UDK 636.03

Izlaganje sa znanstvenog skupa
Conference paper

EUROPEAN APPROACHES TO CONSERVATION OF FARM ANIMAL GENETIC RESOURCES

D.L. Simon

Summary

Based on several sources of information an overview has been given on the development, present situation and problems of conservation of animal genetic resources in Europe.

Presently, 1029 breeds of cattle, sheep, goats, pigs, horses and asses are registered by the EAAP-Animal Genetic Data Bank, Hanover. 42.8 % of the breeds are classified as being `at risk'. More than 360 conservation programmes are underway, which, however, in many cases seem to be operated independently of the status of endangerment and of similar breeds in other countries.

The primary objectives of conservation in Europe, i.e. 'conservation for potential use, later' and conservation for cultural reasons', are different from the objective conservation, for sustainable use, now, which is primarily expressed for developing countries. Different objectives call for different answers to questions, such as: are breeds appropriate units of genetic diversity, how should endangerment be defined, what should be conserved and is incrossing and selection compatible with conservation?

In view of the large number of breeds at risk and of similar breeds existing in different countries as well as the high costs of conservation it is concluded that characterisation of breeds for genetic uniqueness is presently the most urgent task in conservation. This requires effective co-operation across national borders in Europe.

Key words: Genetic diversity, Farm animals, Endangerment, Conservation programmes, Objectives, Europe

Introduction

Europe is a heterogeneous region of the world with 46 or so countries, several supra-national institutions and many Non-Governmental Organisations (NGOs). As a result approaches to conservation of farm animal genetic resources (FAGR) differ not only in the observed objectives and species but also in length of involvement and, possibly, in the effectiveness of actions in this field.

Rad je tiskan u AGRI, 1999, 25:79-99

D.L. Simon, Institute of Animal Breeding and Genetics, School of Veterinary Medicine, Buenteweg 17p, 30559 Hanover, Germany

According to FA0's World Watch List for domestic animal diversity (1995), about 34 per cent of the so far listed breeds of the major farm animal species; cattle, goats, horses, pigs and sheep are bred in Europe and about 69 per cent of the active conservation programmes of breeds at risk of the mentioned species are underway in this region. Obviously, Europe can play an important part in the maintenance of the world's farm animal genetic resources.

The activities in Europe started some time before the UNCED Rio Conference in 1992 formulated the Convention on Biological Diversity. One significant milestone in the process of growing awareness of conservation was the informal and later formal foundation of the Rare Breeds Survival Trust (RBST) in 1968 and 1973, respectively, and the foundation n of the Rare Breeds Farm Park, 1969, at Warwickshire in the United Kingdom. Subsequent milestones were:

1969 Discussion of "Needs and methods of gene conservation in animal breeding" in the Genetics Commission of the European Association for Animal Production (EAAP), in Helsinki (Maijala, 1970).

1970 Use of markers to estimate genetic distances among breeds (Kidd and Pirchner, 1971).

1979 Animal breeding scientists propose a definition of the status of endangerment of breeds and criteria for conservation of endangered breeds (Deutsche Gesellschaft fiir Zuchtungskunde, 1979).

1979 Foundation of the Nordic Working Party on Animal Gene Banks for the Scandinavian countries (Maijala et al.,1992).

1980 Set-up of the Working Group on Animal Genetic Resources (EAAP-WGAGR) by the Commission on Animal Genetics of the European Association for Animal Production.

1983 Survey by the EAAP-WGAGR on breeds and country populations in Europe (Maijala et al.,1984).

1987 Set-up of the EAAP Animal Genetic Data Bank (EAAP-AGDB) at the Institute of Animal Breeding and Genetics, Hanover (Simon, 1990) .

1992 Commission of European Communities "Workshop and Training Course on data collection; conservation and use of animal genetic resources" in Hanover.

1993 EAAP-publication No. 66 "Genetic diversity of European livestock breeds", with status of endangerment and formation of groups of similar breeds.

1994 Nomination of National Focal Points in FAO Member-Countries of Europe as national co-ordinators for conservation of FAGR.

1996 INTERNET presentation of information of European breeds by the EAAP-Animal Genetic Data Bank, Hanover, and INTERNET-presentation of information of the FAO Domestic Animal Information System DAD-IS, Rome.

Conservation of farm animal genetic resources is a continuous process, which in Europe is taking place on several levels and with different kinds of actions. Earlier reports on the situation in Europe were given by Maijala et al.(1984), as a report of the EAAP-Working Group on Animal Genetic Resources; Simon and Buchenauer (1993), as a report of the EAAP Animal Genetic Data Bank, and by Ollivier et al. (1994), with concluding remarks on the situation in different regions of Europe and on urgent tasks. Since then the nomination of National Co-ordinators for conservation in European countries and the forthcoming of the EC-Regulations 2078/92 and 1467/94 have given additional strength to the idea of conservation of FAGR in this region.

For the preparation of this paper, information of the following sources could be used: From the EAAP-AGDB, Hanover, information on breeds of the major farm animal species; cattle, sheep, goats, pigs, horses and asses, as registered until February 1997; in addition information from the National Organisations of EAAP, the National Focal Points for Animal Genetic Resources of European countries, the European Commission in Brussels, from many NGOs and from individual experts who are active in this field.

The intention of this paper is to collect present information of various sources and form one integrated picture of approaches to conservation of farm animal genetic resources in Europe and to come to conclusions on priorities of actions in this field.

Quantity of Farm Animal Genetic Resources, Number of Breeds

Following the practice of the EAAP-WGAGR, the quantity of farm animal genetic resources is measured in terms of breeds. This term is used for a group of similar interbreeding animals within a country; which, according to the people who work with them, should be regarded as a breed. The term breed includes groups of animals, which by other people may be called strain, variety or line. Anonymous term could be 'country population' as explained by Maijala et al. (1984).

The number of breeds of the major farm animal species; cattle, sheep, goats, pigs, horses and asses which have been recorded by the EAAP-AGDB until 1997 is presented in table 1.

In 36 countries a total of 1029 breeds is recorded. Only breeds are listed for which a reasonable amount of information could be obtained. The number of breeds of the individual species; cattle, sheep, goats, pigs, horses and asses is 311, 338, 101, 134, 139 and 6, respectively. These numbers are quite impressive; however, due to the recording systems within countries they may include several breeds with the same or similar genetic background. This can be a problem if decisions have to be made, such as which one out of several endangered breeds should be conserved and which not. It will be of interest to know how many of these breeds are considered to be endangered.

Status of Endangerment of Breeds

The question which criteria should be used to define the status of endangerment of a breed is not settled. Several systems have been proposed (Deutsche Gesellschaft ftir Züchtungskunde DGfZ,1979; Maijala et al.,1984; European Commission 1992,1994; Bodo, 1995; FAO, 1995; Simon, 1995; and others). The procedure applied here is basically the same as that proposed by Simon and Buchenauer (1993). It considers four conditions which represent danger for the continuance of the present genetic makeup of a breed:

- Low number of breeding herds and decreasing population size, each as an indicator of imminent danger of the loss of the breed in the near future,
- 'immigration' or use of animals of other breed(s) for reproduction, as a factor in the genetic change of the breed,
- low' effective population' Ne size as a condition which affects the increase of inbreeding as well as random drift of the population's gene frequencies.

