

# Trajectories of Evolution and Extinction in the Swedish Cattle Breeds

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## Introduction

An assessment of the current status and possible future dynamics of the domestic animal species is a critical step in the management of Animal Genetic Resources (AnGR). Permanent extinction of livestock breeds is considered to be the main reason for the loss of genetic diversity (Scherf, 2000). So far, the pace of the extinction process of livestock breeds has outstripped the creation of new breeds leading to a remarkable loss of genetic diversity (Gandini et al., 2004). The FAO's Global Databank for AnGR predicts the loss of breeds at one breed per month (DAD-IS web). In this paper, the terms *evolution* and *extinction* are defined and illustrated using examples from the Swedish cattle breeds. Thereafter, the dynamics of the Swedish cattle breeds mentioned in DAD-IS and the status given as regards their endangerment/extinction are described. In addition, an analysis on the actual situation was conducted, to verify whether the breed is really endangered, extinct or has just evolved in one way or another for sustainable use.

## Status of Swedish cattle breeds

Evolution is the change in the genetic make-up of a population of organisms from one generation to the next. Evolution itself is the product of processes that constantly introduce variation (i.e. mutation and genetic recombination) and that make variants either to become more common or rare (i.e. natural/human selection and genetic drift). On the other hand, animal breeds are regarded as extinct when it is no longer possible to recreate the breed (Scherf, 2000). In reality, extinction may be realized well before the last animal, gamete or embryo is lost. A breed is regarded as critical (C) when the number of breeding females is <100, and endangered (D) when <1000. A breed is not at risk when breeding females are >1000. Breeds are identified as critical maintained (CM) and endangered maintained (DM) when conservation programs on the breeds are in place. More information on the definition of the status is given in Scherf (2000). The status of Swedish cattle breeds currently recorded in DAD-IS is shown in Table 1.

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Since the late 19<sup>th</sup> century, cattle breeds and populations in Sweden have been tremendously transformed, with a few breeds becoming more common, while others getting rare or sometimes lost. Based on Table 1, five scenarios for the Swedish cattle breeds were deduced:

**Table 1: Status of the Swedish cattle breeds in DAD-IS and the total number of registered females in the population (N) in 2008**

Breed	Status <sup>1</sup>	N <sup>2</sup>	Breed	Status	N <sup>2</sup>
Herrgård	X	-	Rödbrokig Svensk Boskap (RSB)	X	-
Skåne	X	-	Ringamålako	CM	119
Småland	X	-	Rödkulla	NR	1,746
Allmoge ko	C	? <sup>3</sup>	Svensk Jersey Boskap (SJB)	NR	5,527
Fjällnära ko	C	? <sup>4</sup>	Svensk Röd och Vit Boskap (SRB)	NR	307,112
Bohuskulla	CM	36	Svensk Kullig Boskap (SKB)	NR	3,792
Väneko	DM	187	Svensk Låglandsboskap (SLB)	NR	100
Fjällras	? <sup>5</sup>	4,423	Svensk Holstein (SLB)	? <sup>5</sup>	401,089

<sup>1</sup> Extinct (X); Critical (C); Critical-Maintained (CM); Endangered-Maintained (DM); Not at risk (NR)

<sup>2</sup> Source; Swedish Board of Agriculture (2010)

<sup>3</sup> Includes the breeds *Väneko*, *Ringamålako*, *Bohuskulla*

<sup>4</sup> Numbers are included in the *Fjällras*

<sup>5</sup> Unknown

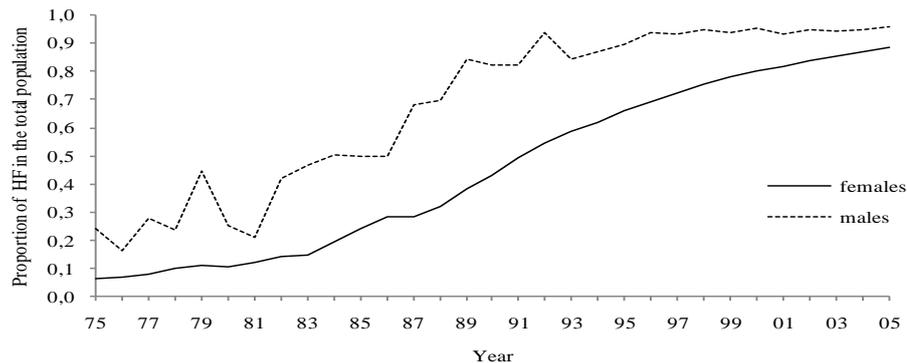
**Scenario 1: Old breeds have been declared extinct but the genes have been absorbed in other breeds.**

In reality all these breeds have merged with one or a few other populations having similar characteristics, breeding objectives and geographical area. The genes have been preserved and exploited in a “new” breed. *Herrgård*, *Småland* and *Skåne* are listed as extinct by DAD-IS yet they were absorbed into *Rödbrokig Svensk Boskap* (Red pied Swedish- RSB) between 1892 and 1928. The RSB breed was numerically a large cattle breed in Sweden in 1920s (Swedish Country Report, see FAO, 2007). In 1928, RSB was however joined with the Swedish Ayrshire to form the SRB breed. Genes of its ancestral breeds have been exploited for sustainable use under successively changing environmental conditions. Afterwards, genes of the red breeds in the Scandinavian neighbor countries have continuously been incorporated into SRB for the last five decades. Currently, there is a joint breeding program for the red dairy cattle in Sweden, Finland, and Denmark, and partly with the Norwegian Red (NRF) in Norway. Semen of SRB breed is currently used in other countries/continents (for crossbreeding) to even a larger extent than in Sweden due to its consistent improvement of production and functional traits.

