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Postnatal Development of European Bison and Domestic Cattle Hybrids of Backcrosses B_2 and B_3

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Krasińska M., 1979: Postnatal development of European bison and domestic cattle hybrids of backcrosses B_2 and B_3. Acta theriol., 24, 16: 211—220 [With 4 Figs. & 3 Tables].

A description is given in this paper of the development of European bison and cattle hybrids, backcrossed with cattle generations B_2 and B_3 from time of birth up to the 24th month of life, on the basis of 10 measurements and 8 structural indices. The results were compared with data on the development of parent forms. The similarity to cattle of structural characteristics and rate of development increases with increasing percentage of cattle blood. The phenomenon of heterosis was not observed in either of the two generations of hybrids examined. Hybrids of backcross generations do not hold out the same promise of economic advantages as were obtained with the F_1 generation.

[Mammals Res. Inst., Polish Acad. Sci., 17-230 Białowieża, Poland].

1. INTRODUCTION

During the period from 1958—1976 cross-breeding was carried out between European bison and two breeds of cattle — the black and white lowland (*bw*) and Polish red cattle. As no fertile male hybrids were obtained, all the cow hybrids were mated with bulls of the *bw* breed. A total of 71 hybrids with different percentages of the parent forms during this time were obtained (Krasińska, 1976).

During the experiments inheritance of parent characteristics was observed in the hybrids, chiefly in respect of morphological analysis of body structure, rate of individual development, inheritance of certain physiological properties and fertility in hybrids with different percentages of the initial forms. An attempt was also made at examining these questions in all generations of hybrids.

The postnatal development of the last backcross hybrids obtained at Białowieża, *i.e.*, B_2 and B_3, is described in this paper. The data obtained were compared with the development of the initial forms — B_1 hybrids, which were examined in previous years (Krasińska, 1971) and *bw* cattle (Skolasiński, 1964; Skolasiński *et al.*, 1966).

2. MATERIAL AND METHODS

The animals studied were 17 (6, 11) B_2 generation hybrids ($^1/_8$ European bison and $^7/_8$ cattle) obtained by matings of B_1 females with a *bw* bull during the period from 1967—1975, observing their development for the first 24 months of life. In the case of data at birth there were 24 (10, 14) hybrids of this generation available.

In the group of B_3 generation hybrids ($^1/_{16}$ European bison and $^{15}/_{16}$ cattle) it was only possible to observe development during the first 24 months of life in two cases (1, 1), but data were available for the first year of life for 5 (1, 4) hybrids, and for data at birth for 6 (1, 5) animals.

The development of hybrids was examined on the basis of changes with increasing age in body weight and of linear body measurements and analysis of structural indexes. The principles adhered to were the same as for generation F_1 and B_1 hybrids (Krasińska, 1969, 1971).

3. COMPARISON OF HYBRIDS DEVELOPMENT WITH THAT OF PARENTAL FORMS

3.1. Body Weight at Birth

No differences were observed to occur in average body weight at birth in B_2 hybrids of either sex. In comparison with cattle they are distinctly lighter in weight, bull calves on an average 42.2%, and heifer calves 23.6% lighter, but are similar in weight to B_1 hybrids (Table 1, Fig. 1).

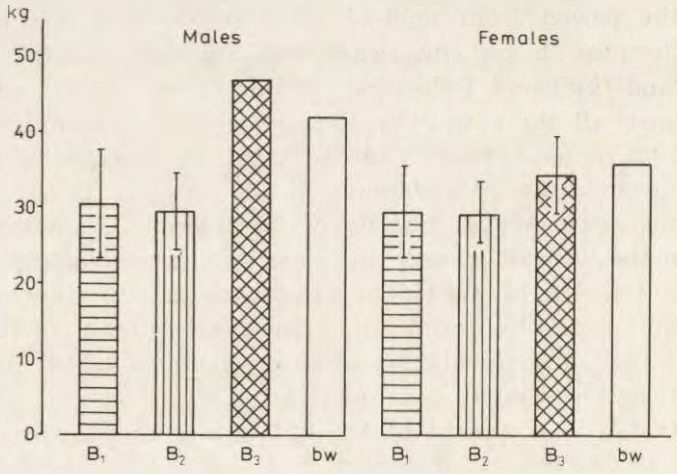

Fig. 1. Comparison of average body weights at birth of backcross hybrids and cattle.