A three-step procedure, is applied. Firstly, definition of species' specific minimum values of effective population size Ne for five classes of endangerment, depending on maximum values of acceptable inbreeding F-50, after 50 years of conservation. For the five classes of endangerment the following maximum values of F-50 were assumed:

1) not endangered ≤10%,
2) potentially endangered 10-20%,
3) minimally endangered 21-30%,
4) endangered 31-40%,
5) 5 critically endangered >40%.

The corresponding maximum increase of inbreeding per generation ΔF is deduced from F-50 by solving formula (1)

$$Fg = 1 - (1 - \Delta F)g \text{ (Falconer,1989) (1)}$$

$$\text{for } \Delta F = 1 - (1 - Fg)^{1/g} \text{ (2), where } Fg = F\text{-}50.$$

The generation interval y (in years) with the resulting number of generations g in 50 years are assumed for the six species as follows (y/g): pigs 1.5/33, sheep and goats 2.5/20, cattle 3.5/14, horses and asses 4.5/11.

The required minimum effective population size per species and class of endangerment is deduced from ΔF per generation by formula (3)

$$Ne = 1/(2\Delta F) \text{ (Falconer, 1989) (3)}$$

Table 1. – NUMBER OF BREEDS IN SIX FARM ANIMAL SPECIES IN EUROPEAN COUNTRIES (EAAP-ANIMAL GENETIC DATA BANK, 2/1997)

Country	Species						Total
	Cattle	Sheep	Goats	Pigs	Horses	Asses	
Albania	5	8	8	4	4	0	29
Austria	8	2	0	0	2	0	12
Belgium	10	6	3	3	4	0	26
Bulgaria	2	0	0	0	0	0	2
Croatia	5	4	1	1	4	0	15
Cyprus	2	2	2	3	0	0	9
Czech Republic	1	1	0	1	1	0	4
Denmark	5	4	1	2	2	0	14
Estonia	3	0	0	1	1	0	5
Finland	4	2	1	2	11	0	20
France	44	55	6	17	31	0	153
Germany	27	26	5	16	11	0	85
Greece	3	12	2	0	2	0	19
Georgia	3	0	0	1	0	0	4
Hungary	1	3	0	1	6	0	11
Iceland	2	2	1	0	1	0	6
Ireland	12	5	1	2	5	0	25
Italy	31	54	29	9	20	5	148
Latvia	1	0	0	1	0	0	2
Lithuania	2	0	0	1	0	0	3
Luxembourg	4	1	0	1	3	0	9
Netherlands	4	11	2	3	3	0	23
Norway	3	6	1	2	4	0	16
Poland	4	8	0	8	2	0	22
Portugal	8	9	3	1	3	0	24
Romania	5	5	1	7	0	0	18
Slovakia	2	3	0	1	0	0	6
Slovenia	3	2	0	3	1	0	9
Spain	34	37	18	3	1	1	94
Sweden	2	3	1	0	2	0	8
Switzerland	8	9	9	3	3	0	32
Ukraine	6	0	0	3	0	0	9
United Kingdom	36	56	4	14	10	0	120
Other*	21	2	2	20	2	0	47
Total	311	338	101	134	139	6	1029

*former CSFR, USSR, Yugoslavia

The resulting values of effective population size Ne per species and class of endangerment are listed in table 2. Secondly, for the individual breed computation of the effective population size Ne' by means of the formula (4)

$$Ne' = 4mf/(m+f) \text{ (Falconer, 1989) (4)}$$

With m and f the number of male and female breeding animals, respectively, wich are used for the reproduction of the breed. We defined f as the number of females wich are registered in a herdbook (since) these allow pedigree-information in planning of matings for reproduction to be observed),

Table 2 – ASSUMED MAXIMUM VALUES OF INBREEDING IN 50 YEARS OF CONSERVATION, F-50% (), AND RESULTING RANGE OF EFFECTIVE POPULATION SIZE NE PER CLASS OF ENDANGERMENT

Species	Class of endangerment				
	1)	2)	3)	4)	5)
	Not ending. (≤10%)	Potentially ending. (11-20%)	Minimally ending. (21-30%)	Ending. (31-40%)	Cirtically ending. (>40%)
Pigs	≥ 157	156-74	73-47	46-33	<33
Sheep+goats	≥ 95	94-45	44-28	27-20	<20
Cattle	≥ 67	66-32	31-20	19-14	<14
Horses/asses	≥ 52	51-25	24-16	15-11	<11

and which are used in the order of 100 per cent for purebreeding. In case these requirements are not met f is estimated as ¼ of the number of unregistered females U (or of the total population size T), times the percentage of purebreeding p:

$$f=pU/4 \text{ or } f=pT/4$$

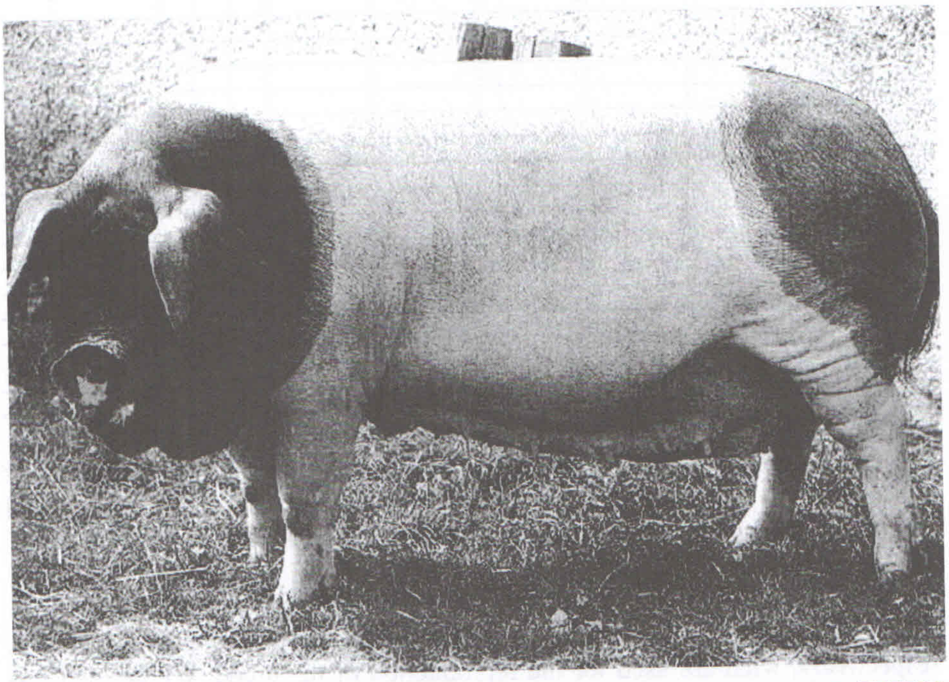

Figure 1 – SOW OF BREED GERMAN SADDEL BACK. FOR SEVEN SIMILAR BREEDS CONSERVATION PROGRAMMES ARE UNDER WAY IN SIX EUROPEAN COUNTRIES. (PHOTO: ANONYMOUS)

Table 3 – NUMBER OF BREEDS CLASSIFIED FOR ENDANGERMENT

Species	Total	Class of endangerment					
		Not ending.	Potentially ending.	Minimally ending.	Ending.	Critically ending.	"At risk"
		(1)	(2)	(3)	(4)	(5)	(2-5)
Cattle	305	165	87	24	9	20	140
Sheep	322	210	58	21	7	26	112
Goats	88	64	8	7	4	5	24
Pigs	126	61	23	10	3	29	65
Horses	135	59	51	12	5	8	76
Asses	6	3	1	0	0	2	3
Total	982*	562	228	74	28	90	420

*47 additional breeds – due to missing information – could not be classified

For a known number of registered female breeding animals that are used for purebreeding only with a percentage of p f is reduced accordingly by multiplication with p.

