THE STATE OF POULTRY GENETIC RESOURCES IN RUSSIA

Irina G. Moiseyeva
N.I. Vavilov Institute of General Genetics,
Russian Academy of Sciences. GSP-l, 117809, Gubkin St., 3, Moscow, RUSSIA

SUMMARY

This paper presents a review of past and present effort for the maintenance and improvement of breeds of chicken. This involves what is done on large state farms, in research institutes and by fancy breeders. The present sate of this genetic resources is illustrated by a long table listing all the breeds with the available information.

RESUME

Cet article présente une revue des efforts menés actuellement et dans le passé dans le but de conserver et améliorer les races de poules. Il illustre les travaux réalisés dans les fermes d'Etat, dans les instituts de recherche et par les améliorateurs. Les ressources génétiques actuellement disponibles sont indiquées dans une longue liste avec les différentes races et l' information disponible sur celles-ci.

1.0 INTRODUCTION

The development of civilization is accompanied not only by great scientific and technological discoveries and achievements in all spheres of human being but also by the appearance of a lot of serious problems which have not been satisfactorily solved so far. One of such problems is the increasing reduction of species diversity. 3 to 5 out of 45 000 species of vertebrate animals existing on the Earth die out annually. The tempo of disappearance of species is constantly increasing. According to FAO information, one breed of domestic animals disappears every week. Analogous processes reducing the genetic diversity of livestock animals occur in Russia as well, and their unfavourable consequences are aggravated by a general economic recession.

The present publication informs of the state of the genetic resources of poultry husbandry (chicken breeding, in particular) in Russia. Some of the data concerns the territory of the former USSR. It is apparent that poultry husbandry involves other species of domestic fowl besides chiclcens. There is an abundant gene pool of native goose and pigeon breeds in Russia. Its description, however, may be the subject of another publication.

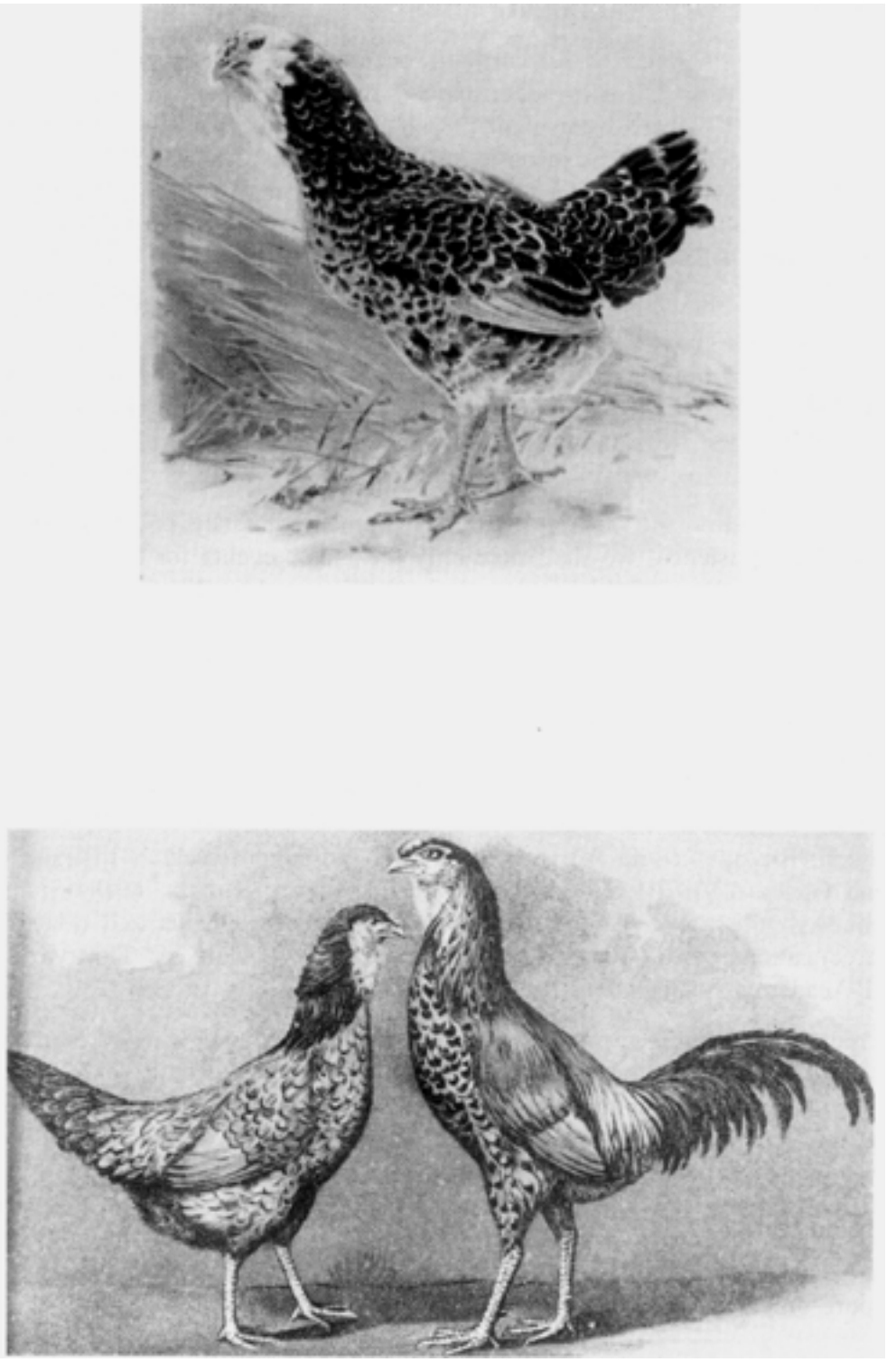
Poultry breeding in Russia, as well as in other developed countries, exists in two forms: commercial and farmyard poultry. A variety of the latter is fancy poultry and together with its specificity is the main source of genetic resources of domestic poultry.

2.0 COMMERCIAL POULTRY BREEDING

The basis for the development of commercial poultry breeding in the country was the organization in the late 1920s of large breeding farms and in the 1930s of poultry factories. Since 1964 the USSR government has adopted resolutions to practise poultry breeding on an industrial basis. The commercial poultry breeding in Russia (as formerly in the USSR) is based on chiclcen lines imported from other countries. Many of the imported lines have been improved in the course of adàptation to new conditions, and new crosses have been produced as a resul.t of crossing between chicken lines purchased in different countries and belonging to different crosses.

On January I st 1994 the total number of chickens in the system of Ptitseprom (poultry industry) of the Russian Federation made up: in egg crosses - 207 Ol 1 100, in meat crosses - 144 979 000, in meat-egg breeds - 1 543 100. As compared to 1990, the total number of chickens in egg crosses decreased by 6.35o/o, in meat crosses the quantity of birds increased by I5.65% and the size of meat-egg breeds remained constant.

