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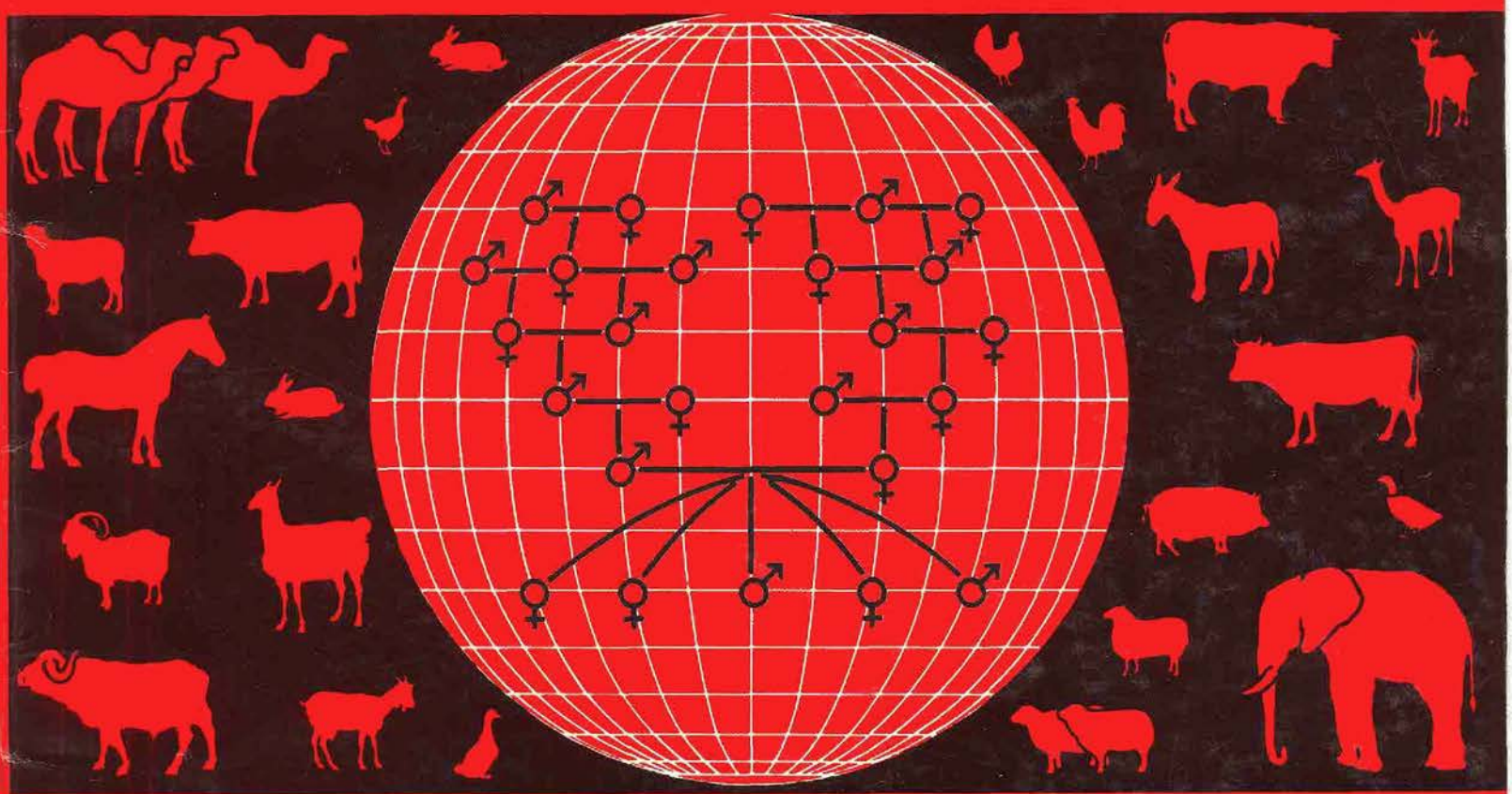
14

ANIMAL GENETIC RESOURCES INFORMATION

BULLETIN D'INFORMATION SUR LES RESSOURCES GÉNÉTIQUES ANIMALES

BOLETIN DE INFORMACION SOBRE RECURSOS GENETICOS ANIMALES

1994



Food and Agriculture Organization of the United Nations

Organisation des Nations Unies pour l'alimentation et l'agriculture

Organización de las Naciones Unidas para la Agricultura y la Alimentación

UNEP

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UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT
PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

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CONTENTS

Animal Genetic Resources Information is published under the joint auspices of the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme (UNEP). It is edited in the Animal Genetic Resources Group of the Animal Production and Health Division of FAO. It is available direct from FAO or through the usual FAO sales agents.

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El *Boletín de Información sobre Recursos Genéticos Animales* se publica bajo les auspicios de la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO) y del Programa de la Naciones Unidas para el Medio Ambiente (UNEP). Se edita en el Grupo de Recursos Genéticos de la Dirección de Producción y Sanidad Animal de la FAO. Se puede obtener directamente de la FAO o a través de sus agentes de venta habituales.

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ANIMAL GENETIC RESOURCES INFORMATION will be sent free of charge to those concerned with the conservation, management or utilization of domestic livestock. Anyone wishing to receive it regularly should send their name and address to the Editor, at the address on page v.

LE BULLETIN D'INFORMATION SUR LES RESSOURCES GÉNÉTIQUES ANIMALES sera envoyé gratuitement aux personnes intéressées par la conservation, l'élevage ou l'exploitation du bétail domestique. Les personnes souhaitant recevoir cette publication régulièrement voudront bien faire parvenir leurs nom et adresse à l'éditeur, à l'adresse indiquée en page v.

El BOLETÍN DE INFORMACIÓN SOBRE RECURSOS GENÉTICOS ANIMALES será enviado gratuitamente a quienes estén interesados en la conservación, gestión o utilización del ganado doméstico. Si se desea recibirlo regularmente, se ruega comunicar nombre, apellido y dirección al editor a la dirección indicada en la página v.

GUIDE TO CONTRIBUTORS

Animal Genetic Resources Information will be pleased to receive contributions up to 3000 words long in English, French or Spanish. If accepted, they will be published in the original language. Reports, news and notes about meetings, conservation and evaluation activities, and techniques would be appreciated. Manuscripts should be typed in double space and accompanied by a summary of not more than 5 percent of the original length. Photographs are acceptable but only high quality black and white prints. AGRI will also review new books on animal genetic resources. Correspondence is invited.

All contributions should be addressed to:

The Editor, AGRI, AGAP, FAO,
Via delle Terme di Caracalla,
00100 Rome, Italy

Le Bulletin d'information sur les ressources génétiques animales souhaite recevoir des articles en anglais, en français ou en espagnol, de 3000 mots au maximum. Les communications publiées paraîtront dans la langue originale. Les rapports, informations et notes concernant les réunions et les activités de conservation et d'évaluation et les techniques seraient particulièrement appréciés. Les manuscrits devront être dactylographiés en double interligne et accompagnés d'un résumé ne dépassant pas cinq pour cent de la longueur de l'original. Le Bulletin accepte les photographies à condition qu'il s'agisse de bonnes épreuves en noir et blanc. Le Bulletin rend également compte des ouvrages nouvellement parus sur les ressources génétiques animales. Un échange de correspondance est le bienvenu.

Adresser toutes les contributions à l'adresse suivante:

L'Éditeur, AGRI, AGAP, FAO,
Via delle Terme di Caracalla,
00100 Rome, Italie.

El Boletín de Información sobre Recursos Genéticos Animales recibirá con mucho gusto colaboraciones de hasta 3000 palabras de extensión en español, francés o inglés. Si son aceptadas, las contribuciones se publicarán en el idioma original. Interesa recibir informes, noticias y notas sobre reuniones, actividades de conservación y evaluación, y cuestiones técnicas. Los originales deberán presentarse mecanografiados a doble espacio y acompañados de un resumen que no supere el 5 por ciento de la extensión original. Se aceptan fotografías, pero únicamente en blanco y negro y de buena calidad. AGRI también publicará reseñas de libros sobre recursos genéticos animales. Cualquier intercambio de correspondencia será bienvenido.

Todas las contribuciones deberán dirigirse a:

El Editor, AGRI, AGAP, FAO,
Via delle Terme di Caracalla,
00100 Roma, Italia.

EDITORIAL

There has been a small gap between AGRI No. 13 and this one, due to budgetary restrictions within FAO. The regular publication is now restarting with the financial support of UNEP, with three issues per year, as long as you, the reader, make available enough material.

Meanwhile the day to day work on the Global Databank for Animal Genetic Resources is going on. A considerable amount of data which had been received and could not be validated before is now being processed and entered in the bank. We have established many new and efficient contacts in a lot of countries for which no or limited information was available before. In this regards the training courses on establishment and operation of genebanks and databanks have proved very useful. After two such courses held in May 1994 in Africa (in French at CIRDES in Bobo Dioulasso, Burkina Faso and in English at ILCA, Addis Ababa, Ethiopia) the flow of data for the countries involved has increased significantly, both as regards the quantity, and more important, the quality of the information.

Discussions have been held with EAAP, and an agreement has been reached to develop a common list of contact persons in Europe (Eastern and Western), who will be asked in a near future to update the data already entered in the Global Databank.

With all this new set of data, we plan to produce in 1995 a second edition of the World Watch List for Domestic Animal Diversity. This second edition will be available in English, French and Spanish, be expanded to include poultry and camelids, and include also a section on wild relatives of livestock species, which may be a source of diversity in the future. This second edition of the WWL is also necessary to redistribute the genetic resources between the new countries born as a result of political changes occurring in Eastern Europe and in the former USSR.

The report of the working group for the design of the information system outlined a series of activities to be set up to establish the whole information system, known as DAD-IS. A first step has been implemented with the recruitment of a consultant to determine the user requirements (type of data to be stored, types of queries) and detail the field definition and structure. The next step will be the design of the user interface.

NOTES - BIBLIOGRAPHY

Races domestiques en péril. 1993. Ethnozootechnie No. 52, 92 pages. Prix: 90 FF.

Cet ouvrage est un numéro spécial d'Ethnozootechnie; il présente les textes de la 4ème Journée d'Etude de la Societé d'Ethnozootechnie, tenue le 2 décembre 1993 à l'INAPG, sous la direction de Jacques Bougler et Etienne Verrier. Cette réunion a fait le point sur les travaux réalisés, les difficultés rencontrées et/ou surmontées et les lacunes des politiques en matière de conservation du patrimoine génétique animal, avec référence spéciale à la France.

L'ouvrage souligne le fait qu'à l'origine des années 80 la sauvegarde des populations autochtones encore existantes était la préocupation dominante, puis a succedé une approche de mise en oeuvre de projets de conservation. Aujourd'hui il faut raisonner la mise en valeur de certains d'entre eux.

En introduction de l'ouvrage on trouve les synthèses de deux importants colloques tenus en France. Le premier, à Rambouillet le 24 septembre 1992, est une contribution sur les problèmes des races domestiques en péril, les initiatives de conservation et leur relative absence de coordination. Le deuxième, à Montpellier le 28-30 septembre 1993, a discuté les méthodologies d'étude et de gestion des ressources génétiques, autant animales que végétales.

Les c.r. du colloque ont été structurés en sept parties avec des études de cas spécifiques; suit en conclusion un excellant document par J.G. Hall sur la biodiversité du bétail de ferme, traduit de l'Anglais. Les sept parties sont:

- La nécessité d'une valorisation des populations conservées.
- Le rôle économique de la conservation des races en péril.
- Les produits d'Appellation d'Origine Contrôlée (AOC) comme élément de soutien et de mise en valeur des races régionales.
- Stratégie de recherche à long terme.
- Le rôle des éleveurs.
- La PAC et l'aide aux races de petits effectifs.
- Les lacunes des politiques actuelles.

Pour obtenir cet ouvrage, s'adresser à la Société d'Ethnozootechnie, 25 Bd. Arago, F - 75013 Paris, France.

Jean Boyazoglu

Production of Hides, Skins, Wool and Hair. O. Güney, O. Biçer and M.S. Ranieri (Compilers). PUDOC Scientific Publishers, Wageningen, 1993, 292 pp., EAAP publication N° 56. Price: Dfl 180.

This book reports the Proceedings of the Symposium held in Adana, Turkey, from 2-6 November 1991, which was organised as part of the series of Symposia jointly conceived by the European Association for Animal Production (EAAP) and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM). It is useful to recall that the goal of these symposia is to develop aspects of animal agriculture in the Mediterranean region which are now normally covered by other scientific meetings. The Adana Symposium was dedicated to the production and use of hides, skins, wool and hair; these are considered in the Mediterranean basin as by-products or at least of secondary economic importance, in respect to the production of meat and milk. Merino-type and semi-fine wool were not dealt with in the symposium. Nevertheless, among the

35 main papers, 12 refer to fibres from sheep and goats. The accent is put on the Angora goats, of which Turkey is the world cradle, and also on the cashmere. Many papers discuss the development strategies of these genetic resources outside their country of origin, where they provide possibilities of diversifying animal production for high-value products in specialized small flocks. Examples are reported for both from western Europe (France and Italy) where they were imported during the last 10 years; three papers are also dedicated to the development of cashmere goats in Australia (Ponzoni). These reports reveal the interest for a better inventory and knowledge of the original germplasm; in Turkey for Angora goats and in China for cashmere (Ryder).

The originality of this book is probably now to be found in this field, despite the quality of the information and the interest of review papers on the physiological basis of wool and hair production (Allain, Ryder), on the nutritional characteristics and feeding recommendations for developing fibre goat flocks (Morand-Fehr), or on the objective measurements of wool (Sergent). This publication attempts to provide information on the whole production chain; from the animal to the final processed commodity. In fact, two subtitles could have been adopted covering two main sets of reports: the first "from skin to leather" and the second "from wool to carpets and rugs". In this respect, this book presents real interest in providing information from various sources difficult to collect by a single person: statistical data on the production and world trade of hides, skins and leather (Krostitz), analysis of the physical properties of sheep leather (Eskolin et al), the factors which determine the quality of the raw material (animal diseases and slaughterhouses; Blajan), case studies on the characteristics of the leather industry in Turkey (Kosar, Artan) and in Morocco (Eddebarh), the environmental issues of this type of industry (Sari and Yapici in Turkey; and Simoncini and Miriani in Italy) and the possible uses of by-products of the industry in agriculture (Silva and Baffi).

Two chapters are dedicated to special wool for the carpet industry, including several reports on the relation between the specific qualities of the local sheep breeds and the characteristics of the hand-made carpets in Egypt (Guirguis), Turkey (Erdem et al), Algeria (Benyoucef), Morocco (Bourfia et al) and Italy-Sardinia (Casu et al). Many reports present the tradition and the various characteristics of carpets in Turkey, but unfortunately without reproduction of the very significative photographs of the various designs and natural colours of the carpets that illustrated the oral presentation of the reports, because of high printing costs.

The intention of the organisers of the Symposium was to examine to which extent the lower productivity of the animal material and production systems in the Mediterranean basin could be compensated by high-value specific and typical products (Boutonnet and Flamant). These reports provide technical information on the relation between the conditions of producing the raw material and processing in order to control the performance of the whole chain. One problem was discussed but did not receive an answer: to which extent the farmer could beneficit from this final high commercial value, in order to maintain livestock activities in the difficult and marginal Mediterranean environment?

In conclusion, we can observe that this book has the qualities and the weaknesses of the Proceedings of a good Symposium: it contains original information rarely available normally but there is a lack of balance between the various subjects of interest, due to an unequal quality of the reports and papers presented. Overall, this book reflects perfectly the unique opportunity given by such a Symposium: the exchange of information between the specialists of animal production and the representatives of an industry; in this case including the leather industry as well as specialists of the traditional hand-woven carpet sector.

Jean-Claude Flamant

Taking Stock : The North American Livestock Census. D.E. Bixby, Carolyn J. Christman, Cynthia J. Ehrman and D.P. Sponenberg. 1994. The McDonald & Woodward Publishing Company, P.O. Box 10308, Blacksburg, Virginia 24062-0308, U.S.A. 182pp. Price: $ 14.95.

This book is an interesting, even exciting, but classical approach to the presentation of the state of the art and census of national and regional animal genetic resources in North America. It can be a reference for the reporting of other similar cases, reviewing the information available and linking the local policies towards the conservation of genetic diversity in livestock at a moment when census data become available.

The book is produced by the American Livestock Breeds Conservancy (ALBC) a non-profit organization working to protect genetic diversity in American livestock through the conservation of nearly 100 breeds of donkeys, cattle, goats, horses, sheep, pigs, and poultry. The organization is supported by gifts from individuals, grants from foundations and corporations, and contracts; it was founded as the American Minor Breeds Conservancy (AMBC) in 1977 in New England.

Agricultural historians, while seeking authentic period livestock for interpretive programs at Old Sturbridge Village and other historic sites, discovered that many heritage breeds were nearly extinct. The historians joined with farmers and animal scientists to form AMBC, and set its mission as the conservation of endangered breeds of livestock. The organization moved to Pittsboro, North Carolina in 1985. The name was changed to the American Livestock Breeds Conservancy in 1993 to reflect the increasingly serious threat to all livestock breeds, and a consequent widening of the organization's sphere of activities.

The American Livestock Breeds Conservancy directs many conservation and research programs. A periodic census of livestock breeds, which includes the monitoring of bloodlines within many of the rarer breeds, provides the knowledge base for developing these programs. Conservation projects include a gene bank, blood typing and DNA fingerprinting to characterize breed identity, rescues of threatened populations, and the development of genetic recovery breeding programs. It provides technical support for conservation breeding, registry operation, and livestock use to breeders, breed associations, and agriculture organizations. Outreach programs educate the public and policy makers about the importance of genetic diversity in livestock.

The book is divided into three main sections. The first section can be considered a compact manual on livestock genetic resources, their diversity and conservation. The first chapter gives a short historical overview of the livestock sector from the first stages of domestication to the specifics of North American populations. Then follow four chapters, written in a rather academic way, on the importance of genetic diversity, the principles of genetic erosion with special reference to North America and the influence this can have in an agricultural context; and finally a chapter describing the reasons for the consecration of genetic diversity in farm animals : food security, economic opportunities, environmental monitoring, stewardship of scientific knowledge and the aspects relating to culture, history and ethics.

The second section covers the census results, breed per breed, of 1990 to 1992 with some reference to previous information, particularly the 1985 data from the first census that ALBC undertook. The information (U.S.A. and Canada) includes registration figures, estimates of global populations, numbers of breeders and lists of all officially recognized associations, cumulative registrations and summary information on breed registration policies; evidently when information was available which is not true for all breeds. The information is presented by species : donkeys, cattle, goats, horses, sheep and pigs. A useful short census summary completes this section.

The third section touches on conservation and selection policies with summary descriptions of the breed status, the characterization of the breeds and their potential and actual use. The importance of research in livestock conservation and the role of public and private sectors in conservation programs is discussed as well as the need for corporate support and some superficial information is given on international cooperation.

Two appendices give further value to the book. The first describes three case studies : An Economic History of the U.S. Livestock Industry; Extinct Horse Breeds and Extinct Goat Breeds. The second is the North American Feral Livestock Census. A short glossary completes the publication.

Attractively produced, this book can serve as a reference publication not only to all those involved or interested by the conservation of farm animal genetic diversity but also as a good text book for university students.

Jean Boyazoglu

L'homme, l'animal domestique et l'environnement du Moyen Âge au XVIII Siècle. Enquêtes et Documents No. 19 (Centre de Recherches sur l'Histoire du Monde Atlantique, Université de Nantes). R. Durand (Ed). Published by Ouest Éditions, 1 rue de la Noë, 44071 Nantes Cedex 03, France. 387 pp. Prix: FF 180.

This book contains the proceedings of a workshop held in Nantes in October 1992 around the central theme of "Man, the domesticated animal and the environment from the Middle Ages to the XVIIIth century". This very interesting meeting was jointly organized by the History Department of the University of Nantes (Brittany) and the Nantes National School of Veterinary Science.

The book was collectively produced by a number of scientists and academics who are at the origin of the development of CRHMA at the University of Nantes and who all have an interest in the history and development of regional identities.

Studying man and domesticated animals in relation to the environment during the specific period from the XIIth to the XVIIIth century in Europe brings to evidence a mass of existing relationships and interactions that played a major role and deeply influenced the socio-economic history of the Western world as a whole. Some relations that developed throw a definite light on the parallel and intermingled evolution of three groups of research activities: history, veterinary and animal science, and the sciences of the environment. Herein we can retain the role of archeozoology in the study of breeds and types of domesticated animals that were developed in the past and those existing today; the historical role of major domesticated species in the extension of the agricultural zones in Europe and the evolution of the various ecosystems at specific periods in the history of Europe.

An introduction places the contours of this workshop within the borders of Europe and the Mediterranean : from Byzantium and the Orthodox world to Moslem Spain, and from the Viking North to Catholic Hungary. This is followed by a brilliant descriptive paper on animal domestication and the relationship between man and farm animals.

The book is subdivided in four main sections. Section I covers the social status of domesticated animals; section II covers the management of domesticated animals; III covers protection and animal health; and IV domesticated animals and their environment.

The book contains 28 full papers; the authors are eminent French scientists, academics and professionals in their fields of interest and study. The importance of this workshop is that it brought

together experts of disciplines as different as sociology, history of the rural world, veterinary science, archeozoology, ethology and animal agriculture, to mention only a few.

The papers are, with no exception, of great interest as they touch on fields long underestimated by the practising end of 20th century animal scientists. Each paper is completed by an up-to-date bibliography.

The organizers of the workshop truly succeeded in convening interested people from varying fields of expertise and professional involvement. This publication is an original contribution, rich in material as different as economic anthropology and social history. This diversity of information underlines the decisive role played by the farm animal sector in history and explains its dynamic role in evolution. The book includes information on very interesting and yet unpublished studies on the crossroads of history, animal agricultural and veterinary science, ecology, ethology and literature.

Jean Boyazoglu

Equine Reproductive Physiology, Breeding and Stud Management. Mina C.G. Davies Morel. 1993. Farming Press Books, Wharfedale Rd., Ipswich IP1 4LG, U.K., 450 pp.

This book contains a wealth of practical information for those involved with the management and breeding of horses at all levels. The necessary knowledge of reproductive anatomy and equine physiology and the state of the art information on embryo transfer, artificial insemination, hormonal manipulation and their applicability to the various systems existing on stud farms are presented and discussed in depth in a practical and efficient way. The author underlines successfully that whatever the developments and achievements in the adoption of new and avant-garde technologies might have been in the last century, this was only made possible through the direct involvement of stud breeders and horse farm managers.

The book is subdivided in two sections. The first concerns reproductive anatomy and physiology with equal attention given to stallions and mares. Two informative chapters deal with pregnancy and parturition. Problems relating to early and late pregnancy as well as foaling abnormalities are included. Two very original chapters concern lactation and milk secretion : mammogenesis, lactation curves and milk quality, milk synthesis, milk ejection, lactogenesis and galactopoeisis.

In the second section the author successfully describes and presents in an easily understood and comprehensible language matters relating to breeding and selection with several well documented, practical chapters on animal management : mating practices, the pregnant mare, parturition, the lactating mare and foal, youngstock, and the stallion. In the two last chapters a mass of practical tips on artificial insemination and reproduction biotechnology are given.

The book is richly illustrated by numerous attractive and explanatory photographs and very explicit drawings. Each chapter is enriched by an up-to-date bibliography. It is not only of special interest to university lecturers, scientists and students but also to veterinary practitioners, breeders, stud farm managers and those individual horse owners that are keen to update their scientific background and knowledge. The book aims also at giving practical information of common benefit to horse lovers. It is destined to take its rightful place among the limited number of books published this past decade, recognized as authoritative and truly informative.

Jean Boyazoglu

Animal Breeding: The Modern Approach. K. Hammond, H-U Graser, C.A. McDonald (Editors). Published by Post Graduate Foundation in Veterinary Science, University of Sydney, P.O. Box A561, Sydney South 2000, NSW, Australia. 1992. 257 pp., 50 figures, index, softcover. Price: AUS$ 58.00 plus $ 7.00 post.

This new book is destined to take its place among a limited number of books which, over the years have become recognized and authoritative texts in practical animal breeding. This book combines enough sound theory with a realistic understanding of what can an what cannot be done in practice to gain genetic improvement in farm animals producing milk and meat (mainly cattle, sheep and pigs). Some books are so rich in theory, that they explore every nuance and option at the mathematical level without apparently appreciating the complicated infrastructures that would be needed to implement some of the refinements. Often in practice, these infrastructures are missing or would be beyond the skills and/or means of the practical livestock owners to provide. Other breeding books are so friendly and desirous of showing their understanding of the management practices of livestock, that they offer the livestock owner little that he does not know already about breeding. This book succeeds in getting the balance right between theory and what can be achieved in real situations.

The secret formula is probably the mis of editors and authors, of whom there are twelve. The three editors, who are strong in both theory and application, clearly drew an advance profile of the book they hoped to produce. They then recruited authors in addition to themselves who brought the discipline of decades of successful extension and industry experience. This has been gained mainly in Australia, but has strong international components. There are important species differences in animal breeding programmes in practice. These differences have been taken on board by inviting authors with species specific experience, not simply as advisors to individual livestock producers, but also key scientific managers in group breeding schemes operated either by government agencies or by private companies. Thus, to the credit of the editors and authors, the whole book is has an authentic economic touch. The reader knows that their breeding plans are not concepts but accounts of what has been done. The benefits therefore include knowing what is not possible as well as what can be done, in the light of the expectations and evaluations of large numbers of livestock farmers and the boards of directors of companies.

The book is in five sections. The firs section, written by the senior author, gives an overview of the new era in genetic improvement, which takes account of scale, new technologies, economics and product pricing. It then identifies the essential components of animal breeding operations and thoughtfully removes some common misconceptions. It concludes with an analysis of measurements, records, record gathering, data analyses, identification and the quantitative/population approach.

The second section explains genetic evaluation also bringing heritabilities and economics together. It covers BLUP, the BLUP Animal Model, within and across herd evaluations and then considers the special aspects of beef cattle, wool sheep, meat sheep, dairy cattle, pigs, and crossbreeding.

The third section explains breeding objectives and covers traits and combinations of traits, selection indices and puts the process of breeding objectives firmly in the economic setting. The choice of breeding objectives is examinated for each of the species and products.

Section four moves into the design of breeding programmes by explaining and illustrating selection theory and selection intensity. The items to be considered in the design of a breeding programma are then examined, including such important issues as numbers and distribution of animals, generation turnover, inbreeding, mating plans, management imperatives, costs and

possible benefits. These are first evaluated in terms of a straight breeding programme, but then are considered in the light of alternatives which may change both the operational issues and the expectations. These alternatives include open nucleus schemes, artificial insemination, multiple ovulation embryo transfer (MOET) and the longer term possibilities of cloning. Crossbreeding is given a special place.

The final, fifth section stands back from the technology again and reviews the breeding business from the point of view of those capital, labour, resources and future are being affected for good or bad, by the use of breeding, programmes. These are the seedstock producers, the commercial producers, the industry and consumers. The book concludes with risk analysis.

An interesting feature of the book is the Guide for Consultants at the end of each section. Another valuable point is the emphasis on livestock producers being able to capture genetic gain by grouping themselves, either thorough self-help schemes or by buying the group benefits through a successful breeding company which offers both germplasm and the system to use it successfully.

Although the material in this book was originally prepared for a course, the intellectual home stable is the Animal Genetics and Breeding Unit (AGBU) of the University of New England, Armidale, Australia. The senior author is the founding director of this well-known institution which has high standing academically and in the industry by contributing, for example, to the design of breeding tools known as BREEDPLAN, PIGBLUP and B.-OBJECT. The book offers the benefits of the essential genetic formulae of genetic theory without expecting the reader and user to study and understand them. One gains the feeling that the authors belong to that group of animal breeders whose underlying philosophy is the successful application of animal genetics in the economic realities of the farm business. Their enthusiasm for animal genetics is not triggered by genetic formulae alone, but by the positive economic and financial equations which genetic improvement can produced on livestock farms.

John Hodges

CORRIGENDUM: AGRI vol. no. 12 (1993) pages 73 to 92.

In the preparation of the two articles refering to the "Garole microsheep of Bengal, India" and the "Goat and sheep of the Deccan plateau in the Maharashtra State of India", a number of mistakes were introduced involuntarily.

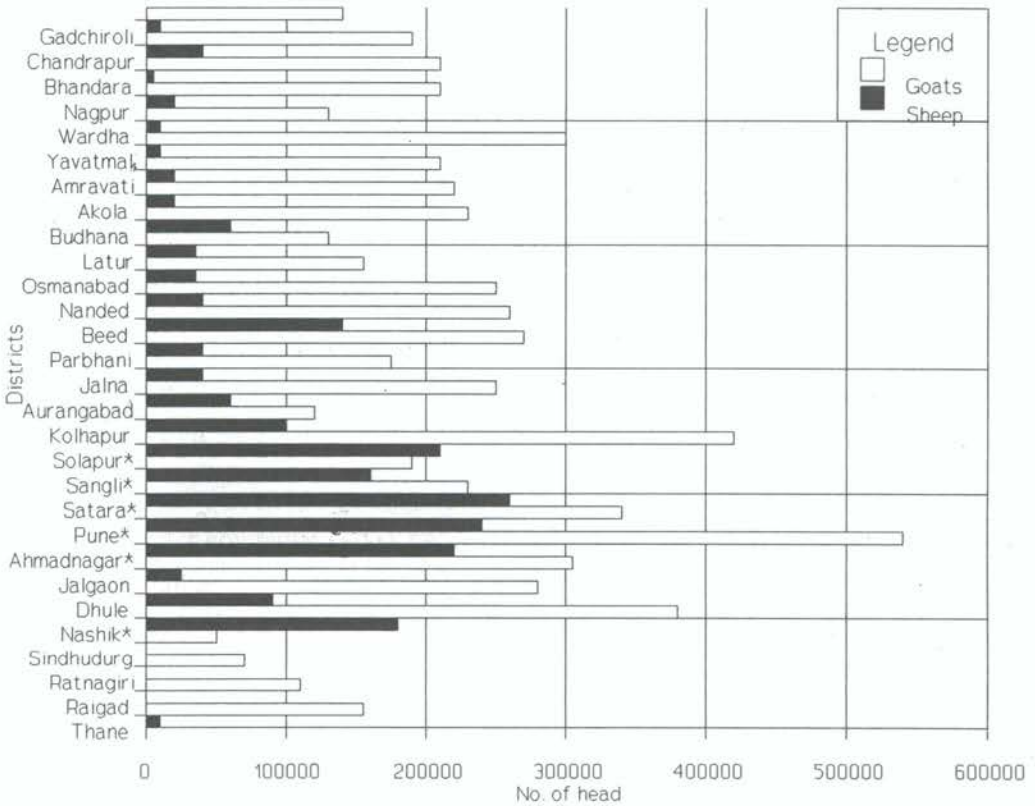
1. A bar chart that permits the distinction of the sheep and goat populations in Maharashtra State, which accompanied the map given on page 83 of AGRI vol. no. 12, was inadvertently omitted; it is now printed on page 12 of this AGRI volume.

2. The maps received from the authors (full map of India) were not printed in their entity on pages 75 and 83 of AGRI Vol. No. 12 due to a re-dimensioning of both maps to fit the publications standard page size.

3. There was a misprint in page 86, paragraph 4.1 titled "The Osmanabadi breed". The last sentence of this paragraph should read "The average daily milk yield of the Osmanabadi goats is 0.5 to 1.5 kg".

The editors of AGRI wish to apologize for any incovenience caused by this errors introduced involuntarily in the originally published text.

Figure: *Districtwise Sheep and Goats population in Maharashtra State (*: drought-prone districts)*



LE RÔLE DES BIOTECHNOLOGIES DE LA REPRODUCTION POUR LA CONSERVATION DES RESSOURCES GÉNÉTIQUES ANIMALES

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RÉSUMÉ

Cet article analyse dans quelle mesure les nouvelles perspectives offertes par les biotechnologies de la reproduction s'appliquent aux activités de conservation des ressources génétiques animales. Ces activités ont été regroupées autour de cinq thèmes: Décrire, Détruire, Défendre, Stocker, Recréer. Ces techniques n'apportent aucun plus pour la description des caractéristiques d'une population ou d'une race. La principale menace qui pèse sur une race d'animaux domestiques est de disparaître par croisement avec une autre, et l'insémination artificielle représente de ce point de vue un danger certain. Inversement, l'insémination artificielle peut devenir un instrument de défense des races locales. Il serait plus difficile de trouver une justification à l'utilisation de la plupart des autres biotechnologies (transfert d'embryons, sexage, clonage) pour la protection et la promotion des races locales. Pour la conservation des ressources génétiques, la cryoconservation des spermatozoïdes et des embryons, mais également les ovocytes, voire des morceaux de gonades et des cellules somatiques est un outil irremplaçable. La dernière partie présente des calculs sur les possibilités de re-création de races, selon la nature du matériel stocké.

