

Woolgathering

The official publication of the Selkirk Rex Breed Club

INTRODUCTION

I have been breeding Selkirk Rex (SRX) since 1993 when I got my first three from Jeri (two came to me pregnant). Since then, I have done extensive research on breeding practices, pedigrees, inbreeding, etc., to understand the implications of my breeding program.

During these last 14 years or so, I have been called many things by many people, but I was never more surprised and disappointed than by hearing two newbies state that I was NOT a SRX breeder because I was using outcrosses; because I wasn't breeding SRX to SRX only at this stage. I was informed that "20 years is long enough to develop a viable gene pool," "CFA got it wrong by allowing outcrosses" and that we should all follow FIFe's prohibitions on exhibiting a SRX that was less than three generations SRX to SRX breeding.

At the point where this discussion started, it was me against two instant experts – people who had been breeding cats/SRX for less than 4 years. Their minds were made up and nothing I said could sway them from their certainty that they were the only true SRX breeders, because they were breeding "pure" SRX (in other words, breeding SRX to SRX to get five or more generations away from any outcrosses).

The goal was to get to five cats, all 5 or more generations "pure" SRX to SRX breeding that would then be used to breed from for succeeding generations, with the help of all of us "non-SRX breeders" who had been using outcrosses.

I don't want this article to appear that I am trying to justify myself or put the newbies down with the discussion. My purpose is to clarify the purpose of a SRX breeding program that uses outcrosses and why outcrosses are not only needed but required at this stage in the development of the SRX.

As a side note, I am not averse to breeding SRX to SRX when done with the dangers in mind. I am also not averse to using outcrosses when they are sufficiently unrelated to increase the gene pool. So, the following discussion will include basic genetic information and reasons to consider using outcrosses for your breeding program if you are not already doing so.

As always, if you have comments or discussion that you would like to expand on, send it to me for the next *Woolgathering*.

First, we have to define what it is we are working with and toward. This is a discussion specifically about SRX, but applies to any structured breeding program in general.

WHAT IS A SELKIRK REX?

If we don't define what it is we are working toward, how will we know if we have reached that point? One of the ways to define a SRX is with the standard. But there are other definitions that apply more to this discussion.

The easy answer to the question, "what is SRX?" is "a curly coated cat descended from Miss DePesto of NoFace." But this doesn't take into consideration the straighthairs that are produced because of the heterozygous, dominant nature of the

gene that produces the curly coat. So, we can change our definition to “A cat descended from Miss DePesto of NoFace.” But if we were to leave it at that point, we would in essence open up our breed to using any and all breeds of (or random-bred) cats.

So we have chosen to define SRX as “a cat descended from Miss DePesto of NoFace showing only British Shorthairs, Persians, Exotics and until 1997, American Shorthairs as ancestors.”

Now that we have defined what our breed is, how do we develop an effective breeding

program for SRX, which is still a relatively young breed, that will ensure as much as possible the long-term genetic health and survivability of this breed?

A discussion of genetics is necessary at this point, including some definitions of genetic terms so we are all on the same page with the same understanding of the genetic concepts involved with the non-random breeding we do as SRX breeders. These definitions can be found in many of the articles found at the links listed at the end of the article¹.

GENETICS 101

Inbreeding

The mating together of animals more closely related to one another than the average relationship within the breed. Inbreeding selects for both the phenotypic and genotypic traits, and dramatically increases the probability of producing animals homozygous for defects with the possible concomitant effect of inbreeding depression.

Line breeding

The mating of later generations back to some ancestor or its descendents. Line breeding is a form of inbreeding.

Inbreeding Coefficient (or COI)

The parameter used to express common heritage. It indicates the probability that the two alleles for any gene are identical by descent. The computations necessary to determine the COI of any particular animal are too complex to go into here and are better done by a pedigree program that can handle the number of calculations necessary. Like many other genetic calculations, the IC is based on probabilities, not certainties. An individual may be more or less highly inbred than the number computed.

COIs for typical matings (assuming that the parents are not inbred) are:

Brother-sister	25%
Parent-offspring	25%
Half-siblings	12.5%
Uncle-niece	12.5%
Grandparent	12.5%
First cousins	6.25%

¹Because the experts have experience stating their thoughts more succinctly than I, most of the comments are taken directly from their articles.

