percentage—*Hundraðshluti*.

first time (A), secondly for mares which had foaled in the previous year (B) and thirdly for mares which were not foaling for the first time but had been barren in the previous year (C). While the mean foaling date was 9 June for all the mares it was 16 June, 25 June and 27 May for categories A, B and C, respectively. Over 30% of the births were recorded in the second half of May, 78% in May and June and 12% in July. Thus only 10% of the births occurred outside these three months and no foals were born on the farm in December, January and February, i.e. in mid-winter. Information obtained from other breeders substantiated these findings indicating a pronounced seasonal breeding pattern. However, limited sporadic out-of-season breeding and foaling was evident which led to a further study of such rare events on other farms than Lágafell Farm.

A total of four, three, three, thirteen, eight,

three and five births were recorded from survey data in October, November, December, January, February, March and April, respectively. This information was derived from 29 sources in all parts of the country, mostly relating to the last 20 to 30 years, involving mares in the age range of four to at least 20 years. Although neither actual frequency nor distribution of such sporadic events is known their occurrence is clearly rare. The view was expressed by some of those replying to the survey that breeding was extremely rare in free-ranging horses during the period December to March. Furthermore, it was claimed that out-of-season breeding was associated with a good nutritional status and body condition of both mares and stallions. This was supported by the fact that several of the mares foaling in winter had received good supplementary feeding outdoors or were housed and fully fed indoors, and at least nine of the 39

Table 3. Duration of gestation.
3. tafla. Lengd meðgöngutíma.

Age of mare, years <i>Aldur hryssu, ár</i>	Foaling date <i>Kastaði, dags.</i>	Number of foals born <i>Fjöldi fæddra folalda</i>	Gestation, days <i>Meðgöngu- tími, dagar</i>
4	30 April	1	345
4	27 November	1	345
5	23 November	1	333
9	7 April	1	357
16	9 July	2	369
18	1 June	1	376
Mean— <i>Meðaltal</i>			354

events reported above applied to trained mares. Coat-colour was only known for 14 of the mares and 11 of the foals in the 39 foalings and they were found to have a wide range of colours. The sex was known for only 15 of the foals being eight males and seven females. Little information was available on stallions mating out-of-season. Their age was only stated in four cases, all ranging from less than two years to three years. There were remarks on stallion fertility being severely depressed by poor nutrition in winter under free-range conditions.

Gestation period

As mating dates of free-ranging mares are unknown in most cases the survey only yielded accurate records of six gestation periods with an average of 354 days (333–376 days). These are listed individually in Table 3 including information on the age, foaling date and fertility of the mares. Although of little statistical value these figures indicate considerable variation. This finding was supported by general statements of some of those replying, namely that gestation length could range from approximately 315 to 390 days, being commonly close to 350 days.

Reproductive efficiency

The limited information received suggests that under free-range condition over 80% of

mares running with stallions produce live foals, commonly up to ages of around 20 years. Information obtained from Lágafell Farm strongly indicates that the incidence of barrenness was highest in young mares the year after their first foaling late in the previous season, i.e. in late summer and autumn of the preceding year. A total of 16 twin births were recorded, 15 in various parts of Iceland and one in an Icelandic mare in Germany, mainly occurring during the period 1978 to 1992. The age of the mares, known in only seven cases, ranged from two to 20 years, and of the 10 foaling dates known four were in May, five in July and one in September. The sex ratio, known for 19 of the foals, was 63% (12) males and 37% (7) females. Of the 12 males two died but all the seven females survived. Table 4 shows the survival rates of all the 32 foals born to these 16 mares. A total of 68.8% of these foals survived.

DISCUSSION AND CONCLUSIONS

The results suggest that a high proportion of Icelandic fillies have experienced their first oestrus by two years of age and it is likely that with improved winter feeding a greater number will attain puberty at one year of age. Similarly, well-grown colts may achieve fertile matings at one year of age. It is in fact worth noting that the Livestock Management Act nr. 46/1991 stipulates that free-ranging

Table 4. Survival of twin foals.
4. tafla. Afdrif tvíburafolalda.

