Rescue and Conservation Breeding
(or How to Grow Your Flock with Only One Ram)

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Starting Out Small

When I acquired my first two Barbados Blackbelly ewes, they had already been bred at their previous owner's location. I kept their lambs, one ram and one ewe, and thus began my flock of four. It didn't take me long to realize that my breeding options were limited—my ram could be bred to his mother and to his sister, but never to his half-sisters. (The consensus among sheep breeders is that you can get away with inbreeding only one generation--never more.) I purchased an additional two unrelated ewes, but I was still stuck with the limitations of one ram.

I thought about getting another ram, but I was full of dire warnings I'd received about the problems that come with having a single ram and was unwilling to consider a second ram at this stage. Also, as a newbie to raising sheep, I didn't have space or pasture to accommodate a separate ram pen, which I would need if I wanted to be certain about which ram had bred my ewes. What to do?

Luckily, about that time I read an email posted to the Sheep-L listserv that mentioned the American Livestock Breeds Conservancy's (ALBC's) breeding plan for rare and endangered animals. I want to summarize their information in this article so that it might help other Barbados Blackbelly breeders who are stuck in a "One Ram Rut." All information in this article is liberally and thankfully borrowed from the American Livestock Breeds Conservancy's book *A Conservation Breeding Handbook* authored by D. Phillip Sponenberg and Carolyn J. Christman (ISBN 1-887316-00-0, 136 pp, $12.95 +P&H). You can purchase this book directly from the ALBC's Web store at http://www.albc-usa.org/ with my heartiest recommendation. You can contact the ALBC directly at P.O. Box 477, Pittsboro, North Carolina 27312, telephone 919-542-5704.

Small Is a Lot Like Rare

There are almost 100 breeds of cattle, goats, horses, asses, sheep, pigs, and poultry that are in danger of becoming extinct. The Barbados Blackbelly sheep, although not threatened by imminent extinction, is considered a "watched breed" because there are fewer than 10,000 of them in the world and fewer than 2,500 of them registered annually in North America. Many of the truly endangered breeds of livestock live in isolated clusters where a single male lives with a few females (the foundation male and females). Intense inbreeding occurs as the male, and eventually his sons, breeds with the only available females, which are all related to him. The ALBC has developed a breeding program to rescue these endangered breeds from extinction. The rescue breeding program is designed to increase the animal count in a breed while also maintaining the breed's genetic diversity and decreasing its incidence of inbreeding.

For the small farmer choosing to raise Barbados Blackbelly sheep, a flock of one ram and two or three ewes often resembles one of the "endangered" breeds. There may be no place close to obtain replacement livestock or funds to purchase good breeding stock. Without new blood, the flock will become seriously inbred, reducing the value and vitality of the flock. Therefore, for the purpose of this article, we will treat the small Barbados Blackbelly flock as if it were rare and describe a rescue breeding program useful for the small farmer.

Step 1—Rescue Breeding

If anything happens to your only ram, your "rare" flock is essentially extinct. The goal of a rescue program is to develop at least three distinct male bloodlines from the original ram and ewes, thus preserving your male line while also reducing inbreeding. Because you have only one ram, it will be the ewes who contribute most heavily to the genetic diversity in your breeding program.

In order to develop three or four distinct male bloodlines, you will need to breed your ewes to as many different rams as possible. Since you have only one ram, you will need to make more. The following paragraphs explain how to do this using a sample flock of one ram and four ewes.[1] Throughout this article, alphabetic letters are used to represent each of the bloodlines in your flock. We start off in this example with Ram A and four ewes, B, C, D, and E. Their offspring are identified by the combination of letters from the ram and ewe. For example, Ram A + Ewe C=lamb AC. Table 1 illustrates the steps using alphabetic letters. As the number of generations increases, so does the number of letters used to identify the lambs. I found this to be very complex and learned that I could better understand what was going on by referring back and forth between the text and the table. Hopefully, you will, too.

Only the rams, the original ewes, and the ram lambs are listed in the table because they are the most important members of the rescue breeding program. When the daughters enter the breeding program, mate them to whatever ram lamb is scheduled to breed with their mother. Because Barbados Blackbelly sheep will breed at any time throughout the year, you can breed the ewes back shortly after you have weaned their lambs.

1. If you don't have four ewes, you can easily modify Table 1 to illustrate a situation with two or three foundation ewes and one ram.

First breeding cycle: Breed the foundation ram to all four ewes. Keep the foundation ram until the next generation of rams is ready to breed, then cull him (sell, butcher, or transfer to a different breeding program). Keep all of the lambs for the third breeding cycle.

Second breeding cycle: Do the same thing you did with the first breeding cycle because your foundation ram is still the only ram old enough to be reliably fertile. Keep all of the lambs for the fourth breeding cycle.

Third breeding cycle: Divide the flock into two small breeding groups (this can be a problem when space is really limited, but it is necessary to at least temporarily cordon off a small area for each breeding group (using electric netting or some other temporary fencing that is sturdy enough, however, to prevent ram break-throughs). In each group place one of the best young rams born from the first breeding cycle, two unrelated foundation ewes, and those ewes' daughters from the first breeding cycle. (The daughters are half-sisters of the rams, but as we progress through the rescue breeding program, this inbreeding will be reduced.) Cull the ram lambs used in this breeding after their offspring are born. Also cull any ram lambs born to the daughters of the foundation ewes in this group.

