

Reindeer coat colour variants in Finland

Jean J. Lauvergne¹ & Mauri Nieminen²

¹ COGNOSAG (Committee on Genetic Nomenclature of Sheep and Goat), 147 C/3 avenue J.B. Clément, F 92 140 Clamart, France (jean.lauvergne@sfr.fr).

² Finnish Game and Fisheries Research Institute, Reindeer Research Station, FIN-99910 Kaamanen, Finland (mauri.nieminen@rktl.fi).

Abstract. A research program based on reindeer coat colour had its first field survey in Finland after the calving season of May 2009. This short notice advances the main observations of the survey where, besides the wild allele, a new mutant could be identified, at least at three colour loci: *Agouti* (*A*), *White Spotting* (*S*) and *White* (*W*).

Key words: colour mutants, coat colour, genetics, *Rangifer tarandus*.

Rangifer, 30 (1): 11 - 14

Introduction

During a reindeer meeting at Vantaa (Finland) in 2006, delegates of the *Reindeer Research Station* (FGFRI) in Kaamanen (Finnish Lapland) and COGNOSAG (*Committee on Genetic Nomenclature of Sheep and Goats*) discussed to study genetics of reindeer coat colour in Finland.

The Reindeer Research Station is run by two full time scientists and three technicians, welcoming guest scientists. It has at its disposal a herd about 150 adult reindeer at *Kutuharju* experimental station with 43 km² of natural pasture. Kutuharju estate and the reindeer belong to the Association of Reindeer Herders (*Paliskuntain yhdistys*).

COGNOSAG has developed an expertise in cataloging mendelian loci in ruminants: Men-

delian Inheritance in Sheep (Lauvergne *et al.*, 1996), Mendelian Inheritance in Cattle (Millar *et al.*, 2000).

May 26-30, 2008, a round table meeting was held in Kaamanen summarized by Lauvergne (2009): the knowledge of reindeer coat colour was examined, and a research program in Finland was planned (Lauvergne, 2009).

A first field survey of this research project was operated in May and June 2009.

Argument

In every animal species after its domestication it happens that:

1) a number of viable mutations are no more eliminated under the pressure of natural se-



Fig. 1a-d. Adult colour phenotype induced by different alleles¹.

- a) allele A^+ (*wild*) at the *Agouti* (*A*) locus;
- b) allele A^b (*badger face*) at the *Agouti* (*A*) locus;
- c) allele S^p (*piebald*) at the *White Spotting* (*S*) locus;
- d) allele W^{wb} (*white*) at the *Dominant White* (*W*) locus.

lection which is acting in the wild (Darwin, 1859, 1868; Geoffroy St Hilaire, 1861);

- 2) the mutations controlling coat or plumage colour are the most numerous mutations with visible effects to be maintained, illustrated in dogs (Sponenberg & Rotschild, 2001) and sheep (Sponenberg *et al.*, 1996).

1 Photos of the live animals are from the Kutuharju herd, 2008 (a, b), and the Napapiirin Porofarmi Oy, 2009 (d). The hide (c) of a typical piebald animal was discovered at the Napapiirin Porofarmi Oy, near Rovaniemi, 2009. Photos a-d: J.J. Lauvergne.

This property deserved to be proved in reindeer of which the domestication is believed to have started around one thousand years ago in different areas of Eurasia (Nieminen, 2005; Roed *et al.*, 2008).

Results of the 2009 field survey

The program was carried out immediately after the spring calving season of May 2009 at the *Kutuharju* experimental herd and in several commercial herds near Rovaniemi in which living animals as well hides could be checked. Some colour pictures from the FGFR1 archives were also checked.

Using the principle of comparative coat colour genetics in Mammals of Searle (1968) the field observations may be interpreted in terms of alleles segregating at the following loci:

Locus *A* (*Agouti*). The colour pattern of most adult reindeer was the so called *wild pattern* which is very common among Mammals,

with various kinds of striped hairs on the back and a white belly (Fig. 1a). One can postulate that this pattern is controlled by the *wild* allele A^+ at the *Agouti* (A) locus.

Several adult animals were carrying another well known pattern among ruminants called *badger face*, with a black belly, usually induced by the *badger face*, A^{bf} allele at the locus *Agouti* (A) (Fig. 1b).

Locus S (*White spotting*). Some adult reindeer were presenting an irregular white design also very common among mammals (see, for example the *Holstein Friesian* cattle) usually induced by the *piebald* S^p allele at the *White spotting* (S) locus (Fig. 1c).

Locus W (*White*). Totally white reindeer are commonly seen in Finland. They could carry the *white* allele W^{wb} usually described in Mammals at the *White* (W) locus (Fig. 1d).

Other colour patterns obviously induced by colour mutants could be observed more scarcely

- A dark pattern at *Agouti* or at *Extension* (E) locus ?
- A brown pattern at *Brown* (B) locus ?
- Several white designs with a variable expressivity already described by Delaporte (2002) in Norway and also present in Finland but their identification could not be made during the 2009 field survey.

