

**Contents:**

- 1 Preface and Overview  
*Maurice Shelton*
- 6 Selection for Reproductive Efficiency  
*G. E. Bradford*
- 11 Genetic and Environmental Impacts on Prenatal Loss  
*H.H. Meyer*
- 15 Lamb Mortality  
*Maurice Shelton and Tim Willingham*
- 20 Opportunities to Reduce Seasonality of Breeding in Sheep by Selection  
*D. R. Notter*
- 33 Strategies for Genetic Improvement of Carcass Value in Lambs  
*D.F. Waldron*
- 38 Relationships Among Traits: Growth Rate, Mature Size, Carcass Composition and Reproduction  
*G. E. Bradford*
- 42 Composite Trait Selection for Improving Lamb Production  
*G. D. Snowden*
- 50 Fundamental Aspects of Crossbreeding of Sheep: Use of Breed Diversity to Improve Efficiency of Meat Production  
*K. A. Leymaster*
- 60 Use of Finnsheep Crosses in a Western Commercial Sheep Operation  
*Richard and Burrows Hamilton*

# Use of Finnsheep Crosses in a Western Commercial Sheep Operation

Richard and Burrows Hamilton  
Hamilton Brothers Ranch, Rio Vista, CA

The Hamilton family has been engaged in agriculture, including sheep production, in California for more than 130 years. The farming and ranching operation is diversified, and includes row crop farming, dry land grain and safflower farming and livestock which also includes cattle. The sheep flock today consists of about 3800 commercial whiteface ewes that are 3/8 Finn, and about 85 purebred Suffolk ewes.

The climate of the area is Mediterranean, with rain from October or November to March or April, and thus with a dry season of at least six months in most years. Sheep are an integral part of our cropping system, and particularly important to the dryland wheat and barley production, which is our largest cropping enterprise. Following harvest of the grain crop, the sheep graze the crop residues during the summer. The land is left fallow the following season or sometimes two seasons, but with the rains there is a substantial "volunteer" crop of grasses and forbs, which provide good grazing for the sheep. If not grazed, this growth would make crop preparation the following season more difficult, especially in better than average rainfall years. Sheep have an advantage over cattle in this system in that they cause much less compaction of the heavy clay soils. The ranch includes considerable areas of native grass range that are also grazed much of the year to complement the stubble and fallow grazing. The sheep are also used to enhance sensitive native California grasslands for the Nature Conservancy, Solano County Open Space and the California Fish and Game Department.

Ewes are lambled in two seasons, a fall lambing from October 18 to December 15,

when 75% or more of the mature ewes lamb, and a winter lambing from January 20 to March 15, when the ewe lambs and remainder of the mature ewes lamb. Ewes in each group are pregnancy tested and separated by fetal count and estimated stage of gestation. Mature ewes with singles are generally field lambled, while those carrying multiples and all ewe lambs are barn lambled. A very successful fostering system is used to maximize the number of ewes raising twins and minimize the number of ewes that fail to raise a lamb.

## Breeding Plan

The traditional plan for obtaining replacement ewes in nearly all California commercial sheep operations is to purchase yearling whiteface ewes, of predominantly Rambouillet and Targhee breeding, from the intermountain states, Texas, New Mexico and Arizona. While such ewes at maturity will have reasonably satisfactory fall lambing performance, there is no selection for that in the spring-lambing intermountain flocks. The yearling ewes, often little more than 12 months of age when put with the rams in California, often have a high percentage of dries (typically 10 to 15%) the first year. These ewes do not produce enough twins to reach a 100% lamb crop. California's average lamb crop is approximately 90%.

In the late 1960's, we realized that the traditional range ewe wasn't productive enough to meet the ever-changing demands of the sheep industry in our area. Our weaning rate per ewe in the flock was not much over 100%, typical for the area then and still for many flocks today. A decrease in the number of dry ewes and an increase

in twinning rate seemed essential. In 1970, Dr. Eric Bradford of the University of California at Davis had acquired from USDA the first Finnsheep rams in the state, and had mated these to some Targhee ewes from a group selected for several years for increased weaning weights. Ken Ellis of UC Cooperative Extension organized a program with a few ranchers to evaluate the performance of ewes sired by these Finn-Targhee rams. We obtained rams from these first Finn crosses and used them on selected twin-bearing ewes in 1972.