If m, the number of male breeding animals used for reproduction of the breed is not known m is estimated from f as m = f/30, i.e. by assuming a mating ratio of m:f =1:30. If m is less than 40 and the number of males MC is known of which cryo conserved semen is available, the number of males m is increased by addition of the value of MC/3, i.e. it is assumed that 1 / 3 of the number of males with cryo conserved semen can be regarded as additional males which are available for reproduction of the breed.

By comparing Ne' of the breed with the minimum values of Ne for the relevant species in table 2 the breed is allocated to one of the five classes of endangerment.

Thirdly, downgrading the breed into one class of higher endangerment for each one of the following additional conditions:

- The number of breeding herds is less than 10 and the number of female breeding animals is below 500,
- the number of female breeding animals is decreasing and already below 1000, the percentage of matings for reproduction of the breed with animals of other breed(s) is equal or higher than 20 percent. Compared with the system of Simon and Buchenauer (1993) the starting points for acceptable F-50 values of the classes 1 to 4 were raised and the maximum value of incrossing was increased from 10 to 20 percent. This resulted in fewer downgradings and a higher percentage of breeds classified as being not endangered.

Following this system 420 or 42.8 % of a total of 982 breeds with sufficient information were allocated to classes 2 to 5 and as such were classified as breeds `at risk` (table 3).

The species with the highest percentage of breeds classified as being 'at risk' was horses (56.3 %), fallowed by pigs (51.6), asses (50.0 %) and cattle (45.9%). Sheep and goat breeds appear to be least endangered with 34.8% and 27.3% 'at risk', respectively. It is interesting to note that in all species the number of breeds classified as being 'critically endangered' is remarkably higher than the number of breeds classified as being 'endangered'.

Conservation Activities

Apart from breeding companies for poultry and pigs, nothing is known about activities of commercial breed - societies on conservation of rare breeds. However, in Germany some breed - societies are committed to the herdbook operation for a rare breed of their region. Actual conservation is mainly performed by farmers, hobby-farmers, research institutions and state-farms.

Live-animal conservation programmes

Live-animal conservation in reproducing herds is the most frequently adopted conservation method. It is an attractive method, allowing adaptation of the breed to changing production and environmental conditions and an immediate use of animals for evaluation, research and commercial breeding. Information on the number of live-animal conservation programmes was obtained from three sources: The EAAP-Animal Genetic Data Bank (EA), the newly nominated National Focal Points in Europe (NFP) and from the European Commission (D: Dessylas, Brussels, 1997, personal communication) (EU).

The information from the EU is related to endangered breeds that are supported according to EEC Regulation 2078/92. So far this support has been restricted to local breeds in danger of extinction of the cattle, sheep, goat and equidae species in e 15 EU-Member States.

A total of 365 programmes is registered by EA for the major farm animal species, 285 of these or nearly 78 per cent are underway in EU-Member States (table 4). The total sum reported by NFP is in the same order (334); however, within countries and within species the numbers of the reported conservation programmes can be quite different (e.g. in France, Italy and Portugal). The NFP also reported live-animal conservation programmes for additional species, i.e. for asses, dogs, rabbits, chickens; ducks, geese and even for bees, fishes and silkworms. It can be noted that the EU-Member States Denmark, Greece, Netherlands and the United Kingdom have not participated in the EEC-project 2078/92 so far.

Table 4. - LIVE ANIMAL CONSERVATION PROGRAMMES IN COUNTRIES OF EUROPE, AS REGISTERED BY EAAP ANIMAL GENETIC DATA BANK EA, NATIONAL FOCAL POINTS NF AND EUROPEAN UNION EU, RESPECTIVELY; NR=NO RESPONE TO REQUEST

Country	Cattle			Sheep			Goats			Horses			Pigs		Total per country		
	EA	NF	EU	EA	NF	EU	EA	NF	EU	EA	NF	EU	EA	NF	EA	NF	EU
a) 15 EU-member countries																	
Austria	6	NR	10	1	NR	4		NR	4	2	NR	6		NR	9	NR	26
Belgium	2	3	2		8		1				2	2			2	13	8
Denmark		4		1	1			1		1	3		2	2	5	11	0
Finland	3	3	3	1	2	1	1	5	1	1	1	1			5	6	6
France	40	18	14	43	22	9	2	3	2	2		15	5	6	91	51	40
Germany	14	11	9	12	14	12		2	3	7	12	12	6	4	41	44	36
Greece		2			8					1	2				1	14	0
Ireland		3	3	1	2	7		11	1			1		2	1	7	5
Italy	25	10	16	1	7	19			7	7	3	18	4	4	37	35	60
Luxembourg	2	2						1		1	1	1			3	3	1
Netherlands	3	5		4	4		2			1	2				10	12	0
Portugal	6	2	4	6	1	3	1	NR	2	3					16	3	9
Spain	12	NR	25	4	NR	13	2	2	4		NR	12	2	NR	20	NR	54
Sweden	2	3	3	2	3	3		7	2		2			1	4	11	8
United Kingdom	12	9		16	23		2			4	6		6	2	40	47	0
EU-Countries	127	75	89	92	95	70	11	32	26	30	34	68	25	21	285	257	253
b) 18 Non EU member countries	16	21		22	21		12	3		19	24		11	8	80	77	
Total	143	96	89	114	116	70	23	35	26	49	58	68	36	29	365	334	253

Table 5 – EX-SITU KEEPING OF FARM ANIMAL BREEDS IN ZOOS AND FARM PARKS ON 124 LOCATIONS IN GERMANY. RAW DATA FROM FALGE (1996); NE=EFFECTIVE POPULATION SIZE

Species	Number of		Animals per "herd"	Average number of (in different herds)		Ne
	Breeds	"Herds"		Animals per breed	Males per breed	
Cattle	28	136	4.9	20.3	6.3	20.7
Sheep	30	253	10.3	86.9	15.9	54.1
Goats	24	172	8.6	61.3	15.1	48.2
Pigs	12	131	5.4	59.3	19.5	59.7
Horses	23	120	5.0	26.1	7.0	22.1
Asses	6	80	3.7	48.8	14.8	45.9
Chickens	42	112	7.7	20.6	5.6	18.7
Geese	10	48	3.3	16.0	6.3	19.5
Ducks	12	39	5.3	17.3	7.5	21.8
Total	187	1091	6.0	39.6	10.9	31.1

Contributions of zoos and farm parks

As already mentioned, conservation of endangered breeds of farm animal species is generally, performed on farms. However, such animals are also kept 'ex situ' in zoos, farm parks and in so-called Ark-farm projects (Seibold, 1996). Falge (1996) reported animal numbers in 124 institutions of this kind in Germany (table 5):

Animals of 187 breeds of 9 farm animal species are kept in these institutions. The average number of males and of total animals per breed, spread over several locations, is quite low (10.9 and 39.6, respectively). Computation of the effective population size Ne according to formula (4), chapter 3, resulted in values from Ne =19 for geese and ducks to Ne = 60 for pigs. These values appear rather low if long-term conservation should be achieved.

