

---

# ANIMAL GENETIC RESOURCES IN BOTSWANA

E.K Senyatso and B.S Masilo

Department of Agricultural Research, Private Bag 0033, Gaborone, BOTSWANA

## RESUME

Cet article fait le point sur l'état des ressources génétiques animales du Botswana, notamment après plusieurs années de sécheresse. Sont également présentés les résultats de comparaison des performances des principales races locales entre elles, avec des races importées et avec des animaux croisés. Grâce à leur grande adaptation aux conditions locales, les animaux de race Tswana restent les plus productifs.

## SUMMARY

This article presents the current situation of animal genetic resources in Botswana, particularly following several years of drought. Likewise, a series of results is presented comparing the yields between the main local breeds and also between them and imported and crossed animals. Due to their greater capacity of adaptation to local conditions, the Tswana breed animals continue to be the most productive.

## 1.0 BACKGROUND

Before independence (1966), the livestock industry contributed substantially to both agricultural production and export earnings. The native livestock were the main breeds. While cattle played a major role in the economy, small ruminants contributed significantly at household level, providing meat for home consumption, milk and cash from the sale of live animals. Cattle provided milk, draught power and a major source of household income to those who owned them. Livestock production was very important in economic and social status. After independence, the Ministry of Agriculture launched Artificial Insemination, Bull and Ram Subsidy Schemes with the aim of improving growth rates and overall productivity. The operation involved mating native female stock to various imported bull and ram breeds. In cattle, the Brahman and Simmental became the most popular breeds, whereas in small ruminants the Boer goat and Dorper sheep were preferred. The schemes were open to all farmers, without targeting either farmer groups or production systems. Their presence was viewed as an opportunity to improve production, without considering the negative consequences of replacing the native breeds.

Since breeding stock were allocated by raffle, some applicants submitted several applications in order to improve chances of success. Annual lists of applications exceeded the number of available stock up to ten times. Some farmers privately imported exotic breeding stock from neighbouring countries. Some progeny from private importations, AI, Bull and Ram Subsidy Schemes were sold as breeding stock, further reinforcing the crossbreeding operations. In cattle, at least 15 imported breeds (in total) have been used through AI, Bull Schemes and private importations.

## 2.0 INTRODUCTION

Animal products such as eggs, meat, milk, hides and skins are essential in the life of a human being. Domesticated animals provide draught power and manure which fertilizes crop fields, and in some cases serve as a form of social security. The demand for animal protein has risen due to urbanization and general population increase, which has also resulted in serious competition for land. These factors have compelled farmers to improve productivity per animal. Breeds that are not very productive are therefore left out and run the risk of becoming extinct.

Experience has shown that although indigenous breeds may not be very productive, they possess a valuable trait, adaptability. In Sub-Saharan Africa such as Botswana, the production environment is suboptimal. Droughts and disease outbreaks are common and thus breeds of cattle, sheep and goats from temperate countries find it difficult to survive. The indigenous breeds should be utilized and conserved. Conservation should be aimed at preserving their adaptive traits as well as genetic diversity.

Although some traits may seem not to be valuable, they may become valuable in future as market trends change.

It is for these reasons that the FAO and UNEP have encouraged conservation of animal genetic resources. Botswana is aware of the need to conserve biological diversity, and thus supports the idea of conservation of animal genetic resources. The aim of this paper is to look at the population trends of indigenous breeds in the different species and suggest remedial action where the breeds are endangered.

## 3.0 TRENDS IN LIVESTOCK POPULATIONS

### 3.1 Cattle

Cattle in Botswana play an important role in the economy. Beef exports earn the country substantial foreign exchange (200 pula per year). Cattle also provide milk and draught power. The cattle population increased from just above 1 million in 1966 to about 3 million in 1987.

During the drought in the 1980's, the cattle population was drastically reduced to 2.3 million, but it is increasing towards 3 million again. There are several breeds of cattle found in this country, but no accurate population estimates are available. Among the beef breeds are:

- Tswana: This is the indigenous breed of Botswana, with a variety of coat colours and horn shapes. It is used for multipurposes.
- Tuli: The breed was developed in Zimbabwe through selection of local and Tswana cattle. It has a light brown to yellow coat colour. It is used for pure and cross breeding.
- Bonsmara: This is a composite breed developed from Afrikaner and Shorthorn cattle in South Africa. It has a dark brown coat colour. In Botswana, it is used for pure and cross breeding.
- Brahman: A wellknown improved tropical breed. It is popular in both pure and cross breeding.
- Simmental: A temperate breed from Germany, used for crossbreeding.
- Afrikaner: The breed was developed from the local cattle in South Africa. The coat colour varies from light brown to yellow. The breed used to be popular in pure and cross breeding in Botswana, but has lost fame because of the introduction of Brahman and European breeds.

Other breeds are commonly used for crossbreeding such as Charolais, South Devon, Sussex and Santa Gertudis. There are some dairy breeds which make an insignificant proportion of the national herd. These are, Friesian/Holstein, Brown Swiss and Jersey.

Cattle in Botswana are mostly owned by the traditional sector (80 percent of the national herd). Cattle in this sector are kept in the communal areas where overgrazing is a problem. Large European breeds find it difficult to survive and produce in this suboptimal environment. Animal Production Research Unit (APRU) has evaluated the productivity of Tswana, Bonsmara, Brahman, Tuli and Afrikaner under ranch conditions.

Despite its good productivity, the Tswana breed is reducing in proportion to the national herd. Setshwaelo (1992), estimated that Tswana cattle made up 50% of the national herd. Although the Tswana is not yet endangered, there are clear indications that it will be soon. Uncontrolled crossbreeding has drastically reduced the population of Tswana cattle and commercial farmers have no interest in the breed. Artificial insemination has made it easy for farmers to use semen from imported bulls. The popular breeds are Brahman and Simmental, and to a limited extent Charolais, Sussex, South Devon and Santa Gertrudis.