Fourth breeding cycle: As you did with the third breeding cycle, divide the flock into two breeding groups, except use the ram lambs from the second breeding cycle, all of the foundation ewes, and all of their daughters from the second breeding cycle. Cull the ram lambs used in this breeding after their offspring are born. Also cull any ram lambs born to the daughters of the foundation ewes in this group.

Fifth breeding cycle: This breeding cycle continues to use ram lambs born from foundation ewes rather than from the daughters of those foundation ewes (which you should have culled). This further reduces inbreeding and increases genetic diversity. Again, create a small breeding group for each of the rams born in the third and fourth breeding cycles. Each ram will be assigned one of the foundation ewes and her daughters from the #1, #2, and #3 breeding cycles. (If there are more than four rams available that were born from foundation ewes, create a separate breeding group for each ram if you have space.)

The rams that result from this fifth breeding are quarter-brother rams and only one-fourth the genetic influence of the foundation ram. Genetically, they can be considered to be four distinct male bloodlines.

Table 1: Rescue breeding program

Generation[a]	Breeding Cycle	Ram used	Ewes bred	Young rams produced[b]
First	*1*	*A*	*B, C, D, E*	*AB, AD*
	2	*A*	*B, C, D, E*	*AC, AE*
Second	*3*	*AB*	*C, D (plus their daughters from the #1 breeding cycle)*	*AB/C*
		AD	*B, E (plus their daughters from the #1 breeding cycle)*	*AD/E*
	4	*AC*	*D, E (plus their daughters from the #2 breeding cycle)*	*AC/D*
		AE	*B, C (plus their daughters from the #2 breeding cycle)*	*AE/B*
Third	*5*	*AB/C*	*E (plus her daughters from #1, #2, and #3 breeding cycles)*	*[AB/C]E*
		AD/E	*C (plus her daughters from #1, #2, and #3 breeding cycles)*	*[AD/E]C*
		AC/D	*B (plus her daughters from #1, #2, and #3 breeding cycles)*	*[AC/D]B*
		AE/B	*D (plus her daughters from #1, #2, and #3 breeding cycles)*	*[AE/B]D*

a. All offspring of an animal are considered to be in the same generation, regardless of the breeding cycle they were born in.

b. This model assumes that each ewe produces one lamb and that half of the lambs born will be rams. Barbados Blackbelly regularly produce twins; this will increase the number of lambs to work with but will not speed up the time it takes to complete five breeding cycles.

In as little as three years, you have four rams instead of one, and at least 30 ewes! Each foundation ewe now has daughters sired by different rams, and each ewe's bloodline is distinct from the other ewes' bloodlines. From a rescue perspective, the flock is no longer genetically endangered and can now progress to a conservation breeding program.

Step 2—Conservation Breeding

Once you have established several distinct bloodlines, you can change from a rescue breeding program to a conservation breeding program. The goal of a conservation breeding program is to maintain those bloodlines over several breeding cycles. The good news is that you can manage the flock as a single unit. This is much easier from a management perspective because you no longer have to separate breeding groups. Instead, you need only house your rams in one area and your ewes in another.

In the conservation breeding program, you will breed each of the rams (from your three or more distinct bloodlines) sequentially to the entire flock of ewes. The following paragraphs describe how to do this using three of the four bloodlines you established in the rescue breeding program. (You can use the fourth bloodline too—or sell it— but it makes this article too complex, so I'm

leaving it out!) For simplicity, each bloodline is assigned a new letter, A, B, or C, as shown in Table 2.

Table 2: Dividing the flock into bloodlines

Rescue Ram ID	Ewes	New Conservation Bloodline
[AB/C]E	*D (plus her daughters from the rescue breeding program)*	*A*
[AD/E]C	*B (plus her daughters from the rescue breeding program*	*B*
[AC/D]B	*E (plus her daughters from the rescue breeding program*	*C*
[AE/B]D	*C (plus her daughters from the rescue breeding program*	*D (sell)*

Rather than describing each of the breeding cycles in detail, have a look at Table 3 and study each breeding cycle carefully. You will see that for each of the breeding cycles, you breed one of the rams to all of the ewes in the flock. Assign an identity to each lamb born based on its parents' bloodlines. For example, because Ram A sired all of the lambs in the first breeding cycle, the lambs are labelled A/A (or simply A), A/B, or A/C.

