



Congenital Defects in Reindeer: A Production Issue

by

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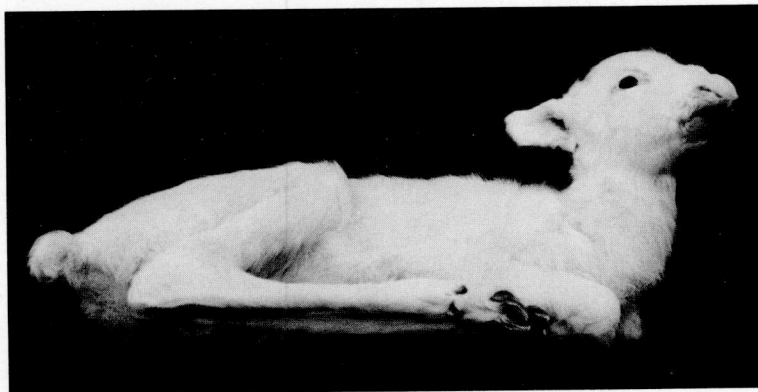
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Introduction

High rates of female breeding success and offspring survival are the two major factors in productivity of any commercial livestock industry. To improve breeding success and offspring survival, the herd manager will establish selection criteria and choose which males and females will breed. The genetics or characteristics of future animals will reflect their parentage.

Selection pressure is evident in both wild and captive populations of herbivores. Predators, environment, and human harvest strategies are a few forces which influence the characteristics of free-ranging populations of reindeer, caribou, moose, wapiti, etc. In livestock production systems, herd managers often breed for specific characteristics such as larger body size, high birth and growth rates, leanness, etc. A single color or combination of colors has been another characteristic often selected by purebred cattle producers as well as reindeer herders.

Basic Genetics of Color

Color of an animal is a function of genetics. Simply, this is the visual description of whether the trait is dominant (trait or appearance that expresses itself, such as wild coat color in this case) or recessive (trait or appearance that fails to express itself when paired with a dominant trait or gene; usually, recessive traits only express themselves when both members of a pair of genes are recessive, as albinism does in this case). On the basis of the parent's genetics, several color combinations may be possible. Diagrams of several parent crosses have been provided in Figure 1a and 1b to show the color possibilities of offspring from several pairs of rabbits.

In the case of rabbits, there is a multiple allelic system, which means that more than one factor controls color and the outcome can be solid, spotted, or albino (white with no color pigment). In rabbits, the order of dominance for which coat color the animal will show is in the order of wild, chinchilla, himalayan, then albino. Rabbits are used as an example here because the possibility of solid colors or

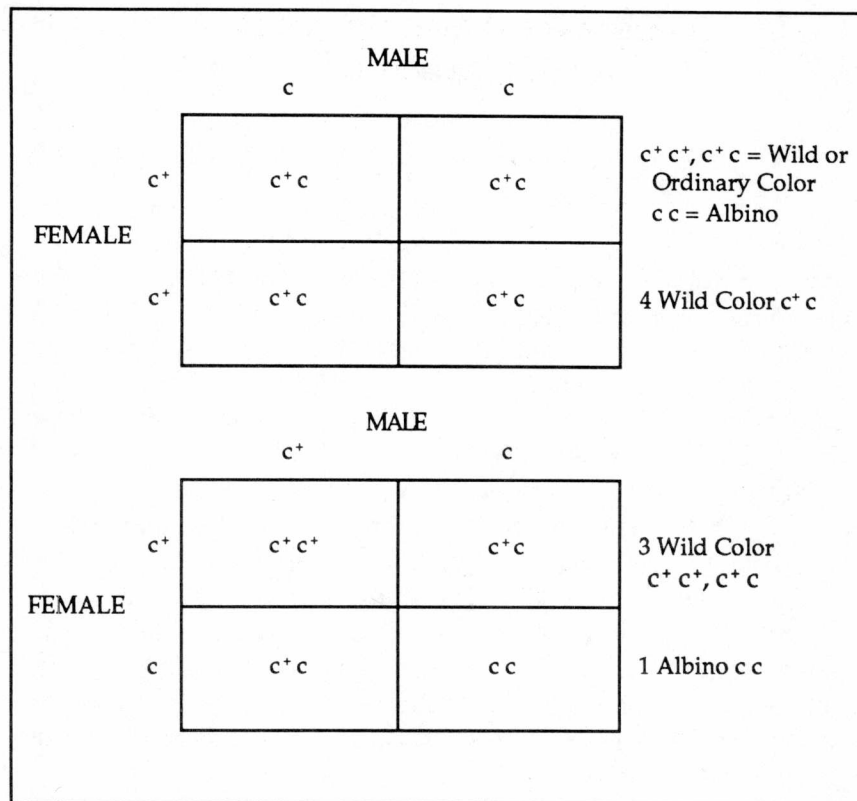


Figure 1a: Diagram showing offspring of several crosses of coat color in rabbits (Wild or Ordinary Color = banded hairs with portion near the skin being gray, followed by a yellow band, and finally a black or brown tip on the hair).

color combinations is similar to those of reindeer.