Mots clés : Biotechnologie animale, ressources génétiques, reproduction

SUMMARY

This article analyzes to which extent these new possibilities apply to the conservation of animal genetic resources activities. These have been divided in five topics: Describe, Destroy, Conserve, Store, Recreate. These techniques do not bring any "plus" for characterizing breeds or populations. The main threat faced by livestock breeds is disappearance as a result of crossbreeding, artificial insemination representing on this aspect a real danger. Conversely, artificial insemination can become a tool for the active conservation of local breeds. It would be more difficult to justify the use of other more sophisticated biotechnologies (embryo transfer, sexing, cloning) for the active conservation of local breeds. For the preservation of animal genetic resources, the feasibility of freezing sperm cells and embryos, and also, with improvements of the technology, oocytes and part of the gonads, and somatic cells is an irreplacable tool. The last section presents calculations on the possibilities of re-creating a breed, according to the kind of material which has been stored.

Key words: Animal Biotechnology, Genetic Resources, Reproduction

1.0 INTRODUCTION

Toute activité dans le domaine de la gestion des ressources génétiques est basée sur une utilisation de la reproduction. Aucune action n'étant possible directement sur l'animal, c'est sur les descendants que l'on pourra agir. Longtemps limitées à un simple contrôle des accouplements, les possibilités du généticien dans le domaine de la reproduction se sont enrichies dans les dernières décennies de nouvelles techniques, en commençant par l'insémination artificielle dans les années 50, puis le transfert d'embryons à la fin des années 70, et dans les dernières années le sexage ou le clonage.

Au delà de ces possibilités "traditionnelles" d'intervention, le généticien peut aussi de plus en plus agir directement sur la composante de base du patrimoine génétique, puisqu'il peut désormais analyser l'ADN, le stocker, et (avec un peu de science fiction) le ré-injecter pour créer un nouvel individu doté de potentialités supplémentaires prises dans un autre individu, une autre race, voire une autre espèce.

Dans quelle mesure ces nouvelles perspectives s'appliquent-elles aux activités de conservation des ressources génétiques animales? On peut regrouper celles-ci autour de cinq thèmes:

Décrire
Détruire
Défendre
Stocker
Recréer,

et réfléchir sur les apports des différentes biotechnologies.

2.0 DÉCRIRE

Comme l'identification des caractéristiques des animaux à sélectionner est la base des programmes d'amélioration génétique, de même l'identification des caractères d'une race, de sa différence par rapport aux races voisines, de la pureté d'une population, sont à la base des programmes de conservation des ressources génétiques animales.

L'insémination artificielle, en permettant de multiplier le nombre de descendants d'un mâle donné, a accru le niveau de connaissance des potentialités de cet individu. Le transfert d'embryons a encore accru la précision de cette connaissance et a, de plus, ouvert la voie à des actions similaires sur la voie femelle. Le clonage est supposé accroître encore ces possibilités, et ce aussi bien pour les voies mâle que femelle. Mais ceci ne s'applique qu'au cas des individus, pas des populations.

Ces techniques n'apportent aucun plus pour la description des caractéristiques d'une population ou d'une race. La seule exception concernerait la possibilité, grâce au transfert d'embryons, de tester les potentialités de la race en dehors de son environnement habituel, et ainsi de faire la part entre les caractéristique propres de la population et les conséquences d'un environnement ou d'un mode de conduite particuliers. De même, la possibilité offerte par le TE d'étudier l'effet maternel, tant au niveau de l'environnement utérin que de l'allaitement (en choisissant la race de la receveuse) peut permettre de distinguer, dans les caractéristiques d'une race, ce qui est d'origine génétique de ce qui est apporté par les conditions de vies, avant et après

la naissance. Un exemple en est donné par l'expérience en cours à l'ILRAD, dans laquelle des embryons de N'Dama originaires de Gambie ont été transférés sur des femelles Boran au Kenya, ce qui peut permettre d'étudier la réaction de veaux d'une race réputée trypanotolérante, nés de femelles qui ne le sont pas.

Toutes les techniques qui se rattachent à l'analyse de l'ADN, au contraire, améliorent et affinent la description des populations ou des races. Ceci a été décrit en détail dans l'exposé de M. Duplan "caractérisation génétique des races". Particulièrement importante, compte tenu du coût des opérations de conservation et du grand nombre de races menacées (voir exposé de R. Loftus), est la possibilité de mesurer précisément le caractère unique d'une population et les distances génétiques qui la sépare des populations voisines ou semblables. Seules les races réellement différentes et possédant des caractéristiques clairement individualisées pourront bénéficier d'actions de sauvetage.

3.0 DÉTRUIRE.

La principale menace qui pèse sur une race d'animaux domestiques est de disparaître par croisement avec une autre, parfois simplement par hasard, souvent en conséquence d'un croisement délibéré dans l'espoir d'améliorer significativement et rapidement les performances. Le recours à cette stratégie, qui est rendue encore plus attractive par l'effet d'hétérosis, qui s'observe tout particulièrement en cas de croisement entre taurins et zébus, est indiscutablement facilitée par l'emploi de l'insémination artificielle. Au cours des dernières décennies, toute une série de programmes d'importation de doses de semences de taureaux européens (Holstein, Jersey, Brune des Alpes, Montbéliard), souvent facilités dans le cadre de donations (voir programme de dons de semence de taureau de la FAO), ont développé le recours à l'animal croisé. Dans la plupart des pays africains, les conditions climatiques et sanitaires ne permettent pas un élevage rentable des ces animaux croisés, même de première génération, et leur extension se limite au pourtour des grandes villes pour l'approvisionnement en lait de celles-ci. Mais lorsque les conditions sont moins difficiles, ces animaux se répandent, jusqu'à mettre en péril les races locales. En Albanie par exemple, il n'est plus possible de trouver un bovin de race locale pure, tous les animaux ayant été croisés avec des Holstein en plaine et des Jersey en montagne.

Le transfert d'embryon, qui permet d'importer directement la race "exotique" pure, est potentiellement moins dangereux, compte tenu des problèmes de survie de ces animaux, des difficultés dans la mise en place efficace du transfert lui même dans les conditions du terrain et du coût du veau produit. Il n'y a pas d'exemple de race mise en danger par le recours à cette technique.

4.0 DÉFENDRE.

Inversement, l'insémination artificielle peut devenir un instrument de défense des races locales. Au Bénin, les éleveurs des races Somba et Borgou, comme dans beaucoup d'autres pays de la région, ont laissé faire, ou ont volontairement favorisé, le croisement de leurs femelles avec les mâles zébus des troupeaux transhumants. Cela leur permettait d'accroître le format des animaux, source de prestige, dans l'espoir d'améliorer l'aptitude au travail et les rendements en viande. Ces éleveurs ont pris conscience, par eux même et à travers le travail de sensibilisation des projets de développement, des difficultés supplémentaires que représente l'élevage de ces animaux, notamment du fait de leur sensibilité à la trypanosomiase, de la nécessité de frais supplémentaires en traitements

vétérinaires et de la difficulté de les maintenir en bon état, avec pour conséquence un prix de vente en carcasse inférieur aux espérances et souvent non différent de celui des animaux de races locales. Ils souhaitent maintenant revenir à l'accouplement en race pure, mais ont les plus grandes difficultés à trouver des mâles purs. Dans ces conditions, l'insémination artificielle, pour la diffusion de la semence d'un petit noyau de mâles de race pure, pour permettre aux éleveurs de réorienter leurs troupeaux vers la race pure, sera un puissant outil de protection de ces races, même en limitant l'usage de l'IA à une petite série d'opérations, chez des éleveurs particulièrement motivés et répartis sur tout le territoire d'expansion de la race considérée.

Mais l'IA ne doit pas se limiter à donner accès à la race pure. Les mâles retenus pour la production de semence doivent apporter un plus sur le plan des performances. Pour revenir à l'exemple du Bénin, pour conforter les éleveurs dans leur choix de revenir à leurs races locales, il faut que les produits soient immédiatement attractifs: dans ce cas les taureaux devront être choisis sur leur format et sur leur trypanotolérance, de façon à ce que les veaux bénéficient d'un jugement favorable dès les premiers mois par rapport à des croisés zébus et par rapport aux animaux de race pure ordinaires. La sélection sur les performances laitières est par définition beaucoup plus difficile en l'absence de contrôle de performances et d'identification. Toutefois, les systèmes à noyau ouvert (Open Nucleus Breeding Schemes ou ONBS), associés à un screening de la population de base pour identifier les meilleures femelles, ont prouvé leur faisabilité et leur efficacité (voir par exemple l'expérience réalisée à Kolda, Sénégal). Dans le cadre d'un contrat temporaire avec l'éleveur (il n'est pas nécessaire d'acheter ces meilleures vaches, ce qui serait, dans la plupart des cas, impossible), ces femelles élites sont fécondées par des taureaux sélectionnés (soit après rassemblement dans un même lieu, soit même maintenues dans leurs troupeaux d'origine), et les produits mâles rachetés prioritairement par le programme pour être utilisés ensuite soit comme taureaux de saillie dans des troupeaux multiplicateurs, soit, lorsque cela est possible, dans un programme d'insémination artificielle.

Bien qu'elles ne soient généralement pas incluses sous l'étiquette "biotechnologies", les techniques de maîtrise des cycles se sont avérées un complément absolument indispensable de tout programme de promotion de l'insémination artificielle en Afrique. Il n'est pas possible de fonctionner sur la base de l'observation des chaleurs avec appel de l'inséminateur: l'état des moyens de communication ne le permet pas. Par contre, plusieurs projets ont démontré la faisabilité d'opérations totalement planifiées, grâce l'utilisation des traitements de maîtrise des cycles associés à des inséminations à dates prédéterminées (par exemple: Bénin, Gambie, Malawi, Mali, Sénégal), et ce même en milieu villageois.

Il serait plus difficile de trouver une justification à l'utilisation de la plupart des autres biotechnologies (transfert d'embryons, sexage, clonage) pour la protection et la promotion des races locales. L'effet amplificateur de la dissémination n'est pas suffisant pour compenser les difficultés de mise en place ni les surcoûts.

Cependant, la fécondation *in vitro*, dans la mesure où elle utilise comme matériel de départ des ovaires récupérés à l'abattoir, donc sans interférence avec la conduite des élevages et à coût très réduit, et dans la mesure aussi où toute la phase de production se fait en laboratoire, donc en dehors des contingences du terrain et à peu près sous contrôle, peut être un outil important de protection ou de sauvetage d'une race. Trois exemples peuvent être proposés:

En cas d'épidémie ou de sécheresse dans une zone limitée occupée par une race particulière à faible effectif, il est possible de prélever les ovaires de toutes les femelles abattues en urgence, de maturer, féconder et cultiver *in vitro* les ovocytes ainsi récupérés, puis, par transfert sur des receveuses de n'importe quelle autre race, sauvegarder l'existence de la race en situation d'urgence.

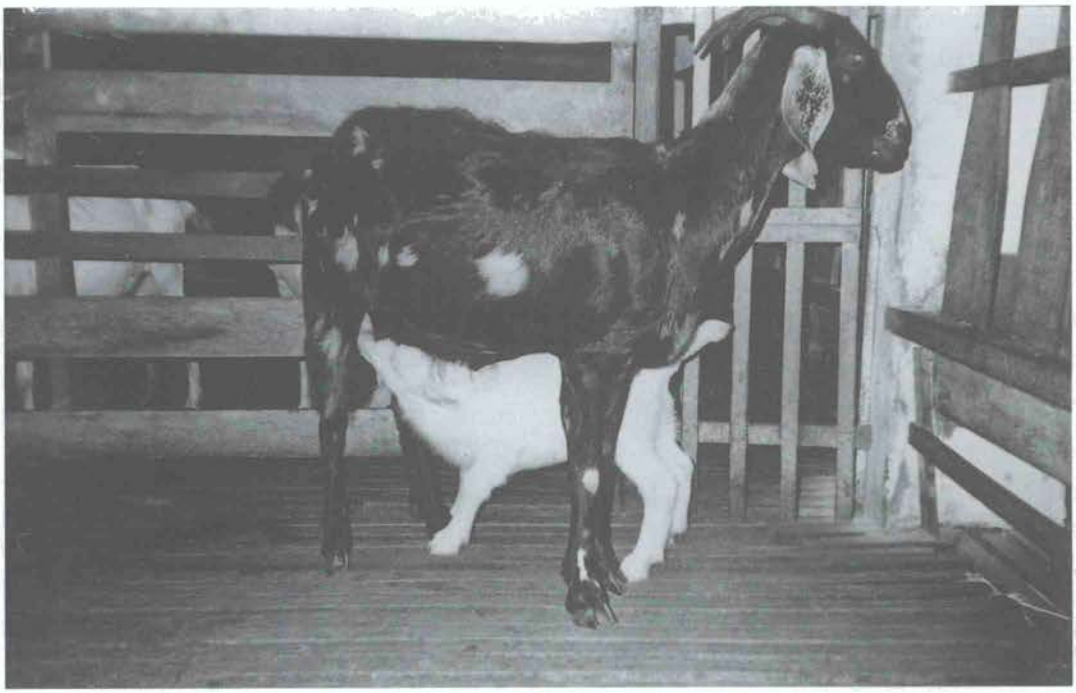
Pour une race à faibles effectifs, sans menace particulière, il doit être possible, en prélevant systématiquement les ovaires de toute femelle abattue normalement pour la réforme ou pour la production de viande, de produire *in vitro*, en marge de la conduite d'élevage normale, des embryons qui, après transfert sur des receveuses de n'importe quelle race, viendront augmenter le nombre de naissances de la race considérée, entraînant à terme une augmentation de la taille de la population.

Dans le cas où seules quelques doses de semence d'un mâle d'une race donnée ont pu être sauvées, il serait plus efficace d'utiliser ces doses par fécondation *in vitro* (une seule dose suffit pour féconder plusieurs centaines d'ovocytes, provenant de plusieurs dizaines de femelles), que de tenter de féconder quelques femelles par IA, avec l'espoir de produire seulement un ou deux veaux.

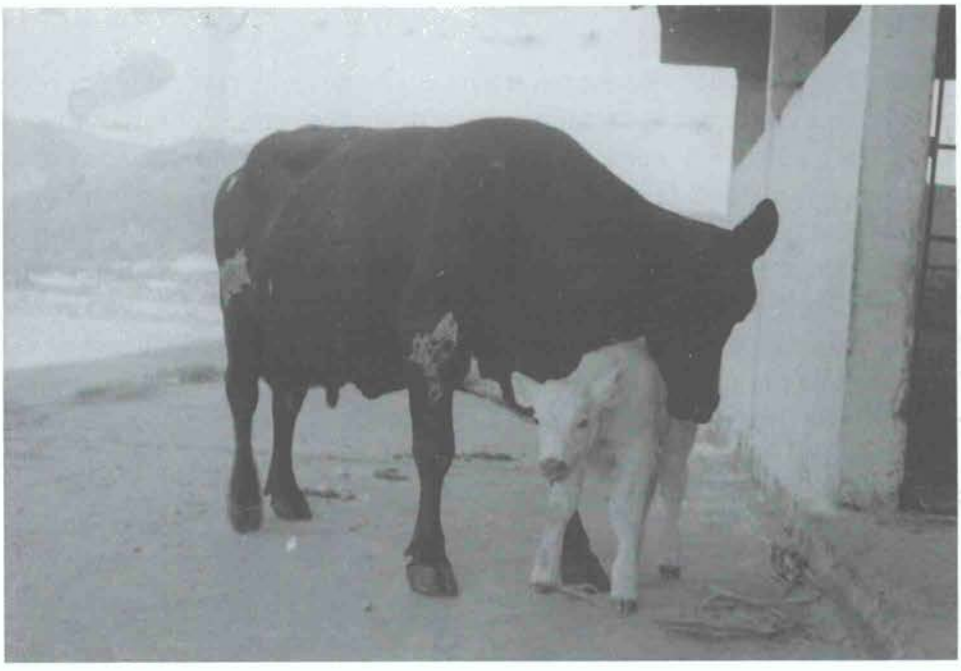
La possibilité de choisir le sexe des produits, que ce soit par détermination du sexe des embryons ou par tri des spermatozoïdes, est de peu d'intérêt pour la protection des races à faible effectif dans la mesure où la "taille de population effective", qui mesure le risque de consanguinité, est plus favorable pour un sex ratio voisin de 1 que pour une structure habituelle de troupeau de 1 pour 10 ou 1 pour 20. Il n'y a donc pas lieu de chercher à faire naître préférentiellement des femelles, si ce n'est pour augmenter rapidement les effectifs, mais dans ce cas il est nécessaire d'avoir au préalable un stock de semence d'un grand nombre de mâles non apparentés.

5.0 STOCKER.

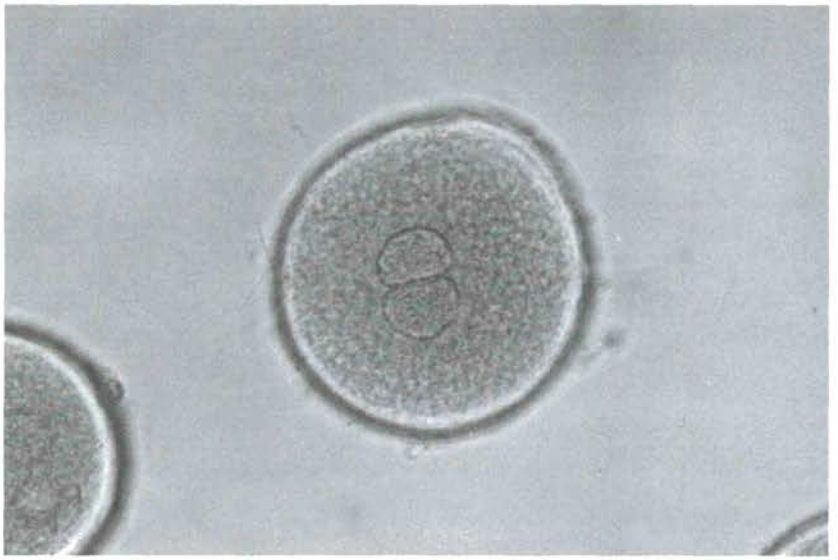
La possibilité d'arrêter les mécanismes enzymatiques de façon réversible par refroidissement progressif et maintien à une température suffisamment basse permet de conserver toute une gamme de cellules animales. Pour la conservation des ressources génétiques ceci concerne plus particulièrement les spermatozoïdes et les embryons, mais avec le développement des techniques, également les ovocytes, voire des morceaux de gonades et des cellules somatiques. L'intérêt respectif de ces différentes possibilités sera examiné dans la section suivante qui considère la re-création d'une race après la phase de stockage. Le tableau 1 présente de façon synthétique l'état actuel des techniques. Les techniques elles-mêmes ont été décrites précédemment dans les exposés consacrés à l'insémination artificielle et au transfert d'embryons. Elles ont été considérablement simplifiées au cours de dernières années, et ne nécessitent généralement plus d'avoir recours à du matériel sophistiqué d'un usage difficile sur le terrain. L'ultime évolution est la vitrification qui ne nécessite plus aucun équipement particulier.



Utilisation du transfert d'embryons pour introduire une race exotique : chèvre receveuse de race locale du Nord Est du Brésil avec son chevreau de race Saanen né après transfert d'embryons produits en France et conservés à -196 °C.



Utilisation du transfert d'embryons pour introduire une race exotique : vache receveuse croisée (Vietnam) avec son veau de race charolaise né après transfert d'embryons produits en France et conservés à -196 °C.



*Fécondation **in vitro**. Zygote bovin au stade deux pronoyaux (environ 24 heures après la pénétration du spermatozoïde dans l'ovocyte).*

*Fécondation **in vitro**. Embryon au stade 8 cellules (après trois jours de culture).*

Tableau 1: *Etat actuel des connaissances dans le domaine de la congélation des gamètes et des embryons.*

Espèce	Semence	Ovocytes	Embryons
Bovins	+	0	+
Buffles	+	?	0
Caprins	+	0	+
Ovins	+	0	+
Porcins	0	-	-
Equins	+	?	0
Lamoids/Camélidés	0	?	?
Lapins	+	0	+
Volailles	0	*	-

\+ Technique de routine disponible
0 Résultats positifs au niveau de la recherche
\- Impossible dans l'état actuel de la technique
? inconnu
* Quelques pistes de recherche

Fécondation in vitro. Agneaux Île de France transférés dans l'oviducte de receveuses 24 heures après la pénétration du spermatozoïde dans l'ovocyte.

La congélation de la semence est certainement la technique la mieux maîtrisée, et cela pour la plupart des espèces. Technique de routine pour les bovins depuis les années 50, plus récemment pour les ovins et les caprins, la congélation de la semence est également possible chez les buffles, les équins et les volailles. Seuls les porcins, pour lesquels cependant des résultats positifs ont été publiés, présentent une difficulté.

Les embryons de bovins, ovins et caprins sont congelés avec succès depuis le début des années 80. Des succès ont également été publiés avec des embryons de buflesse et de jument. Par contre les embryons de porcins ne supportent pas le refroidissement en dessous de + 15°C, sans doute à cause de la teneur en lipides des cellules. Il n'est évidemment pas question de congeler les oeufs de volailles en raison de leur volume.

La congélation des ovocytes est encore au stade de la recherche pour la plupart des espèces, avec des résultats encourageants publiés chez les bovins et des perspectives ouvertes chez les ovins, les caprins et la buflesse. Les ovocytes de volaille, prélevés avant la formation de l'albumen, pourraient être congelables. Une des difficultés consiste à définir le stade optimum pour la congélation par rapport au déroulement de la maturation ovocytaire: convient-il de congeler des ovocytes immatures (avant la rupture de la vésicule germinale), ayant juste repris leur maturation (Métaphase I), en cours de maturation (entre les deux métaphases), ou mûrs (Métaphase II)? Au cours du refroidissement le fuseau de maturation (sur lequel se déplacent les chromosomes au cours de la méiose) se dépolymérise. Il se reforme lors du réchauffement, mais un chromosome (notamment lorsqu'ils sont rassemblés dans la plaque métaphasique) peut avoir été déplacé par les cristaux de glaces dans la phase de cristallisation et ne plus se trouver sur le fuseau. Le zygote qui résultera de la fécondation de cet ovocyte est condamné.

Des résultats positifs ont été publiés chez les animaux de laboratoire après congélation de morceaux d'ovaires, qui ont ensuite, après décongélation, été greffés sur des ovaires de receveuses et ont repris leur fonctionnement avec la croissance de nouveaux follicules de la lignée de départ. Ceci peut être important pour la conservation des ressources génétiques animales dans la mesure où cela simplifierait considérablement les procédures de prélèvement, et, dans une certaine mesure de re-création, si l'on peut créer par greffage de ces morceaux d'ovaires, des femelles d'une race X (courante) produisant des gamètes de la race Y (à recréer).

Différentes cellules somatiques peuvent être stockées sous forme congelée en vue d'analyser ultérieurement l'ADN, que ce soit pour analyser le génome de la race considérée, ou pour identifier, et éventuellement isoler, un gène particulier. L'ADN lui-même peut être conservé pendant quelques mois à température ambiante en solution dans l'alcool. Pour une conservation plus longue, l'ADN est conservé à -20°C (ou mieux à - 80°C, mais ceci est plus difficile à mettre en oeuvre dans toutes les situations) dans un tampon tris-EDTA. En pariant sur la mise au point de techniques de transfert nucléaire pour les cellules somatiques, il pourrait être aussi tentant de stocker divers types de cellules, par exemple des cellules sanguines.

La durée maximum possible de la conservation de ces différents types de cellules n'est évidemment pas connue précisément de façon expérimentale, les plus anciennes semences de taureau n'étant congelées que depuis une trentaine d'années, et les plus anciens embryons depuis quinze ans. Aucune expérience n'a été réalisée pour préciser l'évolution du pouvoir fécondant après plusieurs décennies de stockage, exception faite de l'étude de Goffaux et al. (1975) après seulement 6 ans. Les stocks existent et il serait sans aucun doute utile de susciter une telle étude. En ce qui

concerne les embryons, leur aptitude à reprendre leur développement après le réchauffement ne semble pas évoluer au cours du temps (confirmé après 13 ans chez la souris, Wood et al., 1987). On a par contre évoqué la possibilité que les radiations puissent induire des mutations au cours du stockage à long terme. Une simulation faite avec des embryons de souris et correspondant à 2000 ans de radiations n'a provoqué aucune augmentation significative du taux de mutations (Glenister et al., 1984).

Il semble malheureusement plus probable que ce qui limitera la durée de conservation sera la difficulté de maintenir constantes les conditions de stockage, notamment le réapprovisionnement régulier en azote liquide et le maintien des containers en état. C'est pour compenser ce risque qu'il est suggéré de mettre en place, en parallèle avec des banques nationales, un stockage de sécurité au niveau mondial, auquel sera envoyée une quote-part des échantillons. Ce stock pourrait en outre être mis à la disposition de la communauté internationale, sous réserve de la rédaction et de la signature d'un protocole d'accord règlant les droits et responsabilités des différentes parties.

Le nombre de donneurs d'échantillons à conserver est conditionné par la nécessité de maintenir la consanguinité aussi limitée que possible lors de la re-création de la race. Le calcul montre (Smith, 1984) qu'un taux de consanguinité équivalant à 4 générations de pratique normale d'élevage (2%) est obtenu pour une taille effective de population de 25, ce qui s'obtient avec 25 mâles pour produire de la semence ou 25 paires mâle-femelle pour produire des embryons. Tous ces animaux ne doivent pas être apparentés. Le nombre d'échantillons par parent ou par paire de parents est fonction de la procédure suivie lors de la re-création de la race.

6.0 RECRÉER

En suivant le même raisonnement que ci-dessus, il est recommandé de chercher à recréer au moins 25 femelles prêtes à saillir non apparentées. Les estimations présentées dans cette section prennent en compte le cas des bovins. Pour les autres espèces, il convient évidemment de tenir compte de la prolificité, en plus de différences notables dans les niveaux de fertilité.

Dans le cas où seule de la semence a été stockée, la race sera re-créée par croisement d'absorption sur une race existante. Il faut 5 générations pour que les animaux soient à 97% de la race stockée. Le nombre de femelles devant être fécondées à chaque génération dépend du niveau de risque que l'on accepte de ne pas avoir au moins 1 femelle ($1/2^n$): 3% avec 5 veaux, moins de 1% avec 7 et moins de 0,1% avec 10. Mais le risque est répercuté de génération en génération. Ainsi, pour être à peu près certain d'avoir en cinquième génération au moins une femelle de chaque taureau de départ, il faut faire naître au moins 100 veaux par génération, ce qui signifie disposer de 185 doses de semence par mâle et par génération (36 femelles x 3 vêlages x 1,7 doses par gestation, avec 10% des vaches vides par campagne), soit un total de 925 doses par mâle. Avec 25 mâles par race, cela représente 23 125 doses par race, chiffre qui peut paraître excessif et difficile à obtenir pour des taureaux non entraînés, et accroître le coût du stockage.

Si on accepte un plus grand risque de ne pas avoir de filles de certains mâles, on peut se contenter de faire naître 20 veaux par génération, ce qui suppose de stocker 205 doses par taureau (8 femelles x 3 vêlages x 1,7 doses par gestation, avec 10% des vaches vides par campagne) ou 5 125 doses par race.

Les estimations présentées ci-dessus considèrent des paramètres de reproduction qui sont ceux de races européennes entretenues en conditions optimum. Dans le cas de races locales, en conduite traditionnelle, les chiffres seraient de l'ordre de 2,5 doses par gestation et 30% des vaches vides par campagne. Les nombres de doses à stocker doivent être revus en conséquence. Il ne faut pas non plus sous-estimer la difficulté de collecter ces grands nombres de doses sur des taureaux non entraînés, peut être même directement en milieu villageois.

Lorsque ce sont des embryons qui sont stockés, et toujours dans l'optique d'obtenir au moins une femelle de chaque origine, il faut faire naître 10 veaux, ce qui suppose d'avoir stocké 25 embryons de chaque accouplement, soit 625 embryons par race. Ceci suppose que chaque donneuse retenue soit collectée au moins 6 fois, ce qui complique et prolonge considérablement la phase de mise en stock (il faut 1 an pour collecter 6 fois une même femelle), au point de ne plus être compatible avec le concept de sauvetage en urgence d'une race en danger. Inversement, s'il n'est pas possible de collecter chaque femelle plus d'une fois, il faut pouvoir collecter 150 donneuses différentes, ce qui suppose que les effectifs n'aient pas encore atteint un niveau réellement critique.

La re-création par transfert d'embryon repose évidemment sur l'utilisation de femelles receveuses d'une race différente. Il conviendra de choisir la race des receveuses aussi voisine que possible de la race à re-créer (phénotype, mode de conduite), pour éviter que les effets maternels (environnement utérin et allaitement) n'affectent significativement le phénotype des veaux, sans parler de leur comportement, conséquence des relations mère-jeune et dans la recherche et le tri de la nourriture.

Si le stock est constitué d'ovocytes et de doses de semence, la re-création passe par la fécondation *in vitro* après décongélation. Les paramètres techniques actuellement connus sont susceptibles d'amélioration. Au niveau actuel, 30% des ovocytes deviennent des embryons transférables, et 30% des embryons transférés deviennent des veaux, ce qui signifie qu'il faut 100 ovocytes pour produire 10 veaux. Il faut donc disposer de 2 500 ovocytes en stock pour être certain ($p<0,1\%$) de produire au moins 25 femelles. Ces 2 500 ovocytes sont par définition récoltés à l'abattoir, sur un grand nombre de femelles (en moyenne 5 ovocytes utilisables par vache), et le problème de la variabilité génétique ne devrait pas se poser, pas plus que celui de la consanguinité.

Les ovocytes pourraient aussi être récoltés par ponction folliculaire (Ovum Pick-Up, OPU), éventuellement répétées, sur quelques animaux particulièrement représentatifs (ou sur les seules survivantes de la race). Dans ce cas il importe, comme précédemment dans le cas de transfert d'embryons, que ces donneuses ne soient pas apparentées. Le nombre total d'ovocyte nécessaires est identique. Dans le cas idéal il faudrait donc pouvoir récolter 100 ovocytes de 25 femelles différentes. En utilisant les chiffres publiés pour des races européennes ceci peut être réalisé en 6 semaines à raison de 2 collectes par semaines. Sur les races locales africaines, en considérant les résultats préliminaires de collecte d'ovocytes à l'abattoir obtenus sur la N'Dama (Wagner, comm. pers.), il faudrait sans doute 3 à 4 fois plus de temps. Il en serait de même pour la buflesse, compte tenu de son faible stock folliculaire (Le Van Ty et al. 1989).

En utilisant 1 dose de semence pour féconder 10 ovocytes, il faut avoir stocké 10 doses de chacun des 25 taureaux non apparentés entre eux et si possible, et si connu, également non apparentés avec les femelles dont sont originaires les ovocytes.

