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**STATISTICAL CONSIDERATIONS CONCERNING THE  
DISPOSAL OF DAIRY BULLS USED FOR  
ARTIFICIAL INSEMINATION IN  
HOKKAIDO FROM 1958 to 1979**

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A survey was conducted on Holstein bulls kept for service at artificial insemination centers in Hokkaido from 1958-1979. Analysis was made of the reasons for discharge of 312 bulls considered to be no longer serviceable. The following results were obtained: 1) It was revealed that the main reason for disposal was not sexual trouble or seminal vesiculitis but impotentia coeundi followed by undesirable factors, which were the reasons given for more than 60% of the discharged bulls. It was shown that 10-15% of the bulls used at the beginning of the year were slaughtered for some reason or other within that year. 2) The lowest age for semen collection was 10 months and the highest age was 12 years and 8 months. Analysis of the bulls entered for service under 24 months revealed that one half of the bulls were a full 17 months of age and that 90% were entered before 20 months of age. 3) It was shown that approximately one half of the total number of bulls were used for service for 6 years, and those used for 8 years accounted for a quarter of the number. The longest period of service was 16 years. 4) The maximum number of years of survival was 16 years and 10 months. One half of the bulls used for service were discharged at 7-8 years while three quarters of them were discharged until 10 years old. 5) A comparison was made between the bulls employed for service during the period 1958-1965 and 1966-1979, and it was shown that the latter period group entered service later than the former period group. The reason for the delay remains unknown.

Although almost all dairy cows are artificially inseminated in Japan, little information has been reported concerning the status of the bulls used at artificial insemination centers. This paper will report some statistical considerations of the disposal rate of dairy bulls which were used for artificial insemination in Hokkaido from 1958 to 1979.

**MATERIALS SURVEYED**

Statistical analysis was carried out on 312 Holstein breed bulls discharged from

breeding for artificial insemination (AI) service. No bulls which were discharged natural service after the termination of AI were included. The information herein was collected from insemination centers in Hokkaido from December 31 of each year from 1958 to 1979.

#### METHODS

1) Reason for disposal: The discharged bulls were classified on the basis of examinations by the veterinarians at the centers or by personal judgement from the clinical findings as reported by the owners.

i) Sexual troubles: At the AI centers, the semen is usually collected in an artificial vagina using live mounts, such as a female or another bull, or a dammy; therefore it may be preferable to designate refusal or inability to mount rather than sexual troubles as the reason for disposal.

ii) Impotentia coeundi (inability to copulate): This category included the following; arthritides, rheumatism, tendon or hoof disease, abdominal hernia or control difficulties due to nasal septum laceration or nervous temperament.

iii) Testicular degeneration: Low quality semen caused by such conditions as asthenozoospermia, oligozoospermia, teratozoospermia, as well as low fertility without special clinical findings, comprised this category.

iv) Seminal vesiculitis: Diagnosis of seminal vesiculitis was based on the high percentage of abnormal sperm, especially the presence of normal free heads without tail, the appearance of neutrophils in ejaculates, etc., as well as by rectal examination of the seminal vesicles and bacteriological examination of semen.

v) Organic diseases: Digestive and cardiac diseases comprised this category.

vi) Undesirable factors: This category included cases of red factors, mule-foot, avoidance of inbreeding, suspected prolonged gestation, poor-type progeny, low milk performance of offspring, etc. As the use of frozen semen has become popular, the low freezability of semen was considered one of the main undesirable factors.

vii) Old age (senility): Owing to the use of frozen semen, not only the number of cows inseminated by a bull but also the danger of inbreeding has been on the increase. At the centers, bulls above 7 years of age were considered old.

viii) Others: The term "Reason not stated" was used in these cases.

2) Service: The age of the first service, the time when the semen was first collected for AI service, is hereafter referred to as "age at entry".

The statistical analysis was carried out at Hokkaido University Computing Center.

#### RESULTS

1) Disposal: The number of discharged bulls for each year surveyed is shown in table 1. During the 22 years from 1958 to 1979, 312 bulls were discharged from

TABLE 1 *Reasons for disposal of bulls from artificial insemination service from 1958 to 1979*