### **3.2 Horses and donkeys**

Horses and donkeys are used for transport and draught power. The general development of infrastructure and technology advancement have rendered the use of donkeys and horses unnecessary in some parts of the country. Horses are mostly used in the Western and Maun Region because roads there are poor and sandy. Donkeys are mostly used for draught power and horses for riding.

- Donkeys: The donkey population has increased from 130 000 in 1980 to 158 000 in 1990 (Agricultural Statistics, 1990). The donkey population did not reduce during the drought years. This may be due to the fact that donkeys are not culled, mostly because they are not eaten. There is no controlled breeding in donkeys and thus the donkey population is randomly mated without selection. There is no information on importation or exportation of donkeys. It has been estimated that 98% of the donkeys are on traditional farms.
- Horses: The horse population increased from 11 000 in 1970 to 34 000 in 1990. The reasons for increase are probably the same as that of donkeys. Approximately 82% of the horses are on traditional farms. The horses are not indigenous to Botswana and most of them are probably imported from South Africa. There is limited controlled breeding but little is known about breeds of horses found in Botswana.

### **3.3 Pigs**

According to Agricultural Statistics reports from 1970 to 1990, the pig population has increased steadily from 8 000 to 16 000. Of the 16 000 pigs, 12 500 were confined to rural areas. The pork quality of indigenous pigs is of low grade because of excessive fat which also limits its marketability. The lard from indigenous pigs was used to produce soap but due to infrastructure development and general improvement in the standard of living, the demand for this soap has virtually ceased to exist. Commercial pig breeds are kept by both commercial and traditional pig producers. The common breeds are Large White, Landrace and Duroc. These breeds are either bred pure or crossed amongst each other.

Although some of the local people do not eat fresh pork due to religious and traditional reasons, the demand for pork, bacon and processed pork products continues to grow. According to the Central Statistics Office, in 1992, Botswana imported 98.7 tons of fresh pork and bacon/ham. It is because of this demand that commercial pig production is encouraged. The indigenous pig has no role to play in this market and thus runs the risk of being left to perish. Government should therefore make an effort to preserve indigenous pigs and also their performance should be evaluated. There is considerable variation within indigenous pigs and thus further characterization is essential.

### **3.4 Small ruminants**

In 1970 there were nearly 400 thousand sheep and over 1 million goats. During the course of the decade, small ruminant population dropped severely due to droughts combined with cold weather such that at the end of the decade (1979) there were 152 000 sheep and 616 000 goats. The decline caused great concern among livestock producers. However numbers grew steadily during the 1980s despite the droughts which killed cattle and other livestock. The ability of small ruminants to withstand droughts, together with reproductive efficiency, stimulated many producers to undertake small ruminant production. This was enhanced by government financial assistance on small ruminant projects. Common goat breeds are the local Tswana whose proportion is estimated at about 80 percent of the goat population, while the rest are Boer and crossbred goats. About 90 percent of the sheep population are the local Tswana, while the rest are Karakul, Dorper and crossbred sheep.

Native poultry have been important in supplying limited quantities of eggs and meat, thus supplementing human protein intake from large stock. Sales for cash were common during the pre-independence period, but earning inadequate cash for family needs because of the small numbers of birds available for either eggs or meat production. During the 1970's, commercial breeds of White Leghorn, Plymouth Rock, Rhode Island Red and their crosses were introduced and profitable poultry was encouraged. Commercial birds were to be maintained under a healthy confinement system, while indigenous poultry foraged in the range near the homesteads. Currently, among the commercial layer breeds used in the country are the Hi-line and Isa Brown. The broiler breeds (for meat production) include the Ross, Cob and Indian River. Poultry numbers have increased over the past two decades as a result of importation of commercial flocks. The indigenous flocks are still important in the traditional production system.

**TABLE 1:**  
*Trends in Livestock Populations (x 1 000)*

Year	Cattle	Sheep	Goats	Donkeys	Horses	Pigs	Poultry
1970	1221	392	1112	42	11	8	390
1979	2840	152	616	127	18	6	740
1980	2911	148	637	130	22	6	833
1981	2967	140	621	127	24	5	1046
1982	2979	140	635	138	24	5	1146
1983	2818	164	783	142	23	5	960
1984	2685	167	889	139	23	7	714
1985	2459	200	1137	146	23	9	1028
1986	2332	229	1332	142	24	11	1178
1987	2264	240	1469	147	24	11	1282
1988	2408	258	1691	150	28	13	1809
1989	2543	286	1897	151	32	15	2013
1990	2696	317	2092	158	34	16	2126

Source: Botswana Agricultural Statistics, 1970-1990.

**TABLE 2:**  
*Trends in average herd size according to production system*

Year	Traditional				Commercial			
	Cattle	Sheep	Goats	Poultry	Cattle	Sheep	Goats	Poultry
1980	42	10	14	12	1341	104	87	289
1982	43	10	13	13	1397	141	97	1717
1983	41	12	16	10	1190	146	104	1500
1984	40	12	17	9	1116	120	123	1071
1986	37	15	22	12	741	121	119	2245
1987	37	14	23	12	793	113	117	2100
1988	37	15	26	14	871	135	136	2667
1989	38	15	27	14	921	131	146	2803
1990	40	15	30	15	932	144	156	2884

Source: Botswana Agricultural Statistics 1980-1990.

**TABLE 3:***Trends in population proportion (%) according to production system*

Year	Traditional				Commercial			
	Cattle	Sheep	Goats	Poultry	Cattle	Sheep	Goats	Poultry
1980	84	90	98	94	16	10	2	6
1981	84	87	97	90	16	13	3	10
1982	84	83	97	82	16	17	3	18
1983	85	85	97	69	15	15	3	31
1984	85	86	97	79	15	14	3	21
1986	84	87	97	62	16	13	3	38
1987	82	85	97	59	18	15	3	41
1988	82	84	97	56	18	16	3	44
1989	82	84	97	54	18	16	3	46
1990	82	84	97	54	18	16	3	46

*Source: Botswana Agricultural Statistics, 1980-1990.*

## 4.0 A REVIEW OF COMPLETED STUDIES ON CATTLE AND SMALL RUMINANTS

### 4.1 Cattle

Animal Production and Range Research Unit, has evaluated the productivity of Tswana, Bonsmara, Brahman, Tuli and Afrikaner under extensive ranching conditions. The results are summarized below.

