PAPERS PRESENTED AT EAAP/PSAP SYMPOSIUM ON SMALL POPULATIONS OF DOMESTIC ANIMALS IN EUROPE

GENERAL
CATTLE
BISON
SHEEP/GOATS
EQUINES

POSSIBLE ROLE OF ANIMAL GENE RESOURCE IN PRODUCTION, NATURAL ENVIRONMENT CONSERVATION, HUMAN PLEASURE AND RECREATION

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1. INTRODUCTION

Genetic variation in animals has developed during millions of years. In the course of time the usefulness of different genes and gene combinations has been under severe tests, especially concerning adaptability to different conditions and resistance to diseases and parasites.

During the last ten thousand years man has partly influenced this evolution, and many breeds adapted to local needs and environments have been developed. The possibilities of making changes in the genetic make-up of farm animals and of concentrating on the utilization of the breeds considered to be the best, have increased in recent decades, thanks to the availability of modern reproduction, computer and communication techniques.

The increased rate of changes and parallelization of breeding goals have awakened concerns about losses of genetic variation both within and between breeds. Many breeds have disappeared or are threatened. A recent survey showed that 81, 51, 67 and 12 European breeds of cattle horses, sheep and goats, respectively, were considered endangered (Maijala et al., 1984).

Activities for preventing gene and breed losses have been started in different parts of the world (FAO, 1981), in order to maintain the possibility of adjusting animals to future, unpredictable needs. In many countries the emphasis is on conserving breeds, and hence it is topical to discuss whether this could be done economically, when the current competing ability of the breed is unsatisfactory and the population is small.

2. REASONS FOR CONSERVING SMALL POPULATIONS

Before discussing the possibilities and ways of maintaining small populations or so-called rare breeds it is important to make clear why they should be conserved. in Europe, the reasons for conserving genetic variation have been discussed among others by Maijala (1970), Mason (1974), Simon (1984) and Maijala et al. (1984). On the basis of these and other papers, the following list of arguments for conservation can be made:

A. Economic-biological reasons

1. The production conditions for farm animals are changing. This concerns especially feeding, since one has to find new economic feedstuffs, and to utilize various kinds of wastes from agriculture and industry. It may also become topical to return to extensive pastures in case the intensively cultivated areas will be needed for direct production of human food or energy crops. Changes in management of animals may also continue to change (e.g. mechanization, milking frequencies and methods, densities, etc.). Similarly, the housing conditions (regulation of temperature, moisture, light etc.) may change. Changes are possible also in the hygienic conditions of animals (new kinds of disease agents, new vaccines and medicines) and in climatic conditions (temperature, humidity, altitude).
2. The demands for products and services desired from animals may change for many reasons, e.g. with opinions and knowledge concerning wholesome food, with increased standard of living and leisure time or with new fashions in eating and clothing. Changes in international trade and trade blocs influence costs of materials and prices of products. The increased human population may increase the need of quantities, and it is important to combat hunger. The need of compensating exhausted natural reserves of fuels, minerals, etc., with renewable plant and animal materials may become more and more topical. The competition between animal species in production costs and services, as well as that between animals

and plants as food producers may affect the usefulness of various kinds of animals. The need of finding new ways of utilizing agricultural plant products in case of surplus problems may also increase.
3. Experiences of crossbreeding in utilizing heterosis and complementarity speak in favour of maintaining the possibility of systematic crossbreeding also in the future.
4. In order to satisfy the rapidly changing needs it is important to make rapid, one-sided progress in some populations without losing the possibility of starting again in another direction if needed.
5. There is an increasing need of being able to adjust the breeding work to the new biotechniques such as embryo transfer, splitting and sexing, or gene technology.
6. There may appear needs to overcome selection limits and antagonisms.

B. Scientific reasons

1. For the measurement of genetic progress and correlated responses control populations or frozen stocks are very useful.
2. Research in genetics, physiology, biochemistry, immunology, morphology, etc., benefits from maintenance of a large variety of animal materials.
3. Many different populations are valuable for research in evolution, ontogeny, behaviour, etc.
4. They are also useful as teaching material in animal sciences.

C. Cultural-historical reasons

1. Conserved breeds can be considered to be valuable memorials of nature and culture (living cultural heritage).
2. They can be used as research and teaching material in history and ethnography.
3. There are ethical-moral grounds to take care of the existence of different creations of nature.

In many points (e.g. A.1, 2, 4) it is a question of maintaining the possibility of changing breeding objectives according to unpredictable changes in needs. Even negative changes in the production conditions of ruminants are possible, if grains are needed directly for human consumption or for fuel. In Italy it has already been necessary to return to the original local breeds in utilization of dry mountain pastures (Rognoni, 1980).

The arguments A.3, B.1-4 and C.1-3 require conservation of entire breeds. Availability of distinct and different kinds of breeds or lines makes the utilization of conserved variation more rapid and effective in the case of need, both in pure- and crossbreeding. Gene combinations are conserved besides genes, and both the cultural-historical and emotional interest are satisfied, which is not the case in storing material in frozen form or as gene pools. On the other hand, both the initial and maintenance costs are high, and there are risks for diseases, accidents, genetic drift, inbreeding and contamination from other breeds. Because of the smallness of population, genetic improvement by selection is slow, and hence the gap in current breeds or selection lines increases (Maijala et al., 1984).

These disadvantages can be considerably lessened with the aid of simultaneous conservation of frozen semen and embryos, which also makes it possible to manage with rather small numbers of live animals (e.g. 20-300 females). These are needed for evaluation purposes as well as for cultural-historical reasons even if frozen semen and embryos were satisfactory for the conservation of the genetic variation itself. It is also very probable that the frozen material would be forgotten in store by our descendants, if no live animals could be seen and studied.

Additional arguments for maintaining many breeds as pure were given by Land (1981), who suggested a planned development of strains with divergent biological traits, since some old local breeds have proved themselves useful in many countries, because of their special traits for the modern market (e.g. lean carcasses, double-muscling, high fertility). Their maintenance would increase genetic flexibility and the rate of progress and ensure the availability of desired genetic variation at the time of need.

Bowman (1981) considered that "the conservation of a wide range of genetic variation coupled with the development of a capability to reproduce and multiply quickly and cheaply desirable types of animals, are far more important to the future of animal production than the development of over sophisticated forms of within-population selection".

3. COSTS AND PROFITS

An idea of the relative costs for maintaining purebred populations for the purpose of genetic conservation can be obtained from Table 1, based on the studies by Brem et al. (1984) and by Smith (1984).

In both calculations, maintenance of live animals as pure breeds was many times as expensive as frozen semen, even though the number of animals was assumed to be very low, allowing no selection in the population during storage and not even in the first years after starting its reuse. In the study by Brem et al. (1984) the conservation as frozen embryos was also considerably cheaper than as live animals, while there were very little differences in the study by Smith (1984). in the latter study, conservation of sheep breeds was not essentially cheaper than that of cattle breeds.

Availability of many-sided semen stores makes it possible to conserve a breed without big risks for genetic drift and inbreeding depression. Frozen embryos offer the additional advantage that the breed can be regenerated and used for crossbreeding within a generation, even if the number of live animals of the breed is zero or minimized to show only its type and colours to our descendants. In addition, frozen embryos conserve better than frozen semen gene combinations and frequencies. It is likely that the costs of preparing embryos for frozen stores will decrease, especially if it becomes possible to make embryos by taking ova from the ovaries of slaughtered females and by using in vitro culture and fertilization.

Table 1 ESTIMATED ANNUAL COSTS FOR CONSERVING CATTLE AND SHEEP BREEDS IN THREE DIFFERENT WAYS, WHEN STORAGE TIME IS 20 YEARS AND INVESTMENT COSTS AND INTERESTS ARE NOT CONSIDERED

Species	Author	Live animals		Frozen semen 1/		Frozen embryos 2/	
		Establ. +storage cost/yr.	Remarks	Establ. +storage cost/yr.	Remarks	Establ. +storage cost/yr.	Remarks
Cattle	B 3/	4 860 £5/	5m,25f	174 £5/	25mx20d	694 £5/	25f x 4e
Cattle	S 4/	5 000 £	10m,26f	600 £	25mx50d	4 250 £	25f x 25e
Sheep	S 4/	3 000 £	22m,60f	635 £	25mx30d	3 000 £	25f x 25e

1/ Requires at least 10 additional years to regenerate the breed.

2/ Requires about one generation (3 yrs in cattle) to regenerate the breed

3/ Brem et al., (1984)

4/ Smith (1984)

[5/] 1 £ = 3.6 DM

m = males, f = females, d = doses, e = embryos

The returns from breed maintenance are still more difficult to estimate than the costs, because of the difficulties in predicting the future. However, Smith (1984) tried to calculate the probabilities of future uses of stocks to justify conservation from the national viewpoint. He based his calculations on the following factors: (1) total value of market, (2) cost of conservation, (3) proportion of the stock used in future commercial production, (4) proportional gain in economic efficiency over current stocks, (5) number of years until commercial use, and (6) length of the utilization period. Table 2 shows the estimated probabilities for the market volume in the U.K.

The general conclusion of Smith (1984) from the probability-values was that even small gains in efficiency and low proportions of the genes from a conserved stock would bring profit for the nation. Thus, it would be worthwhile to maintain a stock, even if there is a very small chance that the stock would be useful in the future. The costs of conservation appear to be small relative to possible future gains in national production. The required probabilities were the lowest for frozen semen, while those for live purebred animals and for frozen embryos were 5 to 10 times higher. In small countries with a limited market the probabilities required are, of course, higher. It has to be stressed also that the profits can be harvested only on the national level, not by individual enterprises.

In his extended studies Smith (1985) calculated the reduction in uncertainty about the permanence of breeding objectives by selecting alternative stocks for different sets of objectives. The size of each line was 5 males and 150 females, of which 50 were selected per year. The national return/cost ratio (in U.K.) in one year of one year's genetic improvement was 1900 in dairy cattle, 940 in beef cattle, 500 for meat production traits in sheep, and 200 for sex-limited traits in sheep. Even if these values might not be entirely realized in practice, there appears to be sense in developing alternative selection stocks for reducing the uncertainty with regard to the future needs and breeding objectives. The longer the time horizon, the higher number of stocks one could develop profitably. The high R/C values can be applied on the national level, while smaller investors have to apply lower values (e.g. 10), where the maximum benefit is sensitive to the number of stocks selected.

Table 2 PROBABILITIES NEEDED FOR THE USE OF CONSERVED CATTLE AND SHEEP STOCKS IN U.K. TO JUSTIFY THEIR CONSERVATION, ACCORDING TO SMITH (1984). USE MADE AFTER 20 YEARS FOR 20 FURTHER YEARS. REQUIRED ECONOMIC EFFICIENCY OVER THEN CURRENT STOCKS 5%

Species	Products	Method of conserv.	Probability (%) needed with different degrees of substitution		
			100%	50%	10%
Cattle	Milk 1/	Live	0.021	0.042	0.211
Cattle	Milk	Semen	0.003	0.006	0.027
Cattle	Milk	Embryos	0.018	0.035	0.177
Cattle	Beef 2/	Live	0.027	0.053	0.267
Cattle	Beef	Semen	0.004	0.007	0.035
Cattle	Beef	Embryos	0.023	0.045	0.226
Sheep	Meat&Wool 3/	Live	0.060	0.120	0.600
Sheep	Meat&Wool	Semen	0.013	0.025	0.127
Sheep	Meat&Wool	Embryos	0.060	0.120	0.600

100% = complete substitution

50% = 2-breed cross or synthetic

10% = specialized use

1/ Total annual value of production in U.K. 1900 mill. £.

2/ Total annual value of production in U.K. 1500 mill. £.

3/ Total annual value of production in U.K. 400 mill. £.

Smith concluded from his calculations that there is scope and many benefits from creating and manipulating genetic diversity to maximize the future economic efficiency of our livestock.

4. WHICH BREEDS DESERVE TO BE MAINTAINED?

In spite of the many motives for maintaining several breeds and of the obvious national economic profitability of their maintenance in the long term it may not be possible or realistic to maintain all breeds. A choice is often made necessary by the fact that the number of people understanding the motives is limited, and hence also the resources available are limited. The criteria for choosing breeds for maintenance have been discussed by many authors (e.g. Mason, 1974, Simon and Schulte-Coern, 1979, Simon, 1934, Maijala et al., 1984, Bodó et al., 1984). They are closely connected with the motives and partly with the methods of conservation.

An important question is whether there is time to evaluate a breed before deciding to conserve it. Provisional maintenance may often be well-founded. Evaluation is even impossible for unknown traits, which may-became important in future. Compromises are needed between ideals and possibilities, between motives and methods and among different objectives. Both practical experience and theoretical knowledge from different sectors are important in the decision making, which thus may sometimes become complicated. The main viewpoints to be considered can be listed as follows:

1. Value of the breed as a biological material
    a. performance (overall or in some special trait)
    b. adaptation (climate, feed, management system, local tastes)
    c. resistance (infection, parasites)
    d. special characteristics (major genes, biochemical traits)
    e. heterosis or complementarity expectations in crosses

2. Genetic status and distinctiveness of the breed
    a. history and age as a separate breed
    b. breed purity and relationships within breed
    c. relationships to other breeds and evolutional origin
    d. population size and its trends (vulnerability)

3. Ecological aspects (e.g. landscape management)
4. Cultural-historical and aesthetical importance
5. Social importance (e.g. in leisure time)
6. Possibilities of evaluation and maintenance, and availability of adequate information.

It is important to consider whether the breed should be preserved without selection or maintained with simultaneous selection. For some breeds which occur in several countries, international cooperation is desirable in both decision making and action.

5. UTILIZATION OF RARE BREEDS IN PRODUCTION

The economic-biological reasons mentioned above for maintaining minority populations referred to possible future needs. However, changes in needs and production conditions do not vary only with time but also with geographical and agricultural location within a certain era. Considering the whole world, some places are now living the stage of development which in some other places occurred hundreds of years ago. An interesting feature of history is that it often repeats itself even at the same location. Taking into account the wide spectrum of environmental and economic circumstances and the versatility of many farm animal species, it should be possible to find good economic niches for many minority breeds. Examples of special uses for cattle, goats, horses and sheep are listed in Table 3.

There are several alternative uses for each species, and it is likely that different breeds suit differently for them. It is also probable that some minority breeds can be utilized many-sidedly, while the popular majority breeds often are specialized to just one or two tasks. An idea of the many-sided uses and of special qualifications of farm animal breeds can be obtained from a recent working party report (Maijala et al. , 1985). An effective utilization of the many-sidedness may be the key to the profitability. The production conditions may vary even in the same village or community, and in the era of A.I. it is possible to use males of different breeds within the village, even within a farm. For some products, marketing may cause problems, if all neighbouring farmers do not produce the same product, but for some' products it is advantageous to be the only producer in the community. A creative imagination has often given good results in finding new ways for production and marketing, and its importance is obviously increasing in the era of surpluses concerning conventional products.

Table 3 POSSIBLE SPECIAL USES IN ECONOMIC PRODUCTION FOR BREEDS OF SOME FARM ANIMAL SPECIES

	Possible in breeds of			
	Cattle	Goats	Horses	Sheep
Tractive power in difficult conditions	X		X	
Production of "biological" food	X	X		X
Production in prison farms	X	X	X	X
Production at school farms	X	X	X	X
Pasture and lawn management	X		X	X
Forest management, underbrush-clearing				X
Production of sera for research & health	X		X	
Production of unallergenic milk				
Production of other medicines		X		X
Dam line in crossbreeding for meat	X	X	X	X
Utilization of harsh environments	X			X
Utilization of marginal areas	X	X		X
Experimental animals in research	X	X		X
Production of luxury furs	X	X	X	X
Production of wool for handicraft				X
Animals in part-time farming		X	X	X

Utilization of marginal areas or otherwise harsh environments deserves special attention, since ruminants do not have competitors in that field, the importance of which may increase. It is important that some breeds are continuously kept and selected in those conditions, in order to have suitable animals available at the time of need. Especially beef cattle, whose feed efficiency is poor, should be kept under extensive conditions, in order to minimize the costs of calf production. The adaptation and hardiness of local breeds can be exploited now by using them in commercial crossing for meat production with specialized meat breeds. Mason (1989) considered that a commercial crossbreeding system serves breed conservation because of the need of continuous supply of local adapted breed as foundation stock, giving financial inducement for maintaining such breeds.

The utilization of prison farms for breed conservation turned out to be possible in Finland, when it was realized that animals on these farms serve largely the psychological care and employment of prisoners so that top yields are not necessary and not even possible.

6. USE OF RARE BREEDS IN CONSERVATION OF NATURAL ENVIRONMENT

Animals are part of nature, and hence native breeds of farm animals are often kept in natural parks. In France, at least two breeds of cattle, two breeds of 'sheep and one goat breed are kept in that way (Mason, 1982). The Rove goats graze the fire-breaks and keep them clear of scrub. In Hungary, flocks of indigenous breeds of cattle (Hungarian Grey) and of sheep (Racka and Cigaya) are kept in two big national parks (Hortobágy, Kiskunság), which were established in 1972 and 1974 (Salamon, 1982, Szabo, 1982). Bodó et al. (1984) considered that "the costs in maintenance of cattle can be minimized by keeping them in national parks, where they can also help to maintain the biological balance by grazing the tail grasses".

Small numbers of indigenous farm animals are also kept in ecological museums in different countries.

7. UTILIZATION OF RARE BREEDS FOR HUMAN PLEASURE AND RECREATION

An important way of decreasing the costs for conservation of breeds is to use them for leisure time activities, the demand for which is increasing with shortening working time and increasing standard of living. Examples of such activities are given in Table 4.

Table 4 POSSIBLE USES OF FARM ANIMAL BREEDS FOR PLEASURE AND RECREATION

	Possible in breeds of				
Kind of use		Cattle	Goats	Horses	Sheep
Animals in national parks	X			X	
Farm animal parks and museums	X	X	X	X	
Trotting-matches			X		
Riding for hobby and racing			X		
Agricultural and native place museums	X	X	X	X	
Social company of humans, pet-keeping		X	X	X	
Aid in bringing up children, 4 H-farms	X	X	X	X	
Maintenance of local culture & tradition	X	X	X	X	
Exhibition in zoos	X	X	X	X	
Tourist attraction	X	X	X	X	
Folk art			X		
Ceremonial purposes	X		X	X	

The use for pleasure has been especially important for horses, where trotting and riding competitions bring in considerable amounts of money, not only to the successful enterprises but also to the states, which thus can support maintenance of working horses, too. At least in fir land it has been compulsory to arrange a certain proportion of starts in trotting matches for Finnhorses, and so the decrease in the number of Finnhorses has stopped many years ago, and the number of foals has been increasing in the 1980s. A working party set up by the Ministry of Agriculture and Forestry suggested in 1982 that the prize level of Finnhorses should be developed in proportion to that of warm-blooded trotters, in order to safeguard the continuation of the positive development in numbers. Whether this secures the maintenance of the right horse type for working is another question.