Survival Afdrif	Births Fæðingar n	Foals Folöld n	%
Both foals survived <i>Bæði folöldin lifðu</i>	10	20	62.5
One foal survived <i>Annað folaldið lifði</i>	2	4	12.5
Both foals died <i>Bæði folöldin dóu</i>	4	8	25.0
Total— <i>Samtals</i>	16	32	100.0

n = Number—*Fjöldi*. % = Percentage—*Hundraðshluti*.

of all stallions 16 months and older is forbidden and if horse breeding associations and/or local authorities so wish this age limit may be lowered to 12 months. Some breeders maintain that this should become the general rule, namely that all colts 12 months and older should be safely confined to the owners' premises, whether housed or on enclosed pasture. In general it seems that pubertal age of Icelandic horses is within the common range documented for other breeds (Nishikawa and Hafez, 1972). Clearly more detailed studies are required into the sexual development of foals and young Icelandic horses.

A seasonal breeding pattern in relation to daylight has been demonstrated in several breeds of horses (Nishikawa and Hafez, 1972; Palmer, 1978; Freedman *et al.*, 1979). The present study has indicated that the peak of cyclic activity of free-ranging Icelandic mares is restricted to the spring and early summer months resembling, for example, the breeding pattern of feral mares on Sable Island, Nova Scotia, Canada (Lucas *et al.*, 1991). The foaling data of the present study imply that the resumption of cyclic activity in spring is modified by the reproductive status of the mare. Thus adult non-pregnant mares are likely to be mated earlier in spring than both pubertal fillies and foaling mares. Environ-

mental factors, such as the plane of nutrition may also be of considerable importance in this respect. The limited sporadic out-of-season sexual activity certainly supports the view that at least some Icelandic mares may ovulate and even exhibit oestrous cycles throughout the year (Sigurdsson, 1989). However, until further research has been undertaken no definite conclusions can be drawn. Figure 1 illustrates a hypothesis based on the assumption that the seasonal distribution of sexual activity of free-ranging Icelandic mares has evolved by natural selection in the breed and its North European ancestors in the past. Thus their breeding pattern may have evolved in a similar way as in Icelandic sheep with births in spring being most favourable to the survival of the progeny (Dýrmondsson, 1978, 1979). As indicated above the maximum estimated incidence of oestrus in mares is in May and June, a few weeks before the longest day. Thus foaling of free-ranging mares coincides with the beginning of grass growth in spring. It is tempting to speculate that the breeding season may become more extended in mares receiving preferential treatment of feeding and housing. Certainly housed mares are increasingly mated earlier in the spring than those kept under traditional free-range condition. Although not studied in any detail it may be noteworthy that there was no evidence of coat-colour being associated with

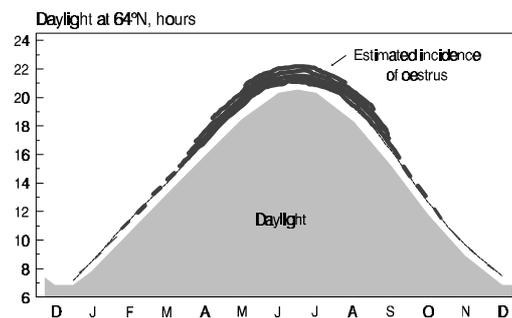


Figure 1. Seasonal distribution of oestrous activity of Icelandic mares.

I. mynd. Árstíðabundin dreifing fengitíma íslenskra hryssa.

breeding out-of-season. Such a relationship has been demonstrated in Icelandic sheep (Dýrmundsson and Adalsteinsson, 1980).

The majority of horse breeders are now adopting controlled mating management as a means of utilizing the stallions more efficiently. Thus housed stallions are bred to individual mares in May and early June followed by mating at pasture to two 25–30 mare batches, from mid-June to mid-July and from mid-July to mid-August, respectively.

The limited data available on the duration of gestation indicate considerable variation seemingly agreeing quite well with such information published for several other breeds of horses (Nishikawa and Hafez, 1972). The mean of 354 days may, however, be somewhat higher than normally expected for Icelandic mares (Sigurdsson, 1989, 1990). This remains to be clarified by a thorough investigation requiring accurate recording of both mating and foaling dates taking into account factors such as seasonality, age of mare, sex of foals and number born.

It would seem that in free-ranging mares, particularly in the young ones, the inherent reproductive potential may not always be fully expressed, probably due to nutritional deficiency. Yet, the rate of barrenness in Icelandic mares appears to be relatively low compared with that of other breeds (Nishikawa and Hafez, 1972; Merkt *et al.*, 1979; Cunningham *et al.*, 1980).

