

Breeding with the Icelandic Sheepdog in the USA

August 1, 2009

Our active involvement in the Icelandic Sheepdog International Committee (ISIC) has opened the door to our participation in the international community of Icelandic Sheepdog (ISD) clubs. Working with these clubs, we have discovered and have access to exceptional, breed specific, information that has been published on our club website in two sections; the Breeder's Corner and the ISIC chapter. We value the input of respected researchers who have knowledge and expertise they are willing to share with us. We believe this is an important part of our continuing growth and education as a club.

A report entitled "*Analysis of Breeding with the Icelandic Sheepdog*" was published years ago using data collected from ISIC clubs. We are excited to announce that we have been working with Dr. Per-Erik Sundgren and have successfully added the U.S. breeding records to that analysis. We are proud to present you with the completed report. Several important conclusions are included which we hope you will find interesting and useful.

Dr. Sundgren has completed extensive study with the ISIC regarding breeding issues specifically related to the ISD. He has generously allowed us to use the articles and publish them. You can find the original report and a great deal of other relevant information on our website <http://iceland-dogs.com/Dr-Per-Erik.html>.

Dr. Sundgren developed the LatHunden Program that makes it possible to analyze the data base of thousands of ISDs in the ISIC database. We encourage you to read the other articles on our club's website as they contain the most relevant information and scientific study available regarding the breeding of the ISD worldwide.

We welcome your feedback, comments and ideas and encourage you to actively participate in the club's decision making process. To that end, we have included a page at the end of this report entitled "*Conclusions & Survey*". We are interested in specific feedback related to those issues as we continue to work toward incorporating best breeding practices, specific to the Icelandic Sheepdog, for our approved breeders. We invite all members to answer the questions on the last page of this report and email them to us by September 1st so that we can include your feedback in our decision processes regarding these recommendations and represent your wishes at the 2009 ISIC Breeding Conference in October. If we don't hear from you, we appreciate your continued support as we move forward.

It is our hope that this information, specific to us and our place in the worldwide picture of preserving the ISD through responsible breeding practices, will generate productive dialogue between members, breeders and the ISAA Board of Directors. Our goal is always to ensure the continued health and vitality of Iceland's cultural heritage as represented by the Icelandic Sheepdog.

The ISAA is indebted to Dr. Sundgren, BRCC Committee member Terry Warnock and member Holly Kilpatrick for their tremendous assistance with this project.

Best regards,

Donna, Spike, Judi, Peg, Shellie, Maggy

Breeding with Icelandic Sheepdog in the USA

By Per-Erik Sundgren

There has been a long period of cooperation between the European countries breeding Icelandic Sheepdogs (*Islenskur fjarhundur*). The goal was set to preserve the breed as it has been for almost one thousand years of isolation in Iceland. An analysis of the state of the dog breed over all these countries, joined in an organization named ISIC, was presented in October 2006 at an international meeting in Copenhagen, Denmark. The present report is intended to add information about the U.S. population of the Icelandic sheepdog to the information compiled from the European population in 2007.

A data set comprising 918 records was supplied by the president of the ISAA, Donna McDermott, of the USA. This set was expanded to 1131 dogs by finding dogs only registered as parents but with no own records in the supplied data set. The final set thus included 598 female and 533 male dogs. For some of the analysis it has been necessary to build a register of litters. To do so it is necessary to have both identity of mother and birth date for individual dogs. This requirement is met for 899 of the dogs. A total of 307 litters were identified. In addition to the USA data, a data set compiled by Guðni Áugustsson, ISIC, has been available for some of the comparisons.

The ISIC data includes dogs from Iceland, Denmark, Germany, Norway, Finland, Sweden and the Netherlands born until the beginning of 2007 and includes a total of 8587 dogs. A computer program, LatHunden 2006, developed by Genetica AB has been used for the main part of the analysis. The program was specially designed for "Breed Data" supplied for all breeds by the Swedish Kennel Club. After a request from ISIC, the program was translated into English for use in their international cooperation. As a part of this report both the computer program and the compiled data file including all the USA dogs were sent to the President of the ISAA in USA.