Table 6 – PROGRAMMES FOR CRYCONVERSTION OF SEMEN AND EMBRYOS. T=TOTAL, IS=PROGRAMMES WITH INFORMATION ON NUMBER OF SIRES INVOLVED. DATA FROM EAAP-AGDB

Species	Semen		Embryos	
	T	IS	T	IS
Cattle	194	173	74	49
Sheep	46	39	6	3
Goats	18	15	1	1
Pigs	30	29	0	0
Horses	26	25	4	3
Asses	0	0	0	0
Total	314	281	85	56

Thirty-five farm-parks with *ex-situ* conservation of several rare breeds are reported from seven European countries, with 25 farm-parks alone in the United Kingdom (J. Guenterschulze, Warder, 1997, personal communication): In the UK, farm-parks are visited on average approximately by 100 000 people per year (L. Alderson, Warwickshire, 1997, personal communication). The Rare Breeds Survival Trust in the UK and the Gesellschaft zur Erhaltung alter und gefährdeter Haustierrassen, GEH, in Germany developed approval schemes for farm-parks m order to ensure given standards (Chiperzak et al.,1995). No information is available on the number of animals and on the farm animal breeds and species which are kept in zoos and farm-parks in the whole region of Europe. The specific value of zoos and farm-parks is that they offer visible evidence of endangered breeds to the public, hence contributing to an increased awareness of the need of conservation.

Cryoconservation of semen and embryos

Cryoconservation of gametes and embryos is a quick and rather inexpensive way to prevent the loss of the genetic potential of a breed (Brem et al.,) 1984). Properly structured stores of frozen semen and embryos can also be used to support live animal conservation programmes with a minimum increase of inbreeding (Simon, 1993). Table 6 summarises the information on cryoconservation as reported by the EAAP-AGDB.

The largest number of projects of semen and embryo storage is reported for breeds of cattle. Here the number of programmes for semen (194) is even higher than the number of live-animal conservation programmes (139, table 4). Possibly, these numbers include projects of cryostored semen for commercial use. Information on the number of males or sires represented in stored semen and embryos is important to judge their usefulness for the re-activation of an extinct breed. As can be seen in table 6 this information is available in most cases, though completion appears necessary.

Activities on a supra-national level in Europe

Several organisations and institutions are active in projects of conservation which involve more than one country in Europe. In chronological order – according to the start of their activities – the following have to be mentioned:

1. EAAP, the European Association for Animal Production, regularly offers a platform for the presentation of papers on topics of conservation of FAGR at its annual meetings (see "milestone" 1969, chapter 1). Its Commission on

Animal Genetics established the EAAP Working Group on Animal Genetics Resources in 1980, whose main objectives are the study, documentation and cataloguing of conservation and development of animal genetic resources in Europe. In 1987 the working group suggested setting up a data bank, wich, with the support of the Deutsche Forschungsgemeinschaft DFG, was founded as the EAAP-Animal Genetic Data Bank at the School of Veterinary Medicine, Hanover, in the same year. Since then the volume and quantitiy of European breed resources could steadily be increased. During the years 1989-1992 the Hanover data bank accepted responsibilities as "EAAP-FAO-Global Animal Genetics Data Bank has been transferred to the newly established FAO Domestic Animal Information System DAD-IS in Rome. Since 1997 EAAP has been acting as co-ordinator for the EU-concerted action "A Permanent Inventory of European farm animal genetic resources". This project is supported by EC-Regulation 1467/94 and delegates additional responsibilities to EAAP.

Figure 2 - HEIFERS OF BREED TYROL GREY. FOR FIVE SIMILAR BREEDS CONSERVATION PROGRAMMES ARE UNDER WAY IN FIVE EUROPEAN COUNTRIES (PHOTO: AVERDUNK)

2. NAGB, the Nordic Working Party on Animal Gene Banks, was established in 1979 by the five Scandinavian countries Denmark, Finland, Iceland; Norway and Sweden. It has mapped out conservation needs and activities and built a Nordic Information Centre with a data bank. The Nordic Council of Ministers, NCM, is funding the secretary of the working party, the operation of the Nordic Data Bank and specific research (Maijala et al.,1984). Breed information of Scandinavian countries is transferred via the Nordic Data Bank to the EAAP-AGDB Hanover.

3. DAGENE, the Danubian Countries Alliance for Conservation of Genes in Animal Species, was founded in 1989 as a group of individual experts, NGOs and governmental institutions of 10 countries of the Danubian region which are interested in conservation of FAGR in this area. Main objectives are the exchange of information and co-operation in similar projects and the organisation of meetings on regional aspects (I. Bodo, Budapest, 1997, personal communication).
4. Commission of the European Communities. The European Union has become an important factor in improving co-ordination and actual support for conservation of FAGR in the 15 Member-States: Council Regulation

No. 2078/ 92 `On agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the country side . The scheme allows support of farmers who `rear animals of local breeds in danger of extinction'. An EU-specific system for the classification of endangerment is used, which presently allows the promotion of 253 breeds with up to 100 ECU per livestock unit. - Council Regulation 1467/94`On the conservation, characterisation, collection and utilisation of genetic resources in agriculture'. The main objective is to co-ordinate and promote existing work on plant and animal genetic resources in the Member States. Until now 12 plant and 3 animal projects have been supported, the animal side having been severely underrepresented so far. One of the projects deals with the initiation of a `Permanent Inventory of European farm animal genetic resources and of current work on conservation, characterisation, collection and utilisation of those resources'; it is hoped that this can be developed into an efficient instrument. - AIRE 2066, the concerted action project 'Analysis of genetic diversity to preserve future breeding option'. The main objective is to co-ordinate the work of 27 participating laboratories in 14 countries, in particular to use the same set of DNA-markers for assessing genetic diversity within and between cattle breeds. In addition, a Cattle Diversity Data Base, CaDBase, was set up in Edinburgh with a link to the EAAP-AGDB, Hanover.

5. SAVE, Safeguard for Agricultural Varieties in Europe, was founded in 1995 as an umbrella-organisation for NGOs in Europe. Main objectives are: co-ordination of similar activities in different countries, development of awareness of conservation, exchange of know-how and actual support for specific conservation projects. SAVE became particularly active in countries of Eastern Europe (Gruenenfelder, 1995; W. Kugler, St.Gallen, 1997, personal communication).