Finnhorse has also been found to be a suitable riding horse for beginners. Here the working type suits the purpose rather well. In order to increase this type of use of Finnhorses, the working party suggested that opportunities to participate in horse-racing should be arranged for Finnhorses in their own classes.

In some countries, there are farm animal parks, which have importance in creating interest in the old breeds among people and help in getting money for conservation activities through tourism. The best examples can be found in the United Kingdom, where Cotswold Farm Park has representatives of 22 old breeds and attracts over 100 000 visitors per year (Henson & Henson, 1982). A Finnish animal park also has a farm animal section, and Norway has plans to establish such a farm for conservation purposes. The numbers of animals per breed in those farms are small, and hence one should have animals also elsewhere, in order to conserve enough variation and to avoid inbreeding.

The latter concerns also zoos, in which representatives of old farm animal breeds are sometimes kept. It is generally thought among animal geneticists that the role of zoos is to maintain wild ancestors of domestic breeds. The wild types would be valuable sources of genes and should thus be conserved. In 1975 there were altogether 244 Przewalski horses in 58 zoos in the world (Mason, 1980).

Mason (1980) considered pet keeping important in the sense that the close relationship between human and animal gives a motive for breeding rare or disappearing breeds. On this basis large groups of people become interested in visiting animal parks and in supporting conservation activities. Private societies for conservation purposes have been established among others in France in 1971, in the United Kingdom in 1973, in the Netherlands and in North America in 1977, in Denmark in 1981, in Austria, FRG and Swizerland in 1982. These have already increased the interest in conservation in their countries and in many cases prevented endangered breeds from disappearing.

8. MISCELLANEOUS PROBLEMS IN MAINTAINING SMALL POPULATIONS

Besides the direct economic problems, for which finding other uses for the breeds is important, there are genetic, hygienic, organizational and safety problems making the conservation of breeds more difficult.

The genetic ones are mainly of two kinds:

1. One should try to minimize the risk of inbreeding and genetic drift with the aid of sufficient effective population size, appropriate mating systems and as equal sex ratios as possible.
2. One cannot make rapid genetic progress in a small population. In spite of this, some undesired natural selection may take place. Some one-sided selection could be applied in populations of 150 females, and utilization of embryo transfer techniques would give additional possibilities, but this would cause costs.

The hygienic problems are also of two kinds:

1. The animals should be protected from destroying diseases.
2. The stored material should not be a risk to other materials at the time of reuse.

An appropriate organization is needed for collecting and disseminating information, preparing mating plans, exchanging animals, etc.

In order to avoid risks of accidents (e.g. fires) the stored material should be placed in several locations.

These different kinds of problems are inclined to increase the costs of conservation. In addition, investments have to be made much before the returns, which for their part are uncertain and may be harvested by another group of people than by those who made the investment. Therefore, it is important to find and utilize various alternatives for getting immediate incomes for the material and that the society (state) takes at least partial responsibility for the costs as a national insurance fee.

9. SUMMARY

The possibilities of conserving breeds of cattle, horses, sheep and goats for future needs were discussed, especially from the economic viewpoint. At first, several economic-biological, scientific and cultural-historical

motives for conservation were presented. Many of them spoke in favour of conserving entire breeds, but it was realized that simultaneous conservation of frozen semen and embryos makes the conservation cheaper or better.

Referring to the calculations by Smith (1984, 1985) it was stated that even small gains in efficiency and low proportions of the genes from a conserved stock would bring profit for the nation and that it pays to create genetic diversity to maximize the future economic efficiency of livestock.

The main viewpoints to be considered in choosing breeds for conservation were presented.

Several alternative ways for utilizing rare breeds in economic production were listed. Special attention was directed to the utilization of marginal feed resources and of local breeds as dam lines in commercial crossing-for meat production. Keeping indigenous breeds as a part of the natural environment in natural parks was also noted, as well as utilizing them for leisure time activities. These have been especially important in horses, which are used for riding and trotting. Attention was paid also to tourism, farm animal parks, zoos and hobby organizations. In spite of these possibilities, the state has to assume a partial responsibility for the costs of conservation, since the main returns from it can only be harvested in the future and not by those who invested the money.

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THE USE OF NATIVE HARE BREEDS IN MANAGEMENT OF AREAS OF IMPORTANCE FOR NATURE CONSERVATION IN SWEDEN

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1. THE ACREAGE OF AGRICULTURAL LAND HAS DECREASED IN A RADICAL WAY

As a result of the improvement in and intensification of agricultural production in Sweden, the acreage of natural grazing land decreased from nearly 1 million ha to 200 000 ha from the time between the two world wars up to today.

The importance of well managed natural grazing land has been discussed in Sweden especially during the last years. In these areas, there are several endangered species of wild fauna and flora.

Agricultural policy in Sweden today is to reduce the overproduction of agricultural products and this will affect the total number of farmers and acreage of both arable land and grazing land. The number of grazing animals will probably diminish in a radical way.

2. NATURE CONSERVATION AUTHORITIES HAVE INSTRUMENTS FOR LAND USE REGULATIONS

It is of great importance for Swedish nature conservation to ensure that areas of agricultural land - from the scientific and cultural point of view - will be managed in the right way to conserve fauna and flora. But it is also of vital importance for the understanding of the cultural background to use indigenous, local breeds in the management of the reserves for research and education.

Therefore, the Environment Protection Board already supports and in the future intends to support further the maintenance of native breeds.

Out of a total acreage of well over 1.5 million ha of national parks and nature reserves about 10 000 ha is agricultural land. A great portion of this land is owned by the government but also local communities and individuals are landowners. Restrictions through e.g. management plans makes it possible for the authorities to regulate land use.

The most significant instrument to keep adapted native breeds in reserves is through subsidies to tenants. A tenant can, if he keeps indigenous grazing animals in a traditional way, get support in the form of a lower rent and in some cases, acreage allowances or head payment. Governmental funding can also be done for bushclearing, fencing, transport and support for farm buildings.

3. AN EXAMPLE OF SUPPORT FOR KEEPING NATIVE BREEDS IN SWEDEN

Just recently, the Environment Protection Board, in cooperation with local authorities, started a scheme for the management of chalets (mountain pastures) in Dalarna county in Sweden. These chalets are not nature reserves. Chalets are a traditional, very specific type of agricultural system in the mid parts of Sweden. Cattle, sheep and goats are for about 2-3 months taken to grazing areas up in the woodlands far away from the villages in the valleys.

For each dairy cow of local breed (SKB) the farmer gets a yearly subsidy of SKr 500 (about $75.00). If the cow is of lowland type or a crossbreed the subsidy is SKr 300. Subsidies are also available for heifers, goats and sheep.

The main reason for the Board to release funds for these activities is to get the farmers interested in this traditional form of production and by that keep the cultural landscape open. By allowing higher subsidies for native breeds the authorities emphasize the importance to preserve native breeds in the areas from where they originate, not least from the educational point of view.

BREEDING SCHEHE AND GENETIC PROGRESS IN A SMALL CATTLE POPULATION (Tyrolean Grey)

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1. INTRODUCTION

Population size has received much attention both in population genetics and in applied animal improvement. Official recognition of a group of breeders as a herd book society depends in some countries., e.g. in the Federal Republic of Germany, on the number of animals deemed sufficient to carry on an effective breeding plan. Size of a population can be viewed from the genetic and economic aspects. The genetic aspect concerns prospects of genetic improvement without consideration of costs incurred by the breeding work. On the other hand, population size may reflect on the economy of the breed improvement.

Common sense would lead one to expect more genetic progress in large populations - selection intensity can be greater and outstanding and rare individuals are more likely to be found there than in small populations. However, the reproductive rate is by and large independent of population size which implies that selection differences are roughly equal in populations of different size. High selection intensity in small populations will lead to a high rate of inbreeding in much shorter time than in large populations. It can be shown theoretically .(Robertson, 1960) that long-term selection response will be greater in larger populations simply because they harbour more genetic variability.

In populations with normally distributed traits, selection intensity increases somewhat with size. This increment is relatively modest and may have little impact on breed improvement except in well ' planned and precisely executed breeding schemes. Robertson (1960) has developed a theory which predicts that the total selection gain should be 2 N_e times the genetic improvement of one generation selection. The half-time of the total genetic advance should be reached after roughly 1.4 M generations (N_e = effective population size). However, in practical breed improvement, longterm time scales barely matter apart from the fact that the predictions were only partly substantiated by experiments. In breed immprovement where changing market requirements etc. are important, short term and medium term considerations would appear to be of overriding importance, i.e. selection gain over, say, a dozen or two dozen generations at the most.

The importance of population size on medium and long term genetic progress has been investigated in a number of experiments. Roberts (1966) reports from mouse experiments that the half-life of genetic progress is of the order of N /2 generations. This indicates that genes with large effects are responsible for a large part of the genetic advance. The Australian group (Frankham et al., 1968) reports rather large scale Drosophila experiments. They did find the expected connection between size of the population and selection intensity.

However, there was little change in the magnitude of realized heritability even though it increased slightly with increasing population size. On the long term, i.e. over 40-50 generations, large populations showed more progress but in the short and medium term the advantage of larger populations was rather modest. However, it must be emphasized that mass selection only was employed in the experiments.

An investigation by Hanrahan et al. (1973), employing mice, revealed clear advantages of larger populations. Effective population size was greater and the rate of inbreeding clearly lower in populations with 16 mating pairs than in those with 4 mating pairs. Genetic progress was greater in the larger population which is a consequence of a greater realized heritability. Selection intensity showed little difference which was to be expected due to within family selection.

Summarizing experimental investigations, larger populations permit greater selection gain, even on short term and medium term scale, partly due to greater selection intensity but mainly, however, due to greater realized heritability. The cause of the greater realized heritability in larger populations may be genetic drift which in smaller populations soon leads to increased homozygosity and thus to loss of genetic variability. a number of investigations indicate this in addition to theoretical expectations.

The other aspect of population size and genetic improvement concerns economics. Improvement work in large populations can be much more economi cal if one succeeds in spreading the genes of superior animals widely. Nowadays this may be accomplished by A.I. The advantages of large populations is great in particular if selection is very expensive as it is when progeny testing is used. A number of investigations indicate these advantages (Comberg, 1980).

The experimental investigations were performed with populations of comparatively small numbers. So the next question concerns the size of domestic animal populations and whether these are comparable with those mentioned above. The effective population size in respect -to inbreeding and drift of the latter is surprisingly small and comprises but a fraction of the real numbers.

We have investigated three Bavarian horse populations (Fehlings et al., 1983). The Haflinger has an effective size of about 80, the Bavarian draught horse about 120 and the German trotter a little more. The figures are comparable to N_e's from other horse and cattle populations. The inbreeding increment of U.S. Holsteins indicated, before introduction of A.I., an N_e of about 120 (Lush et al., 1936) and that of the Bavarian Fleckvieh is not very different. Some populations have lower effective numbers and one may pose the question whether breed improvement work can be effective in such populations. However it can be stated that respect to effective population size, smaller breeds have numbers which are not much bigger than those of the largest experimental population investigated by Frankham et al. (1968) and others.

Another question concerns the connection between population size of domestic breeds and their genetic progress. Hintz et al. (1978) have published the estimates of yearly genetic progress of the five major U.S. dairy breeds over a period of about 15 years from the early 1960s to the middle 1970s. A perusal of the figures of Table 1 indicates no connection between size and genetic progress of these five breeds - Brown Swiss have a greater genetic trend than Holstein-Friesians even though their real numbers are but a fraction of the Holsteins and their effective size is also somewhat, though only little, smaller. The conclusion from this comparison must be that genetic progress depends on several things, possibly also on population size but that the latter's effect is overshadowed by other factors and that it is not discernible in the published figures. This may be due to the flattening of the curve relating genetic progress to population size when this curve approaches the asymptote. This flattening appears to occur at relatively low numbers ($N_e < 100$) and other factors become much more important. At any rate, as can be judged from the figures published by Hintz et al. (1978) under practical circumstances population size appears to be a minor factor with regard to genetic progress.

Table 1 GENETIC CHANGE IN YEARLY MILK YIELD OF U.S. DAIRY BREEDS (Hintz et al., 1978)

Breed	kg milk			Approximate number of yearly herd book registrations
	A.I. cows	Non-A.I. cows	A.I. bulls	
Ayrshire	36	36	24	11 400
Guernsey	25	35	15	24 500
Holstein	26	31	18	330 000
Jersey	25	13	18	38 100
Brown Swiss	38	36	35	13 100

In closed populations increase of the rate of inbreeding is unavoidable. However, the increase can be effectively postponed as has been found by Vangen (1983) in Norwegian horses or by Strom (1982) and Fehlings et al. (1983) who found inbreeding to be less than expected from inter se relationship. However, increase in inbreeding cannot be postponed indefinitely and at a later point inbreeding in such a population will even overshoot the level which would have arisen by continued panmixis (Robertson, 1964). Of course, any immigration will drastically reduce the level of inbreeding.

One must assume that populations of domestic animals are not closed to the same extent as laboratory populations are - in Central Europe herd books were never closed and only recently herd book societies on the continent have started to follow the Anglo-Saxon tradition in this respect.

Another question concerns the maximum intensity of selection compatible with a tolerable rate of inbreeding. The latter may be taken as the rate of inbreeding which is found in successful populations. In Holstein-Friesians this is roughly 0.4 percent F per generation. If one surmises that the inbreeding is largely caused by sires one arrives at a minimum number of about 30 sires per generation. The generation interval in cattle is about 5 years, therefore 6 bulls should be taken in every year, on average. This presupposes random mating after breeding animals have been chosen. If one would take one son from each sire and one daughter from each dam - not a realistic assumption if selection is to succeed - then the effective population size is roughly $16\ N_m/3$ (N_m = n. sires/generation). Again if 0.4 percent inbreeding increment is tolerated, 23 to 24 bulls should be used per generation, about 5 per year. These numbers are easily met by most breed societies.

2. BREEDING PROGRAMMES AND RESULTS IN TYROLEAN GREY

The Tyrolean grey cattle number about 30 000 - 35 000 cows of which 4 000 - 5 000 are recorded each in North and South Tyrol. Insemination is Practised on about 40-50 percent but since herd size is small, the use of community bulls is the rule.

The practical genetic improvement via A.I. breeding programmes would appear to be severely hampered in such small populations. In many papers, the size of populations which permits sustained progress is in the order of several 10 000 and to become profitable the numbers should still be larger (Comberg, 1980).

The bottleneck in breed improvement lies in the selection of A.I, bulls which must be progeny tested and which would require testing of some 4 to 5 x as many bulls as are eventually desired. Furthermore, a certain number of selected bulls is required to avoid inbreeding to increase too rapidly.

In conventional A.I. breeding programmes (Comberg, 1980; Schmidt and Van Vleck, 1973) young bulls are testmated to produce 50 - 100 daughters which are tested for dairy performance which provides the criterion for selection of the bulls. About 1/5 to 1/3 of tested bulls are retained for general use while the future bull sires are chosen from the top 1/20 to 1/10 of all tested bulls. A programme such as this supplemented by efficient selection on the female side permits an increase in genetic merit for dairy performance of up to 2 percent of the average per year. However, the realized genetic advance is considerably less, more of the order of 1.0 to 1.5 percent.

The advantage of A.I. over natural service lies in the much greater numbers possible but also in the fact that daughters are distributed over many herds and preferential treatment or the prevalence of single herd effects in the progeny are unlikely.

Therefore, the fairly widespread use of community bulls and the fact that their progeny are distributed over many herds - not unlike the progeny of A.I. bulls - can result in some 15-20 daughters and thus permits a fairly accurate estimation of their breeding values. Naturally, the accuracy will be lower than that of A.I. bulls on account of the smaller number, but apart from this, the accuracy is comparable to that of A.I. progeny.

The bulls can and should be slaughtered after sufficient progeny - some 15-25 recorded heifers - can be expected. Before slaughter sufficient semen must be collected to permit their use as elite sires for producing young bulls. The procedure is fairly economical since it does not involve a waiting period of bulls or the storage of large quantities of semen. Rather the semen is collected after their use for natural service and the additional cost of the programme consists only of collection and storage of fairly limited quantities of semen. Therefore, many bulls can be tested and a fairly intense selection of bull sires is possible.

In Table 2 the theoretical genetic superiority of bulls selected in a conventional A.I. improvement scheme is juxtaposed to that of bulls from a young bull system as outlined. The differences are negligible but the loss of heterozygosity is less in the latter scheme and the costs would be much less than in the aforementioned "classical" A.I. scheme.

This "natural service" progeny testing scheme has been applied in the North Tyrolean Grey population beginning in 1977. In Table 3 bull numbers and selection intensity as well as progeny group size and age of bulls are outlined.

From 31 bulls whose semen was deposited in the 4 years 7 were selected. During this period the scheme had some difficulties as can be seen from Table 3. The numbers of progeny were uneven and the age of bulls at the time of semen collection became progressively older (the trend was reversed meanwhile).

The genetic progress in the North Tyrolean Grey population was estimated for the period 1977 to 1985. All the bulls were included which had progeny in at least 2 years. They numbered 98 with altogether 240 sire year averages (i.e. 2,4 per bull). The genetic progress was estimated via the regression of progeny average on year. The results given in Table 4 indicate considerable genetic improvement in the segment of the population which participated in the programme. In the case of milk fat-kg the genetic change amounts to more than 1.2 percent of the population average.

Table 2 GENETIC SUPERIORITY OF BULLS SELECTED IN A.I. AND IN NATURAL SERVICE IMPROVEMENT SCHEME

	Progeny Tested				
	Testbulls	Bull sires	Cow sires	r 1/	n 2/
AI	10	2	4	0.85	45
Δ G, kg milk/year		360	205		
Natural Service	30	3	8	0.71	15
Δ G, kg milk/year		370	260		

1/ Correlation between breeding value and progeny average.

2/ Size of progeny groups.