It should be noted that inbreeding has a breed-specific context: an animal is considered to be inbred if its COI is greater than the breed's average COI. For instance if the average COI of a breed is 10%, an individual COI of 15% is considered inbred. If the average COI of a breed is 25%, 15% is not considered inbred.

Outcross	Mating two individuals of the same breed that are sufficiently unrelated that the IC of the progeny is lower than the average of the parents.
HETEROZYGOUS	Two different copies of a gene.
HOMOZYGOUS	Both copies of a gene are the same. As animals are mated to their relatives, however distant, simple mathematics will show that the likelihood of any one gene becoming homozygous will increase. As homozygosity increases, variation among offspring decreases. The breeder takes advantage of this in line breeding to produce a breed which "breeds true" and conforms to a "breed standard" and within the breed to produce offspring that are like peas in a pod. Unfortunately this search for perfection and uniformity comes at a cost. Undesirable genes also become increasingly likely to be homozygous and so affect the health of the animal. Most of these genes have minor effects, which gradually accumulate. There are many genes involved in traits like fertility, immune competence and mental stability and accumulation of homozygous recessive "bad" genes gradually diminishes the function of these systems.
HETEROSIS (or Hybrid Vigor)	The burst of fertility, good health and growth that is seen in the progeny when two unrelated breeds are mated.
Drift	Change in genetic makeup in a population when mating is not random. Genes not specifically selected for tend to drift out of the gene pool. Many of these will be for things so subtle they might never come to a breeder's direct attention.
Fixation	Loss of all alleles of a gene but one. All homozygous curly SRX have fixation of the curly gene – there is no other allele. There is a straighthair allele carried by heterozygous SRX.
Random Breeding	In a random-breeding situation the frequencies of different alleles will remain constant. The key is in the concept of "random" breeding; every male in the population has an equal chance of mating with every female and vice versa; every mating is equally productive.
Assortative Mating	The mating of individuals that are phenotypically similar. If animals

heterozygous for certain genes are more fit, assortative mating will preserve more heterozygosity than inbreeding. However, unlike inbreeding, assortative mating should not result in an increased risk of the parents sharing hidden recessive mutations. Though we might like to eliminate deleterious recessives, everyone carries a few. Trying to find the "perfect cat" without either visible or hidden flaws is like betting on the lottery. There may conceivably be a big winner out there, but they are certainly not common.

Phenotype breeding is still selective breeding, since the breeder is selecting those animals which show the desired traits, while minimizing the probability of doubling up on hidden, undesired ones.

Founder An individual (Pest) drawn from a source population (domestic cats) who contributes genetically to the derived subpopulation (all SRX).

Founder Effect Changes in allele frequencies that occur when a subpopulation (SRX) is formed from a larger one (domestic, Persian, Exotics, British Shorthairs and American Shorthairs). Typically, many rare and usually undesirable alleles are excluded while a few carried by the founders get a big boost in frequency.

Genetic Load The difference between the fittest possible genotype and the average fitness of the population. Fitness is the individual's over-all health and vigor. The greater the genetic load, the more genetic difficulties members of a breed are likely to suffer. In a closed gene pool, the situation may remain stable or deteriorate. It cannot get better.

"Because random drift has a greater impact on a small population, the population needs to grow rapidly, to at least several hundred breeding individuals, so as to minimize the loss of valuable alleles. During this time, we should select cautiously. . . too rigorous selection during the early generations increases the possibility of accidental loss of a valuable gene closely linked to one of the genes under selection." (ELIMINATING MUTATION THE IMPOSSIBLE DREAM by John Armstrong)

Genetic Diversity The population contains most of the possible alleles for a particular gene locus rather evenly distributed throughout the population. The conclusion is that genetic diversity is desirable for the health and long-term survival of a population.

For those genes that establish breed identity, there will be markedly less variability within a breed than within [the species] as a whole. The tricky bit is restricting variability for those genes that make a breed distinctive without sacrificing the variability/diversity that is necessary for good health and long-term survival of the breed.

BREEDING SRX

"The creation of a pure breed, by its very nature, is a genetic narrowing of allelic traits. Unfortunately, when selecting for desired characteristics, some degree of diversity is lost throughout the genome."
Inbreeding in Dalmatians *James E. Seltzer, Ph.D.*

When a breed is deliberately created from a small number of founders, the creator(s) generally concentrate first on inbreeding and selection to define the qualities they are after, rather than increasing the initial population and subsequently selecting for those that come closest to meeting their goals. Such a beginning generally removes most of the genetic diversity in the first few generations. In concentrating on inbreeding it is possible to be unlucky or to have chosen badly, there may be little that can be done to reverse the lack of genetic diversity.