In I993, nine crosses were used in egg poultry and 6 crosses in meat poultry. The numnber of birds in some of them make up less than 1 o/o of the total number and therefore such crosses do not play an important role in the gene pool of commercial poultry breeding. In t 9991l3 egg crosses were maïnly composed of Belarus-9, Lohmann Brown and P-46 (30.2; 22.2 and 21.4% respectively). Meat crosses were composed of Smena and Broiler-6 (48.6% and 24.7%). The initial breeds of Belarus-9 are Leghorn White and Californian Gray, Lohmann Brown consists of Leghorn White, Rhode Island Red and Plymouth Rock White, P-46 includes only Leghorn White; Smena and Broiler-6 involve Plymouth Rock White and Cornish White. Thus, the main part of the gene pool of commercial crosses consists of 5 breeds only, which is a negligible portion (0. 33%) of the world gene pool of chicken breeds (assuming that there are about 1 500 chiclcen bzeeds in the world).



3.0 FANCY POULTRY BREEDING

For understanding the processes currently occurring in amateur poultry breeding in the country, it is necessary to cite some data about how it developed and what we possessed previously. Up to 1917, there were about 80 chicken breeds, varieties and populations of home production and selection (the information from fanciers). Some of them gained world recognition (Orloff, Pavlov). During the Soviet years about 22 breeds, breed groups[1] and their varieties were produced, 4 of which (Russian White, Yerevan, Moscow, Kuchino Jubilee) were registered in the USSR Ministry of Agriculture as breeds.

Almost all our breeds are synthetic or, in other words, produced by crossing foreign breeds with each other or with local chielcens. The origin of some old breeds is unlcnown. In the past, Russian native breeds were produced using Asian chickens brought from Persia and Mediterranean breeds reared by the populations of the Greek colonies on the Black Sea coast. However, the first flow of genes was more significant and therefore our local peasant chickens had many traits of the Asian fowl.

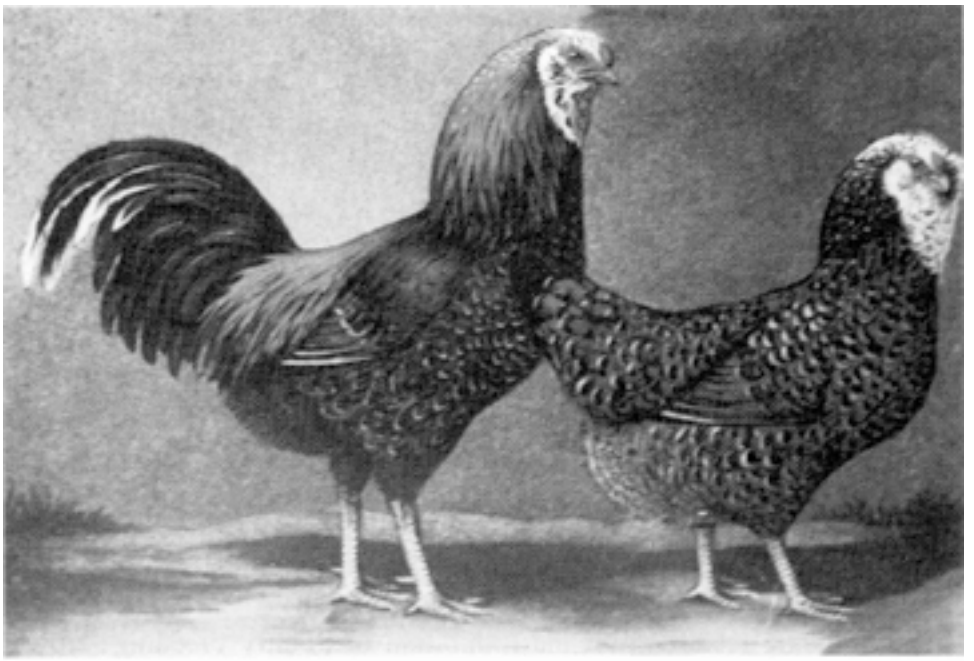
Without going into the details of the development of fancy poultry breeding for the whole period of ïts existence, we shall note only the major events for the past two decades. The first lcnown collections of chicken breeds in the former USSR existed in the fifties and sixties of this century in the Ukrainian Research Institute of Poultry (now Poultry Research Institute of the Ulcrainian Agrarian Academy of Sciences) (NIIP, Borki, Kharlcov region, Ukraine) and since 1963 in the Poltava Agricu.ltural Institute. Since the mid seventies the state organs of the USSR made attempts to preserve and extend the available pool of native and foreign breeds. In this connection, in 1976 the Ptitseprom of the USSR issued an edict about the establishment of chiclcen breed collection farms which were organized in the All-Union (now All-Russian) Research and Technological Institute of Poultry (VNITIP, Sergiyev Posad, Moscow region, Russia), in the All-Union (now All-Russian) Research Institute of Animal Breeding and Genetics (VNIIRGZH, Pushkin, St-Petersburg, Russia), at the State Breeding Farm "Kuchinsky" (Moscow region). Small collections of chiclcens and other birds were available in educational institutes such as those belonging to the K.A. Timiryazev Moscow Agricultural Academy, St-Petersburg State University, etc.

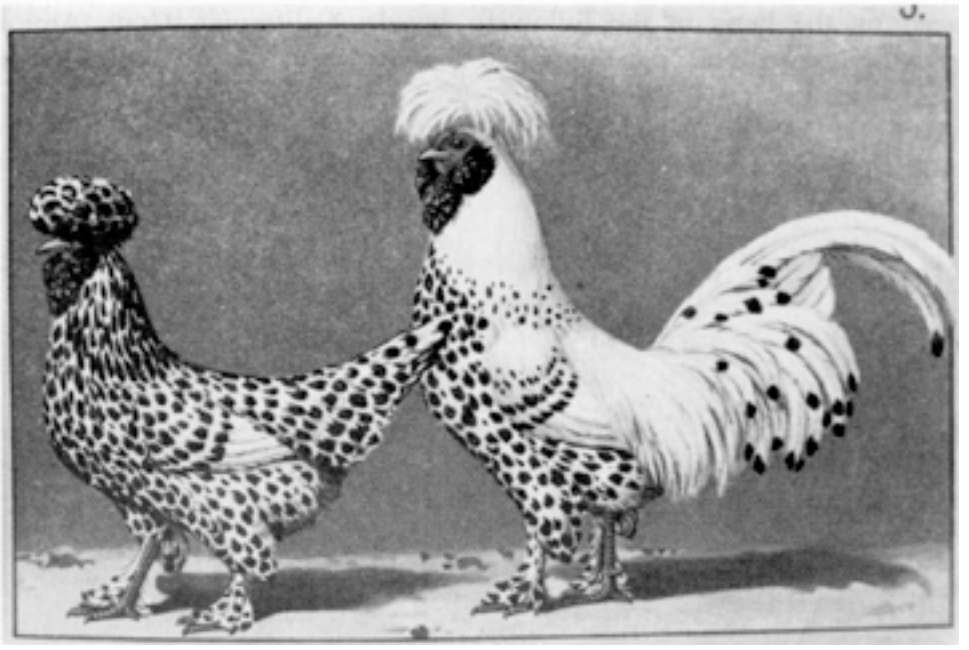
The measures undertaken promoted the activity in fancy and farmyard poultry breeding. This found its expression in the creation or reorganization of societies or clubs of poultry fanciers. Some of them may be considered the successors of analogous societies (for example, inz Moscow, St-Petersburg, Riga, etc.) existing before 1917. In 1990, the All-Union (now All-Russian) association of all fancy fowl clubs was formed. In 1991 the club of native fowl breed fanciers was registered with this society. The clubs of poultry fanciers carry out the work on the conservation, reproduction and search for rare fowl breeds. They organize expeditions and exhibitions, issue special literature and help fancy fowl breeders providing them with pure breeding material.

