CURRENT DEVELOPMENT IN THE CONSERVATION OF DOMESTIC ANIMAL DIVERSITY: THE AMERICAS

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SUMMARY

Besides plants and seeds, the European settlers brought domestic animals when they came to the Americas: cattle, horses, goats, sheep, poultry, etc. Those first animals have multiplied themselves and have been submitted to a long process of natural selection, having thus acquired adaptative and/or productive traits for the diverse ecological conditions of the continent, becoming what is known as "local" or "criollo" breeds. According to Rouse (1977), throughout Latin America if "the cattle of the country" cannot be related to a modern breed they are known as Criollo—the designation given to man or beast considered "native" to the land. About three centuries after the discovery of America, aiming at an increease in productivity, many breeders started importing animals of new breeds. The establishment of breeding policies which encouraged dilution of indigenous germplasm through the use of extensive crossbreeding programs with those imported breeds caused a quick substitution of the "local" breeeds. Even though these "local" breeds present lower production levels than the exotic ones, they are extremely well adapted to the environmental conditions where they have been naturally selected. This paper presents a brief report of the efforts being carried out in the Americas to avoid the complete disappearance of this valuable germplasm.

INTRODUCTION

The importance of biological diversity in all life forms has been recognized as an increasing international concern, especially in the past decade. During the 20th century, existing genetic diversity of animals has been effectively used to make vast improvements in production efficiency and in the quality of animal products. Conservation of genetic diversity is necessary to provide optimum access to desirable genes and gene complexes that will contribute to our future food and fiber supply. Animal products will continue to provide a significant portion of nutrients to human diets in the world's ever-increasing population. Research on the evaluation conservation, and utilization of unique genetic stocks and genes of livestock and poultry should provide the foundation for effective utilization of germplasm on a global basis. Complementing the traditional use of animal genetic resources are the recent significant advances in animal genetics that have been achieved in the last two decades by applying techniques of molecular biology, i.e., gene mapping and identification of genes. This new technology, when used in conjunction with traditional animal breeding programs, can significantly increase the current annual rate of genetic progress in animals. All this concern with the domestic animal diversity called the attention of researchers to the quick disappearance of the "local" breeds, and consequently a dilution of the indigenous germplasm, through the use of extensive crossbreeding programs.

IDENTIFICATION OF BREEDS/POPULATIONS IN DANGER OF EXTINCTION

The objective in genetic conservation is to store genetic variation which may be used in the future, though it is hard to predict what this may be. Since prediction is uncertain, it may be argued that all breeds are unique and hence should be preserved, even if sample sizes are small due to limited storage facilities. However, this approach may be impractical in most cases, since most breeds have sub-strains, each with claims of uniqueness (FAO, 1990). In developing countries,

besides the criteria presented, the usefulness of the population should be considered. That is, the conservation of breeds that present characteristics of economic importance should be guaranteed.

LATIN AMERICA

In Situ Conservation

Most of the conservation being done in South America refers to Criollo cattle, as shown in one FAO publication: "Recursos Geneticos Animales in America Latina" published in 1981, where of 13 papers, eight described Criollo cattle, three described native species, one presented a methodology, while the last one presented results of two other species: sheep and goats (Mariante, 1990a).

The subject of animal conservation is relatively new in Latin America. However, the quick substitution of "local" by exotic and, in many cases, less adapted breeds has just recently awakened the consciousness of breeders and researchers that do not want to witness their complete disappearance. The establishment of national or regional programs for conservation of endangered livestock breeds, are a must in order to maintain this inestimable domestic animal diversity.

In order to avoid the disappearance of their "local" breeds, some Latin American countries have already created their conservation programs, such as the Brazilian National Program for Animal Genetic Resources; the Criollo Project developed by CIAT and the British Tropical Agricultural Mission in Bolivia, as well as Programs including the other three Bolivian breeds of criollo cattle: Yacumeño, Chaqueño and from the High-Andean region; the Argentine Criollo Cattle Project in Argentina, the Colombian Program; the Calabozo Project in Venezuela; the CATIE Program in Costa Rica including the Romosinuano and the Milking Criollo, and the Reyna Cattle Program in Nicaragua, among others. Peru and other High-Andean countries also have important programs, dealing with camelids. Even though other countries such as Honduras, Guatemala and Dominican Republic do have criollo breeds, they have no established conservation programs (Mariante, 1992).