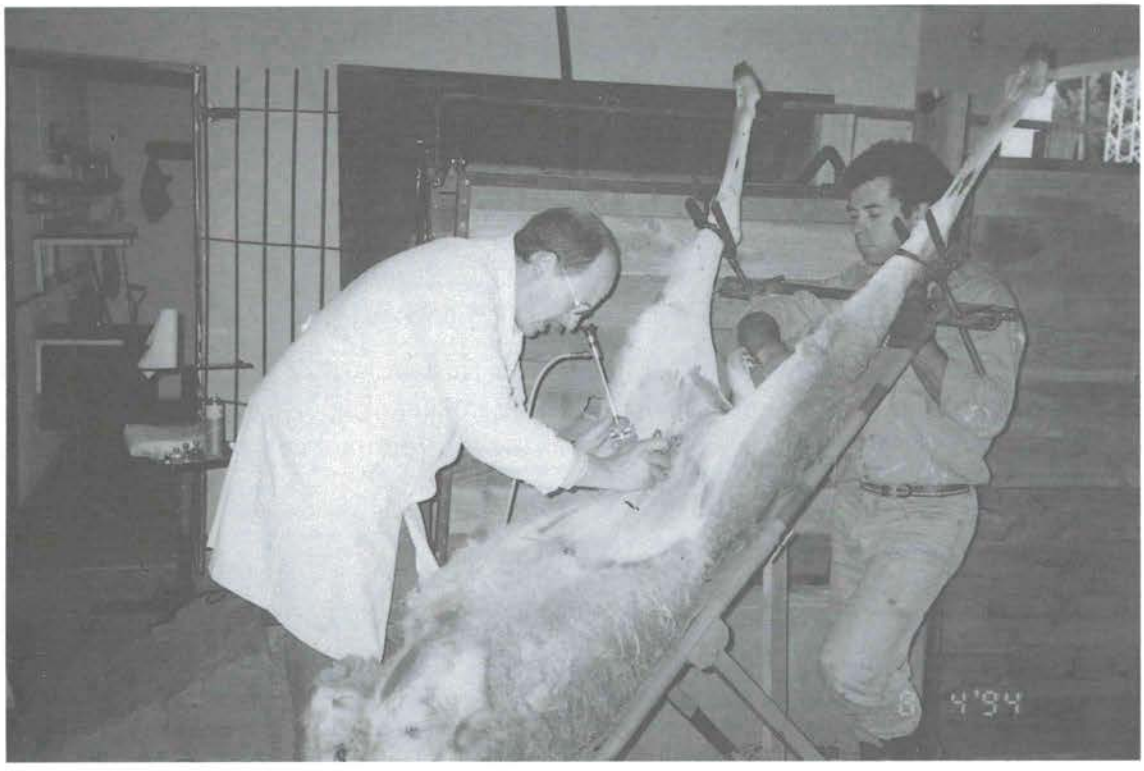
Si l'on doit rechercher absolument à créer 1 femelle apte à la reproduction pour chaque parenté stockée, il n'est sans doute pas utile (ni pratiquement et économiquement faisable) de conserver également 1 mâle de toutes les paires. Le sexage des embryons avant la congélation pourrait ainsi permettre de limiter le nombre d'embryons stockés (mais pas le nombre d'embryons produits) et le nombre de receveuses nécessaires, en ne conservant et en ne transférant que le nombre minimum d'embryons mâles pour créer les quelques reproducteurs voulus (plus nombreux toutefois que dans une conduite de troupeau normale). De même, le sexage de la semence par tri des spermatozoïdes X et Y permettrait, en cas d'utilisation de la fécondation *in vitro* (compte tenu du faible rendement de l'ordre de 100 000 spermatozoïdes à l'heure) d'orienter la production en faveur des femelles. Toutefois, il s'agit là de raffinements qui ne sont pas indispensables et seraient sources de complications pratiques et d'accroissement des coûts dans des programmes qui seront, par définition, à mettre en place dans des conditions difficiles. Le coût du stockage sous forme congelée est si faible que l'intérêt de diminuer le nombre d'échantillons à stocker est douteux.

Le même raisonnement sur le maintien de la variabilité génétique et le contrôle de la consanguinité rend difficile l'usage de techniques comme le clonage par transfert de noyaux qui ne ferait qu'accroître les effectifs mais en reproduisant seulement quelques animaux à l'identique. En caricaturant, il serait théoriquement possible de recréer une race à partir de deux embryons préalablement sexés, un mâle et un femelle. La race ainsi recréée ne possèderait qu'une partie du réservoir de gènes de la race de départ, en ce sens que 1 ou 2 individus ne peuvent contenir toute la variabilité génétique d'une population: on n'aurait pas totalement recréée la race originelle, mais plutôt une nouvelle race en partie semblable à la race de départ.

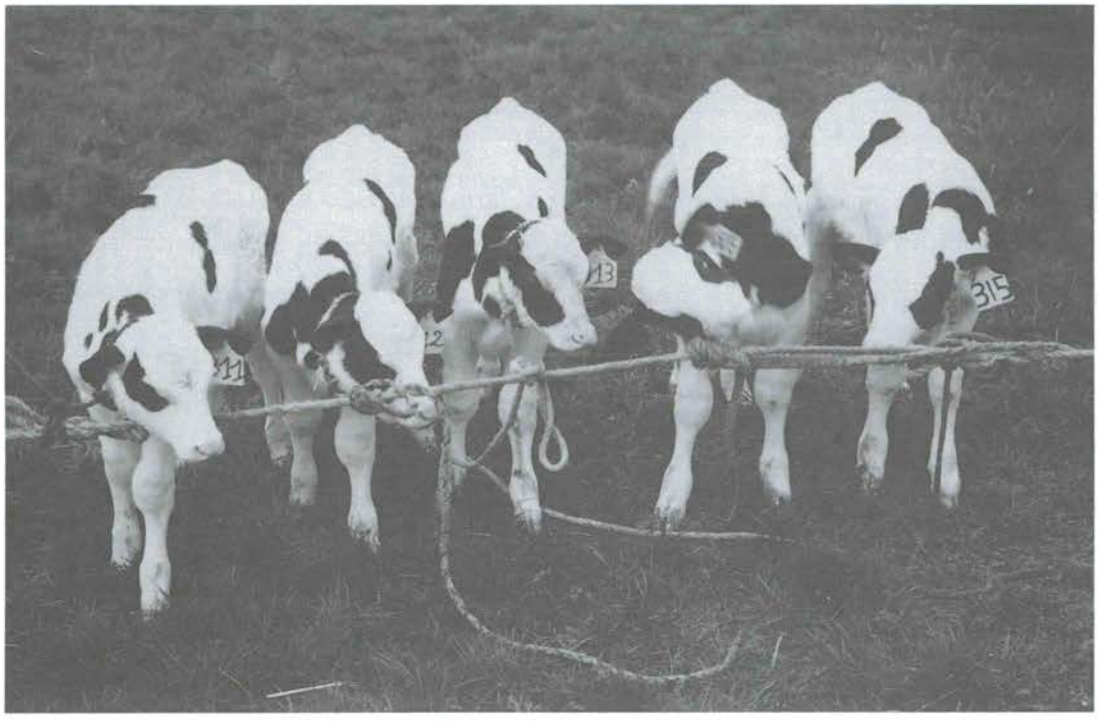
Pour toutes les utilisations de la technique de transfert de noyau il convient également de ne pas sous-estimer l'influence possible du cytoplasme de l'ovocyte receveur (par les mitochondries). Un cas a déjà été publié d'hérédité cytoplasmique de la forme des oreilles chez le porc: les porcelets nés après transfert de noyau avaient la forme d'oreille de la race ayant produit les ovocytes et non de celle ayant produit les noyaux. Il pourrait donc se faire que la race re-créée possède, de façon visible ou non, des caractères de la race des ovocytes receveurs.

Par parthénogénèse (ou gynogénèse: développement d'un individu à partir de gamètes femelles) il est possible de produire, chez les animaux de laboratoire, des embryons qui se développent normalement jusqu'au milieu de la gestation mais ne donnent jamais naissance à des jeunes vivants. La technique est encore moins fonctionnelle chez les animaux de ferme. Elle peut le devenir. Aurait-elle un intérêt pour la conservation et recréation d'une race à partir d'ovocytes? Cela semble douteux dans la mesure où tous les animaux produits seront des femelles. Si des doses de semence sont disponibles il serait certainement plus efficace de passer par la voie de la fécondation *in vitro*. Si aucune dose de semence n'a été stockée, cette voie est une impasse.

L'évolution des techniques pourrait rendre possible la re-création directe d'individus d'une race donnée même dans le cas où seule de la semence a été stockée (ou androgénèse: aucun individu n'a été produit à ce jour de cette façon). Ceci passe par l'induction volontaire et contrôlée de la polyspermie (fécondation par plusieurs spermatozoïdes) suivie de l'élimination par micromanipulation du pronucleus femelle (opération facile chez les animaux de laboratoire, beaucoup plus malaisée chez les animaux de ferme en raison de l'opacité du cytoplasme qui rend extrêmement difficile l'observation des pronuclei). Cette polyspermie peut être provoquée au hasard en déséquilibrant simplement le rapport nombre de spermatozoïdes/nombre d'ovocytes dans la



Les biotechnologies mises au point par les espèces traditionnelles de bétail doivent être adaptées pour les espèces moins connues : ici un chercheur de l'INTA à Bariloche (Argentine) pratique l'endoscopie sur une femelle Guanaco.



Le clonage chez les bovins : un clone de 5 mâles Holstein nés à l'INRA (France) en janvier 1993.

fécondation *in vitro* (avec augmentation de la consanguinité), ou sous contrôle beaucoup plus strict par micro injection de deux spermatozoïdes sous la zone pellucide. Il est même possible de choisir des spermatozoïdes de deux mâles différents, l'individu ainsi produit ayant deux pères et pas de mère. Ce dernier cas permet de maîtriser la consanguinité, ce qui n'est pas possible quand on opère par fécondation *in vitro* normale. On pourrait aussi imaginer de fusionner, en utilisant les techniques utilisées dans le clonage par transfert de noyaux, deux spermatozoïdes et un ovocyte énucléé. Cette voie a, par rapport à la parthénogénèse, l'intérêt de produire des mâles et des femelles, même si c'est avec un sex-ratio moins favorable que normalement (2/3 de mâles et 1/3 de femelles).

Reste la solution "Jurassic Park". Elle est pour l'instant hors de notre portée. En sera-t-il toujours ainsi? Pour être prêts le jour venu, il suffirait de stocker n'importe quelle cellule somatique diploïde. Ceci ne coûte pas cher, ni à collecter, ni à stocker. Pourquoi ne pas le faire aussi, en plus des banques de gamètes, à tout hasard?

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SAVING THE TUROPOLJE PIG IN CROATIA

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SUMMARY

On the front lines of Croatia's war areas live the Turopolje pigs, in danger of extinction. Immediate action is sorely needed. The new European Foundation SAVE (Safeguard for Agricultural Varieties in Europe), an umbrella organization for the *in-situ* conservation of agricultural genetic resources, has started an international rescue project. The remaining pigs are listed and will be regrouped for a mating program, which avoids inbreeding. For an additional insurance, SAVE will also bring new breeding groups away from the front lines in, and outside of, Croatia. A breeding register has been set up provisionally at the herdbook office for endangered breeds with Pro Specie Rara in St.Gallen, Switzerland.

Key words: Genetic Resources, Pig, Croatia

RÉSUMÉ

En Croatie, entre les frontières de guerre, la race porcine du Touropolje a tellement diminuée, qu'elle est menacée d'extinction. Une action immédiate est nécessaire. La nouvelle fondation européenne SAVE (Sauvegarde pour l'Agriculture des Variétés d'Europe), une organisation faîtière pour la conservation in-situ, a commencé un projet pilote international. Les porcins existants sont registrés et seront regroupés pour un programme d'accouplement, qui évite la consanguinité. Pour la sécurité additionnelle SAVE est en train de créer des nouveaux groupes d'élevage loin des zones de guerre, en arrière-Croatie et même à l'étranger. Le registre de troupeau (herd-book) est administré provisoirement par la Fondation Pro Specie Rara, qui s'occupe à St.Gall/Suisse du registre des troupeaux de bétail menacé.

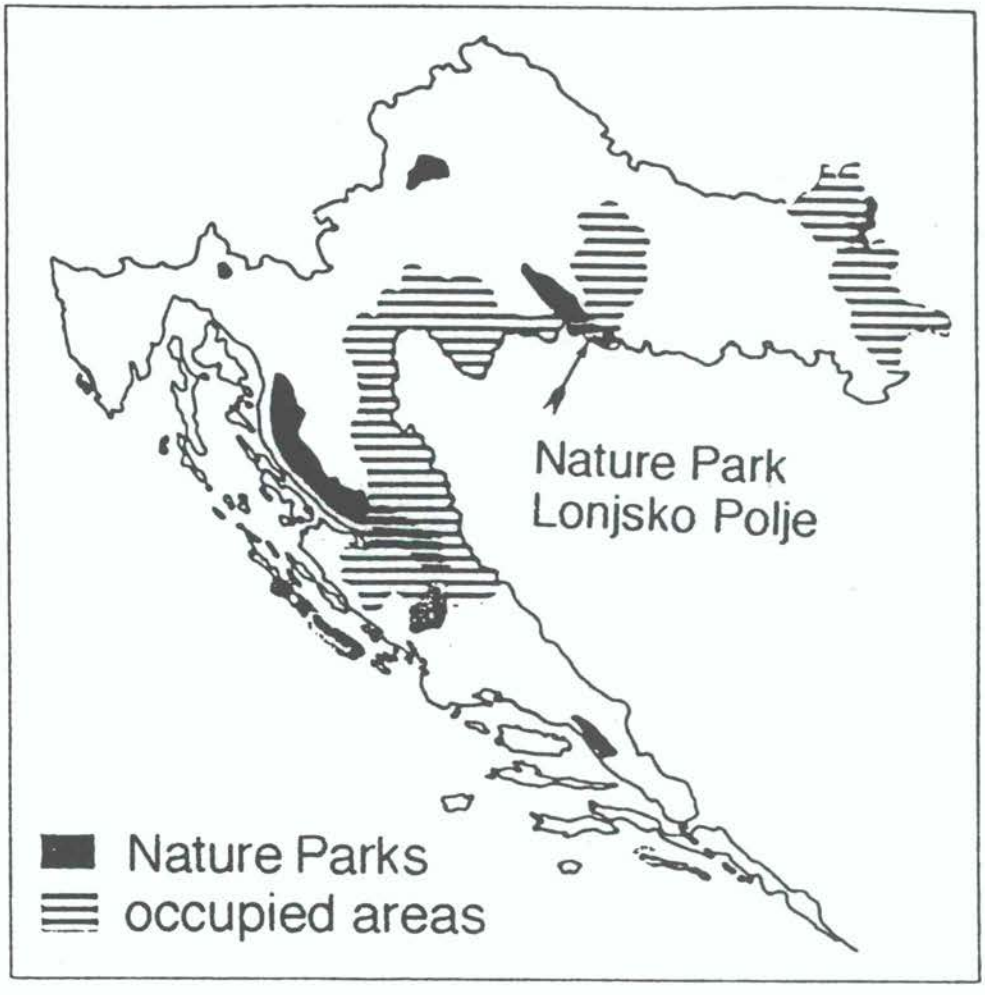
Mots clés : Ressources génétiques, porc, Croatie

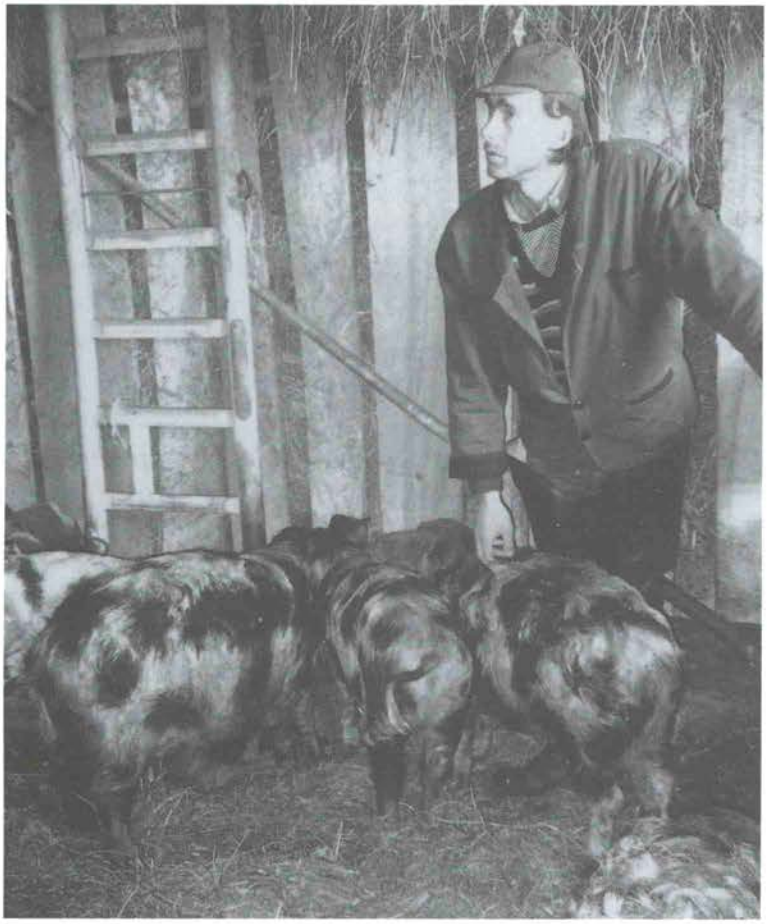
1.0 INTRODUCTION

The most valuable genetic and cultural heritages of biological diversity have survived primarily in marginal lands, with ethnic minorities or in barely accessible areas, i.e. in regions of high ecological adaptability and low pressure to change. This inheritance is particularly threatened in times of war or economic and political turmoil. The last of the Turopolje Pigs live on the front lines in Croatia between the Croatians and the Kraina Serbs and are in danger of being wiped out. In a war situation where people need help, it may, at first sight, seem cynical to work for the preservation of a breed of farm animals. It must be clearly stated, however, that this sensitive project will especially help the local people to maintain one of the bases of their present and future survival. Furthermore, when the war broke out in October 1990, preservation measures were already being discussed and were postponed at that time. If we don't act now - while the front lines are "frozen" - there won't be anything left to rescue.

2.0 CHARACTERISTICS OF THE BREED, HUSBANDRY AND USE

The Turopolje belong to the bacon pigs. The curly-haired animals are similar to the Swallowbelly Wooly Pig; they are grey-white-yellow with 5-9 saucer-sized black spots. The Turopolje are uncommonly hardy pigs, able to overwinter outdoors and forage extensively for themselves. They can survive on a minimal diet, with sows losing up to 50% of their body weight during the nursing period if need be.





Breeding group at Kratecko

Sows in winter

The Turopolje has adapted itself optimally to its life in the river bottom lands; this strain of slow-maturing bacon pig was previously found along the entire length of the Sava River in Slovenia and Croatia. The Kraina Landpig has almost died out on the upper reaches of the river. In Middle Croatia, between Zagreb, Sisak and Nova Gradiska, tiny remnants of the Turopolje have survived until today primarily in the Lonjsko Polye Nature Park and sporadically in the neighboring Odransko Polje.

The forester and wildlife biologist Goran Gugic has minutely studied the keeping and exploitation of pigs in the unoccupied part of the Lonjsko Polje Nature Park; this is described in his thesis, "Swine Husbandry and Sylvan Forage in Lonjsko Polje" (Munich,1992). This preserve threatens to lose much of its ecological value if the natives lose their traditional extensive agriculture with old varieties: the pigs roam freely in the periodically flooded, square kilometer-sized communally-used grazing meadows and hardwood bottom lands. Since the prohibition of swine foraging in forests throughout the rest of Europe, the management of the Sava river lands today is unique.

The free-ranging pigs are an attraction of the nature park. They root in shallow water for food, enjoy cracking large fresh-water mussels and keep the shallows free of vegetation. Their rooting in the meadows breaks up old grass and helps fresh grass to sprout. They improve the food chain in the riverain woods and the physical characteristics of hydromorphic soils. At night, the pigs are not herded into the villages, but are placed in pigsties in the meadows or forests. They respond only to the specific calls or whistles of their herders.

3.0 THE DANGER

The Turopolje overcome the hardships of their regularly flooded environment outstandingly. They swim well and can overwinter in the open. On the other hand, they grow slowly and produce more bacon instead of the ham desired today. As a result, the farmers have repeatedly tried introducing other less hardy breeds or crosses using foreign boars. As a result, the Turopolje population has decreased steadily in recent years..

The greatest blow to the Turopoljes, however, has been the war that broke out in Croatia in 1991. The entire southern part and a large part of the eastern area of the Lonjske Polje Nature Park was occupied by the Kraina Serbs and cut off from the Northeastern part (see map). Since then, this entire area has been used as a staging area by the armies. Regular troops, paramilitary bands and all sorts of questionable people are now moving around in this region. These have severely decimated the free-roaming pig herds and the remaining farmers have been forced to keep their pigs year-round in barns. Feed costs are higher than the profits from sales; as a result, the herds have been reduced even further.

The market situation has also changed completely because of the war and the economic crisis. Previously, the Turopolje sold well to the middle-class butchers (now ruined) and the Gavrilovic sausage factory. This was the chief purchaser of the bacon pigs and made the well-known Gavrilovic salami out of their flesh. The factory lies, however, in occupied Petrinja and, for the time being, is out of the question as a purchaser. Even though there is hardly any fighting along the front at the moment, the Turopolje will not survive the next few months if measures are not taken quickly.

4.0 THE RESCUE PLAN

The nature protection foundation Euronatur has been active for years in the Lonjsko Polje Nature Park. It was already clear in 1990 that the wide expanses there could be protected only through the maintenance of the traditional agriculture and the preservation of the old robust breeds. An agricultural concept worked out by the wildlife biologist Goran Gugic can be fully implemented, however, only after the war is over. In the meantime, an emergency program is necessary:

- Euronatur will, in order to preserve the old meadow husbandry, support the Turopoljes locally by paying the farmers a premium to help keep pure-blooded animals in their barns. A marketing plan will also be developed.

- SAVE will take on the additional insurance of building up new breeding groups away from the front lines in, and outside of, Croatia; they will assist the breeding programs technically. A herd book (breeding register) containing all desirable animals shall be established. Great weight will be put on the use of good breeding boars. Further remnant populations are being sought

5.0 FIRST SUCCESSES

The first animals were assessed and marked in the Sava meadows in early January, 1994. The Tiergarten Schoenbrunn in Vienna arranged for 3 young boars and 3 young sows to be transported to the Zagreb Zoo; these are the first breeding groups safely away from the front lines. The buying up of pure-bred young animals is not to be underestimated as a signal for the villagers: "Something is happening and the traditional breed is finally valued again!"

In the meantime Goran Gugic has made the inventory of the relipopulation and set up the breeding register. With a mating program, which avoids inbreeding, the Turopolje pig may rise again. We cannot let these initial successes fool us, however. The way to the goal is a long and delicate process.

Transport of pig at the Zagreb Zoo

Pigstie in Sava meadows

IMPROVEMENT AND ADAPTATION OF THE FAYOUMI CHICKEN

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SUMMARY

The Fayoumi (Oasis/Province of Fayoumi) or Ramadi (village of Dar-el-Ramad) breed of chicken is said to have been introduced into this area in the early part of the 19th century; phenotypically it recalls the Silver Campine from which it is reputed to descend. A hardy and well adapted breed it was saved through the creation of the Fayoumi Poultry Research Station in 1946, which also assured an active improvement policy of the breed. The creation in 1958 of the Fayoumi Poultry Cooperative Society further strengthened the conservation of the breed and its use through distribution of genetic material to farmers and smallholders of the Fayoumi province. Since the early 60's the breed is reported to have been successfully introduced to countries as different as the UK and the USA, Vietnam, Iraq, Pakistan and India. Its adaptability and resistance to the problems of xyrothermic tropical and sub-tropical conditions is confirmed by its actual prevalence in Southern Egypt.

Key words: Genetic Resources, Poultry, Egypt

RESUME

On considère que la race de poulet Fayoumi (Oasis/Province de Fayoumi) ou Ramadi (village de Dar-el-Ramad) ait été introduite dans cette zone au début du 19ème siècle. Du point de vue phénotypique elle ressemble à la race Silver Campine de laquelle on retient qu'elle descend. Cette race vigoureuse et bien adaptée a été conservée grâce à la création de la Station de Recherche pour le poulet Fayoumi, qui d'ailleurs a assuré une politique d'amélioration continue de cette race. La création en 1958 de la Société Coopérative pour la race Fayoumi a renforcé la conservation de cette race à travers la distribution de matériel génétique aux agriculteurs et aux petits éleveurs de la province de Fayoumi. Dès le début des années 60 cette race a été introduite avec succès dans différents pays tel que le Royaume Uni ou les Etats Unis, le Vietnam, l'Iraq, le Pakistan et l'Inde. Son adaptabilité et sa résistance aux problèmes des conditions xyrothermiques tropicales et subtropicales est confirmée par sa présence actuelle dans le Sud de l'Egypte.

Mots clés : Ressources génétiques, volaille, Égypte

1.0 INTRODUCTION

The Fayoumi breed of chickens has been for a considerable time in the Fayoum province in the western part of middle Egypt. From there the breed has been disseminated to all parts of the country. The origin of the breed is not definitely known. One theory is that it was introduced into Egypt from a village called "Biga" in Turkey during the reign of Mohamed Ali Pasha (19th Century), hence, its synonym "Bigawi". The other theory is that it originated from the "Silver Campine" breed and was introduced during the same reign or at the time of Napoleon's campaign in Egypt.

In fact the Fayoumi looks much more like the Silver Campine than any other breed but its barring is a sex-linked trait, while the barring in the silver campine is autosomal. It might be that the sex-linked barring gene has been introduced by crossing with other breeds since its first introduction.

In Egypt it is also called "Ramadi" named after the village Dar-el-Ramad, the most famous place from which the breed could be obtained from the native hatcheries. The Ministry of Agriculture of Egypt established "The Fayoum Poultry Research Station" (FPRS) in 1946 near this village to maintain the breed and to improve its characteristics. For the same purpose, and to distribute the Fayoumi chickens to farmers and smallholders, the Fayoum Governorate established the "Fayoum Poultry Co-operative Society" (FPCS) in 1958.

2.0 THE BREED

The Fayoumi is an active and hardy type of fowl and is placed by some people in the Mediterranean class. In contrast to all other Egyptian fowls, the adult Fayoumi birds are characterized by a uniform, distinct and sexually dimorphic plumage of black and white barred-like pattern although the barring is not uniform (Pencilled) (Picture 1). Silver-like feathers are found covering the neck and the saddle of the bird and they are markedly found in the male in the hackle and sickle feathers. The neck feathers are whiter and by selection, white neck lines may be produced. Single comb is generally found but sometimes it is split at the end. The skin is dark, nearly blue, but there are birds of lighter colour. The beak and shank are dark grey. The ear lobes are usually red but occasionally birds with white ear lobes are found and the eyes are deep brown. Rim-fan tail females may be produced by selection (Hossari, 1958).

The down feathers of day-old chicks have a spangled pattern with white and brown stripes along the back. The newly hatched chicks can be divided into six distinct classes according to these stripes and spots on the head.

3.0 DISTRIBUTION OUTSIDE EGYPT

The Fayoumi breed was first introduced to USA by Prof. D.C. Warren in Purdue University in 1948 and then to Iowa State University by Prof. A. W. Nordskog. The Fayoumi was also introduced to Iraq and Vietnam (Ghany et al, 1962) and Sudan, Pakistan and India. Recently it was exported to the United Kingdom by the "Domestic Fowl Trust" of England (Eastwood, 1988).

4.0 FAYOUMI FLOCKS

In 1946 a flock of Fayoumi chickens was established in the Fayoumi Poultry Research Station (FPRS) from a flock that used to be in Dokki (Cairo) Poultry Experiment Station. A further introduction to FPRS was made in 1951 where samples of day-old chicks from different native hatcheries in the Fayoum Governorate were collected and some selected cockerels were brought from raisers in the villages of Dar-el-Ramad, Menshat Abdalla and Kohafa, where the Fayoumi chickens were usually kept and successfully produced. Since that time, the flock at FPRS has been closed. Establishment of the Takamoli Poultry Project (TPP) flock in 1983 and the Poultry Strain Improvement Project in Beheira Province (PSIP) flocks in 1981 was made from the flock at FPRS.

At present there are three main flocks of Fayoumi chickens in Egypt, though they have one origin. These are kept at FPRS and TPP, in Fayoum Governorate and in PSIP in Beheira Governorate.The approximate size of these flocks are 1500, 45000 and 3500 - 6000 layers, respectively. There are also small flocks for experimental purposes in some Agricultural Colleges which originated from the main ones.

There are two main lines developed in FPRS by Hossari (1970), one by selection for egg number (PP) and another for body weight at 8 weeks of age (GG). There is also a random-bred control (RR) flock maintained at FPRS.

5.0 BREED PERFORMANCE

Table 1 shows the performance of the original flock (Hossari, 1958) and of the two lines GG and PP (Hossari et al, 1992). The average heritability estimates of some important characters reported by different workers are also given in table 1 (Abdel-Warith, 1993).

Table 1: *Breed performance and estimates of heritability (h^2) for some traits.*

Trait	Original Flock	Production Line	Egg Line	h^2
Body wt. at 8 wks of age, g, male	361	579	657	0.57
female	329	444	504	0.41
Body wt. at 12 mo age, g	1120	1456	1671	0.40
Egg wt. at 12 mo age, g	45	46	47	0.33
Age at sexual maturity, day	188	172	203	0.24
Egg number to 72 wks of age/(annual)	134	216	183	
Fertility (%)	87	95	96	
Hatchability (%)	77	89	88	

6.0 DISTINCT CHARACTERISTICS OF THE FAYOUMI

6.1 High fertility and hatchability

Fayoumi had a higher fertility percentage when it was compared with most other breeds or strains of chickens (Eastwood, 1988, and Hossari et al, 1992). Radwan (1992) showed that semen quantity and quality of the Fayoumi were higher and better than those of White Leghorn and Rhode Island Red (RIR) chickens. For comparison he used Fayoumi (PP & GG) lines and their crosses.

6.2 Performance under restricted feeding

Restricted feeding reduced growth of the Fayoumi during the growing period relatively less when compared with New Hampshire and White Leghorn (Dorgham, 1989).

6.3 Egg quality

Dorgham (1989) showed that Fayoumi eggs had less cholesterol than White Leghorn (7.3 vs 9.1 mg/g), while Mostageer (1958) and Ali (1993) reported a thicker shell for the Fayoumi egg than for other breeds (White Leghorn and RIR), hence eggs can withstand shipping with less breakage. The latter authors showed that yoke percentage was higher in the Fayoumi than White Leghorn chickens (36.32 vs 28.01%).

6.4 Protein requirements

Ali (1977) and Darwish et al (1990) reported that the best laying performance was at 14% protein diet as compared to 16% or more for other breeds of chickens. Moreover, the amino acids requirement for the Fayoumi chickens was estimated to be less than other breeds (El-Sheikh, 1987).

6.5 Disease resistance

Fayoumi chickens have a lower mortality rate than other breeds or strains raised in Egypt. Many workers have quickly demonstrated the superiority of this breed over the imported breeds regarding disease resistance (Dardiry, 1945). Kenzy (1952) reported that Fayoumi birds incubated with Rous Sarcoma virus showed no tumor development, while Price (1958) pointed out that the Fayoumi was more resistant than White Leghorn to infection when Rous Sarcoma virus was injected into incubated eggs. Nordskog and Phillips (1960) reported that the Fayoumi was more resistant to leucosis, particularly to the neural type, compared with other breeds.

7.0 BREED SHORTCOMINGS

The Fayoumi is characterized with a dark shank and meat due to the concentration of melanin pigment. The Fayoumi is a small nervous bird and produces smaller eggs than standard breeds.

8.0 ADAPTATION

The Fayoumi chicken is more adapted under the Egyptian village conditions than other breeds. Moreover, its good adaptation in other countries has been reported in Iraq, Pakistan, India, Vietnam, U.S.A. and England by Ghany et al (1962). The Fayoumi is well adapted to tropical and semi-tropical conditions as evidenced by its prevalence in southern Egypt (Hossari et al, 1992). Ghany et al (1962) reviewed that the Fayoumi birds have good reproductive qualities with respect to fertility, hatchability and mortality, compared with the performance of the standard breeds in Egypt. Hossari (1975) found no reduction in fitness traits, fertility and egg production, of the

Fayoumi due to artificial selection towards increasing body weight. This could mean that natural selection did not affect artificial selection for body weight which implies that the Fayoumi has a wider range of genetic homeostasis. If this interpretation were true, this could explain the wider range of adaptability of the Fayoumi chicken.

No experimental results could be found on the differential effect of heat on Fayoumi and other breeds, particularly exotic, under different degrees of intensification of production. Valle-Zarate et al (1988) compared the performance of Fayoumi and Dandarawi (another local Egyptian breed) with the medium-heavy high performance layer Dahlem Red (D) under 18-20°C and 32°C. While high temperature adversely affected D, it still outperformed the other two local breeds in egg production and egg size under both temperatures, but fertility, yolk ratio, shell percentage and shell thickness were always better in Fayoumi and Dandarawi.

9.0 IMPROVEMENT OF THE FAYOUMI FOWL

9.1 Selection

In the early stages of establishing the flock at FPRS starting in 1946, selection was mainly based on breed characteristics, culling the very large and small eggs before setting the eggs and at hatching the poorly-feathered day-old chicks were eliminated (Hossari, 1961).

