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Recovery program of Cádiz's Golden Iberian pig strain (*Dorado Gaditano*)

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Abstract. The diversity of the Iberian Pig, in last century, has suffered severe erosion due to the concentration of production in the most productive strains. This has led to the extinction of several Iberian pig breed subpopulations. One of them was Cádiz's Golden Iberian Pig Strain (*Dorado Gaditano*), which was characterized by its golden glow hair. However, recently, *Dorado Gaditano* pigs were localized in different areas of the southern mountains of Cádiz province. These pigs are isolated and usually live wildy. This finding has ecological and cultural value. So members of several public institutions came together to promote a recovery program. This program was funded by a project in the 2008 call for *Conservation of Genetic Resources of Agrifood Interest* of the INIA. In this paper we expose the steps taken so far with a first recovery nucleus consisting of two boars, six sows and forty-five candidates for breeding animals (twenty-two males and twenty-three females).

Keywords. Cádiz Golden Iberian Pig Strain (*Dorado Gaditano*) – Feral domestic pigs – Wild biodiversity.

Programme de récupération de la variété de porc ibérique Doré de Cádiz (*Dorado Gaditano*)

Résumé. L'isolement et la dérive génétique dans les populations de petite taille sont la principale source de variation intra-raziale. Le porc Ibérique a subi ce processus, accumulant au fil du temps une hétérogénéité génétique. Cependant, au siècle dernier, cette diversité génétique du porc Ibérique a été l'objet d'une importante érosion due à la concentration de la production dans les souches plus productives. Ceci a provoqué l'extinction de diverses sous-populations du porc Ibérique. L'une d'elles était le Dorado de Cádiz, souche qui se caractérisait par l'éclat doré de sa robe. Cependant, on a localisé récemment dans différentes régions des montagnes du sud de Cádiz, principalement dans les environs de Campo de Gibraltar, des porcs sauvages qui pourraient répondre à la morphologie du Dorado de Cádiz. Cette constatation a une incontestable valeur culturelle et écologique. Ainsi, les membres de diverses institutions publiques se sont réunis pour promouvoir un programme pour sa capture et sa récupération. Ce programme est financé par un projet de l'édition 2008 de la Conservation des Ressources Génétiques d'Intérêt Agroalimentaire de l'INIA. Dans cet article nous présentons les mesures prises jusqu'à ce jour, avec un noyau de récupération composé de deux verrats, trois reproductrices adultes et trente-deux candidats pour la reproduction (14 mâles et 18 femelles).

Mots-clés. Dorado de Cádiz – porcs sauvages – Biodiversité.

I – Introduction

The Iberian Pig Breed is recognized as a heterogeneous breed characterized by its great intra-breed diversity including several lines and strains. This intra-breed diversity of the Iberian pig breed is usually structured on the basis of morphology and coat colour. The Govern of Spain has included five traditional Iberian pig strains in the Official Catalogue of Livestock Breeds of Spain (RD 2129/2008). Therefore the diversity of the Iberian Pig, in last century, has suffered severe erosion due to the concentration of production in the most productive strains. This has led to the extinction of several Iberian pig breed subpopulations. One of them was Cádiz's Golden Pig Strain (*Dorado Gaditano*), which was characterized by its golden glow hair and it

was mainly located in mountains of Cádiz. This Iberian pig subpopulation are officially extinct since the nineties of last century.

However, possible Cádiz's Golden pigs were recently localized in different mountains of Cádiz province (southern Spain), mainly around the Campo de Gibraltar. These pigs live wildly as feral domestic pigs. They coexist with wild boars, other feral domestic pigs and crossbreed animals from wild boars x feral domestic pigs. This finding has ecological and cultural value. So some members of several public institutions came together to initiate a recovery program. This program is funded by a project approved in the 2008 call for *Conservation of Genetic Resources of Interest Agrifood* of the INIA. In this paper are described the steps taken to get the first recovery nucleus.