Table 3 PROGENY TESTING OF NATURAL SERVICE BULLS IN NORTH TYROLEAN GREY CATTLE

Year of semen collection	Tested/selected	n	Age of bulls in 1983
1977	5/2	33 (20-51)	9 ys
1978	15/5	22 (1-52)	8.5
1979	5/-	13 (3-17)	8
1980	6/-	9 (3-18)	7

The figures given in Table 4 indicate the natural service - progeny testing scheme was effective. It has been pointed out elsewhere that use of young bulls in A.I. and the use of progeny tested bulls mainly for production of the young bulls should give a high rate of genetic advance (Bar Anan, 1973). However, this was investigated for an A.I. population while the thrust of this paper is the procurement of progeny tests from natural service community bulls and selection of future bull sires from among these; The economy of this approach affords the possibility of progeny testing fairly large numbers of bulls which permits rather intense selection among them. Therefore the deficit in the accuracy due to lower numbers compared to regular A.I. bull selection schemes can be balanced by the greater intensity of selection possible. Therefore genetic progress due to such breeding plans should be competitive. However, in contrast to regular A.I. schemes more bulls participate in the reproduction which should decrease the inbreeding increment and increase the genetic effective population size (N) thus permitting sustained genetic improvement without the necessity to import genetic material from other services.

Table 4 GENETIC PROGRESS IN THE NORTH TYROLEAN GRAUVIEH POPULATION 1977 TO 1985

	b daughters/bulls x year			
	Daughters of all bulls			Daughters of bulls in Nsprogeny testing programme
	1977-1985	1977-1980	1980-1985	
Milk-kg	0.3	6	12	-1.4
Fat-%	-.0025	-.0095	-.019 1/	-.01 2/
Fat-kg	-.3	3	-.6	-.8 1/
		Δ G/year		
Milk-kg	-.5	-11	-24	3
Fat-%	.005	.01	.04	.02
Fat-kg	.5	-.5	1.2	1.7

1/ $p < .05$

2/ $p < .10$

b regression coefficient of daughters of a bull on year.

Δ G/year genetic change per year.

3. SUMMARY

Genetic progress is expected to be greater in larger populations. Experimental investigations bear this out in populations of small size (up to 50 breeding animals). Empirical evidence fails to indicate any connection between numerical size and genetic progress in U.S. dairy cattle populations, also genetic effective size of populations of domestic animals appears to be similar, almost independent of actual size.

The large expense of identification of superior sires in dairy cattle breeding favours large populations. Therefore, low cost methods of identifying superior transmitters are of paramount importance if modern methods of genetic improvement are to be applied in numerically small populations.

It appears that progeny testing of natural service bulls in combination with intense selection permits effective identification of superior sires. Collection of semen from the young bulls as soon as sufficient progeny is assured permits their use as future bull sires. Therefore such a system should be a feasible alternative to the conventional A.I. schemes wherever general A.I. is absent and/or where the populations are too small to sustain large scale progeny testing and selection of A.I. bulls.

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POSSIBILITIES OF UTILIZATION OF ENDANGERED CATTLE BREEDS IN PRODUCTION OF MILK, BEEF AND VEAL, IN CONSERVATION OF THE NATURAL ENVIRONMENT OR IN OTHER NON-ECONOMIC SPHERES

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In the opening reports many economically important as well as other aspects were mentioned indicating quite explicitly the necessity of restoring threatened breeds or individual species of farm animals. Thanks to the intensive worldwide movement for conservation of the natural environment, where FAO and UNEP (1980, 1983) play such an important role in the sphere of animal production, practically all countries have gradually become aware of the need to preserve and conserve the diversity of present species as well as to pass on the results as fully as possible to future generations. We therefore appreciate that the present symposium will concentate its attention on major species of farm animals.

We will consider genetic resources primarily in cattle, and contemplate the possibilities of utilizing threatened and disappearing breeds not only in the context of production of milk, beef and veal, but also in the non-economic sphere.

Let us consider individual possibilities of genetic resources preservation in cattle. Taking into account existing experience, present state of knowledge and further development of some biotechnical techniques in reproduction, particularly in cryogenic storage of sex cells and early embryos, the following possibilities of genetic resources preservation are available:

- small populations of living livestock;
- preservation of frozen semen;
- preservation of frozen embryos;
- combination of the above alternatives;
- establishment of a so-called gene-pool.

Each of these possibilities has its advantages and disadvantages, both of a biological and economic character.

The first possibility is the breeding of live animals in small populations where it is most important to avoid selection pressure and retain the complex of traits and characters of a corresponding genetic resource, unchanged if possible, from generation to generation. From the genetic point of view it is therefore imperative to choose a constant number of offspring per each sire and dam and through an appropriately controlled plan of mating (rotational system) prevent undesirable effects of inbreeding and random pressure, designated also as genetic drift and/or the effect of Sewal Wright, leading either to full elimination or fixation of some alleles.

The major disadvantage of the second possibility, when the genetic resources are preserved in the form of frozen semen only, i.e. from the sires, is that grading up through repeated matings of each next generation of crossbreds must be done with the semen of genetic resource to develop in such a way the preserved genetic resource in living animals, which must be carried out for five generations at least to achieve the gene proportion of the genetic resource amounting to approximately 97 percent. This accounts for a considerably long period owing to the length of the generation interval in the corresponding animal species. The possibility of practical use of the genetic resource obtained in such a way is therefore remarkably problematic in cattle. Supposing the generation interval is 5 years, 25 years will be needed to obtain living animals of the genetic resource. During this time economic conditions, market demands and technological systems may change so much that the development of the new genetic resource will no longer be desirable.

In terms of time, the third possibility, i.e. preservation of frozen embryos, is the most advantageous. Live animals capable of further reproduction may be obtained during one generation. The present state of development and utilization of this biotechnical method indicates its wide implementation in selection work in the immediate future. However the possible negative influences of those techniques on the transfer of pathogenic microorganisms and/or on future development should also be investigated in detail.

The fourth possibility consists in the combination of the above-mentioned possibilities. For instance, with live animals kept in small populations it is convenient to preserve the desirable number of sires through frozen semen to ensure the necessary rotational matings. The combined preservation of frozen embryos with frozen semen is also advantageous, which substantially extends the blood basis and thus the establishment of genetic resources in living animals. To avoid using grading up, prolonging considerably the "animation" of preserved genetic resources, it is convenient to sustain a certain number of living dams when frozen semen is used.

The fifth case, i.e. the establishment of a so-called gene pool, remains a theoretical possibility for the time being. Its realization is possibile, of course, as evidenced for example by the American experience with the establishment of a gene pool in pigs. Again, generally it concerns the breeding of living animals obtained on the basis of one breed with subsequent inclusion of other breeds. Animals mate with one another which results in a mixture of various hybrids, out of which the animals of desirable type are obtained through strict selection, i.e.

not indigenous breeds entering the gene pool. In this case, the aim is not to preserve the breeds as such but their genes.

Therefore, this fifth possibility for back restoration of disappearing breeds is not simple. Desirable animals for such a gene pool may be obtained only through particular and long-term selection on in the course of a number of generations aimed at a desirable productivity type and an increase in the numbers necessary for reproduction.

An integral and important aspect in contemplating the choice of a certain possibility of genetic resource preservation is the economy, which plays an important role above all in the cattle, horses, pigs and sheep, while in subtle species of farm animals, particularly in poultry and rabbits, many indigenous breeds are preserved only thanks to enthusiasts.

Work by Brem et al., (1982) provided some initial information. The data indicated that 5reeding live animals in small populations is the most expensive method. The second method is less expensive. However due to the necessity of grading-up for approximately 25 years, the final costs are particularly high. Another adverse feature of this method (when only semen is used) is the loss of resource of extrachromosomal genetic information comprised in the female sex cell.

The most favourable seems to be the use of frozen embryos and semen. Purchase costs are high. However live animals with genetic reserves are available within one generation. Therefore this method of preservation is recommended most frequently and indicative calculations carried out in Czechoslovakia in cooperation with the State Breeding Enterprises, General Management, also confirm this fact.

Detailed model calculations of costs for individual methods of genetic resources preservation in animal production were carried out by Smith in UK (1984a, 1984b).

Based on present current prices in UK the costs of genetic resources preservation in small populations, in the form of frozen semen and finally in the form of frozen embryos were established by Smith (1984c) in cattle, sheep, pigs and poultry, with the similar conclusion as that from Germany (Brem et al., 1982).

Despite the high costs of genetic resources preservation in the form of live animals in small populations, in some cases this method is almost imperative and justified. In the context of general breeders, public, historical and cultural values, therefore also of international importance, it is hardly conceivable to breed a certain breed through a gene bank. However, in such cases too if not embryos, then at least semen of individual sires, participating in the development of a certain population in the course of its genesis, should be preserved, particularly due to possible inbreeding depression.

The review which is presented of costs of individual methods of gene resources preservation indicates equally the desired numbers of animals. These numbers must be minimal. In genetic resources preservation in small populations the ratio of 5 males to 25 females is currently reported, whereas the ratio of 50 to 250 is being recommended in cases with traits of low heritability. With the objective of ensuring consistent rotational matings the more convenient ratio is 1:1. When selecting males to freeze their semen, 25 unrelated animals must be chosen. Twenty-five different matings must be ensured to freeze the embryos.

Apart from their aesthetic and cultural significance, genetic resources preservation and conservation are important in terms of selection and thus are of national economic value.

Economic effects resulting from possible later utilization of the hereditary basis of the preserved genetic resources are given by the difference between the overall increase in performance of animals with the proportion of genes of the breed preserved and the costs for preservation of the breed used. In the model calculations by Smith (1984a) the product of the value expressing the used proportion of genes of the genetic resource and relative profit in economic efficiency, expressing the justification of conservation and preservation of genetic resources, is underlined.

Also in this case we will make use of the model calculations valid for UK. It is surprising how low a proportion of genes of the genetic resource used is sufficient to achieve a great economic effect. This is, by the way, in harmony with the well-known experience that a seemingly high investment used for a relatively small number of selection herds is reflected in tremendous financial gains in commercial herds.

Under UK conditions Smith (1984a) chose the following example. He Presumed a genetic resource preserved for 20 years. After this period it was used again and would be used for another 20 years. A yearly inflation rate of 5 percent was considered. For instance, in dairy cattle, genetic resource preservation is fully justified at only 0.1 percent use of this resource, and at 1 percent profit in economic effectiveness. In the case of frozen semen, the values were even lower.

Thus, on a national-wide scale, the conclusion can be drawn from the above economic considerations that although the envisaged possibility for future use of genetic resources is small, it is worth preserving because the potential economic profitability will greatly exceed the costs for its preservation.

What is as a matter of fact the common feature of all endangered local cattle breeds? First of all it is their extraordinarily good adaptability to local conditions, i.e. relatively better utilization of local feed resources, resistance and longevity. The old proverb is fully true which says that a breed is the product of the soil, i.e. of the natural conditions under which it has originated and has been formed. This outstanding adaptability to extraneous natural environmental conditions can be illustrated by the almost disappearing breeds of the USSR, e.g. Kirgizian breed (Kasachian), Siberian, Petchorian, North Carrelian or Buryatyan (Zebrovskij et al., 1984).

Perfect adaptability is also a prerequisite for a notable heterosis effect in possible commercial crossing of local breeds with improved cultural breeds thus providing better results compared with crossbreeding for improvement or grading up. Another important character, much appreciated by the breeders, is modesty and associated with it hardiness, so that production achieved, however low in comparison with a highly improved but demanding, breed corresponds fully to production conditions of the given region and for this reason is also economically advantageous. Local breeds are also distinguished for their satisfactory diverse, not only one specialized, performance. The quality of consumable products, i.e. milk or meat, of local cattle breeds is better regarding the ratio of their components, particularly protein and fat, and in terms of meat production, better taste and smell, due to a direct effect of free pasture or utilization of animals for draught.

We will now comtemplate the possibilities of using local breeds for milk, beef and veal production. Without going too far for an example, we shall pay our atttention to the characters of Bohemian red cattle formerly kept in our country. This breed of cattle has gradually disappeared and become a component of the Czech Pied cattle (Bílek 1926, 1933; Valenta, 1930; Smerha et al., 1955). Bílek (in Smerha et al., 1955) reports that the Bohemian Red cattle "were good draughters due to their lively temperament and breathing habits, were good dairy cows with yellow, fatty and very tasty milk, and butchers appreciated their good quality meat. Their major disadvantage was relatively late maturity for which they were displaced by earlier maturing, however, more demanding, Simmenthal Bern cattle with no better results in milk yield, ability to draught and longevity at relatively low demands achieved in the poorer mountainous regions along frontiers or in South Bohemia with its primary rocks."

Some concrete data on performance were reviewed by Valenta (1930) demonstrating that, e.g. in the Giant Mountains, the liveweight of Red cattle was higher compared with Bern Bohemian cattle and that with respect to their liveweight (522.2 kg) and low protein consumption (251 kg) they showed the most economic milk production amounting at that time to 2817 kg with 4.1 percent fat, being the highest of all the breeds compared.

The situation was also similar in the country of our hosts with their Polish Red cows always giving a desirable performance due to their advantageous characters and following further improvement by Polish breeders. On this occasion we would like to recall the International Agricultural Congress in Warsaw, 1925, which accentuated local breed maintenance as one of the most attractive items of the working programme in the sphere of animal production (Bílek, 1933).

In Hungary, where Hungarian Gray cattle have been successfully conserved with 187 females and 6 bulls, a number of experiments demonstrated the suitability of these cattle as a component part in maternal lines in the production of beef by crossbreeding (Bodó, 1985).

Similarly we could report on local cattle breeds in other European countries. In this connection as an example we refer to a publication on autochtonous cattle breeds in Spain (Belda, 1981) with 25 breeds recorded.

The situation overseas does not differ, of course. For further illustration only we present some conclusions from the comprehensive study by Wilkins (1984) on Crillo cattle in both Americas, and in various countries of Latin America in particular. This study provides explicit evidence that grading-up of these cattle aimed at obtaining a more cultural breed was a mistake because the purebred Criollo, which is not to be preserved and extended, has a whole number of more favourable characters when compared to both European breeds and zebu.

Compared with zebu, for instance, Criollo cattle have not such a developed herd instinct so that animals are scattered over pastures, which is of considerable advantage under Bolivian conditions. Also the temperament of the Criollo is milder compared with zebu. Zebu is a wilder animal and therefore worse to manage and that is the reason why even hybrids are refused by farmers. However zebu hybrids achieve better meat production and, using the knowledge of genetics of quantitative traits, also show higher fecundity, reduced mortality in calves and a higher growth rate.

Crossbreeding with European dairy breeds is beneficial; the adaptability of the tropical breed with the high milk performance of the European breed is achieved explicitly with the F_1 generation, but not in the following generations.

The Criollo, improved by selection for higher milk performance, is very favoured in small isolated farms in the countries of Latin America where its production amounting to over 2000 kg milk for rearing a calf is fully satisfactory for farmers's needs because under such conditions no hybridization scheme can be used (Wilkins et al., 1984).

However here we are in the sphere of ecology, particularly in the sphere of complicated relationships between organisms within pasture chains (Farb, 1977; Odum, 1977). In our case this concerns the so-called pasture chain beginning with green plants, continuing over herbivorous to carnivorous animals; compared with other chains it is relatively simple.

In essence, the effectiveness of pasture depends on two decisive circumstances. First, on their primary productivity and, secondly, on the share of net production which can be annually taken away so that sufficient reserves ensure the future grass stand and plant composition to survive occasional periods of bad weather such as drought etc. (Humphrey, 1949).

When the reasonable utilization of pastures is ensured - and under this precondition only - local cattle breeds, which spread out on pastures, can considerably contribute to better pasture utilization and cultivation, particularly in mountainous regions, so forming a grass stand of good quality and preventing the loss of pasture areas which occur usually on the edges of forests due to natural self-sowing. History speaks mostly of the opposite case when excessive overgrowing of pasture stands has resulted in erosion first and later in complete landscape devastation (Dorst, 1974). Another practical and important characteristic of local cattle breeds in terms of selection is their use as a control population not only with the breeds developed from them through improvement or grading-up but also with imported breeds substituting them gradually. In all cases the technique of frozen semen or early embryos may be used, i.e. the widespread preservation methods used in cattle breeding.

Justification of conservation and preservation of disappearing and endangered local breeds is not based on their economic utilization only There is a whole range of other aspects that should be taken into account in terms of cultural, historical, research, study and other points of view some of them having already been mentioned and referred to so truely by Maijala (1984).

From the cultural and historical aspects, local cattle breeds represent a vivid proof of the creative work of ancient selectioners and breeders establishing many populations through experience and observation and therefore being as valuable a monument as a costly restored and preserved historical construction.

Hence, from the point of view of selection process the endangered and disappearing cattle breeds, as well as all other species of economically significant animals, are extremely valuable material reflecting accurately the goals of past national economies and also the concept of selectioners at that time of animal body conformation. The existence of living animals of these breeds facilitates important comparative studies of anatomical and particularly physiological character, determination of many polymorphous traits enabling evaluation of phylogenetic relations in presently kept breeds, etc.

It is therefore highly desirable to present typical individuals of the endangered and disappearing cattle breeds at agricultural shows for object studies on possible changes in animal performance and breed during the process of improvement. This would be of special value when such breeds are kept in conserved regions, scansens, etc. as already mentioned in the example from Hungary.

In conclusion it can be deduced that the possibilities of utilization of endangered and disappearing local cattle breeds as well as other animal species are indeed versatile. In any case we must not forget our moral and human obligation to preserve these breeds for future generations as a vivid proof of the creative activities of man. If the human community can spend astronomical sums on armaments, construction of spaceships and technical development, then it ought not to hesitate to devote a negligible fraction of these expenses to conserve and preserve natural resources including endangered breeds because they are decisive and necessary for the further existence of man on this planet.

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POLISH RED CATTLE - BREEDING, BREED PRESERVATION AND UTILIZATION

K. Zukowski 1/ and Z. Reklewski 2/

1. HISTORY OF THE BREED

The Polish Red breed (PR) belongs to the brachycephalic type of cattle that has existed in central Europe since prehistoric times and was reared by western and northern Slavs. Until the second half of the 19th century no organized breeding work aiming at improving the basic directions of local breed performance had been conducted. According to Jakóbiec (1959) the most important influence on the formation of this primitive local breed has been the specific mountain and submountain environment of southern Poland where in small farms the only feed available is hay in winter and poor pastures in summer.

In the 19th century many enlightened farmers were already aware that the local cattle varieties had such qualities as strength, resistance to diseases, good roughage utilization and adjustment to local rearing conditions (Rolnik i Hodowca, 1899). The native cattle were acknowledged as being the most suitable for small farms and where conditions did not allow intensive breeding. According to Pruski (1967) local cattle populations varied in colour - from black and brown to red and mouse-grey.

