



FROM THE SCIENCE — DESK —

Rare Breeds, Inbreeding, and Breed Survival

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Managing rare breeds often boils down to the management of inbreeding. The same is true of the genetic management of individual herds. I used to be somewhat cavalier about inbreeding, thinking that selection for productivity could minimize the risk of inbreeding depression. With a few more years under my belt, I have more respect for inbreeding, inbreeding depression, and the potential risk that it poses to rare breeds. Inbreeding can be a positive and powerful tool in rare breed conservation and management, but it needs to be used wisely because it very definitely has a potentially negative downside!

Inbreeding is the mating of related animals. Exactly how to distinguish it from linebreeding is subjective, because they are both “inbreeding,” but they are usually taken to mean different degrees of relationship. One useful distinction is to consider inbreeding to be the mating of first-degree relatives. “First degree” means parent to offspring, full-sibling, or half-siblings to one another. More distant relationships pose less of a threat, and can be considered linebreeding instead of

inbreeding.

The reason inbreeding needs to be taken seriously is “inbreeding depression,” which refers to diminished vitality in inbred animals. This occurs to different degrees in different populations, breeds, or herds, but usually includes reproductive characters (fertility and prolificacy), and also general health and environmental adaptation. The perplexing part of this is that some populations tolerate great degrees of inbreeding, while others do not. Unfortunately, predicting which is which before undertaking inbreeding is impossible. Some lines of rare breeds have been intensely inbred for several generations, but then suddenly hit a real wall of inbreeding depression where fertility and vitality reach levels that threaten the survival of the line.

Inbreeding within a breed usually occurs in one of a few different ways. In some breeds that are very separated into different bloodlines, inbreeding can occur within a bloodline, or multiple bloodlines, but from bloodline to bloodline unrelated animals are still available. Pinewoods cattle are an example, with many distinct family lines. Each is relatively linebred, some are highly inbred, but each is completely unrelated to other lines of the breed.

Other breeds, usually through use of individual popular sires and their sons, end up with all animals of the breed inbred to

the same individual animal. If memory serves correctly, Lusitano horses all have at least some relationship to a popular sire from the early 1900s. In this case, completely unrelated matings are no longer available to breeders, even though the actual inbreeding level is relatively low, occurred in the distant past, and may pose no real threat. Individual closed herds can experience the same thing by using one male for a single generation, because after that generation every animal within the herd is related to that same single male, even if other herds in the breed are not. Randall cattle are a good example of this, because Everett Randall used a single bull in the herd for several years, then replaced him with a son. That pattern was repeated over several generations, so now all Randall cattle are related.

These two situations (inbreeding across an entire breed versus inbreeding limited to single bloodlines) can have different significance to the breed. In the first instance there are still unrelated matings available for every animal of the breed. In the second situation there is no option for a completely unrelated mating, and if inbreeding depression occurs, there is therefore no remedy. The important and tricky detail here is that when an inbred animal is mated to a completely unrelated mate, the offspring is not inbred at all.

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The Pinewoods cattle breed has many distinct family lines. Pictured: Desoto Pinewoods bull owned by Jess Brown. Photo by Jeannette Beranger.

Inbreeding and Breed Survival

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This means that inbreeding can disappear completely in one generation if a population's structure is managed well to ensure that all animals are not related. The challenge in rare breeds is to manage the entire breed so that unrelated matings are indeed available, because this can take careful planning and thinking several generations into the future.

Managing inbreeding is always most difficult for small populations, because maintaining all of the genetic diversity that is needed for long-term management is tricky. Add to that the fact that linebreeding certainly does have some advantages as a breeding strategy by assuring such things as predictability and uniformity, and it is important to not throw out the baby with the bathwater! A few practical ways for breeders and breeds to manage inbreeding can be noted. The main goal is to assure that inbreeding is optional, or, to put it another way, to assure that every animal has a potential mate that is completely unrelated.

One strategy is to not necessarily avoid all inbreeding, but to try to limit it to levels that qualify as linebreeding rather than inbreeding. This can take careful consideration, because the goal is to assure that each animal in the herd has a mate that is no more closely related than a cousin of some sort. As a practical issue, this means that several male lines need to be kept going, and, while they can be related, it must be kept to a relatively low level. As males are retained for breeding, their pedigrees must be compared to other males to ensure that relationships are kept distant enough.

While inbreeding of first-degree relatives does have risks, it can still be used as a last resort to save rare bloodlines within a breed. This can be a very useful breeding tool to rescue rare lines. In general, a successful strategy is to not inbreed/linebreed for multiple generations in a row. Therefore, follow close inbreeding by an outcross to another strain, or to a less-related animal. In that way the inbreeding level does not creep up higher and higher, but is taken down a notch every generation or so.

In order to structure breeds to maintain genetic distance between herds, one op-



Everett Randall used a single bull in the herd for several years, then replaced him with a son. Pictured: Randall cow owned by Joe Henderson of Chapel Hill Farm. Photo by Jeannette Beranger.

tion is for different herds to be linebred in different directions. This means that each herd can be linebred to a different founding strain, or a different set of ancestors. In this situation the breed is assured of several completely unrelated choices for mates if need be, because animals from different herds are unrelated. One way to manage this strategy over the long term is to use an occasional outcross to the herd, but then to take those outcrossed animals and linebreed back to the original strain for a generation or two. In this way the power of the original strain is not lost, but neither is the risk of inbreeding depression very high.

An opposite situation, where all breeders carefully avoid inbreeding or linebreeding, also has a subtle threat in it. This is especially true of rare breeds that have few options for outside stock. If all breeders of a rare breed carefully search out unrelated males to bring in every two or three generations, the result over time is that they have eventually used up the source of unrelated males. When done across all herds of a breed, the final result is that all of the herds are at least somewhat related to one another. This is because the search for unrelated animals takes the breeder further and further afield, and if this is multiplied over all the herds of the breed, pretty soon they are all dipping into the

same pool in just about the same way. Depending on numbers in the breed, this can eventually result in all animals being related to one another at some level, and at that point every breeding will be inbred to some degree or another.

The most challenging situation for managing inbreeding is small herds, with single males used in the herd over several years. This situation is all too typical of several species like hogs and cattle. As new males are brought in, eventually the source of unrelated males dwindles, and eventually completely unrelated males may no longer be available. "Unrelated" in this case can take on a nearly tyrannical aspect, and very distant relationships may actually not count for much in inbreeding, but should still be noted for long-term management.

Managing inbreeding can be tricky, and usually takes good communication among breeders. Breed associations can be a big help in this regard, by keeping up with the different directions that the breeders are taking their herds and flocks. ❖

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