# AN ANALYSIS OF AGE PATTERN OF AI BULL'S PARENTS IN HOKKAIDO DAIRY HERD

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Received November 14, 1985

## Introduction

The official recording of milk production has been practiced in Hokkaido since 1974, and half of all cows were recorded for milk production in 1984 (Hokkaido Dairy Cattle Recording Association). These records are used in progeny testing of young bulls started in 1984. A cow evaluation (cow index) was also started in Hokkaido. All these projects were primary importance in creating systematic scheme for genetic improvement of dairy cattle. In this way, the same arrangement for dairy cattle breeding as in North America and Europe has now been organized in the Hokkaido dairy industry. It is of urgent necessity for the Hokkaido dairy industry to evaluate the optimum breeding plan for dairy cattle which incorporated these projects.

An analysis of the age pattern of parents of Hokkaido dairy cows was published in a series of papers, in order to understand current mating patterns and to obtain information necessary for evaluation of the optimum breeding plan[1,2]. This study, investigating the age pattern of AI bulls' parents in Hokkaido dairy herds, was also a part of the series.

## Materials and Methods

The source data used in this study includes information about the pedigrees of the 1,161 sires that produced the cows produced in Hokkaido after 1966 which were used in previous papers[1]. Sires and dams were classified into 3 groups according to the districts where they were produced (Hokkaido, the USA and Canada), irregardless of their orgin.

[J. Fac. Agr. Hokkaido Univ., Vol. 63, Pt. 4 1986]

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## Results and Discussion

Since this study was limited to the sires whose female offspring were registered after April 1st, 1975, all sires that had female offspring before then were not always included. In a previous paper[1], the number of cows from sires younger than three years old was relatively small. In consideration of these limitations on the source data, the number of bulls produced in Hokkaido before 1972 might be underestimated (Table 1). More than 100 bulls were produced in Hokkaido every year before 1976, after which the number decreased. This decrease might closely reflect the increased use of bulls introduced from North America[1]. In addition to these bulls produced in Hokkaido, about fifteen bulls were imported from North America to Hokkaido every year and were used for AI service[1].

The changes in the proportion of sires by year are shown in Fig. 1 for the three groups of parents. Among the three groups of sires, Hokkaido sires showed the most decrease. The proportion of Hokkaido sires decreased only recently, while the proportion of Canadian sires increased year by year.

TABLE 1. Changes in the number of bulls produced in Hokkaido after 1966

| Year when bulls were born | Districts where sires were produced | | | |
|---|---|---|---|---|
| | Hokkaido | USA | Canada | Sub-total |
| 1966 | 4 | 11 | 0 | 15 |
| 1967 | 14 | 21 | 6 | 41 |
| 1968 | 14 | 19 | 11 | 44 |
| 1969 | 16 | 14 | 16 | 46 |
| 1970 | 26 | 32 | 6 | 64 |
| 1971 | 22 | 28 | 9 | 59 |
| 1972 | 29 | 53 | 26 | 108 |
| 1973 | 34 | 37 | 46 | 117 |
| 1974 | 35 | 34 | 42 | 111 |
| 1975 | 18 | 39 | 65 | 122 |
| 1976 | 12 | 36 | 57 | 105 |
| 1977 | 12 | 33 | 48 | 93 |
| 1978 | 11 | 36 | 47 | 94 |
| 1979 | 8 | 30 | 44 | 82 |
| 1980 | 10 | 24 | 26 | 60 |
| Total | | | | 1,161 |

About half of the bulls were the progeny of foreign-bred sires and home-bred dams (Table 2). Bulls whose parents were both home-bred accounted for only 18.6% from 1966 to 1980 and 10.1% from 1976 to 1980. Sires and dams which were produced in North America and brought to Hokkaido produced 29.0% (1966-1980) and 38.2% (1976-1980) of bulls born in Hok-