When discussing the history of the Polish Red breed Pruski (1967) reports that the local cattle were concentrated mainly in the area of sub-Carpathia, Swietokrzyskie mountains and Lomza. Because of poor industrial and transportation facilities the market for milk and milk products was very small. Thus, good milk performance was not the most important aim in breeding. Acccording to Pruski (1967) Swietokrzyskie cattle of one colour were known in the middle of the 19th century as being mainly good oxen.

In the second half of the 19th century an important role in improvement of dairy breed performance was played by large herds formed from cattle purchased from small farmers. Among the first herds were those formed by Jan Popiel in Wójeza and Adolf Rudzki in Branszczyk in 1869.

Sub-Carpathia was an important region as far as breed improvement was concerned. In 1894 the Red Cattle Breeders' Association was established under the auspices of the Agricultural Society in Cracow. At that time Stefan Romer from Jodlownik formed a Red cattle herd which is still existing. In 1906 official milk performance recording was introduced. First herd books of the Polish Red cattle were published in 1913. At the beginning of the 20th century other important herds were formed by Kuberski in Subierczyn, Frackiewiez in Wieprzowe Jezioro, Czecz in Kozy, Slonecki in Jurowce, Bujwid in Wolica, and Mars in Limanowa.

After the Second World War the most important breeding herds of Polish Red cattle, apart from Jodlownik, were those in the Experimental Farm in Konskowola, the State Pedigree Breeding Stations in Koszecin, Elk and Tarnawatka, the Animal Science Experimental Farm in Grodziec and Rossocha, as well as indivdual farmers' herds: in the Wysokie Mazowieckie centre, the herds of F. Kulesza in Golasze-Puszcza, M. Wlostowski in Mystki-Rzym, J. Kulesza in Kalinowo-Czesnowo; in the Podhale centre, the herds of A. Serafin in Kobylec, L. Krzak in Golkowice, J. Zur in Chabówka W. Majchrowicz in Skawa; in the Cieszyn centre, the herd of J. Miech in Godziszów; in the Lubliniec centre, the herds of S. Piechaczek in Sucha near Strzelce Opolskie and Kolaczuch in Harbutowice. Many of the herds mentioned had already existed for about 40 years or more.

After the war many scientific centres carried out investigations on the improvement of Polish Red cattle; the following scientists should be mentioned: Professors Z. Zabielski, M. Czaja, T. Marchlewski, Szezekin-Krotow and H. Jasiorowski and Drs. S. Poczynjlo and K. Zukowski.

Milk productivity of Polish Red cattle was not high (Table 1) due to the lack of selection in the post-war period when the main task was to reproduce a sufficient number of animals. Since there was no marked progress in milk performance, in 1950 upgrading with Danish Red cattle was introduced by Prof. M. Czaja in the Animal Science Experimental Farm in Grodziec Slaski (Zukowski and Luchowiec, 1964).

Table 1 DAIRY PERFORMANCE OF POLISH RED COWS

Year of recording	Average number of cows	Average year productivity		
		Milk kg	Fat kg	Fat %
1955	11 990	2 425	93	3.85
1960	23 633	2 551	99	3.87
1970	13 065	2 901	116	4.01
1975	5 365	2 961	121	4.09
1980	4 245	2 901	118	4.05
1985	1 414	3 085	130	4.21

A total of 1969 full lactation records were collected from 481 cows sired by 51 bulls (Table 2). Milk productivity was over 17 percent better in cows with 1/4 Danish blood, 19 percent in 1/2 Danish cows and 22 percent in cows with 5/8 and 3/4 Danish blood.

In 1959 the first Red Danish herds were established, mainly in the State Pedigree Breeding Stations, from a few thousand heifers imported form Denmark. At the same time crossing was introduced in mass breeding and in breeding herds. For this purpose, Red Danish and crossbred bulls were purchased for the insemination stations in all areas in Poland where Red cattle were bred, except the Cracow region where Danish bulls were not imported until 1964. The main effect of this crossing programme seems to be a steady increase in fat content in the milk of Polish Red cows observed over the last ten years (Table 1).

According to Szarek et al. (1981) the quantitative and qualitative needs of the Polish milk and beef market changed in the 1960s. In order to adjust Polish Red cattle to changing maintenance and utilization conditions resulting from better feeding, other attempts at upgrading were made. Red Danish and Jersey cattle were used as improving components (Jasiorowski and Poczynajlo, 1970). A change for the better in the dairy performance of crossbreds was evident (Table 2). This crossing model, however, was not adopted in practice because of. the poorer beef performance of the offspring. Red-and White bulls were then used for crossing. They improved milk productivity by about 400 kg and even if they did not improve beef performance, which took place especially when body weight was lower than 450 kg (Nahlik, 1973), they did not make it worse (Szarek et al., 1981-Table 6).

Table 2 DAIRY PERFORMANCE OF PRIMIPARAS OUT OF PR COWS WITH DANISH RED OR JERSEY BULL MATINGS

Genotype	Milk	Productivity kg		
		Fat	Fat Content %	Source
Polish Red	2 561	100.0	3.97	Jasiorowski H., Poczynajlo S. materials of IGHZ PAN Jastrzebiec, 1970: performance in the Bull. Eval. Station, Szepietowo
PR x Danish Red	4 287	175.3	4.09	
PR x Jersey	3 733	175.2	4.69	
Polish Red	2 334	93.6	4.01	Zukowski K.: Effect of improving crossing with DR cattle on dairy performance of Polish Red cattle (experimental data) from Exp. Farm in ZZD Grodziec S1.), 1970, Ms. PP 99.
PR x Danish Red (DR)	2 781	111.4	4.00	
F_1 x F_1	2 698	107.3	3.97	
3/4 dc DR	3 163	125.8	3.98	
3/4 DR x 3/4 DR	3 565	142.4	3.99	

By the end of the 1970s crossing with Angler bulls began. First results were encouraging. F_1 cows in a first lactation produced 1000 kg more milk and 0.15 percent more fat than the daughters of Polish Red bulls (Staszczak, 1985). The Angler crossbreds were decisively of dairy type.

By the end of the 1960s the population of Polish Red cattle was about 2 million animals, i.e. about 18 percent of the whole cattle population in Poland. A tendency in the 1970s to intensify Polish agriculture resulted in the disappearance of Red cattle from the greater part of the area where they had existed up to that time. This was also a consequence of administrative directives. The herds of Red Danish cattle also ceased to exist at that time, some because of mass leukaemia, others as a result of new opportunities for export of young beef slaughter cattle not including, however, Red bulls which in the importers' opinion were not suitable enough for fattening. In northern and central Poland, Red cattle were replaced by Black-and White cattle, and in south-eastern Poland by Red-and-White cattle.

2. PRESENT SITUATION

A concentration of Polish Red cattle still remains in sub-Carpathia within the boundaries of the Nowy Sacz province. This population, together with animals disseminated in the adjacent Bielsko, Tarnów and Cracow provinces, is estimated to comprise 100 000 cows. Another 100 000 Red cattle are found in enclaves in Bialystok, Kielce and Rzeszów provinces. These two populations together form about 3 percent of the whole Polish population of cattle.

Breeding work was continued only in the Nowy Sacz province and in the surrounding area. Since 1975 this work has been conducted in line with an officially accepted breeding programme. Milk recording is applied to under 1 500 cows. The main centre around which this work is concentrated is the State Animal Breeding Station in Jodlownik where breeding bulls are performance tested in rearing stations. Milk progeny testing is carried out at the station. Seven young Red bulls purchased every year by Animal Insemination stations in Brzesko and Zabierzów are tested in this way About 50 percent of cows in the Nowy Sacz province are inseminated. An interest in this native breed and willingness to breed it may be testified by the fact that since 1982 when the official regionalization of cattle breeds was cancelled, the regions mentioned peviously have bought from the Nowy Sacz region considerable amounts of semen of proven Red bulls.

Environmental conditions in sub-Carpathia have improved in recent years. Feeding of cows is better and production has increased. Breeders anticipate better animal material capable of higher productivity. Tables 3, 4 and 5 show characteristics of milk and beef performance of Polish Red bulls tested in recent years. The aim of future work will be to breed animals of higher productivity and fat content in milk which determines the price. With present needs in view, upgrading with the Angler breed is carried out. In the Nowy Sacz province a moderate crossbreeding programme with 50 percent bulls which constitute a half of all the bulls used for insemination is practised. In the remaining regions of Red cattle breeding use is made of the semen of proven Angler bulls received by the Cattle Breeders' Association in Nowy Sacz from the Angler Cattle Breeders' Association in 1983 and 1985.

Table 3 PRODUCTIVITY OF RP PRIMIPARAS IN STATIONARY MILK PROGENY TESTING OF BULLS IN POHZ JODLOWNIK IN YEARS 1980-1984 (Nahlik K., Bienkowski M. and Zukowski K., 1986, in press)

No. of primiparas	No. of sires	Calving age months	Dairy performance					
			Days of milking	Milk kg	Fat kg	Fat %	Protein kg	Protein %
342	30	28	271	2 574	110	4.28	88	3.40

Table 4 GROWTH AND DEVELOPMENT OF PR HEIFERS IN THE PROGENY BULL EVALUATION STATION IN POHZ JODLOWNIK FROM 1980-1984

No. of:		Body weight at:		Measurements at 18 months age:			Index of:	
Heifers	Sires	12 mths kg	18 mths kg	Height at withers cm	Forechest depth cm	Forechest circumference cm	Depth	Massivity
390	30	264	348	117	59	161	50	138
				Measurements and indexes 10 days after calving			Index of:	
Primiparas	Sires	Calving age months	Body weight 10 days after calving	Height at withers cm	Forechest depth cm	Forechest circumference cm	Depth	Massivity
342	30	28	437	121	64	174	53	144

Table 5 BEEF PERFORMANCE TEST RESULTS OF YOUNG BULLS IN THE JODLOWNIK REARING STATION
(Szelag and Nahlik, 1980-84)

No. of bulls	Body weight at 12 mths of age kg	Daily gain: 121-360 days g	Height at withers cm	Forechest circumference cm	Index of massivity
244	398	1 132	117	167	143

The aim of breeding work is to achieve an average milk production of 3500 kg with 4.5 percent fat content and 3.6 percent protein content as well as to improve lactation length to about 300 days. The body weight of Red cows should be 450-500 kg and height at withers 125 cm.

It is expected that this programme for the improvement of Red cattle will lead to the formation of a population with at least a 25 percent share of the Angler genotype. At the moment it is difficult to predict to what degree the genotype of native cattle will change.

Stalinski (1985), when discussing the future of Polish Red cattle as a breed in danger of extinction, supposes that if the breed improvement process is still based on a small, as at the moment, active population and concentrated (including the production of sires for the breed) around only one herd - Jodlownik - it will be necessary to look for "genetic qualities from the outside" and then only will it be possible to talk about Polish Red cattle as a gene reserve in preservation herds. The author is convinced of the necessity to preserve the breed.

At present two programmes are being carried out: breed improvement and preservation of the gene pool. In view of the need to preserve the old Polish Red breed type the following action was undertaken:

- a reserve of semen from 39 Polish Red sires was formed (an average of 320 doses per sire);
- embryos were frozen from the most valuable cows (long living, fertile and healthy). Sixty-nine embryos from 19 cow donors were collected (Wierzbowski et al., 1984). It is planned to collect 650 embryos from 50 cows which, according to Smith (1984), may provide a sufficient frozen genetic stock;
- three preservation herds comprising 280 cows were established. The cows were purchased from all the regions where the breed was kept. The male to female ratio is planned to be 1:10 to 1:15. The herds will be divided into groups comprising 10-15 females.

The size of the preservation herd will be constant, thus only a very small percentage of offspring will be necessary for herd reproduction. In order to prevent a decrease in variability, offspring will not be selected. To counteract too much inbreeding only one son per sire will be left for rearing and, if possible, one daughter to replace her mother.

3. CHARACTERISTIC TRAITS OF THE POLISH RED BREED

Environment, and most of all feeding, have not led to high milk Production in Polish Red cows. Natural selection in this breed developed traits which make it possible to adapt to local conditions but which, unfortunately, usually lead to low milk production. A very slight improvement of performance traits through selection was accomplished and so the breed is not specialized and is characterized by a high genetic variability of productive traits. Average milk production of cows in small private farms is about 2500 kg with a general tendency for lactation to be restricted to 200-250 days. The cows whose milk performance was recorded in 1985 produced 30S5 kg milk, with 4.21 percent fat and 130 kg fat. in various dairy laboratory analyses it was found that protein content in milk in Red cows reaches 3.5 percent and dry matter content 12.7 percent. The milk, from these cows is highly regarded by the dairy industry due to the higher output and quality of casein coagulum which is necessary for cheese production. Table 8 presents a comparison of dairy industry data from adjacent regions where Polish Red and Red-and-White cattle are bred. To produce one unit of low-fat cottage cheese, less than 6.2 percent milk from Red cows is needed. For high-fat cottage cheese this difference reaches 5.5 percent. Dairy industry technologists feel that the milk from Red cows is the most suitable for the production of noble cheese types, especially emmentaler.

Beef performance traits are rather poorly developed in the Polish Red breed. Young cattle fattened extensively and semi-intensively give fairly good results, but because of the small size of an animal, fattening has to be finished early. Bulls should be slaughtered when their body weight reaches about 400 kg since further fattening is unprofitable because of the early development of a fatty carcass and low weight gains (Szarek et al., 1980). Fattened cattle utilize roughage feed well. Their carcass tissue composition and dressing percentage are good. They do not, however, belong -to the highest slaughter classes. Excellent material for fattening is obtained by mating Red cows to beef-type Charolais or Simmental bulls (Tables 6 and 7).

Table 6 BEEF PERFORMANCE OF PR BULLS X CHAROLAIS; PR X RED- AND-WHITE (RW), AND PR X SIMMENTALER CROSSBREDS
(Szarke et al., 1980)

	Genotype			
Trait	PR	PR x RW	PR x Sim.	PR x Charol.
Mean daily gain from 120-500 kg	720	709	769	733
Consumption of oat feed units per 1 kg gain.	7.3	7.2	7.1	7.3
Dressing percentage	57.6	57.6	58.6	59.5
Meat share in a carcass-side %	68.3	69.6	71.6	70.5
Fat share in a carcass-side %	10.4	9.1	7.8	9.2
Musculus longissimus dorsi section area (cm^2)	77.8	93.4	92.1	90.2

The investigations of Cieslar and Wawrzynczak 1978) show that when compared with Red-and-White, Polish Red cattle are distinguished by good quality meat properties, i.e. better raw meat consistency, better texture after heat treatment, more tender, juicy and better organoleptic qualities. Meat of Polish Red bulls has the highest indices of so-called total quality.

Table 7 NORMS OF RAW MATERIAL EXPENDITURE IN CHEESE PRODUCTION

			Raw material expenditure for production of 1000 kg cheese calculated so-called plasma units of milk		
Assortment	Breed Region	Producer	Year average	Winter season	Summer season
Low-fat	RW	Bobowa	8 202	8 062	8 342
Cottage	RW	Gorlice	8 112	8 094	8 130
Cheese	PR	Nowy Targ	7 690	7 060	8 320
	PR	Zakopane	7 706	7 566	7 846
High-fat	RW	Bobowa	8 228	8 202	8 374
Cottage	RW	Gorlice	8 364	8 314	8 414
Cheese	PR	Nowy Targ	7 829	7 150	8 508
	PR	Zakopane	7 957	7 690	8 224

Source: 1986 Woj. Zw. Sp. Melecz., Nowy Sacz.

Table 8 COMPARISON OF SLAUGHTER VALUE OF FATTENED BULLS (IN SLAUGHTER CLASS A)

					Share in 5 cuts		
Breed	No. of animals	Pre-slaughter weight	Dressing percentage	Share of 5 cuts in hot carcass	Meat	Fat	Bone
PR	10	483	53.1	61.6	75.4	6.4	18.2
RW	17	499	53.9	58.0	72.4	9.0	18.6
Sim	8	534	55.9	59.0	75.8	6.5	17.7
PR x Ch.	9	509	57.3	62.0	77.2	6.2	16.6
PR x Ch.	13	516	57.5	58.7	75.4	8.0	16.7

The Polish Red breed has features typical of primitive populations which are well adjusted to local environmental conditions and management. This is expressed in longevity, resistance to diseases, good fertility and good calf-rearing performance. This may be illustrated by the fact that there were no problems in choosing 14-20 year-old cows which were still fertile to be donors of embryos for genetic reserves (Wierzbowski et al., 1984).

The results achieved in test bull rearing stations proved the good reproductive ability of this breed. Only 2 percent Red bulls are culled because of bad semen quality which could not be used for reproduction. In Black-and-white and Red-and-White bulls 9 percent of animals were culled for this reason (Szelag and Nahlik, 1980-1984).

The health of Polish Red cows is much better than that of Friesian cattle. Metabolic disorders, footrot and limb and hoof ailments are practically unknown in Red cows. Udder inflammation is also rarely found. The good health standard of the breed may also be testified by the fact that in a group of 400 cows, mostly old, purchased from several provinces to complete preservation herds, no cases of illnesses, including leukaemia, were officially recorded.

4. PROSPECTS TO UTILISE THE POLISH RED BREED

It is difficult to foresee at the moment which traits characteristic of the Polish native breed may be utilized in the future. Friesian cattle including Holsteins, although having undeniable production qualities are characterized by lower fertility and susceptibility to numerous diseases and thus their period of production is shorter. As a result even when milk productivity increases, the economics of cattle breeding become unattractive due to the poor results from rearing young cattle. Polish Red cattle have these qualities which highly-productive breeds lack.

Sceptics claimed that it was no use building up genetic reserves since from the economic point of view crossing with low-productive local breeds would not be profitable. In recent years, however, the situation has changed. Due to the development of genetic engineering it becomes possible to use not only the whole genotype or genome, but also selected chronomsome fragments which carry particular genetic information. Theoretically, this would make it possible to introduce a qualitatively important trait without the risk of causing a decrease in the performance parameters which could take place in the case of a simple interbreed crossing.

The possible utilization of primitive breeds does exist. In Poland some pastures are not fully utilized because of unfavourable environmental conditions and it would appear that feed reserves both in the north and on mountain pastures could be successfully used by Red cattle.

At present it is difficult to predict the future nutritional diet for ruminants. At present more and more grain feeds are being used. In the years to come it might be advisable to offer cattle feeds which are not suitable for human consumption, i.e. forage, straw and by-products of agricultural production. Animals of the Polish Red type could prove very useful in a production system based on straw feeds complemented with concentrates.