In general, the animals are being preserved in the habitats where they have been naturally selected for centuries (Table 1). The reasons for conservation of each one of the listed breeds are also shown. In a large continent like America, with so many different climates, there would be little use in conserving animals in environments different from those where they have been naturally selected. However the fact that the breeding nuclei are in general kept close to the original environment, does not indicate that the animals cannot be evaluated under different conditions. The Lavradeiro horse in Brazil is an example. Even though it is found in the extreme North of Brazil, this breed constitutes the only horse population developed in conditions similar to those of the Cerrado (Savanna) of Central Brazil, and represents an extremely valuable potential genetic resource. This region has about 200 million hectares with 39% of the cattle raised in Brazil and, for this reason, it is easy to imagine the importance that the Lavradeiro horse may represent to their beef cattle industry.

Ex situ Conservation

The conservation is known as *ex situ*, when the sample is placed in cryogenic storage. Techniques in cryopreservation, thawing and embryo transfer to recipient cows are wholly dominated in many Latin-American countries. Micro-manipulation of embryos already permits the production of identical twins from single embryos. Hemi-embryos can be frozen and stored for a long time, allowing evaluation of many traits of an individual or its progeny, while maintaining a copy in the gene bank. Genotype by environment interactions can be evaluated over time, by allowing identical twins to develop in different years. There are lot of studies showing that when the infra-structure for collecting and storing is available, the *ex situ* conservation is safer and cheaper than the *in situ one.*

For this reason, and due to the speed in which so many breeds are being lost, FAO decided to create Regional Animal Gene Banks (RAGB) in different continents. A RAGB is a repository of

animal germplasm. It should be capable of storing semen, oocytes, embryos and other types of genetic material, where appropriate, of all farm animal species where storage is possible. In each continent, two different countries have been selected to be the repositories of the samples sent by each one of the participant countries. The two centers of each region will keep duplicate samples. The chosen countries for Latin America are Argentina and Brazil. Besides these two centers, Latin America will have a third one, located in Mexico, for the storage of materials sent by the countries free of foot and mouth disease (Central America and the Caribbean). It is foreseen that the success of the implantation of the RAGB, proposed by FAO, will depend upon the mutual cooperation between countries with a common objective of conserving semen and/or embryos of endangered populations.

The countries participating in the scheme shall be responsible for decisions concerning the breeds/populations to be conserved. They shall be influenced in these decisions by some guidelines common to all countries involved in a similar activity. Until now, the bottleneck for the establishment of the RAGB are the differences in sanitary legislation among countries. While these RAGB are not established, many countries already started their own National Animal Gene Banks, where semen and/or embryos of their "local" breeds are being stored. In the future, part of this material being stored in National Gene Banks can be transferred to the RAGB.

Domestic Animal Diversity Data Bank

The first World Watch List for Domestic Animals diversity (**WWL-DAD**) published by FAO in 1992 (FAO, 1992) shows 2,719 entries in the Data bank, with population size for 1,433 or 53% of these. From this total, 118 breeds were reported in the Americas (North America, Latin America and Caribbean), and 53 of these were classed as "at risk of loss" (when the total number of females is between 100 and 1,000 or the total number of breeding males is less than or equal to 20 and greater than five). It is also expected that, in the near future, FAO will establish Networks on the different regions, that will take care of data collecting (at national level), in order to constantly update the **WWL-DAD**, helping to determine in what regions and with what breeds urgent actions should be taken to avoid the disappearance of "local" breeds.

