



## **Finnish Kennel Club**

## **Suomen kromfohrländer ry**

## **Kromfohrländer Crossbreedings**

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# Finnish Kennel Club – Suomen kromfohländer ry - Kromfohländer Crossbreedings

## – Project Overview – History through F1 –

2013 Poodle X kromfohländer		2014 Parson Russel X kromfohländer		2014 Tibetan Terrier X kromfohländer	
Sire: FIN CH FI ACH FI ACH-J CRUSEA'S HARD-CORE	Dam: SM-13 FI ACH FI ACH-J KRUMME FURCHE YOLANDER	Sire: C.I.B POHJ MVA FIN MVA SE MVA FI AVA FI AVA-H POHJ AVA NO MVA EE MVA NO AVA SE AVA(H) SE AVA JACKVILLE GLENNY	Dam: C.I.B FI MVA EE MVA LV MVA LT MVA BALT MVA LTV-09 JAZZMO FUNK	Sire: FI CH TIBICINAN EMPEREUR RESOLU	Dam: FI CH EE CH ANDROMEDA
					
<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN41547/04&amp;R=172.21">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN41547/04&amp;R=172.21</a>	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN18863/08&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN18863/08&amp;R=192</a>	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN42495/04&amp;R=339">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN42495/04&amp;R=339</a>	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN16904/07&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN16904/07&amp;R=192</a>	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN53185/06&amp;R=209">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FIN53185/06&amp;R=209</a>	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FI25051/09&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=FI25051/09&amp;R=192</a>

### F1 Litter: FIN CH FI ACH FI ACH-J CRUSEA'S HARD-CORE X SM-13 FI ACH FI ACH-J KRUMME FURCHE YOLANDER

ER17032/13	female	<a href="#">BINGIS BALOO</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17032%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17032%2F13&amp;R=192</a>
ER17030/13	female	<a href="#">BINGIS BOO</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17030%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17030%2F13&amp;R=192</a>
ER17028/13	male	<a href="#">BINGIS BAGHEERA</a>	seal, white markings.	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17028%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17028%2F13&amp;R=192</a>
ER17031/13	male	<a href="#">BINGIS BAMSE</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17031%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17031%2F13&amp;R=192</a>
ER17027/13	male	<a href="#">BINGIS BARBABEAU</a>	seal, white markings.	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17027%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17027%2F13&amp;R=192</a>
ER17025/13	male	<a href="#">BINGIS BASIL</a>	seal, white markings.	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17025%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17025%2F13&amp;R=192</a>
ER17024/13	male	<a href="#">BINGIS BOB THE BUILDER</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17024%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17024%2F13&amp;R=192</a>
ER17026/13	male	<a href="#">BINGIS BOLT</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17026%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17026%2F13&amp;R=192</a>
ER17029/13	male	<a href="#">BINGIS BOO BOO BEAR</a>	brindle, white markings	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17029%2F13&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER17029%2F13&amp;R=192</a>



Bingis Bagheera



Bingis Baloo



Bingis Bamse



Bingis Barbabeau



Bingis Basil



Bingis BobTheBuilder



Bingis Bolt



Bingis Boo



Bingis BooBooBear

**F1 Litter: C.I.B POHJ MVA FIN MVA SE MVA FI AVA FI AVA-H POHJ AVA NO MVA EE MVA NO AVA SE AVA(H) SE AVA JACKVILLE GLENNY X C.I.B FI MVA EE MVA LV MVA LT  
MVA BALT MVA LTV-09 JAZZMO FUNK**

ER28567/14 female	<a href="#">RAASILLAN CARPE DIEM</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28567%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28567%2F14&amp;R=192</a>
ER28568/14 female	<a href="#">RAASILLAN CELAVIE</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28568%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28568%2F14&amp;R=192</a>
ER28566/14 female	<a href="#">RAASILLAN CHESTNUT</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28566%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28566%2F14&amp;R=192</a>
ER28565/14 female	<a href="#">RAASILLAN CHIC</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28565%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28565%2F14&amp;R=192</a>
ER28562/14 male	<a href="#">RAASILLAN CHAMP</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28562%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28562%2F14&amp;R=192</a>
ER28561/14 male	<a href="#">RAASILLAN CHAMPAGNE</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28561%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28561%2F14&amp;R=192</a>
ER28563/14 male	<a href="#">RAASILLAN CRESCENT</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28563%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28563%2F14&amp;R=192</a>
ER28564/14 male	<a href="#">RAASILLAN CRUISER</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28564%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER28564%2F14&amp;R=192</a>



