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Longevity of use and reasons for beef cattle culling in Poland

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Summary

The analysis concerned the longevity and production period of beef cattle of seven breeds born in 1990-2011, as well as the reasons for culling the animals. We observed a distinct tendency for a decrease in the average production period in beef cattle herds. It has been estimated that the longevity of beef cattle is influenced highly significantly by the sex, breed, birth year, and birth season. Most animals were culled between the 6th and 12th month of age.

Keywords: production period, culling reasons, beef cattle

One of the main problems faced by cattle breeders in Poland is an extremely short production period. Longevity is affected by both milking traits and functional traits that are mostly connected with reproduction and breeding, i.e. fertility, calving ability, and viability of calves. Health status and disease resistance are also important, as is proper leg and feet conformation. The selection for those functional traits is comparatively difficult and slow because of their low heritability (4, 15).

In both dairy and beef cattle husbandry, efforts have been made to extend the production period to at least 6 years, which means that the cow's lifespan would have to be about 9 years (6). The existing research results prove that there is a tendency for the cattle lifespan to decrease. In the 1990s the natural maximum lifespan for cows was 20 years. At present the average longevity of dairy cattle in Poland is 4.5-6.6 years (11). For beef cattle the natural maximum longevity is even harder to estimate, as they are slaughtered at a comparatively young age.

Longevity is directly influenced by culling, that is, removing individuals of reduced productive or breeding value from the herd. If the breeder has to cull too many animals, the breeding progress is hampered, which is undesirable for both breeding and economic reasons. Analyses of longevity, production period, and culling are therefore important for population improvement.

The aim of the present research was to analyze the production period and culling reasons in selected beef cattle herds in Poland.

Material and methods

Material for the study was derived from the BOS computer program (with the consent of the Polish Association of Beef Cattle Breeders and Producers), which holds the records of all animals under evaluation. The research was conducted on 80 605 individuals of the most common beef cattle breeds: Limousine, Charolaise, Hereford, Beef Simmental, Salers, Black Angus, and Red Angus. The animals came from 16 countries and were born in 1990-2011. The date of their removal from the herd was known. On that basis the number of days of use was calculated for each individual, and then the classes of the longevity of use were determined – Tab. 1.

Two calving seasons were distinguished: the summer season (March-August) and the winter season (September-February). The animals were divided into two genetic groups: purebred individuals (with a minimum of 93.75% of the breed genes) and the other animals. The database also contained information on culling reasons. The codes of culling reasons are given in Table 2.

We used an SAS statistical package (2010) with means, GLM, and REG procedures for the analysis of differences among breeds with respect to the animals' age and culling reasons.

$$Y_{ijkmn} = \mu + S_i + R_j + P_k + HYS_m + e_{ijkmn}$$

Y_{ijkmn} – observed trait vector (lifespan in days)
μ – general mean
S_i – fixed effect of i sex
R_j – fixed effect of *j* breed
P_k – fixed effect of *n* culling reason
HYS_m – fixed effect of *m* herd-year-season class
e_{ijkmn} – vector of random error effect.

Tab. 1. Codes for the longevity of cattle use with respect to class interval and the number of days for each class

Class code	Age	Number of days	Class code	Age	Number of days
1	< 3 months	1-90	12	5-6 years	1825-2190
2	3-6 months	90-180	13	6-7 years	2190-2555
3	6-9 months	180-270	14	7-8 years	2555-2920
4	9-12 months	270-365	15	8-9 years	2920-3285
5	12-15 months	365-455	16	9-10 years	3285-3650
6	15-18 months	455-545	17	10-11 years	3650-4015
7	18-21 months	545-635	18	11-12 years	4015-4380
8	21-24 months	635-730	19	12-13 years	4380-4745
9	2-3 years	730-1095	20	13-14 years	4745-5110
10	3-4 years	1095-1460	21	14-15 years	5110-5475
11	4-5 years	1460-1825	22	> 15 years	> 5475

Tab. 2. Codes for the culling class and culling reason

Class code	Culling reason
1	withdrawal from evaluation
2	sale
3	herd shutdown
4	old age
5	change of owner
6	change of owner without evaluation
7	unknown
8	death

Results and discussion

Most (63%) of the analyzed animals were females. The average longevity of use for the population was 1545 days (4.23 years), with cows being kept, on average, for 2052 days (5.62 years), that is, 3.7 years longer than bulls, which were kept for 701 days (1.9 years).