YEAR	NO. OF CENTERS	NO. OF BULLS ON JAN. 1	REASONS								TOTAL	PERCENTAGE
			Sexual trouble	Impotentia coeundi	Testicular degeneration	Seminal vesiculitis	Organic diseases	Undesirable factors	Old age	Others		
1958	12	75	0	3	0	0	0	2	3	0	8	10.67
1959	12	84	0	6	0	1	0	0	1	1	9	10.71
1960	11	87	2	8	1	0	3	1	1	1	17	19.54
1961	11	87	0	2	0	1	0	1	1	1	6	6.90
1962	11	93	0	1	2	0	1	3	0	0	7	7.53
1963	11	95	0	4	1	0	2	3	0	0	10	10.53
1964	11	100	0	4	2	0	2	4	1	0	13	13.00
1965	11	106	0	6	0	0	0	3	1	1	11	10.38
1966	11	113	0	8	2	0	0	4	3	1	18	15.92
1967	11	108	1	6	0	0	1	4	1	0	13	12.04
1968	9	111	1	2	2	2	2	1	1	0	11	9.91
1969	10	111	0	6	0	0	2	6	1	1	16	14.41
1970	10	129	0	4	2	0	2	3	4	0	15	11.63
1971	10	139	0	3	1	0	8	4	4	0	20	14.39
1972	10	134	0	5	2	0	0	3	1	0	11	8.21
1973	8	135	0	4	6	0	1	15	2	0	28	20.74
1974	7	114	0	4	1	0	2	9	0	0	16	14.04
1975	7	115	0	6	1	0	1	6	5	0	19	16.52
1976	6	111	0	6	3	0	2	6	0	1	18	16.22
1977	6	111	0	6	0	0	2	7	1	0	16	14.41
1978	6	103	0	4	1	0	0	3	4	0	12	11.65
1979	6	117	0	4	1	0	3	6	4	0	18	15.38
Total	2378		4	102	28	4	34	94	39	7	312	13.12
	Percentage		1.28	32.69	8.98	1.28	10.90	30.13	12.50	2.24	100.00	

Statistical consideration on disposal of bulls

breeding. Few bulls were discharged for sexual inadequacies or seminal vesiculitis; however, a large number of bulls were discharged because of impotentia coeundi or undesirable factors. Nearly two-thirds ( $102+94/312=0.628$ ) of the discharged bulls belonged to categories ii and vi. During one year, a minimum 6.9 % (1961) of the bulls used at the centers and a maximum 20.7 % (1973) were discharged, and 10-15 % of the bulls used at the beginning of the year were discharged for some reason or other within that year.

2) Service: A recent tendency is to import bulls of proven reproductive ability or to keep homebred bulls at centers where semen is collected and inseminate tentatively with the approval of the bull owners. Therefore, the youngest age for entry into AI service was 10 months and the oldest age was 12 years and 8 months. Analysis of the entry age of 248 bulls under 24 months of age revealed that half of the bulls began at 16 months of age and 90 % began at less than 20 months (tab. 2 & fig. 1). The summary of duration of service is shown in table 3. The bulls which were discharged within one year after entry has been used previously for breeding at other places or had suffered from acute arthritides during service. Nearly half of the bulls employed for service were less than 6 years, and the maximum number of service years was 15 years. The summary of survival is shown in table 3. One bull which survived only 753 days was used for AI service for only 210 days.

Statistics revealed that approximately half of the total number of bulls were used for service less than 8 years old, and those used until 10 years old accounted for three quarters of the bulls. The duration of service and survival is shown in figure 2.

TABLE 2 *Age at entry*

AGE IN MONTHS	NO. OF BULLS	CUMULATIVE TOTAL	PERCENTAGE
10	1	1	0.4
11	2	3	1.2
12	4	7	2.8
13	13	20	8.1
14	26	46	18.5
15	38	84	33.9
16	42	126	50.8
17	43	169	68.1
18	32	201	81.0
19	16	217	87.5
20	11	228	91.9
21	9	237	95.6
22	8	245	98.8
23	3	248	100.0