The daughters of these rams weaned more lambs than any ewes we had had up to that time. Furthermore, as ewe lambs, mated at about 9 months of age, they had fewer dries than the purchased yearling ewes that had been our replacements in the past. With our 1/4 Finn cross ewe lambs, we typically would get 82 to 87% conception rate and turn out 1.15 lambs per ewe and today, with our 3/8 Finn cross, we typically get between 90 and 96% conception rate and turn out 1.20 to 1.30 lambs per ewe. We therefore obtained more 1/2 Finn rams, and converted the entire ewe flock to 1/4 Finn breeding. Our weaning percentage from mature 1/4 Finn ewes, lambing predominantly in the fall, rose to 135%. When we started selecting Finn cross ewes and rams, we instituted strict production and quality standards in our program. We tried to achieve standards in wool quality, conformation, and production that best utilizes our available resources and meets the needs of our markets. Our goal is to produce a ewe that at the minimum twins yearly during the fall, produces a wool clip between 22.05 to 23.49 microns, and produces Yield 2 market lambs weighing between 135 and 140 pounds. Concerns about size,

conformation, and adaptability to Western sheep operations are reasons often stated by other producers for not being willing to try Finn crosses. What other producers often don't realize is the high lamb production potential of these sheep, which is so important to net returns, and thus the potential advantages from incorporating a percentage of Finn to meet production goals. Our results show that the risk of loss in wool quality, conformation and adaptability can be overcome through selection.

With 1/2 Finn rams of the type we were using not readily available to purchase, and recognizing that we could probably raise better rams than we could buy, we started to raise our own rams, from the best of our 1/4 Finn ewes and rams, in 1981. We chose not to use Polypays, which were becoming available, because we felt our sheep were somewhat larger, and more consistent and finer in wool quality. Had the Polypay been available when we first started our own breeding program, we might have used that breed, but by the time it was available, we had our own program which was working well for us.

By 1985, our management and success in raising twins had improved to the point that we felt we were ready to move to a higher level of prolificacy. After discussing some possibilities with Dr. Bradford, we decided to evaluate 3/8 Finns, and in 1986 purchased several large, heavy-boned 1/2 Finn x Targhee rams from Art Christiansen of Montana. These were mated to our best 500 1/4 Finn ewes, and their daughters evaluated before proceeding further. The first year, 96% of the 3/8 Finn ewe lambs lambled at 14-15 months of age (vs. 88% for 1/4 Finns). When the performance of these ewes at older ages showed that they regularly outperformed the 1/4 Finns, we made the decision to convert the entire flock to 3/8 Finn. Our philosophy in trying any new genetics is to compare the new cross with the control, in this case our established 1/4 Finn flock. We evaluate all of the potential benefits and problems of the new cross during a lifetime production cycle, with enough numbers to be confident of the results. This takes about five years and it is at that time we decide if the new cross is going to become the established cross.

## Identification, Flock Management and Selection

With the exception of rams and of our purebred Suffolks, our sheep are not individually identified, but we do use a system of types and shapes of ear tags, ear notches, ear tattoos and type and color of paint brand to keep information needed in facilitating our selection process. The pertinent information is year of birth, type of birth and rearing, wool quality and lambing history (being dry their first year, what breeding group they are in, time of year they lamb - fall or spring - and what type of lambing they have had).