At present, about 40 native chicken breeds and populations are reared in Russia: VNIIRGZH farm - 18; VNITIP - 23; the fanciers rear about 18. The size of populations on some farms has sharply reduced in the past two years, for instance, at the VNIIRGZH farm trom 2 181 individuals in 1991 to 1 525 in 1993, i.e. by 30%. At the VNITIP farm there are 4 195 individuals of native fowl without essential changes in recent years.

In addition to the reduction in the number of birds composing breeds, whole breeds or breed varieties also disappeared. 10 breeds have been lost and there is no information about the existence of 25 out of 72 native breeds recorded in the Breed Data Bank of N.I. Vavilov Institute of General

' The term "breed group" means the group of fowl formed in the process of creating a breed but does not satisfy all breed requirements.





Genetics of the Russian Academy of Sciences (IOGen) (Moscow, Russia). These losses constitute nearly 50% of the decrease of genetic resources with respect to breed composition. Many other breeds are on the verge of extinction (see table).

Scientists of research institutes and amateur poultry breeders malce attempts to restore and preserve native chicken breeds. The Orloff breed, which is the pride of Russia like the game breeds in England, has been regenerated. The Moscow Game breed is being maintained. The Russian Black Bearded breed has been found and now reared. The Jurlov Crower breed[2] was reproduced from a few birds remaining after World War II. On the basis of old drawings the Pavlov breed is being restored. At the Exhibition of Poultry breeding (November 1993) organized by the Moscow Regional Club of Fancy Fowl rare breeds were demonstrated: Russian Crested, Muffed, and Russian Butterfly.

To increase genetic diversity in a single population, experimental groups of chickens with a wide spectrum of genes are produced at gene pool farms of research institutes. For example, in VNITIP randomized populations of chiclcens with barred feather patterns have been produced on the basis of the following breeds: Californian Gray, Amrolcs, Kirgiz; population of chickens with black coloured plumage on the basis of Minorlca Black, Moscow, Australorp and Pantsirev Black. Red birds have been produced on the basis of Rhode Island Red, New-Hampshire, Yerevan Red, Poltava Clay; the population with the Columbian restriction pattern of feather colour has been obtained on the basis of Sussex Light, Adler Silver, Pervomai.

Several populations have been produced in VNIIRGZH: Australorp Black Speckled, Leningrad Golden Gray, Plymouth Roclc Barred Speckled, Pushkin Barred Speckled. In NIIP, heterogeneous populations have been obtained by crossing several strains of Poltava Clay and of Leghorn White.

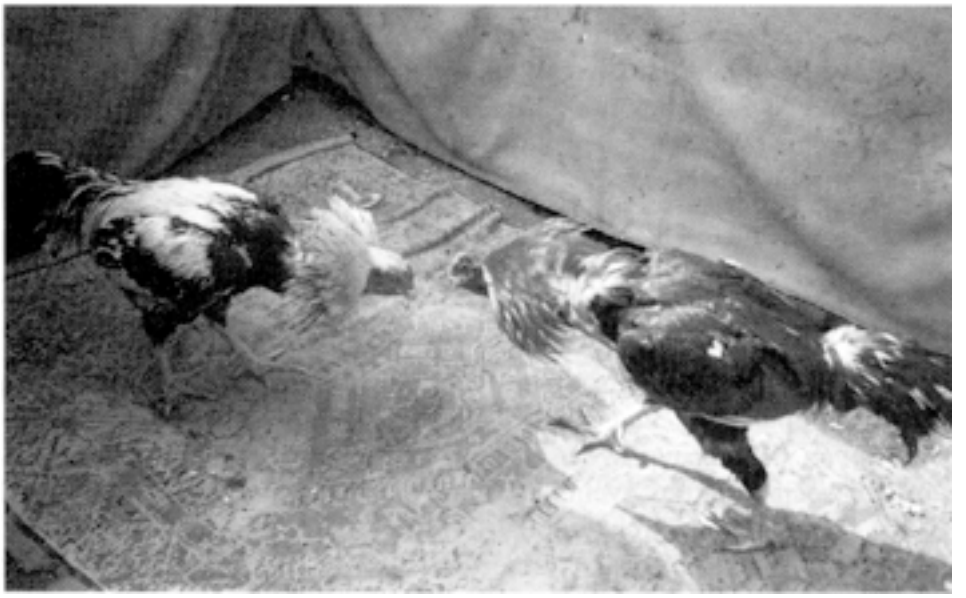
Some fancy poultry breeders worlc to create new forms. For example, at the exhibition organized by the Moscow Regional Club of Fancy Poultry Breeders in February of 1990 chiclcens under the name of Zaryanka (beautiful birds with pink feathers recalling the colour of dawn) were demonstrated.

4.0 RESEARCH IN POULTRY GENETICS

Besides practical worlc with chiclcen breeds, studies of the biological, genetic and economnic characteristics of breeds are carried out at research institutes. Blood group studies in different chiclcen breeds were carried out in IOGen and NIIP; electrophoresis of egg, blood, seminal fluid and cardiac muscle proteins were performed in IOGen, NIIP, Institute of Zoology and Physiology of the Moldavian Academy of Sciences (Kishinev, Moldova); screening of DNA polymorphism - in the Institute of Gene Biology of the Russian Academy of Sciences (Moscow) and in VNIIRGZH; chicken genome mapping- in the St-Petersburg University; studies of discrete mendelian morphological characters (comb type, plumage colour, the presence of a crest, muffs and beard, neclc feathering, etc.) and quantitative cilaracters (body dimensions, serum esterase activity, parameters of egg quality) were carried out in IOGen; genetic analysis of breeds by thé traits included in the breed standard as well as by the feathering rate, the age of sexual maturity was carried out in VNITIP. In VNIIRGZH, methods to preserve cock sperm have been developed and genealogical trees of individual breeds are being constructed.