In 1952/53 season a progeny-test program was started at FPRS. Birds were trapnested and individual records for egg number, egg weight, body weight, fertility and hatchability were kept. From 1953 to 1957 a sib-test plan was started and the best breeders for intensity of egg production (first two months) were selected as parents for the next generation. Selection was carried out in two directions, increased body weight at 8 weeks of age and increase of egg number (Hossari, 1961). Two lines of Fayoumi were established, the egg line (GG) and the production line (PP), respectively. The reasons for choosing body weight at 8 wks as a criterion for selection to improve body size was its high heritability estimated at 0.55.

Hossary (1980) estimated genetic gains in the two Fayoumi lines, as compared to a random-bred control flock. Through seven generations, the GG line gained 20g/generation by individual selection while PP line gained 20 eggs/generation through family selections.

As growth traits have been improved due to selection for body weight, age at sexual maturity was delayed by 6.5 days and egg weight increased by 0.66 g per generation as correlated responses. However, egg number has not been affected.

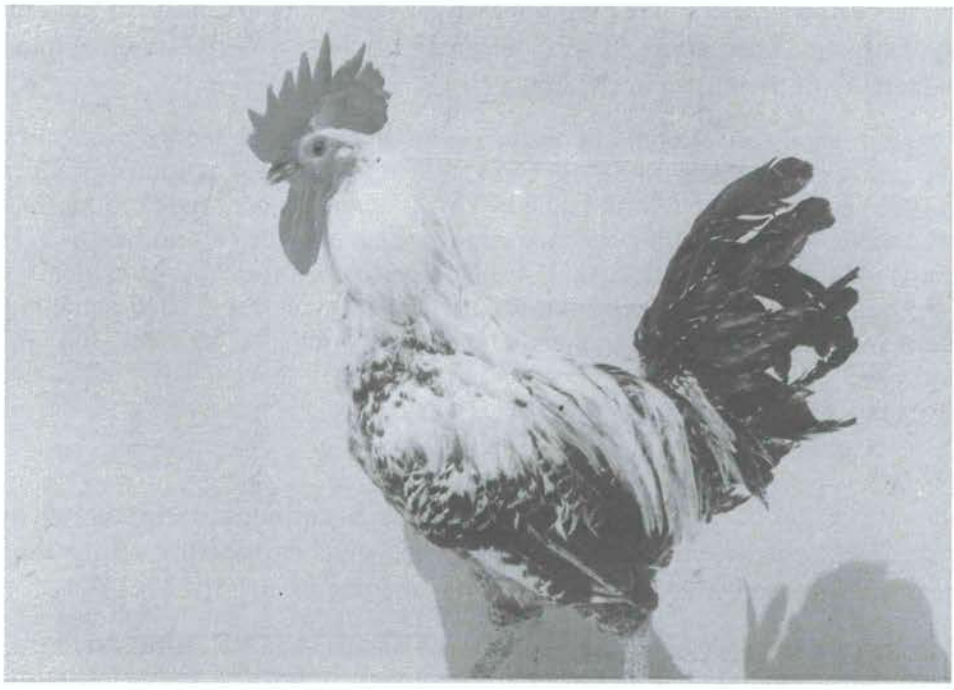
Selection to increase egg number has decreased age at sexual maturity by 6.5 days, adult body weight by 20.9 g, egg weight by 0.64 g and winter pause by 5.8 days, per generation as correlated responses.

Abdel-Gawad (1961), at Alexandria University, estimated the genetic parameters of another flock of Fayoumi in order to plan a breeding program. Similar work was also undertaken at Cairo University.

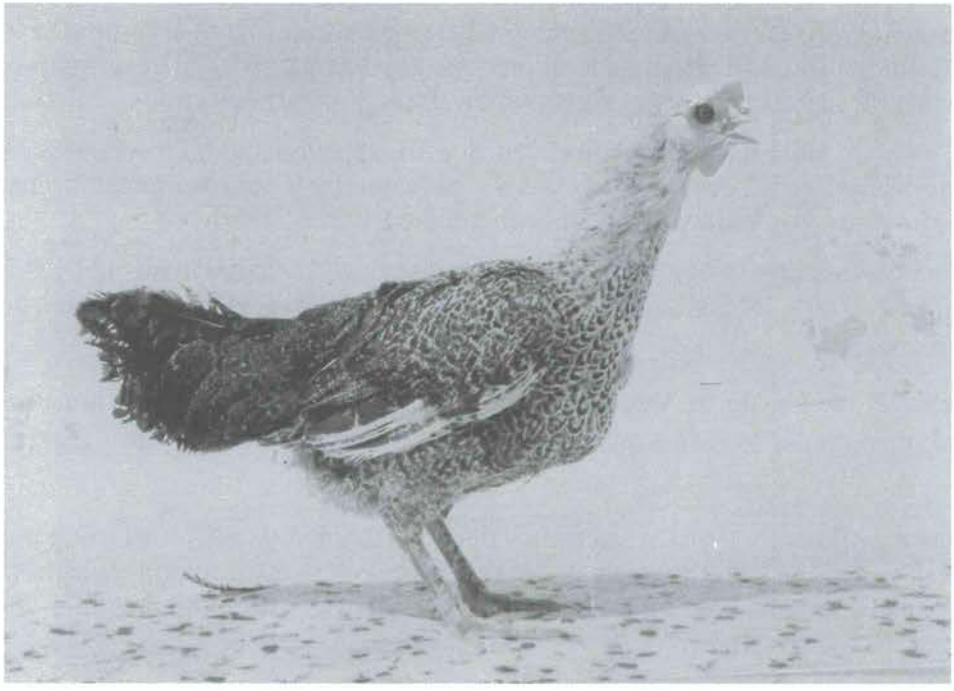
Several workers constructed selection indexes (I) to improve the breed using more than one economic trait such as early body weight at 8 wks of age (BW8), mature body weight (MBW), egg weight (EW) and egg number (EN) (Abdel-Gawad, 1961, Hossari, 1980 & Abdel-Warith, 1993). The latter author indices were:

I = 0.1194 MBW + 0.7261 EW + 0.7481 EN (3 traits)

I = 0.7490 BW8 + 0.1221 MBW + 0.7132 EW + 0.7306 EW (4 traits)



Fayoumi Rooster



Fayoumi Hen

Different selection methods to improve the two lines of the Fayoumi (GG and PP) have been tested (Hossari, 1980). There is evidence that mixed family selection method (half plus full sibs) was not more efficient than individual selection or ordinary family selection (full sibs) to increase body weight or egg number in the two lines unless dam family size is increased to ten or more, which is difficult to attain in practice. Increasing the number of dams per sire is not so critical. Combined individual selection and family selection in an index could be a useful method to improve the two lines relatively more rapidly even with regard to early body weight which shows a high h^2 estimate.

9.2 Crossing for heterosis

Crossing the two lines of the Fayoumi with each other improved some productive and reproductive traits (Hossari, 1970). Many workers found that the economic traits were improved and a considerable heterosis was obtained, when crossing the Fayoumi with other breeds i.e. White Leghorn (WL), RIR and New Hampshire (NH) (Kader et al, 1986, Hossari and Dorgham 1992). The economic evaluation of Fayoumi (F) crosses; two-way, Fx RIR, and three-way cross, RIR x Gimmeza (Fayoumi x Plymouth), was carried out under a controlled environment as compared with WL of Hypeco and LSL of Lohman (commercial layers). The actual economic return from the Fayoumi cross F x RIR exceeded that of the commercial strains because of its good adaptation and more favorable market demand on it (Hossari, 1993). It is also observed that crossing the Fayoumi with other foreign breeds and strains has improved adaptation and fitness traits of the crosses as compared to the exotic parental breeds.

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PRESERVATION OF LIVESTOCK GENETIC RESOURCES IN BULGARIA

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SUMMARY

The objective of this study is to present the local livestock breeds threatened with extinction as well to suggest an alternative initiative for their preservation and utilization. Both the geographical location and natural resources of Bulgaria are prerequisites for a large variety among species and strains of farm animals. Traditionally a considerable number of local breeds and strains have been bred on the territory of the country. In the recent 25-30 years an evident decline of their numbers is marked chiefly due to the introduction of high-productive, widespread breeds. This study presents the biological features of local indigenous breeds of farm animals threatened with extinction as well as the specificity of their region of location. The genetic research results based on polymorphism of serum blood proteins and blood groups are discussed. The diversity of indigenous sheep breeds is the largest, and 15 of them are under control. In latter years investigations show that they are 1.3 to 3.6 per cent from the total number of this species. The genetic analyses attest that these specific genetic resources can be used for keeping the genetic variety within and between sheep populations as well as for improving the adaptability of the newly-established breeds. Among the cattle two local breeds are of interest for genetic resources preservation purposes. As the most attractive emerges, Rhodope's Short-Horned cattle having unique biological characteristics as a representative of *Bos Taurus* in Europe and whose domain of location is over 1800 meters above sea level. The only impressive strain among the pig breeds has a different biological status from the well-known breeds on the European continent. The results of the present study show that the investigated indigenous breeds and strains are mainly located in mountainous regions considered as "hard" for farming. Thus, the preservation of genetic resources of local farm animals will contribute in using their valuable abilities of adaptation for breeding programmes in ecologically clear regions.

Key words: Livestock, Genetic resources, Indigenous breeds, Bulgaria

RÉSUMÉ

L'objectif de ce travail est de présenter la menace d'extinction des races locales d'animaux et de suggérer une initiative alternative pour leur conservation et utilisation. Aussi bien le site géographique que les ressources naturelles de la Bulgarie présentent les conditions nécessaires pour une grande variabilité entre espèces et races des animaux d' élevage. Traditionnellement, un grand nombre de races locales et espèces ont été croisés dans la zone. Dans le courant des dernières 25-30 années, on a assisté a une diminution importante de l'effectif dû à une large introduction de race hautement productives. Cette étude présente les caractéristiques biologiques des races autochtones d' élevage menacées d'extinction, ainsi que celles du site géographique. On présente également les

résultats de la recherche génétique effectuée sur le polymorphisme des protéines du sérum et des groupes sanguins. La diversité plus importante se trouve chez les races ovines autochtones, et 15 de ces races sont sous contrôle. Les recherches effectuées dans les dernières années montrent que celles-ci représentent de 1.3 à 3.6 pour cent du nombre total de cette espèce. Les analyses génétiques ont montré que cette spécifique ressource génétique peut être utilisée pour conserver la variabilité génétique à l'intérieur et entre les populations ovine et aussi pour améliorer l'adaptabilité des races de nouvelles introduction. Parmi les bovins on trouve deux races locales intéressantes dans le but de la conservation des ressources génétiques. Une des races bovine plus importante est la Rhodope's Short-Horned qui possède des caractéristiques biologiques uniques, représentatives du *Bos Taurus* en Europe, avec une localisation dans les milieux se trouvant à 1800 m d'altitude. La seule race importante parmi l'espèce porcine présente des caractéristiques biologiques différentes de celles bien connues parmi les races du continent européen. Les résultats de cette étude montrent que les races locales se trouvent principalement dans les régions de montagne, considérées, normalement, comme zones difficiles pour l'élevage. Pour tout ceci, la conservation des ressources génétiques des races locales d'élevage pourra être utilisée pour leur remarquable capacité d'adaptation dans des programmes d'amélioration génétique pour les régions tempérées.

Mots clés : Bétail, ressources génétiques, races autochtones, Bulgarie

Table 1: *Farm Animals Number in Bulgaria by October 1992*

Livestock species	Total number	Compared to 1987 ± %	Mature Females
Cattle	1 113 949	- 33.9 %	526 980
Sheep	5 079 938	- 76.1 %	3 821 094
Pigs	3 214 339	- 37.5 %	283 393
Goats	599 836	+ 22.0 %	470 424
Buffalo	23 273	- 17.2 %	12 626
Fowl	24 198 600	- 51.4 %	10 291 150

1.0 HISTORIC PRECONDITIONS FOR ANIMAL BREEDING DEVELOPMENT

Animal breeding has ancient traditions in Bulgaria. The great diversity of livestock species is typical for the country. This fact is determined by the different breeding conditions in the particular regions regardless of the relatively small territory of the country. In addition to that both the ethnographic peculiarities and traditions of the people inhabiting the different regions have played an important role. This is a crucial prerequisite for the formation of farm animals typical for each region, differing quite frequently not only by certain choice of breed but by choice of specie as well.

The present preservation of such a large variety of livestock could be related to a certain extent to the fact that animal breeding was one of the basic occupations of the population for centuries. As a consequence to that various breeds of cattle, sheep, goats, buffaloes, pigs, fowl, horses, etc., are preserved and being bred on the territory of the country.

2.0 FORAGE BACKGROUND AND LIVESTOCK BREEDING TECHNIQUES

The arable land in Bulgaria figures out to 4 649 979 hectares including 83 per cent fields, 7 per cent natural meadows, 7 per cent perennial plants, and the remaining area is occupied by artificially cultivated pastures. Of the total area of arable land 1 955 413 hectares are used for forage production: 47 per cent for fresh forages and 53 per cent for corn forages. Apart from all that, there are 2 035 000 hectares of uncultivated, natural pastures, mainly located in semi-mountainous and mountainous districts. The usage of these grasslands is extensive and the amount of forages cropped is limited. Basically these areas are intended for free pasture sheep and cattle breeding.

The artificial pastures are owned by state farms and by some research units. The main activity related to grassland areas is performed by the Institute of Mountain Agriculture and Animal Science near the town of Troyan. The whole research and development work for grassland maintenance and farming is concentrated there.

Cattle are predominantly tied, without using free pastures. As an exception are some beef and indigenous farms. Grassland farming is more typical for sheep and goat breeding. The rest of species and mostly fowl and pigs are concentrated in big breeding units close to the larger cities. 59 per cent of the pigs and 40 per cent of the fowl are bred in such farms.

3.0 STRUCTURE AND NUMBERS OF LIVESTOCK

Data on livestock numbers by species and their varying during the recent 5 - 6 years are presented in Table 1. The major decline in livestock numbers during the latter 2 years is due to the ongoing process of land restitution and reorganization. For instance the decline in cows is about 22 per cent, whereas their number in the private sector increased from 25 to 52 per cent at the end of 1992. The tendency in other farm animals is similar.

4.0 GENETIC RESOURCES OF LIVESTOCK

The major part of the local breeds are concentrated in state-owned farms and experimental research stations. The National Service for Selection and Reproduction in Animal Breeding

(NSSRAB), supervised by the Ministry of Agriculture has undertaken their preservation and development. This state unit has branches in all major regions of the country. It includes 6 stations for artificial insemination, located in Sofia, Sliven, Varna, Veliko Turnovo, Shoumen and Pleven.

5.0 INDIGENOUS CATTLE BREEDS

5.1 **Grey Iskar** and **Rhodope Short-Horned** are of interest among cattle breeds. The **Grey Stepland** is an indigenous cattle breed, but spread in the neighbour Balkan countries as well. The two breeds discussed are attractive for some unique genotypes discovered by the research workers.

5.2 **Rhodope Short-Horned** breed is the smallest one of this species in Europe. These animals descend from craniological type *Bos Taurus Brachiceros*. However some particular characters approximate it more to peat cattle than to culture brachiceros breeds. This breed represents the last remnants of the pre-historic cattle in Europe along with the Albanian, South-Montenegrian, Ilirian and Georgian *Brachiceros* cattle, originating from Asia.

Its distribution area is in the internal Western, Middle and partly Southern and Eastern Rhodope Mountains. These are forest lands 1800 meters above sea level. The animals are small and their height at withers is about 97 centimeters. The coat colour of this breed varies from light to dark brown, and even some with a black coat can be found. The horns are pale with dark tips, thin, soft and crumply and about 15 centimeters long. The hooves are dark and strong. Body weight varies between 160 and 220 kilograms. New-born calves weigh 14.6 kilograms on average. The milk yield of cows is between 966 and 1133 kilograms with 4.5 to 4.6 per cent fat [34,27]. The animals are not particular about farming and feeding conditions. In summertime they are fed on grasslands, in winter - mostly on hay and forest-leaves forage [35].

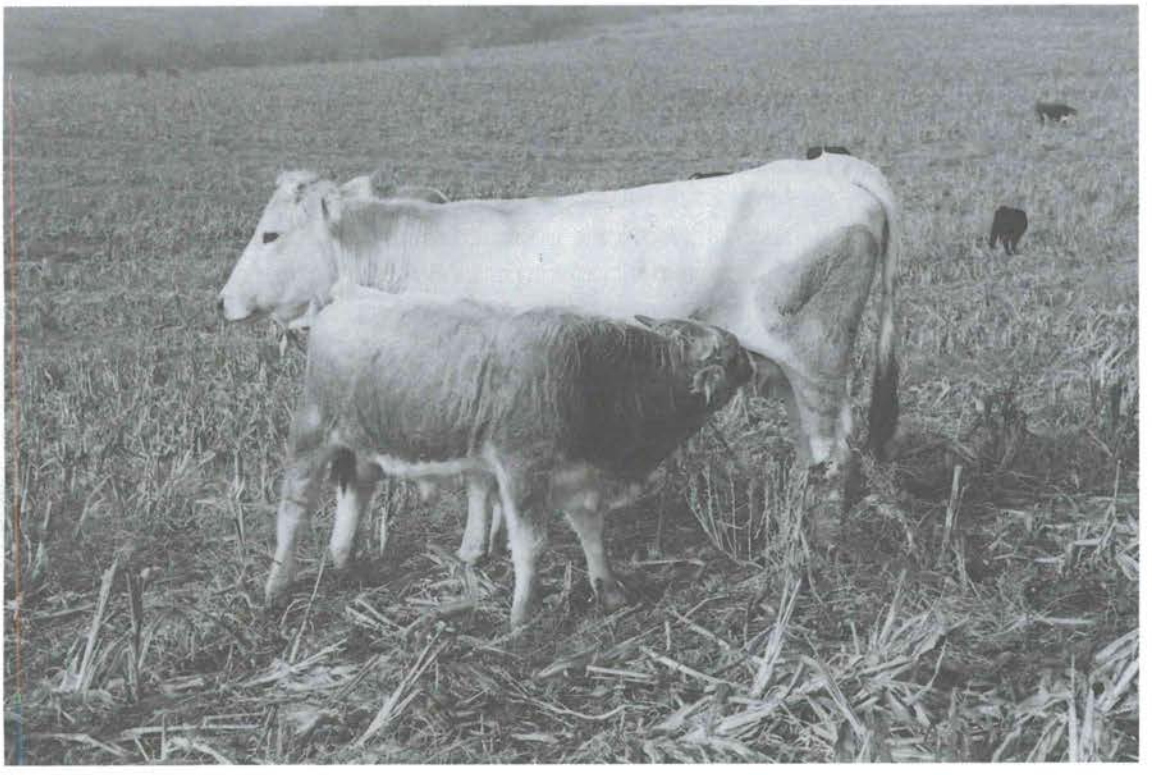
The genetic research on transferrin and erythrocytic antigens (Table 2) [6,7] shows that the frequency of transferrin types Tf A and Tf D of this breed are close to that of the *Brown Brachiceros* breeds in Germany and Switzerland. Furthermore, that the presence of the very rare transferrin allele Tf F, is discovered which is not common for any of the European cattle breeds, but is found, though rarely, in some local Asian and African strains. Availability of the Tf F allele allow us to confirm the hypothesis of other researchers [4] about the Asian origin of this breed.

5.3 **Grey Iskar** is a local cattle breed, kindred to the Grey Stepland breed spread in Europe. The craniological class of animals from this breed is between *Bos T. Primigenius* and *Bos T. Brachyceros* which distinguishes it from the Grey Stepland breed [6]. The region of distribution of the Grey Iskar Cattle was by the river valleys of Iskur, Vit, Osam, Skat and Rositsa [35]. At present a limited number of animals of this breed are mainly located near the town of Sevlievo and a few in private farms. The Grey Iskur breed has a grey coat colour with different shades. The muffles and eyelids are black. Horns are U-shaped, pale with black tips. The body is proportionate, legs are strong. Height at withers is about 115 - 120 centimeters. Body weight is between 300 and 350 kilograms. Calves have birth weight about 20 - 22 kilograms. Average milk yield is 1200 - 1300 litres with 4.1 - 4.2 per cent fat while in herds with better farming conditions milk yields reach 1947 - 2648.9 litres [39,24,35]. The length of the lactation period is 256 - 282 days. Animals of this breed resist unfavourable climatic conditions and diseases.

Local Indigenous Cattle, Pig, and Buffalo Breeds

Table 2: *Allele Frequency In Cattle*

GREY ISKAR				
Albumin (n=184)	Makaveev 1980 :		Alb A	0.636
			Alb B	0.364
Haemoglobin (n=275)	"	1970 :	Hb A	0.984
			Hb B	0.016
Haemoglobin (n=189)	"	1983 :	Hb A	--
			Hb B	0.071
Alkaline				
Phosphate (n=190)	"	1980 :	A Kp F	0.161
			A Kp S	0.818
			A Kp D	0.621
Transferrin (n=215)	"	1965	Tf A	0.404
			Tf D	0.448
			Tf G	0.146
Transferrin (n=373)	"	1970	Tf A	0.417
			Tf D	0.458
			Tf E	0.215
			Tf F	0.010
RHODOPE SHORT HORNED				
Transferrin (n=424)	Makaveev 1966 :		Tf A	0.230
			Tf D	0.710
			Tf E	0.046
			Tf F	0.020



Grey Cattle

Table 3: *Numbers of Indigenous Cattle Breeds by January 1993*

Name of Breed	Region of distribution	Number	Ownership
1. Grey Iskar	Dragana,Sevlievo	75	Private Sector
	Troyan	6	State sector
	Shoumen	30	" "
	Chiflika	20	" "
	Total Number	**131**	
2. Grey	Groudovo	30	State sector
	Stoudena, Svilengrad	50	" "
	Ustrem	100	" "
	Lovech region	50	Private sector
	Total number	**230**	
3. Rhodope Short Horned	Hamzovo, Smolyan	80	State Sector
	Smolyan region	70	Private Sector
	Total number	**150**	
Total Number of Indigenous Cattle		511	

The Grey Iskar breed has been an object for genetic research in terms of different blood serum components: albumins, transferrins, haemoglobins, amylase, etc. Some of the more interesting results are presented in Table 2. The frequency of haemoglobin alleles in this breed differs significantly from the widespread European cultivated breeds by very low values of Hb B allele frequency [9, 36]. The presence of the Akp D allele is rare, thus its higher frequency invokes definite interest among geneticists. Analysing the obtained results, it is worth noticing that just as in Rhodope Short-Horned cattle breed the transferrin allele Tf F is found in Grey Iskur breed. These investigations prove the unique genetic status of the breed compared to the rest of the European cattle breeds.

6.0 INDIGENOUS SHEEP BREEDS

By numbers and diversity the local indigenous sheep breeds and strains in Bulgaria significantly exceed other farm animal species (Table 4). By contrast with cattle, sheep breeds have domains of distribution in different districts of the country - in lowlands, semi-mountainous and mountainous regions. Some of these breeds (**Pleven Black-Face, Sakarska**), although valuable as a specific genetic resource, will not be described in detail, since they are not threatened with extinction.

6.1 Indigenous sheep breeds in lowlands and semi-mountainous areas

6.1.1 The ***Karnobatska*** sheep breed is a local strain of the Red-Brown sheep bred in Eastern Bulgaria for ages. It is supposed that the origin of this breed has much in common with Tzigay sheep and Asia Minor sheep breeds [33]. At present there are 650 Karnobatska ewes bred in a state-owned farm.

The animals of this breed are small and compact with a well-built body. Rams have heavy whirled horns while ewes are polled. Their fleece colour is mostly red and brown and very rarely pale. Their height is 50 - 55 centimeters, length - about 60 centimeters. Ewes' body weight is 31 kilograms on average, rams' - 38 - 40 kilograms. The body weight of new-born lambs is about 3 kilograms. Karnobatska is a dual-purpose breed with equal emphasis on meat and wool. The meat has good eating qualities, since fattening is only from free grazing. Fleece weight is about 2.4 kilograms exceeding other indigenous sheep breeds in the country. Staple length is 18 centimeters. Average milk yield per ewe varies between 40 and 50 litres for 150 days of lactation. Milk fat is 8.4 to 8.97 per cent, casein - 3.98 per cent, lactose - 5.47 per cent. The investigations of haemoglobin alleles showed that animals of this breed have the very rare allele Hb A with frequency of 0.07 [9].

6.1.2 ***Copper-Red Shoumen*** breed is distributed mainly in the North-Eastern part of Bulgaria in regions with moderate continental climatic conditions from 0 to 800 meters above sea level. Representatives of this breed are medium-to-large with average body weight of 43 - 45 kilograms, compact body with height of 59 centimeters and length of 64 centimeters [3,31]. Fleece colour is rusty-red, while one can find individuals with black fleeces. Ewes are polled, rams have twisted horns. They usually have well covered body and legs free of wool. Twining rate is about 25 - 30 per cent. The milk yield per lactation period is 48 litres on average with 7.32 per cent fat. Wool production per ewe is about 2.6 kilograms [16]. The results of polymorphic analyses of blood serum proteins are shown in Table 5 [12,13]. The presence of some rare alleles such as Tf G, Alb F, Alb S, Alb W is found, compared to the available allele pool on the Balkans.

Local Indigenous Sheep Breeds

Country Boundary

Local Indigenous Sheep Breeds

1 - KARNOBATSKA
2 - Cooper-Red Shoumen
3 - STAROZAGORSKA
4 - MARISHKA
5 - Svishtovska
6 - DABENSKA
7 - BREZNISHKA
8 - KOTLENSKA
9 - STRANDJANSKA
10 - SREDNOGORSKA
11 - REPLYANSKA
12 - KARAKACHANSKA
13 - TETEVENSKA
14 - STAROPLANINSKA

6.1.3 The ***Starozagorska*** breed is the most typical among the indigenous sheep bred in Bulgarian lowlands. The regions of distribution are valleys around the city of Stara Zagora, peculiar of moderate continental climatic conditions. The breed is thought to have developed from crossing Tzigay and Zackel. The animals are large and body weight of mature ewes is up to 60 - 70 kilograms. Weaning weight of lambs is 4.3 kilograms. Height is 64 - 65 centimeters, length - about 70 centimeters. The fleece colour is white. Sheep of this breed have an elongated head, sagging ears, long neck and levelled back. Face, belly and legs are free of wool [31]. Milk yield is 165 litres with 6.09 per cent fat and 5.92 per cent proteins [2]. Wool production is about 3.7 kilograms [31]. Owing to its high productivity and good adaptability to local conditions the Starozagorska breed is used as a terminal for improving crosses with cultivated sheep breeds. The implemented genetic research [22] shows presence of the rare haemoglobin allele Hb A at high frequency of 0.470.

6.1.4 The ***Marishka*** breed is distributed mainly in the private farms by the valley of river Maritza near the cities of Plovdiv and Pazardjik. 350 individuals of this breed are registered. Animals are multi-purpose with emphasis on meat, wool and milk. Average milk yield per lactation is 120 litres. They have semi-coarse, white and levelled lustrous wool. Average fleece weight is about 2.4 - 2.8 kilograms. Sheep of this breed are large, with long legs, light shouldered and long body, light bone system and strong hooves. Rams and ewes are polled. Ears are large and sagging. Their height is about 65 centimeters, body weight - 40 kilograms. Twining rate varies between 16 and 30 per cent [37,31].

6.1.5 The ***Svishtovska*** breed is based mainly on private farms located in the lowlands between the rivers Danube, Yantra and Osam. The moderate continental climate is typical for these regions. According to some research work [30] this breed is an intermediate strain between Tzigay and Zackel breeds. The Svishtovska sheep is one of the largest indigenous breeds in Bulgaria. Animals are 68 centimeters high, and of 70 centimeters body length. Body weight is 42 - 44 kilograms. The body is well-covered with white wool. Very often face, poll, ears and legs are black or spotted. The animals have strong muscular body constitution and are resistant to hard climatic and feeding conditions. Milk yield is comparatively high: 90 - 100 litres with 8.2 per cent fat. Fleece weight is up to 2.7 kilograms. Ewes have early maturity and lambs rapid weight gain.

6.1.6 The ***Dabenska*** sheep breed is spread throughout the lands around the town of Karlovo. At present this breed numbers 370, bred in a state-owned farm. The animals are large, 65 - 67 centimeters high and 68 - 70 centimeters long. Body weight is 40 kilograms [20] and the body is well-covered with wool. Typical for this sheep is the long tail. Ewes have late maturity and slow weight gain of lambs. Wool is a semi-coarse type, well levelled. Fleece weight is 2.5 kilograms. Milk yield is high - 94 litres [20]. Analyses of polymorphic systems are presented in Table 5 [23, 10].

6.1.7 The numbers of ***Breznishka*** sheep is about 500, bred in some private farms near the towns Breznik, Radomir and Tran. Animals are medium-to-large with black spots around the eyes and nose. Legs are white, black or spotted and the tail is long. Ewes are polled, while rams are sometimes horned. Body weight is on average 40 kilograms, height is 60 centimeters. Milk yield of ewes is about 110 - 150 litres. Fleece weight is 2.0 - 2.6 kilograms with semi-coarse wool. Results on blood polymorphic analyses are shown in Table 5 [1].

Table 4: *Numbers of Indigenous Sheep Breeds by January 1993*

Name of breed	Region of distribution	Number	Ownership
1. Pleven Black-Face	Pleven	10.300	State Sector
	Pleven	6.000	Private Sector
	Dobrich	800	State Sector
	Rousse	700	State Sector
	Sliven	500	State Sector
	Stara-Zagora	500	State Sector
	Vratsa	9.000	State Sector
		27.800	
2. Karakachanska	Lovetch	450	State Sector
	Smolyan	200	Private Sector
	Sofia	200	State Sector
	Shoumen	140	State Sector
		990	
3. Starazagorska	Stara Zagora	1.200	State Sector
4. Sakarska	Stara Zagora, Haskovo	2.400	State Sector
5. Kotlenska	Sliven	680	Private Sector
	Kotel	300	Private Sector
		980	
6. Replyanska	Vidin	1.300	State Sector
	Montana	1.600	Private Sector
		2.900	
7. Copper-Red Shoumen	Shoumen	430	Private Sector
8. Breznishka	Breznik	490	Private Sector
9. Marishka	Plovdiv	350	Private Sector
10. Svishtovska	Svishtov	240	Private Sector
	Pleven	200	
		440	
11. Karnobatska	Karnobat	650	State Sector
12. Strandjanska	Sliven	750	State Sector
13. Dabenska	Plovdiv	370	State Sector
14. Tetevenska	Teteven	450	State Sector
15. Staropaninska	Pleven	800	Private Sector
	Sofia	600	Private Sector
		1.400	
16. Srednogorska	Pirdop, Koprivshtitsa	920	Private Sector
Total Number of Indigenous Sheep		**42.680**	

6.1.8 ***Kotlenska*** sheep breed is located in the semi-mountainous regions of Eastern Stara Planina. Animals are medium-to-large with strong body constitution. The body is well-covered with wool, which is relatively short but well levelled and softer than in mountainous sheep breeds. Wool production is 2.3 - 3.0 kilograms. Milk yield is low : 40 litres per lactation. Individuals of this breed have very good adaptive capability. The Kotlenska breed differs from other sheep breeds located on the Balkan Peninsula by the frequency of some alleles of the transferrin and albumin polymorphic systems [11, 13]. This breed is a carrier of some very rare alleles : the albumin Alb T and transferrin Tf C.

6.2 Indigenous sheep breeds in mountainous areas

6.2.1 The ***Strandjanska*** sheep breed is spread throughout the highlands of Strandja mountain. Animals are very well adapted to the local conditions and are resistant to the piroplasmosis disease compared to the other breeds in the region. Individuals are one of the smallest in this country having body weight of about 30 kilograms. Height is 50 - 54 centimeters. Lambing weight is 3.0 - 3.5 kilograms. Twining rate is very low. The wool is coarse and fleece weight is hardly 2.1 kilograms [38].

Purebred animals are raised in state farms in the Sliven region. Often the valuable genetic resources of the Strandjanska breed are used in crossing to other sheep breeds in the region aiming to improve their adaptability and endurance.