Table 3 shows the representatives of the seven most common breeds and their mean longevity of use in the herd.

The highest mean for the longevity of use was over 6 years, and it was found in the Salers and Hereford breeds – 2238 days and 2214 days, respectively. A slightly lower mean was obtained for the Red Angus (5.2 years), the Beef Simmental (5 years), the Black Angus (4.8 years), and the Charolaise (4.7 years) breeds. The lowest mean for the longevity of use was estimated for the Limousine breed (3.7 years).

The analysis of the genetic groups showed that purebred animals were the majority (59%) in the examined population. That tendency prevailed in all of the breeds. Purebreds were kept in herds longer than cross-breds, except for the Limousine breed. The longest longevity of use was estimated for Hereford and Salers purebreds (6.6 years and 6.5 years, respectively), and the shortest for the Limousine breed (3.5 years) – Fig. 1.

We also found a decreasing tendency in the mean longevity of use with respect to the birth year (Fig. 2).

Moreover, we found that the cattle born in the winter season were used, on average, for 180 days longer than the cattle born in summer, and that the difference was statistically highly significant. This was proved by a similar analysis of longevity with respect to the birth season and sex of the animals (Tab. 4).

The animals born in summer were kept in the herd, on average, 6 months shorter than those born in winter. Cows born in winter were used, on average, 153 days longer than cows born in summer. Similarly, the mean lifespan of males born in winter was by over 175 days longer than that of males born in summer.

The analysis of culling reasons (as stated in the regulations for beef cattle evaluation) shows that the

Tab. 3. The mean longevity of use for the most common beef breeds

Breed	Number of records	Min.	Max.	Mean	Standard deviation
Black Angus	1384	1	6931	1769.50^{bC}	1738.03
Red Angus	1055	1	6388	1907.00^{cd}	1517.70
Charolaise	10696	1	6513	1721.37^{dC}	1466.66
Hereford	8347	1	7164	2214.18^{a}	1704.47
Limousine	54958	1	6944	1367.77^{eC}	1374.85
Salers	1168	2	6440	2237.88^{a}	1536.44
Beef Simmental	2997	3	6324	1812.53^{cDB}	1535.27

Explanations: small letters indicate a statistically significant (0.05) difference, and capital letters indicate a statistically highly significant difference (0.01)

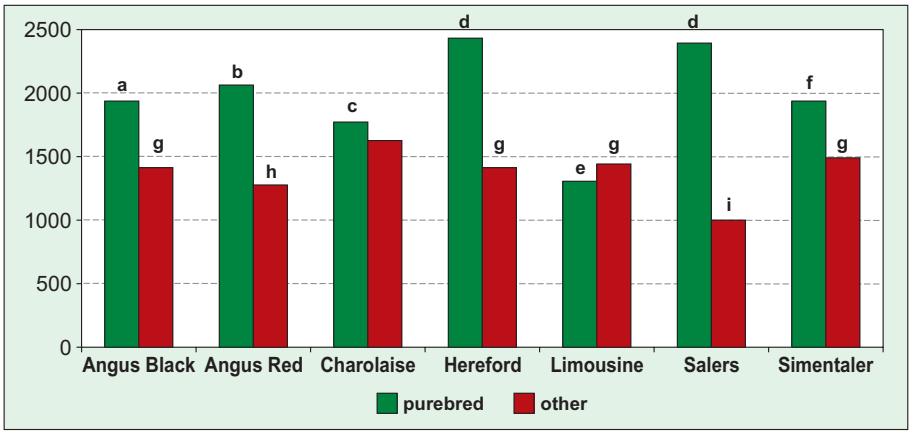

Fig. 1. The mean longevity (in days) depending on the genetic group
Explanation: small letters indicate a statistically significant (0.05) difference, and capital letters indicate a statistically highly significant difference (0.01)