Dogs born and their inbreeding level

Until year 1996 there are less than 10 dogs registered per year, *Table 1* summarizes the registration of dogs, their inbreeding levels and generations in their pedigrees. In this report, all the dogs included in the material are treated as belonging to one coherent population irrespective of country of origin or registration.

Table 1. Dogs born and their inbreeding.

BORN YEAR	NUMBER	INBREEDING %	GENERATIONS IN PEDIGREE
1996	9	0,0	0,0
1997	1	-	-
1998	23	0,0	0,0
1999	31	9,9	1,9
2000	39	0,0	1,5
2001	50	1,0	1,8
2002	61	0,0	1,3
2003	58	0,0	1,9
2004	88	0,2	2,2
2005	102	1,1	2,6
2006	136	0,3	2,4
2007	136	0,8	2,5
2008	102	0,4	2,7
Total/Averages	791	0,5	2,2

Data in *Table No. 1* demonstrates clearly that the inbreeding coefficients are calculated on very incomplete pedigrees and thus not reliable estimates of the real inbreeding of the population. The reduction from 1131 to 791 dogs in the calculations is because a large number of dog had too short or no pedigree for the calculations.

Breeding base (effective population size, N_e)

Inbreeding is a measure of loss of genetic variation in a population. What is measured is the relative number of gene pairs in the progeny getting identical genes from father and mother due to common ancestors on both sides of the pedigree. For each pair of genes getting such identical genes another gene is lost, and hence inbreeding causes loss of genetic variation. The loss of genetic variation becomes, with long term strong inbreeding, eventually so large that the survival of an entire population may be threatened.

It should be pointed out that inbreeding coefficients never tell the entire truth about the real inbreeding of an animal. All calculations of inbreeding have to start at some point in the past. At that point inbreeding is always set to zero. Thus, inbreeding coefficients only tell us how much of the genetic variation that was present at the starting point for the calculations has since then been lost. If we need to know the real amount of inbreeding, or homozygosity, of a breed it is necessary to analyze DNA.

Effective population size (N_e) is a measure used in population genetics to estimate the continuous loss of genetic variation in a population. It does not correspond to any actual number of animals used in breeding. The effective population is an idealized randomly mated population with equal number of males and females. Calculation of the effective size of a real population is done in two steps. First the rate of increase in inbreeding per generation is calculated for the real population. Then one calculates the number of individuals of an idealized population that would produce the same rate of increase in inbreeding. This number is then the effective population size of the real population. Thus the more intensive inbreeding is in a real population the lower is the effective population size compared to the real number of breeding individuals. In short, closer relation between the breeding animals of a population will result in a smaller effective population size.

The utilized and available effective population sizes for all the ISIC member countries are presented in *Table No. 2*.

Once again it is necessary to point out that although calculations of effective population size are based on calculations of inbreeding, the values tell us nothing about the real genetic variation of a population. As a matter of fact, two populations with very large differences in general inbreeding may have an identical effective population size. The type of information we get from calculating effective population size is, thus, only at what proportional rate the population is losing genetic variation. This is only dependent upon how many animals are used for breeding purposes and their relationship. It is however, an international rule of thumb that when the effective population size is reduced below 50 the entire population is endangered, regardless of what one tries to do to counteract loss of genetic variation. When the effective population size is reduced below 50, random forces become too strong and cannot, any more with certainty, be controlled by deliberate selection to preserve genetic variation.

Calculations of effective population sizes in this report have been carried out by the use of the computer program "LatHunden 2006". Two values are calculated, "Utilized effective population size" and "Available effective population size". The first of these values is calculated directly from the pedigrees, i.e. is based on the way the breeders have actually used their dogs in breeding. The second value is a simulated value based on the same breeding animals but for two generations ahead. Males and females of the real breeding stock are mated together randomly in the computer to produce a

new generation F1. "Animals" from this F1-generation are then mated randomly to produce a second theoretical generation F2. The "Available effective population size" is then calculated from the relative increase in inbreeding between generation F1 and F2 calculated back to the common starting point, i.e. 4 generations for the F1-parents and 5 generations for the F2-progenies.