If local breeds are distinguished by some specific production qualities characteristic of a given genotype, there should be no doubt as to the necessity of their preservation. There are some specific examples of local breed utilization for the improvement of production traits, as in the case of crossing Finnish sheep with Romanowska.

It is likely that quality, including taste of products of animal origin will become so valued with time that they will be given economic importance. Then the positive traits distinguishing the milk and beef of Polish Red animals will be appreciated, which could become the basis for wider breed utilization.

Genetic reserves in the preservation herds may also be treated as a control group in the estimation of genetic progress in the active population. Animals from preservation herds may be used in immunogenetic, physiological and nutritional investigations.

Those who are against the active protection of local breeds of domestic animals emphasize the costs of this undertaking. Also, there is no certainty that the protected breeds will ever be useful and therefore they doubt if these activities are justified from the economic point of view. These doubts are difficult to be refuted with valid arguments. However one may certainly talk about reasons of an aesthetic nature, willingness to preserve elements of material culture of previous generations or, simply, saving from complete extinction. We live in times when the views on . future development models of civilization on our globe are changing. This change is caused by the shortage of energy and minerals. If it is desired to have the possibility of manoeuvrability in animal breeding, we cannot waste the genetic potential of local breeds.

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GENETIC ANALYSIS OF THE EUROPEAN BISON POPULATION

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In 1923, at Poland's suggestion, the International Society for the Protection of the European Bison was created. Its principal aim was to preserve the European bison by planned breeding and reproduction. Stocktaking in 1924 showed that only 54 individuals existed (29 males and 25 females) with a reliable pedigree. The European bison pedigree book was initiated for this species and it is still in operation. For each animal the book contains its sex, number, name, dates of birth and death, numbers of parents and breeding place.

The species was derived from a foundation herd of only 17 animals. Some pairs of ancestors were represented by only one descendant and that is why the gene pool of the species contains only 12 genotypes. It was impossible to prevent inbreeding in this population, and in consequence the inbred animal has a negative influence on viability, fertility and health. The aim of this paper is to show the situation in the population of European bison born before 1985 according to their inbred level.

The European bison is a wild species living in a mostly natural environment, but mating is under control. This is why very interesting material exists for studies on inbreeding and its effects.

For bison born before 1985 the following values were computed: inbreeding coefficient, length of life, and for females also age at first calving, average interval between calvings and number of offspring.

Mean value of inbreeding coefficient for 4509 animals is 0,202 ± 0.002; for 68 individuals it is greater than 0.500. Such a high value of inbreeding coefficient can seldom be found in stocks of farm animals. That fact could lead to the conclusion that the population of bison has degenerated. This is not true: bison are very well adapted to their living conditions, they are healthy and their reproduction level is satisfactory. It was noticed that only young animals were sensitve to a high inbred level. With the growth of inbred level the percentage of juvenile deaths increases. The chi-square test showed that this influence ; is highly significant. Table 1 presents percentage of juvenile deaths (in to the age of two years) in groups with a growing value of inbreeding coefficieni.

Correlation between inbred and some reproduction traits was estimated, and the results are presented in Table 2. Correlation coefficients are rather low, the only significant fact being that inbreeding increase: the average interval between calvings and the age at first calving and indirectly decreases the number of offspring. This influence is highly significant but still rather low. If parents have high inbreeding coefficients, the smaller number of their offspring takes part in further breeding (i.e. have offspring themselves). On the whole,, such a low influence of inbreeding on reproduction traits is surprising.

Table 1 PROPORTION OF JUVENILE DEATHS ACCORDING TO INBREEDING COEFFICIENT VALUE

Inbreeding coefficient value (%)	Number of animals	Percentage of juvenile deaths
0-3	608	21.55
3-10	616	25.00
10-17	690	22.61
17-24	744	20.57
54-30	779	21.57
30-37	528	25.76
37-44	306	25.16
44	238	29.41

Table 2 CORRELATION COEFFICIENTS BETWEEN INBREEDING COEFFICIENT AND SOME REPRODUCTION TRAITS

	Females	Males
Age at first calving	0.14 xx	
Average interval between calvings	0.15 xx	
Number of offspring	-0.116 xx	0.022
Proportion of offspring for breeding	-0.070 x	-0.097 x

Percentage of genes of each of the 12 ancestors was estimated for all bisons born between 1980-1984 (876 individuals). The results obtained were almost the same as given by Slatis (1960) for animals living in December 1954 (Table 3). The proportion of ancestral genes has practically remained unchanged in 30 years. Unchanged genetic contribution proves that variability of the population was preserved, which is rather difficult to obtain in inbreeding.

<u>Table 3</u> PROPORTION OF ANCESTOR GENES FOR BISON BORN BETWEEN 1980 AND 1984.

Number, name and of ancestor	sex	Proportion for bison living in 1954 (Slatis)	Proportion for bison born between 1980-84
15 Begriinder	M	7.05	8.2
16 Plavia	F	7.70	9.1
35 Plevna	F	3.23	2.7
42 Planta	F	19.30	18.8
45 Plebejer	M	27.03	26.4
46 Placida	F	1.33	0.9
87 Bill	M	7.71	7.2
89 Bilma	F	10.09	9.6
95 Garde	F	3.51	3.8
96 Gatczyna	F	5.68	6.3
147 Bismrck	M	0.62	0.9
100 Kaukasus	M	6.74	6.1

The reconstitution proved to be successful because the genetic variability has not been lost. The inbreeding depression has rather small effects on adults but results in lower viability of young animals. It is probably an indication of natural selection, the intensity of which is directly porportional to the inbreeding coefficient.

The reconstitution was successful due to several reasons:

- great number of breeding places (thus subpopulations were formed);
- loss of artificial selection - only natural selection which favours healthy and vital animals;
- keeping animals in their natural environment, which avoids development of physical sensibility.

THE ROLE OF SHEEP AND GOAT GENE RESOURCES IN PRODUCTION, NATURAL ENVIRONMENT CONSERVATION AND IN OTHER ACTIVITIES

L. Veress 1/

1. INTERNATIONAL TRENDS IN SHEEP AND GOAT BREEDING

There are two trends in modern sheep and goat breeding: to compete with other branches of agriculture, producers strive to increase products per animal and thus decrease production costs. Of necessity, sheep and goat breeding becomes intensive (Veress, 1984).

The rural population will leave areas unfavourable for agricultural production, arid and semi-arid steppes and mountain regions if sheep and goat breeding is not supported by the state and consequently these lands will become unused (Veress, 1984). The examples are some mountain pastures in Yugoslavia and Slovakia, where the number of sheep has greatly diminished. In UK, the Soviet Union and a number of other countries sheep and goat breeding is supported by the state in such regions to retain the population and protect the environment.

Ancient breeds have mostly survived in regions having unfavourable conditions where views on breeding and economy are more conservative. It is also in these regions where efforts are made to preserve them.

Unfortunately breeding in farms of these regions is carried out with the help of their own gene reserves, which diminshes their chances of making a profit. This process in itself therefore does not guarantee the prevention of further decreases in the population and the immigration of genes. The creation of the "Rare Breeds Survival Trust" in UK is considered an important step on an international level. This Trust gives further support to preserve breeds that have a less than 20 percent ratio from outside the breed. It is firmly believed that the ancient breeds can only be preserved if state aid is accompanied by social unity together with financial support.

This conviction led us in 1982 to establish the Society of Hungarian Racka Breeders whose members are mostly private breeders. Breeding and further improvement of Racka sheep are carried out by the members partly through a sense of patriotic duty to preserve this noble and well-composed breed. Apart from the fact that this activity gives pleasure, it is also a useful hobby.

The leaders of the Society were elected by the members and they do their jobs unpaid. Since the Society was founded, interest in Racka breeding has increased, the stock has also multiplied and breeding animals have also been sold abroad. Meetings and consultations are held on workdays but out of working hours.

2. WHAT ARE THE REASONS FOR PRESERVING ANCIENT BREEDS?

It is well-known that local breeds are well-adapted to local conditions, in many cases with an unfavourable climate, and that they utilize the less attractive vegetation better than culture breeds. For example, the main feed of the North Ronaldsay sheep are the mosses washed onto the sea-shore (Alderson, 1981). In fact, crosses with culture breeds will not improve, but in certain cases decrease, the productivity of the population (Hodges, 1984).

Several local breeds seem able to resist certain diseases (piroplasmosis, scrapie, etc. - Rendel, 1981).

Growth rates of several local breeds remain stable in poor feeding seasons, but these are fully recuperated on spring pastures. Other breeds such as fat-tailed and fat-rumped sheep endure thirst and hunger excellently, and use their fat deposits to satisfy their needs.

Especially at the turn of the 19th and 20th centuries, experts aimed at a thicker skeletal conformation of culture breeds. They supposed that the animals might grow stronger this way. The clumsy, usually diploe-skeleton resulted in difficult lambing. The unrefined breeds are usually characterized by finer skeletons and easy lambings.

All over Europe breeders nowadays are forced by the slaughter animal trade to produce animals that are not far from the phenotypes of the so-called terminal breeds. The outcome is that within the English Down breed type, mature weight differences between the early maturing Southdown and Dorset Down types and later maturing Oxfordshire Down and Suffolk breed types diminish, or more exactly body weights in both breeds become higher (e.g. American Suffolk). A similar case can also be seen with mutton Merinos, since their mature weight has increased by about 40 percent in 30 years. I consider it to be even more irrational that milk Friesians are selected for mutton in Western Germany (Luke and Müsch, 1983). The body weight of the Finnish breed known for its prolificacy increased to an even greater extent than that of the German mutton Merinos. It is an aim in Romanov stock sheep farms to increase body weights and wool production. At the same time the frequent lambings which are characteristic of this breed have in many stock farms been reduced to one lambing per year. In broiler production it was made clear a long time ago that it is possible to have the least expensive and at the same time a very good quality slaughter chicken by crossing a prolific mother line having a small body weight with a less prolific but heavy and well-muscled cock line. Increases in body weights in reared sheep and goat lines decrease the number of population per given (and at the same time non-increasable) land unit and so the number of lambs possible to include in this unit also becomes fewer. It is well known that the bulkier breeds demand for feed is greater. I would like to mention one Brittany breed as a rarity whose mature body weight does not exceed 10 kg (J.M. Elsen, 1985, personal communication).

Another, also poorly studied topic, is mutton quality. In Europe, mutton containing less total pigment is regarded to be of better quality because it is supposed to be less mature. Nevertheless, in UK the more finely muscled Herdwick breed having a smaller body, and in France the Massif du Central breed, also with a small body and mutton of a darker colour, give the tastiest mutton. At the permanent agricultural exhibition in the USSR lambs of the same age from 20 different breeds were slaughtered and given to the best known sheep breeders of the country to taste. The meat of finely muscled Romanov breed with high total pigment was most favoured (Kovnerev, 1978, personal communication).

In New Zealand, the question as to which breed tastes best was answered by the most authoritative Romney breeder, A. McGregor (1985, personal communication), who said it was the meat of the Merino because its mutton is less fatty, more finely fibred and pigmented. It is well known in Hungary that the mutton of the Racka breed is much tastier than that of Merino. The ancient sheep breeds having lighter body weights usually have tastier mutton than the mass-produced mutton breeds whose muscles contain more insoluble connective tissues.

In most culture breeds the aim is to select a white stock despite the well-known fact that it is the fleece of pigmented crossbreed types that gives the best hides (e.g. Romanov). A couple of years ago several scientific articles from Iceland claimed that the local pigmented breeds had a higher fecundity and a longer, more favourable heat season (Adelsteinsson 1970; Dyrmundsson 1978; Dyrmundsson and Adelsteinsson 1980). More recently Maijala (1981) also put forward a proposal to preserve the earlier colour variants in Finnish breeds. In a smaller sized Merino Landschaf selected for the highest possible litter size and lambings in every 7 or 8 months more and more frequently smaller or bigger pigment spots appeared on the heads and legs (M. Burgkart, 1981, personal communication). A similar case was observed in Booroola Merinos.

In the Kazahstan region of the USSR Butarin (quoted by Litovcsenko and Esaulova, 1977) has for the sake of better acclimatization crossed the Argali breed with Merinos. Mason (1981) gives an account of crosses with moufflons in Cyprus. The experiments made with crossing dedomesticated goats and angora goats in Tara Hill by the Invermay Agricultural Research Institute are also of great interest (J. Allison, 1985, personal communication). However I must agree with the earlier standpoint of Cunningham (1980) and Bodó (1982) that the carefully studied local breeds seem more suitable to create new synthetic breeds.

So long as a breed consists of a small population inbreeding cannot be avoided (Bodó, 1982). The low variability seen in immunogenetical examinations of pure-bred animals also points to this fact (Fésüs, 1981). The black variant of the Hungarian Racka sheep was conserved for more than 30 years by one of our members who rarely bought rams from other stocks. Lambs from the inbreeding of the Romanov breed, which has a relatively small population, gave more favourable results in body weight increase and fecundity rate than the ones from top-cross matings. Only the lambs from very lose inbreedings ($R = 0.25$) had a significantly higher mortality rate (Arszeniev, 1982). This points to the fact that the probability of lethal and sublethal genes appearing is greater in breeds having a small population than in the highly populous ones.

3. MEASURES TO BE TAKEN IN THE FUTURE

Many excellent proposals to preserve breeds have been advanced by others (Bodó et al., 1980; Barker, 1980; Alderson, 1981; Maijala et al., 1984) and two of these only will be repeated: in breeds likely to be utilized in gene reserves, at least 500 ewes and 7 or 8 ram lines have to be conserved in every colour variant. So as to preserve a wider possible range of gene frequency in breeds it is advisable to deep-freeze semen from excellent rams and zygotes from outstanding ewes. St. Salamon (1985, personal communication) had a 60 percent fecundity rate through direct endoscopic insemination into the uterus with ram semen stored for 15 years.

As far as possible the intervals between generations have to be widened, i.e. animals with great life productions and a solid body frame have to be kept for breeding for possibley longer periods.

The fashion of crossing for its sake alone has to be abandoned. Local breeds must be entered in international flock books (Dohy 1984). Apart from state support national collaboration is also essential. National funds are needed to preserve, individually register and mate breeds. In addition the hobby of breeding ancient breeds has to be popularized in areas where herds can be put on common pastures in summer and can spend winter around houses surrounded by large sites.

The tastier mutton of local breeds has also to be popularized to increase its demand which would lead to higher purchase prices of animals for breeding and for slaughter.

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FUTURE PROSPECTS ON THE USE OF POLISH NATIVE SHEEP BREEDS

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Several native breeds of sheep could be distinguished in Poland before World War II. The most important among them were the following:

Zackel	-	white and dark varieties - in the Carpathian mountains in the south of Poland
Fagas	-	along the Baltic Sea shore
Karnówka	-	central northern part of Poland
Krukówka	-	south eastern part of Poland
Swiniarka	-	central part of Poland
Wrzosówka		

Most of these local breeds were described in the outstanding book of M.L. Ryder, "Sheep and Man" (1983).

These native breeds were either improved later by means of crossing with cultural European breeds or they completely disappeared. However the sole native breed which now exists was recently conserved as a gene resource, viz. the Wrzosowka or Polish Heath sheep. This is a very old native breed of small, grey fleeced sheep, once forming a numerous population which is very well adapted to the extensive system of feeding and management. It expanded over into the north-eastern territories of Poland within her former borders.

In the late 1920s, in the centre of this region, the Polish Government established an experimental station in Swiskocz (actually in Belorussian SSR) with the main task of studying the local native breeds of farm animals. The present authors are fortunate in being able to compare the actual data on performance of the Wrzosówka sheep with the report on this breed by Czaja (1937), who was director of the experimental station in Swislocz at the time.

The situation changed during World War II, but we still have within our borders a large strip of land formerly occupied by the Wrzosówka breed.

In the 1950s and 1960s the Wrzosówka population rapidly decreased in favour of more productive breeds of sheep. In 1970 it was nearly extinct, at which point the conservation programme started. At present (1986) we have about 1000 breeding ewes registered in the Wrzosówka flock book and several hundreds in commercial flocks of this breed. The breeding scheme adopted is based on a model elaborated in New Zealand: 1 nuclear flock and 10 affiliated flocks, introducing rams from the nucleus and sending some replacement ewes there.

The Wrzosówka fleece is a coarse one, consisting of numerous and rather long down fibres supported from inside by comparatively short, stiff, medullated hairs. The fleece as a whole is downy. the skins are thin, light and show a good tensile strength. A short tail is characteristic for Wrzosówka sheep. This trait together with the type of fleece and body conformation are important indicators of the mouflon origin of the breed, which is usually classified as belonging to the North European, short-tailed group of sheep. As such it is a close relative of the Romanov breed, but there are apparent differences: it is smaller, its body is more compact and its nutrient requirements are by far lower. A very important trait of the Wrzosówka breed is its good reproductive performance level (see Table 1). Its breeding season extends nearly all the year round First matings of ewe lambs can be successfully done at the age of 8 months. Average litter size in adult ewes ranges up to 1.75-1.82. Good results were obtained with Wrzosówka ewes in a frequent lambing system (see Table 2).

Wrzosówka sheep can be kept in pure-bred flocks, expecially in areas where extensive, poor grazing on light sandy soils is available. Its wool can be best utilized for hand-made folklore type carpets. Its skin is an excellent material for making coats, which are light and well insulated from the cold.

Table 1 PERFORMANCE LEVEL OF POLISH HEATH OR WRZOSOWKA SHEEP
In once per year lambing system
(according to Zelewska et al. 1985)

					Number of lambs weaned	
Age group of ewes	Total number of ewes put to ram	Lambing period	Fecundity %	Litter size at birth	per 100 lambs born	per 100 ewes put to ram
Ewes over	1 541	Jan-Mar	84.2	1.71	91.2	131.0
1 year old		July-Aug				
(mixed age)		Nov-Dec				
		1975-80				
Ewes over		Jan-Mar 1981	92.5	1.50	89.0	123.8
1 year old		Feb-Mar 1982	90.6	1.38	92.0	115.3
(mixed age)						
Average			86.0	1.64	90.9	128.5
Ewe lambs bred	57	Jan-Feb 1983	93.0	1.36	90.3	114.0
when 8 mths old	43	Feb-Mar 1984	97.7	1.48	100.0	139.5
Average for ewe lambs			95.0	1.41	94.8	127.0

Table 2 PERFORMANCE LEVEL OF POLISH HEATH OR WROZOSOWKA SHEEP
In frequent lambing system
(according to Zalewska et al., 1985) Mixed age of ewes, all over 1 year old.

