



# Icelandic Sheep Breeders of North America

---

Volume 5 No. 4 Fall 2001  
Editor, Kathy Hayes

## Horn Inheritance in Icelandic Sheep: An Interview with Emma Eythorsdottir

Liz Harker, Back Forty Sheep Camp

Published on Cornell University Sheep Page and ISBONA Newsletter

Last fall, in Issue 105 of the *Black Sheep Newsletter*, Letty Klein shared some thoughts about horn genetics that really piqued my interest. Pondering the horned and polled sheep in my flock, I began to wonder how the genetics for this trait worked. All of a sudden, I had a lot of questions about horn inheritance in sheep in general, but more specifically in Icelandics. Finding answers certainly has proven to be trickier than I originally anticipated. A query to Cornell University Animal Science connected me with Richard Quaas, who forwarded my questions about horn inheritance to the Animal Geneticist Discussion Group (a world-wide list serve). There were a variety of responses from Colorado to Sydney to Italy all dealing with horn genetics in various breeds. But the treasure chest was opened regarding Icelandic sheep horn inheritance with a response from Emma Eythorsdottir of the Agricultural Research Institute in Reykjavik (thanks again Emma!).

It somehow comes as no surprise that our unique and wonderful Icelandic sheep are also quite special in the genetics governing horn type! The evolutionary history of Icelandic sheep is distinct. So is the manner in which horn inheritance is exhibited in this breed. Ms. Eythorsdottir has some insights on horn genetics gleaned through research in Iceland. What follows is the result of an interview with the expert!

L.H. Where did you get your information about horned/polled inheritance?

E.E. Our knowledge on the inheritance of horned/polled is based on records on phenotypes in registered flocks over many years. Horns on all autumn lambs (4 months) are recorded very precisely in our experimental flocks and there are also records from other registered flocks.

L.H. What exactly do you mean by phenotype?

E.E. The phenotype of an animal is the actual appearance or what you see when you observe it. The genotype on the other hand is the genetic makeup of the animal, which may or may not be concluded from the phenotype directly.

L.H. How is the appearance of horns controlled?

E.E. Horned/polled in Icelandic sheep is controlled by a single locus with incomplete dominance of the polled gene. Heterozygous animals can have different forms of horns or scurs so there are presumably other genes that modify the type of horns in heterozygotes. Animals with "normal" horns, or fully horned are homozygous recessive.

L.H. How is Icelandic horn inheritance different than other breeds?

E.E. The trait is not sex linked or sex limited like in many other breeds, such as the Merino. In those breeds the males are usually horned and the females polled. This is not the case in the Icelandic breed where both sexes may be horned or polled. Yet, this type of horn inheritance is not unique for the Icelandic breed; there are other breeds that have the same pattern.

L.H. What other breeds share this pattern of horn inheritance?

E.E. I am mostly familiar with Northern European breeds. Some examples are Old Norwegian sheep and the Norwegian Spaelsau (both probably closely related to the Icelandic). Also, the Gute sheep in Sweden (they now have a fixed horn genotype, polled does not occur but I think it is the same genotype as in the Icelandics) and the Romanov breed have horned and polled in both sexes. There are probably other breeds, for example in Scotland, but I do not know which breeds for sure.

L.H. How are the different horn phenotypes in Icelandic sheep classified?

E.E. We have classified horns into five groups in our flocks:

1. Full horns (homozygous recessive/pp)
2. Round narrow horns (heterozygous/Pp)
3. Solid large scurs (heterozygous/Pp)
4. Small scurs (heterozygous/Pp)
5. Polled (homozygous dominant/PP)

L.H. How would you describe Category 1 (homozygous/pp)?

E.E. Full horns are not uniform and there is a lot of variation within this phenotype as to the size and shape of horns – they can be thick or thin, long or short, sweep back or to the side, etc. What is common, is a sharp ridge on the underside of the horn, especially on males, so if you grab the horn it's never smooth and round but more triangular. These animals are homozygous pp – recessive at the polled locus. Obviously there are other genes that decide the size and shape of horns for this genotype. Parents with full horns always breed true – all offspring will develop full horns also.