6.2.2 The ***Srednogorska*** sheep breed is raised by the private farmers on the slopes of the Sredna Gora and Stara Planina mountains near the town of Pirdop. This is a small sheep breed with body weight 35 - 38 kilograms. Body height is 60 - 65 centimeters, and body length - 59 - 62 centimeters. Animals have a compact, well-built body. Ewes are polled, rams have nice whirled horns. Lambing weight is about 3 kilograms. Over 70 per cent of the population have pale wool containing some red pigmented fibres and kemp. Usually the face, ears and legs are black. Individuals with white red spotted wool are rarely found. Wool is mild and fine compared to other indigenous breeds but with very low fleece weight - 1.3 kilograms. Milk yield of ewes is 45 - 47 litres with 8.09 per cent fat. Fertility is low - about 90 - 100 per cent although ewes have unusual maternal abilities [37, 31].

6.2.3 The ***Replyanska*** sheep breed is a typical representative of the coarse wool breeds. Distributed is in the Western part of the Stara Planina mountains. The Replyanska breed is relatively small with a compact vigorous body. Extremely tenacious animals, they are very well adapted to mountainous farming and feeding conditions. Body weight is 34 kilograms on average. Height is 58 centimeters, length - about 65 centimeters. Over 95 per cent of the animals have white fleece. The whole body is well-covered by wool, including belly and legs. The wool is coarse of different qualities. Fleece weight is about 2.0 - 2.2 kilograms. Milk yield is 90 - 100 litres per lactation. Results of analyses carried out on polymorphic erythrocyte enzyme and protein systems are shown in Table 6 [1].

6.2.4 The ***Karakachanska*** sheep breed is spread throughout mountain areas in Bulgaria. The number of purebred individuals of the indigenous Karakachanska sheep breed is very small. In different parts of the country there are larger numbers of crosses with other breeds. In the past the breed was one of the most widespread on the Balkans.

Animals are small, vigorous, strong-boned with short legs, lively and resistant to unfavourable climatic and feeding conditions, and diseases. Hooves are hard, rams have long, heavy whirled horns. The head profile is bowed. Face, ears, legs and nose are black. Most of the population has pigmented wool - grey-to-black, sometimes brown. Wool is predominantly coarse. Fleece weight is 1.5 - 2.5 kilograms. Body weight of ewes is 25 - 30 kilograms, of rams - 40 - 45 kilograms. Body height of animals is about 57 centimeters. Body length is 62 - 69 centimeters. Belly, legs, poll and face are covered with wool. Milk yield is 40 - 55 litres with 6.5 - 8.0 fat percentage. The allele frequency of some polymorphic systems of the Karakachanska sheep breed are presented in Table 6 [1, 8].

7.0 INDIGENOUS PIG BREEDS

7.1 The **Eastern-Balkan (Iztochno-Balkanska)** pig breed is located in the mountainous areas of Eastern Bulgaria. It belongs to the group of small European primitive pig breeds with short prick ears. This local breed originated from the domesticated European pig (*Sus Skrofa Domestica*). Obviously at the later levels of its development this breed was also developed under the influence of Asian pig breeds (*Sus Skrofa Palustris Rutt*). The short legs and levelled back of the individuals [32] are a proof of this hypothesis.

These pigs are raised in herds almost annually in the forests. The basic food are pannages. Animals practically do not suffer from diseases and can reach 15 - 16 years of age. Anatomically the pigs of this breed are similar to the wild-boars. The head is very big with an elongated muzzle, having a slightly bowed nose and short strong frontal bones. The profile length of the skull is about 31.5 centimeters, the width of the frontlet is 9.8 centimeters. There are 7 cervical vertebrae, 14 thoracic (with 14 pairs ribs), 5 lumbar, 4 sacral and small knitted caudal vertebrae. Animals are of medium size and at the age of 3 years carcass length is 110 - 120 centimeters and height is 70 - 80 centimeters. Within the natural environment its body gain reaches the maximal level at the 3rd year of age having 80 - 120 kilograms weight. In a particular cases one can find animals with 180 kilograms body weight. The body is compact, with heavy, strong shoulders, short neck, slightly bowed up back and skewed rump. The coat is sleek over the whole body, while in a stress situation hard bristles on the back go up. Ears are short, prick and move easily.

The prevalent coat colour is black (which is dominant), but there are individuals with a spotted coat, and very rarely white coloured. Sows farrow twice per year having 112 days pregnancy. The average litter size is 4 to 7 piglets, but sometimes reaches 10. Sows have an unusual maternal ability. Duration of suckling period is about 3 months. By meat production capacity pigs of the Eastern Balkan breed defer to pigs of the contemporary cultivated breeds. Slaughter analyses show significant contents of intra-muscular fat and low yielding meat carcass - 32 per cent. The investigations for stress resistance with Hallotane test [21] showed that hardly 7.2 per cent of the treated group had positive reaction. This gives evidence to claim that the pigs of this breed have extraordinary adaptive abilities. Research on the blood groups antigen composition have shown significant differences with other pig breeds. In this breed one can find two very rare blood group antigens, Bb and Lf [5]. Other research work [28,14] confirms that the Eastern Balkan pig differs from other big breeds by the transferrin, amylase, 6-phosphogluconate dehydrogenase and phospho-hexisomerase. A research study [6] discusses the discovery of the phospho-hexisomerase allele PHI C, on the basis of which the presence of genotype AC - not common with any other pig breed is determined. These results are confirmed in another work [15], as in addition it specifies that the unique genotypes of this breed are two: AC and AB. All these investigations prove the hypothesis that the Eastern-Balkan pig breed is unique in terms of genetic variety and is of unconditional interest for preserving as a valuable genetic resource.

Table 5: *Polymorphic Erythrocyte Enzyme and Protein Systems and Allele Frequenccy*

System	Allele	Allele Frequencies by Breeds			
		Copper-Red Shoumen	Breznishka	Kotlenska	Dabenska
Haemoglobin	Hb A	0.354	0.209	0.149	0.117
	Hb B	0.646	0.791	0.851	0.823
Catalase	Cat F		0.211	0.583	
	Cat S		0.789	0.413	
Diaphorase - 1	Dia 1A		0.546	0.598	
	Dia 1B		0.454	0.402	
Diaphorase - 2	Dia 2A		0.587	0.404	
	Dia 2B		0.413	0.596	
Carbonic	Ca F		0.014	-	
Anhydrase	Ca S		0.986	1.000	
X - Protein	X A		0.258		
	X a		0.742		
	X X	0.285		0.211	
	X x	0.715		0.789	
Arylesterase	EsA+			0.263	
	EsA-			0.737	
Alkaline	Akp B			0.442	
Phosphatase	Akp O			0.558	
Glutathion	GSH H	0.474			
	GSH R	0.526			
Albumin	Alb F	0.010		-	
	Alb S	0.051		-	
	Alb V	0.909		0.848	
	Alb W	0.030		0.130	
	Alb T	-		0.022	
Transferrin	Tf E	-		0.016	0.016
	Tf A	0.091		0.221	0.199
	Tf B	0.212		0.284	0.309
	Tf C	0.551		0.337	0.111
	Tf D	0.010		0.079	0.365
	Tf M	0.015		0.005	-
	Tf G	0.121		0.058	-

Table 6: *Polymorphic Erythrocyte Enzyme and Protein Systems and Allele Frequency*

System	Allele	Allele Frequencies by Breeds		
		Replyanska	Staroplaninska	Karakachanska
Haemoglobin	Hb A	0.400	0.208	0.202
	Hb B	0.600	0.792	0.798
Catalase	Cat F	0.323	0.329	0.360
	Cat S	0.677	0.671	0.640
Acid Phosphatase	Acp A	0.414	0.657	0.548
	Acp B	0.586	0.343	0.452
Diaphorase - 1	Dia 1A	0.786	0.517	0.615
	Dia 1B	0.214	0.483	0.385
Diaphorase - 2	Dia 2A	0.432	0.347	0.245
	Dia 2B	0.568	0.653	0.755
Carbonic Anhydrase	Ca F	0.005	-	0.014
	Ca S	0.995	1.000	0.986
X - Protein	X A	0.390	0.308	0.337
	X a	0.610	0.692	0.663
Arylesterase	EsA+			0.130
	EsA-			0.870
Alkaline Phosphatase	Akp B			0.293
	Akp O			0.707
Glutathion	GSH H			0.709
	GSH R			0.291
Albumin	Alb A			0.020
	Alb B			0.030
	Alb C			0.740
	Alb D			0.210
Transferrin	Tf A			0.200
	Tf B			0.110
	Tf C			0.180
	Tf D			0.460
	Tf E			0.050

8.0 INDIGENOUS LOCAL BUFFALO BREEDS

8.1 The **Bulgarian Mediterranean Buffalo** is a local breed. Its origin can be related to the Wild Asian Buffalo (*Bubalos Arnee*). There are over 23,000 buffaloes, spread throughout the lowlands of southern and northern parts of the country. The present population was developed by crossing the local Mediterranean breed with some breeds imported from the Indian Subcontinent. As a consequence now the number of purebred animals of the local buffalo breed is limited to 1 or 2 per cent of the whole population. Small herds are bred in some state farms near the town of Shoumen, while larger ones are raised in the private sector, mostly in the northern part of the country.

The Bulgarian local buffalo is a large animal - 570 kilograms body weight, strong bone-system and well-developed muscularity. Height at withers is about 130 centimeters. The coat is coloured black or brown-black. Horns are long and heavy with grey-black colour. The age of first calving of buffalo heifers is about 36 - 38 months. Pregnancy lasts 315 days [58]. Calving weight is about 34 kilograms. Milk yield is between 1500 and 1700 litres with 7.4 - 7.7 per cent fat [3,19,17]. The lactation period is 263 days.

Investigations on the characteristics of buffalo milk were carried out immediately after the Chernobyl disaster in 1986 - 1987. Compared to the other treated milks (dairy cattle, sheep and goat), the lowest rate of radioactive contamination of 519 Bq/l was found in buffalo milk. Investigation also showed the lowest content of such radionucleotides as Iodine 131, Caesium 137 and Caesium 134 [3].

9.0 CONCLUSION AND POSSIBILITIES FOR PROTECTION AND UTILIZATION OF THE LOCAL INDIGENOUS LIVESTOCK BREEDS IN BULGARIA

In conclusion it is worth emphasizing the large variety of genetically valuable local livestock breeds in Bulgaria. Some of them belong to exclusively rare genotypes and could be of interest in the non-distant future pursuing the crucial objective for the preservation of a larger genetic diversity within different populations of farm animals. A certain way to preserve this precious genetic resource is designing and applying programmes for development and improvement of small populations of farm animals as well as the promotion of gene banks. There are some detached programmes with emphasis on the implementing of deep freezing of semen and embryos. This activity is applied mainly in cattle and buffalo breeding and is in practice for the most part in the Research Institutes where the necessary equipment and experts are available.

The majority of local indigenous animals are under the control of the National Service for Selection and Reproduction in Animal Breeding (NSSRAB). Although predominantly such animals are bred on the state-owned farms, the problems of protection of the local breeds are caused by the situation that some of them are property of private farmers. Their preservation is getting more complicated by the fact that these animals have lower productive abilities than the cultivated breeds, which makes them uncompetitive.

In this sense a reasonable financial support and preferences for the private owners will be indispensable. This necessity is made even more pronounced by the fact that more of this livestock is located in so-called "hard" regions in the mountainous parts of the country.

Thus the preservation of genetic resources of the indigenous local breeds of farm animals will give us a possibility for future utilization of their valuable adaptive abilities for developing animal husbandry in these ecologically clear regions of Bulgaria.

Strandjanska Sheep

East Balkan Pigs

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THE KOREAN HANWOO BEEF CATTLE

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SUMMARY

The Hanwoo cattle of Korea are probably one of the oldest autochthonous breeds in the world that are known to have populated a specific geographic region for over 2 000 years. They are also a unique case of a domestic animal genetic resource (DAGR) that after having followed the classical tendency of dangerously and rapidly decreasing numbers (1 740 000 in 1940 down to 393 000 in 1950) moved slowly back to near 2 000 000 in 1993, following an exemplary and voluntary conservation programme and a well organized national improvement scheme. This well-planned selection scheme made it possible for the average live weight of Hanwoo cattle to nearly double their measure adult weight since the first in official controls were made in the early seventies: sires from 290 kg to 477 kg and cows from 246 kg to 309 kg in a more than 30 year period. This is a unique reference case of D.A.G.R. conservation, of domestic preservation, development, and economic use within the traditional production terms and management conditions of a specific geo-cultural environment.

Key words: Indigenous Breeds, Cattle, Korea

RÉSUMÉ

La race bovine coréenne Hanwoo est probablement une des races autochtones plus ancienne connue dans le monde, ayant peuplé une région géographique spécifique depuis plus de 2000 ans. De plus, c'est un des rares cas de ressources génétiques d'animaux domestiques (DAGR) qui, après avoir subit la tendance classique d'une diminution rapide et dangereuse de sa population (1 740 000 en 1940, passés à 393 000 en 1950), ont augmenté lentement jusqu'à atteindre presque 2 000 000 d'exemplaires en 1993, suivant un programme de conservation adapté et volontaire et un schéma d'amélioration national bien organisé. Ce schéma de sélection bien planifié a permis d'augmenter la moyenne du poids de la race Hanwoo jusqu'au double du poids adulte dès les premiers contrôles officiels effectués au début des années 70 : les mâles sont passés de 290 kg à 477 kg et les femelles de 246 kg à 309 kg, dans une période de plus de 30 ans. Ceci est le seul exemple de conservation de DAGR de ressources domestiques, de développement et d'utilisation économique suivant les valeurs de production traditionnelles et de conduite dans un environnement géo-culturel spécifique.

Mots clés : Races locales, bovins, Corée

1.0 THE ORIGIN OF THE HANWOO

On the basis of the serological researches and the studies on the skull that shows the least variation of the animal skeleton, the Hanwoo has been reported to originate from the cross between Bos primigenius and Bos Zebu. The crossing was assumed to have taken place in Northern China and outer Mongolia when Bos primigenius moved from the central Asia and Bos Zebu moved from the south.

The ancestors of the Hanwoo appear to have moved to the Korean peninsular in the New Stone Age when agriculture started. The excavated cattle bones among the relics buried in the Kimhae shell mound showed that the Hanwoo was raised in the Korean peninsular in B.C.100. It appears that the Hanwoo was regarded somewhat closely to the farmers because of its intimacy to the farming and of the religious (Buddhism) influence, rather than as the animal producing the meat in ancient times. It can be noted from the historical records that the Hanwoo has been used as a farming tool during the Samhan Dynasty of 2000 years ago, and the various records from Kokuryo, Baekjae and Shilla Dynasties to the end of Yi Dynasty (A.D. 1900) also indicate the importance of the Hanwoo for farming.

2.0 THE CHARACTERISTICS OF THE HANWOO

Unlike Westerners, most Korean cattle farmers still have the cow within their house fence, feed it three meals daily, let it graze during the day, and take it into the barn for the night.

In ancient times, Hanwoo was mainly used for transportation as well as for farming, and when it became too old then people slaughtered it for beef. Since A.D.100, with the introduction of Buddhism, killing had been prohibited, Hanwoo was, therefore, by no means, fed for meat. However, with the rapid industrial development over the past 20 years, it became less useful as a work animal, and the effort to convert its usage to meat production has begun. But its characteristics still make it viable for farming. They can be summarized as follows:

1) Coat color is brown
2) It is relatively gentle, wise, friendly, tameable, and easily approachable
3) Moves fast
4) Small-bodied and easily moves on steep hills
5) Has sharp sense of smell and consumes relatively small amount of feed
6) Good adaptability under the hot or cold weathers and strong resistance to disease, but not well adapted when raised in a group and weak resistance to disease recently introduced from the foreign countries
7) Slow maturity, but capable of producing a calf each year
8) Milk production is poor and weans calf at an early age
9) Although the body is strongly built, the body width is relatively narrow. The front quarter is well developed. However, since the hind quarter is not well developed, the amount of meat produced is somewhat small
10) Excellent flavour of meat and marbling but tough muscle fibre
11) Due to late marbling, good quality meat can only be produced after 18-24 months of age
12) Strong enough to work and to carry loads on its back
13) Excellent feed efficiency and rough feed can be used
14) Has a strong maternal love for calf

3.0 HANWOO RAISING

3.1 Barn

Except those who specialize in beef cattle farming, most of cow-calf farms have barns in their residential area or in the attached buildings, so that all the family members can take good care of Hanwoo.

3.2 Feed

Wild grass is fed in summer, and in winter such by-products of farming as straw, bean husk, sweet potato leaves or rice bran, etc. are fed.

3.3 Disease

Hardly any diseases can seriously attack the Hanwoo. Therefore, protective inoculation or disinfection is rarely required, and for group raising vermifuge or vaccination is occasionally given.

3.4 Management

Most non-commercial beef farms have Hanwoo within easy access and treat it affectionately. Hanwoo plays an important role occupying the time of the old people. They brush the cattle and cover its back with cloth to protect it from cold.

3.5 Changes in management method

A recent decrease of the labor force, ever increasing wages, high standards of education, and specialized livestock industry etc. have resulted in significant changes in cattle raising.

In particular, the farmers who raise a large number of cattle have been continuously developing methods to reduce costs and improve productivity. In connection with an environmental protection campaign, commercial beef farmers have been forced to find a suitable way of disposing of the wastes.

3.6 Changes in the number of Hanwoo

Koreans have always concentrated their efforts on increasing the number of cattle, valued by both the government and farmers.

In the year of 1940, 1 740 000 Hanwoo were raised across the South/North Korea, but in 1945, after the end of World War I, the number was decreased to 597 000 in South Korea (the statistics will refer to south Korea) due to the unstable post-war society, and in late 1950 when the Korean War began, there were only 393 000 Hanwoo left. Since there was an urgent need for the Hanwoo after the War, a law to protect the cattle was enforced.

The number of Hanwoo was on the increase reaching 1 313 000 in 1965 as a result of the stock farming improvement plan started in 1953.

Along with the remarkable economical progress in the 1970's, the beef consumption grew and commercial beef farms increased in number. Korea imported 10 600 foreign beef cattle in 1978 to fulfil the need. The beef consumption per capita marked 3.0Kg in 1979. In the late 1970's, the increased need for beef and decreased number of cattle brought about a huge importation. However during 1983-1985 beef consumption became dull, which resulted in a drastic drop in the price of beef.

The number of Hanwoo became 1 913 000 as of the end of June, 1992, and the national beef supply came down to 44%.

Table 1: *The annual trend of the Hanwoo raising in South Korea*

Year	'45	'50	'55	'60	'65	'70	'75	'80
Number in thousand	597	393	867	1,010	1,313	1,247	1,546	1,427
Households in thousand	-	-	774	893	1,15	1,102	1,277	997
Number per household			1.1	1.1	1.1	1.1	1.2	1.4
Year	'85	'86	'87	'88	'89	'90	'91	'92
Number in thousand	2,553	2,370	1,923	1,559	1,536	1,622	1,773	2,019
Households in thousand	1,048	991	854	702	654	620	601	585
Number per household	2.4	2.4	2.3	2.2	2.3	2.6	3.0	3.5

4.0 MEAT QUALITY

There has been limited research on Hanwoo meat quality. The industry has been dependent on over 75% of importation for concentrated feed.

The beef national supply rate was under 50%. This situation prevented the industry from working on meat quality, and the main concern was the feed efficiency.

It is, however, believed that the Hanwoo has the gene for high quality meat. As mentioned before, due to its late maturity, good meat can only be available after 18-24 months of age. With the GNP over US$ 5000 per capita, the public wanted high quality meat, and to be competitive internationally, thus having deep interests in high quality meat.

The carcass evaluation and grading system was introduced in July 1992, and is on the experimental stage.

According to the system, the yield grading is classified by 4 grades; A, B, C, and offgrade, and about 64% of the meat falls into grade B. The grading of meat quality, 1st, 2nd, 3rd, and offgrade, is made according to marbling, meat color, fat color, texture, degree of maturity etc. For

meat quality 53 % is 3rd, and 23% is 2nd, which resulted from early slaughter within 18 months. There is no doubt that the industry can improve the quality by means of good meat production.

It is well known that foreigners who visit Korea and Koreans alike prefer Hanwoo beef to imported beef. A constant improvement on raising methods will make Hanwoo beef competitive on the market. The largest supermarket in Japan, DAIEI, made an extensive research on Hanwoo and the results of the DAIEI research on Hanwoo are as follows:

1) Hanwoo had better marbling, more loin and tender loin than Waguyoo
2) Smaller decrease in weight between live body and carcass
3) Dressing percent was lower than Waguyoo but much higher than Holstein
4) The grade of C or better was 43.7 % which is higher than the Waguyoo's 37.8%
5) The lean meat percent was higher in Hanwoo than in Waguyoo.

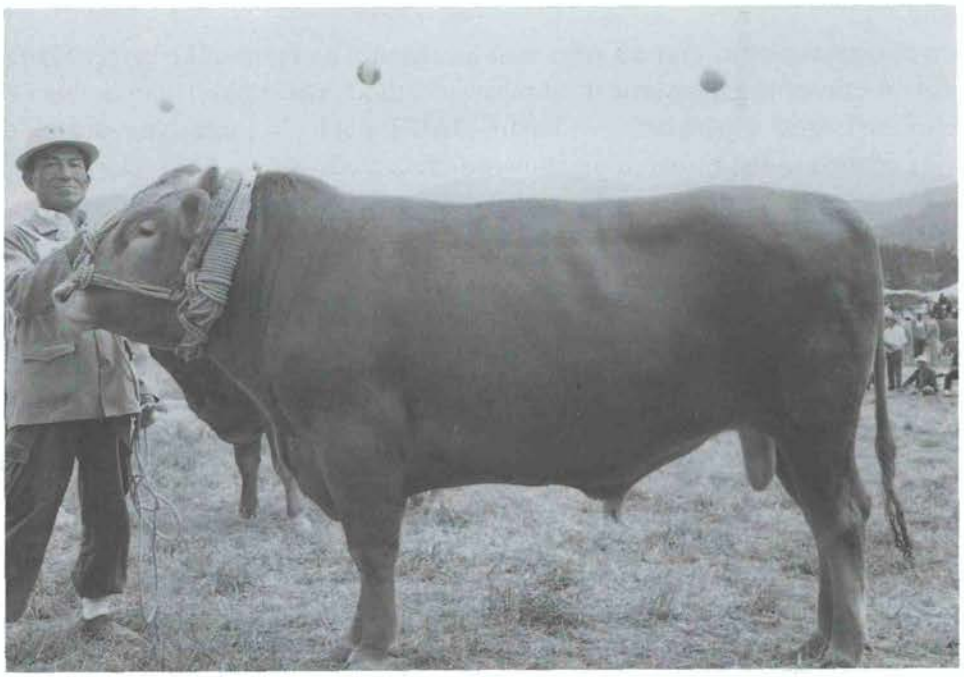
As negative points, the research listed thick fat, short body length and weak rump.

Table 2: *Carcass yields by breeds (unit : %)*

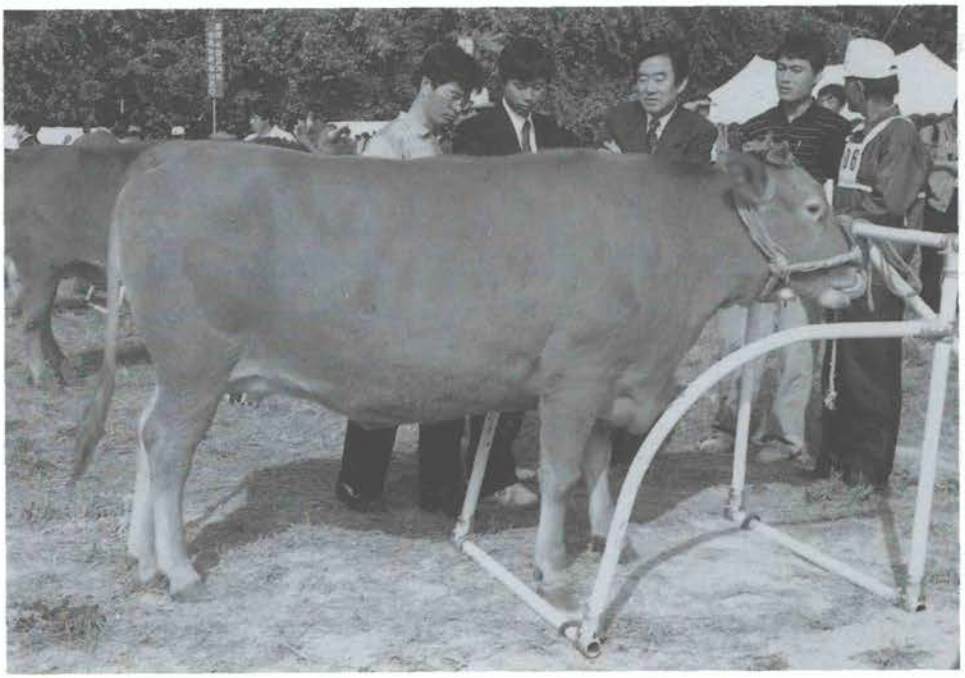
Breed	Live Body Weight or Yield				Carcass composition			
	Farm gate Weight (A)	Slaughterhouse Weight (B)	Carcass Yield		Lean meat (Boneless)	Fat	Bone	Others
			Based on A	Based on B				
Hanwoo	100	96.1	59.7	62.1	64.6	20.8	11.6	3.3
Waguyoo	100	95.3	59.9	63.0	63.6	22.4	10.0	2.8
Holstein	100	93.6	56.1	59.6	64.6	18.0	14.2	3.1

Table 3: *Meat weight by breeds (unit : %)*

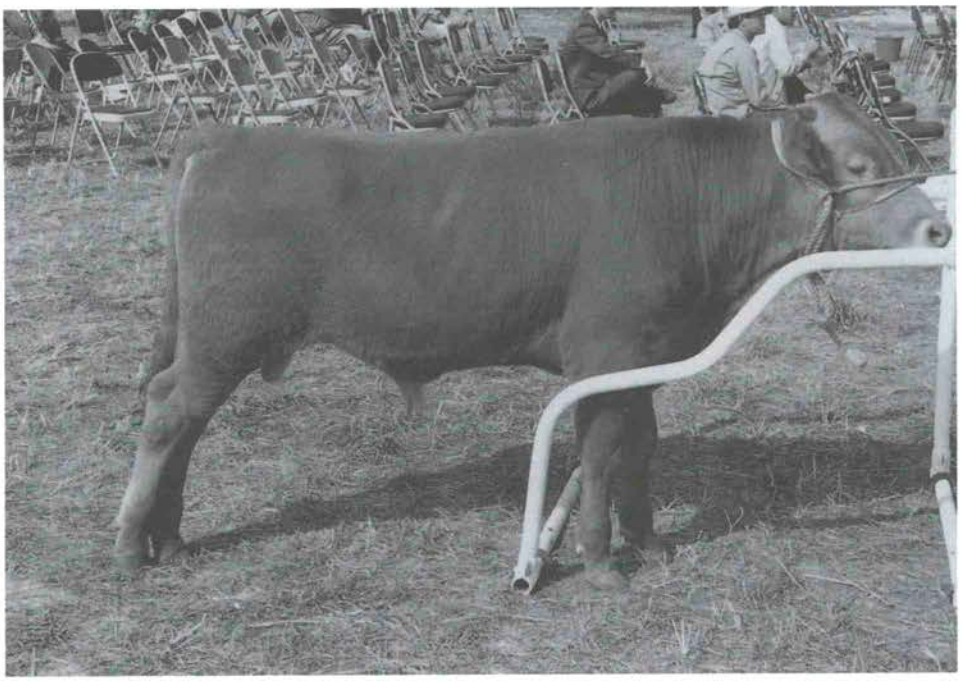
Breed	Chuck	Loin	Brisket	Rump	Tender Loin
Hanwoo	42.8	11.2	18.7	26.8	3.1
Waguyoo	38.2	11.1	19.9	28.3	2.5
Holstein	37.9	10.7	18.9	30.0	2.5



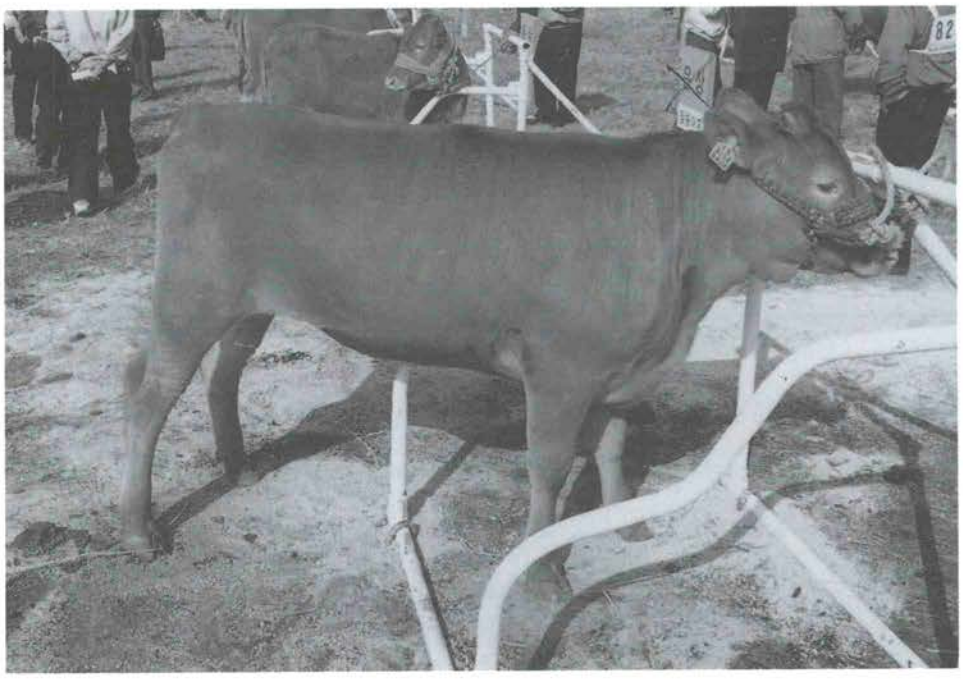
Hanwoo Bull (18 months)



Hanwoo Cow (3 years)



Hanwoo Calf (6 months male)



Hanwoo Calf (6 months female)

5.0 BREEDING PROGRAM AND OBJECTIVE

The Hanwoo beef is most liked by Korean people for its tenderness, flavor, taste etc. As beef cattle the productive performance of Hanwoo is relatively low compared to other breeds. Various efforts have been made to convert the Hanwoo from working cattle to beef cattle.

In the early 1970's, the improvement program for the Hanwoo was carried out on a relatively small scale, and it was not until mid - 1980 that the extensive breeding program for the improvement of the Hanwoo became systematically set up, utilizing testing, selection and planned mating. Of the many economic traits of Hanwoo, reproductive traits, growth rate and carcass traits are to be improved.

(1) Improvement on reproductive traits should bring about a high rate of pregnancy and early puberty, (2) improvement should be made for heavier weaning weight and rapid growth rate and (3) improvement on carcass traits should bring about higher dressing percent, higher lean meat percent, larger rib eye area, high marbling score and less backfat thickness.

Table 4: *Goal of the Hanwoo improvement*

	Weight by Age (Kg)				Average Daily Gain (Kg)	Carcass Yield (%)
	3 mo.	6 mo.	12 mo	18 mo		
Goal	110	200	380	550	1.0	62
Present	100	150	340	480	0.9	59

	Meat Yield (%)	Marbling Score (1- 5)	Rib eye Area (cm)	Backfat Thicknes s (cm)	Conception Rate	Calving Rate (%)
Goal	79	5.0	80	1.3	95	93
Present	75	2.5	77	0.9	82	80

6.0 PROGRAM FOR CONSERVATION AND IMPROVEMENT OF THE HANWOO

The program for the above subject can be summarized as below.

6.1 Selection of A. I. Bulls

Progeny testing for selection of Hanwoo bulls for artificial insemination was initiated in 1983, and the proven bulls selected by the progeny test have been placed at the Korean Native Cattle Improvement Center (KNCIC) of the National Livestock Cooperatives Federation for artificial insemination. Of a total of 100 Hanwoo bulls at KNCIC at present, 78 head are proven bulls selected by the progeny test.

The candidates for the progeny test at KNCIC were selected by the performance tests conducted at the National Institute of Animal Breeding and 8 provincial Animal Breeding Stations. To conduct the progeny test, the KNCIC purchased the Hanwoo bulls which showed excellent performance at the performance tests of the National Institute and 8 provincial stations.

Before the initiation of the progeny test program for the genetic improvement of Hanwoo, the Hanwoo bulls for breeding were selected on the basis of growth rate performance and the visual evaluation ratings at the National Sire Evaluation Fairs held each year.