The most systematic studies on genetics of native and foreign chicken breeds have been carried out during several decades in IOGen. By the present time, the scientifiic workers of this Institute have prepared a data banlc including evidence on the origin, genetic, morphological and economic characteristics of 260 breeds, breed groups and varieties (among them 72 native populations of the former USSR). The data was taken from their own investigations and from

2 Cocks of the Jurlow Crower breed have a strong and pleasant voice. Among them "tenors", "baritones" and "basses" are distinguished. The best singers can sustain a note for up to 25 seconds.



literature. The data bank is used in studying the level and structure of genetic diversity of native chicken breeds as compared to foreign and wild chickens (Red Jungle Fowl) and in establishing genetic similarity and relations between breeds and different groups of breeds.

Using genetic marlcers, the current systems of breed classiflcations are assessed and hypotheses on the origin of individual chicken breeds and groups of breeds as well as on the centres of their origin and formation are checlced. The available data on biochemical markers and discrete morphological characters malce it possible to carry out genogeographical studies c[f] nat::e and foreign chic[k]cen breeds.

Three books with materials describing native chicken breeds have been published in ouur country.

5.0 CONCLUSIONS

The material presented demonstrates that in our country the work on the production of chicken breeds and populations and studies of their features have been carried out rather extensively. However, achievements of selection and science in this field could not be fully realized because of social-historic events constantly occurring in the territory of Russia and the former USSR since the beginning of this century. Unfortunately, nor does the present economic recession in Russia favour the preservation of poultry genetic resources at the level of the developed countries. Some unreasoned decisions, such as the bans on coclc-fighting repeatedly imposed by the Society for Animal and Plant Protection (the last one was accepted in 1992), lead to the disappearance of game breeds or to the loss of their fighting qualities.

As a result of the above mentioned and other unfavourable factors, the number of chickens and chiclcen breeds as well as the genetic diversity of preserved but small-sized breeds have been decreased. The total number of chickens in fancy poultry has decreased for the past 2-3 years by about 30[o]/o. We do not possess exact data with respect to the number of individuals in particular breeds and a possible degree of their inbreeding since a corresponding estimation in amateur poultry breed.ing over the vast territory of our country is rather diffïcult. However, it can be assumed that the level of inbreeding is undoubtedly high in breeds consisting of only several dozens of birds (for example, there are only about 50 Moscow Game coclcs and 300 hens in the whole country). The loss of breeds (10 out of 72) for the 50-100 year period has made up nearly 14[o]/o and with the breeds about whose existence we have no information (25) this estimate constitutes nearly SO[o]/o. 13 breeds out of the remaining 37 are considered endangered or critical, which may decrease the breed genetic resources even more than by 35%. The latter include such chicken breeds as Orloff, Moscow Game, Jurlov Crower, Russian Black Bearded and others which are of aesthetic, sport and economic value and which are living material monuments of human culture and the genetic heritage of the past centuries. Destruction of these monuments leads to irreplaceable losses since they cannot be fully regenerated in the future. In connection with this, it is desirable to include endangered and critical chiclcen breeds in the International Register of rare and disappearing animal breeds. They need to be protected.

This work has been supported by the Russian Foundation of Basic Research and the Russian State Scientific Programme "Biological Diversity".

6.0 ACKNOWLEDGMENTS

I am grateful to A.A. Sevastaynova (VNITIP), N.D. Philippova (VNIIRGZH), G.P.Shevyreyva (fancier) and S.G. Ryzhov (fancier) for providing me information about native Russian chicken breeds.

7.0 REFERENCES

Karimov K.K. 1976. Local and indigenous chiclcen breeds. Catalogue of native local breeds of livestoclc and fowl in the USSR. Ivanova K.M.L. (Ed.). All-Russian Research Institute of Animal Breeding and Genetics. p.112-135.

Loftus R. and Schere B. 1993. World Watch List for Domestic Animal Diversity. Rome, Italy. p.376.

Moiseyeva I.G. 1992. Native chiclcen breeds. Farm animal resources: rare and endangered breeds. Zalcharov I.A.M. (Ed.). Nauka. p.ll-112.

Paronyan J.A. and Yurchenko O.P. 1989. Domestic fowl. Animal genetic resources of the USSR. FAO, Rome, Italy. p.401-430

Veprintsev B.N. and Rott N.N. 1991. A strategy of preservation of the animal and plant world of Earth. Conservation of genetic resources. Collected scientific articles. Pushchino. p.5-18.

List of native chicken breeds, breed groups, varieties and populations of the territory of the former USSR

Breed, breed group, population	Variety	Period of origin	State of a breed, breed group, population at the present time
Adler Silver (Adlerskaya serebristaya)		Middle of the XXth century	Distributed widely. Especially in Krasnodar territory, Volgograd region, reared at GPR* of VNIIRGZH and VNITIP
Anatolian Astrakhan (Anatoliyskaya, Astrakhanskaya)		Information is not available	Lost
Andizhan Game (Andizhanskaya Boitsovaya)		Information is not available	Information is not available
Armenian (Armyanskaya)		Long ago	Information is not available
Arzamas (Arzamasskaya)		Information is not available	Lost
Asian Crested (Aziatskaya Khokhlataya)		Information is lost	Information is not avaiable
Australorp Black Speckled (Avstralorp Chemo-Pestryi)		1963-1973	Distributed in the Northern regions of Russia and Karelia, reared at GPF of VNIIRGZH and VNITIP
Azerbaijan (Azerbaijanskaya)	Black Speckled	Information is not available	Both varieties are distributed in Azerbaijan
Bashkir (Bashkirskaya)		Information is not available	Information is not available
Bukhara (Bukarskaya)		Information is not available	Information is not available
Capunok		Information is not available	Lost
Caucassian Silky (Kavkazskaya Shelkovistaya)		Information is not available	Information is not available
Cossack (Kazak)		Information is not available	Information is not available
Georgian Game: crosses of different game breeds (Gruzinskaya boitsovaya)		Information is not available	Endangered. Distributed in Georgia
Georgian local (Gruzinskaya mestnaya)	Vanana Chalispery Chia Cochara Natsara Megrula	Information is not available Information is not available Information is not available Information is not available Information is not available Information is not available	Information is not available Distributed in Georgia Distributed in Georgia Distributed in Georgia Distributed in Georgia Distributed in Georgia, reared at GPF of VNITIP