The idea behind the calculation of "available effective size" is that breeders often tend to line breed their dogs or, in the case of the USA, overuse a few dogs that are often too young so that the population is "saturated" with these genes. Because of the closer relationship between animals within lines the average inbreeding of the entire population may be overestimated and thus the estimate of the effective population size too low. By random mating of all used breeding animals all such line breeding is broken and the true relation between animals of the population is revealed. This will in cases of strong line inbreeding in the real population cause the calculated available effective size to become larger than the utilized. The reverse will be true if breeding in a small population is based largely on imported and less related animals. The relative increase in inbreeding will then become low, in some cases even negative and thus the estimated utilized effective size to be very large. With simulation of random mating in such population the outcome often is that the available effective size is much smaller than the utilized effective size as is the case in the USA. In such cases we know that continued breeding with the animals present in the population, without any new animals introduced by importation from elsewhere, will cause the inbreeding to increase again and hence the population may lose too much of genetic variation to preserve health and viability. Such populations are in need for continuous introduction of new breeding animals.

Table 2. Utilized and available effective populations size of Icelandic sheepdog 2003 – 2007
(*Ne* = effective population size or breeding base)

Country	No of Litters	No. of Dogs	Utilized Ne	Available Ne
Iceland	70	292	500	29
Denmark	54	245	150	30
Finland	32	122	500	13
Germany	34	161	44	14
The Netherlands	31	164	Too few for analysis	
Norway	40	175	500	18
USA	141	590	440	40
Sweden	81	335	28	52
All Countries	483	2083	500	207

As is seen from **Table Number 2**, the size of utilized populations are for all countries but Sweden substantially higher than the available population size. Now, the effective population size does not tell the number of breeding animals really in use but the size of a randomly mated simulated population, with equal numbers of females and males, that would cause the same increase in inbreeding as found in the real population. But for Sweden and Germany the sizes of the utilized populations are acceptable. The size of the utilized population for the other countries, including the USA, is not acceptable. Figures for the available effective populations show however that none of the countries have a large enough breeding stock to be self supporting. When calculated over all the ISIC countries both the utilized and the available effective population sizes are satisfactory. Thus, by close cooperation between breeders in the eight countries it should be possible to keep the losses of genetic variation on an acceptable level and to avoid severe genetic disturbances.

Effects of inbreeding on fertility

The level of inbreeding of a progeny is always half the relationship between the two parents. In the following the inbreeding coefficient of progenies is named "F_x" and given as percentages. Based on degree of inbreeding the litters were divided into four "breeding types".

Table 3. Mating types, inbreeding and litters sizes (entire ISIC database) .

Type of mating	Numbers	Inbreeding%	Litter size
I	1156	1.7	4.2
II	374	9.1	3.8
III	393	16.9	3.5
IV	123	30.9	3.1

Type I = parents less related than cousins (F_x < 6.25 %)

Type II = parents related as cousins but less than half sibs (F_x = 6.25-12.24 %)

Type III = parents related as half sibs but less than full sibs (F_x = 12.5 – 24.99)

Type IV = parents are related as full sib or parents to progeny (F_x >= 25 %).

The above table includes only the second and third litters of the bitches for all bitches in the ISIC database. There are two reasons for the reduction of the material prior to calculation of inbreeding effects on fertility. There are age effects on litter sizes such as larger litters up to the third litter and then again smaller litter sizes. This effect of the ages of bitches is reduced when only their first litters are compared. The second reason is that many "litters" have only one puppy because that puppy is the only one imported from a group of litter mates. Litters with only one puppy are thus over represented in the database and will partly hide the true effects of inbreeding on fertility. The values given in table 3 demonstrate however clearly the normal loss of fertility accompanying inbreeding with a loss of about half a puppy, in highly inbred litters. This might not seem very large, only a little above 20 % in loss of fertility. Loss of fertility is, however, always an indication of disturbances in the basic gene systems also responsible for normal immune response. At the same time as one can foresee an increase in the frequency of infectious diseases and other genetic disturbances there will also be an increase of the frequencies of barren bitches. The real loss of fertility due to inbreeding is thus always greater than what can be seen from counting number of puppies per litter.