L.H. Categories 2, 3, 4 are heterozygous/Pp. How are they classified?

E.E. Category 2 is round, narrow horns – only observed in males. The horns are lacking the ridge of full horns, they are smooth and round on 3-4 month old male lambs and usually smaller, more narrow and less curled than full horns on mature males. Category 3 is solid large scurs resembling small horns or “half horns”. They can be different sizes and shapes, but always smaller than full horns. This type is mostly found in females. Category 4 is small scurs. These are attached to the skull and will grow to some extent, but most often they curl and have a tendency to grow back into the head. They need attention in many cases if the animals are not to be hurt.

L.H. How do you define scurs?

E.E. Scurs is a term for horns that cannot be defined as regular horns. They are always smaller than the regular type but otherwise very variable. I have been using the term here for all types of smaller horns –

this may not be totally correct. In cattle, scurs refers to very small horn structures only.

L.H. How is Category 5 described (homozygous/PP)?

E.E. Polled is a tricky one because in fact, only the females are truly polled. Males do always have very small scurs, that are usually loose and do not grow to any extent. This phenotype (truly polled females and males with small scurs) usually indicates the homozygous PP genotype. However, the offspring of two polled parents can be horned which indicates that the parents were really heterozygous although they do not show the typical heterozygous phenotype. This will occur from time to time in most polled flocks. Apparently the heterozygotes can also have an almost polled phenotype – I suspect that sometimes the scurs are so small that they go more or less unnoticed.

L.H. Do truly polled females have a depression or undulating horn site?

E.E. I have not looked at this in detail, but I think that a slight depression is the usual appearance.

L.H. What is the difference between very small scurs in the males in Category 5 and small scurs in Category 4?

E.E. The scurs in category 4 would usually be firmly attached to the head (skull) of the animal while the scurs of “polled” rams are loose and seem to be merely growing out of the skin alone. However, it is very difficult to give definite rules on this. We have limited records on how the different horn types develop in heterozygous adult animals, since they have been avoided as breeding animals in our flocks.

L.H. If the loose, very small scurs in the polled males get broken off, do they grow back?

E.E. No, I don't think so.

L.H. You mentioned polled flocks. In Iceland, do farmers try to keep the horned and polled phenotypes separate as best they can?

E.E. Types 2, 3, 4 are all heterozygous Pp – the appearance of horns is different between males and females and there is great variation within this group. Icelandic farmers are reluctant to breed horned and polled together because of this. The flocks that come out of such interbreeding become very heterogeneous in appearance and some of the phenotypes do need repeated cutting or trimming of horns. Many farmers find it practical to mate their ewe lambs from a horned flock to a polled sire to avoid lambing difficulties. The lambs would all go to slaughter and the ewes would be mated to a horned sire in their second year.

L.H. I am understanding you correctly, two truly homozygous (PP) polled parents will always throw truly polled offspring. Two truly homozygous (pp) horned parents will always produce truly horned offspring. If any one of those parents are heterozygous (Pp) they can give offspring with horn types 2, 3 or 4. Is this right?

E.E. Yes, in theory this is true, in case of the homozygous parents. Two heterozygous parents can produce all phenotypes in the offspring. In some cases, parents that seem to be truly polled may produce horned or scurred offspring. To test the genotype of a polled ram, you can mate him to several truly horned ewes. If the ram is heterozygous (Pp), half of the offspring produced should be horned (pp) and the other half heterozygous with various types of horns or scurs (categories 2-4). If the ram is homozygous polled, all the offspring should be heterozygous and no offspring with “normal” horns should appear.

L.H. Are the sires for the Artificial Insemination programme truly polled or truly horned?

E.E. The horned sires are all truly horned since only homozygous animals will show this phenotype. The

polled ones are truly (homozygous) polled in most cases. They have, however, not been test-mated prior to use for insemination so it is possible that the odd heterozygote may be found.