6.2 The Registration of Hanwoo

The Korea Livestock Improvement Association is the main authority for the registration of Hanwoo breeding stock. They keep records on the pedigree, performance and visual evaluation scores of Hanwoo breeding stock, and provide the training on the Hanwoo improvement, if necessary.

6.3 Artificial Insemination

In 1962 the artificial insemination technology was brought in, and it has been actively used since 1968. In recent years, over 95% of cattle were born as a result of artificial insemination. KNCIC provides Hanwoo semen. In order to prevent any inbreeding depression possibly caused by artificial insemination, registration of bulls is a must. Various training programs on selection of bulls and mating systems have been available for livestock farmers and artificial insemination specialists. For cows which are not registered, they are providing suitable semen for various regions.

6.4. Work on Hanwoo Improvement Base

The work began in 1979 in order to convert Hanwoo from working cattle to beef cattle,and to keep Hanwoo's pure pedigree from unorderly crossing with imported beef cattle. The work started with 8 bases consisting of about 300 to 500 head respectively. Now it has 200 bases, and there are in all about 100 000 registered Hanwoo cows in the bases. Two to 6 year old females selected are registered and artificial insemination is made with pre-selected bulls.

The calves born by this method undergo another evaluation procedure, and the stock that have passed the test are eligible for another higher registration. By this way the fifth descendent of the first registered cattle has been born and improved as beef cattle. Calves from these bases are sold at a higher price than the other calves.

7.0 HANWOO SELECTION

The formation and the size of the testing herds is systematically related nationwide. Mating, testing, and selection made at each testing herd are explained in Table 6.

7.1 Mating of cattle for testing

7.1.1 *Cows which produce candidates for bull testing*

Cows which produce young bulls for performance and progeny tests are fed at the Hanwoo improvement bases, Animal Breeding Institute, and KNCIC. The cows are mated with the new proven bulls which enter the KNCIC stud every year.

7.1.2 *Cows used for progeny testing*

Cows which produce calf for progeny tests are fed at KNCIC and some Hanwoo improvement bases. Thirty to fifty cows are randomly mated with each candidate for proven bull in spring and fall each year.

7.2 Testing

7.2.1 *Performance test*

Male progenies produced by mating between proven bulls and cows which have high growth rate are selected and a performance test is conducted from 6 mo. to 12 mo. of age for average daily gain, weights at 180, 270 and 360 days, body measurements, feed efficiency, body conformation, quality of semen and physical health condition.

7.2.2 *Progeny test*

Progeny testing is performed for reproduction, growth rate and carcass traits to estimate genetic ability of proven bulls. Also, undesirable genetic traits are monitored for the pregnancy up to 22 mo. of age.

7.3 Selection of bull

7.3.1 *Candidates for proven bulls*

There are two ways to select the candidates for the proven bull. First, the records collected from the performance tests are analysed at the KNCIC twice a year, and the performance-tested bulls are ranked on the basis of the selection index including the body weight at 12 mo. of age, average daily gain and feed efficiency.

The highest ranking 30-32 bulls are then selected as the candidates for the progeny test among the performance-tested bulls which meet the requirements on visual evaluation scores (75 points or above) and semen examination. Second, the best 8 to 10 bulls are selected from the National Sire Evaluation Fair being held every year at each province.

7.3.2 *Proven bulls*

The data collected from the progenies of the tested bulls are statistically analysed to estimate the genetic parameters of the economically important traits after statistically adjusting for the differences in the environmental factors. Selection index value is calculated for each tested bull on the basis of the index which includes 6 month weight, 18 month weight, average daily gain, lean meat percent, rib eye area, backfat thickness and marbling score.

The twenty highest indexed bulls are then selected as the proven bulls among the progeny tested bulls which do not show any genetic defect in the offspring.

7.4 Performance test results

The average performances of the bulls selected as the candidates for the progeny test are shown in Table 5. The average 12 month body weight and average daily gain were somewhat higher after 1989.

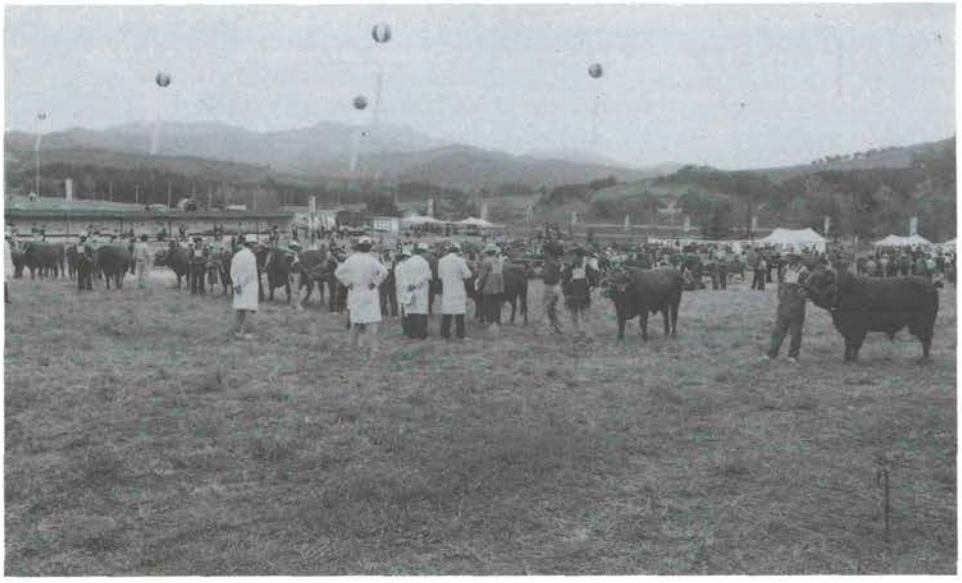
The average performances of the bulls selected as the proven bulls on the basis of the results of the progeny test were somewhat improved after the 9th test. However, due to the relatively low intensity of selection among the progeny tested bulls, it was not possible to obtain large selection differentials for the economically important traits in the progeny test phase.

Table 5: *Average performance of the bulls selected as the candidate for proven bull (unit: kg)*

Year	Weight at 12 mo.	Average Daily Gain
1983	357.6 ± 22.20	1.21 ± 0.10
1984	359.0 ± 23.94	1.11 ± 0.12
1985	355.7 ± 25.98	1.15 ± 0.09
1986	338.6 ± 32.15	1.13 ± 0.07
1987	362.9 ± 24.77	1.17 ± 0.08
1988	368.0 ± 25.76	1.15 ± 0.07
1989	401.3 ± 20.63	1.33 ± 0.05
1990	396.3 ± 34.25	1.31 ± 0.09
1991	392.2 ± 19.37	1.22 ± 0.09
1992	387.0 ± 24.80	1.37 ± 0.06

8.0 IMPROVEMENT TRENDS IN HANWOO

Distinct trends of improvement in Hanwoo can be found in the data obtained from the National Sire Evaluation Fair held each year as well as in the data from the nation-wide studies on Hanwoo based on the body weight measurements for 5,000 head of Hanwoo that have been conducted every three years since 1973, although this kind of data showing the improvement of Hanwoo are not numerous. Table 6 shows the improvement trends in the bodyweights of Hanwoo in the nationwide studies on Hanwoo.



Hanwoo Sire Evaluation Show

Table 6: *Improvement trends in the body weights of Hanwoo in the nationwide studies on Hanwoo*

	Year	Body Weight (kg)			
		3 mo.	6 mo.	12 mo.	18 mo.
Cow	1921 a	67.3	97.8	150.5	195.0
	1974	83.2	127.8	190.7	245.9
	1977	83.1	130.8	194.0	250.8
	1980	85.5	130.2	203.1	165.2
	1993	88.9	144.2	214.0	274.5
	1986	88.5	146.0	219.7	272.2
	1989	86.3	143.8	240.4	294.7
	1992	89.2	144.2	242.3	308.7
Bull	1921 a	83.1	104.6	173.1	211.5
	1974	87.9	133.1	214.2	289.6
	1977	88.4	138.0	218.8	305.7
	1980	92.0	147.1	244.1	331.4
	1983	94.9	157.4	259.7	361.5
	1986	97.5	166.2	283.1	376.8
	1989	103.7	183.8	339.0	419.2
	1992	103.6	178.9	366.1	477.2

a: The figures for 1921 are the data obtained at the Livestock Experiment Station.

LA RAZA RUBIA GALLEGA ECOTIPO DE MONTAÑA

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RESUMEN

La Rubia Gallega de montaña se localiza en el Norte de la provincia de Lugo. Presenta caracteres étnicos muy relacionados con el medio agreste en que se desenvuelve (menor formato, extremidades cortas, etc.)

Posee buenas aptitudes maternales y una especial predisposición para aprovechar recursos naturales en zonas difíciles que le han asegurado su permanencia en estas áreas, compitiendo con otras razas de mayor formato y mejores cualidades carniceras.

Palabras clave: Razas locales, bovinos, España

RÉSUMÉ

La Rubia Gallega de montagne est localisée dans le Nord de la province de Lugo. Elle possède des caractères ethniques en étroit rapport avec le milieu agreste où elle vit (taille plus petite, membres courts, etc.)

Elle a de bonnes aptitudes maternelles et une prédisposition spéciale pour utiliser les ressources naturelles des zones difficiles, ce qui a assuré sa permanence dans cette région, en concurrence avec d'autres races de plus grande taille et à meilleure qualité de viande.

Mots clés : Races locales, bovins, Espagne

1.0 INTRODUCCION

La Comunidad Autónoma gallega es una región en la que las sierras montañosas alternan con mesetas y amplios valles, presentando una variabilidad de clima y suelos muy acorde con estas distintas condiciones geográficas.

Todas estas particularidades han dado origen a la existencia de diferencias morfológicas entre los animales autóctonos de la raza Rubia Gallega que habitan en estos terrenos, apreciándose que en los individuos de la montaña aparecen caracteres étnicos manifiestamente diferentes a los descritos para esta raza en la Reglamentación Específica del Libro Genealógico (1976).

El Ecotipo de Montaña de la Rubia Gallega (R.G.m.) es por tanto una agrupación local que está formada por animales rústicos y montaraces; muy similares a aquellos que Faelli en 1932 y Agenjo en 1946, encuadran dentro de la variedad de montaña de esta agrupación racial y para los que no han cuajado los planes de mejora que se han estado realizando durante los últimos años en la R.G. Mejora, que ha estado orientada fundamentalmente hacia la producción de carne (Sánchez 1978), aun a costa de perder en cierta medida la rusticidad que poseían estos animales.

2.0 LOCALIZACION

El mayor número de efectivos de la raza R.G.m. se localiza en las sierras montañosas del Norte de la provincia de Lugo (Sierra de la Carba, Sierra del Xistral y Sierra de Lorenzana), con altitudes que superan los 550 metros.

El clima es templado, con lluvias constantes desde Octubre a Marzo, que pueden convertirse en nieve en el mes más frío (Enero); a medida que transcurre la primavera y se inicia el verano estas precipitaciones van disminuyendo para dar paso a nieblas y lloviznas que mitigan la sequía estival.

Los suelos son poco profundos, la vegetación herbácea de praderas naturales alterna con especies arbustivas (tojos y brezales principalmente) y con un estrato arbóreo en el que predominan pinos, castaños y robles.

3.0 CARACTERISTICAS ETNICAS

3.1. Caracteres generales

Se trata de una raza de aptitud cárnica, subeumétrica, de proporciones reducidas respecto a las actualmente estipuladas en la Rubia Gallega y con cierta predisposición hacia formas brevilíneas. Se incluye en un perfil recto o ligeramente subconvexo, presentando un desarrollo corporal equilibrado y esqueleto fino perfectamente adaptado al medio en que se desenvuelve.

3.2. Caracteres regionales

Cabeza: De tamaño proporcional al desarrollo general, más bien pequeña y alargada en las hembras. Protuberancia frontal provista de pelos largos a modo de tupé. Los ojos sobresalen poco de sus órbitas y están rodeados por un halo claro que los dota de una mirada tranquila y afable, pero mostrándose muy vivaces en situaciones de alerta. Los pabellones auriculares son pequeños, móviles y generalmente con pelos largos en su interior.

Cuello y tronco: Presentan el cuello corto, con reducida papada y más musculado en los machos. El tórax es profundo y arqueado, seguido de la región de los lomos, amplia y bien proporcionada. La línea dorso-lumbar manifiesta una ligera elevación desde la cruz hasta la grupa, adoptando esta última una disposición horizontal o ligeramente inclinada. La cola es larga, de abundante borlón terminal e inserción casi siempre alta (en cayado).

Extremidades: Perfectamente adaptadas a la montaña, cortas y robustas, como es propio de los animales andariegos. Destaca su esqueleto fino con articulaciones netas y bien desarrolladas, sobre ellos se disponen muslos y espaldas musculados, de líneas suaves, aunque con tendencia a formas más redondeadas en los machos.

Sistema mamario: Dado el gran interés que conlleva el desarrollo del ternero en sus primeras etapas de la vida, los ganaderos eligen como nodrizas aquellas hembras con buena conformación de la mama, de este modo no es difícil encontrar vacas de ubres globosas, bien implantadas, de piel fina y elástica que permite destacar al exterior su red venosa. Los pezones son de tamaño medio y están regularmente dispuestos.

3.3. Faneróptica

Cuernos: Son largos y delgados, de sección entre circular y elíptica, que aparecen dirigidos hacia fuera y arriba, tomando en las hembras adultas finalmente una orientación caudal. También es posible que en este sexo adopten una disposición horizontal a modo de tirabuzón de longitud considerable. Su colocación varía entre el blanco-amarillento y el gris pizarroso, aunque pueden aparecer conjuntamente ambas tonalidades, reservándose la primera para la base y el pitón.

Piel y pelo: Responden al modo de vida de estos animales, prestándoles protección frente a las inclemencias del clima, el pelo es fuerte y denso, implantado sobre piel gruesa y poco elástica.

Capa: Su coloración predominante es la rubia, mostrando una gama de tonos que van desde el claro (marelo) hasta el oscuro (bermello), con degradaciones de color en las axilas, bragadas, cara interior de los muslos y nalgas. Sin embargo, dado el alto grado de cruzamiento interracial sufrido a lo largo del tiempo, no es raro encontrar animales bragados, carinevados, carinegros, coliblancos, etc.

Mucosas: De párpados, labios, vulva y àno de color rosáceo más o menos claro y con tendencia, en este último caso, al amarillento.

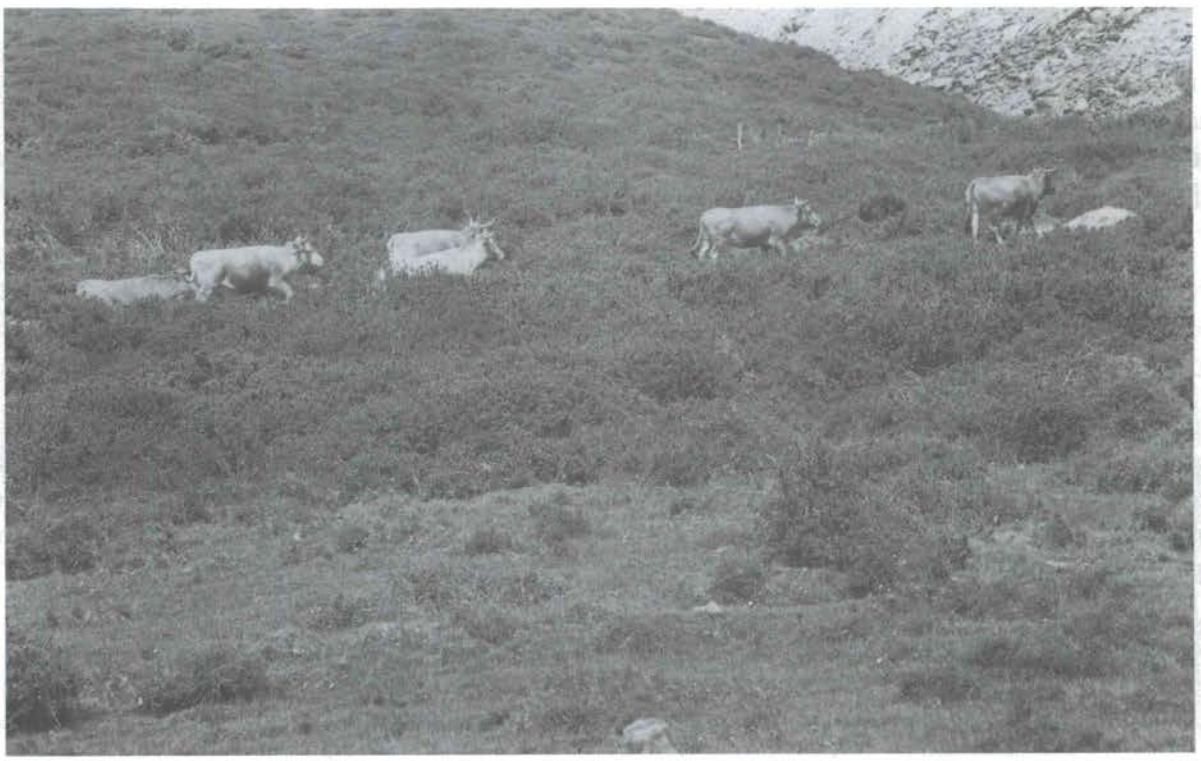
Pezuñas: Al igual que las mucosas presentan tonalidades acordes a las de su capa, oscilando entre el blanco-rosáceo y el castaño.

4.0 MANEJO ACTUAL

4.1. Sistema de explotación

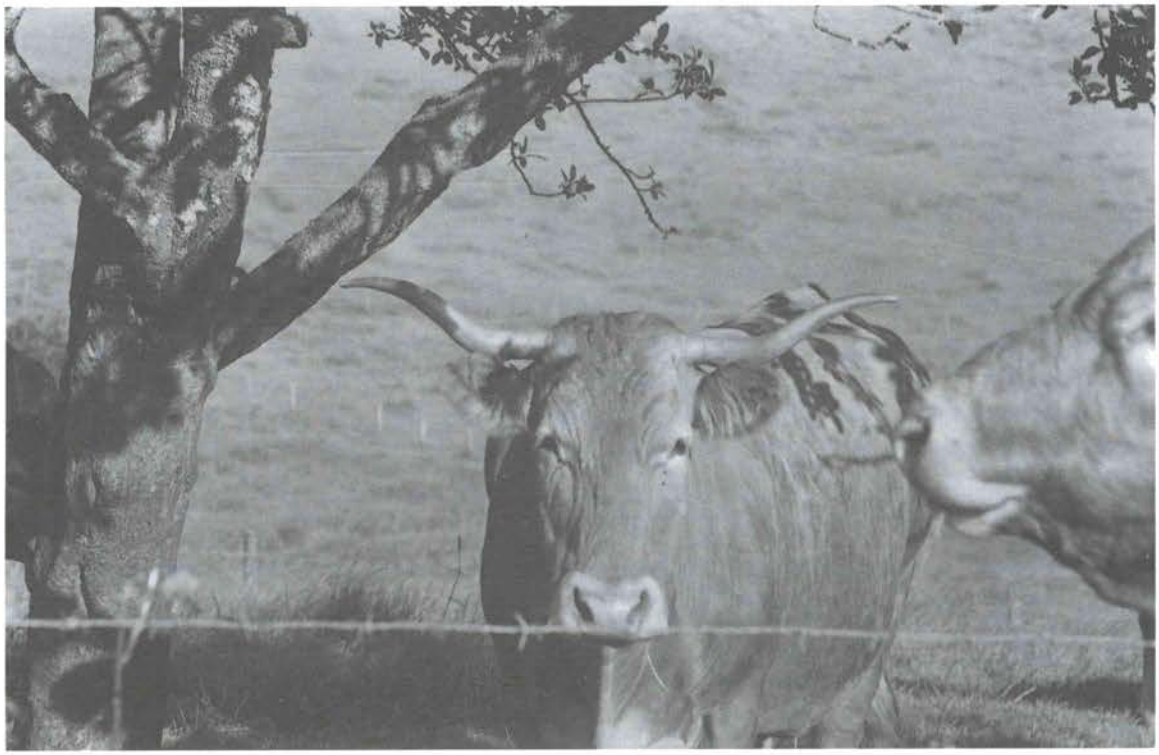
En los últimos años se están utilizando simultáneamente dos tipos de explotación en la R.G.m.:

- El sistema tradicional, en el cual los animales son explotados en régimen extensivo, utilizando los pastos de montes comunales donde viven continuamente a la intemperie.



Animales de raza Rubia Gallega, ecotipo de montaña

Toro de raza Rubia Gallega de montaña



Cabeza de la vaca Rubia Gallega

Hembra de raza Rubia Gallega, ecotipo de montaña

- Una tendencia reciente a seguir un sistema de pastoreo rotacional utilizando fincas de propiedad particular, en las cuales los animales disponen de refugios para resguardarse de las inclemencias climáticas y en donde reciben una alimentación complementaria cuando el pasto escasea.

4.2. Alimentación

Se basa principalmente en el consumo de hierba en pastoreo y, en aquellas explotaciones más innovadoras, esta dieta es reforzada con heno y ensilado cuando disminuye la producción herbácea (finales de otoño e invierno), y que proceden de los excedentes forrajeros almacenados al final de la primavera.

4.3. Reproducción

Los machos y las hembras se localizan en los mismos pastos, se utiliza la monta libre a lo largo de todo el año como sistema de cubrición, observándose una tendencia natural a concentrarse el mayor número de reproductoras cubiertas en los meses de Mayo-Junio, con lo que el parto relativamente agrupado tiene lugar en Febrero-Marzo.

Las hembras de la raza R.G.m. son altamente prolíficas, con una gran facilidad de partos y su longevidad supera fácilmente los 15 años, llegando incluso hasta los 20 años sin acusar mermas importantes en su función reproductora.

4.4. Sistema productivo

Está orientado hacia la producción de carne en base a la cría de terneros con lactancia natural directa y pastos. El destete se realiza a los 8 ó 9 meses, momento en que se destinan al matadero, reservándose un número reducido de animales que se destinan a la renovación de efectivos.

5.0 PERSPECTIVAS DE FUTURO

La entrada en vigor de las cuotas lácteas tras la integración de España en la U.E., así como la prestación de ayudas por parte de la Administración para el abandono de la producción de leche y las primas a vacas nodrizas, están llevando a que los sistemas de explotación de vacuno se orienten cada vez más hacia la producción de carne.

La R.G.m. posee la adaptación y cualidades necesarias para producir fácil y regularmente terneros en estas zonas montañosas, constituyendo dos de los elementos más importantes que pueden hacerla partícipe de estos cambios en la orientación de las explotaciones gallegas.

6.0 CONCLUSION

La raza R.G.m., ecotipo de montaña, es una agrupación autóctona formada por animales rústicos y productivos, que tienen una natural predisposición para aprovechar los recursos naturales de zonas montañosas y agrestes; recursos que, dificilmente utilizarían otros animales con mayor formato y menos adaptados, sin repercutir sobre su rendimiento productivo.

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POPULATION CHARACTERISTICS OF WATER BUFFALOES IN GREEK WETLANDS[1]

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SUMMARY

The present study was carried out with the aim of proposing the preservation of buffaloes not only as productive livestock, but also as a part of the diversity of the Greek wetlands. The total buffalo total population in Greece was in the late 40's over 100 000 animals. At present, only a few hundred animals are found in four Ramsar wetland sites in Macedonia and Thrace. This small population is threatened with immediate extinction because of the rapidly changing rural socio-economic conditions and the expansion of cultivated fields in the old marshlands. Furthermore, consumers are rapidly losing contact with buffaloes and their products.

Key words: Genetic Resources, Buffalo, Greece

RÉSUMÉ

Cette étude a pour but de proposer la préservation des buffles, non seulement comme des animaux d'élevage, mais aussi, comme une partie de la diversité des zones humides. La population totale des buffles en Grèce vers 1950 était de plus de 100.000 animaux. Actuellement, seulement quelques centaines d'animaux existent dans quatres Ramsar, zones humides de la Macédoine et de la Thrace. Cette petite population est menacée d'extinction a cause du changement rapide des conditions socio-économiques et de l' expansion des terres cultivées dans les vieux marais. En outre, les consommateurs perdent rapidement le contact avec les buffles et leurs produits.

Mots clés : Ressources génétiques, buffles, Grèce

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1.0 INTRODUCTION

In Greece, the water buffalo, though it is not mentioned as an indigenous farm animal in antiquity, constitutes valuable genetic material worthy of being conserved. Few decades ago, this magnificent ruminant formed an integral part of the biodiversity of many Greek wetland ecosystems, enriching the landscape, and providing valuable services and products to the rural people and to the economy in general.

Until the beginning of the 20th century, buffaloes were spread all over the country. The most important part of their population, which numbered about 100 000 animals, was kept in the swampy areas of Thrace, Macedonia and Thessaly (Dimitriadis, 1957; Zervas, 1975; FAO - The water buffalo, 1977). According to the Statistical Service of the Ministry of Agriculture of Greece, 70 000-75 000 animals were kept in these regions at the end of the 50's. Because of the rapidly changing socio-economic conditions and the introduction of important dairy cow populations, the number of buffaloes was reduced dramatically at the beginning of the 60's and at the end of the decade only 20 000 animals were left. By the end of the 70's only 1 000 animals remained and, as a result of this process, only few hundred head have been counted in some wetlands of northern Greece recently (Diagram 1). This small population is now threatened with immediate extinction because of the evolution of agriculture, the expansion of cultivated fields into the old marshlands, and the lack of an appropriate conservation programme (FAO, 1990).

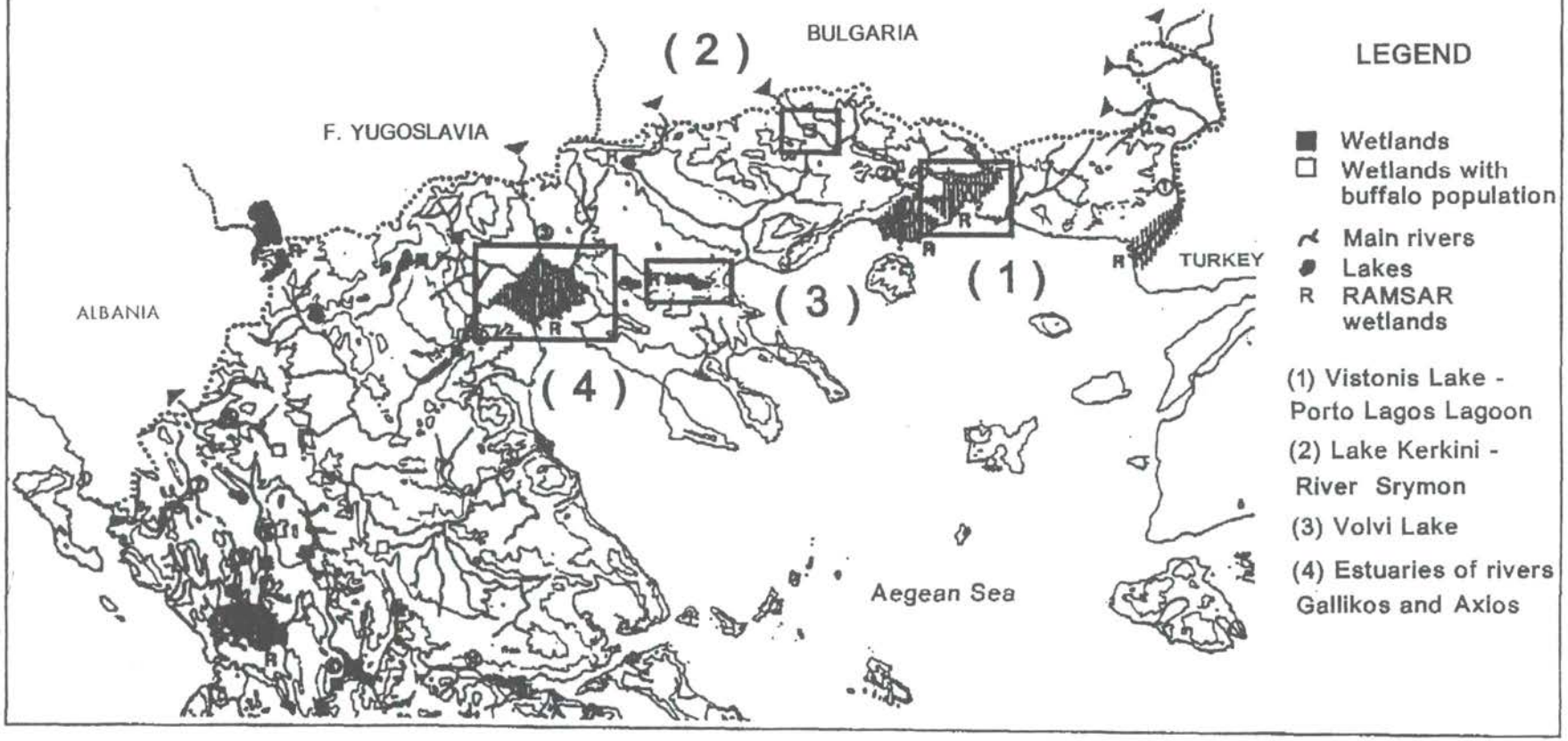
Greek specialists in the fields of animal breeding and ecology have pointed out in relevant studies (Gerakis, 1990 a,b; Georgoudis, 1993) the unfavourable survival perspectives of this small buffalo population, still existing in certain wetlands of northern Greece. The main characteristics of this species, namely their ability of utilising roughage of variable nutritional value, their minimum need for treatments, their high disease resistance, the easy management practices needed, and, finally, the possibility for the production of traditional quality products (yoghurt, cheese, butter etc.), are promising factors to render buffalo breeding a valuable branch of the livestock sector, which can also contribute to the maintenance of the wetland environments (NAS, 1981).