Changes in genetic frequencies, and thus loss of genetic variation, can only take place between successive generations. Thus the rate of change over time is dependent on the generation interval, i.e. the number of years between the first litter of the parents and the average age of their progenies when they produce their first litters. The average generation interval was 5 years before year 2000 calculated over all ISIC countries. During the years after 2000 this values has decreased to 4.2. For the US population, the generation interval is as low as 3.5 years. The lowest age at first breeding in the USA was only 7 to 8 months for both males and bitches and 64 male dogs were used for breeding before an age of 2 years. This is more than one third of all the males used. Mental and physical capabilities cannot be fully evaluated before an age of two to three years. A number of inherited diseases and defect will not show until the dogs are adults. It is thus, strongly recommended not to breed from dogs before they are at least 2 years old.

Very short generations intervals, as for the US populations, are often caused by competitive breeding for show points or to sell puppies irrespective of the effect such breeding will have on the health and vitality of the dogs. Since puppy buyers generally are much more interested in the health and vitality of their dog than those goals, breeders should reconsider their breed-ing goals.

BREEDING MATADOR

The term "Breeding Matador" needs an explanation. "Matador" was one Swedish bull used in the northern part of Sweden on a breed of cattle without horns. The bull inherited testicular hypoplasia (small testicles due to a recessive gene). Due to the very intensive use of the bull this gene was spread in high frequency over the entire population and caused a genetic disorder it took decades to overcome. Since that time any overused breeding male of any species is, in Sweden, called a "Breeding Matador".

To keep the level of effective size of a population (about 50-100), one needs at least 20 males and about 3-5 females per male. Thus a male should never produce more than 5 % of the puppies produced during the years he is active as a breeding male. The generation interval is for many breeds about 5 years. Five percent of the puppies during 5 years is equal to 25 % of all puppies produced a normal year. Any male dog producing more puppies is classified as a "Matador" in my computer program "LatHunden 2006". As there is a potential for any individual to have twice as many grandfathers as fathers the number of grandchildren of any male should not exceed twice the number of his children. If this number is exceeded the male will again be classified as a "Matador".

It has to be pointed out that the figures used to classify "Matadors" are not to be confused with the ideal number of progenies from breeding point of view. They are maximum values that should not be exceeded. If possible one should have the ambition to keep the number of progenies below 2 % of all progenies produced in the breed during a period comparable to the generation interval of the breed. That is the same as to say that one should aim at no less than at least 50 breeding males used as equal as possible in every generation.

Based on these definitions, a male of the USA breeding stock should, if the population was closed within USA, not have more offspring than 19 and if possible not more than 7, which is about a maximum of 2 litters and twice that number of grandchildren. Added to this report is a list of those males classified as matadors in the US breeding population.

In the world, the population of the Icelandic sheepdog is treated as one coherent breeding population there are, therefore, only three matadors and all of them registered in Denmark. If an effective cooperation with exchange of breeding dogs is organized between the ISIC member countries, the maximum acceptable production of offspring from a male is 70 and the recommended maximum is 28. Thus such cooperation will open for a more intensive use of the better males without the risk of too rapid loss of genetic variation in the entire breed.

Please observe that the maximum amount of progeny is reduced compared to an earlier report due to the rather dramatic shortening average generation intervals in the breed both internationally and in the USA

THE SECOND GENERATION PROBLEM

It is fairly easy to state rules for the maximum number of progenies sired by a single male. To make rules reducing the number of grandchildren is a lot more complicated if at all possible. The only way I can see to avoid overuse of males and females as grandparents is rapid and free communication of information to all breeders. Without information the breeders will never know in time if a specific male is already used above recommended limits. This has not been a large problem to overcome in Sweden since all pedigree data of any breed is freely available to any breeder or breed club. The gathering of data from many different countries, as has been done for the Icelandic dog, is as far as I know unique. If this initiative is continued the data will constitute an invaluable source of information for all breeders of the breed all over Europe.

It has not been possible this time to gather also veterinary data from all the countries. There is however complete data for some traits in the Swedish data base. With so much of interchange of breeding animals during the years one might suppose that the Swedish subpopulation is representative for the entire breed.

Milder forms of HD do not affect the dog in a serious way. HD is however strongly inherited as a polygenic trait (many genes are involved). In such cases the values for the progenies tend to fall approximately equally on both sides of the parental average. Due to this one cannot recommend breeding from dog affected by HD although it might be of a mild form. There is a potential risk that such dogs will produce a larger proportion of affected dogs of which some will get HD in a degree that is injurious.