L.H. Is the Agricultural Research Institute planning on doing any work with genotypes and horn inheritance in the near future?

E.E. No, the inheritance of horns is not a priority area within the current research programs we are working on. Icelandic sheep farmers are in a tight economical situation at the moment and our projects are mainly aimed at methods to make the production more profitable and to increase the market share of lamb both on the home market and export markets.

Thanks for the insights Emma!! With this information about horn phenotypes, we may begin to understand and distinguish between what is truly horned, truly polled, or scurred (heterozygous). One way to decide whether our sheep are horned, polled or scurred will be through our own personal observations of their offspring. Two truly horned individuals will always throw truly horned lambs. Two truly polled sheep will always produce truly polled offspring. If there is any deviation from these results, you will know at least one of the parents is not homozygous. It seems that there can be quite a few shapes and sizes of horns in the truly horned category yet they all share the ridge on the underside of the horn as a common trait. Polled ewes could have undulations with no horn growth, yet polled rams will have a very small amount of vestigial horn loosely attached. If an animal is heterozygous all bets are off considering what phenotype may be displayed but rams will often fall into Category 2 and 4, and ewes will often exhibit traits of Category 3 and 4. Whew. This is a lot of information to assimilate. Perhaps a recap on horn genotypes and phenotypes would help:

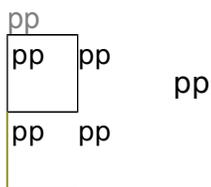
**Polled:** P (incompletely dominant)

**Horned:** p (recessive)

- Horned homozygous (pp)
- Polled homozygous (PP)
- Heterozygous (Pp)

**Category 1:** Offspring are homozygous recessive or fully horned. This category phenotypically may have a variety of shapes but all permutations do seem to possess the ridge on the underside of the horn. Breeding two truly horned animals would produce truly horned offspring, *always*.

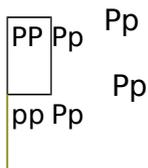
Two truly horned parents ...



Outcome: The chances for horned homozygous offspring is 100%

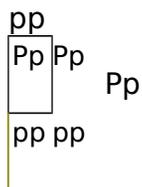
**Categories 2, 3, 4:** Offspring are heterozygous and fall into one of the categories depending on their phenotype. Because these animals carry one horned gene, and one polled gene, they are neither truly horned, nor truly polled, although they may produce offspring that can be horned or polled.

Two heterozygous parents...



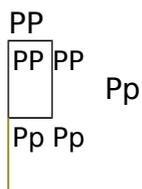
Outcome: Horned homozygous 25%; polled homozygous 25%; heterozygous 50%

One heterozygous parent and one truly horned parent...



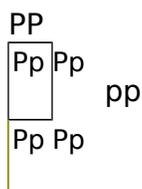
Outcome: Horned homozygous 50%; polled homozygous 0%; heterozygous 50%

One heterozygous parent and one truly polled parent...



Outcome: Horned homozygous 0%; polled homozygous 50%; heterozygous 50%

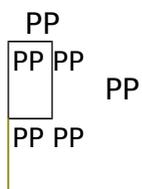
One truly polled parent and one truly horned parent...



Outcome: Horned homozygous 0%; polled homozygous 0%; heterozygous 100%

**Category 5:** Offspring are homozygous dominant or polled. Females that are polled have no horn growth although males have some vestigial horn that is loose (not attached to the skull) and very small. Two truly polled parents will *always* produce truly polled offspring.

Two truly polled parents...



Outcome: The chances for polled homozygous offspring are 100%.

Well, I think we have the phenotype angle of horn inheritance in Icelandic sheep covered! Thanks so much Emma, for your patience, assistance in this interview, and your willingness to share your knowledge. You've really cleared up some questions about horn phenotypes and inheritance in Icelandic sheep. This information will surely assist interested breeders identifying and breeding for truly horned or truly polled animals if they choose to do so.