**TABLE 4:***Performance of Tswana and other breeds studied in Botswana*

Breed	Calving (%)	Mortality %	18 months wt (kg)
Tswana	80	9.4	293
Bonsmara	83	17.5	315
Tuli	87	7.2	287
Brahman	72	18.6	309
Afrikaner	67	13.5	278

*Source: Animal Production and Range Research Unit, 1980.*

These results proved the Tswana a highly productive breed despite the fact that it has not been selected. It has further been demonstrated that crossing Tswana with Brahman and Simmental productivity was improved (APRU 1980).

### 4.2 Small ruminants

#### 4.2.1 Studies on breed performance

From 1976 to 1984 the Animal Production Research Unit monitored the performance of indigenous small ruminants (Tswana sheep and goats) together with that of imported Boer goats and Dorper sheep. The aim was to evaluate the productivity of these breeds for meat production under local conditions and recommend future breeding strategies. A summary of results follows.

**TABLE 5:**  
*Performance Tswana, Boer goats and Crossbreeds*

Trait	Tswana	Boer	Crossbred
Reproduction: Kidding rate per doe bred	1.21	1.27	-
Kidding rate per doe kidding	1.5	1.71	-
% of does kidding	80	74	-
Mortality: From birth to weaning (4 mths)	9	25	11
From birth to 12 months (%)	24	42	26
From birth to 18 months (%)	30	46	29
Growth: Weaning wt. (4 mths) kg	13.4	14.9	14.4
12 months wt. kg	29.6	33.3	31.5
18 months wt. kg	34.5	36.5	36.1

Source: *Animal Production and Range Research Unit, 1983-84.*

The difference between Tswana and Boer goats in kidding rate per doe bred was not significant. Both breeds have the ability to produce twins as reflected in the kidding rate which was greater than 1.0, but the Boer goat had a higher twinning rate. The percentage of does kidding indicates fertility rate, which was higher in the Tswana goat.

The level of mortality among the Tswana and crossbred was moderate, at weaning, at 12 months and at 18 months. The Boer goat on the other hand had a very high mortality rate at weaning, 12 months and 18 months.

The growth of the three breeds was impressive up to weaning, 12 months and 18 months. The Boer goat and crossbred were not significantly different in live weights, but were significantly heavier than the Tswana. Combining the three traits of reproduction, survival rate and growth, the Tswana goat would have higher productivity.

**TABLE 6:**  
*Performance of Tswana, Dorper and Crossbred sheep*

Trait	Tswana	Dorper	Crossbred
Reproduction: Lambing rate/ewe bred	0.86	0.74	-
Lambing rate/ewe lambing	1.02	1.09	-
% of ewes lambing	84.00	68.00	-
Mortality %: From birth to weaning	11.00	39.00	8.0
From birth to 12 months	25.00	58.00	21.0
Growth (kg): Weaning wt.	17.10	20.70	19.6
12 months wt.	26.70	30.80	30.4
18 months wt.	34.10	38.20	38.2

Source: *Animal Production and Range Research Unit, 1983-84.*

The Tswana sheep had a higher lambing rate per ewe bred than the Dorper. Lambing rates per ewe lambing indicate low twinning rates of 2% and 9%, for the Tswana and Dorper, respectively. The Tswana sheep had a higher fertility rate as expressed by percentage of ewes lambing. Mortality of the Tswana and crossbreeds was similar and at acceptable levels, at weaning, at 12 months and at 18 months, but the Dorper on the other hand, had an extremely high mortality rate at those

stages. The mortality of the Dorper on the other hand was extremely high, at weaning, 12 months and 18 months. Mortality rates at these levels, would be a major problem limiting the production of pure Dorper sheep under conditions where the study was conducted.

Like the goat breeds, all three sheep breeds had satisfactory growth rates as reflected in their liveweights at various stages. The Dorper and crossbred had similar weights at weaning, 12 months and 18 months. The Tswana on the other hand weighed lower but satisfactorily the three stages. The combined traits of reproduction, survival rate and growth would give the Tswana sheep a higher productivity index.

#### 4.2.2 Seasonal Performance of Tswana goats

From 1985 to 1991, APRU observed the influence of season of kidding on goat performance at the Lesego Ranch. Each year, one group of Tswana goats was bred to kid in autumn while the other was bred to kid in spring. The aim of the study was to find the extent to which seasonal differences would affect production traits in goats kept under extensive farming conditions. The following table summarizes the results.

**TABLE 7:**  
*Seasonal performance of Tswana goats*

Trait	Spring	Autumn
Reproduction: Kidding rate per doe bred	1.66	1.39
Kidding rate per doe kidding	1.79	1.71
% of goats kidding	93.00	81.00
Mortality %: Birth to weaning (4 mths)	15.00	7.00
Birth to 12 months	27.00	17.00
Growth (kg): Birth wt.	2.50	2.60
Weaning wt.	17.40	17.10
12 months wt.	30.00	29.00

*Source: Animal Production and Range Research Unit, 1991.*

In general, the results show a satisfactory production performance when goats kidded in either spring or autumn. However, spring kidding had a higher kidding rate per doe bred and per doe kidding. The differences in reproductive performance could result from the level of nutrition during the mating period. Mortality rates were higher in spring, at weaning and at yearling age. Preweaning losses contributed significantly to mortality differences at 12 months. Higher mortality rate in spring kids could result from lack of adequate feeding at the early postnatal stages of kid development during that season.

Weaning weights were not significantly different. Autumn lambs were expected to weigh heavier because they were born during the peak of forage growing season. Nor were the yearling weights different. Whether born in spring or autumn, kids had to go through a dry period of limited forage availability at some stage before attaining the yearling weight. This could have contributed to similar yearling weights.