By now, everyone knows the story of the beginnings of the SRX. It is the usual sort of story of a new mutation that occurs that captures someone's eye and it becomes a passion to continue that mutation. Left to chance or nature, the mutation might disappear or could take over the feral cat population in the neighborhood.

With selective breeding and tracking of pedigrees, a breed was developed, becoming the SRX in the case of the dominant gene introduced by way of Miss Depesto of Noface.

Using the database of SRX currently in existence, it can be seen that few, if any, SRX are further than 10 generations away from the original cat. Having one founder limits the amount of genetic diversity our breed contains – not just the curly gene, but genes for health, longevity, temperament, boning, looks, breeding capability, mothering ability, etc.

At the beginning, the best way to have started the breed would have been to breed Pest to many different cats and then breed the offspring of those cats to cats with different lines and so on for several generations (always retaining those that had the curly genes to use for breeding). This would have increased the genetic diversity of the breed since there would have been few, if any, common ancestors between the various non-sibling offspring. It is unfortunate that this didn't happen.

Unfortunately, most of the Persians used early on were related to the original Persian (from one very prolific Persian sire, who unfortunately turned out to have passed on PKD to many of his offspring).

Most of the British Shorthairs used were related to the early Brits that were originally accepted by CFA.

The Exotics were from a variety of lines, but most were related, since the Exotic breed was a created hybrid using Persians and various breeds of shorthairs. Most are related through the Persian side.

Then there was the problem of far too many breeders of the breeds used for outcrosses who refused to have any of their lines used with the SRX, which limited the number of different lines available to SRX breeders.

There are some breeders who believe that in order to have a "pure" breed called the Selkirk Rex, we should not be using any

outcrosses, even at this early stage in the development of the breed. This is a danger to the breed for several reasons:

First, there is no such thing as a “pure” breed of any cat, dog, horse, etc. While it is possible to get to 99.999999...% “purity”, it will never be 100% “pure” (even the Persian – the largest breed in CFA – is not pure. Until the 1940’s and 1950’s, any cat could be registered as Persian – actually called “longhair” - if it looked like a Persian, or the

owner swore under oath that it was a Persian regardless of its actual parentage).

Second, by breeding only Selkirk to Selkirk, concentration of some genes (either positive or negative) will occur with the concurrent loss of other genes (either positive or negative). By limiting the number of potential gene combinations, these breeders are setting up the breed to fail at some time in the future.

OUR RESPONSIBILITIES TO THE SRX AS BREEDERS

How do we develop a population diverse enough for long-term survival while producing cats good enough for exhibition? What breeding schemes could we use to meet our goal of healthy cats that meet the various association breed standards.

As breeders, we have the responsibility to make sure our breed survives and is healthy, not only for the individual animals but for the long-term health of the breed. Only breeding SRX to SRX for multiple generations can lead to problems in breeding, health, size, temperament, etc. as genes are doubled up on and other genes are discarded (whether deliberately or accidentally).

John Armstrong, in his *Breeding Schemes* article, described the differences between the three major breeding schemes:

- a. Random
- b. Linebreeding
- c. Assortative

In general terms, here are brief descriptions of the differences.

Random: mates are chosen with no regard for similarity or relatedness. Another way to think about it is if all the cats in the neighborhood roamed around together and there was no human decision on which male was bred to which female.

Inbreeding/Linebreeding: Breeding related animals to create more homozygosity in the genes.

Assortative: Mating of individuals that are phenotypically similar. This is the reason that Jeri selected Persians, Exotics, British Shorthairs and American Shorthairs as outcrosses. It is also the reason that American Shorthairs were dropped as an outcross. The ideal SRX has a round head, round eyes, heavy boning and a non-Persian face. The idea was to create a gene pool using unrelated outcrosses while developing a particular look. Judicious use of these three breeds with SRX can create offspring that meet the standard as well as increase population diversity, decrease the average COI of the population and decrease genetic load while retaining the curly gene.

Each of us has to choose what type of breeding scheme we will follow. Each has to decide what is most important for his/her breeding program as well as the population of SRX as a whole.