Number of Registered Conservation Programmes and Its Relation to the Degree of Endangerment

Table 7. – PRECENTAGE OF BREEDS WITH LIVE ANIMAL CONSERVATION PROGRAMMES BY CLASS OF ENDANGERMENT. RANK CORRELATION R_s BETWEEN OF ENDANGERMENT AND PERCENTAGE OF CONSERVATION PROGRAMMES

Species	Class of endangerment					R_s
	1	2	3	4	5	
	Not end.	Pot. end.	Min. end.	Endangered	Cirt. End.	
Cattle	38.8	59.8	41.7	66.7	50.0	0.60 n.s.*
Sheep	30.0	48.3	66.7	28.6	19.2	-0.44 n.s.
Goats	29.7	12.5	14.3	25.0	0	-0.62 n.s.
Pigs	13.1	34.8	60.0	33.3	37.9	-0.62 n.s.
Horses	42.4	25.5	41.7	40.0	37.5	-0.32 n.s.
Total	32.0	44.9	48.6	42.9	33.3	0.12 n.s.

*P<0,05

Table 8 – LIVE ANIMAL CONSERVATION PROGRAMMES LAC FOR "SIMILAR" BREEDS SB, TOTAL AND IN CLASSES OF ENDANGERMENT

Subgroup of similar breeds, formed by EAAP-AGDB	Total number of			Number of SB and LAC			
	Countries involv.	SB	LAC	In class 1 (not ending.)		In class 2-5	
				SB	LAC	SB	LAC
Cattle							
1.2 Origin Black Pied	6	8	6	6	4	2	2
3.7 White Lineback	4	5	5	4	4	1	1
5.2 Alpine Brown	4	6	4	3	2	3	2
5.4 Iberian Brown	2	11	9	7	6	4	3
6.2 Grey Mountain	5	7	5	4	3	3	2
Sheep							
5.2 S. Europ. Milk Sheep	6	15	7	11	4	4	3
8.4 Churra Type	2	8	4	7	3	1	1
Pigs							
3.1 Saddle Backs	6	8	7	1	0	7	7
Horses							
5.10 South Europ. Ponies	4	6	5	3	3	3	2
Total		74	52	46	29	28	23

Table 4 shows that the number of registered live-animal conservation programmes is quite high. The differences in numbers reported by the three sources, EAAP, National Focal Points and European Union, can be explained in part by different countries involved in the respective survey, different ways of assessing endangerment, different requirements for support; (e.g. number of female breeding animals, accepted herdbook) and possibly by different interpretation of what is meant by conservation.

It is of special interest to look at the relation between the percentage of conservation programmes and the class of endangerment of breeds. The figures are presented in table 7, including the coefficient of Spearman's rank correlation r_s. The average of the five species shows no tendency of an increased proportion of conservation programmes in classes of higher endangerment. Spearman's rank correlation rs=0.12 is low and not significant. None of the five species has the highest proportion of conservation programmes in class five of the breeds with the highest risk status. For sheep, goat and horse breeds the rank correlation even turns out to be negative (-0.44, -0.62 and -0.32, respectively). In class 1, with breeds. classified as 'not endangered', conservation programmes are reported for 32% of the breeds. This is remarkable since the system of assessment of endangerment applied here appears to be rather severe, compared with the system used by FAO (1995) (see chapter "Assessment of breeds for endangerment"). It is difficult to explain these results.

However, it seems to be meaningful in countries of Europe to examine more closely the objective of conservation, the system of assessing the status of endangerment of breeds and the question whether all breeds which have been classified as being endangered equally deserve to be conserved.

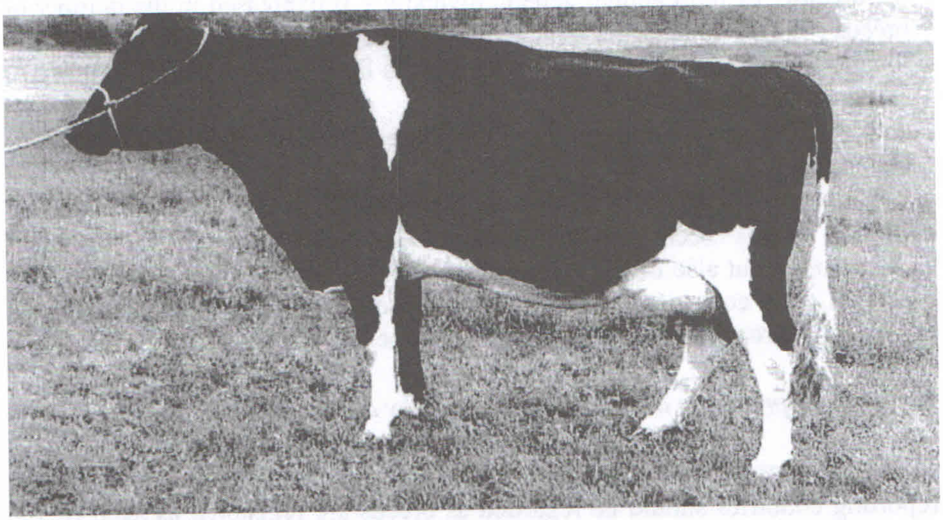

Figure 3 – AN EXAMPLE OF ORIGINAL BLACK PIED CATTLE

Conservation Programmes within Groups of similar Breeds

For breeds registered in the EAAP-AGDB, an attempt was made to form groups of similar breeds by use of information of breed history, geographic origin, phenotypic appearance, type of use, known genetic background, etc.

(Simon and Buchenauer, 1993). For this report an additional analysis was run in order to find out to what extent conservation programmes are underway for similar breeds in different countries. An extract of the results is presented in table 8.

In nine subgroups of similar breeds a total number of 74 breeds is listed; 28 of them were classified as being 'at risk'. The breeds within subgroups are located in 2 to 6 countries, the number of conservation programmes for breeds at risk is n = 23. Obviously the decisions to conserve endangered breeds are made without taking into account the existence of conservation programmes for similar breeds in other countries. The situation appears even worse if we realise that for 46 breeds of the same subgroups, which were classified as begin not endangered, 29 additional conservation programmes are reported. This draws attention to the need of clarifying the genetic raltionship among breeds and to the need of co-operation across national borders.

Discussion

In the previous chapters it could be shown for Europe that:

- the quantity of farm animal genetic diversity – if expressed in the number of breeds – is still quite large,
- on average some 43 per cent of these breeds have to be regarded as more or less endangered,
- and that an impressive number of conservation programmes (~360) is underway.

However, it has become also apparent that in many cases decisions to conserve breeds seem to be not only independent of their status of endangerment but also of the existence of conservation programmes for similar breeds in other countries. This calls for a closer look at the essential elements of present approaches to conservation in Europe.

Breeds as appropriate units of genetic diversity and of conservation

All groups of interbreeding animals which according to the practice in the reporting countries should be regarded as breeds are registered as such by the EAAP-AGDB. This number probably includes several breeds with the same or similar background. The total number of registered breeds of a species there are has to be regarded as an overestimate of the available genetic diversity.