**Scenario 2: An old breed is being upgraded with a similar breed and has more or less lost its original characteristics.**

Holsteinization of the breed Svensk Låglandsboskap (SLB) (earlier called Swedish Friesian) in Sweden exemplifies this scenario. The breed is now called Swedish Holstein, but still the abbreviation SLB is used. As such, it has not been recognized to be at risk by DAD-IS, despite being practically lost a long time ago. The proportion of Holstein-Friesian (HF) genes in the SLB bull and cow populations is shown in Figure 1. It demonstrates how fast the change/upgrading of the breed has been over time, and the ultimate loss of the original SLB breed. The HF genes have increased rapidly in the SLB

female breeding population from 6% in the 1975 to over 90% by 2005. The proportion of HF males used in the SLB herds has increased even more rapidly. The main reason for holsteinization was lack of competitiveness of the old SLB when compared to the new North American Holstein, but the quick process also led to loss of valuable genes. There are about 100 females in one herd of the original SLB cattle remaining, with no live bulls, but only frozen semen currently available. Given, the FAO criterion on breeds at risk (Scherf, 2000), the original SLB cattle breed should currently be considered extinct. This outcome is contrary to the DAD-IS status presented in Table 1 that the breed is not at risk at all (Swedish Board of Agriculture is the reporting agency).



**Figure 1: Proportion of Holstein-Friesian (HF) genes in the Swedish bull and cow populations**

**Scenario 3: An old breed is declining in numbers, and further split into subpopulations - not exchanging genetic material, despite same origin.** The Swedish Mountain Cattle and Swedish Red Poll were merged in 1937 and named *Svensk Kullig Boskap* (SKB). However, currently, breeders of the two original breeds pursue separate breeding activities as before and run different breeding associations. Part of the SKB breed is split into another three subpopulations namely *Rödskulla*, *Fjällnära ko* and *Fjällras*, are deemed to become extinct if they do not cooperate.

**Scenario 4: A transboundary breed with small numbers:** The Swedish Jersey Breed (SJB) is an example. All the semen for the SJB is imported. This breed is part of the big Danish population and has a great future as the Danish Jersey is a very competitive breed internationally.

**Scenario 5: Small breeds that are remnants of the landrace breeds that formed the more evolutionary breeds.** The remnants of the old Swedish cattle breeds that have withstood the evolution of the SRB breed are an example. The *Allmoge ko* includes three small breeds: *Väneko*, *Ringamålako*, *Bohuskulla*. These three breeds have the correct statuses in DAD-IS. Conservation programs have also been put in place to reverse their loss. Logically, these breeds can be considered as a living gene bank for the SRB breed, which is

utilized in their original environment. However, the breeds are rather unproductive and conservation practitioners face the dilemma of conserving and utilizing the breeds separately for long periods of time.

## Discussion

Research on the breeds recognized as extinct has long been “ignored”, especially the fate of these breeds. Therefore, it was considered important to conduct this study on the issue of *extinction* versus *evolution* of breeds taking Swedish cattle breeds as an example. It is clearly evident that “extinct” breeds have played important roles in forming “new” breeds. However, retaining a breed name for a long time, as in the case of SLB, does not necessarily mean that the breed is not at risk. In fact it can be genetically extinct through several generations of upgrading with another population.

Further studies analyzing the situation of breeds on other countries/continents using a similar model (five scenarios) that is described for Sweden are required. Information on the status of breeds available in DAD-IS and country reports could be used as a starting point. Investigation on the past events and future projections of the breeds may follow. A qualitative approach would be more appropriate for such a study because historical development of breeds (breed concept) is a result of administrative decisions rather than genetic considerations. Analytical models can be used for projecting the future of breeds and estimating the costs of conservation programs (e.g. Simianer et al., 2003; Gandini et al., 2004; Holmes, 2004; Bennewitz and Meuwissen, 2005).

## Conclusion

Merging of breeds and the ultimate loss of some of the distinct breeds is a deliberate action that is often unavoidable and strictly speaking, such breeds shouldn't be considered as extinct, given that even breeds that remain continue to evolve. This illustrates not only the flexible way of defining a breed, but also that the breed concept must be questioned as a measure of genetic diversity. The issue of conserving genes or genotypes always needs consideration, regarding gene banks as well as programs for breed improvement.

## References

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