Tab. 4. The longevity of use with respect to the sex and season of birth*

Number of records	Total			Females			Males		
Season of birth	N	Mean	Max	N	Mean	Max	N	Mean	Max
Summer	51 011	1482.45^{A}	7164	31 878	1991.63^{A}	7164	19 133	634.08^{A}	5873
Winter	29 594	1662.64^{B}	6944	18 927	2145.48^{B}	6944	10 667	809.18^{B}	5933

Explanations: * the minimum of days of life in each group = 1; small letters indicate a statistically significant (0.05) difference, and capital letters indicate a statistically highly significant difference (0.01)

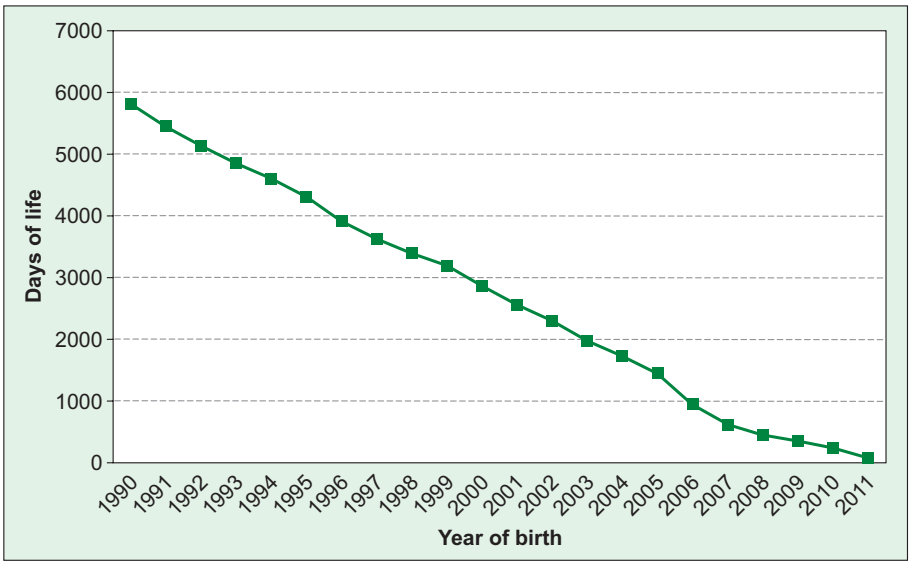

Fig. 2. The mean longevity of use for beef cattle breeds with respect to the birth year

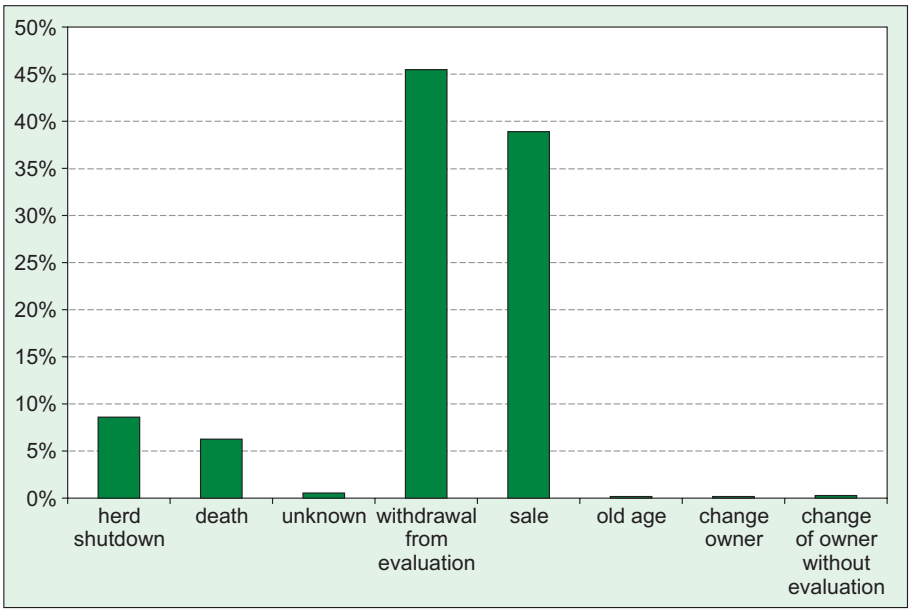

Fig. 3. The percentage of culling reasons for beef cattle breeds undergoing evaluation