B_1 after Krasińska, 1971b, *bw* — black and white cattle after Skolasiński, 1964) (males) and Skolasiński *et al.*, 1966 (females).

Table 1

Comparison of body weights of backcross hybrids.

Age months	Body weights in kg				Percentage increase of body weight				Age months	Average daily gains			
	1	2	3	4	1	2	3	4		1	2	3	4
0	29.6	47.0	29.2	34.4	100.0	100.0	100.0	100.0	0—3	1.02	1.14	0.83	0.81
3	121.9	150.0	104.7	107.8	383.3	319.1	367.0	316.2	4—6	0.67	1.77	0.49	0.79
6	179.3	309.0	147.7	178.8	628.5	657.4	522.7	536.8	7—9	0.77	0.45	0.67	0.70
9	249.3	350.0	195.0	242.2	880.8	744.7	699.2	731.8	10—12	0.55	0.78	0.44	0.49
12	299.3	420.0	235.0	289.0	1058.2	893.6	845.1	859.7	13—15	0.60	0.55	0.31	0.57
15	355.3	470.0	262.7	322.5	1260.3	1000.0	941.4	1032.0	16—18	0.63	0.50	0.43	0.67
18	400.0	515.0	301.7	390.0	1489.0	1095.7	1077.5	1500.0	19—24	0.67	0.42	0.44	0.40
24	521.0	590.0	365.0	426.0	1935.6	1255.3	1277.4	1638.0					

Numbering of colums: 1 and 3 males and females B_2, respectively; 2 and 4 males and females B_3, respectively.

The situation is different in the group of B_3 generation hybrids in which weight at birth is similar to that of cattle, but is markedly higher than the second initial form — B_2 hybrids. These differences are not, however, statistically significant ($P>0.05$).

3.2. Body Weight during Postnatal Development

During the hybrids' development differences connected with sex were observed to increase in relation to body weight. While B_2 hybrids of

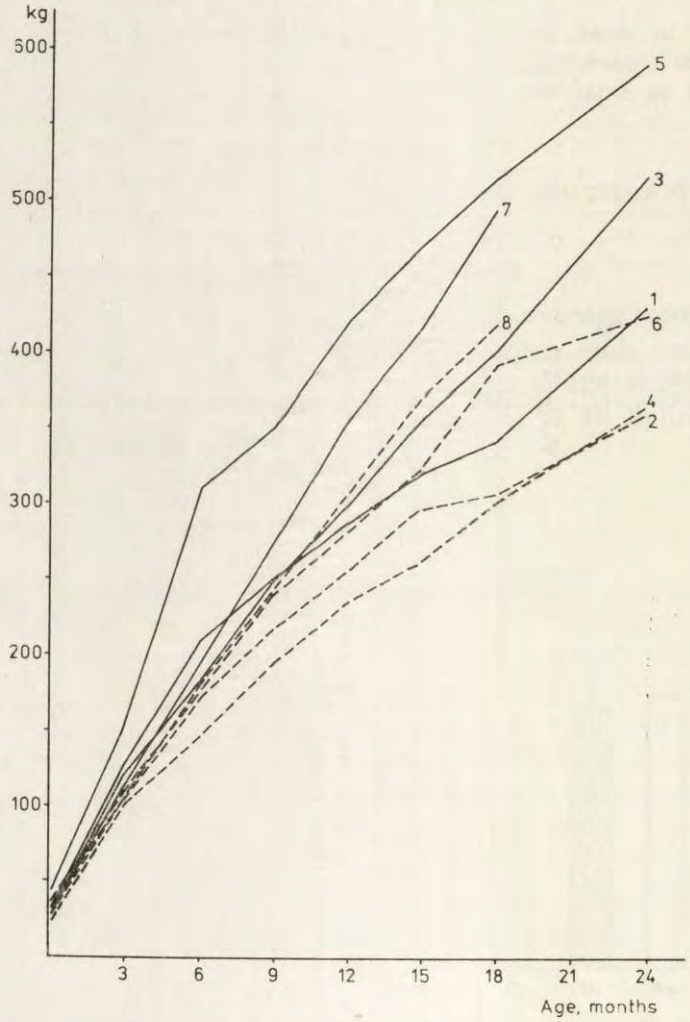

Fig. 2. Age variability of the body weights of backcross hybrids and cattle.
1, 2 — males and females B_1 after Krasińska, 1971b; 3, 4 — males and females B_2; 5, 6 — male and females B_3; 7 — males of black and white cattle after Skolasiński, 1964; 8 — females of black and white cattle after Skolasiński *et al.*, 1966.