II – Materials and methods

1. Animal location, capture and sampling

Numerous locations of the mountains around of Campo de Gibraltar were explored to locate possible feral Cádiz's golden Iberian pigs. The catches of animals were carried out with cages located in areas defined as capture zones. Inside these cages were placed baits (food). The captured animals were subjected to a preliminary morphological analysis to make an initial screening and determine their morphological adequacy. At the same time, blood samples from these captured animals were collected to carry out a preliminary cytogenetic study, genetic studies and health analyses for the notifiable diseases.

2. Morphological evaluation of the catches animals

All animals captured were morphologically evaluated according to the standard defined for *Dorado Gaditano* from previous morphological characterization studies (Mata *et al.*, 1998; Pardo *et al.*, 1998) and compiled old photos.

3. Cytogenetic and genetic studies

Captured animals were subjected to a preliminary cytogenetic study to reject crossbreeding with European wild boar and to avoid the main chromosomal defects. This study was based on the analysis of the karyotypes (chromosome number) and several chromosome bands. The karyotypes were prepared according to the recommendation of the Committee for the Standardized Karyotype of Domestic Pig (1988).

For the DNA molecular analysis, 34 microsatellite markers, including the 27 recommended by FAO for genotyping of pig populations (FAO, 2004), were used. Furthermore, the genotyping for SNP mutations of the IGF2 and MC1R genes were carried out using real time polymerase chain reaction (RT-PCR). This methodology differentiates Iberian pig breed from other breeds such as Duroc, lean breeds, etc. This methodology is officially used by AECERIBER to ensure racial purity of animals registered in studbook.

III – Results and discussion

After quarantine time, some of the captured animals were selected by their correct results for cytogenetic, molecular and serological analyses. These animals (two boars and three sows) were moved to the recovery nucleus as initial foundational population. This nucleus was located in the Experimental Agricultural and Livestock Center of the Provincial Deputation of Cádiz. In a short time, a secondary recovery nucleus (safety nucleus) is going to be located in the farm "La Algaba" in the "Serranía de Ronda", due to its adequate isolation characteristics.

1. Genetic characterization studies

Regarding MC1R and IGF2 genes, all selected animals showed the characteristic genotype of the Iberian breed, ensuring the absence of introgression of foreign breeds.

In Table 1 are shown the main genetic variability parameters (Ho, He and alleles/locus) of then main Iberian pig subpopulation including the Cádiz's Golden Iberian Pig Strain.

Table 1. Genetic diversity values by Iberian pig subpopulations

Subpopulations	He†	Ho‡	Alleles / locus
Dorado Gaditano (DGA)	0.493	0.577	2.86
Entrepelado (ENT)	0.622	0.526	5.19
Torbiscal (TOR)	0.585	0.536	4.68
Negro Lampiño (NLA)	0.534	0.443	5.16
Manchado de Jabugo (MDJ)	0.319	0.352	2.26
Retinto (RET)	0.610	0.527	6.00
Alentejano (ALE)	0.559	0.608	4.23
Negro de los Pedroches (NDP)	0.605	0.616	4.10

†He: expected heterozygosity; Ho: observed heterozygosity.

As expected, the He value (0.493) and number of alleles per locus (2.86) for the *Dorado Gaditano* strain showed a worrying genetic diversity status in comparison with most of Iberian strains. This values are only exceeding those shown by the *Manchado de Jabugo*, an Iberian Pig Strain in serious danger of extinction with an estimated population size at around 30 individuals.

In Table 2 are shown F_{ST} values (a measure of genetic differentiation among subpopulations) between pairs of Iberian pig subpopulations. According to this F_{ST} values, *Dorado Gaditano* was genetically closer to *Retinto* and *Entrepelado* strains than to other analyzed subpopulations, while *Dorado Gaditano* was very genetically different to *Manchado de Jabugo*. Important levels of genetic differentiation were also observed between *Dorado Gaditano* and other Iberian pig strains such as *Torbiscal* and *Lampiño*.