## 5.0 ON-GOING PROJECTS

### 5.1 Cattle

#### 5.1.1 Breeding and Selection of Tswana Cattle

Although there is no set policy to conserve Tswana cattle, the Department of Agricultural Research has started a selection programme of Tswana cattle. The aim of the project is to improve the productivity of Tswana cattle by selecting for reproduction, growth rate and maternal ability.

Two herds, each consisting of 300 cows, have been assembled for selection. In one herd, emphasis for selection is placed on weaning weight adjusted to 210 days. This is aimed at increasing the maternal performance of Tswana for calf preweaning growth. In the herd, selection is for 18 months weight adjusted to 540 days. This is aimed at increasing the post-weaning weight gain.

### **5.1.2 Beef Cattle Recording Scheme**

As a pilot project, the beef cattle recording scheme has been started to record performance of cattle and hence facilitate selection. It is hoped that the Recording Scheme will promote the establishment of Breed Societies which will include the breeders of Tswana cattle. There is considerable variation within the Tswana and thus it is necessary to study and characterize the breed in more detail.

## **5.2 Sheep and Goats**

### **5.2.1 Breeding and Selection of Indigenous Sheep and Goats**

- Objectives
  - a. To improve the productivity of the native sheep and goats for meat production.
  - b. To establish a basis for preservation of the native stock.

Status: Two sheep flocks have been established at the Goodhope and Morale ranches, about 330 km apart. A third herd consisting of goats only has been established at Sunnyside, about 70 km from Goodhope. Between 250 and 300 breeding females and 15 to 20 rams are maintained at each ranch.

- Selection Criteria

Replacement stock are selected for growth, body conformation and structural soundness (feet, mouth, genitals etc). Does and ewes are selected for fertility, mothering instinct, kid/lamb survival, kid/lamb growth, structural soundness and ability to maintain mature body weight.

- Flock Management

Management of flocks is extensive. Flocks derive their food intake from natural pastures on fenced farms. Vaccinations and antibiotic treatments are used to control common diseases. Internal and external parasites are controlled by regular drenching and plunge dipping respectively. The breeding system is that of random mating and multi-sire. Rams/bucks are introduced into the breeding flocks for two months, once a year.

### **5.2.2 Future**

More flocks will be established in order to widen the genetic pool and make both conservation and improvement more meaningful.

## **6.0 SUGGESTED CONSERVATION STRATEGIES**

Botswana is committed to the ideas of conservation of biological diversity. Some achievements have been made in conservation of wildlife, indigenous plants and rangelands. It is regretted that presently there is no clear policy for conservation of domestic animal diversity. Based on existing infrastructure and facilities, and with possibilities of further development, the following methods seem appropriate for the conservation of animal genetic resources:

- a. In-situ (conservation of live animals). This method requires a large number of animals to avoid inbreeding and thus a substantial amount of land on which the animals are to live, feed and breed. In order for this method to succeed, co-operation of farmers should be sought.
- b. Cryo-preservation (storage of frozen semen and embryos) Under the present conditions, cryo-preservation may be restricted to semen. The embryo technology has not yet been developed.

The Department of Agricultural Research has among others, suggested the following points to the Ministry of Agriculture for consideration.

- a. That appropriate legislation and institutional structures be developed to facilitate conservation of animal genetic resources.
- b. That the Department of Agricultural Research be assigned responsibility to develop and monitor a national programme aimed at preservation, conservation and utilization of animal genetic resources. Presently, a plant germplasm section has been established in the department.
- c. That crucial information be collected on the nature and characteristics of indigenous breeds of livestock. Populations should be monitored.
- d. That the farming community should be sensitized on the importance of conserving the animal genetic resources, particularly the indigenous breeds.

## **7.0 REFERENCES**

- Animal Production and Range Research Unit. 1991. Range Research in Botswana. Annual Report. Agriculture, Botswana.
- Animal Production and Range Research Unit. 1983/84. Range Research in Botswana. Annual Report. Agriculture, Botswana.
- Animal Production and Range Research Unit. 1980. Ten years Animal Production and Range Research in Botswana. Ministry Agriculture, Botswana.
- Botswana Agricultural Statistics. 1970-1990. Annual Reports. Ministry of Agriculture, Botswana.
- Central Statistics Office. 1992. External Trade Statistics, Annual Report. Ministry of Finance and Development Planning, Botswana.
- Setshwaelo, L.L. 1992. A case for conservation of animal genetic resources in Africa. Department of Agricultural Research, Annual Seminar. Ministry of Agriculture, Botswana.

# ETUDE DES RESSOURCES GENETIQUES CAPRINES DE L'ALGERIE DU NORD A L'AIDE DES INDICES DE PRIMARITE

E. Khemici<sup>1</sup>, M. Mamou<sup>1</sup> A. Lounis<sup>1</sup> D. Bounihi<sup>1</sup>,  
D. Ouachem<sup>2</sup>, T. Merad<sup>2</sup> et K. Boukhetala<sup>1</sup>

<sup>1</sup>Université de Blida, Institut d'Agronomie, Dép. de Zootechnie ,  
BP 270 09000 Blida, ALGERIE

<sup>2</sup>Université de Batna, Institut d'Agronomie, Dép. de Zootechnie,  
05000 Batna, ALGERIE

## RESUME

Les ressources génétiques caprines (*Capra hircus* L.) d'Algérie n'ont pas fait l'objet d'une attention particulière comparativement au reste des populations de l'espèce du Bassin méditerranéen. En témoigne la méconnaissance de leur degré d'appartenance à l'une des trois catégories de la classification évolutive des animaux de ferme qui comprend espèce sauvage, population primaire - initialement population traditionnelle - et race standardisée. Des données relatives à la variabilité génétique de douze loci à effets visibles sont considérées pour caractériser les populations caprines des Monts Dahra et Aurès. Ces travaux se basent sur l'emploi de deux indices récemment introduits: l'indice de primarité loci en ségrégation (IPs) et l'indice de primarité allèles au locus *Agouti* (IPa). Les résultats obtenus plaident en faveur de l'appartenance de ces populations à la catégorie de population primaire.