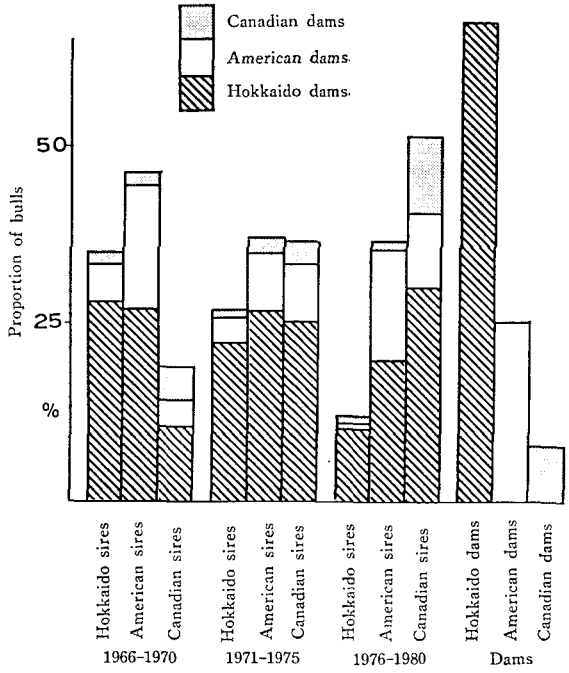


**Fig. 1.** Changes in the proportion of bulls produced by three groups of parents.

TABLE 2. Proportion of bulls produced by pairs of home-bred and foreign-bred parents (%)

| Districts where parents were born | | Period when young bulls were born | |
|---|---|---|---|
| Sires | Dams | 1966-1980 | 1976-1980 |
| Hokkaido | Hokkaido | 18.6% | 10.1% |
| North America | North America | 29.0 | 38.2 |
| USA | USA | 13.0 | 15.9 |
| Canada | Canada | 5.9 | 10.6 |
| Hokkaido | North America | 4.2 | 2.1 |
| North America | Hokkaido | 48.1 | 49.5 |
| Total number of bulls | | 1,161 | 434 |

TABLE 3. Median ages of parents when bulls were born

| Year when bull were born | Districts where sires were born | | | Sub-total |
|---|---|---|---|---|
| | Hokkaido | USA | Canada | |
| Age of sires: | | | | |
| 1966-1970 | 6.75 ( 58) | 5.35 ( 56) | 4.88 ( 22) | 5.43 (136) |
| 1971-1975 | 9.73 (114) | 8.15 (137) | 9.91 (129) | 9.28 (380) |
| 1976-1980 | 7.86 ( 44) | 12.33 ( 85) | 10.18 (130) | 10.54 (259) |
| 1966-1980 | 8.31 (216) | 8.41 (278) | 9.79 (281) | 9.15 (775) |
| Age of dams: | | | | |
| 1966-1970 | 5.25 ( 54) | 5.75 ( 45) | 5.00 ( 19) | 5.35 (118) |
| 1971-1975 | 6.06 (113) | 6.30 (133) | 5.39 (126) | 5.93 (372) |
| 1976-1980 | 6.88 ( 44) | 6.94 ( 85) | 6.18 (120) | 6.44 (259) |
| 1966-1980 | 5.96 (211) | 6.32 (263) | 5.70 (275) | 6.00 (749) |

The number in the parenthesis is the actual number of bulls.