The frequency of hip dysplasia in the Swedish population has been rather unchanged around a value of about 20 % with a maximum of 28 % in the year 2001. During the last few years the frequency has been reduced to values about 20 %. Such high frequencies make it necessary to continuously monitor the situation and to be careful not to breed from affected dogs. There is no need for complicated breeding programs. In a herd of German shepherd dogs owned by the Swedish Dog Training Centre we managed to reduce HD from above 50 % to below 10 % within ten years by adopting some very simple breeding rules. Animals affected by HD were not allowed for breeding. They had to be the progeny of HD-free parents and at most one of their litter mates should have HD and in a milder form. These were the only rules for selection against HD and it had very rapid effect on the frequency of HD in the herd. There is no need for complicated breeding indexes as those applied to some breeds in Germany. Breeding indexes have their main value when selection for traits with low heritability. The general heritability of HD is about 40 to 50 % and in such case simple and straight forward selection programs are fully sufficient to produce rapid effects. They also have the great advantage that any breeder will understand exactly what he or she is doing and thus can avoid the problem of weighing their own knowledge about their dogs against figures they do not really understand how they are calculated.

There are in all 251 dogs subjected to eye inspection in the Swedish database. Sixteen of these dogs have notations about cataracts. The tested dogs may not be representative for the breed as the number of tested dog is small. Several of them may have taken to veterinary inspection due to sight problems. There is thus no need to be alarmed by the eye data. It might though be of interest to make some comments about selection against single, often recessively inherited, genes.

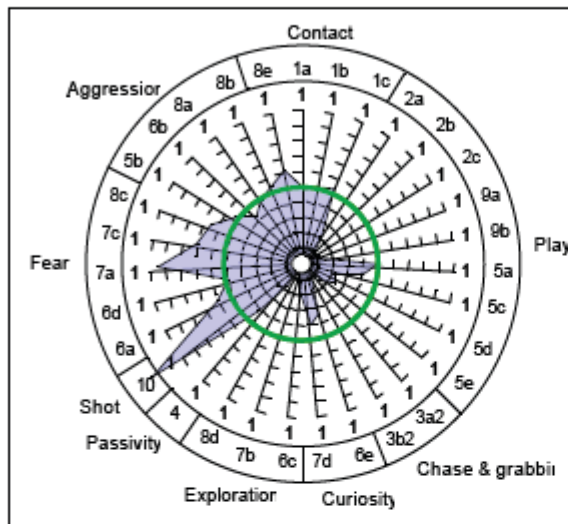
There is no tendency whatsoever for deleterious genes to spread by themselves in a population. On the contrary, natural selection forces will normally reduce the frequency of deleterious genes. There are only two ways through which inherited defects and diseases can increase in frequency. In small populations inbreeding becomes unavoidable. All sort of genes are then duplicated due to inbreeding and some of them will cause genetic disorder. The other possible way for deleterious genes to increase in frequency is bad breeding habits and selection traditions among breeders.

The solution is though very simple. Again there is no need for complicated selection programs against a number of unwanted genes. There is no possible way to get in control of 30-40 thousand gene pairs by applying selection programs to all of them. In nature deleterious genes are kept at low frequencies with much simpler methods. Avoid close inbreeding, and do not allow any animal to produce large number of progenies. But also in nature the effects of too small population will easily get out of control and the populations are eradicated. Sorry to say breeders of many pet breeds violate all the simple rules of nature to keep populations healthy and viable.

The working dog club of Sweden has, since the end of 1980, been testing dogs according to a standardized scheme named MH-description or mental description of dogs. It is not a testing system to find out which dogs perform well or less well. The intention is just to describe reaction at standardized test situations. The descriptions are transformed into a scale of scores ranging from 1 to 5, where 1 is a low intensity in behavior and 5 a high intensity. This is not to say that a higher score is better than a low one, it all depends upon what type of reaction is studied and the goal of breeding for the breed in question. There are however some reactions of general interest for any breed, reactions of aggression and fear. Both should be avoided as far as possible in most breeds, especially in breeds kept as pet or companion dogs.