major culling reasons are withdrawal from evaluation and sale (Fig. 3). This does not mean, however, that a given animal is slaughtered. After "withdrawal from evaluation" an animal may be kept on without undergoing evaluation. Likewise, after sale, an animal may, or may not undergo the further evaluation. The mean ages of individuals culled because of withdrawal from evaluation, herd shutdown, and the change of the owner without evaluation, did not differ significantly, the differences in the ages of animals culled for other reasons were statistically highly significant.

The proportion of animals culled because of old age, change of the owner, or change of the owner without evaluation was marginal compared with the whole database. For the individuals culled for "unknown" reasons we could not determine the culling reason. The animals' longevity of use depending on the culling reason is presented for the population and for each sex in Table 5.

In the analyzed population the longest lifespan of statistical significance was that of the animals culled because of old age (almost 9 years), whereas the shortest lifespan was noted for cattle whose removal from the herd was due to death (2.7 years).

With respect to the sex of the animals, it was observed that females culled because of old age had the longest mean lifespan (over 11 years), and those whose removal was due to death lived the shortest (3.9 years). In the case of males, the longest mean lifespan was noted for bulls withdrawn from evaluation (slightly above 3 years). The culling reason for males with the shortest mean lifespan was „death," just as for the females, and the average age of such males was 131 days. The major reasons for removing both females and males from the herd were withdrawal from evaluation and sale.

There was a statistically significant difference among the breeds with respect to the age at which the animals were sold. The Salers cattle were the oldest to be classified for sale. This breed is considered to be a late-maturing one. The mean age of cattle for sale was 5.5 years. The Charolaise and Hereford cattle were sold, on average, at 4 years of age, whereas the Black Angus and Beef Simmental cattle at 3.3-3.5 years of age. The Limousine cattle, the most numerous in this study, were sold at the average age of 2.7 years. The Red Angus cattle, considered to be an early-maturing

Tab. 5. The longevity of use (in days) depending on the culling reason

Observation	Total			Females			Males		
Culling reason	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Herd shutdown	1	6658	1763.88^{ABCDE}	1	6658	2199.78	1	4853	694.57
Death	1	6421	1003.62^{BCDE}	1	6421	1423.26	1	2945	131.31
Unknown	1	5929	1796.68^{ABcDE}	3	5929	2176.46	1	2801	532.09
Withdrawal from evaluation	1	6820	1942.60 ^{aCbDE}	1	6820	2245.49	1	5933	1213.02
Sale	1	7164	1131.41^{BCDE}	1	7164	1825.25	1	4844	402.27
Old age	194	5489	3256.30^{DAB}	1491	5489	4043.13	194	2581	895.8
Change of owner	67	4912	1758.58^{ABCDE}	67	4912	1805.82	879	1020	971.33
Change of owner without evaluation	108	3626	2007.83^{EBD}	108	3626	2014.75	1419	1419	1419

Explanation: small letters indicate a statistically significant (0.05) difference, and capital letters indicate a statistically highly significant difference (0.01)

breed, were sold at the average age of 2.5 years. Over the last two decades the average age of animals for sale has changed. In the 1990s mostly mature and old cattle were sold (9-17 years). There has been a gradual decrease in the age of animals for sale: ten years ago it was about 6 years, and nowadays the average age of sold cattle does not exceed 1 year. Our analysis shows that the most animals were sold at 6-9 months of age (5327 individuals) and at 9-12 months of age (5827 individuals).

There has also been a change in the age of animals culled because of death. In the early 1990s the mean age at death was 13-16 years, and at the beginning of the 21st century it was 5-8 years. In the last five years the average age at death has not exceeded 300 days. With respect to the mean age at death for the examined breeds, the Limousine and Black Angus cattle died the soonest, at the average age of 860 days (2.3 years), and deaths accounted for 7% of all cullings in the Limousine and Black Angus groups. The Red Angus animals were culled due to death at the age of 2.8 years (3.4% of the examined Red Angus population), the Charolaise at the age of 3.4 (5.2% of the examined Charolaise population), and the Salers at the age of 4 years (4.2% of the examined Salers population). The Hereford cattle died at the average age of 5 years (2.8% of the examined population). The last to die were the Beef Simmental animals, whose average age at death was over 6 years (4.5% of the examined Beef Simmental cattle were culled for this reason).