In these cases, parents of the first generation (upper diagrams of Figure 1a and b) are homozygous (the male parent is albino and carries both recessive genes; the female carries both dominant genes for wild or himalayan color). They produce offspring all with either wild or himalayan color but which are heterozygous (carry both a dominant and recessive gene).

In the second generation (lower diagrams of Figure 1a and b), parents (offspring of first generation) are heterozygous. They carry one dominant gene for color and a recessive gene. If the offspring receive at least one dominant gene then color will always be present. But the occurrence of 'cc' will result in albinos. This simple example

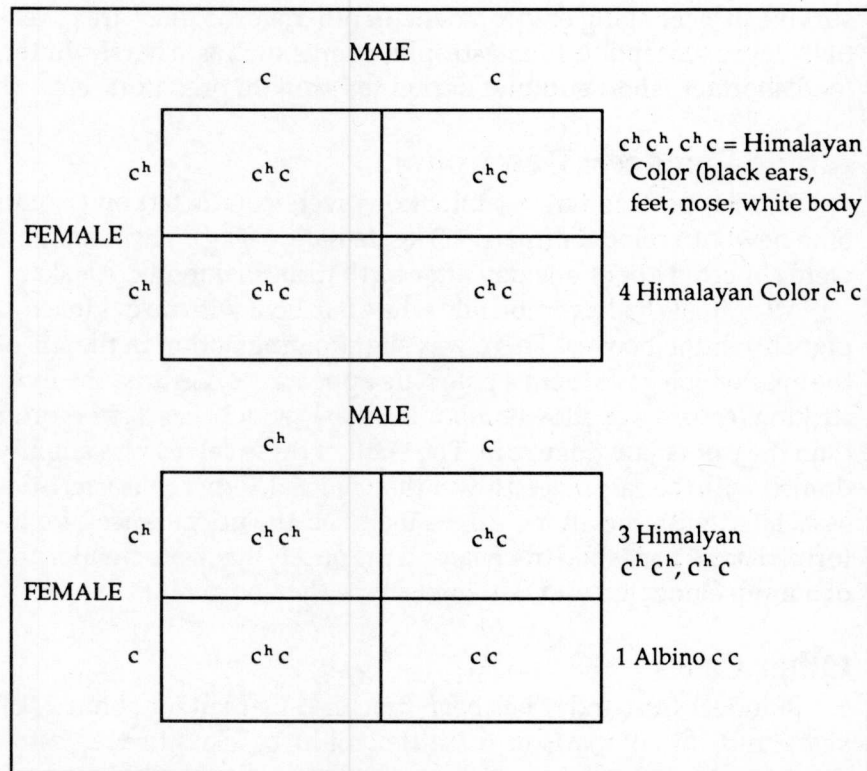


Figure 1b: Diagram showing offspring of several crosses of coat color.

shows that 25% or 1 out of 4 offspring in this population would be albino.

Inbreeding (mating of relatives) increases the proportion of homozygous gene pairs while decreasing those that are heterozygous (Hafez and Dyer 1969). In a small population, more animals will become homozygous for a characteristic and over time this trend could depress animal productivity. Simply, the animal would have lost its ability to adapt to a variety of circumstances (changing climate, food supply, escape from predators, etc.) because breeding was based upon offspring that always reflected a single characteristic. This is especially true for traits such as albinism as described above. In addition, animals with recessive, homozygous alleles (each member of the pair of genes is the same and it can express itself because a dominant trait such as wild color is not present—in this case, the recessive gene 'cc' for albinism) do not appear to have superior fitness or what biologists call "plasticity" to effectively

survive in a changing environment. In other words, they are potentially more susceptible to catastrophic events such as, a harsh winter, food shortage, short summer period for growth, predators, etc.

Albino Reindeer: Description

In 1991, postmortem examinations were conducted on two albino newborn reindeer (male: 4.3 kg; female: 4.8 kg). These animals were collected about one day after birth near Shaktoolik, Alaska.

All animals had a completely white hair coat with no evidence of pigment in the hooves. There was slight pigmentation in the iris of the eyes which gave them a pale blue appearance. Clearly, the most striking feature was a lower mandible (jaw) which was 2 cm shorter than the upper jaw (Figure 2). The skull of these calves was slightly domed with the ears placed lower than normal. Other characteristics associated with the albino calves included the appearance of malformed nasal bones and trachea, and the pupils that were smaller and of a more elongated and flattened shape than normal.

Other Cases

Reindeer husbandry has been practiced by man for about 2,000 years and, in comparison to cattle, could be classified as semi-domestic. More intensive management has occurred within the last 20 years as herd productivity has become more important. However, there are only a few recorded cases of birth defects in reindeer. Multiple congenital defects were observed in reindeer on the Chukchi Peninsula, USSR (Skjenneberg and Slagsvold 1968). Apparently, it occurred in small populations where inbreeding could occur. The Sami people of Scandinavia obviously had observed the disorder as they described it as "rabbit mouth" (Skjenneberg and Slagsvold 1968).