Other Initiatives in Latin America

In 1992, the Centro Agronomico de Investigacion y Enseñanza (CATIE) of Costa Rica, organized a meeting on animal genetic resources, where it was proposed the creation of a Network on Animal Genetic Resources Conservation and Management for Latin America and the Caribbean. This general objectives of the Network are the identification, characterization, conservation and utilization of animal genetic resources while the specific ones are: (i) survey and characterize animal genetic resources in Latin America; (ii) promote the establishment of management practices to maintain genetic variability in those characterized animals; (iii) promote, strengthen and consolidate data banks on animal genetic resources; (iv) promote the exchange of information on characterized animal genetic resources; (v) encourage exchange of animal genetic resources between countries and regions; and (vi) implement biotechnological components to facilitate animal genetic resources conservation and management programs directed towards their utilization and improvement.

Problems with the "in situ" Conservation in Latin America

Lack of funds for conservation of domestic animal diversity - The biggest problem faced by researchers involved with animal conservation in Latin America is the lack of funds for their research, not only because this field of study is recent in this continent but also due to the enormous economic problems that Latin America is passing through. There are no private foundations sponsoring research and/or conservation, but all of them are government owned. Funds are getting

scarcer each year, what is making things even more difficult. In many cases, enthusiastic breeders are also involved, with part of the costs for maintaining their breeding nuclei paid by funds of projects approved by governmental institutions. There are situations, however, in which the breeding nuclei are supported entirely by private breeders. These situations are rare but do exist. In general, preservation work is accompanied by researchers that advise the breeders in many aspects of it.

There is a great amount of money from International Organizations to sponsor research and/or conservation work with wildlife and local species of animals. If the species and/or breeds of livestock that came to Latin America with the first settlers, about five centuries ago, could be considered as "local" due to the natural selection they have been through after such a long time, which made them extremely adapted to the different conditions found in our continent, may be part of these financial resources could be utilized in the conservation of this valuable genetic material. According to Fitzhugh (1990), International, non-governmental conservation agencies could expand their activities to embrace the domestic livestock species. Institutions, such as the International Union for the Conservation of Nature and Natural Resources (IUCN), have a strong base of experience in mobilizing private as well as public resources. Expanding its mandate to include genetic diversity within commercial livestock species would have multiple benefits both for livestock and wildlife species. Much of the technology used to preserve wildlife has been drawn from research with commercial livestock. This complementarity could be expanded.

Inbreeding - For many breeds, the conservation started too late, and with very small populations. Most of them presenting a high inbreeding coefficient. This high inbreeding coefficient does not permit a good conservation work. It is well known that the best way to avoid inbreeding depression is to increase the number of animals to be conserved. This solution, however, is not always a viable one. In Brazil, the Mocho Nacional is an example. Being the only Brazilian polled breed was the main reason for its conservation. The animals used in the conservation herd were provided by a private breeder about 10-11 years ago, and were thought to be the last ones. Recently, some purebred bulls and cows of this breed were found in another property of the same breeder, and are now participating in the conservation program, and thus decreasing the high inbreeding coefficient. In the case of the Crioulo Lageano, a Brazilian breed of cattle, there was a need for an introduction of animals from another herd. It was possible to identify a very similar herd in Argentina, and a few bulls were taken to Brazil, in order to decrease the inbreeding coefficient. For the same reason, Brazilian researchers working with Crioulo Lanado Sheep, are trying to import some Criollo rams from Uruguay, where there is a herd that has identical characteristics to the Brazilian breed.

There is no inbreeding problem in the interesting work carried out by Rojas and Wilkins (1992) with Criollo cattle in Bolivia. The objective of the program is to utilize Criollo cattle for dual purpose production in the lowlands of Bolivia, and bulls of different countries of Latin America are being used to produce good quality bulls for crossbreeding programs.