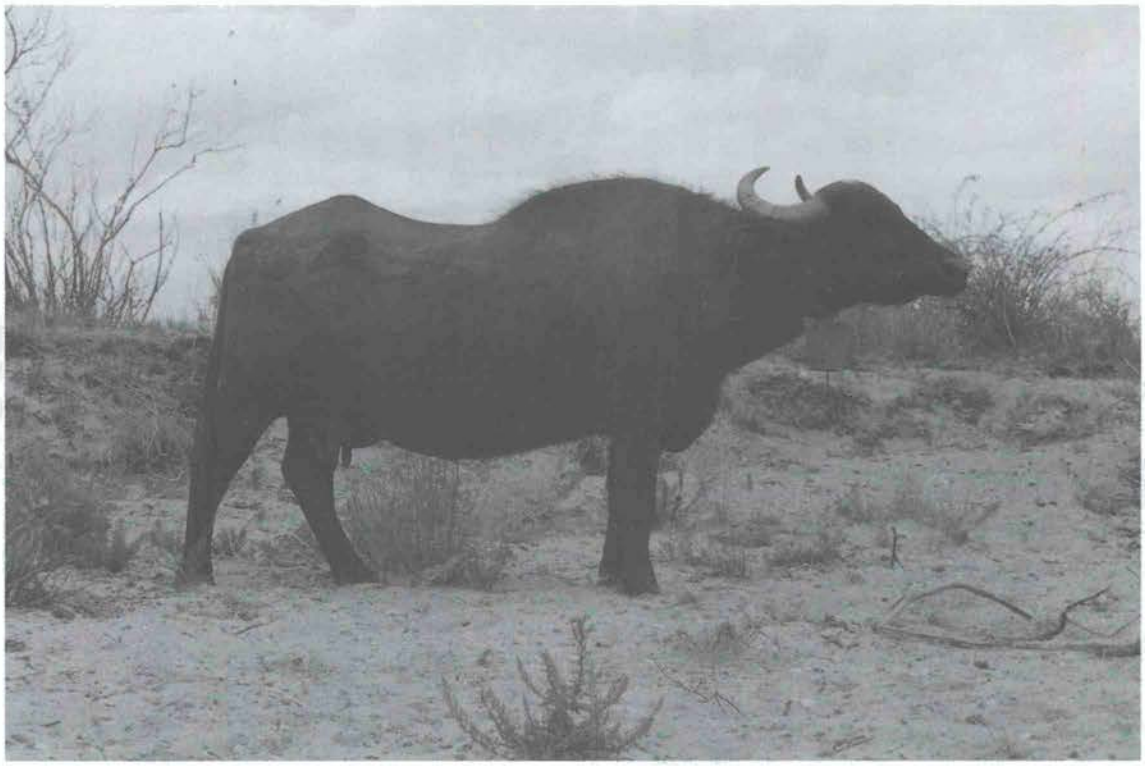
2.0 POPULATION AND HUSBANDRY

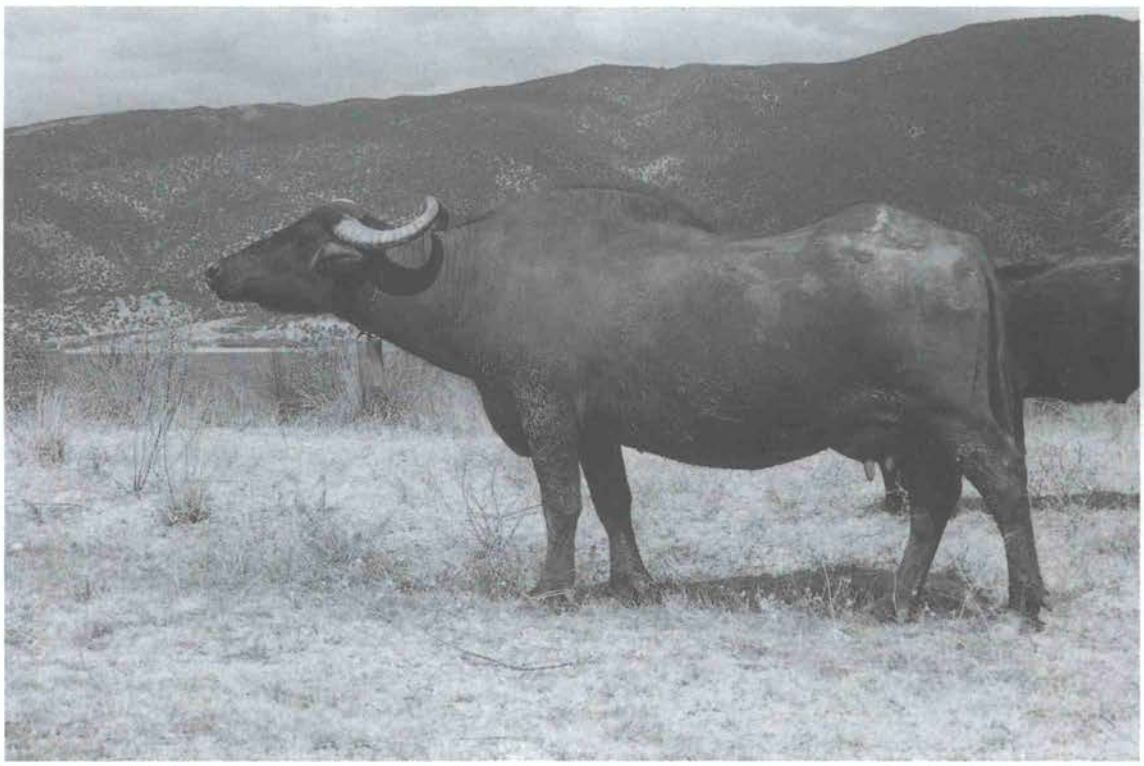
There are, worldwide, two main types of buffaloes - the Swamp buffalo and the River buffalo. The Mediterranean buffalo belongs to the Murrah group of breeds of the River type, but because of its isolation for many years, it has developed some unique characteristics. Mediterranean buffaloes, to which the Greek buffaloes belong, are stocky, well built animals that combine both beef and dairy characteristics (Mason, 1984; Shafie et al., 1993).

Information for this study was collected through a specific questionnaire developed according to relevant international standards, as established by FAO in collaboration with the European Association for Animal Production and the period taken into consideration was 1989-1991 (Nardone and Villa, 1993). According to our investigations, the Greek buffalo population numbered a total of about 600 animals in 1992. This population is found only in four wetland sites in Macedonia and Thrace, namely in the Vistonis Lake - Porto Lagos Lagoon (Photo 1), in Lake Kerkini - River Strymon (Photo 2), in Volvi Lake (Photo 3), and in the estuaries of the Gallikos and Axios rivers near Thessaloniki. It must be noted that these wetlands are Ramsar Sites (Map 1).

MAP 1. GREEK WETLANDS WITH BUFFALO POPULATIONS (1992/1993)

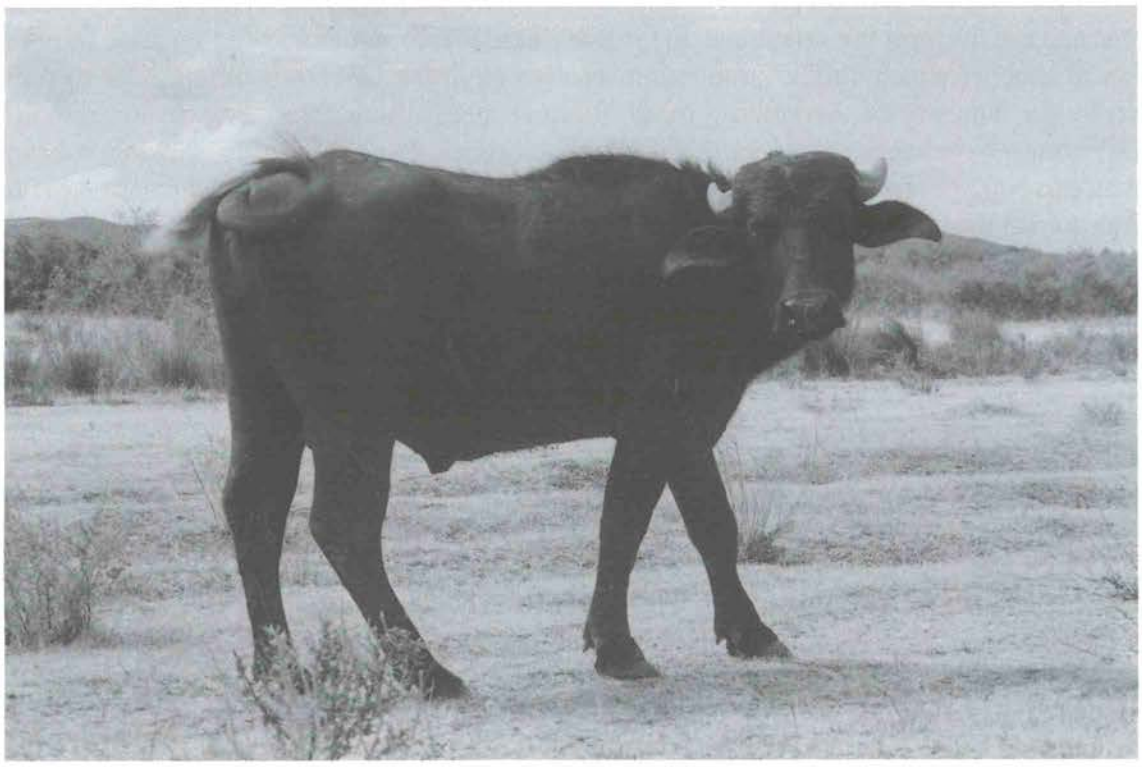






Buffalo Cows

Calf



Young Bull

During the present survey, 593 animals, owned by 11 farmers, were counted, from which 310 were adults (35 bulls and 275 cows); the remaining 283 were young animals, among which the number of replacement females was greater than that of males. It is not meaningful to calculate the average herd size, as it presents a great variation because of the owners' interests and possibilities. In the county of Thessaloniki, the total population (242 head) belongs to four production units; 80% of the animals are found in two of the four farms. In the county of Serres, the total population (332 head) is concentrated in four units, two of which comprise 90% of the animals. The three remaining production units are in Thrace; they raise 1-15 buffalo cows each. In the last case, buffaloes are kept together with the cattle, sharing the same pasturelands and the same sheds.

According to the criteria for the status of a breed (number of female breeding animals between 100 and 1000, FAO, 1992; number of reproducing animals in a stable population equal to or less than 5000, EEC, 1992), the risk status of the remaining buffalo population in Greece, should be considered as endangered to critical. Taking into account the effective number of animals, ($Ne = \frac{4NmNf}{Nm+Nf} = \frac{4*474*119}{593} = 380$) (Wright, 1977), (Diagram 1), the population is above the effective size considered by the Deutsche Gesellschaft für Züchtungskunde as the threshold for the endangered status (N_e=50, DGfZ, 1991). Nevertheless, the above proposals share the notion that the status of endangerment of a breed should be based not only on the absolute number of breeding animals, but also on additional criteria, such as the change in their numbers during the recent years and the number of existing breeding herds. According to our investigation, the decreasing rate of the buffalo population in Greece cannot be more alarming; furthermore, the fact that more than 80% of the population belongs to only four farmers, shows it approaching the final critical status.

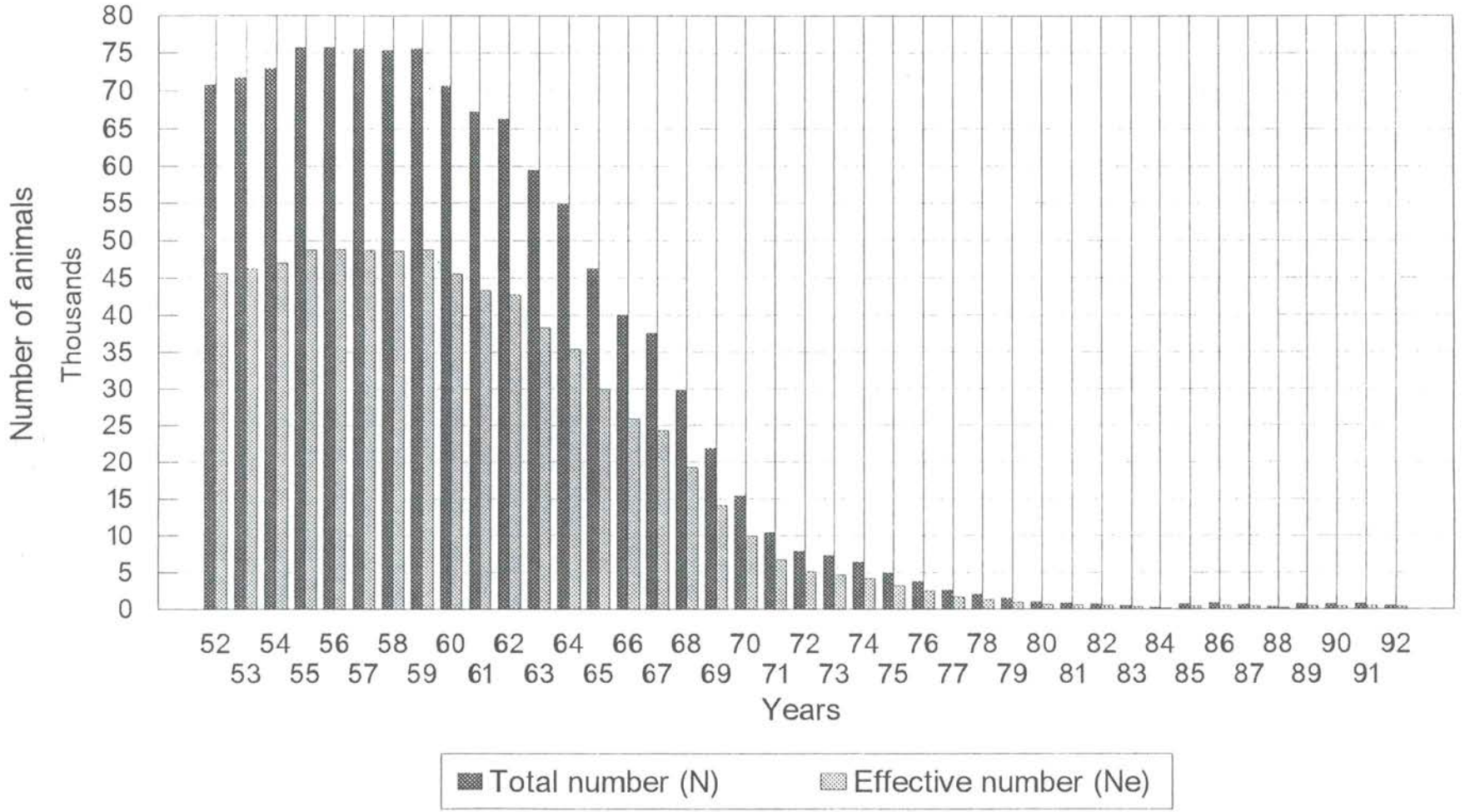
Buffaloes are kept on private family farms, where their breeding is not the only source of income and not the most important one. In Greece, there are no buffaloes bred on state farms. The technical support which buffalo production receives from the Government is similar to the one given by the Ministry of Agriculture to all livestock populations. No research programmes of special interest have been initiated for this production branch. In the last years, the only substantial reference to buffaloes has been in connection with surveys regarding the ecosystems and plants as well as animal production around the wetlands of northern Greece.

Milk, but also meat, are important in the area of Thessaloniki, while in the areas of Serres and Thrace buffaloes are not milked at all; nowhere are they used for draft purposes. Their breeding areas are fluvial wetlands. Buffaloes are stabled at night and graze during the day. While grazing, they are usually tended by the children of the family. Feeding is based on grazing, forage, by-products, hay and concentrates.

3.0 BREED CHARACTERISTICS

The Greek buffaloes are the last representatives of the Mediterranean sub-type of the River buffalo in the regions of Macedonia and Thrace. Their skin colour varies from brown to black and their coat colour from dark grey to black. The horns, nostrils and hooves are black. Most of the animals have white patches on the forehead, legs and tail, while no albino animals were observed (Photos 4, 5 and 6).

DIAGRAM 1. EVOLUTION OF THE BUFFALO POPULATION IN GREECE



ORIGINAL SOURCE: Greek Ministry if Agriculture, Dept. of Statistics

Biometrical parameters ranged as follows: males, wither height from 125 to 145 cm and live weight from 400 to 750 kg; females, from 120 to 140 cm and from 350 to 650 kg (Table 1).

Table 1: *Morphological characteristics of buffaloes*

Factors	Males	Females
Birth weight (kg)	20-40	20-40
Live weight of adults (kg)	400-750	350-600
Wither height of adults (kg)	125-145	120-140
Age at which the buffalo reaches the adult weight (years)	5-6	5-6

Demographic parameters are shown in Table 2. According to this table age at first calving ranges from 36 to 48 months, yearly birth rate from 65 to 85%, and culling age of buffalo cows from 7.5 to 12 years. Reproduction is carried out through natural service. The average age of bulls at the beginning of productive life is about 18 months and at the end about 96 months. Calvings are not normally distributed during the year, but are mainly concentrated in late spring, summer and early autumn.

Table 2: *Reproduction parameters of buffalo cows*

Age at first calving (months)	36-48
Average number of calvings during productive life	9
Number of calves born to every 100 buffalo cows per year	75
Percentage of calves dead before weaning	10%
Percentage of calves dead after weaning	3%
Average age of buffalo cows at the end of their productive life (months)	144
Yearly replacement rate of buffalo cows	10-20%
Duration of pregnancy (days)	310-320
Calving interval (days)	450

Average milked yield of an unimproved buffalo cow ranges from 700 to 1000 kg and lactation length is estimated to be between 180-240 days. There are no data available on milk composition, but this is supposed to be the same as that found in the literature (fat: 7.45%; protein:

4.36%; lactose: 4.83%; total solids: 17.96% - NAS, 1981). Buffalo cows are milked by hand twice a day. In the farms where buffalo cows are not milked, the total amount of milk produced is consumed by calves, which are weaned at the age of 7-8 months with an estimated live weight of 95-110 kg. In farms where milking is applied, calves consume 350-400 kg of milk and they are weaned at the age of 2-3 months, when they reach a live weight of about 75 kg. The slaughtering age of the calves varies considerably, according to the farmer's individual needs, but the most common age is between 15-17 months and a slaughter live weight of 350-450 kg. No systematic production of specific milk products exists and only occasionally the milk is utilised for the production of cream, butter and yoghurt. Buffalo's milk, when sold, receives a price 50-75% higher than that of cow's. On the other hand, buffalo calves are sold at prices lower by 10-15% than those of cattle.

4.0 ENVIRONMENTAL EFFECTS ON THE GREEK WETLANDS

Buffaloes affect the wetlands in various ways, among which their grazing and wallowing habits are the most commonly reported. The impact of grazing depends greatly on its intensity, as overgrazing causes damages, especially in the riparian zones that are usually grazed heavily. Nevertheless, grazing could be considered as a useful tool for the maintenance of early plant successional stages and their associated animal communities, but needs careful management (Gordon et al., 1989).

In Greece, until the last decade, grazing has not disturbed the balance of the ecosystems of wetlands, as most of them evolved in the presence of farm animals, buffaloes included. However, this coexistence and balance of the ecosystems has already been broken because of the expansion of cultivated fields in the old marshlands, a process resulting in the reduction of the available pasturelands, and finally, in the overgrazing of the remaining wetlands.

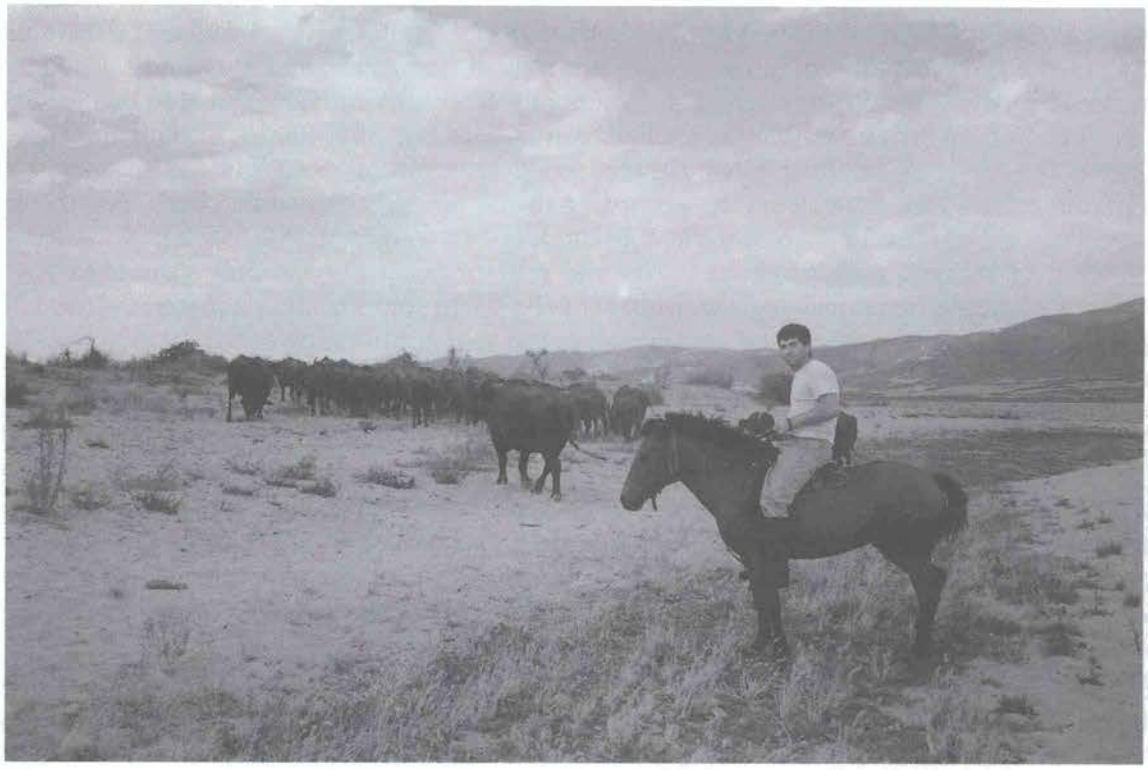
In this context, farm animals are considered as a damaging factor, but their total expulsion from the wetlands does not keep pace with the trend for a sustainable agriculture. It is expected that the supporting of buffalo breeders will result in keeping these animals in their natural environment, and, in the same time, will prevent the reclamation of the riparian pastures (Papanastasis, 1990).

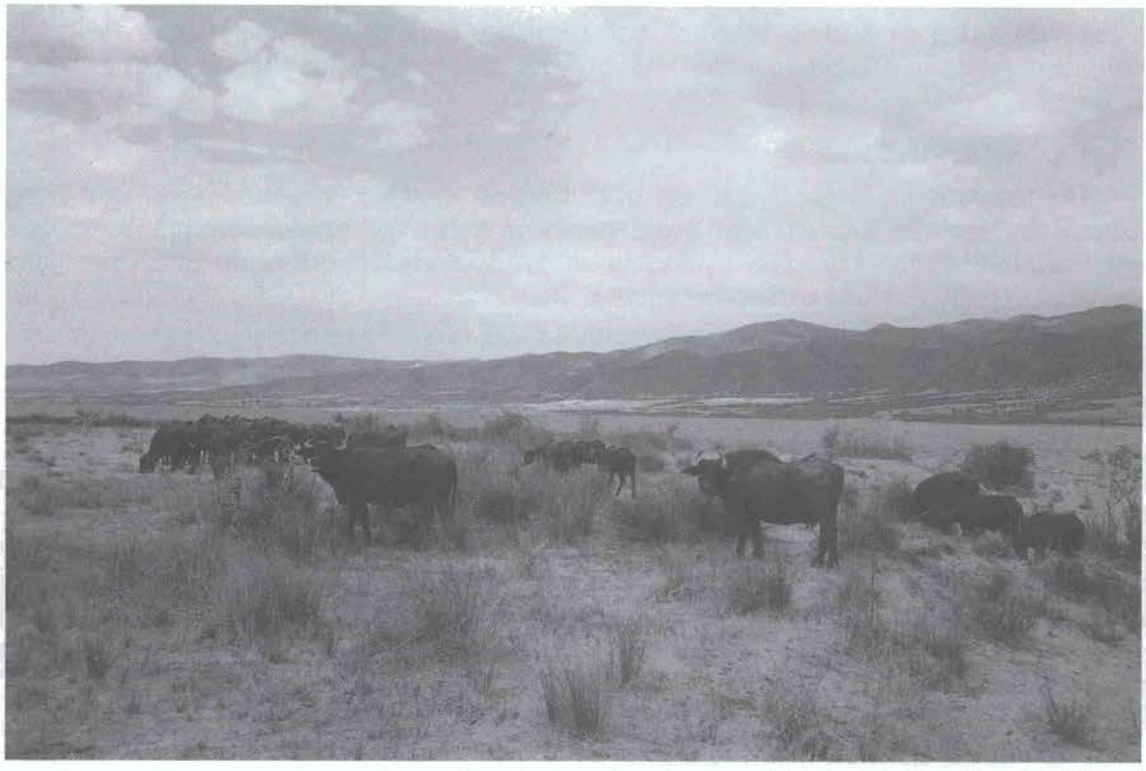
5.0 CONCLUSIONS

Buffalo farming in Greece is not organised on a stable economic basis, and it is not supported by specific Government programmes in terms of production practices, genetic improvement, nutrition etc. The marketing of products is opportunistic and their value is appreciated only by few and older consumers.

To avoid the extinction of this indigenous animal, it would be advisable to combine at first the preservation and then the expansion of buffalo breeding with the conservation and protection of the wetlands, where these animals traditionally lived.

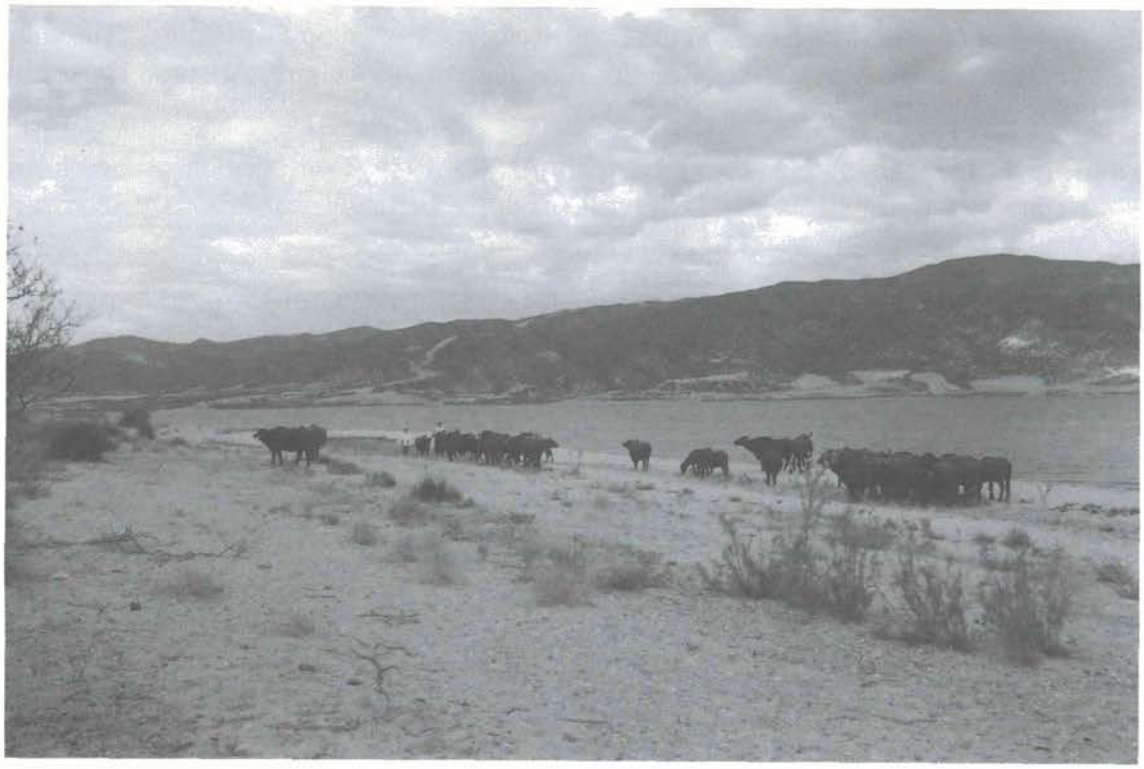
The initiation of a project is recommended to study the future of the water buffalo in the Greek wetlands. The exact potential of Greek wetlands to support again viable populations of this species must be evaluated. One has to explore various options and subsidise, if necessary, its presence in certain wetland ecosystems, e.g., as a tool for managing natural vegetation, and also as a touristic attraction. Finally, an interdisciplinary team (representing farm animal sciences, range management, wildlife management and limnology), must investigate the functional relationships of this species with the other wetland biotypes, e.g., feeding habits of the water buffalo and its position in the food web, and the positive or negative interactions with the key wildlife species of the wetlands.





Grazing buffaloes at Volvi Lake

Kerkini Lake - Porto Lagos



Cattle and buffaloes grazing at Vistonis Lake

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GENETIC EROSION ON CAMELIDAE

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RESUMEN

El autor describe la situación actual de los camélidos en América del Sur, aportando información sobre la geografía, distribución y número de las tres especies existentes: llama, alpaca y vicuña. Vienen presentados igualmente datos estadísticos importantes sobre las razas y sus sistemas de producción. Algunas indicaciones también sobre la escasa, pero cierta, erosión genética como consecuencia de las transformaciones ambientales y de gestión, así como del cambio registrado en la demanda de productos.

Palabras clave: Recurso genético, *camelidae*, America del Sur

SUMMARY

The author describes the actual situation of the South American *Camelidae* with information on the geographic distribution and numbers of the three existing species, namely the llama, the alpaca and the guanaco. Data on vital statistics and products and on the existing breeds and production systems complete the picture. The available indication on the scarse but certainly occurring genetic erosion are described as a consequence of environmental and management changes but also changing demand in the products.

Key words: Genetic Resources, *Camelidae*, South America

1.0 INTRODUCTION

The family *Camelidae*, which originated in North America during the Eocene 40-45 million years ago, comprises two distinct groups of animals. One group, usually referred to as Old-World Camelids, includes two living species: *Camelus bactrianus* (two-humped camel) and *C. dromedarius* (one-humped camel). Both are primarily domesticated animals although some wild ancestors of the Bactrian camel exist in the Gobi Desert. The second group, referred to as New-World camelids, includes two genera: Lama with three species: *L. glama* (llama), *L. pacos* (alpaca) and *L. guanicoe* (guanaco), and the genus *Vicugna* with only one species, *V. vicugna* (vicuna). The llama and the alpaca are domestic animals whereas the vicuna and the guanaco exist only in the wild state. All six species of *Camelidae* have similar karyotypes (2n=74) in spite of the fact that their separation and subsequent migration into two different continents occurred about three million years ago. Crosses between members of the genus *Camelus* as well as between Lama have been reported and the resulting hybrids are fertile. Particularly common in the South American highlands are the crosses between llama and alpaca and between male alpaca and female vicuna. Domestication of llama and alpaca occurred in the Peruvian Andes about 6 000 to 7 000 years ago. It is generally thought that the llama originated from the guanaco whereas the alpaca has often been described as descending from the vicuna, from the guanaco or a llama-vicuna hybrid (Hemmer, 1990).

2.0 NEW-WORLD CAMELIDS (NWC)

The numbers of the four species of NWC in South America are shown in Table 1. Peru and Bolivia possess more than 90% of llamas and alpacas whereas most of the guanacos are located in the southern tip of the continent, in Argentina. Other countries such as the USA, New Zealand and Australia also possess increasing numbers of llamas and alpacas.

The present distribution of NWC extends from about 8 degrees South (Calipuy guanaco reserve in Peru) to about 55 degrees south in the Navarino Island, Chile at altitudes varying from sea level to more than 5,000 m above sea level. Guanaco has the widest distribution among the four species.

The domestic species, llama and alpaca, play a very important role in the economy of a large population of the Andean region of Peru and Bolivia and, to a lesser extent, Chile and Argentina. They are the only means of utilizing the extensive highland resources since neither crops nor sheep or cattle can be raised profitably due to limitations imposed by the high altitude. Even though most of alpacas and llamas are at present raised at altitudes varying from 3 000 up to 5 000 m above sea level, there is historical evidence that during the Incas empire they were more widely distributed among the coastal regions and the highlands. With the arrival of the European conquerors and the introduction of sheep and cattle, camelids were confined to marginal areas where the newly introduced species were unable to survive; their rational breeding was also totally neglected. The main products derived from them are wool (usually called fibre), meat, pelts, hide and dung which is used as fertilizer and fuel. Alpacas are raised mostly for fibre production (commercially called Alpaca); however the contribution of meat to total income may be close to 50%. Llamas produce a coarser fibre but because of their larger size they are a very important source of meat. They are also used as pack animals.

Alpaca Suri (Peru)

Table 1. *Estimated numbers of NWC in South America (000)*

	Alpaca	Llama	Vicuna	Guanaco
Peru	2 687	1 070	60	1,6
Bolivia	324	2 023	12	--
Chili	47	58	30	25
Argentina	1	135	23	578,7
Ecuador	0,2	10	0,4	--
Total	3 059,2	3 296	125,4	605,3

There are two well defined breeds of alpacas: Suri and Huacaya. They differ in the type of fibre they produce. Suri fleece is similar to that of Lincoln sheep whereas Huacaya fleece resembles that of Corriedale sheep. The Suri breed exists only in Peru and its number is declining. From an estimated 22% of the total population about three decades ago it has decreased to only 5%.

Two breeds of llama are also recognized: Kara and Chaku. Kara is characterized by a shorter fibre and a stronger body conformation than Chaku that makes them more suited as pack animals. Chaku is a more woolly type, somewhat intermediate between llama and alpaca. This

appearance gave rise to the question whether Chaku is a true breed or just a llama-alpaca crossbred. On average, llama populations are composed of 80% Kara and 20% Chaku.

Coat color in both llamas and alpacas vary from white to black and different shades of brown; combinations of white with black or brown patches also occur frequently. The predominant color in alpacas is white, especially in large commercial farms, because of the higher demand and better prices paid by the industry for this kind of fibre. The exact mechanism of transmission of fibre color in both alpacas and llamas is unknown.

More than 80% of alpacas and llamas belong to small farms and are usually kept in association with sheep and cattle in extensive systems where the natural pastures are the only feed source. The relative numbers of this species vary according to the altitude; the higher the location the fewer the presence of cattle and sheep. Most of the grazing lands are communal properties while animals are individually owned. This situation usually gives rise to overgrazing since each individual tends to keep as many animals as possible regardless of the carrying capacity of the grasslands. The management of the animals in the small farms is in general very poor which results in low reproductive rates, high mortality, especially of new-borns, and low fibre and meat production. Some large farms, some of which belong to cooperatives, have improved management systems thereby obtaining higher production levels.

Some biological and production parameters of llamas and alpacas are shown in Table 2. The values are the best estimates based on different reports; they may vary with the altitude at which farms are located and the level of management.