The absence of descriptive records does not imply the chance of albinism does not occur in the wild, but simply that the frequency is low and animals are removed rapidly by predators or scavengers. In the Shaktoolik case, the frequency was considerably higher. It has been estimated from observations of the herder that this characteristic appeared at an average rate of 5.9% of the 1991 calf crop. (Percentage was calculated as calves seen in June plus albinos that died. Twenty-five albino animals were observed at calving; the total calf count at the June 1990 and 1991 handlings was 394 and 403 calves, respectively). Because albinism appears to occur with the shortened



Figure 2: Albino reindeer calf collected from the herd of Palmer Sagoonick near Shaktoolik, Alaska.

lower jaw, newborn reindeer calves cannot suckle their mother and would die or be killed by predators shortly after birth. A companion study on the Seward Peninsula has investigated the causes of death of newborn reindeer calves and found that there is constant pressure from a number of predators to either kill or scavenge unfit or dead calves (C. Chetkiewicz, personal communication). As a result, the number of albino calves recorded is probably an underestimate since others were likely scavenged when the herder was not present.

Little information is available on congenital defects in other cervid, or deer species. Observations of an undershot lower jaw have been reported in a newborn fallow deer fawn (*Dama dama*) (Chapman and Chapman 1970) and in a population of red deer (*Cervus elaphus*) on Hebides Island (Brown 1987). Butcher (1984) and Smits and Bubenik (1990) reported that common birth defects in red and white-tailed deer (*Odocoileus virginianus*) include high-domed foreheads, over and undershot jaws, lateral deviation of the maxilla especially in white-tailed deer, laryngeal stenosis in white-tailed deer, and contracted tendons. Chondrodystrophy has been reported in fallow deer fawns (Baker et al. 1979). In Australia, Mulley (1984) observed congenital hip dysplasia in a fallow deer fawn.

Management and Production Implications

The reindeer industry has the opportunity to launch into a new phase of maturity. Interest in lean meats from commercially-raised game has increased throughout North America. For this Alaska industry to tap these consumers, requires steady product supply. This means productive herds and the annual slaughter of large numbers of animals for profit while maintaining the population within the limits of range carrying capacity. An annual loss of about 20 calves could mean a \$12,100 loss in terms of animals inspected and slaughtered at 18 months of age. This does not even take into account the replacement value of female calves, which hovers at about \$1,000 in the commercial reindeer farm marketplace.

Selection for white color has served a valuable purpose for reindeer herders in the past. Much time was spent moving animals between ranges, protecting animals against predators, or grouping animals for the rut. In the past, radio telemetry and fixed-wing aircraft was not available to locate animals. It was easier to see white animals on the green tundra.

The reindeer industry in Alaska began with a respectable seed

herd in the late 1800s. Although this gene pool is larger than many other successful introductions (e.g. red deer in New Zealand) or reintroductions (plains bison [*Bison bison*] in North America), specific selection pressure on a closed population would regularly display certain characteristics. In this herd, the frequency of the trait has appeared to cycle. This implies that both sexes are carrying the trait, however, some breeding bulls have a higher probability of siring albinos. As a dominant bull (that has passed on albinos) graduates from breeding there should be a decline in the traits until his male offspring are recruited as replacements.

The answer to this problem is not simple since both sexes play a role in the outcome. However, the solution ultimately rests in a management program of outbreeding (adding new blood lines or non-related animals from a different population). For the stock manager, there must be firm decisions to cull animals that may be afflicted with the recessive albinism genes in order to keep the rate of occurrence low. Basically, managers make the same hard decisions as nature to cull those that do not maximize production. It is not feasible or realistic to replace the female herd. The most rapid and profound opportunity for change is with a change in the male blood lines and outbreeding. Perhaps a system of male calf exchange among herders would be the easiest. The new blood lines may even provide extra vigor. Outside of exchange among Seward Peninsula, Nunivak Island, Umnak Island, etc., importation is the other option. This is extremely expensive. While influx of caribou from the Western Arctic Herd has been detrimental to reindeer herders (reindeer absorbed by the migrating populations), the hybrid vigor from occasional breeding males may provide a healthy asset for a productive reindeer herd.

Summary

Although reindeer herding in Alaska occurs on the open range, there is the need to maintain control over their movements to prevent overgrazing and for financial reasons, to prevent loss of ownership when animals stray. Without new breeding stock (especially bulls) and with breeding for white animals, reindeer can show signs of inbreeding (congenital defects) such as albinism and short lower jaws. If these animals are not killed or scavenged by predators they will die because they can not feed. This reflects a loss of revenue from lower herd productivity and fewer animals for sale as breeding

stock. It is highly recommended that several young breeding bulls of the wild color (ordinary) should be introduced to the herd every 3-4 years. This will reduce the chance of albinism and produce stock with greater vigor to survive under the extreme seasonal environments in Alaska.

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