As regards the classes of longevity (Tab. 5), we found that up to 40% of animals died at the early stage of life, which might indicate a poor condition of newborn calves, dying soon after birth.

Over the last decade the average age of animals culled because of herd shutdown has also changed. In 2000 it was a culling reason for cattle at 8 years of age, and in 2010 for cattle at a maximum of 1 year of age. With respect to the breed, the Black Angus cattle herds were shut down the soonest, at the average age of a little over 2 years. For the Red Angus cattle this average was over twice as much. For the Limousine and Beef Simmental cattle, the mean age at the time of the herd shutdown was, on average, over 5 years. The oldest were the Salers and Hereford cattle: 5.6 and 6.3 years, respectively.

Tab. 6. Beef cattle longevity (in days) depending on the country of origin

Country	Total	Mean
Belgium	31	1928.31^{c}
Czech Republic	261	2526.09^{B}
Denmark	729	5007.29^{A}
France	1153	2361.78^{B}
Netherlands	1489	2823.79^{B}
Ireland	128	1700.49^{C}
Canada	64	4731.82^{A}
Luxemburg	57	1850.63^{C}
Germany	1534	1908.88^{C}
Poland	74483	1448.35^{C}
Slovakia	35	2014.94^{b}
Switzerland	92	3950.14^{a}
Sweden	283	4332.87^{A}
Hungary	28	2088.46^{b}
Great Britain	199	1799.17^{C}
USA	39	4662.56^{A}

Explanation: small letters indicate a statistically significant (0.05) difference, and capital letters indicate a statistically highly significant difference (0.01)

Another important criterion in the beef cattle longevity analysis was the country of origin (Table 6).

The beef cattle that lived the longest came from Denmark (13.7 years), Canada (13 years), and the USA (12.7 years). The lowest mean longevity was observed for beef cattle from Poland (4 years), Ireland (4.7 years) and Great Britain (4.9 years).

Culling can be classified as voluntary or involuntary. Involuntary culling occurs when animals with reduced reproductive abilities and those with contagious dis-

eases are eliminated from the herd. Culling is described as voluntary when it affects cows with poor milking abilities or giving birth to weak calves, or old cows, over 10 years of age, with reduced productive abilities. Irrespective of the breed or production system, we ought to observe the minimum elimination coefficient. It mainly depends on reproductive abilities, and in the case of beef cattle breeds it is 25% for the Charolaise and Blonde d'Aquitaine, 20% for the Limousine, and 15-18% for other breeds of French origin.

In Poland, owing to the fact that beef cattle production is not very popular, there has been little research on the longevity of beef cattle breeds.

The research on longevity done on foreign populations showed that the optimal longevity of use for beef cattle was 8-11 years (6). This is confirmed by research on herds kept in Florida (U.S.A.), in which production dropped slightly for 10-year-old cows and decreased sharply for cows older than 12 years (7).

Azzam et al. claim that the average age of culled cows is 5.4-9.9 years, depending on the herd (1).

A study conducted on 944 Angus cows born in 1980--2001 proved that they usually remained in the herd for 23-196 months (from slightly under 2 years to over 16 years), with the mean being 65 months (5.4 years) (13).

On the other hand, in the case of Hereford herds in Arizona and Angus herds in Wyoming, 1452 Hereford cows born in 1957-1971 had an average lifespan of 7.4 years, whereas 836 Angus cows born in 1959-1966 lived, on average, for 6.7 years (14).

In the case of the Chinina breed kept in Italy, the mean longevity was estimated at 1829 days (5 years), and for the Black Angus, Charolais, and Tarentaise breeds in the USA the mean productive longevity was 967 days (2.6 years) (3, 9).