						Number of lambs weaned	
Lambing period	Interval between previous to present lambing	Total number of ewes put to ram	Fecundity %	Litter size at birth	Lambs weaned per 100 lambs born	per 100 ewes put to ram per one lambing	per 100 ewes put to ram per year
Nov-Dec 1982	9 months	173	87.3	1.46	93.7	119.7	159.6
Oct-Nov 1983	11 months	175	92.6	1.64	96.2	146.3	159.6
May-June 1984	7 months	161	93.8	1.82	95.4	154.0	264.0
Feb-Mar 1985	9 months	196	94.9	1.69	92.4	148.0	197.3
Average	9 months	92.2	1.65	93.1	142.0	189.3	

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OLKUSKA SHEEP - A HIGHLY PROLIFIC POLISH SHEEP

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In the region of Olkusz a local type of sheep is known for high litter size (triplets and quadruplets). It has never been acknowledged as a breed but is known as the Olkuska sheep. At present the old type of Olkuska sheep is endangered as a result of crossing with rams of different breeds, e.g. Romney Marsh. Compared to 10 000 Olkuska sheep in 1960 the number of today is estimated at no more than 200. It can be found on small private farms, usually numbering from one to five. Ewe lambs are mated for the first time at the age of 10 months. Ram lambs as well as part of the ewe lambs from multiple litters are slaughtered for their skins in the autumn.

For several years studies have been conducted by the Department of Animal Genetics and Breeding, Agricultural University, Krakow, on the old type of Olkuska sheep in the "Domana" flock of about 50 ewes, owned by W. Grabowski, graduate of the Agricultural University. Obeservations show that the Olkuska ewes attain a body weight of about 60 kg, display high litter size (Table 1), good milking performance and mothering ability. It is exemplified by the ewe "Greta", which up to the age of 7 years gave birth to 28 lambs, including 26 weaned, and by the ews "Kaledonia" (Table 2). Studies are also carried out by the Institute of Animal Genetics and Animal Breeding, Polish Academy of Science, on inheritance of high litter size (Olkuska rams are crossed with Merino ewes). The F_1 ewes aged one year have shown high fecundity, unusual in Merino (Table 3). We consider that the Olkuska sheep is suitable for developing synthetic fertility lines.

The need to preserve the genetic material of Olkuska sheep should be officially recognized otherwise it will be completely lost since it is a sheep typical of small private farms which with time is becoming less and less numerous.

Table 1 PEDIGREE OF SIRE KORLEONE FROM DOMANA FLOCK

♂K0RLEONE																		
♂Tobiasz	♀Brahma	3x3																
♂Babinicz	♀Tenka	3	♂Alik	♀Babka	4													
♂Alik	♀Babka	4	♂Alik	♀Szatana	4	♂Graca	♀Asia	5	♂NN	♀NN								
♂Graca	♀Asia	5	♂ NN	♀NN	♂Graca	♀Asia	5	♂NN	♀NN	♂NN	♀Greta	6	♂NN	♀NN				

Maximum number of lambs in a litter born by each ewe is evident.

Table 2 REPRODUCTIVE PERFORMANCE OF EWE KALEDONIA BORN IN 1982

Year	Successive lambing	No. ♂	of ♀	lambs Total	Litter weight (kg)	Body weight and sex of the smallest lamb (kg)
1983	I	1	-	1	-	-

1984	II	1	2	3	11.90	3.65
1985	III	1	1	3	16.95	4.75
1986	IV	1	2	4	16.55	3.45

In 1984 body weight of ewe Kaledonia was 63 kg.

Table 3 FECUNDITY OF EWES (F_1) OBTAINED BY CROSSING OLKUSKA RAMS WITH MERINO EWES

Ram	Daughters No.	Mean litter size X	Litters with triplets No.
Tobiasz	9	1.60	1
Godymin	5	1.40	1
Babinicz	7	1.30	-
Graca	9	1.77	-

Notice: age at first lambing - 1 year.

UTILIZATION OF EQUINES MAINTAINED AS A GENETIC RESERVE IN AGRICULTURE, TRANSPORTATION, MEAT PRODUCTION, SPORTS AND OTHER ACTIVITIES

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France as well as European countries have kept and still keep an outstanding wealth of equine genetics formed by centuries of service to man especially for traction or transportation. The progressive suppression of these uses since the beginning of the 20th century has a caused a decline in some of them, and an increase in others, and in all cases, it has caused deep mutations of the equine population, involving threats upon this wealth. What are the prospects for exploiting equine breeds as genetic reserves?

1. PRESENT MUTATIONS OF EQUINE PRODUCTION

A close look at world stocks over the last 30 years shows a drop of about 17 percent in horse numbers (FAO, 1985). This downward movement is gradual compared to France over the same period: 85 percent (Rossier et al., 1984) In compensation, during the same period, an increase of about 14 percent of the number of small equidae (donkeys and mules, Table 1) can be observed, especially in developing countries. The main reason for these movements which have slowed down in recent years, is the intensive mechanization of agriculture and transportation.

Table 1 EVOLUTION OF THE NUMBER OF HORSES AND SMALL EQUIDAE IN THE WORLD FROM 1950 TO 1984
('000 head)

Year	Horses	Small equidae (donkeys and mules)
1950	79.7	48.4
1960	67.2	54.9
1965	67.0	55.8
1970	66.8	57.2
1975	65.8	55.7
1980	61.0	54.0
1984	63.9	55.2
Evolution 1950-84 (%)	-19.8	+ 14.0

Source: FAO, 1985.

In developed countries, the present large decrease in equine production must be analysed more accurately. In fact, two opposite trends are noticeable: a slow but steady increase of racing, sport and pleasure horses but not enough to compensate the rapid disappearance of draught horses, threatened with extinction. Therefore, husbandry is more orients toward pleasure activities than to food production (horse or small equine meat), and more rarely toward keeping some for draught purposes. This is verified in most of the western and northern European countries (Bjarnason 1973; Graaf; Hulsbergen, 1984; Jansson, 1984; Leuenberger, 1984; Rasmussen, 1974; Stelzer, 1973).

Of course, the situation varies with the country: United Kingdom or Germany have almost no draught horses left; in France, these breeds still form almost half of the population (Boue and Rossier, 1979; Bour and Rossier, 1982; Rossier, 1985). The number of small equidae is particularly high in southern Europe: Greece, Italy and Spain (Zafrakas, 1985; Gougaud, 1984); they are almost inexistent in northern countries. Can this be explained by the movements of both horses and donkeys throughout history? Horses would have touched northern Europe through Asia, while the donkey, probably from Nubia, had two routes, one to southern Europe, the other to northern Africa, spreading across the Middle East and the Mediterranean (Poplin, 1985).

We can therefore see a development of highly specialized racing breeds, strong consumers of feed and needing much equipment and various infrastructures, such as the Thoroughbred for flat racing or the trotting breeds for trotting races. In the same way some special lines of saddle horses for jumping, three-day events, dressage or driving have progressively been established. On the other hand, the old specialized draught breeds are changing, at least in France, Belgium and Netherlands, to produce meat. Finally, strong development of pony breeds has been observed.

Deep changes, both structural and geographic have occurred in the populations of these countries, in the composition of stocks and in their uses. With time these changes tend to make these species marginal, compared with the main objective of animal production (Rossier, 1985). This is, without any doubt, one of the difficulties in saving these breeds.

In developing countries, mechanization, even if well introduced, still leaves a large place to animal traction (Rossier, 1984b). This probably explains the increase of the world stock of donkeys and mules (Audiot, 1982).

Rustic animals, with small maintenance needs, seem particularly well suited in this case. Thus, we note the use of local breeds, which can utilize profitably with low costs, local natural resources.

Equine production in the world and in particular in Europe, is therefore tending to develop:

- in rich areas, toward an elaborate adaptation to pleasure activities, with a steady diversification;
- and in poorer areas, towards rustic animals, able to utilize roughage and scarce feed, which would otherwise be unused.

2. PROBLEMS TO PRESERVE EQUINE GENETIC MATERIAL

The changes undergone by our societies which are mentioned above and which are sometimes extremely rapid, endanger many potentials (such as the genetic types of domestic animals) often heavily and sometimes irrevocably. In general it is not known if there will be a need for them in the future.

In fact the current difficulties in marketing some products, in particular in Europe and EEC with 12 members, and the new constraints they dictate in connection with world markets, cause the emergence of new production systems which may be more economical than during past decades. These systems are not yet very well known, and we should treat our animal genetic material with great care.

The evolution of animal product demand arising from new knowledge in dietetics, the increase in the standard of living, new fashions, more quality requirements, the need to reduce production costs and from environmental changes, strongly encourage the fight against the loss of genes (Maijala, 1970). We must try to conciliate the imperative needs of the present and the possible needs of the future, i.e. in operating and selecting the animal populations in the current economic context, we must preserve their genetic resources and their capacity for future evolution (Vissac, 1972).

In the equine breeds, we are becoming increasingly aware of these problems in relation to the very different uses of these breeds. Some preservation measures are created, such as museums, animals and documentation collections, natural reservations, national and regional parks. Numerous documentation coming from old manuals, local papers, postcards, interviews, calendars, fairs or travel reports, etc., enable the collection of traditional knowledge, but do not always ensure the preservation of the breeds themselves (Society of Ethnozootechny, 1982).

These preservation measures, in some breeds with populations from one to ten head, can even include the freezing of semen of remaining stallions (Bodó and Pataki, 1984), such as of the Dutch breeds, Groningen or Gelderland (Buis, 1984). In France, an "Office of Genetic Resources" has been created in the Department of Research, to coordinate action in this field.

As an illustration, the existence should be mentioned of Poitou donkeys in the zoo of the "Museum d'Histoire naturelle" as. well as the creation of a state "donkeyhouse" by the Regional Natural Park of the Marais Poitevin, to restore quality stock by continuous crossbreeding.

The difficulty of these actions is however more often in their mode of <u>financing</u>, in addition to the human factor. Our economies essentially aim at profitable investments and the long-range is never more than 5 years. It seems that the general increase of people's availability for activities other than directly productive (development of the tertiary sector involving state incentives, civilization generally qualified as a "leisure civilization" allowing the development of new activities) can bring solutions and help conservation. In the horse more than in other species, the preservation of the old and even current genetic types is closely dependent on maintaining their specific utilization and breeding techniques.

The horse is the domestic species showing the biggest polymorphism in development (adult weight ranging from 1 to more than 10), in capacity (draught horses, pack horses, gallopers, trotters, jumpers and walkers) (Langlois, 1973) and above all in adaptation to the most varying and difficult natural environments. This variability which man has used in different ways in various epochs, has been preserved almost undamaged until today by the multiplicity of uses for leisure of the horse. It enabled some breeds to escape the death threat which struck them all in the 1950s.

However, preservation problems arise from local breeds threatened by absorption by some higher performing genetic types, but essentially for specialized breeds whose traditional market has disappeared.

The disappearance of local breeds which were numerous during the 19th century (such as the pony of Corsica, France mentioned by Tertrais, 1982) is a classic feature. It is not specific to the horse and does not always correspond with a loss of potentiality. It is not possible to keep everything, and some choices are necessary.

Conservation or promotion of local varieties is most often only justified by their adaptation to particular and difficult breeding conditions. For instance:

- <u>The French horse of Merens</u>: found in the wild and isolated mountains of Ariège (Pyrenees), protected by people strongly attached to tradition. It has its homogeneity, which is a zootechnical curiosity, because mating occurs freely in the range (Prunet, 1956; Thevenin, 1982).
- <u>The Pottock</u>: perpetuated by the maintenance of a very old method of environmental mangement, used in the wild hills of the Pays Basque and considered by the regional farmers as a standard part of their economic system, a product to be harvested (Lizet, 1976, 1983). The same situation occurs across the boder, in Aragon (Spain) and for the Asturian and Galician ponies.
- <u>The breeds of native horses and ponies in Greece</u>; as for instance the ponies from Skyros, Pindos, Peneia, or from Kefalonia island (Menegatos, 1985a and b).
- <u>Some particularly rustic pony breeds from the United Kingdom</u>: Exmoor, Dartmoor, New Forest, Highland, etc. (Boue and Rossier, 1979) or from other countries: Iceland, Norway (Fjord) and Germany (Dulmen).

In these conditions, even if submitted to crossbreeding with improved breeds, they are most often preserved by themselves. A good example is the Corsican horse through breeding traditions adapted to the hard and frugal environment (essentially based on two principles "freedom" and "no human intervention on the territory"), they survived by progressive and continued elimination of the so-called "improving" genes which were not compatible with breeding methods (Tertrais, 1982; Audiot and Flamant, 1982). The Corsican horses, submitted to a harvest system, must find their feed in winter in a vegetation where only the cellulose-rich parts remain.

The crossbred products, which are more demanding, must be bred more carefully otherwise they develop badly and are quickly eliminated. The conservation of local varieties depends much more on biotope preservation and breeding methods than on the conservation of the animals themselves (Audiot and Flamant, 1982). The breed of Camargue in southern France is also a good example of this situation: the homogeneity of the type is preserved by natural selection, despite the various choices made in every "manade" (herd) by the breeders (Langlois, 1977).

<u>The initiation of horse husbandry in hilly areas</u>, in often very simple maintenance conditions, should promote some genetic types well suited to this environment. The recent development of draught horse breeds of Breton-type or Comtois-type in the mountains of southern France is an outstanding example of the convergence between an animal production objective (contributing to the protection of a threatened patrimony by finding another end purpose and low cost breeding methods) and the utilization of difficult areas, which are becoming increasingly deserted and damaged. The horse appeared as a very good instrument to utilize and manage land

areas (Coleou and Rossier, 1986). Otherwise, breeding methods must be improved; this is only possible if economic conditions exist. As for the pony breeds, the appearance of an interesting market, through youth riding, has led breeders to put more care in their husbandry. This enables them to use improved breeding stock and to increase the quality of their production. However, this trend does not lead to the disappearance of the rustic types, constituting the biggest part of these populations but permits more value to be obtained from more economical animals, with less obvious but more varied performances, well suited to the taste of the public as useful and durable products.

On the contrary although traditional markets have not completely disappeared for draught horses, they have decreased so strongly that the breeds concerned are threatened with disappearance (Bougler et al. , 1983). The classical symptoms of the dangers threatening the breed's with small populations are appearing: dissemination of the population, inbreeding, genetic drift, disappearance of coordination structures and advanced age of the remaining breeders. This is proved by recent studies made on some French breeds of draught horses: (Breton: Treguer, 1980; Comtois: Guillon-Dubeuf, 1981; Cob: Gorioux, 1982; Boulonnais: Rossier et al., 1983) or foreign breeds (Danish breed of draught horses from Jutland: Johansen, 1984):

The average number of mares per farm does not exceed two in each case.

According to the authors, the average coefficients of inbreeding, in general still low except for the Boulonnais (Table 2), have increased during recent years. This situation is especially disturbing as the highest coefficients are shown by the youngest animals. The situation is the same for the "Baudet du Poitou": Audiot (1977) computed an average inbreeding coefficient of 1.5 percent. The case of the Danish Jutland breed is still more serious with an average coefficient of 14.2 percent (Johansen, 1984) .

Table 2 AVERAGE COEFFICIENTS OF INBREEDING OF VARIOUS BREEDS OF FRENCH DRAUGHT HORSES

Breed	% of inbreeding	Author
Breton	0.7	Treguer, 1980
Cob	0.4	Gorioux, 1982
Comtois	1.2	Guillon-Dubeuf, 1981
Boulonnais	4.6	Rossier et al., 1983
Bandet du Poitou	1.5	Audiot, 1977

The breeders are on average older than the breeders of any other animal species. In UK 85 percent of the breeders are more than 40 years old, the average being 50.2 years old; 77 percent of the Comtois horse breeders are more than 40 years old. Among the Boulonnais breeders, almost 80 percent are more than 45 years old. The succession of the oldest is not always ensured.

This could be stopped only by a strong increase in draught horse production for meat (see below), and/or by the appearance of a "leisure" husbandry, carried out by amateurs attracted by the originality and rarity of these animals. These are other ways of utilization. Some preservation associations, more or less regional, can be created, state or private funds can be collected, new activities can be promoted or old activities can be reorganized (driving, ploughing, breeding shows, draught horse races as in numerous foreign countries: USA, Canada, Japan, Germany, UK, etc.). Such races are now organized in France, on the Japanese racing model.

But often, the type of breeder is changed. In these new uses and in the production of milk, hormones or serum, the true problems come from the coexistence between traditional and amateur breeders. The conservation of the breeds does not have the same meaning for both.

3. DRAUGHT HORSES: AN EXAMPLE OF THE CHANGE-OVER FROM AN ANIMAL FOR SERVICE TO ANIMAL FOR PRODUCTION

3.1 The Consumption of Horse Meat - An Opportunity to Retain Tradition

The consumption of horse meat offers an additional market for the heavy breeds. Moreover it offers the opportunity to utilize rustic breeds as a part of territorial planning, and particularly in the planning of marginal areas (Langlois, 1980; Audiot and Flamant, 1982). The case of France is representative: it is a traditional horse meat consumer, and has therefore kept a large population of heavy horses. Thus, France will be taken as an example, although in the EEC, Belgium, Luxembourg, Denmark, Italy and Spain are also consumers, as well as some other European (Switzerland and Sweden) and eastern countries.

The high consumption of horse meat evolved in France at the end of the 19th century, among the lower classes, such as workers and employees. This meat was considered healthy, tender tonifying, low in fat, red and cheap. It was widely consumed in families with children. Most of these remarks are still true, except perhaps regarding price.

Today, the situation has slightly altered. Retail prices have considerably risen and tend to be equal or above the prices of beef meat. French production cannot supply red meat, except for slaughtered blood horses: production is orientated toward the production of young animals with white meat (6-8 months old) or especially pink to dark pink (foals of 10 to 24 months old) (Rossier, 1984a).

Horse meat still keeps a very good image, and its consumption progressed until around 1980, in part due to the better type and location of sales points; after that year, higher retail prices have discouraged buyers.

Horse meat consumption, under various forms (not only steaks or hamburgers, but also as a delicatessen), essentially depends on the efficiency of the delivery network. It is possible that some other countries might be encouraged by this trend, in particular if they want to better utilize their slaughtered blood horses.

Can this consumption really help to create a production system? This is a difficult question, but the description of the economic situation of this production in France can highlight some facts.

3.2 Economic Situation of Horse Meat Production in France

France consumes around 70 000 tonnes (carcasses) per annum of horse meat, but they produce only 20 percent and import 80 percent.