Table 2. Genetic differentiation matrix (F_{ST}) between pairs of Iberian pig subpopulations

	Torbiscal	Lampiño	Alentejano	MDJ	NDP	Retinto	Dorado Gaditano
ENT	0.15	0.17	0.07	0.22	0.10	0.05	0.11
TOR		0.20	0.18	0.32	0.16	0.17	0.25
NLA			0.17	0.29	0.17	0.17	0.20
ALE				0.24	0.10	0.07	0.14
MDJ					0.28	0.22	0.45
NDP						0.10	0.17
RET							0.10

This genetic differentiation value is lower than genetic differentiation levels reported for other Iberian pig subpopulations in relation to the general Iberian pig breed population (Clemente *et al.*, 2008b). Also, this genetic differentiation value is much lower than the average value of genetic differentiation for the whole Iberian pig subpopulations, estimated at 0.190 (Clemente *et al.*, 2008a).

Furthermore, Reynolds genetic distance between *Dorado Gaditano* and several swine populations (different breeds and Spanish wild boar) were estimated from microsatellite allele frequencies (Table 3). The pig population for this analysis included several breeds such as Duroc, Creole (Mexican hairless pig), Mangaliça, commercial breeds (such as Large-White, Hampshire, Pietrain and Landrace), Iberian Pig (excluding *Dorado Gaditano* pigs) and Spanish wild boars.

Table 3. Reynolds genetic distance between swine populations (pig breeds and Spanish wild boar)

Reynolds genetic distances	Duroc	Creole	Sp. Wild boar	Mangaliça	Lean pig breeds	Dorado Gaditano
Iberian Pig	0.20	0.23	0.10	0.15	0.18	0.02
Duroc		0.28	0.27	0.34	0.27	0.28
Creole pigs			0.16	0.33	0.25	0.26
Sp. Wild boar				0.24	0.17	0.08
Mangaliça					0.25	0.27
Lean pig breeds						0.25

The extremely close genetic relationship between *Dorado Gaditano* and Iberian pig breed was outstanding. This confirms that *Dorado Gaditano* is genetically ascribed to the Iberian pig breed. The large genetic distances between *Dorado Gaditano* and each analyzed population (excluding Iberian breed and Spanish wild boars) are also noticeable.

Until recent decades, blond-haired Iberian pigs, such as *Dorado Gaditano* pigs (golden-haired pig), participated in livestock fairs within the red-haired varieties of Iberian breed (today grouped under the *Retinto* strain) without explicit differentiation among them. Therefore, there was usually gene-flow between blond and red Iberian pigs, which would be evidenced in this observed genetic proximity between *Dorado Gaditano* and *Retinto*. As result, blond varieties could be regarded as subpopulations derived from ancient red varieties group of Iberian breed (known today as *Retinto* in which are currently only included dark-red-haired pigs). On the other hand, *Lampião* is the farthest subpopulation to *Dorado Gaditano*.

Finally, a conservation program was established alongside recovery program. One of the main preoccupations in this program is the containment of increase in inbreeding. So this conservation program includes a Studbook and a reproductive scheme between boars and sows assisted by morphologic characterization and genetic data, according to methodology described in Fernández *et al.* (2010). Actually, the recovery and conservation nucleus included two boars, six sows, and forty-five candidates for breeding animals (twenty-two males and twenty-three females).

IV – Conclusions

From a genetic standpoint, there is no doubt that the animals taken to the recovery nucleus are perfectly ascribed to Iberian pig breed. Similarly, these animals are a distinct group from other subpopulations of the Iberian pig breed, showing the specific characteristics that exhibited the extinct *Dorado Gaditano*. It should be noted that the capture zones coincide with areas where once was known the *Dorado Gaditano*. Therefore, the recovery of the extinct *Dorado Gaditano* strain, though not without difficulties, it seems possible.

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