Raasillan  
CarpeDiem



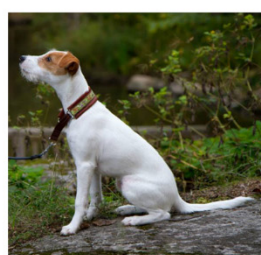
Raasillan  
Champ



Raasillan  
Champagne



Raasillan  
Chestnut



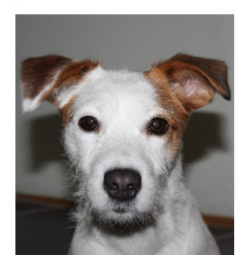
Raasillan  
Chic



Raasillan  
Crescent



Raasillan  
Cruiser



Raasillan  
Celavie

**F1 Litter: FI CH TIBICINAN EMPEREUR RESOLU X FI CH EE CH ANDROMEDA - born 23.3.2014**

ER25895/14 female	<a href="#">ALOBELIN EMPRESS ASSEMBLAGE</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25895%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25895%2F14&amp;R=192</a>
ER25891/14 female	<a href="#">ALOBELIN EMPRESS COCKTAIL</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25891%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25891%2F14&amp;R=192</a>
ER25890/14 female	<a href="#">ALOBELIN EMPRESS MELANGE</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25890%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25890%2F14&amp;R=192</a>
ER25896/14 female	<a href="#">ALOBELIN EMPRESS SYNTHESIS</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25896%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25896%2F14&amp;R=192</a>
ER25894/14 male	<a href="#">ALOBELIN EMPEROR HETEROZYGOUS</a>	white-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25894%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25894%2F14&amp;R=192</a>
ER25892/14 male	<a href="#">ALOBELIN EMPEROR HYBRID</a>	white-brown-black	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25892%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25892%2F14&amp;R=192</a>
ER25893/14 male	<a href="#">ALOBELIN EMPEROR MEDLEY</a>	white-black-brown	<a href="http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25893%2F14&amp;R=192">http://jalostus.kennelliitto.fi/frmKoira.aspx?RekNo=ER25893%2F14&amp;R=192</a>



Alobelin  
EmperorHeterozygous



Alobelin  
EmperorHybrid



Alobelin  
EmperorMedley



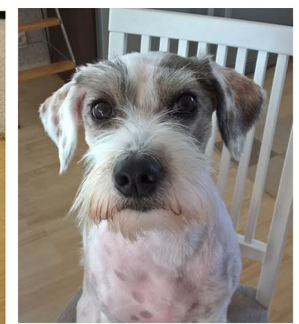
Alobelin  
EmpressAssemblage



Alobelin  
EmpressCocktail



Alobelin  
EmpressMelange



Alobelin  
EmpressSynthesis



## Kromfohländer Breed Information - General

- **Kromfohländer FCI Breed Standard:** <http://www.fci.be/en/nomenclature/KROMFOHRLANDER-192.html>
- **Breed origin: Germany: VDH: Breed Club: Rassezuchtverein der Kromfohländer e.V.:** <http://www.kromfohrlaender.de/>
  - **Health Data:** <http://www.kromfohrlaender.de/der-kromfohrlaender/fuer-besitzer/gesundheit/gesundheitsdaten/>
- **Finland: FKC: Finnish Kromfohländer Breed Club: Suomen kromfohländer ry -** <http://www.kromfohrlaender.fi/index.html>
  - **Kromfohländer JTO:** [http://www.kromfohrlaender.fi/JTO-kromfo-2014\\_2018.pdf](http://www.kromfohrlaender.fi/JTO-kromfo-2014_2018.pdf)
- **MyDOGDNA: Assessing Genetic Diversity in Kromfohländer - View to a cross-breeding project:** <http://www.mydogdna.com/blog/assessing-genetic-diversity-kromfohrlaender-view-cross-breeding-project>

## Breed Registrations

*Internationally acknowledged as a breed by FCI, in 1955, only a few thousand Kromfohländers have ever lived.*

Germany (VDH)		Finland (FKC)		Sweden (SKK)		Norway (NKK)		United States (AKC*)	
								2016	23
		2015	32					A total of 23 Kromfohländers have been registered in AKC's Foundation Stock Service since 2012.	
		2014	53						
2013	222	2013	25	2013	58				
2012	174	2012	47	2012	42	2012	6		
2011	308	2011	41	2011	69	2010	3		
		2010	46	2010	46	2009	8		
		2009	36	2009	36			A total of 23 Kromfohländers have been registered in AKC's Foundation Stock Service since 2012.	
		As of 2016 a total of 827 Kromfohländers have been registered in FKC since 1988.		From 2001 – 2013 a total of 389 Kromfohländers have been registered in SKK.					

## DogWellNet – Finland - the Kromfohländer crossbreeding project

Authored by Viivi Snellman

### History of the breed (*why / how did you come to the decision to do crossbreeding?*)

Kromfohländer is one of the youngest German dog breeds, and it was internationally acknowledged as a breed by FCI, in 1955. The first Kromfohländer breeder, Mrs Ilse Schleifenbaum, lived near Siegen, in southern Nordrhein-Westfalen, close to the area of Krom Fohr, known today as Krumme Furche. The name of the breed is derived from these words.

According to the legend, the original sire of the Kromfohländer breed was a griffon type dog that was brought by American soldiers from France to Germany in 1945. In Germany, the dog got separated from his masters, and the wife of a Siegen lawyer Mrs Ilse Schleifenbaum took him in and named him Peter. He lived the life of a family dog, and mated the neighbour's black and white terrier, Fiffi. The resulting litter was surprisingly even in quality, for a litter of crossbreed dogs. Schleifenbaum herself fell in love with these elegant, medium-sized, lively, devoted and easily trained dogs, and began to develop a breed out of them. According to the stud book, the third founding dog was Elfe, who lived in the 60's. Out of these three, only Peter's photographs remain. As far as we know, none of them was registered, so the breed has its origins in crossbred and mixed breed dogs.

As early as in 1962 Maria Åkerblom brought the first Kromfohländer from Germany to Finland; she was a bitch in whelp, and gave birth to six puppies. Together with Åkerblom's other three German imports, these formed the basis of the early Finnish Kromfohländer breed. Mrs Åkerblom and Mrs Schleifenbaum corresponded frequently, and throughout the years there have been personal friendships between German and Finnish breeders. The German, Swiss, and Finnish breed clubs signed an official cooperation agreement in 2007, after which the exchange of health data and cooperation have expanded and deepened even further.