Breed : Isländsk Fårhund, S
 Completed MD : 104
 MD suspended by
 Judge: 0 Unacceptable behaviour 0
 Owner: 0 Dispense shot: 6
 Incomplete.: 6 Deviation from abreaction: 0

Age in day at test : 892,1



Each mark on the diagram axes equals 0,2 scores deviation from working dog breed averages, represented by the inner green circle. The diagram centre thus corresponds to - 1 and the peripheral ends of the axes equals +1.

- 1a Social contact, greetings
- 1b Social contact, cooperation
- 1c Social contact, handling
- 2a Play 1, interest in play
- 2b Play 1, grabbing
- 2c Play 1, tug of war
- 3a2 Chase, following
- 3b2 Chase, grabbing
- 4 Passive situation
- 5a Distance play, interest
- 5b Distance play, aggression.
- 5c Distance play, exploration
- 5d Distance play, tug of war
- 5e Distance play, play invitation
- 6a Sudden appearance, startle reaction
- 6b Sudden appearance, aggression
- 6c Sudden appearance, exploration
- 6d Sudden appearance, rem. avoidance
- 6e Sudden appearance, rem. approach
- 7a Metallic noise, startle reaction
- 7b Metallic noise, exploration
- 7c Metallic noise, rem. avoidance
- 7d Metallic noise, rem. approach
- 8a Ghosts, aggression
- 8b Ghosts, attention
- 8c Ghosts, avoidance
- 8d Ghosts, exploration
- 8e Ghosts, greeting
- 9a Play 2, interest in play
- 9b Play 2, grabbing
- 10 Gunshot, avoidance

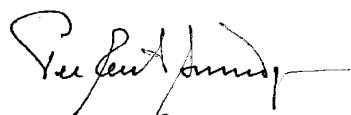
1a. Contacts voluntarily or reply to contact attempts. = 3,7/3,8	1b. Follows but is not engaged in the test leader. = 3,3/3,4	1c. Accepts handling. = 3,3/3,3	2a. Starts slowly, gets active and plays. = 3,1/3,7	2b. Grabbing hesitantly or with front teeth. = 2,6/3,4
2c. Grabbing hesitantly, let go, keeps but no pulling. = 2,3/3,2	3a2. Starting but break off. = 2,3/2,9	3b2. No grabbing, sniffing at object. = 1,5/2,4	4. Observant and mainly calm. Occasional increase in activity. = 3,1/3,2	5a. Interested. Observes the figurant with no breaks. = 2,9/2,9
5b. Occasional (1-2) aggressive behaviour during first part of the test stage. = 1,6/1,5	5c. Approaches the hidden but speaking figurant. = 2,6/2,8	5d. Does not play but is interested. = 2/2,6	5e. Gets active but does not continue. = 1,8/2,3	6a. Avoidance behaviour but facing the object. = 3,3/3
6b. Occasional aggressive behaviour. = 1,7/1,9	6c. Approaches when leader squat down, speaks to the overall and attracts the dog. = 2,2/2,8	6d. Small roundabout way or change of pace while passing by. = 2,2/2,2	6e. Stops. Sniffing or looking at the overall at one occasion. = 1,7/1,9	7a. Escapes at most 5 metre. = 3,5/2,6
7b. Approaches the rattling object when the leader is standing alongside = 2,7/3,6	7c. Small roundabout way or change of pace at one of the passages. = 2/1,6	7d. Stops. Sniffing or looking towards the rattling object at one occasion. = 1,5/1,7	8a. Shows occasional aggressive behaviour. = 2,4/2,4	8b. Controlling and/or acting against both ghosts. Shorter intervals. = 3,8/3,7
8c. Mainly stays in front or at the side of the leader. Changes between escape attempts and control. = 3,2/2,9	8d. Approaches when the leader speaks to the figurant and attracts the dog. = 2/2,6	8e. Responds to contact from the figurant. = 3,4/3,2	9a. Starting slowly, gets active, playing. = 2,6/3,4	9b. No grabbing, only sniffing on the object. = 2,2/3,1
10. Directs interest towards the shot, public or something else, but returns to play/passivity. = 3,1/1,6				



The diagram is what is called a spider diagram. The green ring in the middle corresponds to the average for all working dogs. The blue area reflects the reactions of the Icelandic dogs at each of the testing situations. Generally speaking the dogs show an excess of reactions to sharp noise, gun shot and the noise of a metal chain dragged over a corrugated sheet of iron. They show a less degree of investigating behavior and they are also less active in all sorts of play. This is a pattern not uncommon in herding breeds such as collies. It might have had some value in herding sheep but in modern society these types of behavior are less useful and in some cases they may even be painful to the individual dog who is easily scared by ordinary sounds in the surroundings.