Let me know what you think, if this has been helpful or if you think I'm full of it.

LINKS

<http://www.canine-genetics.com/Genetics.htm>

Site with links to many individual sites and articles about canine genetics, but enough general information to be useful for cat breeders.

http://www.dogstuff.info/backcross_project_nash.html

The link on the genetics page listed above doesn't work. This is a link to the article about the use of one pointer with one Dalmatian to get rid of the high uric acid problem.

<http://www.netpets.com/cats/reference/genetics.html>

Mostly articles by John Armstrong with a couple of articles related to cats

<http://www.alachealth.org/indexgene.htm>

More canine genetics issues, some repeats.

<http://www.geocities.com/breedingcats/links.html>

Information and links to some of the articles listed at the above sites, plus a bunch of new articles specifically related to cat breeding.

<http://www.chromadane.com/VARGASeriesArticles.htm>

Breeding articles by Dr. Susan Vargas, related to canines. In their six-part series, authors Susan Thorpe-Vargas, John Cargill and Caroline Coile discuss how a single breeder's actions may have consequences that are far-reaching. Selective breeding practices may have created a genetic nightmare for many of our breeds today. In the first installment of that series, The Genetic Cul-de-Sac, the genetics task force addresses the origin of the domestic dog with an emphasis on the fundamentals of DNA and gene mutations, and their relationship to vigorous genetic diversity.

<http://www.hdw-inc.com/genetics.htm>

Feline genetics articles

<http://cc.ysu.edu/~helorime/felgen.html>

Feline genetics articles and links

http://cats.about.com/od/felinegenetics/Feline_Genetics_and_Inheritance.htm

Interesting breed specific genetics

<http://www.kolumbus.fi/sarakontu/link/catlinks.html>

Colors and other genetic issues related to cats.

<http://faculty.vetmed.ucdavis.edu/Faculty/lalyons/Sites/color.htm>

Leslie Lyons website

<http://faculty.vetmed.ucdavis.edu/Faculty/lalyons/Sites/webpageref.htm>

Cat peer-reviewed genetics articles

<http://pets.groups.yahoo.com/group/gene-pool/>

Yahoo group for discussions about feline genetics

FLAME RETARDANTS LINKED TO CAT DISEASE

Findings show PBDEs' health risks to humans have been underestimated.

by Douglas Fischer, Contra Costa Times Staff Writer

A mysterious epidemic of thyroid disease in cats may be linked to flame retardants common in carpets, foam furniture and mattresses, according to federal researchers, who suggest that scientists have underestimated the human health risk of the chemicals.

The research, published Wednesday in the journal *Environmental Science and Technology*, does not prove the compounds known as PBDEs or polybrominated diphenyl ethers, caused the rash of hyperthyroidism in the nation's household cats over the past 30 years.

Rather, it shows that cats are heavily contaminated with these compounds, which leach from household products and are

found everywhere, particularly in household dust. Cats, meticulous cleaners, ingest PBDE-contaminated dust daily.

The rise of feline hyperthyroidism – a rare disorder before 1980 that today is a leading cause of death in older cats – matches the increasing sales of PBDEs, or polybrominated biphenyl ethers.

The study was conducted jointly by researchers at the Environmental Protection Agency's National Health and Environmental Effects Laboratory and Indiana University.

The affected cats, they note, are the proverbial canaries for humans, who spend

upward of 90 percent of the day indoors, according to some estimates.

Pound for pound, a 2-year-old ingests nearly as much dust as a cat, based on EPA estimates. And while the blood of every living human in the developed world is thought to be contaminated with PBDEs, Americans have by far the highest levels – 10 to 100 times higher than residents of Japan and Europe.

The spike in hyperthyroidism in cats suggests long-term, low-dose exposure to these compounds is far more endocrine disrupting than laboratory experiments indicate.

“Cats are in the right place to be exposed. They’re in our homes, they’re on our carpets, sometimes they’re on our appliances and furniture.” said Janice Dye, an EPA veterinarian and research biologist who was one of the paper’s lead authors.

The epidemic of hyperthyroidism in older cats, Dye said, is likely a result of the thyroid gland responding to a chronic disruption over a very long period of time.

A chemical industry spokesman downplayed the EPA hypotheses.