The background of practically each Kromfohländer is fully known. This has enabled the evaluation of the state of the breed through international cooperation, and left us with no doubt that the more traditional, less dramatic steps will not lead to a solution to the problems of a small gene pool, until they reach an uncontrollable state.

### Genetic diversity (*background*)

There have only ever lived a few thousand Kromfohländers. Genetic diversity has been evaluated by experts both in Germany, and in Finland. Diversity has been evaluated both through statistical pedigree analysis, and on a genetic level, in the form of DLA haplotype charting and MyDogDNA diversity charting. All studies have come to the same conclusion: the gene pool is very small.

A German study from 2009, "Pedigree analysis for conservation of genetic diversity and purging" (Pfeiffer & Wellman), came to the conclusion that there was no variation within the breed, and that it was not possible to identify a subpopulation based on, for example, their coat type or geographical location. This study finds, that the mean kinship coefficient in Kromfohländers is approximately 0.45. In other words, all individual members of the breed are as closely related as full siblings.

Researchers at the University of Helsinki conducted a study, and reported their findings in "TULOXSIA KROMFOHRLÄNDEREIDEN DLA-MONIMUOTOISUUSKARTOITUKSESTA" ("Results from the DLA diversity charting of Kromfohländers"), also in 2009. This study focused on the genetic diversity in the MHC gene complex. Approximately 180 dogs were studied. Only five different haplotypes were discovered in the

breed. These five were distributed fairly evenly. In Finnish Kromfohrländers, haplotypes 1-4 were each found in 21-29% of the dogs, haplotype 5 in only a little more than 1% of the dogs. German dogs that were studied were mostly smooth haired, where 18% of the dogs had haplotype five, 32% had haplotype four, and haplotypes 1-3 were found in 13-26% each. 18% of the population were homozygous regarding the studied DLA haplotypes. Homozygosity is fairly evenly distributed among the four most common haplotypes. The study recommends, that all groups should be used for breeding, and genetic testing should be performed in order to maintain genetic diversity.

The Finnish breed club Suomen kromfohrländer ry entered the MyDogDNA project at the project's pilot phase in 2013. According to research, the breed's level of whole genome heterozygosity is 21% (situation in 2013, after the first crossbreeding litter), while the mean value for all breeds is 35% (situation in 2016).

### Viability of the breed

Even if the situation seems gloomy, in the light of the given figures, thankfully the actual situation seems brighter. Litter sizes are, for the main part, large. An average litter has 7 puppies, while normal litter sizes vary between 5-9. Some litters of three have been born, but on the other hand, we have also seen a litter of 13. Matings are practically always natural, and after a successful mating, complications during the pregnancy are very rare. Some breedings do not succeed, because the male will not mate with the female, or the female will not accept the male. This might be due to natural selection, since the dogs themselves have not been allowed to select their mates. Puppies are usually energetic and dams are willing and able to care for them.

### Selecting dogs for the crossbreeding project *(what were the main challenges, in terms of knowledge and evidence, choosing dogs to human and political and practical factors?)*

The breed club started the project by setting up a questionnaire for breeders in autumn 2011, and for members later that same year; this was to find out what the membership thought about the issue, and if they were willing to work for improving the situation. We wanted to make sure that the project has a sufficiently wide support from people with unanimous goals, necessary for its completion. The questionnaires revealed wide and active support for the project, so the club decided to move forward with it in 2012. The club worked in close cooperation with the Finnish Kennel Club's scientific committee, ensuring the fast and unhindered progress of the project. The committee was in favour of our project, and the Board of Directors of the Finnish Kennel Club approved it in autumn 2012. The first generations of crossbred dogs will be registered in the Finnish Kennel Club's ER registry. These three generations may only be bred to purebred, FI registered dogs, as per the rules of the Finnish Kennel Club. From the fourth generation on, the dogs from a crossbreeding background may be registered in the FI registry.

Since none of the original founding dogs was purebred, the original breeds could not be named. According to descriptions, the dogs were a terrier of some kind, and a griffon type hunting dog. The present day Kromfohrländer is used solely as a companion dog. For these reasons, we decided that bearing in mind the history of the breed, it would be natural to breed Kromfohrländers to several breeds, one of which should come from FCI breed group 9, companion dogs, and one would be a dog similar to the original foundation dogs.

All breeds have their own problems and procedures, so the challenge is to decide how to place emphasis on different challenges, brought on by different breeds. We began by charting the backgrounds of each individual, three generations back, as completely as possible. In all breeds,

we aimed to cooperate with both the breed clubs, the breeders, and the owners of the dogs. All available information was noted in three-generation pedigrees, and all missing information was clearly pointed out. Our starting point was to find dogs, who did not carry the diseases already in the breed, and on the other hand, we did not want to introduce new hereditary problems or illnesses to the breed.

According to the breed standard, Kromfohrländers are adaptable, docile and high-spirited companions and house dogs, somewhat reserved with strangers, with a little hunting instinct. Aggressiveness and timidity are not desired. Evaluating the dogs' characters, and combining different types of characters is especially challenging. The questionnaires clearly indicated that the members wish to preserve the functional and reserved dog with no hunting instinct, but on the other hand, aggression and timidity were seen as something to breed away from.