Table 2. *Some production parameters in alpacas and llamas*

	Alpaca	Llama
Gestation length (d)	342-345	348
Birth weight (kg)	7,0	11,9
Adult weight (kg)	60	90-110
Fleece weight (kg)	1,8*	1,0*
Diameter of fibre (μ)	23-24	24-30
Age at first parturition (mo)	36	36
Parturition rate (%)	47-50	55-60
Mortality rate (%)**	27-50	<20

* in 12 months
** up to 6 months of age

3.0 INDICATORS OF GENETIC CHANGE (EROSION)

Even though documented information on genetic erosion in *Camelidae* is almost non-existent, there is some evidence indicating that many factors related to management, environment and commercial preferences are causing changes in the genetic diversity of camelids particularly in the domestic species, llama and alpaca. Such factors include:

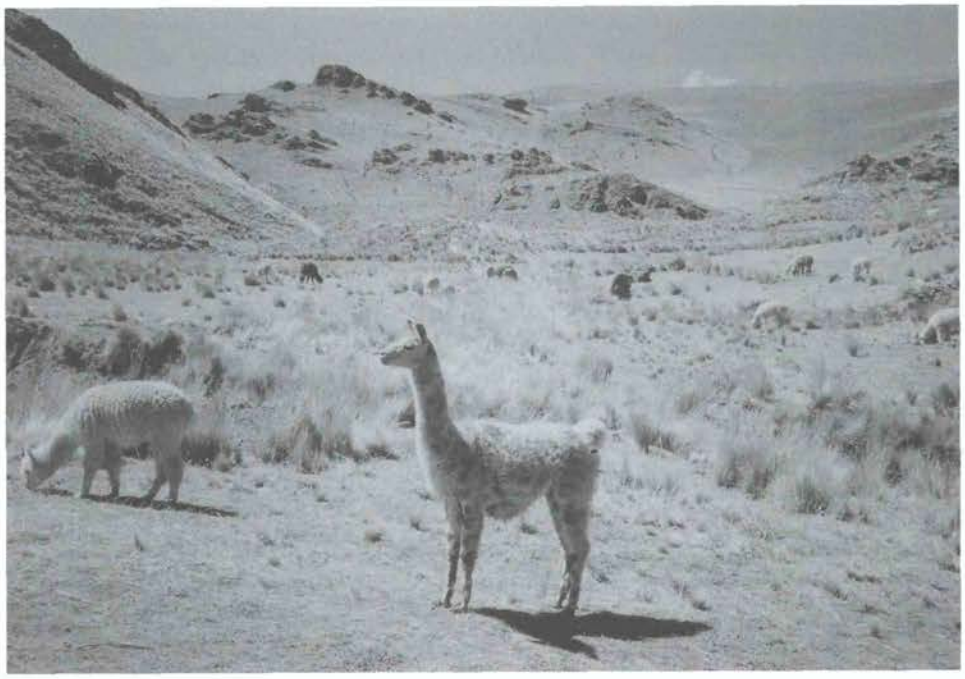
3.1 Hybridization

The introduction to the Incas Empire of new domestic species with the Spanish conquerors in 1532 brought about a drastic change in the management of llamas and alpacas. They were confined to the most marginal lands, the controlled breeding practices of the Incas were disrupted and the numbers of llamas and alpacas were reduced possibly by up to 90%. The ensuing uncontrolled hybridization probably altered the genetic make-up of the surviving populations. Therefore the present populations of llamas and alpacas may not necessarily be the same as those that existed during the times of the Incas Empire. In fact, the recent discovery of 900 - 1000-year-old naturally mummified llamas and alpacas in Southern Peru exhibiting a uniformity of fibre fineness and colour absent in contemporary animals suggests that they either represent presently unknown varieties or are simply pure, unhybridized animals (Wheeler et al., 1992). It is likely that the changes in environment and management conditions imposed on domestic camelids as a consequence of the introduction of other exotic species may have caused the disappearance of some genetic groups unable to withstand the highlands environment to which they were confined.

On the other hand, recent data on molecular evolution in Camelids (Stanley et al., 1994) seems to provide genetic evidence that hybridization has occurred in the history of the NWC thus supporting observations made by llama and alpaca breeders based on phenotypic characters alone. Hybridization also occurs to a great extent in present day farming conditions when llamas and alpacas are run together as happens quite often in small farms. An extreme case of hybridization appears to occur in Argentina (Frank, 1991) where actually no clear differentiation between llamas and alpacas is possible since all animals are kept together in single herds, mating occurring at random.

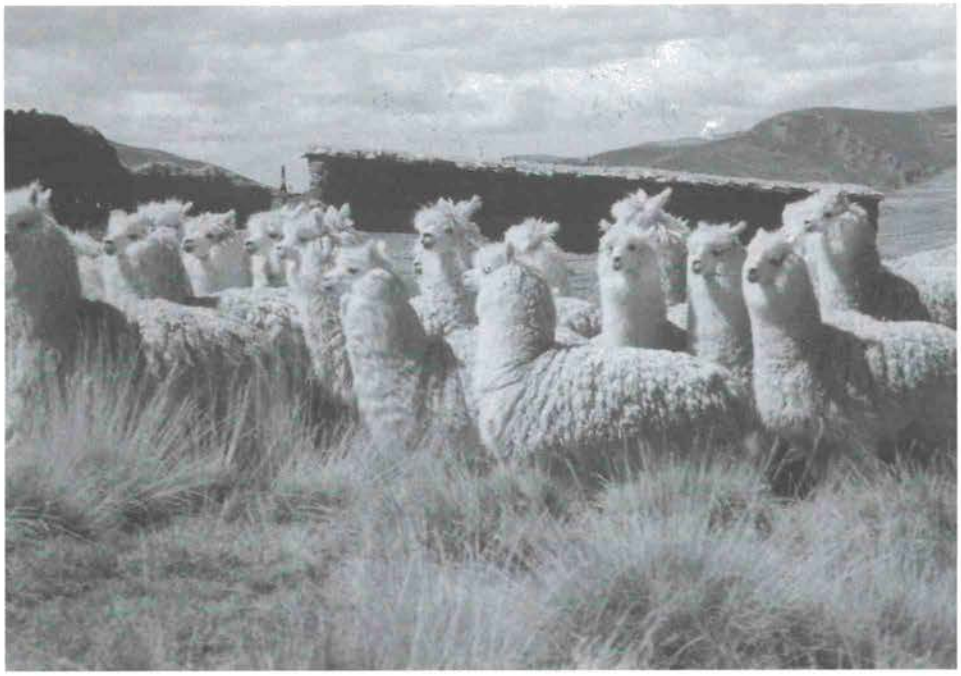
3.2 Decline of the populations of Suri alpacas

As mentioned earlier, populations of alpacas of the Suri breed show a declining tendency. In the last thirty years or so, the proportion of Suri alpacas in Peru declined from about 22% to less than 5% of the total population of alpacas. Furthermore, in a recent survey (Sumar, 1991) no alpacas of the Suri breed were found either in Bolivia or in Chile. No information is available of past populations of the Suri in these two countries. The specific causes of such a dramatic decline of the Suri populations are not known since no systematic studies are available. However, according to breeders' observations, it seems that Suri alpacas are more susceptible to the effects of high altitudes. When kept at altitudes higher than 4 200 m above sea level they show decreased reproductive efficiency and high new- born mortality rates as compared to Huacaya. Whether this is a consequence of their peculiar phenotype (long shaggy hair that hangs on the sides of the animal leaving the upper body parts uncovered) or some other genetic factors, is not known. On the other hand, since death rates of new-born alpacas are usually high (sometimes more than 50%) the sale of pelts for the handicraft industry constitutes an important source of income. Suri pelts are not as desirable as the Huacaya ones for that purpose; therefore, they are sold at lower prices. These factors are likely to influence breeders' preference for Huacaya in detriment of Suri. If this tendency persists it may lead to the total loss of this valuable genetic group and with it the loss of some unique traits not found in Huacaya such as fibre length.



Llama Kaba (Peru)

Llamas Chaqu and Kara (Peru)



Alpaca Hurcaya (Peru)

Vicuñas (Peru)

3.3 Color preferences

The higher commercial demand for white alpaca fibre has resulted in the adoption of selection criteria based exclusively on color without regard to other important traits. As a consequence the proportion of the white population has increased considerably in detriment of other solid coat colors such as black and brown. This is especially true in Peru where white alpacas constitute about 56% of the total population as compared to 24% of brown and 4% black. In contrast, alpaca populations in Chile and Bolivia are reported to be composed of 13% white, 41-52% brown and 14% black. This is explained by the fact that selection intensity for white color in the two latter countries is low since commercial alpaca production is of much less magnitude than in Peru.

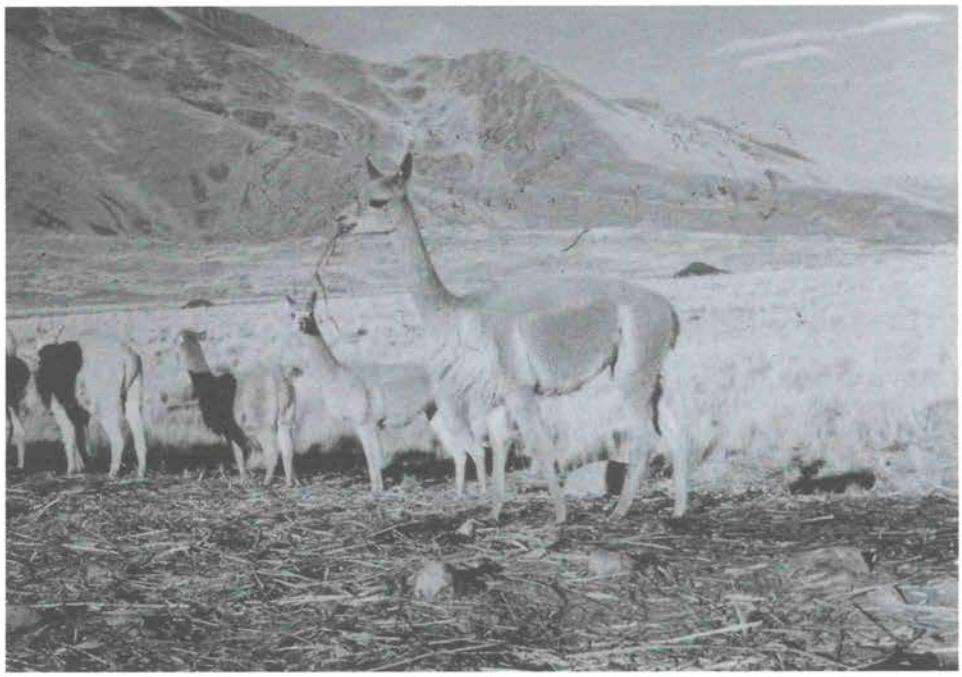
Studies on the effects that selection based on a single trait (white coat color) may have on other traits of economic importance such as body weight, fleece yield, fibre length and fineness, are unfortunately lacking. However it seems obvious that this breeding practice may in the long run cause serious loss of alpaca genetic diversity.

3.4 Effects of management practices

Some management practices are likely to bring about genetic changes in both alpacas and llamas in addition to the extensive hybridization already mentioned. For instance in some commercial alpaca farms an increasing incidence of genetic abnormalities has been observed as a possible consequence of high inbreeding coefficients resulting from the use of small groups of males for several generations; the life-span of alpacas may be as long as 15 to 20 years. Artificial selection for traits other than color of fibre is hardly practised; therefore culling of animals with undesirable characteristics such as genetic abnormalities is not the usual practice. In addition, because of low reproductive rates (an average of about 50%) and high mortality of the newborns, which may reach 40-50% in some years, the number of available replacements is generally low which discourages any extensive cullings. This situation may be aggravated by the common practice of keeping a high proportion of castrated males for fibre production in detriment of breeding females which constitute only about 40% of the total alpacas in a farm. The situation is likely to be similar in llamas where selection for traits of economic importance is hardly practised or non-existent.

4.0 GENERAL COMMENTS

Even though documented information on genetic erosion in domestic South American camelids is very scarce, there are some clear indications that such genetic erosion is occurring as a consequence of several factors such as changes in the environment where they are raised, breeders' preferences, management practices, and preferential demand of products by the industry. These changes, should they persist, may affect seriously the genetic diversity of both llamas and alpacas in the long run. There is an urgent need to determine more precisely the extent to which these factors and others are contributing to genetic erosion on Camelids in order to take the required steps to preserve genetic diversity, on more solid grounds.



Alpaca x Vicuña (Peru)

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THE GERMAN COACH HORSE "SAXONY WARMBLOOD"

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SUMMARY

The author gives information on the phenotypic and genetic characteristics, the history and the present state of the endangered breed German Coach Horse

Key words: Genetic Resources, Horse, Germany

RÉSUMÉ

L'auteur donne des informations sur les caractéristiques phénotypiques et génétiques, l'historique et l'état actuel de la race dénomée cheval de trait allemand, race en voie d'extinction.

Paroles clés : Ressources génétiques, cheval, Allemagne

1.0 HISTORY

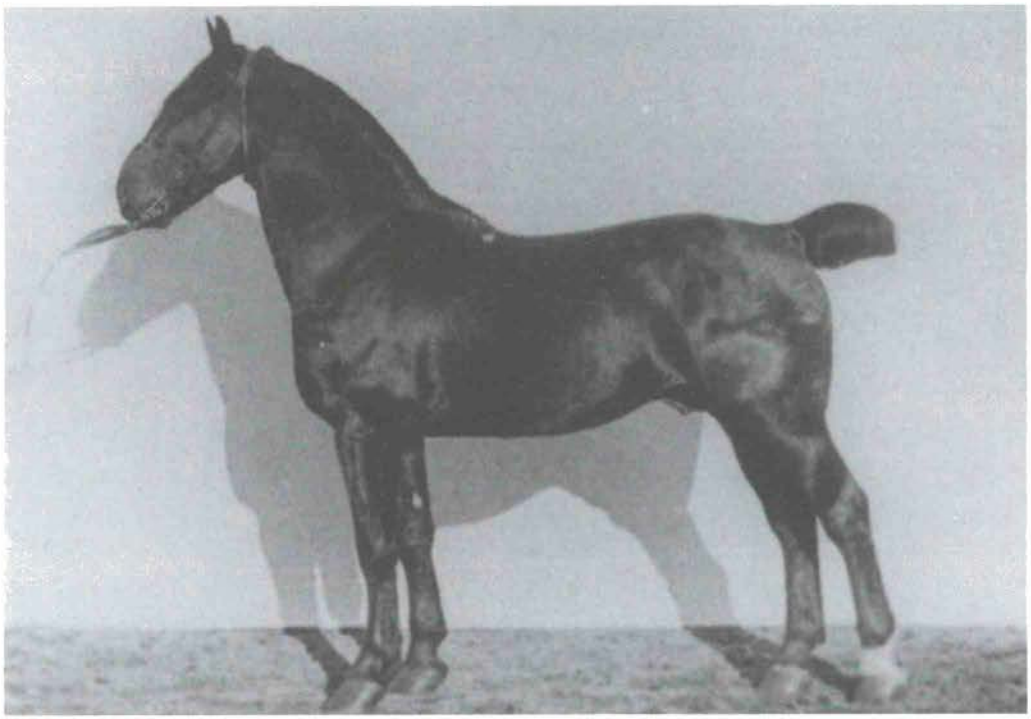
The German Coach Horse, which is also called Schweres Warmblut, Old-Oldenburger, Heavy Warmblood or Saxony Warmblood, developed in the last century and filled the requirement for a horse between the heavy draught horse used in agriculture on heavy soils and the light riding horse used by cavalry individually. The region of origin was the area of Oldenburg/Ostfriesland in the north of Germany, a region with old traditions in animal breeding. The first register was established in 1861. The German Coach Horse had great importance in agriculture on small farms, in transport and in artillery movement. As a result of the reduction of the importance of horses in agriculture and army after the second world war the stock of this breed decreased rapidly. There was a marked increase in demand for a light horse suitable for riding sport. Therefore the heavy mares were mated with Thoroughbred stallions to produce a sport horse. At the end of the sixties the number of heavy stallions decreased and in the years 1975 and 1976 no breeding took place. It is a curiosity that in the region of Saxony and Thuringia 12 heavy stallions of the National Stallion centre in Moritzburg (Saxony) were not castrated and worked as coach horses. They became the basis of the reactivation of the breed "Saxony Warmblood". Now in Saxony and Thuringia there exists a small population of about 600 mares and 20 stallions. Related breeds exist in Oldenburg/Ostfriesland, Denmark, Poland (Slansk), the Netherlands (Groninger), Bavaria (Rottaler) and Baden-Württemberg (Altwürttemberger).

2.0 CHARACTERISTIC OF THE BREED

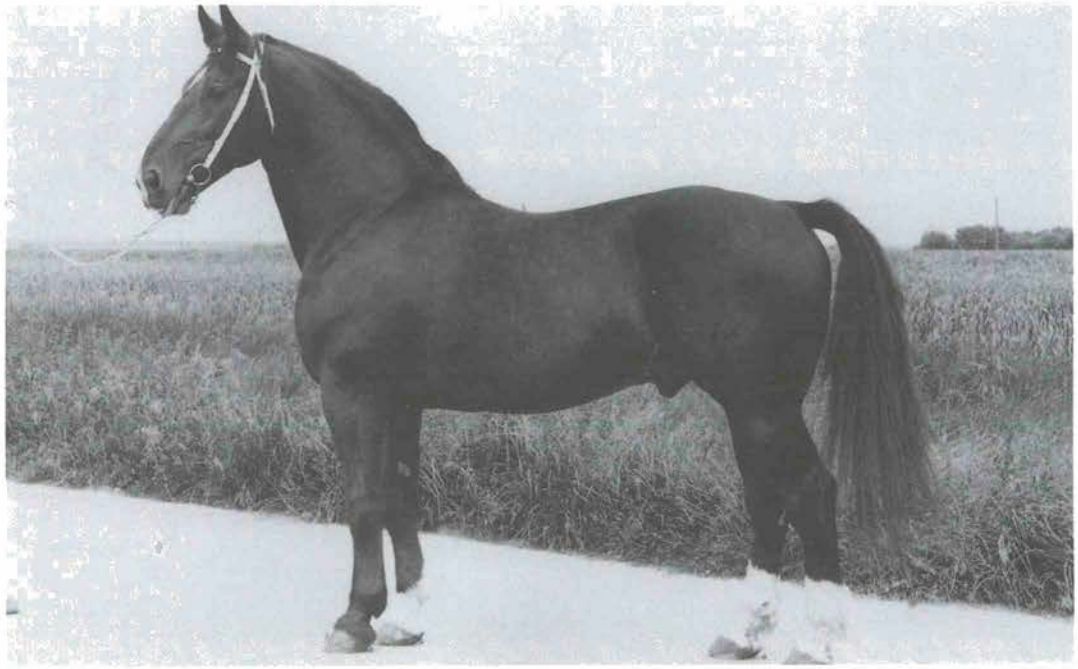
The Saxony Warmblood is a very typical elegant german coach horse. Its body is broad and deep, the neck and the croup are muscular. The two pictures show a representative from the historical and the existing population. Very typical compared with other breeds is the swinging trot with a high action. This breed is precocious, sociable and has a quiet temperament. About 90% of the population are brown or black horses (Table 1). The important data of body measures are shown in table 2.

Table 1: *Distribution of coat color in the population of mares of Saxony Warmblood (Wiesner 1989)*

Color	absolute (n)	relative (%)
Brown	298	58
Black	173	34
Chestnut	30	6
White	8	2
total	509	100



Stallion "Augustus" born 1898



Stallion "Lord II" born 1984

Table 2: *Measurements of Saxony Warmblood (cm)*

height of withers	158 ... 165
length of body	163 ... 170
girth	196 ... 203
cannon	22 ... 24
live weight	600 ... 700

Figure 1: *Development of the stock of mares in Saxony and Thuringia.*

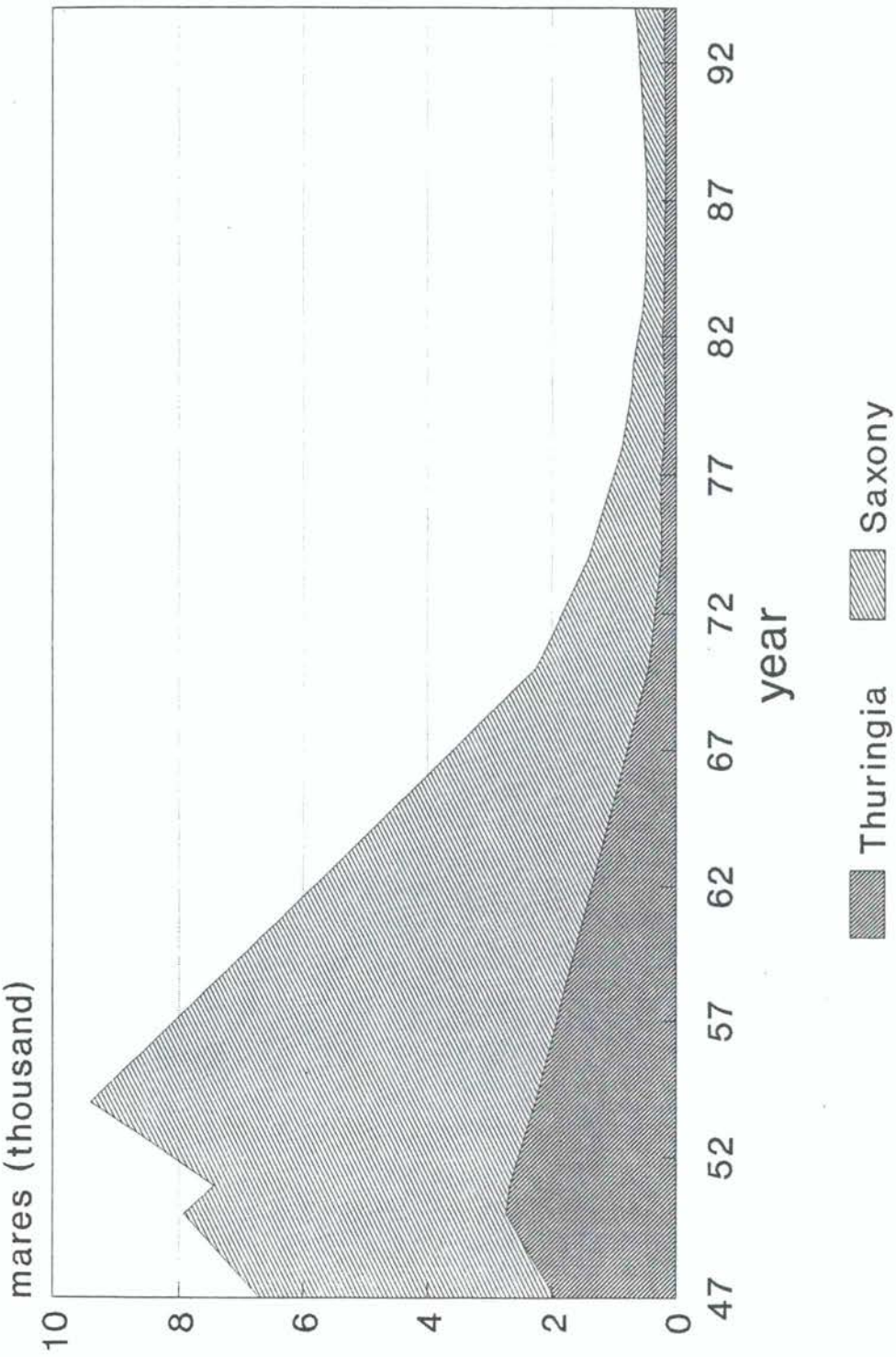


Figure 2: *Average age of stallions used since reactivation of the breed.*

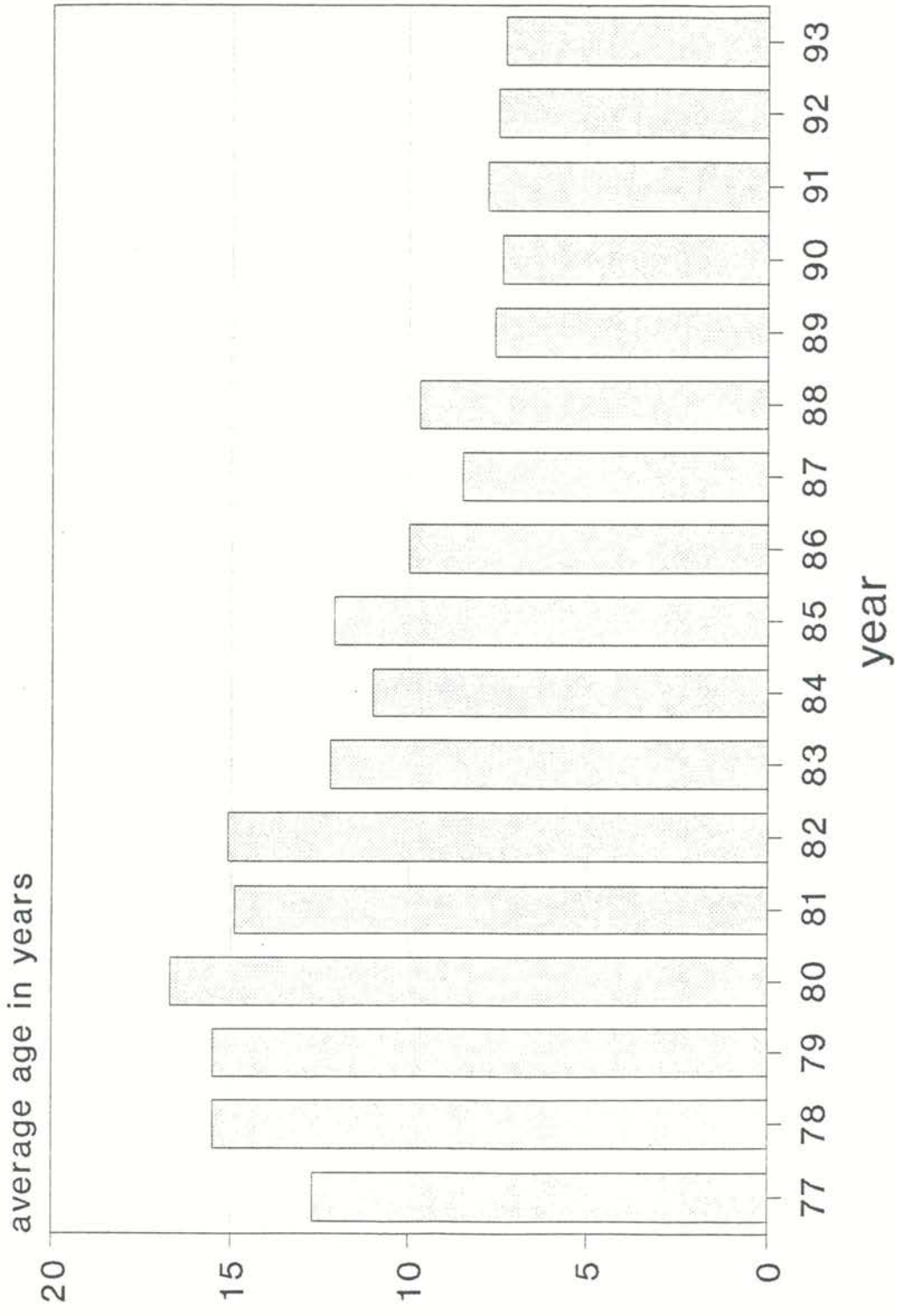
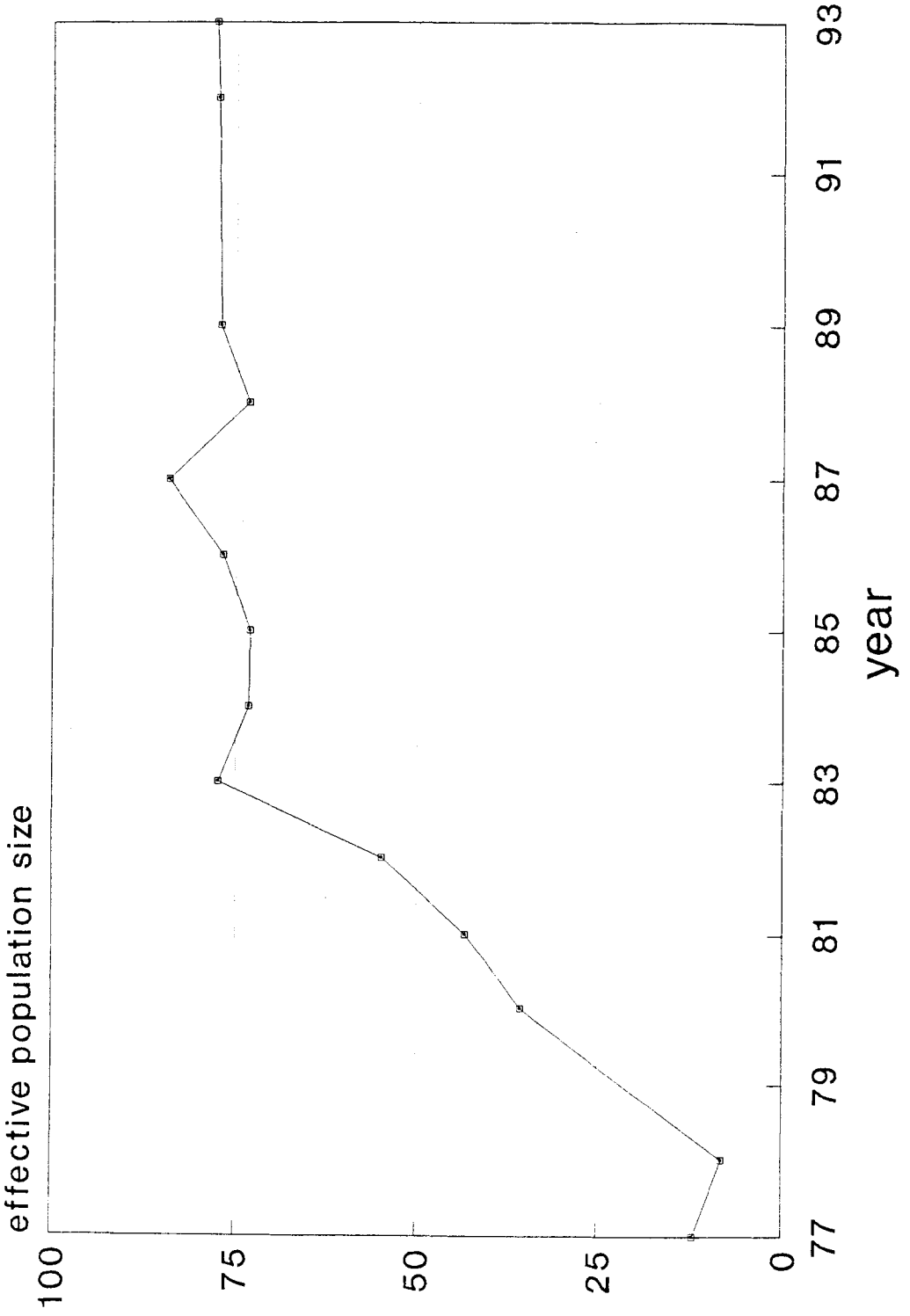


Figure 3: *Development of the effective population size, calculated on the basis of stallions and mares used.*



3.0 DATA OF THE POPULATION

The existing stock of mares descends from the population in Saxony and Thuringia. Figure 1 shows the development of the stock of mares in these two regions. The breed was reactivated by old individuals. Figure 2 shows the average age of the stallions used since 1977. Since the end of the eighties the population has stabilized, and a large generation gap has developed. The survival of the breed seems to be ensured. In 1992, 287 German Coach Horse foals were born and registered in Germany. The breeding takes place without any input of genes from other populations.

However the status of endangerment of a breed should be based not only on the absolute number of breeding animals. A proposal of the "Deutsche Gesellschaft für Züchtungskunde", the German branch of EAAP, concentrates on the concept of ensuring a minimal Effective Population size. Picture 5 shows the development of the Effective Population size (N_e), calculated by the formula $N_e = 4\ N_f N_m/(N_f+N_m)$ (Falconer 1969) on the basis of the stallions and mares which were used for mating. If we want to keep inbreeding below 1% per generation and minimize genetic drift, the Effective Population size should not be smaller than $N_e = 50$ (Simon 1992). The formula assumes unrelated stallions and random mating. Therefore the existing population with about 600 mares and 20 stallions seems to be a practical solution which ensures the preservation of the genetic resource and allows a minimum of selection on type and conformation.

4.0 CONCLUSIONS

With the help of breeders and officials the endangered breed Saxony Warmblood could be maintained in a small population. This would also be an important genetic pool for the related breeds outside Germany.

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