Our studies in Sweden demonstrate moderate heritability for most of the tested reactions. To avoid future problems with the mental status of dogs it is thus recommended that some scheme of mental testing is adopted and generally used in the selection of breeding animals.

Sprötslinge June 8, 2009



Per-Erik Sundgren

Appendixes: 1. Effective Population Size 2. Breed analysis for the US population 3. Matadors in the US population

Effective Population Size (Ne)

Icelandic sheepdog USA

Beräknad på samtliga hundar i databasen.

Eliminated= Parents locked for breeding

Date of calculation =2009-06-08

Period	Eliminated	All		Calculated		Avelsbas (Ne)		Inbred %	Max. no. of puppies	Rec. no. of puppies
		Litters	puppies	Litters	Puppies	Utilized	Available			
2003 - 2007	0	141	590	83	370	426	51	0,9	20	8
1999 - 2003	0	0	0	0	0	0	0	0,0	0	0
1994 - 1998	0	0	0	0	0	0	0	0,0	0	0

Comments

The effective population size (Ne) or the effective breeding base is not a the number of dogs used for breeding. Ne describes the rate of loss of genetic variation in a breed due to inbreeding. With a value Ne= 50 the breed will for example lose 50 genetic variation as fast as if only 24 males and 25 females were used for breeding in a system with random mating. When the breeding base (the effective population size Ne) reaches a value about 500 it does not mean that 500 animals have been used for breeding. It tells that the increase in inbreeding per generation is the same as if 500 animals, equally distributed on sexes, were mated randomly generation after generation. Such populations may survive for centuries without any substantial loss of genetic variation.

High values for Ne may sometimes be reached also in small populations. It will happen if the inbreeding of the offspring is lower than in the parental generation. This will normally only happen if new and unrelated animals are added to the population. The available Ne will then become lower than the utilized Ne. This reason is that no new animals can be added in the two subsequently simulated generations. Hence the relationship between breeding animals will increase again causing a higher inbreeding in the offspring and thus an increasing loss of genetic variation.

The desired level for Ne is at least 100. At values of 50 or below the vitality of the breed is severely threatened due to very rapid loss of genetic variation.



Breed statistics for Icelandic sheepdog USA

during 1999 to 2008

All dogs registred from 1999-2008

Total =	803	i %
Males =	379	47,2
Females =	424	52,8
Breeding Males =	38	10
Breeding females =	62	14,6
Litter size =	4,0	

Year	No.	Inbreeding %	Litter size
1999	31	2	3,2
2000	39	0,3	3,7
2001	50	1,5	3,9
2002	61	0,1	3,6
2003	58	0,1	4,4
2004	88	0,3	4,7
2005	102	1,1	4,8
2006	136	0,4	3,5
2007	136	0,9	4,1
2008	102	0,5	3,8
\bar{M} =	80	0,7	4

Generations in pedigree = 2,6

Breeding with dogs born in period

	Males	Females
Mean age 1st mating =	666	958
Lowest age 1st mating =	235	254
1st litter before 1 year =	7	2
1st litter before 2 year =	26	16
Average no. of progeny =	12,5	8,6
Largest no. of progeny =	31	24
Own inbreeding % =	0,4	0,4

Breeding use of "Matadors"

Max. advisable no. of pups =	7
Max acceptable no. of pups =	19
Largest no. of progeny =	56
Largest no. grandchildren =	132
"Matadors" no. =	28
"Matadors" % =	25,2
Matadors offspring in % =	53
Matadors grandchildren % =	68

GENERATION INTERVAL

	Days	Years
Father to sons =	1117,9	3,1
Fathers to daughters =	1657,5	4,5
Mothers to sons =	977,9	2,7
Mothers to daughters =	1311,8	3,6
Parents to progeny =	1266	3,5

OBS ! the analysis includes all dogs with birth date!
 When the number of dogs is low some values may be unrealistic.