The rate of increase in body weight with age in the animals compared is relatively balanced, and does not exhibit, especially in the case of females, any great differences. Body weight increased most intensively throughout the whole study period in B_2 males and during the period from the 15th — 24th month of life in B_3 females (Fig. 4). During the first year of life relative body weight increases more intensively in male hybrids of all generations than in females.

The lack of homogeneity in material obtained from different months of the year made it impossible to analyze the data obtained from the aspect of possible seasonal variations.

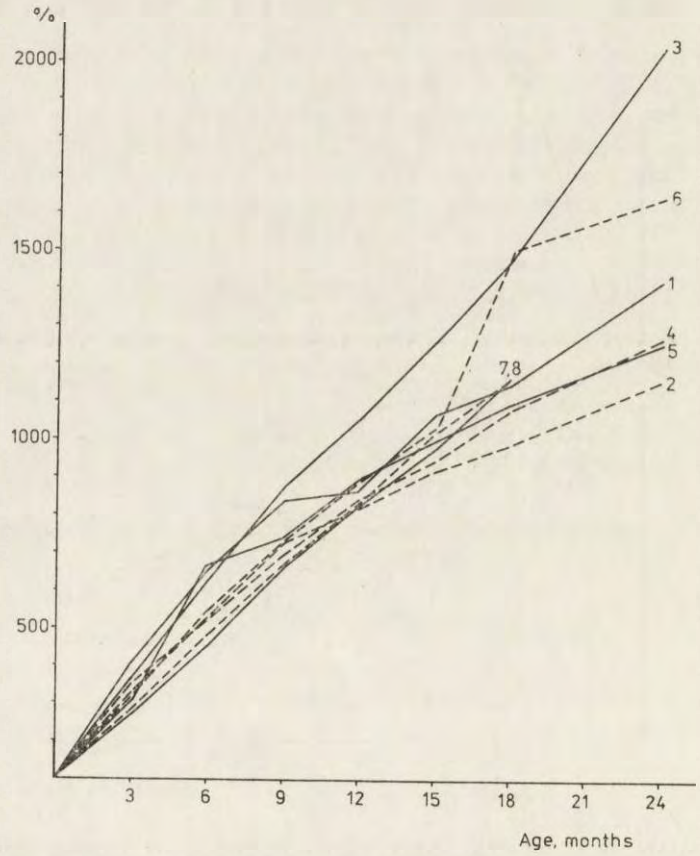

Fig. 4. Increase of the body weights of backcross hybrids and cattle. For explanations see Fig.2.

3.3. Body Dimensions

B_2 generation hybrids of both sexes and B_3 heifers are smaller at birth than domestic calves, B_2 hybrids differing in respect of structural

proportions at birth from domestic calves, being shorter in relation to height, with a deeper chest and narrower hindquarters. They are thus more similar in respect of type of build to the second parent form — B_1 hybrids (Table 2, 3). B_3 generation hybrids, on the other hand, at birth have a greater number of structural characteristics similar to cattle (Table 2, 3).

Table 2

Comparison of body measurements of backcross hybrids.
Numbering columns as in Table 1.