The presumably high conception rate of Icelandic mares of 80 to 90% reported by Hugason *et al.* (1985) and Sigurdsson and Árnason (1990) was evident in the present study. On the other hand their results indicated a relatively low rate of twinning. According to Stefánsson (1992) twin pregnancies in Icelandic mares may be in the range of 1.5–2.0%. Both in Iceland (Sigurdsson, 1989, 1990) and abroad (Nishikawa and Hafez, 1972) it is generally assumed that only a small proportion of twin pregnancies in mares result in two viable foals being born. No meaningful conclusions can, however, be drawn from

this survey as to the actual twinning rate in Icelandic mares. However, it is of interest to note that in the set of data available nearly 70% of the twin foals born actually survived. It is worth considering whether in fact management factors such as better feeding of mares and supervision at parturition are enhancing the probability of twin foals surviving.

In conclusion, it can be safely stated that the results of this study have generated a much greater number of questions than they have given answers to. It is indeed hoped that the information presented in this paper may stimulate research on various aspects of reproduction in Icelandic horses so as to strengthen both the scientific and practical foundations of Icelandic horse breeding.

ACKNOWLEDGEMENTS

The author thanks all the breeders and owners of horses who provided information for this study, particularly Mr Magnús Finnbogason of Lágafell Farm, S-Iceland.

REFERENCES

- Björnsson, Sigbjörn**, 1983. *Söfnun og eiginleikar stóðhestasæðis*. B.Sc. dissertation, Hvanneyri Agricultural College: 44 pp. (In Icelandic).
- Cunningham, E.P., S. Alwan, A.M. Badi & T.M. O'Byrne**, 1980. High levels of infertility in horses. *Farm and Food Research* **11**(2): 41–43.
- Dýrmundsson, Ólafur R.**, 1978. Studies on the breeding season of Icelandic ewes and ewe lambs. *Journal of Agricultural Science, Cambridge* **90**: 275–281.
- Dýrmundsson, Ólafur R.**, 1979. Kynþroski og fengitími íslenska sauðfjárins (Puberty and breeding activity of Icelandic sheep). *Náttúrufræðingurinn* **49**(4): 278–288. (Summary in English).
- Dýrmundsson, Ólafur R. & Stefán Adalsteinsson**, 1980. Coat-color gene suppresses sexual activity in Icelandic sheep. *The Journal of Heredity* **71**: 363–364.
- Freedman, L.J., M.C. Garcia & O.J. Ginther**, 1979. Influence of ovaries and photoperiod on reproductive function in the mare. *Journal of*

- Reproduction and Fertility Supplement 27*: 79–86.
- Hugason**, Kristinn, Thorvaldur **Árnason** & Jón Viðar **Jónmundsson**, 1985. A note on the fertility and some demographical parameters of Icelandic toelter horses. *Livestock Production Science* **12**: 161–167.
- Lucas**, Z., J.I. **Raaside** & K.J. **Betteridge**, 1991. Non-invasive assessment of the incidence of pregnancy and pregnancy loss in the feral horses of Sable Island. *Journal of Reproduction and Fertility Supplement 44*: 479–488.
- Merkt**, H., K.-O. **Jacobs**, E. **Klug** & E. **Aukes**, 1979. An analysis of stallion fertility rates (foals born alive) from the breeding documents of the Landgestüt Celle over a 158-year period. *Journal of Reproduction and Fertility Supplement 27*: 73–77.
- Nishikawa**, Y. & E.S.E. **Hafez**, 1972. Reproduction of horses. In: *Reproduction in Farm Animals* (ed. E.S.E. Hafez). Lea and Febiger, Philadelphia: 289–300.
- Palmer**, E., 1978. Control of the oestrous cycle of the mare. *Journal of Reproduction and Fertility 54*: 495–505.
- Sigurdsson**, Ágúst & Thorvaldur **Árnason**, 1990. Skyldleikarækt og áhrif hennar á frjósemi hjá Kirkjubæjarhrossunum (Inbreeding and its effects on fertility in horses at the Kirkjubær Stud). *Icelandic Agricultural Sciences 3*: 89–100. (Summary in English).
- Sigurdsson**, Helgi, 1989. *Hestaheilsa. Handbók hestamanna um hrossasjúkdóma*. Eiðfaxi, Reykjavík: 35–37. (In Icelandic).
- Sigurdsson**, Helgi, 1990. Meðganga. *Eiðfaxi 5*: 6–7. (In Icelandic).
- Stefánsson**, Páll, 1992. Frjósemi og fang. *Eiðfaxi 7*: 25–27. (In Icelandic).

Manuscript received 21 December 1993,
accepted 12 January 1994.