FIGURE 1 Cumulative percentage curve\*

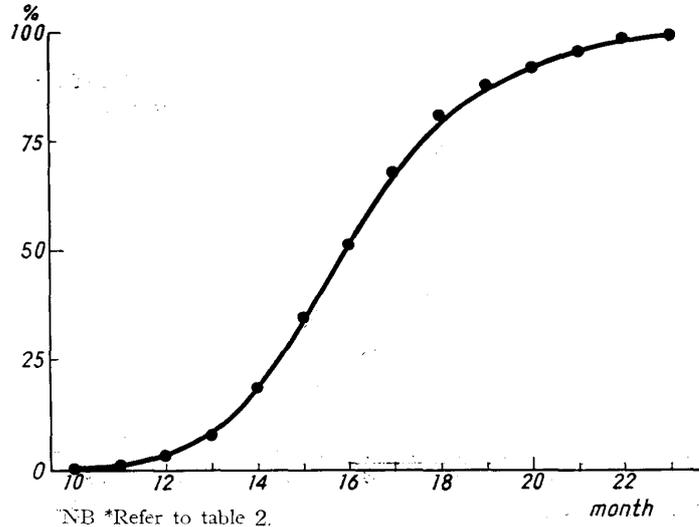
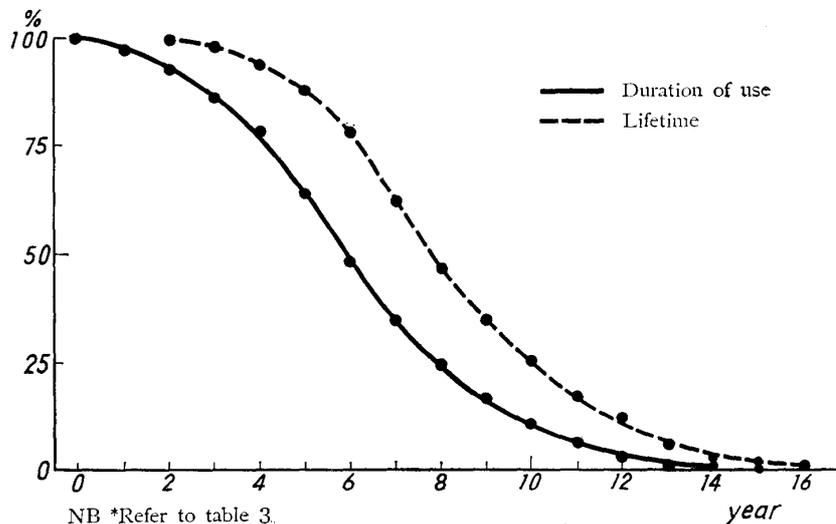


TABLE 3 Duration of service

YEAR	USE IN SERVICE			FULL LIFETIME		
	No. of bulls	No. of uses	Percentage	No. of bulls	No. of survivors	Percentage
0	7	312	100.0	—	—	—
1	16	305	97.8	—	—	—
2	20	289	92.6	6	312	100.00
3	26	269	86.2	12	306	98.1
4	42	243	77.9	20	294	94.2
5	51	201	64.4	31	274	87.8
6	44	150	48.1	50	243	77.9
7	29	106	34.0	48	193	61.9
8	25	77	24.7	40	145	46.5
9	20	52	16.7	27	105	33.7
10	13	32	10.3	26	78	25.0
11	14	19	6.1	15	52	16.7
12	3	5	1.6	20	37	11.9
13	0	2	0.6	11	17	5.5
14	1	2	0.6	3	6	1.9
15	1	1	0.3	1	3	1.0
16	—	—	—	2	2	0.6

FIGURE 2 *Percentage curve of bulls used\**

## CONSIDERATION

In an earlier reports,<sup>1-3)</sup> the present authors had reported the status of dairy bulls used at AI centers in Hokkaido from 1958 to 1965. In this paper, the discharged bulls from 1958 to 1979 were analysed; therefore, some of the information overlaps with that of the earlier study. It was estimated that in Hokkaido the change from the use of liquid semen to frozen semen occurred in 1966; the present data was collected before and after this period. The following effects of the use of frozen semen on the bulls and on AI methods were considered.

1) Fertilization ability of frozen semen may be maintained indefinitely, as opposed to liquid semen. According to the ability or health condition of the bulls, the collection of semen could be carried out at any time, regardless of the demand for semen from the users, and the ejaculate could be stored under frozen conditions. Therefore, when a sufficient amount of frozen semen is prepared, it is no longer a necessity to keep old bulls for further collections.

2) Long-term fertilization ability of frozen semen tends to decrease the number of bulls which need to be kept at centers, thus leading to the reorganization of some artificial breeding organizations.

3) Both the decrease of bulls and the increase of services per bull tend to induce inbreeding, or parent-offspring insemination; therefore, some bulls must be restricted from use.

4) Use of frozen semen tends to encourage the use of the progeny test. When immediate test results are needed, bulls are brought to AI service at a younger age.

5) On the other hand, there is a tendency for AI centers to import bulls proven

by the progeny-test or by actual data, thus the age of bulls at entry may be older.

6) Depending on the use of frozen semen, bulls having low freezability of semen are not qualified as sires.

Using these findings, the survey results will be discussed. The term of survey was divided into two periods: The former period was from 1958 to 1965 and the latter was from 1966 to 1979. The data in the former period is reported in the preceding papers.<sup>1-3)</sup>