Breed, breed group, population	Variety	Period of origin	State of breed, breed group, population at the present time
Gilany (Gilanskaya)	Red, Mille-Fleur, White	XVIIIth century	All varieties have been lost
Guzul Crested (Gutsulskaya Khokhlataya)		Information is not available	Information is not available
Ivanov Game: a local population of the Moscow Game breed (Ivanovskaya Boitsovaya)		Information is not available	Lost
Kabardian (Kabardinskaya)		Information is not available	Information is not available
Kirghiz (Kirghizskaya)		The formation of the breed began in 1948	Distributed mainly in Kirghizstan, reared at GPF of VNITIP and VNIIRGZH
Kirghiz local (Kirghizskaya Mestnaya)		Information is not available	Information is not available
Kotlayarevskaya		1960	Endangered. Reared at GPF of VNITIP
Kuchino Jubilee (Kuchinskaya Yubileinaya)		The breed was registered in 1990	Distributed all over Russia
Kulanghi		Long ago	Reared in the former Middle Asian Republics, at GPF of VNITIP and VNIIRGZH
Latvian Red (Latviiskaya Krasnaya)		Information is not available	Reared in Latvia
Leghorn Bantam Barred		1976-1980	Endangered. Reared at GPF of NIIP
Leghorn Bantam Black		1976-1980	Endangered. Reared at GPF of NIIP
Leningrad Golden Gray (Leningradskaya Zolotisto-Seraya)		1978-1983	Endangered. Reared at GPF of VNIIRGZH
Leningrad Mille-Fleur (Leningradskaya Sitsevaya)		1988-1994	Endangered. Reared at GPF of VNIIRGZH
Leningrad White (Leningradskaya Belaya)		1950-1960	Available
Livny (Livenskaya)		Maybe at the end of the XIXth century	Lost
Lvov Royal (Lvovskaya Korolevskaya)		Information is not available	Information is not available
Margilan Game (Margilanskaya Boitsovaya)		Information is not available	Information is not available
Moldavian, Bessarbian (Moldavskaya, Bessarabskaya)		Information is not available	Information is not available

Breed, breed group, population	Variety	Period of origin	State of a breed, breed group, population at the present time
Moscow (Moskovskaya)		The breed was registered in 1980	Distributed widely from the Northern to the Southern regions of Russia, reared at GPF of VNITIP
Moscow Game (Moskovskaya Boitsovaya)		XVIIIth century	Critical. Reared by fanciers, at GPF of VNIIRGZH
Moscow White (Moskovskaya Belaya)		1948-1960	Reared in the Moscow region and at GPF of VNITIP
Muffed, Russian Muffed, Ukrainian Muffed (Ushanka, Russkaya Ushanka, Ukrainskaya Ushanka)		Information is not available	Distributed widely in the South of Russia and in the Ukraine, reared at GPF of VNITIP and VNIIRGZH
Near Carpathian Greenleg (Pricarpatskaya zelenonozhka)	Partridge White	Information is not available	Information is not available
Neck Naked (Golosheinaya)		Information is not available	Reared in the Southern regions of Russia, Ukraine, Georgia, GPF of VNITIP
Nizhnedevitskaya, Buff Black Tailed (Nizhnedevitskaya, Palevaya Cherno-Khvostaya)		Maybe in the second part of the XIXth century	Information is not available
Orloff (Orlovskaya)	Bantam, Mille-Fleur, Bantam Red, Bantam White, Barred, Black, Clay, Mahagony Black Breasted, Mahagony Brown-Breasted, Mille-Fleur, Red Black-Breasted, Red Brown-Breasted, Speckled, White	XVIIIth century	Endangered. Breed varieties are reared by fanciers, at GPF of VNITIP and VNIIRGZH
Pavlov (Pavlovskaya)	Blue-Golden-Silver	Maybe in the XVIIIth century	All varieties have been lost
Pantsirev (Pantsirevskaya)	Black-White	1947-1960	Both varieties are distributed in the Central and Southern regions of Russia, reared at GPF of VNITIP and VNIIRGZH

Breed, breed group, population	Variety	Period of origin	State of a breed, breed group, population at the present time
Pervomai (Pervomaiskaya)		The formation of the breed began in 1935	Reared at GPF of VNITIP and VNIIRGZH
Plymouth Rock Barred Speckled (Plimut Rok Polosato-Pestryi)		1983-1986	Critical. Reared at GPF of VNIIRGZH
Polessian dikastaya (Polesskaya dikastaya)		Information is not available	Information is not available
Poltava	Black Clay Cuckoo	Maybe in the XIXth century	Lost Distributed widely in the Ukraine and Russia, reared at GPF of VNITIP and VNIIRGZH Lost
Pskov Creeper (Pskovskaya Korotkenozhka)		Information is not available	Information is not available
Pushkino Barred Speckled (Pushkinskaya Polosato-Pestraya)		1976-1981	Endangered. Reared at GPF of VNIIRGZH
Rechitsy (Rechitskaya)		Information is not available	Information is not available
Russian Black and Bearded, Galan, Woodgrouse (Russkaya Chernaya Borodataya, Galan, Gluchar)		In the second part of the XIXth century	Critical. Reared by fanciers
Russian Butterfly, Kursk Speckled (Russkiy Korolek, Kurskaya pestrushka)	Golden, Mille-Fleur, Mottled, White	Information is not available	All varieties are reared by fanciers all over Russia
Russian Chicken (Russkaya Kuritsa)		Information is not available	Maybe conserved in the Volgograd region
Russian Crested (Russkaya Khokhlataya)		Information is not available	Endangered. Reared at GPF of VNITIP and VNIIRGZH, by fanciers
Russian White		The breed was registered in 1953	Reared in Russia, at GPF and VNITIP
Samarkand Game (Samarkandskaya Boitsovaya)		Information is not available	Information is not available
Serpukhov Game: a local population of the Moscow Game breed (Serpukhovskaya Boitsovaya)		Information is not available	Lost
Shershetka		XVIII?	Lost

Breed, breed group, population	Variety	Period of origin	State of a breed, breed group, population at the present time
Shpanka Beloushka		Information is not available	Information is not available
Siberian Buff (Sibirskaya Palevaya)		Information is not available	Information is not available
Siberian Shank Feathered (Sibirskaya Mokhnonozhka)		Information is not available	Information is not available
Tarussa the Best (Tarusskaya Uluchshennaya)		Information is not available	Lost
Tsar Chicken (Tsarskaya Kuritsa)		XIXth century	Lost
Turkmen Game (Turkmenskaya Boitsovaya)		Information is not available	Information is not available
Ukrainian Crested (Ukrainskaya Khokhlataya)		Information is not available	Reared in the Ukraine
Voronezh Black and White (Voronezhskaya Cherno-Pestraya)		Maybe at the end of the XIXth century	Information is not available
Yalta Bantam (Yaltinskaya Karlikovaya)	Black-Red	The breed is registered in 1974	Both varieties are distributed in Armenia, reared at GPF of VNITIP and VNIIRGZH
Yurlov Crower (Yurlovskaya Golosistaya)		XIX?	Endangered. Reared at GPF of VNITIP, VNIIRGZH and by fanciers
Zagorsk	Salmon White	1950-1955	Distributed in the Central regions of Russia, reared at GPF of VNITIP and VNIIRGZH Lost

*GPF = Gene Pool Farm

Note: Breed names written after a comma mean synonyms. In parenthesis Russian name written using the English letters.