### Monitoring, outcomes

Dogs born within the program are subjected to extensive health checks: their hips, elbows, knees, eyes, backs and hearts are checked. Their genetic samples are sent to the MyDogDNA project, so that the development of genetic variation within the breed can be monitored; they are tested for the breed's only hereditary illness that has a DNA test, namely hereditary footpad keratosis and, furthermore, they are tested for hereditary illnesses found in other breeds, as well as their coat type and colour genes. Each individual dog will participate in either the Finnish temperament/character test, or the MH mental description and a special evaluation for breeding dogs, where their temperament and conformation are evaluated. The Finnish Kennel Club requires that each veterinary visit is listed and reported, until the dogs reach the age of eight years. Furthermore, health and temperament questionnaires are set up, and an active contact is maintained with the owners. The individuals used for breeding will not be selected until the dogs have reached full maturity, at the age of 3-4 years. With males, possibly even later.

The crossbred puppies' official health and temperament results are available in the Kennel Club's breeding database:

<http://jalostus.kennelliitto.fi/frmKoirat.aspx?R=192&Rekisteri=ER&Kotimaiset=0>

### Ongoing challenges

Our challenge at this point is a positive one: the combinations have been successful, and there are several breeders interested in them. How do we choose the individuals for the next stage of the project? How many individuals from each combination can our population take? Should we use equally many individuals from each of the three litters? What kind of emphasis is placed on different health issues? How do we evaluate their conformation? How much emphasis is placed on creating a uniform conformation? Do we wish to breed for a showier look, in order to achieve success in conformation shows? How do we evaluate their temperament? How capable of aggression should the individuals selected for breeding be? What is the significance of a recessive disease, that has entered the breed through another breed's genes, but has a screening test? How strict should we be with hooked tails? How do we evaluate damage in tooth enamel? What is the priority of each of these properties, in relation to one another? For the time being, none of these problems have any influence on the well-being of the dogs.

### Lessons learned...

Dogs are extremely important to their owners, who tend to be emotional about them. The crossbreeding project is a balancing act between the common good and one's own benefit. The project requires courage, openness and ability to cooperate. It requires sensitivity and courtesy towards the owners of the dogs, and especially enthusiasts from other breeds. Eventual problems are not to be blamed on any individual or

breed: these things happen, when dealing with living beings. Our crossbreeding project is not a competition between individuals and litters. Everyone has their place in the project.

Continuous evaluation, and the fact that we have not been able to define criteria for emphasizing properties in time for the next phase, build pressure and uncertainty. It may also make it harder to remain open, even if our small circles mean that everyone will hear about possible issues, eventually. For the sake of the confidential continuation of the project, it would be important to agree on matters in time, remember to listen to one another, pay extra attention to being considerate, and keep your eye on the goal: a happy, healthy Kromfohrländer.

### The future.

In 2017, the first f2 generation poodle mixes will be born. The same year, also the individuals used for breeding from the Parson Russel terrier and Tibetan terrier mixes will be selected. Next year is also the year, when the Finnish Kennel Club's special crossbreeding permit expires, and it is time to report on the project's developments thus far.



## REFERENCES

R. WELLMANN and I. PFEIFFER (2009). Pedigree analysis for conservation of genetic diversity and purging. Genetics Research, 91, pp 209-219. doi:10.1017/S0016672309000202. < <http://dx.doi.org/10.1017/S0016672309000202>>

MyDogDNA Blog article: 14/02/2014 at 08:26 am – Jonas Donner. **Assessing Genetic Diversity in Kromfohrländer - View to a cross-breeding project.** <http://www.mydogdna.com/blog/assessing-genetic-diversity-kromfohrlander-view-cross-breeding-project>.

*See the material from this blog below – provided herein for historical documentation purposes.*

University of Helsinki report Kromfohrländer diversity survey: <http://www.kromfohrlander.fi/kromfohrlander-monimuotoisuusraportti.pdf> (Finnish). *The English version is available below.*

Rassezuchtverein der Kromfohrländer e.V.: <http://www.kromfohrlaender.de/>

Suomen kromfohrländer ry - <http://www.kromfohrlander.fi/index.html>

Schweizer Kromfohrländer-Club: <http://www.kromfohrlaender-club.ch/>

Rasklubben Svenska Kromfohrländerklubben: <http://www.kromfohrlanderklubben.se/>

Kromfohrländer Club of America: <http://www.kromiclub.com/>

## THE DLA DIVERSITY OF KROMFOHRLÄNDERS

Dogs spontaneously exhibit several different heritable diseases just as humans do. However, the incidence of many diseases in a breed can be as much as ten times higher than in humans. This phenomenon is due to the history of dog breeds. Breeds have often been developed from a few individuals and are always founded on severe inbreeding. Often the dogs used for breeding are closely related or certain individuals are overrepresented. Using close relatives increases the incidence of carriers for breed specific ailments and consequently increases the number of affected individuals.

Inbreeding narrows the dog's genetic diversity and thus threatens the health of the breed. One vital genomic region of the dog is the MHC complex. The term "MHC" or "Major Histocompatibility Complex" refers to one of the functions of the genes located there. The MHC genes are in charge of, among other things, identifying the dog's own tissue as well as the identification and elimination of foreign pathogens. Variability is crucial to these immune genes, enabling them to react to different viruses, bacteria and other foreign intruders. The dog's MHC genes go by the name DLA, an abbreviation of the words "dog leucocyte antigen".