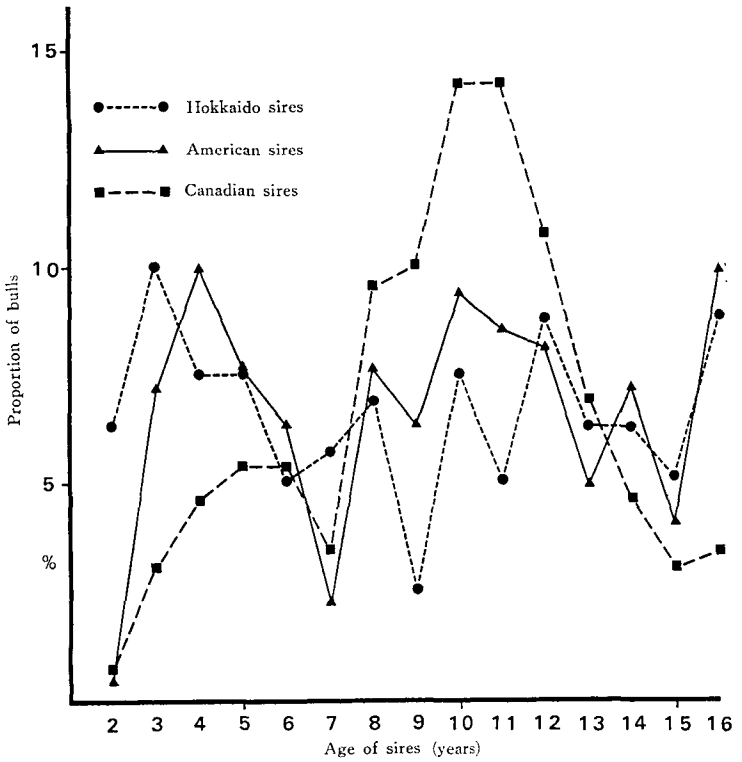


**Fig. 2.** Changes in the proportion of bulls produced by the three groups of sires according to age.

kaido, a higher proportion than bulls from home-bred parents. Among all dams of Hokkaido cows, only about 4% were directly imported from North America[1]. On the other hand, about one third of the bulls' dams were foreign-bred. In recent years (1976-1980) they amounted to 40.3%. The proportion of home-bred bulls producing Hokkaido dairy cows decreased to 17.1% in 1983[1]. Over one third of this proportion includes bulls which were produced in Hokkaido but both of whose parents were foreign-bred.

The median ages of parents when bulls were produced are given in Table 3. The general trend of these ages becoming higher with each calendar year is shown in the table. The age of sires increased from 5.4 years in 1966-1970 by about 4 to 5 years. The ages of dams also became increased, but not so much as the age of sires. Fig. 2 shows changes in the proportion of bulls produced by sires classed according to age. There is no distinct tendency in changes of proportion among three groups of sires, except that the proportion of bulls produced by all three groups dropped six and/or seven years of age. The reasons for the decline at this age is not known. The age pattern of bull's sires apparently differ from those of cow's sire in which the proportion of cows decreased after 6 to 7 years of age as sires became older[1]. The average numbers of young bulls per sire produced by each age group every year from 1971 to 1980, were 1.3, 1.6 and 2.1 for Hokkaido, American and Canadian sires respectively. Changes in the actual number of sires in each age groups were similar to the patterns in Fig. 2.

This source of progress through selection of bulls as sires to produce young bulls was shown to be most important in theory, though selection intensities for bulls to produce young bulls were not nearly as great in practice as are theoretically possible[3]. From Fig. 3, it is shown that sires were used for long period to obtain young bulls in the Hokkaido population. A shorter generation interval for sires producing bulls is more efficient in obtaining greater genetic progress per year.

Changes in the proportions of bulls produced according to the age of their dams show decreases after 4 or 6 years of age (Fig. 3), similar to those of cows' dams[1]. However, recent distribution (1976-1980) shows the pattern shifting to higher ages, reflecting on the increase of dams' ages. The median ages of sires and dams at the birth of bulls were 9.2 and 6.0 years respectively, representing the generation interval of sires to their sons and of dams to their sons respectively (Table 4). VINSON and FREEMAN[4] examined the data on young bulls of seven AI studs in the USA during 1960 to 1970, and reported the generation intervals of sires to sons and of dams to sons to be 11.3 and 7-8 years, respectively. These intervals in practice were much