## SUMMARY

The Algerian goat genetic resources (*Capra hircus* L.) have received no particular attention in comparison to the other goat populations in the Mediterranean area. There is no knowledge as to which one of the three categories of farm animal evolutive classification they belong. This classification includes wild species, primary population -initially traditional population- and standardized breed. Data relative to the genetic variability of twelve loci with visible effects are considered to characterize the goat populations of the Dahra and Aurès mountains. This work is based on two recently introduced indexes: the index of primarity loci *in segregation* (IPs) and the index of primarity *Agouti locus* (IPa). The results obtained show that these goat populations belong to the primary population category.

## 1.0 INTRODUCTION

La population caprine d'Algérie compte environ 3,6 millions de têtes localisées dans les zones montagneuses (28,8%), la Steppe (41,1%) et le sud (22,5%). Le cheptel caprin comprend également, mais en faible proportion (7,6%), des chèvres améliorées importées d'Europe (Saanen, Alpine, Murcienne, Maltaise, Toggenbourg) et les produits de leurs croisements rencontrés principalement au sein des exploitations d'Etat (Chellig, 1978). Ceci est dû au fait que les éleveurs traditionnels, auprès de qui les prospections ont été menées, ne sont pas favorables au sein de leurs troupeaux à la présence de chèvres, ne leur ayant pas été léguées par la voie de l'héritage ancestral. Cette attitude à l'égard de chèvres "étrangères" traduit, selon Laurans (1989) et Flamant, Audiot et Vallerand (1991), la participation de la chèvre locale à l'identité collective de la communauté. Cet article, qui rapporte les résultats des investigations relatives à l'identification de la variabilité génétique visible des populations caprines algériennes des Monts Dahra et Aurès, tente de quantifier le degré d'appartenance de ces populations à un terme de classification évolutive des animaux de ferme en utilisant les indices de primarité récemment introduits (Lauvergne, 1993; Lauvergne et al., 1993; Machado et al., 1992). Il répond, en quelque sorte, au récent regain d'intérêt manifesté à l'échelle internationale à l'égard des ressources génétiques animales exprimé par un grand nombre d'auteurs, à l'exemple de Steane (1993).



*Troupeau de caprins dans les Aurès*

## 2.0 MATERIEL ET METHODES

### 2.1 Choix des zones d'échantillonnage

Ce choix s'est d'abord basé sur la délimitation de deux zones connues pour leur peuplement caprin et suffisamment distantes pour donner une idée de la primarité des chèvres du nord de l'Algérie. De plus, l'existence dans les montagnes du nord rapportée par Chellig (1978) d'une population ou race caprine communément appelée Naine de Kabylie nous a semblé intéressante à retenir comme critère de choix des Monts Dahra, cette population car n'ayant pas fait l'objet d'une étude portant sur l'inventaire de sa variabilité génétique visible comme dans le cas des chèvres des Aurès. Nous devons ajouter que le choix porté sur les Monts des Aurès est justifié par l'existence d'une remarquable industrie artisanale à base de fibres caprines qui caractérise les activités humaines de cette région, particulièrement celles de la zone comprenant le Balcon du Roufi.

### 2.2 Situation géographique des zones échantillonnées

Les Monts Dahra, situés entre 36° et 37° de latitude nord, entre 0° et 2° de longitude est, constituent une chaîne montagneuse côtière n'excédant pas 1 500 m d'altitude. Les Monts Dahra sont situés dans l'étage bioclimatique sub-humide. Les Aurès, compris entre 35° et 36° de latitude nord, entre 6° et 8° de longitude est, forment un massif compact où les crêtes rectilignes sont séparées par des vallées profondes. Le point culminant est atteint au Djebel Chelia (2 328 m). La juxtaposition de deux étages bioclimatiques, sub-humide et semi-aride à aride, caractérise les Aurès (Seltzer, 1946).

### 2.3 Réalisation de l'échantillonnage

Les investigations réalisées en deux campagnes, de décembre 1991 à mai 1993, considèrent 17 troupeaux de taille variable répartis entre les Monts Dahra (D; i = 1:7) et Aurès (A; i = 1:10). Tous les échantillons sont réalisés, d'un commun accord préalable avec les éleveurs; tôt le matin à l'intérieur de la z'riba (enclos de fortune) avant la sortie des animaux vers les pâturages, ou en fin de journée dès leur retour. Au total, 1 097 caprins âgés de plus d'un an ont fait l'objet d'une caractérisation phénotypique: 488 pour les Monts Dahra et 609 pour les Aurès (tableau 1).

### 2.4 Mesure de la primarité

La reconnaissance de la variabilité génétique visible utilise la notion récente d'indice de primarité présentée par Lauvergne (1993) et appliquée dans le cas des chèvres du Brésil (Machado et al., 1992), du Nord Cameroun et Tchad (Lauvergne et al., 1993). La primarité désigne le premier stade d'évolution d'une espèce après sa domestication. La domestication atténue la pression de sélection naturelle sur les mutants à effet visible permettant leur accumulation qui génère inéluctablement une variabilité génétique visible facilement remarquable. Une population primaire - nommée originellement traditionnelle - est une population dans laquelle on n'a pas encore procédé à des sélections avec création d'isolats génétiques. Il y a lieu, cependant, pour vérifier l'existence de cette primarité, de s'assurer de certaines conditions: situation de panmixie, pas de conséquences dues aux effets de dérive génique et pas de croisements anarchiques entre races standardisées pouvant avoir généré la variabilité génétique observée (Lauvergne et al., 1993).