Table 3: Conservation breeding program

Breeding Cycle	Ram used	Ewes bred	Lambs produced	
			Linebred (save ewe and ram lambs)	Linecross (save only ewe lambs)
1	*A*	*A,B,C*	*A*	*A/B, A/C*
2	*B*	*A,B,C*	*B*	*B/A, B/C*
3	*C*	*A,B,C* *A/B, A/C*	*C* *(C/AC)*	*C/A, C/B,* *C/AB*
4	*A*	*A,B,C* *A/B, A/C* *B/A, B/C*	*A* *(A/AB, A/AC,* *A/BA)*	*A/B, A/C,* *A/BC*
5	*B*	*A,B,C* *A/B, A/C* *B/A, B/C* *C/A, C/B, C/AB*	*B* *(B/AB,* *B/BA, B/BC, B/CB,* *B/CAB)*	*B/A, B/C,* *B/AC,* *B/CA*
6	*C*	*A,B,C* *A/B, A/C* *B/A, B/C* *C/A, C/B,* *C/AB, A/BC*	*C* *(C/AC,* *C/BC,* *C/CA, C/CB,* *C/CAB, C/ABC*	*C/A, C/B,* *C/AB,* *C/BA*

Keep all of the female lambs from the breeding cycle. Let the rams grow to butchering weight and select the best A/A, BB, or CC ram lamb to use to replace his father. Sell or butcher the remaining ram lambs as well as the mature ram (A, B, or C) because he has made his genetic contribution and you can replace him with his son.

The ewe lambs from the immediately preceding breeding cycle are too young to mate, so keep them separate, probably where you had them during weaning.

Labelling the lambs after the second breeding cycle can get complex because of all of the letters involved. You can simplify things by using this rule of thumb: if a lamb is more than 50% of a line, you can combine the letters used. For example, the lambs born from the third breeding cycle are C/A, C/B, C/C, C/AB, and C/AC. The C/C lambs are 100% of line C and the C/AC lambs are 75% of line C, so you can simply call both groups C.

At the fourth breeding cycle, you return to the line A ram, who replaced his father after the first breeding cycle. Now, however, he is breeding his sisters as well as his mother, which calls for a discussion of inbreeding, linebreeding, and linecrossing.

Inbreeding, Linebreeding, and Linecrossing

Inbreeding and outcrossing (outbreeding) are about breeding animals who are or are not related to each other.

- To *inbreed* is to mate brother to sister, half-brother to half-sister, father to daughter, or mother to son.
- To *outbreed* (also *outcross*) is to breed animals who are not related in any manner.

Clearly, when you mate one ram to all the ewes in a flock, some inbreeding will naturally occur. Father/daughter crosses will not happen because you will retire a ram after breeding so that he never has a chance to breed his daughters. Likewise, there will never be more than one instance per breeding cycle of a mother/son breeding. However, bother/sister and half-brother/half-sister matings will be somewhat common because the ram you choose to replace the line's sire will return to mate his own line three breeding cycles later. Instances of inbreeding are separated by time (at least three breeding cycles), and managed in such a way as to minimize inbreeding in any one bloodline.

In contrast, linebreeding and linecrossing are about bloodlines, not relatives.

- To *linebreed* is to mate two sheep who have a common ancestor but who are little, if at all, related to each other. A lamb is considered linebred if it is more than 50% of a line's genetic makeup.
- To *linecross* is to mate sheep of different bloodlines. For example, a lamb is considered line-crossed if it is a mixture of A, B, and C but no one line contributes more than 50% of the total genetic makeup.

You need to include both linebreeding and linecrossing in your conservation breeding program.

- Linebred ewes provide replacements only for their line.
- Linecross ewes provide replacements for other lines.

Table 4 describes how this replacement scheme works in your flock:

Table 4: Replacing sheep by linebreeding and linecrossing

Ewes per Line		Source of Replacements for Each Line		
Line or Linecross	**# of Ewes**	**A**	**B**	**C**
A	*5*	×		
A/B	*5*	×	×	
A/C	*5*	×		×
B	*5*		×	
B/C	*5*		×	×
C	*5*			×
Total	*30*			

The conservation breeding program requires only 30 ewes to adequately represent and maintain three separate bloodlines. This is a reasonable flock size for a small farmer. However, the most powerful aspect of the conservation breeding program is its rotation of rams and their replacement by their sons so that members of the flock are alternating between an inbred and outbred condition. This maximizes genetic diversity, strengthens the "good" genetic traits, and breeds out the "bad" genetic traits.

The necessity of replacing rams with their sons, however, is the hardest part of this program for most Barbados Blackbelly breeders. A really good ram, once obtained, is hard to part with, and a breeder is naturally inclined to maximize exposure of that ram to as many ewes through as many breeding cycles as is possible, thus "making his good genes go a long way." This approach will work for a short time, but ultimately will leave the breeder in a "One Ram Rut" and will entail returning to a rescue breeding program to once again establish three distinct bloodlines.

Although the rescue and conservation breeding programs may seem complicated after reading them through the first time, I encourage you to read them again. Put pen to paper and create your own breeding tables with the sheep in your flock. If you have space for a larger flock, read more in ALBC's *A Conservation Breeding Handbook* about managing two parallel flocks. Contact the ALBC with your questions about the rescue and conservation breeding programs. But most importantly, think about your responsibility to breed sound, vital, Barbados Blackbelly sheep and to strengthen this breed's numbers and genetic diversity. In this way you can help ensure that our sheep never become endangered and, ultimately, can cease being a "watched" breed.