NORTH AMERICA

The U.S. Program

The current U.S. Program on National Genetic Resources was established according to Subtitle C of the 1990 Farm Bill. An official U.S. National Animal Germplasm Program (NAGP) was implemented in 1990. The program is administered by the Secretary of the United States department of Agriculture through the Agricultural Research Service (ARS). The program was established and based on a report developed by a national committee comprised of State and federal scientists, and included representatives from private industry and commodity groups and non-profit groups involved in conservation. The NAGP has been designed to maintain and enhance the collection, preservation

and dissemination of genetic material of importance to U.S. food and agriculture production. The primary species to be involved in the program include those of beef and dairy cattle, swine, poultry, sheep, goats, and aquatic forms. The activities that the proposed program will include are: identifying and evaluating promising and unique sources of germplasm; establishing repositories for germplasm preservation; forming a data bank for storage and retrieval of germplasm information; and fostering increase of stored germplasm. The program will include research on characterization, selection, collection, processing, culture and cryopreservation of sperm cells, embryos and embryonic stem cells. The program also includes research on the mapping of the genome of each species. national Coordinating Committees will develop germplasm policies, identify program and research needs for each species, and implement the program.

Central Repository - A central repository is being developed at Beltsville, Maryland. The repository will meet the needs of the program for about 5 years and will allow the fulfillment of the initial objectives of the program. The long-term objectives call for providing storage space for sperm, embryos, oocytes, stem cells, cell lines, and DNA from designated genetics covering a wide range of domestic animal species and aquaculture. It will be available for use later in 1994. The ARS also has satellite repositories in Clay Center, Nebraska, and at Greenport, New York, to hold transient samples for disease research.

Database - A national animal germplasm database has been established at Beltsville, Maryland. The NAGP databases will contain descriptors and characteristics of the world's animal genetic resources; DNA sequences or mapping information on relevant animal genomes will also be available because the databases of NAGP will be relational with those on the National Animal Genome Research Program. The database is compatible with the international FAO index (abbreviated form). At present, the database includes breeds of cattle (55); sheep (41); swine (17); horses (55); and asses (7). It has been initiated an effort on poultry, and there is a hope to address aquaculture next year.

Gene Mapping - The development of a successful National Animal germplasm Program to conserve, improve, and effectively utilize the genetic diversity of animals will require the development of gene maps for all species. Animal genome research is a worldwide effort. For each livestock species, genetic maps of polymorphic loci must be developed with a sufficient resolution to permit the location, definition, and use of genes affecting economically important traits. Essential related objectives include the analysis of the fine structure of candidate genes and gene families, the definition of the genetic basis of quantitative trait loci to be used to implement marker-assisted selection, and development of new experimental technologies for utilization of genome information. Efficient use of carefully designed biological resources and development of a broadly based data management system are essential.

Recent Research Progress - Skeletal linkage maps for cattle (over 400 markers) and swine (over 500 markers) have been developed by ARS scientists at the U.S. Meat Animal Research Center (USMARC), Clay center, Nebraska.ARS and Michigan State University scientists at East Lansing , Michigan, have developed a linkage map for chickens. To date, over 220 markers have been mapped. ARS scientists at USMARC have developed a relational interactive database that contains raw "information" on individual animals within pedigrees, rather than an archival or summary (cooked or derived) database. The database has been developed for cattle, swine, and sheep, and all U.S. scientists will have access to the database.

CONCLUSIONS

There is no doubt that the conservation of animal genetic resources is a must for America. We cannot risk the future of our important germplasm. And the success will be easier reached if all nations work together with this same purpose. The Animal Regional Gene Bank, for instance, is a concept based on the spirit of cooperation and mutual trust between participating countries. Implementation and success of the scheme therefore, depends on the enthusiasm and willingness of participating nations to preserve for future generations the genetic variability we possess. The fast growing science of Biotechnology may lead to new techniques of gene preservation. DNA recombinant techniques, embryo manipulation, cloning of desirable genes from the same or other breed populations may one day become commonplace. We do believe that all doubts that may persist about the importance of the conservation of animal genetic resources will disappear when we think about the future use of just one particular technique: the formation of transgenic animals. The Gene Banks will play an important role when the desirable genes, responsible for characteristics such as adaptation, heat tolerance and resistance to parasites, will be utilized in the formation of such animals. And then only the countries which have started serious conservation programs will be able to form the transgenic animals that will meet their specific needs. It will be too late for some countries to start. The time is now, before most of the "local" breeds disappear due to systematic crossbreeding programs with exotic breeds.