SITUATION OF INBREEDING IN A RETINTO POPULATION

I. Serrano[1], M. Mayer[2], A. Rodero' and J.M. Jimenez[3]
'Department of Genetics, Veterinary Faculty,
University of Cordoba, Cordoba, SPAIN
[2]Department of Animal Production, University of Nairobi,
P.O. Box 29053, Nairobi, KENYA
[3]Research Centre of Agricultural Animal Husbandry, Cadiz, SPAIN

SUMMARY

The degree of inbreeding was studied for a subpopulation of the beef cattle breed Retinto from the Cadiz Province in Andalusia (Spain). The pedigree information from 492 female and 25 male breeding animals was analyzed. On the basis of the available information, only the current inbreeding, that is the inbreeding with consideration of three ancestral generations, could be calculated. While close inbreeding is purposely avoided with the bulls, it is of great importance in cows. The average coefficient of inbreeding for cows born in the years 1982 to 1987 was 2.35o/o, although in the great-grandparent generation only 55% of the ancestors were known. Inbreeding was discovered in 17.7% of the cows; 5.8% of the cows had an inbreeding coefficient of 25%. The rate of inbreeding per generation is very high in comparison with other beef cattle breeds and above all in comparison with dual purpose cattle. Because of the manner in which the bulls are used, also considerable non-current inbreeding has to be expected.

RESUMEN

Se ha estudiado el grado de consanguinidad en una subpoblaci ôn de la raza bovina de carne Retinto en la provincia andaluza de Câdiz (Espana). Se ha analizado la informaciôn de ascenizencia de 492 hembras y 25 machos seleccionados. Sobre la base de la informaciôn disponible, ûnicamente la consanguinidad corriente, es decir la consanguinidad referida a las tres generaciones pasadas, podrf a ser calculada. Mientras una consanguinidad elevada no es importante para los toros, resulta de gran importancia para las vacas. El coeficiente medio de consanguinidad para las vacas nacidas entre 1982 y 1987 era de 2.35%, mientras que sôlo se conocfa el 55% de los progenitores en la generaciôn de los bisabuelos. Se ha encontrado consanguinidad en el 17.7% de las vacas; el 5.8% de la vacas resultô tener un coeficiente de consanguinidad del 25%. La tasa de consanguinidad por generaciôn es muy alta en comparaciôn con otras razas de vacuno de carne, y sobre todo en comparaciôn con los vacunos de doble propôsito. Debido a la forma en que se usan los toros, también debe resaltarse una consanguinidad poco corriente.

1.0 INTRODUCTION

Breeding of livestock is based upon the selection of especially suitable appearing parent animals for the forming of the next generation. Inbreeding can result from intentional or unintentional mating of close relatives. In addition, a more or less intense limitation in the number of selected parent animals inevitably leads to the mating of animals with common ancestors and, therefore, also to inbreeding. Within the framework of the characterization of the genetic structure of populations the description of inbreeding is of special importance. Generally, very few investigations about inbreeding in beef cattle can be found. As for the breed Retinto, this is a local Iberian beef cattle breed which is extensively kept as a maternal breed and which is well adapted to the extreme environmental conditions and the low quality pastures in the west of southern Spain (Rodero et al. 1992a). The breed is found today mainly in the Extremadura and Andalusia Regions. A herd book for this breed was recently established in 1976, in which 18 346 animals from 390 herds were registered. Today we have a registration of 13 041 female and 377 male breeding animals from 262 herds. Kidd et al. (1980) estimated an average inbreeding coefficient of 8% for the breed Retinto by means of a comparison of that observed with the expected frequency of heterozygotes at 7 codominant loci. In the present study the situation of inbreeding in a Retinto subpopulation will be examined by a pedigree analysis. The importance of the results for breeding will be discussed.

2.0 MATERIAL AND METHODS

The basis for this study were the animals of a breeding programme, which has been performed since 1988 in the Province of Cadiz in Andalusia (Spain). At the beginning of the programme there were 9 herds with 680 cows and 54 bulls participating in a reference sire scheme; from the farmers' date of matings and calvings, identification of the parents of the calves born, reproductive data and three weights of the calves until weaning have to be reported (Rodero et al. 1992b). Breeding values for the parental animals are routinely estimated by the Department of the first author, which also co-ordinates the whole breeding programme. The Retinto Breeders Association made the pedigree information of the registered breeding animals used in the starting year 1988, i.e. of 492 cows and 25 bulls available to us. The cows were born between 1975 and 1987. The written material received from the breeding society was transferred to a data bank and the accuracy of the data was checked. For the calculation of the coefficients of inbreeding and relationships, computer programmes developed by the second author were used, which are based on the recursive algorithms of Quaas (1976) and Hudson et al. (1982). These programmes had already been used in several other studies (e.g. Bollmeier *et al.* 1991, Schmidt *et al.* 1993). Not a certain number of ancestral generations, but all available pedigree information was used in the calculations.

3.0 RESULTS

In the pedigrees of the investigated animals, we found 458 cows and 89 bulls wvhich were a part of the founding herdbook population of 1976.

With regard to the use of sires, one can picture the following description of the breeding policy. The bulls, with two exceptions, were used merely in their own herds. In 1985, four sons from one bull and, in 1986, two sons from another bull were used in different herds. The animals newly registered in the herdbook for a year, generally stem from only one or two sires. Exceptions to this was a herd in 1984, and another herd in the years 1985 and 1986. In the referred herds and years, the registered offspring stemmed from four, three and four sires, respectively. The bulls were normally used for only two mating seasons. Three of the bulls were used for four years and one bull for five years.

Inbreeding, e.g. an inbreeding coefficient greater than zero, was calculated for 60 of the 492 cows, corresponding to a portion of 12% (table 1). The average coefficient of inbreeding calculated amounted to 1.57% and the standard deviation was 5.3o/o. For the male animals, two out of 25

bulls, e.g. 9%, showed non-zero inbreeding coefficients; these two inbreeding coefficients are 4.69% and 6.26%, respectively. The average coefficient of inbreeding ainong the bulls was calculated at 0.43%. In the interpretation of these results, one has to consider the coinpleteness of the pedigree information. Among the female animals, for example, the pedigrees show an average completeness of 42.8o/o for the third ancestral generation and this decreases to 6.0% üI the fourth and to 0.2% in the fifth ancestral generation (table 1).

The distribution of the inbreeding coefficients for the feinale animals is presented in table 2. It is interesting here to note the frequent occurrence of very high individual coefficients of inbreeding. For example, 3.9% of all cows show an inbreeding coeffïcient of 25%; such an inbreeding coefficient corresponds to a father-daughter mating.

If one considers the average inbreeding coefficient of the cows according to the coinpleteness of the pedigrees, there is a clear increase of the inbreeding coefficient with increasing completeness of the pedigrees. In table 3 the average inbreeding coefficient according to the extent of the information from the third ancestral generation can be found. For cows where at least two out of eight ancestors from the third ancestral generation are lcnown (CG3 >= 25%), the average coefficient of inbreeding amounts to 2.06% and increases then steadily up to 3.32%, when all of the great-grandparents are known.