Disposal: One-thirds ( $102/312=0.3269$ ) of the discharged bulls were slaughtered because of impotentia coeundi; most were affected by locomotive disturbances, especially of the hind legs or hoofs. For the collection of semen at a rate of two jumps per day, two days a week, bulls must mount more than 200 times a year, and at every jump the joint region and hoofs are weighted down by almost 1000 kg, which may account for the high number of hind leg disturbances in AI bulls. Although many of the AI bulls were slaughtered due to impotentia coeundi, which is an accepted reason for disposal; however, it is possible that impotentia coeundi was used to cover other reasons. As less than 10% of the bulls had testicular degeneration, it appeared that AI bulls used as sires were selected from among excellent class bulls and were maintained in good condition. Thus there was a higher possibility that these bulls could recover from the disease. There were only four cases of seminal vesiculitis reported during the 22 years. It is possible that some of the bulls were slaughtered for other reasons without exact diagnosis, as this disease may not manifest any abnormality and may be easily overlooked. As for organic diseases, with the exception of chronic digestive diseases, some of the bulls suffered from cardiac disease, which may have been induced by insufficient exercise, a highly nutritious diet, etc. A more natural environment may prevent such problems in AI bulls. As for undesirable factors, the problem of low grade type or milk performance of offspring was mentioned. This phenomenon shows the high judging ability of bulls by dairy men or inseminators.

Service: The age range at entry of 312 discharged bulls was from 10 to 152 months, and 64 of the bulls ( $=312-248$ ) had entered after 24 months of age. Of these 64 bulls, 37 were homebred and 27 were foreign-born. Most of the homebred bulls had been used for natural service before entry or had been kept at other centers before the start of the survey period (1958). Moreover, 37 of the 64 bulls entered AI service after 1966; 14 of these were homebred and 23 were foreign-born. Most of the foreign-born bulls were imported after their reproductive ability had been clarified. Next, two groups of bulls, 198 from the former period, and 176 from the latter period, which had entered AI service before 24 months of age, were compared statistically. The cumulative totals of bulls entered at each month of age are shown in table 4. Contrary to expectations, the number of older bulls of the latter period increased considerably. Moreover, although more than one half of the former period bulls ( $103/198=$

TABLE 4 *Comparison of age at entry*

MONTH	FORMER PERIOD (1958-1965)		LATTER PERIOD (1966-1979)	
	Cumulative	Percentage	Cumulative	Percentage
10	1	0.5	1	0.6
11	4	2.0	4	2.3
12	11	5.6	7	4.0
13	29	14.6	21	11.9
14*	61	30.8	38	21.6
15*	103	52.0	69	39.2
16**	143	72.2	88	50.0
17**	167	84.3	115	65.3
18**	181	91.4	132	75.0
19**	187	94.4	143	81.3
20**	192	97.0	150	85.2
21**	194	98.0	162	92.0
22	196	99.0	169	96.0
23	198	100.0	176	100.0

NB \* Significant level 0.05

\*\* Significant level 0.01

0.520) entered AI service at 15 months of age, one half of the latter period bulls entered one month later ( $88/176 = 0.50$ ). The  $\chi^2$  test was used to compare the number of bulls of the same age before and after entry for AI service. The test revealed that at 14-21 months of age the number of latter period bulls after entry was significantly less than the number of former period bulls. The time difference between collection and insemination by liquid semen may be less than one week. However, when frozen semen is used, tests of its livability after storage, preparations for its distribution, etc. necessarily prolong the time between collection and distribution. This difference is especially great when the semen of excellent bulls is used, as large amounts are desired for storage. In these circumstances, it is possible that the date of distribution was reported as the date of collection by the AI centers.

Survival: The number of bulls of each age at disposal is shown in table 3 and in figure 2. The shortest use for AI service was 137 days, but this bull was used in natural service before entry. The longest use was 15 years and 4 months, and the bull entered at 19 months of age and died at 16 years and 10 months old. This bull was used very effectively as a liquid semen bull. The future life expectancy of bulls used for their full lifetime in AI service is shown in table 5. For example, in the former period, a three-year-old bull was expected to survive up to 7 years and 9.5

TABLE 5 *Life expectancy of bulls used for their full lifetime*

YEAR	FORMER PERIOD (1958-1965)		BOTH PERIOD (1958-1979)			
		year	month	year	month	
1	87	7	5.9	312	8	1.4
2	86	7	6.5	312	8	1.4
3	81	7	9.5	306	8	2.8
4	76	8	0.1	294	8	5.2
5	59	8	9.0	274	8	8.5
6	45	9	5.9	243	9	1.4
7	28	10	8.5	193	9	9.5
8	23	11	2.4	145	10	6.5
9	16	11	11.2	104	11	4.1
10	11	12	6.3	77	11	11.4
11	7	13	4.0	52	12	7.8
12	3	14	6.0	37	13	2.2
13	1	16	10.0	17	14	0.2
14	1	16	10.0	6	15	5.6
15	1	16	10.0	3	16	4.8
16	1	16	10.0	2	16	9.4

months, that is, he could have been used in AI service for another 4 years and 9.5 months ( $=7.95-3.0$ ). Future studies are needed to determine the reliability of these estimations in actual cases.

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