Age, month	1	2	3	4	1	2	3	4
	Withers height				Sacral region height			
0	70.6	82.0	69.7	69.2	72.9	85.0	72.0	71.4
6	100.7	112.0	95.4	103.2	102.7	114.0	98.5	106.0
12	121.0	127.0	114.6	122.2	122.8	131.0	115.9	128.2
18	127.4	131.0	114.6	128.0	129.0	133.0	126.1	131.0
24	135.8	135.0	129.9	128.0	136.2	138.0	131.9	132.0
	Body length				Hearth girth			
0	59.8	75.0	58.4	64.4	74.9	87.0	75.0	76.6
6	109.3	135.0	107.6	109.7	149.8	160.0	133.3	138.7
12	129.8	142.0	124.5	133.7	165.3	170.0	161.6	165.7
18	140.4	147.0	138.9	142.0	187.0	188.0	173.7	172.0
24	155.8	150.0	152.0	158.0	201.2	194.0	184.6	181.0
	Thorax breadth				Thorax depth			
0	17.8	22.0	17.2	18.0	27.7	35.0	26.5	27.4
6	30.2	35.0	26.8	28.7	50.5	55.0	46.5	47.2
12	40.2	41.0	35.8	33.7	59.1	65.0	56.8	57.7
18	43.0	46.0	38.5	38.0	70.4	67.0	62.6	64.0
24	47.0	50.0	41.2	46.0	75.8	69.0	68.1	64.0
	Pelvis length				Hip bone breadth			
0	20.7	25.0	19.9	20.4	16.1	21.0	14.9	14.8
6	35.5	42.0	34.9	35.2	28.0	39.0	29.8	31.0
12	44.5	48.0	39.9	42.7	38.5	45.0	36.0	41.7
18	46.6	51.0	45.4	46.0	44.8	49.0	41.3	47.0
24	54.4	55.0	48.8	49.0	49.0	54.0	45.9	49.0
	Fore cannon girth				Pelvis breadth			
0	10.2	14.0	9.9	10.6	18.2	20.0	16.9	17.2
6	16.7	19.0	15.3	15.2	30.7	41.0	30.5	32.5
12	19.3	20.0	17.8	18.0	39.3	45.0	36.3	41.2
18	20.6	22.0	18.8	20.0	43.2	47.0	39.1	45.0
24	21.8	23.0	19.9	20.0	47.8	50.0	43.4	47.0

Since the length of the trunk during the development period in both hybrids of all generations, and also in domestic calves, increases more rapidly than increase in its height, at the age of 6 months the proportions of the trunk in all the animals begin to be the reverse of those

at birth, *i.e.*, the shape of the body gradually becomes similar to a horizontal rectangle (Table 2, 3).

Yearling B_2 generation hybrids, like B_1 hybrids, have more massive bones than *bw* cattle, are less developed in the hindquarters, have a deeper but simultaneously narrower thorax and narrow hindquarters (Table 2, 3).

Tabela 3

Comparison of indices of the body structure of backcross hybrids. Numbering of column as in Table 1.

Age, months	1	2	3	4	1	2	3	4
	Withers height×100/body lenght				Herth girth×100/body lenght			
0	117.1	109.3	114.8	107.8	126.3	116.0	120.7	119.6
6	92.3	83.0	91.3	94.1	137.3	118.5	124.7	126.4
12	93.2	89.4	95.4	91.7	127.3	119.7	129.9	124.5
18	91.4	89.1	94.1	90.1	133.1	127.9	125.2	121.1
24	87.5	90.0	91.3	81.0	129.5	129.3	121.9	120.2
	Heart girth×100/withers height				Fore cannon girth×100/withers height			
0	106.3	106.1	107.9	111.2	14.5	17.1	14.2	15.5
6	149.1	142.8	124.7	134.2	16.6	17.0	15.0	14.8
12	136.6	133.8	140.3	134.7	16.0	17.3	15.6	14.7
18	146.6	143.5	138.8	134.4	16.2	16.8	15.1	14.8
24	148.1	144.4	141.3	141.4	16.1	17.0	15.3	15.6
	Sacral region height×100/withers height				Wither height — thorax depth×100/withers height			
0	103.3	103.6	103.2	103.2	60.6	57.3	61.5	62.1
6	102.0	101.8	102.4	102.5	49.7	50.9	47.7	54.1
12	101.5	103.1	101.6	102.4	48.3	48.8	50.5	57.3
18	101.2	101.5	101.1	102.3	44.7	48.8	49.4	50.0
24	100.1	102.2	101.1	103.1	42.7	48.9	47.6	48.4
	Thorax depth×100/withers height				Thorax breadth×100/thorax depth			
0	39.4	42.7	39.3	39.6	64.3	62.9	58.5	66.4
6	50.2	49.1	48.7	45.9	59.9	63.6	63.6	61.2
12	51.7	51.2	49.5	47.1	60.4	63.1	62.5	58.9
18	55.2	51.1	50.6	50.0	61.0	68.6	61.3	59.4
24	57.3	51.1	52.3	51.6	60.5	72.5	60.4	70.0

Yearling B_3 hybrids are larger than the average data for *bw* cattle of the same age (Table 3). The proportions of their body structure, considered from the aspect of analysis of structural indexes, point to the considerable similarity to cattle, differences being observed only in the proportions of the thorax. The depth of the thorax compared with height of the trunk is greater in B_3 hybrids than in cattle, while breadth of thorax in relation to its depth is smaller than in cattle (Table 3). It

is thus still possible to perceive the effect of bison blood in this structural characteristic, but the differences are already smaller than in the first hybrid generations.