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Table 1. Original environment of endangered species and/or breeds of Latin America, environment where they are being conserved, and reasons for their conservation

Species/Breed	Original Environment	Conservation Environment	Reasons for Conservation
1. CATTLE			
Argentine Criollo	From the Andes to the Chaco (semi-arid) to the humid Pampa cold Southern region)	Leales (semi-arid) and in Balcarce, South of Argentina	High production, and quick growth
Yacumeño	Beni (flood plain area of Bolivia, tropical)	Beni, Bolivia	Produce good quality bulls for crossbreeding
Milking Criollo of Bolivia	Cows from lowlands of Bolivia, bulls from different countries of Latin America	Lowlands of Bolivia	Tropical dairy breed for crossbreeding. There was a high mortality rate with >75% of European blood.
Caracu	Central and South Brazil (from tropical to temperate)	Central Brazil	High production, growth rate, and good potencial for crossbreeding
Mocho Nacional	Central and South Brazil (from tropical to subtropical)	Central Brazil	Similar reasons to Caracu
Crioulo Lageano	Southern Brazil (highlands, cold winter)	Southern Brazil	High production and adaptability to cold winter
Curraleiro	Northeastern (semi-arid) and Central Brazil	Northeastern Brazil (savanna)	Survive on poor pastures, high fertility rate, resistant to long drought periods
Pantaneiro	Pantanal (swampy region) tropical	Pantanal of Brazil	Adaptability, toughness, and high fertility rate
Sanmartinero	Colombian llanos (23-25oC andannual rainfall of 3,000 to 3,500 mm)	Colombian llanos	Heavy weights on poor pastures, resistant to long drought periods
Romosinuano	Northern humid tropical plains of Colombia	Nothern Colombia and Costa Rica	Good beef production and high fertility rate
Blanco Orejinegro	Slopes of the Andes(18-24oC annual rainfall of 1,800mm)	Antioquia, Colombia	Very thick hide, resistant to external parasites

Species/breed	Original Environment	Conservation Environment	Reasons for Conservation
Costeño con Cuernos	Coastal plains (27.5oC, and annual rainfall of 1,235 mm)	Cerete, Cordoba, Colombia	Criollo cattle selected for milk production
Limonero	Limon river area (27.4oC, and annual rainfall of 920mm)	Limon river, Colombia	Selected for milk production
2. HORSES			
Lavradeiro	Northern Brazil savannas	Northern Brazil savannas	Survival on very poor diet, resistant to internal and external parasites
Pantaneiro	Pantanal (swampy region), tropical	Pantanal, Brazil	Adapted to the Pantanal. Resist better to Equine Infectious Anaemia than any other horse breed
3. DONKEYS			
Northeastern Donkey	Northeastern region of Brazil, (semi-arid)	Northeastern Brazil	Animals widely used for transport and draft by the low income population
4.BUFFALO			
Carabao & Tipo Baio	Amazon region of Brazil	Amazon region, Brazil	Well adapted to the Amazonian conditions
5. SHEEP			
Morada Nova & Santa Ines	Northeastern region of Brazil (semi-arid)	Northeastern Brazil	Woolless sheep, well adapted to the semi arid
Crioulo Lanado	Southern Brazil and Uruguay (temperate climate)	Southern Brazil and Uruguay	High fertility, precocity and resistance to internal parasites
6. GOATS			
Moxotó, Marota, Canindé & Repartida	Northeastern region of Brazil (semi-arid)	Northeastern Brazil	Adapted to the region. Responsible for most of the milk for human consumption in the region
7.CAMELIDS			
Vicuña & Guanaco	Andes (highlands)	Andes - most part in Peru and Bolivia some in Argentina	Utilize highlands, where no animals of European origin can be raised