A potential replacement ewe lamb is given an All Flex ear tag in her left ear at docking. The male part of the tag is a sheep type tag and the color of the tag represents the birth year. The colors are rotated and we mix in white also. All our livestock, which includes cattle, have the same color tag each year. The female or bottom part of the tag is either black, meaning twin or triplet raised, or white, meaning single raised. The shape of the female tag represents the type of cross of the ewe. In our 1/4 Finn cross, we used a sheep type tag and in our 3/8 Finn cross, we use a hog type tag. If we are testing a new cross, the females of that cross are also given an ear tattoo in their right ear. We will ear tattoo until the new cross becomes the only cross we are raising. Currently, we are testing a Friesian cross and we are back using the sheep type tag as a bottom tag since there are no 1/4 Finn ewes left in the flock. There is no question that singles grafted as twins are identified as twins and twins born and raised as singles are identified singles. We do not feel that this has had a serious effect on our success in selection. We do try to graft only male lambs as twins to help reduce the effect of any misidentification on replacement ewe selection.

When a ewe reaches 12 to 14 months of age and before she is sheared as a yearling, we visually fleece each ewe and look for wool quality and consistency from shoulder to breech. Ewes that are off in quality are given a black All Flex medium ear tag in their right ear. This means that these ewes can only be used with terminal sires and not used to raise replacements.

We do individually identify ram lambs, since we keep individual wool production and breeding group records on rams. Since we keep only twin born and raised rams out of twin raised ewes, we identify the potential ram lambs before they leave the lambing facilities. Since the lambs and ewes are number branded for twin ID at birth, we can find a potential ram lamb's mother and twin and see their visual qualities. We do note the mother's ID with the potential ram. The ram lambs are given a numbered ear tag that matches the shape of the ewe's left ear tag, and also an identifying ear notch number. Since we are in the voluntary scrapie program, the rams are given a permanent scrapie ear tag in their right ear that matches the number and color of the ear tag in their left ear.

If a ewe at 14 months of age fails to raise a lamb, she receives a metal ear tag in her right ear. If this ewe with a metal tag shows up again open at preg testing or fails to raise a lamb, she is automatically culled. Normally, only first time lambing ewes get a second chance. We do not supplement ewe lambs before breeding so their conception rate is highly correlated to feed conditions.

Ewes are segregated into "single" and "twin" bands (and now in some cases into a triplet band) after lambing, and these are usually kept separate at weaning so that those raising multiples are known when mating bands are made up for the next season.

To maintain our sheep-stocking rate for our available resources and balance with our cattle operation, we need to retain 800 to 900 ewe lambs a year. To achieve our replacement numbers, we breed 1700 ewes to our 3/8 Finn rams. These ewes are selected in terms of size, conformation, fleece quality, history of twinning and fall lambing and are divided into 3 equal size groups. These replacement groups lamb between October 20 and December 15. These groups are known as a Purple group, Green group and Orange group. Once a ewe gets into one of the three groups, she is given an All Flex medium ear tag of the same color as the tag in her right ear. We also put a color ownership (HR) brand to match the color of the group ear tag. The earliest a ewe can get into this group is usually at 3 to 4 years of age, when her performance history has been established. As stated earlier, ewes

with black tags in their right ear are not eligible for this group. A ewe will stay in this group as long as she meets the production standards. All the other mature ewes, which include the black tag ewes, are branded with a blue ownership (HR) brand and they are bred to Suffolk rams.

Each year with our three replacement groups (Purple, Green, & Orange), we designate two groups as ewe replacement groups and one as the ram replacement group (ewe replacements are also selected from this group). Since we have a cross of sheep that is very hard to find outside of our own program, we try to avoid inbreeding through a system of rotation of the group providing replacement rams. Rams never breed ewes from the group in which they were born. Also, rams are used for no more than 3 years, and ewes do not enter a replacement breeding group until 3 or 4 years of age, so sib matings are also avoided. The ram producing group is always the group bred to the new crop yearling rams. Example: In 2000 fall lambing, our 1998 born yearling rams out of the Orange group are the sires of lambs in the Green group, which is the designated ram sire group. These 2000 fall born Green group ram lambs will be used as yearling sires on the Purple group for the fall lambing of 2002. This system has worked well. We have not brought in an outside ram since 1990. We do keep rams out of the ewe replacement groups, but they are sold to other breeders.