The study was small and other research attributes the epidemic to increased awareness and longer feline life spans, said John Kyte, of the Bromine Science and Environment Forum.

“In other words, the increase in the number of cases diagnosed is not at all surprising, and it speculation to try to link it to flame retardants,” he said in a press release. “This is an issue that bears watching, and we will

see what additional research indicates, but people should not be making broad conclusions based on this single, very limited study.”

Millions of pound of PBDEs known as Penta and Octa were added annually to foam in furniture until 2004, when California and Europe banned them and the nation’s sole manufacturer voluntarily agreed to cease production. A third PBDE known as Deca continues to be mixed with hard plastic and is today found in household appliances, with the United States making up more than half the global market.

The thyroid gland is the body’s regulator, controlling how quickly the body burns energy, makes proteins and respond to other hormones.

Before 1980, hyperthyroidism in cats was unheard of; today it is one of the most prevalent health problems in older cats and a leading cause of death. Hyperthyroidism accelerates the body’s metabolism. Typical symptoms in cats are increased appetite, weight loss, irritability, lethargy and diarrhea.

But it’s the human effects that have researchers concerned. PBDEs contaminate virtually every house dust sample ever analyzed. Young children, with their small size and tendency to mouth objects, are likely as highly contaminated as cats, the EPA researchers estimated. Though children quickly outgrow such tendencies, they’re exposed at a critical developmental window to a far higher load of endocrine-disrupting compounds than adults.

“People are just beginning to look to see if we can find anything in the human

population,” Said Linda Birnbaum, research director of the EPA’s Health Effects Laboratory and a paper co-author.

“Nobody’s done any long-term studies with these.”

Next Issue: Deadline is December 31, 2007. Send your responses, new articles, etc. to me by then for the next issue.

As you might surmise from the genetics article above, I want more pedigrees. I would like to be able to calculate the average COI for SRX, but without any current pedigrees (and without the non-SRX ancestors included) it is impossible to figure that out. Please send me your pedigrees, both current and past so I can include them in the calculation. This way, we can all know what the average is and how inbred our cats might be.

Thanks! Donna

Pedigree of Woolibaar This Lamb Is My Lamb and Woolibaar Moon Over My Lambie – my only two breeding females as of 7/31/07 – ignoring my own advice. The COI for these girls is 4.8783888%. The average COI for this pedigree is 6.54309%. If the average COI for the breed is similar, these girls would not be considered inbred. If the average COI for the breed is lower than 4.878%, they would be!

Parents	Grand-Parents	Great-Grand-Parents	Great-Great-Grand-Parents	
Ch Pamacs Blue's Brother of Woolibaar, SRX 3.34251832%	Ch Oaktree Showing My Socs of Pamacs-, SRX 9.299569%	Oaktree Socrates, SRX 0%	NoFace Oscar Kowalski, SRX	
		Woolibaar Bon Bon of Pamacs+, SRX 4.717023%	Oaktree Truly Scrumptious, BSH	
	Kiasutha Singin The Blues of Pamacs-, SRX 0%	Lil'BoPeep Mr Sunshine, SRX 12.5339117	Oaktree Jose Fleeciano, SRX	
		Madeline Basset of Kiasutha, PER 0%	Lil'BoPeep Tia, SRX	
Woolibaar Sweet Baby Jane, SRX 12.98856735%	Woolibaar Nathaniel Woolthorne, SRX 3.784815%	Lil'BoPeep Lambert of Castlekatz, SRX	Lil'BoPeep Jackie Blue, SRX	
		Persiapalace Porsche, PER	Persiapalace Shelby, PER	
	Woolibaar Sealed With A Kiss, SRX 8.657133%	Pr Woolibaar Sunrise Jubilee, SRX 0.01635700%	Pixelpoint Tequila Sunrise, SRX	Cheri Jubilee of Pamacs-, PER
		Oaktree Rosie O'Donwool of Woolibaar, SRX 9.299569%	Oaktree Socrates, SRX	Woolibaar Bon Bon of Pamacs+, SRX
	Oaktree 2QT2BSTR8, SRX 9.299569%	Oaktree Socrates, SRX	Woolibaar Bon Bon of Pamacs+, SRX	
	Lil'BoPeep S. Minnie of Woolibaar-, SRX 19.194206%	NoFace Oscar Kowalski, SRX	Lil'BoPeep Ginger, SRX	