From genetic theory we know that genetic diversity of populations is a function of the frequencies of genes and of gene combinations. As a consequence; the objective of conservation in principle should be genes and gene combinations. It is interesting to note that the UN-Agenda 21 (1992), in chapter 15 Conservation of biological diversity', calls 'to conserve and maintain genes, species and ecosystems', not of breeds.

However, our ability to identify genes of farm animal species and their interaction has been very limited, so far. In addition, for several reasons, farm animal species are subdivided into breeds as operating units within which the decisions and actions for breeding are performed. Therefore, for the time being, it is realistic to use breeds as indicators of available genetic diversity of a species. However, if it comes to conservation of genetic diversity, preference should be given to those breeds which can be assumed to be 'containers' of a unique genetic potential, i.e. of genes or gene combinations which are not available in other breeds.

Assessment of breeds for endangerment

By use of the system explained in chapter 3 a higher percentage of breeds was classified as being 'at risk' in Europe (42.8 %) than by the FAO-system of WWL-2 (1995) (32.8 %). The two systems differ essentially in three criteria:

- the way of considering a minimum population size, below which a breed should be regarded as being 'at risk',
- the way of dealing with incrossing or migration, i.e. the use of animals of other breed(s) for reproduction,
- and taking account of the number of breeding herds in which the breed is kept

For the minimum population size the FAO-system asks for absolute numbers of breeding animals, i.e. that the total number of breeding females and males are greater than 1000 and 20, respectively; same numbers for breeds of all species.

In contrast, the system we used for our analysis asks for a minimum effective population size Ne - a term from population genetics - of the breed in question, where the minimum value of Ne is deduced from the maximum increase of inbreeding, which appears acceptable in a time period of 50 years of conservation (F-50). Taking account of different generation intervals of different species, species-specific values of Ne are obtained (see table 2).

If the minimum numbers of the FAO-system are transformed into the corresponding effective population size the resulting value of Ne = 82 is - compared with the respective values of table 2 - above the value for breeds of horses and asses (52), but below the values for sheep and goats (95) and for pigs (157). In other words breeds of the latter three species will be declared earlier to be more or less endangered by the system used here than by the FAO-system. In addition, in our system only females that are registered in a herdbook - or an estimate of these - are used in estimation Ne of a particular breed. This again increases the probability that the breed will be classified as being 'at risk', compared with considering the total number of female breeding animals or the overall population size.

The factor migration, i.e. incrossing or the use of animals of other breed(s), is not considered in the FAO-system. In our system a breed is transferred into one class of higher endangerment; if more than 20 per cent of the matings for reproduction are performed with animals of other breed(s). Taking account of migration appears meaningful since migration results in a deviation from the Hardy-Weinberg-equilibrium of gene frequencies, which in essence is not compatible with preservation of the present known and unknown genetic potential of a breed.

The number of breeding herds or breeding locations in which the breed is kept: If this number is less than 10 and the number of female breeding animals is below 500 then the breed is downgraded into a class of higher endangerment. A low number of breeding herds can increase the risk of rapid disappearance of the breed due to disease hazards, natural disasters or loss of interest of people.

Considering the three mentioned criteria (time based population size, incrossing and the number of herds) in the risk assessment, results in a higher proportion of breeds at risk than by the FAO-system. However, we feel that it allows a better coverage of breed dynamics, which is relevant to conservation.

Two other systems are of practical importance in Europe: The European Union defines the maximum number of female breeding animals for an endangered breed by EC-regulation 2078/92 (STAR-reports 1992, 1994) with 5 000 for cattle and horses and with 7 500 for sheep and goats, respectively (stable population size assumed). These numbers are 5 to 7 times larger than the limit set by the FAO-system with the result that many more breeds can be declared to be at risk and can apply for support. A justification for these high numbers cannot be seen.

The acceptance procedure of the Rare Breeds Survival Trust (RBST) (Alderson, 1995) on the other hand is quite demanding: Continuous existence of the breed for 75 years and at least 2 of the 3 following requirements:

Table 9 – RELATIVE IMPORTANCE OF RISK FACTORS FOR DOWNGRADING A BREED FROM 'NOT ENDANGERED' INTO CLASSES OF ENDANGERMENT (IN PRECENT)

Risk factor	Species					All Species
	Cattle	Sheep	Goats	Pigs	Horses	
Effective Pop. Size Ne	44.8	62.4	57.6	71.8	46.5	57.9
Incrossing/Migration	29.8	13.1	11.9	6.2	29.9	18.7
Decreasing No of females	13.6	15.2	25.4	12.3	16.5	15.1
Low number of herds	7.5	9.3	5.1	9.7	7.1	8.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Accepted herdbook for six generations, less than 20 per cent contributor by other breeds and thirdly parent breeds used in the formation of the breed are no longer available. In addition: fewer than the following number of breeding females: pigs 500, goats 500, cattle 750, horses 1000 and sheep 1500. Last but not least, the factors minimum number of distinct male lines, decreasing population size and low number of breeding units are considered.

This acceptance procedure appears to be a well-founded system with many valuable criteria (although the critical animal numbers seem to be defined independently of the generation intervals of species). However, it will probably be difficult, in general, to supply both the quantity and quality of the required information on those breeds which are approaching endangerment.

Compared with the various systems of risk assessment mentioned above we feel that the system we used for the breeds of the EAAP-AGDB is an acceptable compromise between considering population genetic theory, short term risk factors and obtainable information. Table 9 presents information on the relative importance of the four factors used in our system for the downgrading of a breed from the status of 'not endangered' into classes of endangerment. Summarising all species, 57.9 per cent of fine downgradings are due to a low effective population size,18.7 % are caused by incrossing and 15.1 % by a decreasing number of female breeding animals. A low number of herds affects endangerment only in the order of 8.3 %. However, this may be caused in part by missing information of the number of herds. For breeds of cattle and horses the use of breeding animals of other breeds for reproduction is obviously not uncommon, because 29.8% and 29.9% of the downgradings, respectively; are due to these factors. In pigs incrossing (6.2%) is of least significance to endangerment, whereas the effective population size Ne is of relatively highest importance (71.8%).

Of course, the results of the applied classification system depend on the observed criteria and on the way of combining these into a system of risk assessment. For example it may be questioned whether the assumed values of maximum coefficients of inbreeding, length of generation intervals of species, maximum percentage of incrossing, etc., are the best possible ones and whether formula (4) for estimation of the effective population size is adequate for small populations with decreasing numbers of breeding animals and with generally increased variance of family size. Nevertheless, for a rational approach to conservation it appears necessary to take a position on these criteria.