The mean age of 498 cows in a herd composed of the Hereford, Angus, Brahman, Jersey, and Holstein--Frisian breeds and their crosses, was estimated at 3470 days (i.e. 9.5 years) (10). For individual breeds the results were as follows: the average lifespan for the Jersey cattle was 6.2 years, for the Holstein-Frisian cattle 7.3 years, for the Brahman cattle 9.6 years, for the Hereford cattle 9.8 years, and for the Angus cattle 10.3 years. For crossbreds the highest average lifespan was obtained for the Angus-Brahman cross – 14.6 years, and for the Hereford-Brahman cross – 13.2 years. For the Brahman, Hereford, and Angus cattle the most common culling reason were reproductive disorders, which accounted, respectively, for 33%, 20%, and 17% of all cullings in these breeds. For the Angus cattle the digestive system diseases were almost equally important, accounting for about 16% of all animals culled. For the Brahmans and Herefords the corresponding figures were, respectively, 7% and 1.8%. Similarily, Saxton et al. (13) found in their research that about 90% of cows had been culled due to reproductive disorders.

Disorders of the locomotive system were the culling reason for 20% of the Angus cattle, 3.3% of the Brahman cattle, and 13% of the Hereford cattle. For 17% of the Angus cattle, 10% of the Brahman cattle, and 9% of the Hereford cattle the culling reason was unknown. In the whole analyzed population, about 5% were culled for unknown reasons, but among calves under 1 year of age unknown reasons were responsible for as many as 95% of all cullings. Digestive system disorders were the culling reason for 7% of cows, but the animals culled for this reason were 9 years old or older. Finally, 3% of cows were culled because of reproductive disorders (10).

The culling reasons for beef bulls have also been analyzed. The analyzed population comprised over 7000 bulls born in 1983-1995, with Charolaise, Hereford, Angus, Beef Simentaler and Limousine bulls constituting 62%, 22%, 6%, 5%, and 5% of the population, respectively. The average age at culling was 5.2 years. The following culling reasons were found: locomotive system disorders and diseases (41.2% of bulls), reproductive system disorders (22.1%), diseases of the respiratory and digestive systems and telasiosis (18.8%), old age (12%), aggression (2.1% of bulls), and injuries (1.5%) (2).

For bulls kept at insemination stations in the Wielkopolska region in Poland the average age at culling was 5 years and 8 months. The main culling reasons were selection for breeding value (30.9% of bulls), leg disorders (16.5%), reduced fertility (12.9%), infertility (9.3%), positive tuberculin test (7.8%), aggression (4.7%), old age (2.1%), and other disorders (15.8%) (5).

In recent years a number of authors have referred to the following reasons for beef cattle culling as the most important: dental erosion, lameness, udder infections, eye cancer, Johne's disease (a digestive tract disease), vaginal prolapse, and aggression.

As the above-mentioned research papers demonstrate, beef cattle are removed from the herd for a number of reasons. There are eight culling reasons recorded in Polish breeding documentation. In order to furnish more details, it might be advisable to describe these reasons more specifically (just as it is done for dairy cattle) and to provide information on slaughter. The more specific culling reasons might be, for example, disorders and diseases of the reproductive system (sterility, miscarriage, difficult calving, ovary or testis disorders), contagious diseases (IBR/IPV, calf diarrhoea, blue tongue disease), accidents, locomotive system disorders, injuries, etc.

Conclusions

On the basis of our results, the following conclusions can be drawn:

1. The longevity of beef cattle is highly significantly influenced by their sex and breed, as well as by their year and season of birth.

2. The average lifespan of beef cattle is only 4.25 years, and cows usually live 3.7 years longer than bulls.

3. For cattle beef in Poland the culling age tends to decrease, especially for animals born in recent years.

4. There are almost twice as many animals born in summer as those born in winter. However, summer-born cattle live, on average, 6-7 months shorter.

5. The majority of culled cattle were 6-12 months old. The percentage of cows culled because of old age is low.

6. Death was the culling reason for 7% of cattle, of which 40% were calves aged 1-3 months.

7. In order to improve the quality of analysis, it would be advisable to provide more specific culling reasons in the breeding documentation.

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