Some dog breeds have very limited DLA gene diversity and this makes them susceptible to different autoimmune diseases. Dozens of such diseases are known, among them diabetes, lupus, rheumatism, polyarthritis, hypothyroidism, immune-mediated hemolytic anemia, Addison's disease and perianal fistelia. Several autoimmune diseases have been proven to be linked to these DLA-genes. Testing them may be important in combating these illnesses and to uphold diversity both in specific breeding programs and in the breed in general.

DLA diversity can now be charted from the DNA of dogs. The idea behind DLA diversity study is to test alleles (= different forms of the same gene, which differ slightly in their base sequence) of the dog's immune genes (3 different genes), and the haplotypes formed by three combined alleles. The information thus gleaned can be utilized in breeding by, for example, choosing a mate that genetically differs from the other as much as possible. This would ensure that the resulting puppies would be likely to inherit from their parents as many different gene combinations as possible, and this in turn would increase the diversity of the line and, in time, the entire breed.

Figure 1 displays the MHC genomic region, which is located in the canine chromosome 12. The MHC region's genes can be divided into three classes based on the activity of the proteins they produce. This research focused on analyzing the Kromfohrländers' class II genes DRB1, DQA1 and DQB1. The class II genes encode proteins that take part in the initial phase of the immune defense. They identify parts chopped of different foreign substances and introduce them to other cells involved in the immune defense. As there is a large amount of foreign matter to be identified, it is important that both individuals and populations retain different alleles. A small amount of alleles can increase the population's sensitivity to a variety of pathogens. A MHC homozygote may be more susceptible to communicable and autoimmune diseases.



Figure 1. The canine MHC genomic region is located in chromosome 12. MHC classes I, III and II are in the chromosome sequentially. The Kromfohrländer study covered genes DRB1, DQA1 and DQB1. Each gene contains forms that differ from each other slightly in terms of their base sequence, in other words, alleles. The genes in question are located next to each other and belong to the MHC II class. (kb = kilobase, the DNA measurement)

### The DLA diversity of Kromfohrländers

The DLA diversity of 100 Kromfohrländers was studied at the Canine Genetics Research

Group led by prof. Lohi in the University of Helsinki and Folkhälsan Institute of Genetics, Finland. The results of the DLA study are shown in Table 1. The breed was found to have five DRB1 alleles, three DQA1 alleles and five DQB1 alleles. The DRB1, DQA1 and DQB1 genes form three-allele combinations, which are inherited together and called a haplotype. Kromfohländers have five different haplotypes. These haplotypes are named Krom1, Krom2, etc. for simplicity.

Table 1. MHC haplotypes and their frequencies in Kromfohländers in Finland and Glatz in Germany.

Haplotype	DRB1	DQA1	DQB1	Frequency (%)	
				Finland	Germany (glatz)
Krom1	01501	00601	02201	29,2	22,7
Krom2	10103	00101	00802	25,5	13,6
Krom3	01502	00601	02301	23	13,6
Krom4	07401	05011	00701	21,1	31,8
Krom5	00901	00101	08011	1,2	18,2

For comparison, examples of different haplotype frequencies from other previously studied breeds are listed in Table 2. However when making comparisons, one should remember that more important than the amount of haplotypes is the way they are distributed in the population. In Kromfohländers too, most dogs carry one of the four most common haplotypes. The number of haplotypes depends on the history of the breed and breeding practices. One should also keep in mind that the MHC genes are not entirely neutral genomic regions, but may be subject to different levels of selective pressures in nature. The MHC genes play a pivotal role in the immune defense and all haplotype combinations are not necessarily beneficial to life. This may explain the rarity or absence of some combinations in a breed.

Table 2. The frequency of MHC haplotypes in other breeds studied in Finland.

Breed	Number of dogs in the study	Number of identified haplotypes
Whippet	100	13
Icelandic Sheepdog	58	10
Finnish Hound	50	8
Löwchen	72	8
Nova Scotia Duck-Tolling Retriever	176	5
<b>Kromfohländer</b>	<b>180</b>	<b>5</b>

One of the aims of MHC mapping is to find out how big proportion of the dogs in the studied population is homozygous with respect to certain haplotypes. Homozygosity means that the dog has inherited same haplotype from both of its parents. A majority of Kromfohländers are not homozygous in the MHC region:

they have inherited different haplotypes from their parents. In this study, 33 dogs were homozygous for the MHC haplotypes, which is 18% of the total number of studied dogs. 5.5% of these dogs were homozygous with respect to Krom1, 4.5% to Krom2, 3.9 % to Krom3, and 4.5% to Krom4. Thus, homozygosity is seen for the four most common haplotypes in the population.

Each breed has a breed specific "DLA map". It mirrors the population history of the breed and breeding practices. Most studied breeds have 3-5 haplotypes and Kromfohländers also fall into that category. Interestingly though, different haplotypes are evenly shared which is not the case in most breeds who often have two major haplotypes together with some rarer.