Different objectives of conservation call for different approaches

One of the main differences among the various systems of risk assessment can be seen in the fact; whether migration, i.e. use of breeding animals of other breeds, is considered as a risk factor or not. The question whether this is meaningful depends on the primary objective of conservation (Simon, 1999). From the many statements on conservation objectives of FAGR, e.g. by Bowman (1974), DGfZ (1979), Maijala et al. (1984), Simon (1984), UNEP (1992), Blair (1995), Hammond (1995); Cunningham (1996), British Society of Animal Science (1997), three main objectives have become apparent:

1. Subunits of species, such as populations, breeds, lines or strains, which under predominantly favourable production conditions are no longer competitive, may possess - unknown so far - a genetic potential which may become useful for future breeding options. The resulting argument, which we may call 'Conservation for potential use, later (Simon, 1999); is mainly expressed in developed countries of Europe and North America.
2. In regions with predominantly unfavourable production conditions, indigenous populations or breeds - in spite of their usually limited production - potential - generally form the basis of food security f or an increasing human population because of their generally good adaptation to harsh production conditions; The argument, which we may call 'Conservation for sustainable use, now', is expressed mainly in and for developing countries of the world.
3. Rare breeds can be regarded as part of our living heritage and as such deserve to be preserved for historical, ethical or local reasons. This argument, which we may call 'Conservation for cultural reasons'; seems to be expressed mainly in developed countries of Europe and North America.

Since objective number 1,'conservation for potential use; later', aims to preserve an unknown genetic potential for requirements that are as yet unknown in far distant unknown future, it is essential to avoid all influences that can change the genetic makeup of the population, or - in terms of population genetics - that can change the Hardy-Weinberg-equilibrium of the population (Simon, 1995; 1999).

This requires avoidance of migration or the use of animals of other populations for reproduction; avoidance of artificial selection of mates in pursuit of defined breeding goals 'for improvement' and it requires the minimisation of random drift of gene frequencies and inbreeding by providing a sufficient effective population size Ne (Falconer, 1989). Therefore, it appears necessary to observe migration or incrossing already in the risk assessment, if conservation for potential later use is the primary objective of conservation, which at least in Europe is of high relevance (Simon, 1995).

Objective number 2, 'conservation for sustainable use, now', asks for a completely other strategy of conservation. Here, immediate use of endangered breeds is required in order to serve the immediate needs of the human population for food security. Genetic changes of breeds for improvements both by artificial selection within the breeds and by planned incrossing of animals of other, highly-productive breeds is an essential tool of sustainable use and conservation (see, for example, Rege and Bester, 1998; Mariante and Fernandez-Baca, 1998). For this reason the situation of incrossing need not be considered in risk assessment, if `conservation for sustainable use, now' is the main objective.

Finally, if objective number 3, 'conservation for cultural reasons' is the main objective of conservation, the situation of incrossing or use of animals of other breeds can be dealt with in either way. Purists may demand strict purebreeding and may reject any minor 'contamination' by 'foreign blood'. Others may tolerate the introduction of animals of similar breeds as long as the outside appearance of the breed is not severely changed. In other words, the consideration of incrossing is not a major issue in risk assessment, if conservation is pursued mainly for cultural reasons. A similar position may be taken on the question of selection of mates for 'genetic improvement' or for adaptation during conservation.

Summing up this section, we can see that the primary objectives of conservation in Europe are different from the ones in developing countries, say in Africa, South America or in Asia. It also follows that different procedures of risk assessment and of practical conservation should be applied (Simon, 1999).

The problem of choice of endangered breeds for conservation

An adequate approach to dealing with this problem is again affected by the primary objective of conservation. Within the context of conservation for cultural reasons, preference for specific breeds is usually expressed by the people or institutions which actually work with the breed. In this situation it is probably not adequate to impose criteria from outside as long as support from outside is not requested. Nevertheless, for example the NGO Rare Breeds Survival Trust requires in its acceptance procedure 'a distinct characteristic not found elsewhere', if other requirements are not met completely (Alderson, 1995).

For the primary objective 'conservation for sustainable use, now' candidate breeds for the combined goal conservation and improvement should be the most promising adapted local breeds, preferably evaluated on the basis of reliable data of their adaptive value and on their combining ability with highly productive exotic breeds, as explained by Rege and Bester (1998).

For the primary objective 'conservation for potential use, later' priority should be given to those endangered breeds which unknown so far - could possess a genetic potential which could become valuable in the future and which cannot be expected in other breeds. The main criterion for selection of a breed, there are; should be the degree of genetic uniqueness or the degree of genetic distance in comparison to other breeds, i.e. both to the more popular breeds and to other endangered breeds, as explained for example by DGfZ (1979), Camussi et al. (1985), Weitzman (1993); Barker (1994) and Ollivier, 1996).

Bearing in mind the relatively high number of breeds ‘at risk' in Europe (Table 3), the availability of similar breeds in different countries and the generally high costs of conservation (Brem et al.;1984; Smith, 1984; Lömker and Simon, 1994), clarification of genetic uniqueness of breeds appears to be one of the most urgent tasks in conservation of FAGR in Europe. This can only be achieved in a satisfying way on a supra-national level, for which effective co-operation among all acting institutions across national borders is required.

REFERENCES

1. Alderson, L. (1995): The value of global information for better estimating the vulnerable status of endangered breeds. In R.D. Crawford; E.E. Lister & J.T. Buekley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August 1994,13-23.

2. Barker, J.S.F. (1994): A global protocol for determining genetic distances among domestic livestock breeds. Proceedings of the 5th World Congress on Genetics Applied to Livestock Production, Guelph, Canada, August 1994, 21, 501-508.

3. Blair, H.T. (1995): Domestic livestock conservation - is it achieving its goal? In R.D. Crawford; E.E. Lister & J.T. Burckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August 1994, 3-11.

4. Bodo, I. (1995): Minimum number of individuals in preserved domestic animal populations. In R.D. Crawford, E.E. Lister & j.T. Buckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston; Canada, August 1994, 57-b5.

5. Bowman, J.C: (1974): Conservation of rare livestock breeds in the United Kingdom. Proceedings of the 1st World Congress on Genetics Applied to Livestock Production, Madrid, Spain, 2, 23-29.

6. Brem, G., Graf, F. & Kralusslich, H. (1984): Genetic and economic differences among methods of gene conservation in farm animals. Livestock Production Science,11, 65-H8.

7. Camussi, A., Oitaviano, E., Calinski T. & Kaczmarek, Z. (1985): Genetic distances based on quantitative traits. Genetics,111, 945-962.

8. Chiperzak, J., Guenterschulze, J. & Alderson, L. (1995): The role of rare breeds parks in genetic conservation programs in Canada, Germany and Britain. In R.D. Crawford, E.E. Lister & J.T. Buckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August 1994, 223-229.

9. Maijala, K. (1970): Need and method of gene conservation in animal breeding. Ann. Genet. Sel. anim., 2, 403-415,

10. Cunningham, P. (1996): Genetic diversity in domestic animals: Strategies for conservation and development. In R.H. Miller, V.G. Pursal & H.D. Norman (Eds.) Beltsville Symposia in Agricultural Research XX, Biotechnology's Role in the Genetic Improvement of Farm Animals, ASA, USA, 13-23

11. Falconer, D.S. (1989): Introduction to quantitative genetics, 3rd ed., Longman Scientific & Technical, pp. 438.

12. Falge, R. (1996): Maintenance and conservation of domestic animal resources ex-situ in zoological gardens and domestic animal parks: In F: Begemann, C. Ehling & R. Falge (Eds:) Schriften zu genetischen Ressourcen; IGIZ, Bonn, 5, 60-77.