Interpretation and conclusion

Variants at three well known homologous loci in mammals could be already described in the few adult animals which were observed in the first field survey in which less than 300 animals could be checked alive or on pictures : *Agouti* locus (with allele A^+ and A^{bf} ; *White spotting* locus (S) with alleles S^+ and S^p , and *White* (W) locus with W^+ and W^{wb} alleles.

Mutants are probably segregating at other loci such as A (*Agouti*), E (*Extension*) or B

(*Brown*). These observations fit well with observations in other domesticated ruminants species.

The number of colour mutants in Finnish reindeer is not that great (at three, perhaps six loci) compared to 18 coat colour loci having segregated in the dog (Sponenberg & Rotschild, 2001) and 11 in sheep (Sponenberg *et al.*, 1996) but reindeer is of a relatively recent domestication, perhaps 1000 years from now as seen above, compared to that of dogs and sheep, resp. 17 000 and 11 500 years BP (Vigne, 2004).

These results are encouraging but deserve to be confirmed by more extensive field surveys and by analysis of segregation data etc.

References

- Darwin, C. 1859. *On the Origins of Species by Means of Natural Selection*. John Murray, London. – In: J.W. Burrow. 1968. Darwin. The Origin of Species. Penguin Books Ltd, Harmondsworth Middlx, England (see § 1: Variations under domestication, 71-100).
- Darwin, C. 1868. *The variation of Animals and Plants under Domestication*. 2 vols. John Murray, London. VIII + 411pp, VIII + 486pp (see Vol. I, pp. 1-321, 2. ed., revised. John Murray, London).
- Delaporte, Y. 2002. *Le regard de l'éleveur de rennes (Laponie norvégienne), Essai d'anthropologie cognitive*. Peeters, Louvain, Paris, Sterling, Virginia. 336pp.
- Geoffroy-Saint-Hilaire, I. 1861. *Acclimatation et domestication des animaux utiles*. Quatrième édition entièrement refondue et considérablement augmentée. La Maison Rustique, Paris. 534pp. (see Section II: Variations subies par les animaux sous l'influence de la domesticité: 221-237).
- Lauvergne, J.J. 2009. Suivi de la domestication du renne en Scandinavie au moyen de gènes contrôlant la couleur du pelage [Studying progress in Reindeer domestication in Scandinavia using coat colour genes]. – *Les Amis du Muséum National d'Histoire Naturelle* N° 239, septembre 2009: 36-38.
- Lauvergne, J.J., Dolling, C.H., & Renieri, C. 1996. *Mendelian Inheritance in Sheep 1996* (MIS 96), COGNOSAG and University of Camerino, Clamart France and Italy. 214pp.
- Millar P, Lauvergne J.J., & Dolling, C.H.S. 2000. *Mendelian inheritance in Cattle*. EAAP publication N° 101, Wageningen Pers. Wageningen. 590pp.

- Nieminen, M. 2005. Reindeer (*Rangifer tarandus tarandus* L.) semi-domesticated. – In: Ulla-Maria Kulonen *et al.* (eds.). *The Saami, a cultural Encyclopedia*. Vammala, pp. 295-299.
- Røed, K.H., Flagstad, Ø., Nieminen, M., Holand, Ø., Dwyer, M.J., Røv, N., & Vilà, C. 2008. Genetic analysis reveal independent domestication origins of Eurasian reindeer. – *Proc. R. Soc. B.* 275: 1849-1855.
- Searle, A.G. 1968. *Comparative Genetics of Coat Colour in Mammals*. Logos Press, Academic Press, London and New York. 308pp.
- Sponenberg, D.P., Dolling, C.H.S., Lundie, R.S, Rae, C., Renieri, C., & Lauvergne, J.J. 1996. 1. Coat colour loci (Category 1). – In: J.J. Lauvergne, C.H.S. Dolling, & C. Renieri. *Mendelian Inheritance in Sheep 1996* (MIS 96), COGNOSAG and University of Camerino, Clamart/France and Italy: 13-57
- Sponenberg, D.P. & Rothschild, M.F. 2001. Genetics of Coat Colour and Hair Texture. – In: A. Ruvinsky & J. Sampson. *The Genetics of the Dog*. CABI, Wellingford, Oxon, UK, New York, pp. 61-85.
- Vigne, J.D. 2004. *Les débuts de l'élevage*. Le Pommier, Paris. 188pp.

Manuscript received 2 November, 2009

revision accepted 25 January, 2010

Poron turkin värityypit Suomessa

Abstract in Finnish / Lybennelmä: Tutkimusprojekti poron turkin väreistä alkoi kenttätutkimuksilla Suomessa vasonnan jälkeen toukokuussa 2009. Tämä lyhyt tiedonanto osoittaa, että porolla on villialleelin lisäksi myös uusi mutanttialleeli vähintään kolmessa värilokuksessa: Agouti (A), Täplikäs (S) ja Valkoinen (W).

Fargevarianter av reinpels i Finland

Abstract in Norwegian / Sammendrag: Et forskningsprosjekt begynte i felt etter kalving i 2009. Resultatene så langt viser at tamreinen har få fargemutanter sammenliknet med forholdet hos andre domestiserte arter.