In viewing the inbreeding coefficients of the cows as regards the years of birth (table 4) - for 10 cows the date of birth was unknown - one observes defnite differences between the years 1975 to 1981 and the years from 1982 to 1987. Among the younger cows, between 13.3% and 27.8% of the cows were found to be inbred; the average coefficients of inbreeding ranged from 1.26% to 4.41 %. The mean value for the inbreeding coefficient of this group is 2.35%. In contrast, the low grade of inbreeding in the earlier years of birth is clearly due to the highly incomplete pedigree information.

4.0 DISCUSSION

As a result of the incompleteness of the available pedigree information, especially for the fourth and earlier ancestral generations, we were only able to determine the occurrence of inbreeding through the intentional or unintentional mating of close relatives. A completeness of 6% in the fourth ancestral generation ineans that froin 16 ancestors only one may be lcnown. While it was apparent that the use of closely inbred bulls was consciously avoided, a high degree of current inbreeding was found for the cows. In reference to the years of birth 1982 to 1987, inbreeding occurred in 17.7% of all cows. The average coefficient of inbreeding amounted to 2.35o/o. Neglecting the little information in the fourth and fifth ancestral generation in this group and taking into account the incomplete knowledge of the great-grandparents a "rate of current inbreeding", using the usual approach to calculate the inbreeding rate, of at least 2.35% / 2 generations. = 1.18% per generati.on can be determined. The high current inbreeding in this group is also evident by the high number of cows with an inbreeding coefficient greater/equal to 12.5% or 25%; the corresponding proportions are 9.8% and 5.8%, respectively. Kidd et al. (1980) estimated an average inbreeding coefficient of 8% for aninlals of the Retinto breed, which they sampled from different herds from different geographical regions. This value is higher than the value which we determined. But the methodical approach used by Kidd et al. (1980) was based on the analysis of the degree of heterozygosity. Here one must remember that this approach reacts very sensitively to coincidental or systematic deviations in the frequency of the genotypes. In addition to inbreeding, for example, the existence of subpopulations also leads to a reduction of the degree of heterozygosity. Because of the extensive management of the beef cattle breed Retinto, with the deployment of bulls in natural inating and because of the manner of bull use described, one must undoubtedly assume the formation of subpopulations. On the other hand as already mentioned, it was not possible in our investigation to determine the inbreeding caused by common ancestors in the period before the great-grandparent generation. Considering all

these aspects, the calculated inbreeding coefficient of Kidd et al. (1980) seems, in comparison, to be a little too low.

A direct comparison of the inbreeding determined with the results from other publications is often very difficult, because the number of ancestral generations in question is either different or not given at all, and the completeness of the pedigrees vary to a high degree. Generally, very few investigations about inbreeding in beef cattle can be found. Willham (1937) found an average inbreeding coefficient of 8.1 % in American Herefords, taking into consideration approximately 13 ancestral generations. Stonacker (1943) obtained an inbreeding coefficient of 11.3% for the American Aberdeen-Angus cattle, using 17 ancestral generations. Barker and Davey (1960) determined an inbreeding coefficient of 1.8% (approx. 5 ancestral generations) for Australian Poll Hereford and Davey and Barker (1963) an inbreeding coefficient of 2.6% (12 ancestral generations) for Australian Hereford. Watson (1963) estimated, considering 4 ancestral generations, an inbreeding coefficient of between 1.2% and 2.2% for British Welsh Black breeding animals used in natural mating, and Ozkiütiük and Bichard (1977) came up with an inbreeding coefficient of 5.7% (12 ancestral generations) for Irish Hereford. For these investigations, the rate of inbreeding, i.e. the increase in inbreeding per generation lies between 0.24% and 0.73%. In comparison, the rate of inbreeding for cows which we determined in our study is very high.

Considering the degree of heterozygosity in another Spanish breed De Lidia (Fighting Bull), Kidd et al. (1980) calculated an average inbreeding coefficient of 17% and for the Portuguese breed Mertolenga, they obtained a value of 5%.

With dual purpose cattle and the usual artificial insemination - breeding programmes here, one must definitely distinguish between current and non-current inbreeding. As shown in the studies of Schmidt *et al.* (1986), Bollmeier *et al.* (1991) and Schmidt *et al.* (1993) for various populations, inbreeding within the last three ancestral generations is, in general, intentionally avoided. Medium-termed, however, the mating of animals with common ancestors, which is an increase in inbreeding, cannot be avoided. The rates of inbreeding for dual purpose cattle from the literature are, in general, lower than those for beef cattle. Thus, Bollmeier et al. (1991) found the rate of inbreeding in Wtürttemberg Brown Cattle (Germany) to be 0.08% to 0.38% per generation for calves born in different years. Schmidt et al. (1993) calculated similar rates of inbreeding of 0.12% to 0.27% in Westphalian Red and White cattle(Germany). The above mentioned rates of inbreeding are representative for the more recent results from the literature for dual purpose breeds (Schmidt, 1990).

High inbreeding coefficients of over 10% or inbreeding rates of over I % per generation can be found in breeds or individual herds in which, during the twenties and thirties of this century, intentional line breeding or inbreeding was practised. This was done in order to obtain a consolidation of the breed or to promote the genetic contribution of an outstanding c;ngle animal fo^{r} ^{t}he impro^{v}vement of the whole population. This occurred within individuûl herds of fàmous breeders (Wright, 1923; Lush, 1934 and Stonaker, 1951) as well as in populations, whereby the breeds Shorthorn (Wright, 1923; Mc Phee and Wright, 1925; Mc Phee and Wright, 1926), Hereford (Willham, 1937) and Aberdeen Angus (Stonacker, 1943) must be especially mentioned.

5.0 CONCLUSIONS

Despite the incompleteness of the pedigree information, a very high current inbreeding has been observed in cows. The rate of inbreeding here was greater than normally found in beef cattle and therefore greater than in dual purpose cattle too. In comparison to our results, the higher inbreeding coefficient in the Retinto population calculated by Kidd et al. (1980) can be attributed to the genetic isolation of herds, the non-current inbreeding and the methodical approach. Due to the observed breeding policy and the manner of using the bulls, the existence of subpopulations as well as considerable non-current inbreeding has to be expected. The present study can only represent a beginning for the analysis of the genetic structure of the Retinto

population. The study is based on a small portion of the population from the Province Cadiz, and one cannot overlook the fact that this breed is distributed over widespread regions of Southwest Spain and Eastern Portugal. Since the calculated current inbreeding coeffiicients are surprisingly high, it would be very useful to perform a more thorough investigation of the Retinto population. It would be especially worthwhile in the future - the necessary comprehensive pedigrees are not yet available - to strive for an analysis of noncurrent inbreeding and of relationships among the breeding animals. Such information will allow for a more exact and across-herd evaluation procedure for breeding values, especially now with the onset of artificial insemination in the Retinto population.