### 2.5 Les loci considérés

L'identification considère douze loci à effet visible susceptibles de ségréger. Cinq sont relatifs à la coloration de l'animal: *Agouti* (A), *Brown* (B+, B<sup>b</sup>; *wild vs brown*), *Frosting* (Fr+, Fr<sup>Rr</sup>; *wild vs frosting*), *Roan* (Rn+, Rn<sup>Rr</sup>; *wild vs roan*) (Alexieva et al., 1990; Millar et Lauvergne, 1990) et le locus pressenti *Spotting* (S+, S<sup>S</sup>; *wild vs spotting*) (Lauvergne et al., 1993). La détection de la présence des allèles au locus *Agouti* multiallélique utilise l'échelle visuelle donnée par Lauvergne, Renieri et Audiot (1987), et Lauvergne et al. (1993). Les données de ségrégation relatives au locus *Agouti* (Millar et Lauvergne, 1990) et le principe de l'homologie interspécifique (Lauvergne, 1983) nous autorisent à tenir compte des allèles suivants: *nonagouti* (A<sup>u</sup>), *badgerface* (A<sup>b</sup>), *black and tan* (A), *black and tan black belly* (A<sup>b</sup>), *red cheek* (A<sup>rc</sup>), *mantled* (A<sup>''</sup>), *reverse*

*mantled* ( $A^{r''}$ ), *red* ( $A^r$ ) et *wild* ( $A^+$ ). Les autres loci concernent les caractères autres que ceux de la coloration: *Beard* ( $Bd^+$ ,  $Bd^b$ ; *wild vs bearded*), *Ear Carriage* ( $EC^+$ ,  $EC^P$ ; *wild vs pendulous*), *Ear Curling* ( $ECr^+$ ,  $ECr^C$ ; *wild vs curled*), *Ear Length* ( $EL^+$ ,  $EL^L$ ; *wild vs reduced*), *Horns* ( $HO^+$ ,  $HO^P$ ; *wild vs polled*), *Hair Length* ( $HL^+$ ,  $HL^L$ ; *wild vs long*), *Wattles* ( $Wa^+$ ,  $Wa^W$ ; *wild vs wattles*) (COGOVICA/COGNOSAG, 1989). Il nous faut signaler que certains animaux n'ont pas pu faire l'objet d'une caractérisation phénotypique. Ceci est généré par certaines interactions complexes entre les gènes allèles au locus *Agouti* d'une part, d'autre part par les interactions possibles de type épistatique survenant entre certains loci. Ce qui est à l'origine de certaines différences observables entre les effectifs des tableaux 1, 2 et 3 pour le même échantillon.

### 3.0 RESULTATS

Le tableau 2 présente les estimations de l'indice de primarité loci à effet visible en ségrégation (IPs) pour chacun des sites échantillonnés et pour chaque regroupement de sites opéré à l'intérieur de chacune des zones.

Le tableau 3 donne les estimations de l'indice de primarité allèles au locus *Agouti* (IPa) pour chaque site échantillonné pris isolément et pour chacune des zones après regroupement.



*Chèvre des Aurès à poils longs et oreilles longues*

## 4.0 DISCUSSION

### 4.1 Primarité des populations caprines d'Algérie

Les tableaux 2 et 3 traduisent sans équivoque la primarité des populations caprines des Monts Dahra et des Monts Aurès d'Algérie. Il n'est pas exclu d'admettre que cette primarité se rencontre chez la majorité des chèvres d'Algérie, comme en témoignent les résultats déjà obtenus dans le cas des populations ou races caprines Arabia (Steppe, région de Laghouat) et Mekatia (Oasis du désert, région de Ghardaïa) (Khemici et al., 1994). La primarité des populations caprines d'Afrique ayant déjà été, en effet, pressentie et implicitement évoquée par différents auteurs comme Epstein et Mason (In: Lauvergne et al., 1993).

### 4.2 Situation par rapport au reste des populations examinées

Les valeurs des indices de primarité des populations caprines du nord de l'Algérie, comme celles du sud de ce pays (Khemici et al., 1994) sont du même ordre de grandeur que celles du Brésil (Machado et al., 1993), du nord Cameroun et Tchad (Lauvergne et al., 1993) et du Bassin méditerranéen nord (Lauvergne et al., 1993). La similitude des indices de primarité estimés pour des populations aussi éloignées que proches plaide en faveur de l'hypothèse émise par Lauvergne et al. (1993). Cette hypothèse envisage l'existence déjà ancienne d'une population primaire qui se serait répandue sur les grands espaces où elle existe actuellement.



*Chèvre des Aurès de coloration noire*

### 4.3 Particularités des populations caprines examinées

Le nanisme de la chèvre des Monts Dahra lui a valu l'appellation Naine de Kabylie (Chellig, 1978). Ce nanisme semble la distinguer qualitativement de la chèvre des Aurès. Force est de constater, à ce propos, la nécessité de procéder à une étude portant sur les aspects morpho-biométriques pour quantifier le pouvoir discriminant de la hauteur sur pattes, en intégrant l'indice de gracilité (rapport du vide sous-sternal à la profondeur du thorax) et l'indice auriculaire (rapport de la longueur de l'oreille à la profondeur du thorax) récemment introduits par Bourzat et al. (1993). Nous adopterons, dans le cadre de cette discussion et pour la distinction des deux populations caprines étudiées, l'autre appellation Montagnarde des Aurès attribuée par les éleveurs de la région au savoir-faire traditionnel non négligeable.