In all the groups of animals examined, the distinct body proportions connected with sex form as age increases. Heifers are smaller, have a narrower and shallower thorax, smaller head and less well-formed horns.

The structural proportions of the hindquarters alter similarly with age in both hybrids and cattle. At birth pelvis breadth is greater than hip bone breadth, whereas the reverse proportions are found at the age of 18—24 month (Table 2).

4. DISCUSSION

It may be concluded from the data given that female hybrids of generations F_1 and B_1 with a high percentage of bison blood ($^1/_2$ and $^1/_4$ bison blood) produce calves with body weight similar to bison calves (avg. body wt. of European bison calf at birth 25.5 ± 6.5 kg Krasiński & Krasińska — unpubl. data), whereas in generation B_2, in which the percentage of cattle blood is distinctly greater ($^7/_8$ cattle blood), cows produce B_3 calves similar in weight to cattle. The effect of the mother on growth of calves during prenatal development is very distinct in these characteristics. Such maternal influence has also been observed in a large number of other mammals (Ellis *et al.*, 1955; Hammond *et al.*, 1958; Meyer, 1964).

The phenomenon of heterosis, which was only sporadically encountered even in generation B_1, was not found in either of the last two backcrosses of European bison and cattle hybrids.

The analysis made of the development of B_2 and B_3 hybrids on the basis of body weight and structural analysis permits of concluding that similarity to cattle of structural characteristics and rate of development increases with increase in the percentage of cattle blood in backcross generations. This is most distinctly evident in the case of our hybrids in the final generation of backcross hybrids ($^1/_{16}$ European bison blood).

The results of our studies show that backcross generation hybrids do not hold out prospects of such economic advantages as the F_1 generation. The decision to concentrate work on mass production of F_1 hybrids, weighing from 350—500 kg, in experiments to implement practical production of European bison and cattle hybrids at the State Farm at Łękno is therefore a correct one (Małecka & Sumiński, 1976; Małecka *et al.*, 1976).

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ROZWÓJ POSTNATALNY HYBRYDÓW ŻUBRA Z BYDŁEM DOMOWYM POKOLEŃ WSTECZNYCH B_2 i B_3

Streszczenie

W pracy prześledzono rozwój postnatalny dwóch ostatnich pokoleń wstecznych hybrydów żubra z bydłem domowym (B_2 i B_3) w oparciu o analizę zmian z wiekiem ciężaru ciała, pomiarów i wartości indeksów budowy (Tabele 1, 2, 3).

Średni ciężar ciała przy urodzeniu hybrydów B_3 jest wyraźnie niższy od bydła, a podobny do ciężaru hybrydów B_1. Natomiast hybrydy pokolenia B_2 mają przy urodzeniu średni ciężar podobny do bydła i wyraźnie wyższy od danych dla hybrydów B_2. Jednak różnice te nie są istotne statystycznie (Ryc. 1). Tempo przyrostu ciężaru ciała z wiekiem jest w porównywanych grupach wyrównane, szczególnie w przypadku samic. W pierwszym roku życia ciężar ciała samców hybrydów rośnie intensywniej niż samic (Ryc. 2, 3, 4). W proporcjach budowy hybrydów B_2 widać jeszcze więcej różnic w porównaniu do bydła niż w grupie hybrydów B_3 co powoduje, że ostatnie pokolenie wsteczne (B_3) jest eksterierowo najbardziej podobne do bydła.

W żadnym z omawianych tu pokoleń hybrydów nie zaobserwowano zjawiska heterozji. Wyniki badań pozwalają sądzić, że hybrydy pokoleń wstecznych nie rokują tak dużych korzyści gospodarczych jak ma to miejsce w przypadku pokolenia F_1.