In California, with our green grass period starting in late December and ending in April, we have to have lambs old enough to take advantage of these grasses. This is why we lamb so early in the fall; we can lamb or run ewes and lambs on alfalfa and then move to the native grasses when the feed is strong

for lambs. Since we are trying to breed at a time of year when ewes aren't cycling as regularly or have lower ovulation rate compared to fall breeding, we can overcome a lot of the difference with genetics (ex. Finn), and also using other tools such as flushing and teaser rams. In our operation, we do flush ewes on native grass fields that were not grazed in the months of March and April, and we also use teaser rams. From past history, we know we get a tremendous "ram effect" on our ewes when we put the rams in. If the ewes breed on the first cycle their ovulation rate is lower, especially in May. To help overcome the lower ovulation rates, we expose the ewes, including the ewe lambs, to teaser rams for one month before the breeding rams go in. This way we hope to get one or two estrous cycles before introducing the breeding rams. We feel it has helped our twinning percentage and also helped even out the peaks of lambing. We make teasers out of single born 3/8 Finn ram lambs.

Ewe lambs are mated beginning August 12, at an average of 9 months of age, until October 23, at the same time as the cleanup mating of the mature ewes. Ewe lambs are bred to 3/8 Finn rams, but no replacements are kept from them, although some of their lambs are sold as replacements for other flocks if there is demand.

Mature ewes are ultrasounded for pregnancy and fetal count in late August, and those with singles and with multiples, and early and later pregnancy, separated, for more efficient use of any supplemental feed and to facilitate management at lambing. Accuracy of counts has been good, about 95%. All the open ewes are run together and continue to be exposed to both Suffolk and 3/8 Finn rams. We continue to keep a couple of 3/8 rams with the pregnant ewes,

so we have ram coverage for any ewes reabsorbing fetuses. All rams are removed on October 23. Ewes from later breeding are pregnancy checked approximately 35 days after the rams are removed.

Selection of rams occurs at several stages. As indicated, rams for use in our flock come from the designated ram replacement group, and other ram lambs for potential sales come also from the two ewe replacement groups. As stated earlier, promising individuals from dams raising twins or triplets are identified before hauling to the alfalfa or native pasture fields, so when docked they don't get castrated. We will identify about 125 to 140 potential rams. We wean the ram lambs at about 70 to 80 days of age to avoid possible mother to son breedings. At weaning, we castrate any "off" or below average ram lambs based on weight for age. After weaning, we take a side and breech wool sample for each ram lamb, and cull some based on wool evaluation. From approximately one month after weaning until they are evaluated as yearlings, the ram lambs are raised strictly on native rangeland and their further evaluation for size, conformation, condition and hardiness is based on these growing conditions. At yearling shearing their fleeces are weighed and graded, and this information, along with size and conformation, is used in selecting rams needed for the flock. Fleece grade is emphasized, in the interests of maintaining a uniform clip for the whole flock. Once we select our replacement yearling rams, we will cull the older rams from the flock. Normally, we turn over 3/8 Finn rams every three years. These older rams and the yearling rams from our ewe replacement groups are popular, and we are finding a more consistent demand than for replacement ewes. We sell on average 40 to 45 rams a year to other producers.

2000/2001 performance levels of the flock are approximately as follows:

	Replacement groups, rams in May 18	Terminal sire groups, rams in June*	Ewe lambs
%preg : by late Aug. preg test	87%	53%	-0-
%preg : end of season preg test	12%	43%	93%
% open : end of season preg test	1%	4%	7%
Lambs/ preg ewe @ late Aug. preg test	1.57 lambs/ewe	1.45 lambs/ewe	-0-
Lambs/ ewe @ Docking (3.5 wks of age)	1.48 lambs/ewe	1.38 lambs/ewe	-0-
Lambs/ preg ewe @ last preg	1.64 lambs/ewe	1.64 lambs/ewe	1.51lambs/ewe
Lambs/ ewe @ Docking (3.5 wks of age)	1.51 lambs/ewe	1.51 lambs/ewe	1.20 lambs/ewe
Weaning wt.			
Twin lambs ( note: 2000 ave. wt)	89 lbs.	85 lbs.	65 lbs.
Single lambs (note: 2000 ave. wt)	102 lbs.	98 lbs.	77 lbs.
Ewe Fleece wt.	8.2 lbs	8.2 lbs.	8 lbs.