Des différences notables entre ces deux populations ou races caprines portant sur la diversité phénotypique méritent d'être signalées. Ces différences sont relatives aux loci Ear Length (EL, longueur de l'oreille) et Hair Length (HL, longueur des poils). L'absence de ségrégation au locus EL et HL chez la Montagnarde des Aurès semble différencier celle-ci de la Naine de Kabylie. L'absence de ségrégation au locus EL correspond à l'absence du variant mendélien  $EL^R$ , à l'origine des oreilles de taille réduite n'excédant pas 2 cm, variant observé chez la majorité des échantillons des Monts Dahra (tableau 2). Ce fait traduirait un avantage sélectif de l'allèle  $EL^+$  (oreille longue) dans les Aurès. Cet avantage sélectif s'exprimerait par l'allongement de l'oreille qui constitue une défense contre la chaleur et la sécheresse en facilitant l'exportation de calories dégagées par le métabolisme par échange thermique de contact plutôt que par exportation de vapeur d'eau dans une zone sèche (Robertshaw, 1982). Ceci témoignerait de l'adaptation de cette chèvre aux conditions de chaleur et de sécheresse qui caractérisent une grande partie des Aurès. Ce dui ne semble pas être le cas dans les Monts Dahra où les conditions bioclimatiques sont du type sub-humide. Bourzat et al. (1993) rapportent une étroite association positive entre l'allongement de l'oreille et la gracilité qui varient quasi linéairement avec le degré de latitude nord chez les chèvres du nord Cameroun et Tchad. La remontée du nord Cameroun vers le Tchad s'accompagne d'une raréfaction du couvert végétal. Selon ces auteurs, l'allongement de l'oreille, mesure de défense contre la chaleur et la sécheresse (Robertshaw, 1982), accompagne l'augmentation du vide sous-sternal en soustrayant l'animal à la réverbération de la chaleur par un sol de plus en plus dPnudo lorsque le couvert végétal se raréfie. On est tenté de penser que la situation est analogue chez les chèvres des Monts Dahra (étage sub-humide, présence du variant  $EL^R$ ) et Aurès (étage semi-aride à aride, absence totale du variant  $EL^R$ ) à condition de retenir l'hypothèse d'un pouvoir discriminant dû à la hauteur sur pattes entre les deux populations étudiées.

Le monomorphisme au locus HL observé chez la moitié des échantillons des Aurès, conséquent probablement à des effets de fondation, correspond à l'homozygotie pour l'allèle  $HL^L$  (poils longs) (tableau 2). Ce fait est manifestement lié à la remarquable industrie artisanale à base de fibres caprines qui caractérise les activités humaines de cette région, comme déjà signalé, et que l'on ne retrouve pas dans les Monts Dahra.

## 5.0 CONCLUSION

Les résultats de ces travaux s'ajoutent à ceux déjà obtenus lors d'un précédent inventaire des ressources génétiques caprines de la Steppe (population Arabia) et des oasis de Ghardaïa (population Mekatia ou Chèvre du M'zab) (Khemici et al., 1994). Les estimations des indices de primarité loci en ségrégation (IPs) et allèles au locus Agouti (IPa) de même ordre de grandeur que ceux obtenus chez les chèvres Arabia et Mekatia attestent de la primarité des populations ou races caprines d'Algérie. Ces résultats plaident en faveur de l'hypothèse d'une population primaire ancienne qui s'est répandue sur les espaces où on la rencontre actuellement (Lauvergne et al., 1993).



*Chèvre naine des Monts Dahra*



*Chèvre des Monts Dahra aux oreilles réduites*

Ils ont besoin, cependant, d'être complétés par une étude morpho-biométrique qui considère la hauteur au garrot, l'indice auriculaire et l'indice de gracilité (Bourzat et al., 1993) pour l'obtention d'une cartographie plus exhaustive des ressources génétiques caprines d'Algérie qui permettra l'identification des principaux groupes ethniques.

## 6.0 FINANCEMENT DES TRAVAUX

Ces travaux, financés à leur début par le Rectorat de l'Université de Blida dans le cadre de l'avant-projet sur les ressources génétiques ovicaprines d'Algérie conçu en janvier 1991, ont pu être poursuivis grâce à l'agrément et au financement, depuis février 1993, par le Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (code projet: H 0934/03/93).

## 7.0 REMERCIEMENTS

Nous remercions les éleveurs des régions prospectées pour leur aide et disponibilité. Nous adressons nos remerciements à l'équipe du Dr. J.J. Lauvergne de l'I.N.R.A. de Jouy-en-Josas (France) avec laquelle les contacts n'ont pas manqué d'être fructueux. Cet article a profité de la lecture et remarques intéressantes du Dr. N. Kafidi (Directeur général du Centre National d'Insémination Artificielle et de l'Amélioration Génétique, Algérie), qu'il en soit vivement remercié.

## 8.0 REFERENCES

- Alexieva S.A., Aliev G.A., Bourzat D., Denis B., Dolling C.H.S., Lauvergne J.J., Lundie R.S., Malher X., Millar P., Rachkovsky M.L., Rae A.L., Renieri C., Sponenberg D.P. et Tucker E.M. 1990. General procedure for listing loci and alleles of sheep and goats ( 1989). In: Loci for coat color of sheep and goats ( 1989) (Lauvergne J.J. ed.), COGOVICA/COGNOSAG, Clamart, France, p.9-13.
- Chellig R. 1978. La production animale de la Steppe. In: Congrès sur le nomadisme en Afrique, Addis-Abbéba, 6-10 février.
- Flamant J.C., Audiot A. et Vallerand F. 1991. Les populations humaines gestionnaires des populations animales. In: Les exploitations agricoles et leur environnement. Essais sur l'espace technique et économique (Brossier, Valceschini, eds.). INRA, Versailles, p.31-40.
- Khemic E., Lounis A., Mamou M., Sebâa-Abdelkader M. et Takoucht A. 1994. Indices de primarité des populations caprines de la Steppe (Arabia) et du désert (Mekatia) d'Algérie. Genet. Sel. Evol. (soumis pour publication).
- Laurans R. 1989. Le concept de race: approche ethnozootechnique, approche biologique. In: La gestion des ressources génétiques des espèces domestiques animales (Lavoisier ed.) p.31-40.
- Lauvergne J.J. 1992. Breed development and breed differentiation. In: Proc. CEC Workshop and Training Course, Hannover 7-9 Decembre 1992, p.53-64.
- Lauvergne J.J. (ed). 1989. Goats allelic series 1987. Visible traits other than color. In: Standardized genetic nomenclature for sheep and goats (1987). Loci for visible traits other than color and blood and milk polymorphisms. COGNOSAG/COGOVICA, Paris, B.R.G., p.125-135.
- Lauvergne J.J. 1983. Utilisation du principe d'homologie interspécifique pour l'étude du déterminisme de la couleur du pelage des ruminants domestiques: l'exemple du locus Agouti. Bull. Soc. Zool., 108:201-243.
- Lauvergne J.J., Bourzat D., Souvenir Zafindrajaona P., Zeuh V. et Ngo Tatia A.C. 1993. Indices de primarité de chèvres au nord Cameroun et au Tchad. Rev. Elev. Méd. Vét. Pays trop., 4:651-665.
- Lauvergne J.J., Renieri C. et Audiot A. 1987. Visible genetic profile to estimate genetic erosion in Provence traditional goat population. J. Hered., 78:307-314.