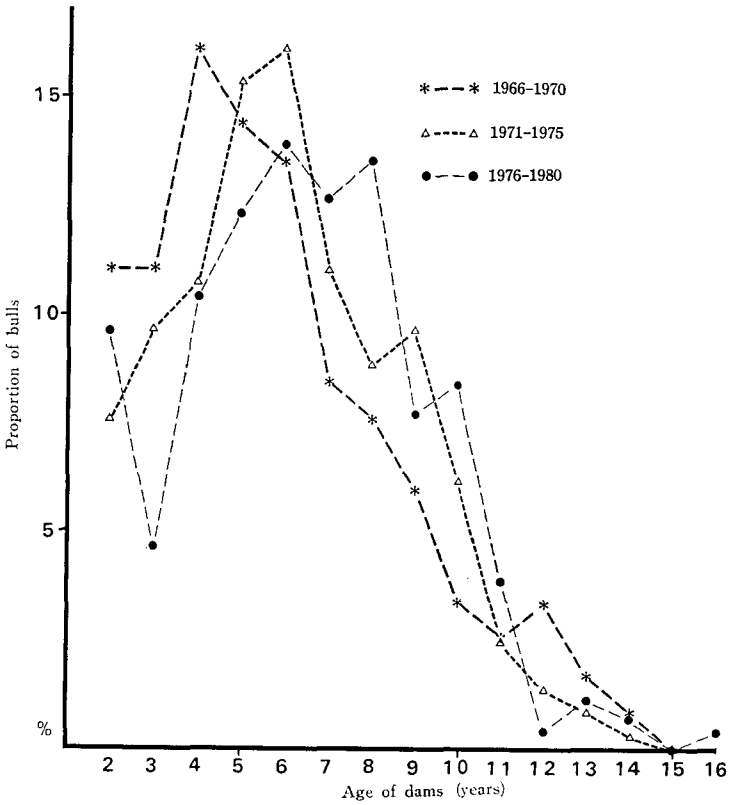


**Fig. 3.** Changes in the proportion of bulls produced by dams during three periods.

TABLE 4. Summary of generation intervals by four paths (median)

| Path | Hokkaido sire group | Total | Periods when data were used |
|---|---|---|---|
| Sires to sons | 8.3 | 9.2 | 1966-1980 |
| Dams to sons | 6.0 | 6.0 | 1966-1980 |
| Sires to cows | 4.9 (5.4) | 7.0 (7.4) | 1972-1983[1)] |
| Dams to cows | 3.9 (4.6) | 5.0 (5.5) | 1972-1983[2)] |

The number in parenthesis refers to arithmatic means,
[1),2)] refer to references,

larger than the theoretical optimum. The intervals obtained in this study were smaller than VINSON and FREEMAN's results but still larger than the optimum. The ages of parents of bulls were higher than those of the respective parents of cows, especially for the ages of sires. The differences in age might be caused by the partial selection of bulls and cows as sires and dams to produce young bulls. It seems preferable to shorten the interval, so that greater genetic progress per year may be obtained. As described in the introduction, a cow evaluation is being prepared for publication as a cow index for Hokkaido. If the cow index is available for selection of bull's dams, the generation intervals of dams to young bulls may be larger.

## Summary

This study investigates the age patterns of AI bulls' parents in Hokkaido dairy herds, in order to obtain the information necessary for evaluation of the optimum breeding plan, by using the pedigrees of 1,161 sires which were produced in Hokkaido from 1966 to 1980.

The proportion of bulls which were produced by mating of home-bred parents (produced in Hokkaido) from 1966 to 1980, was 18.6% with a slight decline from 1976 to 1980. About one third of bulls produced in Hokkaido from 1976 to 1980 were progeny of foreign-bred parents (American and Canadian). The ages of parents when bulls were produced showed a tendency to become higher year by year. In particular, the age of sires after 1971 was larger than the age before then by about 4-5 years. The increased age of sires would be reflected by the extensive use of frozen semen. The average age of sires and dams when bulls were produced in Hokkaido were 9.2 and 6.0 years respectively.

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