\*Rams are turned in two different dates. Group includes all yearling ewes

The wool clip sells under the term "original bag". "Original bag" means that we produce enough wool that it doesn't need to be pooled with other producers' wool, so our wool sells as Hamilton Bros. Ranch wool and how it sells depends on the quality and consistency of our micron reports. We belong to the Cal Wool Marketing Assn., a cooperative, which acts as our selling agent. We skirt and class our wool and it is marketed in two lines. Our A line is approximately 85% of the clip grading 62's, 22.0-23.5 microns, and our A1 line is a 60's clip, which is 23.5-24.9 microns. To help us evaluate our program of selecting for wool quality, we look at the standard deviation and coefficient of variation of our wool. On average, the standard deviation of our A line wool has been 4.6 to 4.9 and the maximum standard deviation for 62s grade wool is 5.89. On average, the coefficient of variation of our A line is between 19 and 20.4%.

As these figures show, the reproductive performance of the flock is much above the average, particularly for large flocks, for California or for the US. The fleece weights and fleece quality, and in fact the size and conformation of the sheep, are much superior to what many producers would expect from 3/8 Finn sheep. The increased prolificacy has no doubt come mainly from the introduction of Finn breeding. The growth rate, conformation and fleece traits we believe come from the selection we have practiced, in choosing the 1/2 Finn rams used to upgrade the flock to 3/8, and the ewe and ram selection practiced within the flock, on the ewe side now for more than 25 years.

Today, when people come to see our 3/8 Finn cross sheep, they can't believe that they have that much Finn in them based on their size, conformation, and wool quality. What we tell people when they visit our ranch is that we developed our Finn cross to work for our operation and that it might not work for you. If you are going to take something from our experience, take the idea that there are a lot of tools available to help you make improvements to your operation to be successful in the sheep industry.

The single most important factor in the success of our sheep operation has been the Finnsheep. Without the benefits of the

Finn, we couldn't have made the changes that we needed to make to have a chance to survive in a global market.

## **Comments added by G. E. Bradford, University of California, Davis**

The Hamilton ranch flock represents an exceptionally successful breeding and production operation, and it may be worthwhile to include an interested observer's comments on factors that appear to have contributed to this success.

1. Clear goals. The Hamiltons recognized that they needed to increase the number of lambs weaned per ewe to maintain a profitable operation, and have focussed on that goal throughout. Emphasis on secondary goals followed achievement of an increase in fertility and prolificacy.
2. Systematic evaluation based on performance. Lambing performance of the first 1/4 Finn crosses was compared with that of their traditional sheep before a decision was made to convert the flock to 1/4 Finn breeding, and the same step was followed before the decision to convert to 3/8 Finn. (A similar approach is currently under way in the flock to test the progeny of East Friesian x Targhee rams, to see if they can improve milk production and/or growth rates). In each case, by maintaining identity of the animals in the test group, the owners retain the option to eliminate all animals from that group if their performance is not better on average than that of the group they would replace.
3. Identification of all animals by breed group, year of birth, type of birth and current prolificacy level. Thus, even without individual identification, much is known about the pedigree and performance of each animal. Combining this with stratification into flocks to produce replacements and to be bred to terminal sires permits quite intense selection on performance,

without individual performance records on the ewes.

4. Management has improved to take advantage of the increased genetic potential for prolificacy. This has included more jugs in the lambing barn, pregnancy checking and separation of single- and multiple-bearing ewes, improved supplemental feeding strategies, and more fostering.

The combination of higher genetic potential for prolificacy from the Finnsheep breed, consistent selection of rams and ewes under commercial production conditions, and improved management, has resulted in a flock production level estimated at 30 to 40% above that of average flocks in the state.