13. Gruenenfelder H.P. (1995):. Monitoring programmes in Central and Eastern Europe. In R.D. Crawford; E.E. Lister & R.T. Buckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August 1994, 234-239.

14. Hammond, K. (1995): A global program for conservation of domestic animal diversity. In R.D. Crawford, E.E: Lister & R.T. Buckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August 1994, 27-39.

15. Kidd, K.K. & Pirchner, F. (1971): Genetic relationships of Austrian cattle breeds. Anim. Blood Grps. Biochem. Genet., 2, 145-158.

16. Lömker, R. & Simon, D.L. (1994): Costs of and inbreeding in conservation strategies for endangered breeds of cattle. Proceedings of the 5th World Congress of Genetics Applied to Livestock Production, Guelph, Canada, August 1994, 21, 393-396.

17. Maijala, K., Cherekaev, A.V., Devillard, J.M., Reklewski, Z., Rognoni, G., Simon D.L. & Steane, D. (1984): Conservation of animal genetic resources in Europe. Final report of EAAP Working Party. Livestock Production Science,11, 3-22.

18. Maijala, K., Adelsteinsson, S., Danell, B., Gjelstad, B., Vangen, 0., & Neimann-Soerensen, A.(1992): Conservation of animal genetic resources in Scandinavia. In L. Alderson & I. Bodo (Eds.), Genetic Conservation of Livestock: CAB International, 2; 30-46.

19. Mariante, A. da 5. & Fernandez-Baca, S. (1998): Animal genetic resources and sustainable development in the Americas. Proceedings of the 6th World Congress of Genetics Applied to Livestock Production, Armidale, Australia, 28, 27-34.

20. Ollivier, L. (1996): The role of domestic animal diversity in the improvement of animal production. AAA Biotec, Ferrara,1-11.

21. Ollivier, L., Bodo I. &. Simon, D.L. (1994): Current developments in the conservation of domestic animal diversity in Europe. Proceedings of the 5th World Congress of Genetics Applied to Livestock Production, Guelph, Canada, August 1994, 455-461.

22. Rege, J.E.O. & Bester, J. (1998): Livestock resources and sustainable development in Africa. Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, Armidale, Australia, 28,19-26.

23. Seibold, R. (1996): Das Arche-Hof Projekt der Gesellschaft zur Erhaltung alter und gefährdeter Haustierrassen, e.V. In F. Begemann, C. Ehling & R. Falge (Eds.) Schriften zu genetischen Ressourcen, IGR; Bonn, 5, 78-87.

24. Simon, D.L. (1984): Conservation of animal genetic resources - a review. Livestock Production Science, II, 23 - 36.

25. Simon; D.L: (1990): The global animal genetic data bank. In G. Wiener (Ed.) Animal Genetic Resources; A global programme for sustainable development. proceedings of an FAO Expert Consultation, Rome, Sept. (1989):, FAO Animal Prod. and Health Paper 80, 153-166.

26. Simon, D.L. (1993): Kryokonservierung zur Unterstiitzung der Lebenderhaltung gef hrdeter Rinderrassen. Züchtungskunde; 65, 91-101.

27. Simon, D.L. (1995): Factors for defining the status of endangeredness of a breed. In R.D. Crawford, E.E. Lister & R.T. Buckley (Eds.) Proceedings of the Third Global Conference on Conservation of Domestic Animal Genetic Resources, Kingston, Canada, August,1994, 384-390.

28. Simon, D.L. (1999): Genetic resources and conservation. In R. Fries & A. Rudinsky (Eds.) The Genetics of Cattle. CAB International, Wallingford, Oxon, UK; 475-495 (in press).

29. Simon, D.L. & Buchenauer, D. (1993): Genetic diversity of European livestock breeds. EAAP Publication No. 66, Wageningen Pers, pp. 580.

30. Smith, C. (1984): Estimated costs of conservation of f arm animals. In Animal Genetic Resources, Conservation by Management, Data Banks and Training, Animal Prod. and Health Paper, FAO, Rome, 44, 21-30.

31. Weitzman, M.L. (1993): What to conserve? An application of diversity theory to crane conservation. The Quarterly Journal of Economics, 157-183.

32. Wright, S. (1922): Coefficients of inbreeding and relationships. Amer. Nat., 56, 330-338.

33. AIRE 2066 CEC Concerted Action. 1998. `Analysis of genetic diversity to preserve future breeding options', Final Report,.

34. British Society of Animal Production. 1997. Meeting & Workshop Publication: The potential role of rare livestock breeds in UK farming systems. Appleby, United Kingdom.

35. Deutsche Gesellschaft fiir Ziichtungskunde. 1979. Ausschuss genetischstatistische Methoden in der Tierzucht, Vors. F. Fewson, Stellungnahme zur Bildung von Genreserven in der Tierzucht. Ziichtungskunde, 51, 329-331.

36. European Commission, Council Regulation (EEC).1992. No 2078/92 of June 301992, Official journal of the European Communities No L 215, 85-90; with Comite des structures agricoles et du developpement rural (STAR)- Working Document VI/ 5104/ 92 and VI/3879/94.

37. European Commission, Council Regulation (EC).1994. No 1467/ 94 of June 20 1994, Official Journal of the European Comrnunities No L 159, 1-10.

38. Earth Summit, Agenda 21. 1992. The United Nations Programme of Action from Rio, United Nations Conference on Environment and Development (UNCED), 3-14 June 1992, Rio de Janeiro, Brazil.

39. FAO - World Watch List for Domestic Animal Diversity.1995. B.D. Scherf (Ed.); FAO-Rome, Italy, pp. 769.

EUROPSKI PRISTUPI OČUVANJU GENETSKIH RESURSA DOMAĆIH ŽIVOTINJA

Sažetak

Na temelju nekoliko izvora informacija daje se prikaz razvoja sadašnjeg stanja i problemi očuvanja životinjskih genetskih resursa u Europi.

Danas je registrirano 1029 pasmina goveda, ovaca, koza, svinja, konja i magarca u genetskoj banci podataka životinja – EAAP u Hanoveru. 42.8% pasmina klasificirano je „u opasnosti". Postoji više od 360 programa za očuvanje koji, međutim, u mnogo slučajeva izgleda da djeluju neovisno o stanju ugroženosti i sličnim pasminama u drugim zemljama.

Prvenstveni ciljevi očuvanja u Europi, tj. „očuvanje radi moguće upotrebe, kasnije" i „očuvanje zbog kulturnih razloga" razlikuju se od cilja „očuvanje radi održive uporabe sada" što prvenstveno vrijedi za zemlje u razvoju. Različiti ciljevi traže različite odgovore na pitanja kao što su: jesu li pasmine odgovarajuće jedinice genetske raznolikosti, kako definirati ugroženost, što treba očuvati i jesu li „incrossing" i selekcija spojivi s očuvanjem?

S obzirom na veliki broj pasmina „u opasnosti" i sličnih pasmina u raznim zemljama kao i velike troškove za očuvanje zaključuje se da obilježavanje pasmina za genetsku jedinstvenost danas je najhitnija zadaća u očuvanju. Ona zahtijeva učinkovitu suradnju preko nacionalnih granica u Europi.

Primljeno: 10. 03. 2007.