Production, which was sufficient to meet French consumption in 1955 has continually decreased since this period with disappearance of animal traction. Currently, the relative part of slaughtered blood horses is increasing: 48 percent of national production. Draught horses, whose breeding stocks are now stabilized and are even increasing again, supply the remainder, either through slaughtering, or by specific foal meat production.

The deficit in production was first filled by imports of living animals from eastern countries. As the deficit worsened frozen meat from the USA appeared on the market. In 1984, out of 100 kg of consumed horse meat, 20 kg came from French horses, 19 kg from horses imported alive and slaughtered in France, and 61 kg from frozen meat.

Therefore, since 1972, and especially since 1979, action has been taken to reorient draught horse husbandry toward meat production: incentives to breed young mares, market clarification and organization, production organization by producer groups, increase of prices at production, development of research and application of results in the field, especially in reproduction (control of cycles, better mare management, echography, pasture exposure, artificial insemination, etc.) But there was no desire of conservation in these measures: they only arose from the economic situation.

The most worrying problem remains the small number of our breeding stock, with the low fertility rate of this species which is the main restrictive factor for the organization of effective production.

Consumption of 70 000 tonnes represents 21 000 slaughtered horses with an average carcass weight of more than 330 kg. This corresponds to the production of around 420 000 mares or to the slaughter of 2 million horses approximately, used on average, for 7 to 8 years. This is much over the present capacity of France's equine stock and the need to import is clear. These compulsory imports do not encourage the progress of national production and had until a few years ago even caused a decline. However, this type of production has some valuable resources and it must develop them: <u>nine breeds, which are a genetic patrimony unique in the world</u>; some additional income possibilities if associated with another type of production utilization i.e. cattle; of misused or no longer used ranges and of unfavourable areas; important productivity gains; a possible export market for breeding stock; a potential power supply; and also a consumption market based on organoleptic and dietetic qualities of this meat.

It is evident that national production which supplies a white or light pink meat, must be clearly differentiated from the imported product (red meat from slaughtered animals). With a particular "label", promotion of the product, based on a policy of quality, becomes possible.

Two types of production can be distinguished:

- the traditional areas, so-called "berceaux de race" (cradle of the breed); all of them are located in northern France, in a relatively intensive farming environment;
- the so-called "production or multiplication areas", relatively recent, located in southern France and especially in the Massif Central, Pyrenees, the Alps and Jura mountains.

The first case includes the residue of draught husbandry; its evolution toward meat production requirements is necessarily slow. The costs are high and productivity is still low: draught stallions traditionally breed the mares in stations or in "breeding trucks"; land Prices are high and horse production is in competition with other more profitable ventures. There is therefore little or no production payback, which implies reducing stock. This is only stopped by subsidies and by traditional selection means, such as breeding shows, considered as rural animation. In 1984, draught mare stock bred in these conditions was only about 18 000 head; the total registered breeding mares are around 40 000 head. Draught breeding, which still has a small market, especially for export, is supported by the Government and by a kind of leisure activity breeding shows; these have a place in the more general policy of rural animation. This type of production can be encouraged, if economic conditions are suitable, only by the development of intensive or semi-intensive fattening units for heavy foals.

On the other hand, in the mountainous areas of central or southern France, there has been a tendency in recent years to settle horses on little productive and increasingly deserted agricultural areas. In these conditions, the use of ranges together with cattle, leads to greatly reduced production costs. The herds are bigger and pasture lands can be better utilized. Animal size is, in general, smaller than in the "berceaux de race", and in some valleys of the Pyrenees, it can even be of pony size. the stallions used are of a semi-heavy type: they are almost exclusively Bretons, Comtois, or Ardennais. The attempts to introduce larger-sized breeds such as Percheron or Boulonnais, do not seem to be successful. Breeding conditions, often very primitive, are without any doubt at the origin of this failure.

3.3 <u>Future Prospects and Possibilities of Action</u>

As can be seen, the existence of an important market for horse meat, that could justify the production of around 300 000 horses a year (current total horse population in France), will delay, but cannot stop the progressive disappearance of draught breeds.

However, the combination of draught horse breeding with mountain agriculture, has, without doubt, been a wise choice; this is proved by the sometimes explosive increase in this type of husbandry in some areas. But this development cannot balance the loss registered in the "berceaux de race" .

If this deficit is to be stabilized, either we have to decrease consumption, which could risk destabilizing the whole sector, or we have to increase all breeds of breeding stock.

Whatever the proportion between blood mares and draught mares, a way must be found to produce these 60 000 horses per year, if only to maintain the current production level. In 1984, there were approximately 50 000 blood mares and 40 000 draught mares, or a total of 90 000 breeding mares. They will produce only 43 000 to 48 000 foals. In these conditions, our meat deficit can only increase. Therefore, our objective is to stabilize at an annual production of 45 000 foals, or around 15 000 tons of meat, and a self-sufficiency rate of 20 percent. Every breeding mare, whatever the breed, will have to be kept.

The racing sector does not show a visible increase in breeding mare numbers. The momentary increase of trotter mares balances the decrease of Thoroughbred mares, and their production, for the main part, is flowing into the pleasure sector. This field has, for some years, increased considerably. Will this expansion balance the regularly registered losses of the draught mare breeding stock in the "bercaux de race"? Will the rise of draught horse production in the production areas continue? The achievement of the previous objective will depend on this factor.

3. 4 Possible Action

The conservation of draught horse stocks starts with a market organization which protects the producers from uncontrolled fluctuations in production price. Otherwise, the draught breeds will disappear from France, as well as from other European countries with only residual populations, in general less than 5 percent of the total.

If this economic plan continues and strengthens meat production could be considered from draught breeds in both existing breeding situations: "berceaux de race" and production areas.

a. In the "berceaux de race" two types of action are taken: to conserve and to promote.

As a conservation activity the continuance of the breeding shows can be mentioned and traditional breeders are strongly attached to them. This social and historical aspect is very important and should not be forgotten. Servicing in "breeding trucks" has been developed and financed to breed mares which are becoming increasingly scattered in country areas. Less and less mares are bred per stallion, but the latter are kept in service to avoid reducing the remaining mares, by their disappearance. Stallions are changed frequently enough, giving this type of production an additional market for its stallions. Traditional husbandry structures are maintained through this commerical stallion channel.

In about 1961, some attempts were made to stimulate horse traction; they resulted in new equipment (AVTRAC) which was more competitive than the old type and was sometimes fitted with auxiliary motors. At this time, however, these attempts failed. Today, with energy savings, the concept or the horse as a supplier of energy is not completely Utopian: the use of horse traction is expanding again in some farms and for some functions.

However, the genetic situation of French draught horse husbandry in these areas is still alarming, even though a small increase of breeding mare stocks is noted. Programmes for genetic management should be set up as soon as possible for some breeds at least to limit the effects of inbreeding and genetic drift. Stud books need to be reorganized and their structures and rules renovated to equip them with the necessary means for a successful genetic policy. The most important step has been the setting up of a unique identification procedure for all animals and a unique production information channel (Bougler et al., 1983). This unique identification procedure is not operational in France.

As a promotional activity, the incentive of setting up intensive or semi-intensive fattening units and the development of better techniques in meat production can be mentioned. Some experiments are undertaken to improve stock productivity: artificial insemination, protocol of compensatory breeding for the mares found not pregnant (by echography) at the end of July, and experiments for growth and sexual control of draught stallions (in testing stations). Some advertising is made in foreign countries to export these breeding horses.

b. In the production areas, it has been recommended to settle the horse again in some underused grazing areas. As a complement to cattle, this action is justified in pasture utilization and in breeder income, independent of its own return.

In these conditions, the horse does not rival cattle. On the contrary, it enables the recovery with low costs, of some deserted pastures. Maintenance costs during winter seem the only constraint to its development. In this system, when the horse does not cost, it pays back; but then, it must be able to resist rigid environmental conditions. If the animals are not well suited to regional production conditions, there is a great risk that bad foals for meat and bad horses for riding will be produced. The development of local breeds which have disappeared since the 19th century can constitute an important organizational factor in this type of husbandry from the technical as well as the commercial aspects. In addition, the definition of various regional policies would be useful, because of the uncertainty of future production. Several ways are possible depending on the areas and the evolution of the economic situation follows:

1. Heavy foal prices at production will be increased and stabilized: this action would then tend to create important "closed herds", to improve technical control of pasture use and to try to extend these pastures to permanent "open herds", for instance in breeding stations. As far as feeding and breeding techniques are concerned the most suitable levels and periods of optimal supplementation in a system are usually sought which require the least investment. in the genetic field, the typing of our draught breed characteristics leads to the improved use of the variability between genetic types in crossbreeding. The definition of "sire breed" (growth potential, meat ability) and "dam breed" traits (size, milk ability, rusticity) becomes more important (Langlois, 1984).
2. Prices at production cannot be stabilized: draught horse husbandry will be retained only if it is impossible to replace it by type of production which is sometimes the case. Then, the promotion of rustic types, clearly defined by region, can be considered. Some mixed solutions, "meat-saddle" are even possible but in this case regional mare breeding stocks must be defined, organized and homogenized and both potentialities (cob type) must be preserved. Some other radical solution, such as the use of mares, can also be studied based on the model of Jersey cows crossed with Charolais bulls. There would appear to be some important and unexplored potentialities in horses, although these have been well known for a long time.
3. If heavy foal production completely disappears, the only way to produce a minimum of meat would be through the strong promotion of pleasure riding in all its forms by a policy of crossbreeding with any kind of French horse. To reduce our deficit, it is better to import horses to breed them, rather than just to consume them. A coordinated import policy of rustic breeding mares should be considered.

4. CONCLUSIONS

Perhaps in this paper, we have given more emphasis to the draught production for meat. However it is a good illustration of utilizing a small horse population.

The extraordinary diversity of existing breeds has been noted as well as the large variety of possible uses, for agriculture, meat production or leisure activities. Without doubt, this wide variety, in addition to an excellent adaptation to hard environments, has enabled the continuance of all these horse breeds up to the present time.

Today, choices need to be made and perhaps we are better armed to make them. However, the human factor might be the most difficult problem to solve.

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FUTURE USE OF THE POLISH NATIVE BREED, KONIK POLSKI, AS A DRAUGHT HORSE IN AGRICULTURE AND AS A RIDING HORSE FOR SPORT AND RECREATION

Tadeusz Jezierski 1/

The Polish Primitive Horse (Konik) derives from the Tarman wild horses which inhabited Eastern Europe in the Middle Ages. In the 18th century the wild horses in Poland were already becoming rare and valuable animals and received special protection in zoological gardens belonging to wealthy people. At that time the Tarpans were considered unsuitable for any kind of work because of their inherited wildness. Due to their wildness and courage the Tarpans were sometimes used in show-fights with predators. Some of the wild Tarpans were brought into a private zoological garden near Bilgoraj belonging to the Count Zamojski. At the beginning of the 19th century the horses, which had so far lived free in that garden, were captured and distributed among the peasants of the neighbouring villages and were tamed and crossbred with the local mouse-grey peasant ponies, though a considerable number of them retained the pure blood of their wild ancestors. The Bilgoraj region was poor and backward, isolated from other parts of the country, thus the type of primitive horse originating from the old wild horse survived until the 20th century. They were 110-130 cm tall, mouse-coloured with a dark dorsal streak, highly resistant to severe environmental conditions and able to find their feed in forests, wasteland and marshes.

For a long time no interest had been given to these small and primitive horses - descendants of the wild Tarpans. In 1914 Grabowski and Schuch described primitive horses from the Bilgoraj environs. Since then many horse breeders under the guidance of Prof. Vetulani began to take interest in primitive horses and to rescue them from extinction. In the inter-war period Prof. Vetulani bought from the peasants in the Bilgoraj environs most of the typical primitive horses and placed them in a forest reserve at Bialowieza in order to breed them back to their wild state. In addition, some studs of Polish Primitive horses, which Vetulani named "Konik", were established.

At present there are five state farms which breed the on the Konik (Table 1). The population of the Konik in state farms has increased during the last few years, but the situtation in private breeds is less optimistic. Although there are about 100 breeding mares in private hands, the breeding material is dispersed and practically out of control.

The measurements of the Konik are given in Table 2. According to Kownacki (1963) the height of the Konik has not changed much since. 1920. On the other hand, the forechest girth, cannon girth as well as the body weight have considerably increased mostly due to better feeding. The Konik are characterized by an excellent ability to adapt themselves to local environmental conditions, utilize cheap feeds very well and resist difficult weather conditions. Young Konik horses are able to compensate for slow growth caused by insufficient feeding in some periods. In the subsequent more favourable period their growth is accelerated. Having small feed requirements, the Konik do not tolerate intensive concentrate feeding. They display behavioural traits such as distinctly marked social hierarchy, vitality and cleverness which are characteristic of primitive breeds of animals. Excellent physiological characters of the Konik strong constitution, good health, fertility, long life cycle and hardiness make them especially suitable for keeping outdoors.

Table 1 POLISH PRIMITIVE HORSE (KONIK) AT STATE STUDS AND FARMS (1985)

Stud or Farm	Number of Stallions	Number of Mares
Polish Academy of Sciences		
Experimental Station (reserve)	3	14
Popielno (Suwalki province) (stable)	6	12
State Stud		
Racot (Leszno province)	4	34
State Stud		
Sierakow (Poznan province)	4	26
State Farm		
Dobrzyniewo (Pila province)	3	15
Roztoczanski National Park		
Zwierzyniec (Zamosc province)	3	5
Bialowieski National Park		
Bialowieza (Bialystok province)	1	4
Total breeding material	24	110

Table 2 BIOMETRIC MEASUREMENTS OF THE KONIK (according to Kownacki, 1984)

Measurement	Stallions		Mares	
(cm)	x	(min-max)	x	(min-max)
Height at withers	136.3	(134-140)	134.2	(127-144)
Height at sacrum	140.3	(135-144)	137.1	(131-146)
Trunk length	139.5	(132-155)	147.1	(141-153)
Chest girth	182.5	(174-190)	170.5	(160-180)
Chest depth	65.7	(63-67)	64.9	(57-76)
Chest width	44.0	(41-47)	38.5	(35-44)
Foreleg length	70.7	(68-73)	69.3	(62-75)
Cannon girth	19.1	(18-20)	17.5	(16-19)
Width of hips	50.0	(46-54)	49.3	(44-52)
Length of head	56.2	(52-61)	53.5	(50-59)
Body weight (kg)	420.0		450.0	

The ability of the Konik as a working horse should however be supported by systematic performance tests and selection. Unfortunately, so far, performance of the Konik horses, especially those from state farms, has tended to decrease in recent years. At state farms the horses are first of all selected for body conformation and not for working ability. It is an undesirable tendency because the Konik can lose its remarkable hardiness and endurance as an economic working horse.

Table 3 RESULTS OF VARIOUS PERFORMANCE TESTS OF THE KONIK

			Long-distance draught trials			
Author and year	Total distance (km)	Mean distance per 1 day (km)	Maximal distance per 1 day (km)	Mean speed (km/h)	Weight of carriage (kg)	
Vetulani, 1928	576	43.6		6.83	610	
Zwolinski, 1968	1 000	48.0	62.0	5.20	840	
	Draught per format tests					
	Maximal draught power in % of body weight		Mean time for 1 km (in min and sec)		Mean length of steps (cm)	
	Stallions	Mares	Walk	Trot	Walk	Trot
Vetulani, 1951	83.6	86.6	10'04"	4'03"		
Zwolinski, 1953	79.2	86.2	11'31"	4'27"		
Kownacki, 1962 a)		64.8	11'32"	3'49"	137	232
Kownacki, 1962 b)		65.2	9'54"	3'51"	150	258
Kapron and Soltys, 1983		47.3	12'05"	4'28"	132	222

[a)] Popielno Stud

[b)] Stubno Stud

During the last two years an attempt has been made to establish systematic training and draught performance tests for young stallions breeding mares should undergo in future a proper performance test before they are included into the stud. In 1982 and 1983 experimental saddle horse training of Konik stallions was conducted. The Konik have never been selected or intensively used for riding. Their body conformation i.e. poorly marked withers, short and straight shoulders as well as a' short gait, strong social instinct and sometimes stubbornness are not desirable in riding. Saddle-horse training has revealed however, that the riding ability of the Konik can be improved. Some riding performances of the Konik are given in Table 4.

Table 4 SOME RIDING PERFORMANCES OF THE KONIK

One-hour distance in walk	6 496 m
One-hour distance in alternate gaits:	
5 x (8 min walk + 3 min trot + min canter)	12 200 m
5 x (9 min walk + 3 min trot)	8 000 m
Maximal speed in canter	666 m/min
Mean speed on a distance of 20 km	8.2 km/h
Mean time for 10 km	1 hr 2 0 min
Mean time for 30 km	4 hr 20 min
Free jump	130-140 cm
Jump with ballast 13-15% of body weight	115 cm
Ballast allowed for cross-country riding (in % of body weight of horse)	23%

At present the state farms have no difficulty in selling young Konik horses. According to an enquiry published in agricultural periodicals, 191 private breeders, 18 agricultural schools and 14 riding clubs are interested in buying the Konik. The demand for the Konik was estimated at approximately 506 animals. Since not all potential buyers have responded to the enquiry, this figure seems to be underestimated. The state farms can offer for sale about 30 mares and 30 geldings a year, i.e. far below the demand. Most of the buyers intend to use the Konik for two or three purposes (Table 5).

Table 5 PLANNED USE OF THE KONIK BY BUYERS
(according to Sasimowski et al. 1984)

	Purpose	Horse breeders		Horse users	
		Number	Percent	Number	Percent
Private buyers	Work in the field	108	81.2	19	90.5
	Transport	94	70.7	19	90.5
	Horticulture	19	14.3	3	14.3
	Riding	49	36.8	4	19.0
	Other use	20	15.0	2	9.5
Experimental	Work in the field	5	55.6	2	20.0
farms of	Transport	2	22.2	2	20.0
agricultural	Horticulture	3	33.2	5	50.0
schools	Riding	2	22.2	-	-
	Other use	1	11.1	-	-

So far the Konik has not been intensively used for crossing with other breeds to transmit their outstanding qualities. Some crosses were made with pure-bred Arabian and Anglo-Arabian horses. Crosses with Anglo-Arabian are good saddle horses for recreation. Crosses of the Konik with heavy draught breeds, suitable for harder work, are needed by the farmers.

The Konik stallions were also exported to countries of Western Europe. Among others, some Konik stallions were bought by Herzog von Croy for his herd of primitively-kept wild horses in Dulmen (Federal Republic of Germany).