- Machado T., Lauvergne J.J. et Souvenir Zafindrajaona P. 1992. Le scénario de peuplement caprin brésilien depuis la découverte. Arch. Zootec. Cordoba, 41:455-466.
- Millar P. et Lauvergne J.J. 1990. Loci for coat color of goats. In: Loci for coat color of sheep and goats (1989) (Lauvergne J.J., ed.), COGOVICA/COGNOSAG, Clamart, France, p.59-66.
- Robertshaw D. 1982. Concepts in animal adaptation, thermoregulation of the goat. In: Proc. Int. Conf. Goat, Goat, Production and Disease, p.395-397.
- Seltzer P. 1946. Le climat de l'Algérie. Travaux de l'Institut Météorologique Physique Globale. Alger.
- Steane D. 1993. More attention to animal genetic resources (Comment). World Anim. Rev., 76(3).

**TABLEAU 1:***Sites d'échantillonnage des Monts Dahra (D<sub>j</sub>) et AuYès (A<sub>j</sub>)*

Zones	Localités	Sites	Effectif mâles	Effectif femelles	Total	
Monts Dahra	Aghabal	Zadra (D )	28	50	78	
	Messelmoune	Bouzérou <sup>1</sup> (D )	27	65	92	
	Damous	T'baint (D ) <sup>2</sup>	19	39	58	
	Mouzaïa	Aïn-Romana	1 (D )	9	30	39
			2 (D ) <sup>4</sup>	9	32	41
			3 (D ) <sup>5</sup>	37	30	67
Zaccar	Chéraga (D ) <sup>6</sup>	31	82	113		
Monts Aurès	Tmgad	El-Merfi (A ) <sup>7</sup>	6	40	46	
		Ouled-Bedda(A ) <sup>3</sup>	28	82	110	
	Batna	Condorcet (A ) <sup>1</sup>	12	75	87	
	Bouhmama	Bohmama (A ) <sup>2</sup>	5	35	40	
			Assoul (A ) <sup>4</sup>	4	46	50
		Bouzouamel (A ) <sup>5</sup>	2	53	55	
		Takaneghir (A ) <sup>6</sup>	8	42	40	
		Ilmathen 1 (A ) <sup>7</sup>	19	61	80	
		Ilmathen 2 (A ) <sup>8</sup>	9	42	51	
	M'sara (A ) <sup>9</sup>	9	31	40		
		<sup>10</sup>				

**Tableau 2:** *Indice de primarité loci en ségrégation (IPs) des populations caprines des Monts Dahra et Aurès*

Loci à effet visible	Monts Dahra							Total	Monts Aurès										Total	
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	D <sub>6</sub>	D <sub>7</sub>		A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>	A <sub>7</sub>	A <sub>8</sub>	A <sub>9</sub>	A <sub>10</sub>		
A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Fr	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rn	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bd	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EL	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
EC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ECr	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
H <sub>a</sub>	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
HL	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	1
Wa	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
S	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Nls <sup>3</sup>	12	12	12	11	11	11	12	12	11	11	11	10	8	11	11	10	10	9	11	11
Nlc <sup>4</sup>	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
IPs <sup>5</sup>	1	1	1	0,91	0,91	0,91	1	1	0,91	0,91	0,91	0,83	0,66	0,91	0,91	0,83	0,83	0,75	0,91	0,91
TT <sup>6</sup>	78	92	52	39	41	67	113	485	110	87	46	40	40	56	50	80	50	40	599	599

<sup>3</sup> Nls: nombre de loci en ségrégation

<sup>4</sup> Nlc: nombre de loci considérés

<sup>5</sup> IPs = Nls/Nlc

<sup>6</sup> TT: taille du troupeau

**Tableau 3:** *Indice de primarité allèles au locus Agouti (IPa) des populations caprines des Monts Dahra et Aurès*

Allèles en Agouti	Monts Dahra							Total	Monts Aurès										Total	
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	D <sub>6</sub>	D <sub>7</sub>		A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>	A <sub>7</sub>	A <sub>8</sub>	A <sub>9</sub>	A <sub>10</sub>		
A <sup>+</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A <sup>+</sup>	0	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1	0	0	0	1
A <sup>+</sup>	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A <sup>+</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A <sup>+</sup>	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	0	0	0	1	1
A <sup>+</sup>	0	1	0	0	1	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1
A <sup>+</sup>	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	1	1
A <sup>+</sup>	1	1	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1
A <sup>+</sup>	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Nao <sup>1</sup>	5	9	4	5	7	4	8	9	5	6	5	5	4	7	4	6	4	6	6	8
Nac <sup>2</sup>	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	6	4	6	6	8
IPa <sup>3</sup>	0,55	1	0,44	0,55	0,77	0,44	0,88	1	0,55	0,66	0,55	0,55	0,44	0,77	0,44	0,66	0,44	0,66	0,66	0,88
TT <sup>4</sup>	78	90	39	34	41	67	103	452	64	82	45	40	40	55	50	80	50	40	40	546

<sup>1</sup> Nao: nombre d'allèles observés

<sup>2</sup> Nac: nombre d'allèles considérés

<sup>3</sup> IPa = Nao/Nac

<sup>4</sup> TT: taille du troupeau