#### **About testing for DLA diversity**

Maintaining the diversity and in particular the heterozygosity of the MHC genomic region is important. Several recent studies indicate that homozygosity increases the risk for autoimmune diseases. The DLA profile of Kromfohländers now provides an opportunity to preserve this diversity by taking it into an account in breeding programs. All breeding lines should be used. The following is an example of how one could monitor the breed's diversity through DLA gene testing:

1. Test the DLA genes of the bitch intended for breeding and 2-3 possible studs.
2. Compare the haplotypes of the bitch and the possible studs and choose the stud whose haplotype is the most different from the bitch's.
3. This should ensure different gene combinations for the future litter. If the bitch and stud both have the same haplotype, the pups inherit only those same gene forms and this narrows the genotype of the line and the breed and may pose a risk to the health of the breed in a longer run.

Enquiries about future DLA testing should be directed to Genoscoper Oy, <http://www.genoscoper.com>.

We thank all Kromfohländer owners and breeders who have donated samples for the study. We are grateful for the Club for its support of the study. This study was also supported by other grant of Dr. Lohi. We acknowledge the investigators and authors of this study including Alina Niskanen, Lorna Kennedy and Hannes Lohi.

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## Progress Towards a Healthier Breed by Selective Outbreeding

### Finnish Kromfohrländer Club Review: September 6, 2013

For several years The Finnish Kromfohrländer Club has been actively seeking opportunities to improve the genetic diversity of the Kromfohrländer breed in order to ensure the health of the breed. The Finnish Kromfohrländer Club has worked to strengthen co-operation with breed clubs from other countries (especially clubs in Germany and Switzerland) for the purpose of determining whether or not resources needed to expand the Finnish Kromfohrländer gene pool might be available in foreign populations. The Kromfohrländer breed was originally established in Germany, and the largest population of the breed still resides there. Since 2007 Germany, Switzerland and Finland have used a common database of the breed's health statistics which is maintained by the German Kromfohrländer Club (Rassezuchtverein der Kromfohrländer e.V.). Essentially, the database includes all pedigree and health information since the foundation dogs of the breed.

Additionally, The Finnish Kromfohrländer Club has been involved in Professor Hannes Lohi's genetic research at the University of Helsinki since 2006. At the end of 2011 there were blood samples of 258 Kromfohrländers in the research group's blood databank; approximately 50 of those samples were obtained from German dogs. Roughly 200 dogs have been DLA-tested by the Finnish Breed Club. In this genetic overview, Lohi's research group found 5 different MHC haplotypes in the breed. This number is one short of the maximum to be expected in the breed in the light of the known pedigree.

Furthermore, there have been attempts to identify the specific genes causing epilepsy, hereditary cataracts and hyperkeratosis. Thus far these efforts have been unsuccessful.

The German Breed Club has sought to improve the health of the breed, both by selective breeding and by scientific research. Among other things the German Breed Club has conducted an extensive study of their own pedigree data. The study is entitled "Pedigree Analysis for Conservation of Genetic Diversity and Purging" (Pfeiffer & Wellman 2009). The results of this study revealed that there was little genetic diversity within the breed. In fact, there were no genetically varied populations even if comparing individual dogs of different appearance (for example, different types of coat) or considering the dogs' geographic origins. Different coat types, as well as dogs from the different locales and countries have been used for breeding on a wide scale, yet has produced little genetic variation.

In 2013 almost 100 Kromfohrländers took part in the MyDogDNA pilot project. The results of the project were made available in the summer 2013. The project included dogs from both Finland and Germany; both hair types, wire haired and smooth, were present. The average level of heterozygosity of the breed was found to be 21.3%. The average of all breeds is 28.6%. (Ed: Higher levels of heterozygosity represent greater genetic diversity.) Neither the German or Finnish, nor the wire haired or smooth dogs formed genetically diverse populations.

More information about the results of this research can be found here:

<http://www.mydogdna.com/breed-health/392/kromfohrlander> (*outdated link*)

CONTENT SOURCE: [http://www.kromfohrlander.fi/Club\\_Review\\_2013.pdf](http://www.kromfohrlander.fi/Club_Review_2013.pdf)



## Assessing Genetic Diversity in the Kromfohrländer - View to a cross-breeding project

English (/blog/languages/english), Kromfohrländer (/taxonomy/term/175), cross-breeding (/taxonomy/term/176), Poodle (/taxonomy/term/177)

14/02/2014 AT 08:26 AM – JONAS DONNER (/BLOG/AUTHOR/JONAS-DONNER)



(/blog/author/jonas-donner)

Kromfohrländer, a native German breed, is known to have a very limited gene pool and is thus subject to a cross-European breeding project focusing to expand the pool. Given the vulnerable genetic status of the breed, the Finnish Breed Association for Kromfohrländer initiated a project aiming at measuring the genome-wide diversity of the breed in 2013. Several dogs of Central European origin were also recruited for the study.

### Study population

Through active promotion and enrollment co-ordinated by the breed club above, buccal cell samples from Kromfohrländers (both wire- and smooth- haired) were collected for DNA extraction and analysis. The majority of the samples were collected during January and February 2013. The final study included all Kromfohrländers tested by MyDogDNA service until the end of January, 2014 (108 dogs). Dogs enrolled in Finland represented the majority of the tested population (73 dogs), with the remaining 35 consisting of both German and Austrian dogs. Of special note, the set of Finnish dogs included a cross-breed litter of 9 from a mating of a female Kromfohrländer, and a male medium-sized poodle (black, brown and white; based on FCI classification).

### Results

All test results from individual dogs were automatically stored in the MyDogDNA database to enable real-time monitoring of genetic diversity and the genetic structure of the breed (e.g., possible intra-breed lines).