6.0 ACKNOWLEDGMENT

This study was part of a project fmancially supported by the Andalusian Government and the C.I.C.Y.T. We wish to thank Mr. Manuel Beteta and Mrs. Belen Alvarez for their help and the Retinto Breeders Association for the contribution of the data.

7.0 REFERENCES

Barker, J.S.F. and Davey, G.P. 1960. The breed structure and genetic analysis of the pedigree cattle breeds in Australia. II. The Poll Hereford. Aust. J. Agric. Res. 11, p. I 072-1100.

Bollmeier, S., Mayer, M. and Simon, D. 1991. Entwicklung der genetischen Struktur beim württembergischen Braunvieh. Ziüchtungskunde 63, p.l-ll.

Davey, G.P. and Barker, J.S.F. 1963. The breed structure and genetic analysis of the pedigree cattle breeds in Australia. III. The Hereford. Aust. J. Agric. Res.14, p.93=118.

Hudson, G.F.S., Quaas, R.L. and Van Vleck, L.D. 1982. Computer algorithm for the recursive method of calculating large numerator relationship matrices. J. Dairy Sci. 65, p.2018-2022.

Kidd, K.K., Stone, W.H., Crimella, C., Carenzi, C., Casati, M. and Rognoni, G. 1980. Immunogenetic and population genetic analyses of Iberian Cattle. Anim. Blood Grps. biochezn. Genet. 1 l, p.21-38.

Lush, J.L. 1934. A herd of cattle bred for twenty years without new blood. J. Heredity 25, p.208-216.

McPhee, H. and Wright, S. 1926. Mendelian analysis of the pure breeds of livestock. IV. The British Dairy Shorthorns. J. Heredity 17, p.397-401.

McPhee, H. and Wright, S. 1925. Mendelian analysis of the pure breeds of livestock. III. The Shorthorns. J. Heredity 16, p.205-215.

Ozkütük, K. and Bichard, M. 1977. Studies of pedigree Hereford cattle breeding. 1. Herdbook analyses. Anim. Prod. 24, p.l-13.

Quaas, R.L. 1976. Computing the diagonal elements of a large nuznerator relationship matrix. Biometrics 32, p.949-953.

Rodero, A., Molina, A., Serrano, I., Burgos, A., Mayer, M., Salado, F. and Jimenez, J.M. 1992a. Caracterizaciô n productiva de la raza vacuna Retinta. Archivos de Zootecnia 4l p.579-586. '

Rodero, A., Molina, A., Burgos, A., Serrano, I., Mayer, M., Jimenez, J.M. and Salado , F. 1992b. Actuality and future of a breeding programme in Retinto beef cattle. Archivos de Zootecnia 41, p.569-572.

Schmidt, T.1990. Analyse der westfälischen Rotbuntzucht bezüglich Inzucht, Verwandtschaft Frezndgenanteil, Generationsintervall und Zuchtfortschritt. Diss. agr. Bonn.

Schmidt, T., Mayer, M. and Simon, D. 1993. Analyse der westfälischen Rotbuntzucht bezüglich Inzucht, Verwandtschaft und Fremdgenanteil. Züchtungskunde 65, p.102-11 I.

Schmidt, T., Mayer, M. and Simon, D.1986. Inzucht, Verwandtschaft und Genanteile in der rheinischen Schwarzbuntzucht. Annual Meeting of DGfZ and GfT in Hannover, Germany, 1986.

Stonaker, H.H. 1951. A uniqué herd of Hereford cattle. J. Heredity 42, p.207-209.
Stonaker, H.H. 1943. The breeding structure of the Aberdeen-Angus breed. J. Heredity 34, p.323-328.
Watson, J.H. 1963. Inbreeding arising through artif cial insemination and natural service in Welsh Black cattle. Anim. Prod. 5, p.209-214.
Willham, O.S.1937, A. genetic history of Hereford cattle in the United States. J. Heredity 28, p.283-294.
Wright, S.1923. The Duchess family of Shorthorns as bred by Thomas Bates. J. Heredity 14, p.405-422.

TABLE 1:
Mean inbreeding coefficients (F) and percentage of known ancestors in the ancestral generations (G1 to G5)

Group	N	N(F>0)	F (in %)	Gl	G2	G3	G4	G5
Cows	492	60	1.57	92.2	81.4	42.8	6.0	0.2
Bulls	25	2	0.43	96.0	91.0	40.0	5.0	0.7

N: Number of individuals
N (F>0): Number of inbred individuals

TABLE 2:
Distribution of the inbreeding coefficients (F) of the cows

F	Frequency	
(in %)	absolute	relative (in %)
0	432	87.8
0.78	1	0.2
1.56	4	0.8
3.13	9	1.8
4.68	1	0.2
5.47	1	0.2
6.25	12	2.4
12.50	10	2.0
15.63	2	0.4
23.44	1	0.2
25.00	19	3.9

TABLE 3:

Mean inbreeding coefficients (F) of the cows and percentage of known ancestors (GI to GS) in dependence upon the completeness of information from the third ancestral generation (CG3)

CG3 (in %)	N	N (F>0)	F (in %)	GI	G2	G3	G4	G5
all cows	492	60	1.57	92.2	81.4	42.8	6.0	0.2
>= 25	363	59	2.06	99.3	95.6	57.5	8.2	0.3
>= 50	261	49	2.13	99.6	98.2	70.3	10.7	0.4
>= 75	146	38	2.65	100.0	99.8	86.3	15.8	0.7
=100	65	23	3.32	100.0	100.0	100.0	21.7	0.1

N: Number of individuals

N (F>0): Number of inbred individuals

TABLE 4:

Mean inbreeding coefficients (F) of the cows and percentage of known ancestors (GI to GS) by year of birth (Total number of cows: 482)

Year	N	N (F>0)	F (in %)	G1	G2	G3	G4	G5
1987	36	10	1.26	88.9	86.8	71.5	21.2	1.7
1986	67	10	1.98	88.8	86.6	53.2	6.7	0.2
1985	67	14	3.57	95.5	94.4	59.0	6.9	0.1
1984	96	15	1.71	98.4	96.1	55.9	9.8	0.4
1983	45	6	2.50	93.3	85.0	44.4	6.4	0.1
1982	17	3	4.41	94.1	76.5	44.1	2.2	0
1981	31	1	0.10	77.4	69.4	25.0	0.8	0
1980	38	1	0.08	98.7	80.9	25.0	0	0
1979	34	0	0	79.4	62.5	18.4	0.7	0
1978	25	0	0	96.0	74.0	10.0	0	0
1977	13	0	0	96.2	61.5	0	0	0
1976	10	0	0	80.0	15.0	2.5	0	0
1975	3	0	0	100.0	50.0	8.3	0	0

N: Number of individuals

N (F>0): Number of inbred individuals