In conclusion it can be stated that the Konik is a native breed of small-sized working horses suitable for small farms. It can be also used for carriage, sport, recreation and distance riding.

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PROSPECTS OF UTILIZING HUCUL HORSES IN AGRICULTURE, SPORT AND RECREATION

Erazm Brzeski, Maciej Jackowski 1/

The Hucul horse holds a special place in Poland. In April 1979 a resolution was passed by the Horse Husbandry Team of the Research and Technical Council, supervised by the Minister of Agriculture, on preserving the Hucul horse together with its valuable genetic traits which have been handed down over many generations and are typical of this breed.

The Hucul horse of today is characterized, among others, by its relatively large head, low-set neck of middle length, long, wide and deep thorax as well as short and strong legs. It has a remarkable uniformity in build, is highly active, of extreme docility and longevity, has a perfect feed utilization, is easy to house and resists diseases.

The Hucul horses are by no means big animals. Their dimensions are within the following range:

Table 1 MEASUREMENTS OF HUCUL HORSES

	x	Min.	Max.	x	Min.	Max.
Height at withers	137.5	133	142	137.0	130	145
Chest circumference	173.0	162	188	180.6	167	192
Cannon circumference	19.0	18	19.5	17.9	17	19

The Hucul horse originated in the Carpathian mountains. The rigid mountain conditions often forced the horses to cover long distances and the harsh environment with scarce feed has toughened them over many generations. Their descent is not fully elucidated in spite of great interest shown by many investigators.

According to Prawochenski, "as early as 1603 K. Dorohostajski, the author of "Horse-riding" knew the Hucul horse and considered it perfectly adapted to its existence as a mountain horse".

The first Polish scientist who emphasized the need to give particular attention to the Hucul breed, as being economically valuable, was Prof. Karol Malsburg (1895).

Since this breed has a long history, only some names of the most Prominent Polish hippologists can be mentioned, such as S. Bojanowski, E. Hackl, M. Herrmann, M. Hollander, Z. Sosnowski, T. Starzewski and K. Ostaszewski .

In the inter-war period much consideration was given to Hucul horse deeding. In 1925 the Association of Hucul Horse Breeders was established with E. Bohosiewicz, a noted breeder of the Malopolska district, as chairman.

At that time the Hucul breeding stock was purchased in Poland by Bulgaria, Czechoslovakia, Greece, Luxemburg, Germany and Hungary.

Following World War II Hucul horses were scarce due to heavy losses suffered during the war. And it is only thanks to the unselfish work of many people that the breeding of Hucul horses is now steadily developing Mention should be made here of: Zdzislaw Hroboni, former chief of the Department at the Ministry of Agriculture; Eugeniusz Skucinski, former Inspector of the Polish Horse Breeders Association; and Kazimierz Gajewski, animal scientist in the Union of Animal Breeding and Trade.

At present the breeding of Hucul horses is located at:

1. Siary state stud farm near Gorlice, with 50 mares (dams) and young stock. Director: mgr Jan Barzyk.
2. Zootechnical Experimental Station of the Institute of Animal Science at Rymanów, with 10 mares (planned to be 20 mares). Director: dr Stanislaw Kolat.
3. Klikowa stallion depot near Tarnów, with 15 stallions. Director: mgr Adam Niedzialkowski.
4. Private breeders, members of the Polish Horse Breeders Association. The total number of the Hucul horse population amounts to 25 sires and 75 mares.

Pedigree horses are derived from 7 male and 11 female lines. Mean inbred index for mares is 0.014 (in the range 0.000-0.250) and for stallions 0.0127 (in the range 0.000-0.127). Mean inbred index for state mares and stallions is 0.1111.

In 1962 Miss Elisabeth Broad purchased 9 Hucul horses in Poland, which were then transported to the United Kingdom. They became acclimatized very easily and were then successfully crossed with English Thoroughbreds and purebred Arab horses. In the 1970s 3 stallions and 3 mares were sold to Finland.

Despite their low height, the ways of utilizing Hucul horses are manifold: as pack horses, saddle horses and draught horses. For long they have been used as pack horses displaying *an* ability to move ;n very rough field conditions. They are noted as being able to overcome carefully and quietly precipices or rapid streams as well as perfectly jumping over natural obstacles with innate agility.

Holländer found them useful as draught horses. Sasimowski et al. have shown in their studies an easy adaptability of the Hucul horse to supplement mechanical traction in field work. They established the normal pulling force for the mare to be 50.14 kg and for the stallion 56.84 kg. Studies on working ability and suitability of the Hucul horse to field work in the region of the Carpathian mountains in Poland were conducted by Krzysztof Bilil. His estimates of normal pulling force for horses were higher and amounted to 57.54 kg for mares and 61.6 kg for stallions. For many years horses were selected among others for their suitability as draught horses. An inquiry among horse breeders and individual users has revealed that the horses are greatly appreciated, being used for light work as a supplementary force to that of a tractor or being kept in large industrial farms of an advanced standard.

As early as 1874 Czapski reported that the Hucul horse was excellent for riding. Gregorowicz (1898) pointed out its ability to overcome obstacles with a rider on horseback. At present they are being kept as riding horses in the Siary stud, and frequently used by holiday makers or scouts during summer holidays.

Wherever the Hucul horse is used, it displays three very positive characters: intelligence, obedience and productivity. Mention should also be made of an important economic aspect - small feed requirements and very low maintenance costs compared to other breeds.

Under the project R-II-8, coordinated by the Ministry of Science and Higher Education, the Agricultural University at Krakow has elaborated a long-term plan (by the year 2000) to preserve the Hucul breed. All Polish experts in horse breeding were involved in preparing the plan which was partly presented at the 4th International Symposium in Leipzig and as a whole was discussed at the following International Symposium in Lublin.

The plan provides, among others, the development of breeding work aimed at the preservation of the Hucul horse in the state sector involving 70 mares (dams) and 15 stallions. This sector will be supplemented by the individual breeder sector involving 30 mares and 15 stallions. Basic aims are pure breeding with much consideration to male and female lines. A preliminary mating plan has been worked out for the next 49 years aimed at preventing an undesirable increase in inbreeding and too close relationships. It was suggested to use a selection method of independent culling levels, and to keep the present biometric standard.

Regulations concerning performance tests, peculiar characteristics of the breed and utilization of Hucul horses in field work and recreation are under elaboration.

The Hucul horse should preserve the valuable traits which have been accumulated as a result of many years' breeding work and coded genetically. We do believe it will perfectly supplement mechanical traction as well as serving the purpose of recreation.

New prospects are open of cooperation with Czechoslovkia, Romania and the Soviet Union in the field of Hucul horse breeding.

In a long-term breeding plan aimed at preserving this breed much consideration is given to the staff working with the animals. Great successes can be expected only when all breeding work is conducted according to the principle of "The right man in the right place".

POLISH XDNIKS IN THE ROZTOCZE NATIONAL PARK

E. Sasimowski 1/ and J. Slomiany 2/

The breeding of Polish Koniks in the Roztocze National Park (RNP) in Zwierzynice (Figure 1) was started in 1982 at the initiative of Professor Miroslow Kownacki. Four mares and one stallion which had been kept in stables and bought from the National Stud in Racot composed the initial material. Their names showing relationship and inbreeding are given in Table 1.

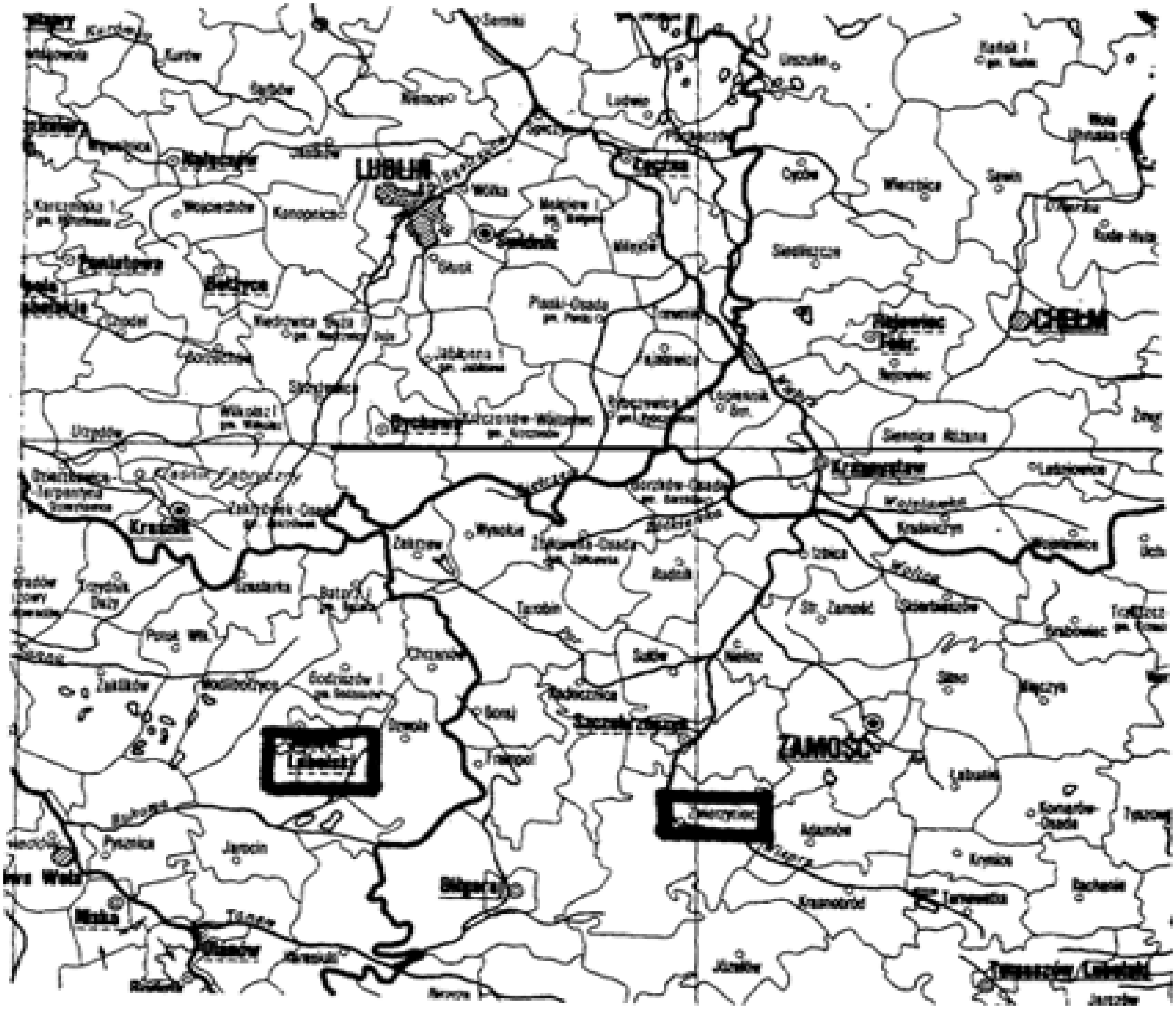

Figure 1. Location of Zwierzyiec and Janów Lubelski.

Table 1 THE INITIAL STUD OF KONIKS - COEFFICIENTS OF RELATIONSHIP (Rxy) AND INBRED (Fx)

		Rxy				Fx
Horse - sex	Mohacz	Husaria	Moda	Tuba	Hanual	
1. Mohacz - sire	_	5.93	19.87	7.58	11.49	6.250
2. Husaria - dam	5.93	_	12.37	11.30	12.68	7.81
3. Moda - dam	19.87	12.37		28.86	30.73	2.15
4. Tuba - dam	7.58	11.30	28.86	_	29.16	5.76
5. Hanula - dam	11.22	12.68	30.73	29.16	_	5.66
Jointly x	11.22	10.57	22.96	19.22	21.02	5.52

At present the stud consists of one sire, five dams (one three-year- old dam of own breeding with foal) and 14 foals and young of different ages; four-year classes of foals have been obtained so far. The stud is under the care of mgr ing. Jan Slomiany of the RNP and co-author of the present article. Research is supervised by the Zootechnical Science Committee of the Polish Academy of Sciences and directed by Professor E. Sasimowski (co-author).

The habitation of the Koniks embraces an area of about 100 ha forest and pasture which is enclosed by a wooden-poled fence. A stream and ponds on the grounds provide a watering-place all the year round.

This area is almost exactly on the spot where at the turn of the 19th century the last heir of the Zamoysky family had his reserve of wild hunting animals - among others Tarpans. When the reserve was disbanded the Tarpans were distributed to neighbouring farms and up to the present horses with some characteristics of Tarpans - e.g. mouse colour - are seen in this region. It seems reasonable that the breeding of Knoniks in the RNP should aim at creating a population which is well accustomed to the natural environment of the nature reserve which is also useful in improving the stock of this breed kept under stable conditions mainly in the neighbourhood.

In this instance the improvement of the Koniks in the reserve could be compared to that of Thoroughbreds and Purebred Arabians in breeding and producing half-bred horses. Thoroughbreds and Arabians are selected by races which test their vigour and physical efficiency; the Knoniks in the RNP are similarly tested - a good adaptation to severe conditions without stabling and concentrates is the basic test of desirable properties. It can be acknowledged as a sufficient selection factor for dams - with attending maternal care - but it appears insufficient for selecting stallions among others because movement is less intensive.

Observation continued day and night (Table 2). Both the gallop and trot portions were relatively small. The distance covered in these gaits and walk jointly averaged 5.6 +2.5 km. Moreover, in this movement there is a lack of such elements as jumps which play a significant role in the case of walk saddle horses and as surmounting resistance which is of main importance in harness.

In this connection in the previous year three two-and-half-year-old stallions were excluded from the stud and trained under saddle and in harness. This year when training was completed a performance test was carried out. It enabled us to determine many significant indices (Table 3).

Table 2 FRACTIONS (IN MIN) OF PARTICULAR GAITS IN THE OVERALL MOVEMENT OF KNONIKS AND THE DISTANCE COVERED DURING DAY AND NIGHT (IN KM)

		Walk				Trot				Gallop				Way passed			
Horses	n	x	Min	Max	S	x	Min	Max	S	x	Min	Max	S	x	Min	Max	S
Sire	7	72.9	42.1	125.9	26.4	5.0	0.3	14.4	4.5	1.4	0.1	7.7	2.8	5.9	3.3	10.9	2.7
Dams	28	67.7	42.3	93.7	16.6	3.4	0.3	9.2	2.9	1.2	0.2	6.8	2.3	5.4	2.7	11.8	2.5
Two-year-olds (born in 1983)	8	78.6	36.8	124.9	26.5	3.8	1.2	6.7	2.4	0.3	0.2	0.7	0.2	5.6	2.5	8.0	1.5
One-year-olds (born in 1983)	20	65.2	41.3	96.5	16.5	3.0	0.3	10.4	5.1	2.0	0.2	7.3	2.6	5.4	2.5	9.7	2.3
One-year-olds (born in 1984)	8	74.0	40.8	106.7	22.3	3.9	1.2	6.3	2.1	0.2	0.2	0.5	0.1	5.3	3.0	6.8	1.2
Sucklings (born in 1984)	16	98.6	57.7	133.7	25.2	3.5	0.3	18.0	4.2	2.6	0.5	18.0	4.2	7.8	4.4	19.0	3.4
Sucklings (born in 1985)	2	150.8	138.5	163.1	17.4	7.6	6.6	8.6	1.4	5.1	1.0	9.1	5.7	12.8	10.1	15.5	3.8

Table 3 RESULTS OF PERFORMANCE TESTS OF STALLIONS (MIN-MAX)

Efficiency of movement during one hour under saddle:		
- 5 x (8' walk + 3' trot + 1' gallop) - 8320 m - 9072 m		
Efficiency of movement during one hour in harness with a resistance of 8 percent body weight:		
- 5 x (9' walk + 3' trot) = 6558 m - 6666 m		
Maximum pulling power:		
248 - 252 kg (2433 - 2472 N) - 73% - 89%		
Speed at a distance of 1 km,	in walk:	11.21'-12.53'
	in trot:	4.30'-4.55'
	in gallop:	2.00'-2.50'
Size of obstacles passed at liberty:		95-115 cm
Size of obstacles passed under rider		80- 90 cm
Length of jumps:		250-300 cm
Length of step in walk	- in hand:	143-166 cm
	- under rider:	141-155 cm
	- in harness:	121-151 cm
Length of step in trot	- in hand:	210-240 cm
	- under rider:	200-210 cm
	- in harness:	180-224 cm
Length of foulée in gallop	- in hand:	224-272 cm
	- under rider:	310-330 cm

All these indices make it possible to compare the stallions observed among themeselves and with the results of experimental training and performance tests carried out on three-year groups of Koniks by Dr. S. Siudzinski at the Agricultural Academy in Poznan and Assistant-Professor R. Tomczynski at the Agricultural-Technical Academy in Olsztyn. The tested stallions can also be compared to the whole population of Polish Koniks.

This year one of the three-year-old tested stallions will become a new sire of the stud.

These tests are also useful as the stallions which cannot be included in the stud or those eliminated from the main herd are immediately used for saddle or harness. In winter during their stay in the reservation, they are even used for transporting hay which is indispensable as additional feed for the stud. They can be used for transport in the area of the RNP and can also be tried as saddle horses for the tourists resting in Zwierzyniec and in teaching local children to ride.

Observations so far demonstrate that rearing the Koniks in liberty in the pasture-forest reservation assures optimal health. Even during the recent very frosty winters when the temperature often dropped under 30° C no symptoms of cold appeared either in adults or in foals. There were also no disorders of the alimentary canal, except for worms which require" systematic treatment (deworming) twice a year - in spring and autumn.

Simultaneously, the hooves must also be trimmed as they do not wear sufficiently on the relatively soft ground and due to not very intensive movement.

Reproduction and rearing are not disturbed and are interesting to observe. Research results of behaviour, stud hierarchy, growth and development of foals controlled by weighing, biometric measurements and haematological tests are also interesting. The latter and the examination of coat and hoof horn structure also include adults.

The results of environmental research - phytosociological, hydrobiological and animal health are important in breeding. Some of them have already been reported and are now being published. The rest are now being prepared and completed by a greater number of new observations.

It is worth mentioning that the authors are actually cooperating with breeders in another herd of Polish Koniks in Janów Lubelski placed about 50 km from Zwierzyiec and 80 km from Lublin, in the Partisans' Park of National Memory. The initial material consists of local mares, i.e. the Bilgorajski horses which have the Polish Konik blood. The results arising from this research are also of interest.

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