### Genetic diversity

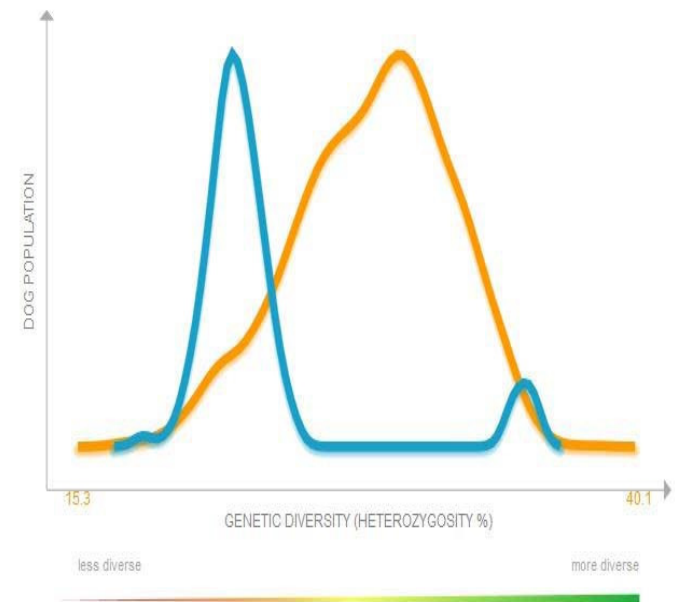
The blue line represents genetic diversity in Finnish and Central European Kromfohrländer. For reference, the orange line depicts the current distribution in all tested dogs in the MyDogDNA database. On the far right of the figure (blue line), a Finnish cross-breed litter (Kromfohrländer/Medium Poodle) stands out as a smaller sub-population with increased genetic diversity. The median heterozygosity 21.4% includes the cross-breed litter.

The median heterozygosity of the tested Kromfohrländer population (excluding the cross-breed litter) was 21.2%, considerably lower than the MyDogDNA database median across all breeds (28.8%). This result confirmed the expected vulnerable genetic status of the breed, further emphasizing the need for approaches to increase genetic diversity of the population, such as cross- breeding. The benefits of cross-breeding are instantaneous in terms of genetic diversity: The analyzed Finnish cross-breed litter clearly represents a group of dogs with increased heterozygosity compared to the original Kromfohrländer population.

### Kromfohrländer



Heterozygosity  
 Median (breed): 21.4%  
 Median (all dogs): 28.8%  
 ■ All dogs  
 ■ Tested dogs within breed  
**> 100**



For further reference, the following table provides an overview to the genetic diversity of Kromfohrländer in comparison to other selected breeds in the MyDogDNA database (situation as of January 2014). The overall current heterozygosity variation in the MyDogDNA database is between 15.3% and 40.1%.

Breed	Dog	Median
Parson Russel	>	34.4%
Finnish	>	31.8%
Lagotto	>	29.3%
Golden Retriever	>	27.8%
<b>Kromfohrländer</b>	>	<b>21.2%</b>

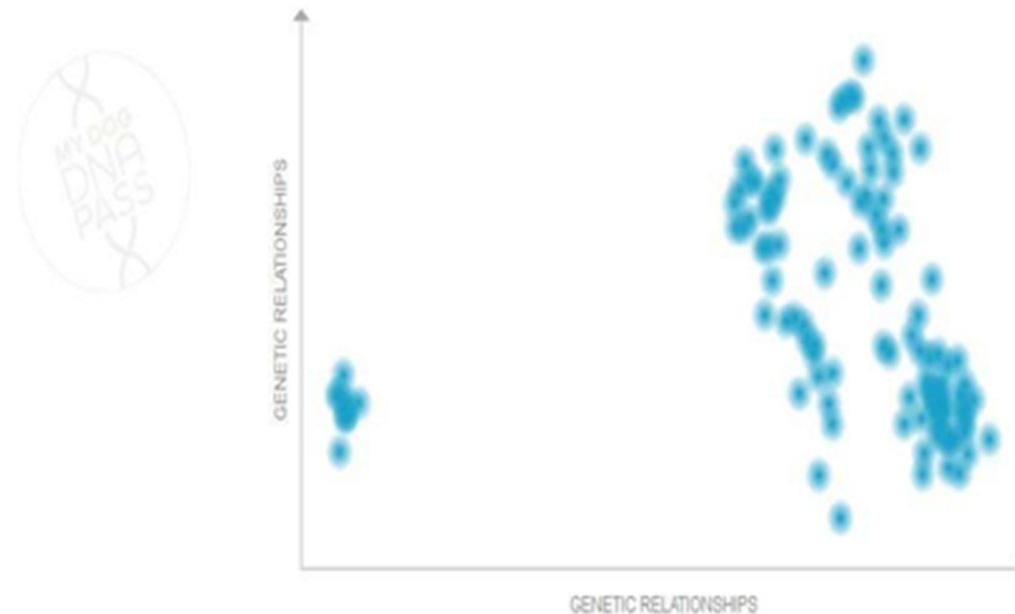
#### Genetic relationships

The genetic structure of a breed, or genetic similarities and differences between individuals can be visualized with a standard multidimensional scaling analysis. Such visualization can be used to identify possible genetically different breeding lines within the population. It also helps to evaluate which dog could be mated to preserve genetic diversity within the line as well as within the entire breed. Owners are able to map all of their tested dogs in the same image, and by exchanging dog information they will also be able to compare known lineages with each other to see whether they are truly genetically different or not. The plots are

automatically updated with each new tested dog that is added to the database.

Each individual dog is represented by a dot in the plot. Dogs that are situated close to one another, have similar genomes, while dogs situated far apart are genetically different from one another. The main population of Kromfohrländers is clearly distinguishable from the cross-breed litter in the lower left corner of the graph. The analysis highlights the expected genetic difference between the cross-breed litter and the main population of the breed.

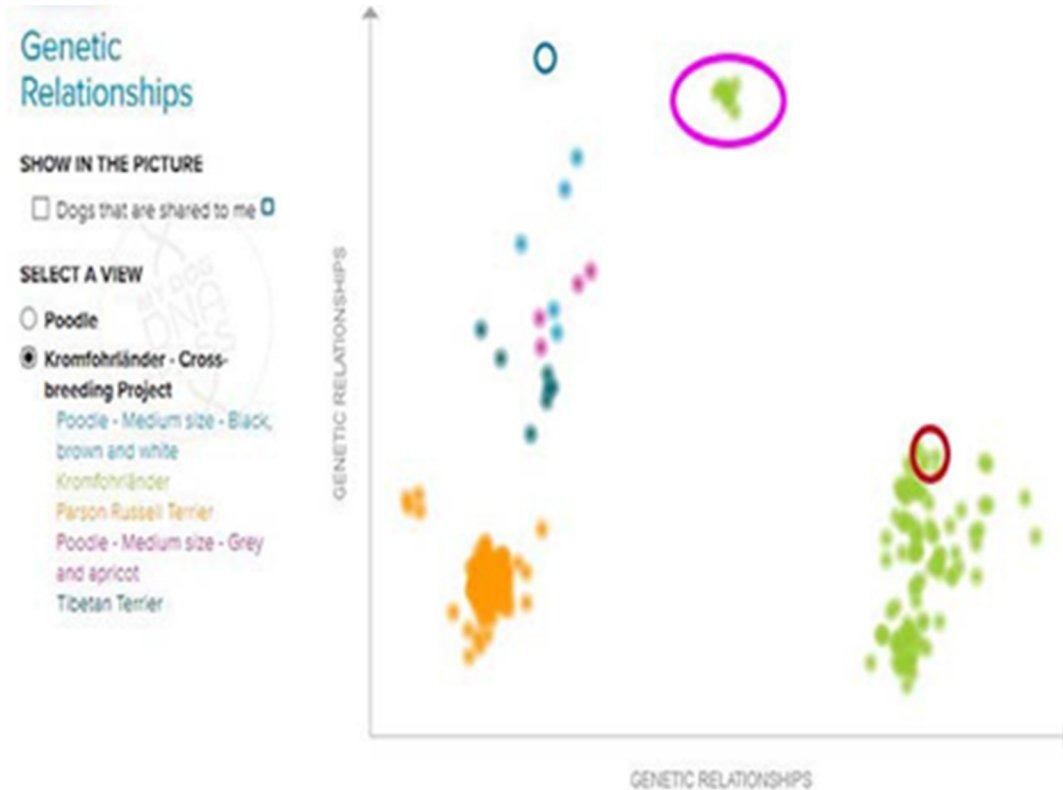
Kromfohrländer



Overall, understanding of the genetic differences present between dogs in a homogeneous breed will aid in future identification of optimal breeding partners (breeding pairs that will result in offspring that is genetically as diverse as possible). For this purpose, the MyDogDNA service includes a custom- developed tool called MyDogDNA Breeder which is available to users free of charge. This tool uses the measured genetic data to identify breeding partners that are genetically different from the breeder's own dog, and does not carry the same inherited diseases based on the single gene disorder tests that are included in the MyDogDNA panel. In brief, the Breeder tool ranks potential partners according to the expected genetic health and diversity of the offspring. It also displays where the identified partners are located geographically, and offers a direct means of contacting the owner.

### Genetic relationships in the Kromfohrländer cross-breeding project

As described above, the Kromfohrländer cross-breeding project has progressed to first generation litters of Kromfohrländer/Poodle mixes. Other breeds besides Poodles were also considered as candidates for the crosses, and may be of future relevance.



Dogs of the Finnish cross-breed litter are highlighted: the Kromfohrländer dam is depicted by a red circle, and the medium size Poodle sire by a blue circle. Their offspring is circled in pink, clearly indicating a genetic identity separate from the main population of Kromfohrländer.

The analysis logically places the cross-breed litter genetically between its dam and sire, visualizing the progress made in developing the gene pool of the breed. The participating breed clubs are strongly advised to proceed systematically in their aspirations for increased genetic diversity in upcoming generations. For such a goal, the MyDogDNA Breeder tool will be immensely useful in the future, as it will help to make sure that the gene pool is optimally maintained with minimal loss of the made progress. In particular in a small breed founded by only a few individuals, pedigree information and inbreeding coefficients may be misleading compared to the information provided by actual DNA measurements. This further emphasizes the need for a supportive tool such as MyDogDNA Breeder.

If requested by the breed clubs, a custom MyDogDNA Breeder breeding group could be created to allow comparison of Kromfohrländers also to other breeds of potential interest for cross-breeding.

### Assessing Genetic Diversity in Kromfohrländer - View to a cross-breeding project | MyDogDNA

Source: <http://www.mydogdna.com/blog/assessing-genetic-diversity-kromfohrlander-view-cross-breeding-project> (accessed on 3/21/2016)