Matadors of Breed statistics for Icelandic sheepdog USA
during 1999 to 2008

ID	Name	Sex	Birth d.	Inbreeding %	Offspring	Grandch.
DN07514406	Alaskastadirs Korpur	M	04-02-17	0	30	23
DN03410104	Aldebaran Gaski	M	02-10-09	0	22	18
IS02514/92	Kolur frá Húsatóftum	M	00-00-00	2,3	33	13
IS02649/93	Islands Tanga Somi	M	00-00-00	12,3	21	27
IS02814/93	Vaskur 93-02814	M	00-00-00	2,1	28	46
IS02818/93	Prins 93-02818	M	00-00-00	10,7	40	124
IS03035/94	Tyr frá Husatoftum	M	00-00-00	2,3	56	51
IS03364/94	Snaelukku Katur	M	00-00-00	14,5	25	29
IS04150/96	Yrar Akkur	M	00-00-00	3,7	35	132
IS04367/97	Kolgrimur 97-04367	M	00-00-00	7,2	32	42
IS04568/97	Rosi frá Husatoftum	M	00-00-00	2,1	29	55
IS04739/97	Gjosku Vaskur	M	00-00-00	0,9	20	37
IS04775/98	Katur	M	00-00-00	5,3	26	60
IS04824/98	Ulfur frá Keldnakoti	M	00-00-00	4,4	15	56
IS05329/99	Hektor	M	99-01-07	3,5	42	41
IS05571/99	Isrima Skuggi	M	00-00-00	8,6	26	5
IS07505/03	Blandon von Hoytts Snati	M	00-00-00	5,6	22	21
NHSB1995280	Djarfur frá Thytur Stadir	M	95-04-18	1	6	51
DL88081402	Fjalla Othin	M	96-10-01	0	20	28
DL90230801	Hjalti frá Dyggur	M	98-04-24	0	27	45
DN05912701	Hofshesta Gloi	M	03-06-16	0	31	29
DN08101001	Lavandels Benedikt	M	04-08-14	0	29	19
DN07173701	Loki frá Palmahaus	M	93-02-01	0	23	48
DN05909701	Sherwood Forests Loki	M	03-05-06	0	27	11
DN07792203	Nor'star Kvekari	M	04-07-26	0	21	13
DL75415001	Virkis Tyri	M	95-11-30	0	27	75
DL91681901	Vittetoos Kutur Hjaltisson	M	01-10-13	0	20	72
DN15134801	Eric frá Bolstad	M	00-00-00	0	19	61

Conclusions & Survey

The ISAA Board of Directors is interested in specific feedback from our membership, in this case, as it relates to the conclusions drawn by Dr. Sundgren in this report. We invite all members to answer the questions below and return your responses to the BOD by September 1st so that we can include your feedback in our decision processes and represent your wishes at the 2009 ISIC Breeding Conference in October. If we don't hear from you, we appreciate your continued support as we move forward.

Please answer the questions and return your responses via email to isaabod@gmail.com or your responses via mail to: **ISAA Secretary: Shellie Greyhavens, 14099 Robinson Ridge Road, Athens, OH 45701-4847**

There are three main conclusions drawn from Dr. Sundgren's 2009 analysis of breeding practices in the United States.

Conclusion #1: *Dr. Sundgren notes, "The main conclusion is that the present increase in inbreeding is not dangerous, but the United States needs to go on exchanging breeding dogs with the other ISIC countries to keep the level of inbreeding down. Your own population is too small to be safe on its own."*

Question #1: True or False (please circle one)

I agree with this conclusion. I believe that improving genetic diversity by importing and exporting breeding stock and sperm is important to overall breed health.

Conclusion #2: *"The most striking figure is the very short generation interval in the US population. This will also narrow the base for selection the best animals for breeding and I seriously recommend that some action is taken against the bad habit of using very young dogs for breeding."*

Supplemental Information regarding Conclusion #2: In September of 2008, Dr. Sundgren warned us about this issue. That warning can be found on our website in the Breeder's Corner Section. Since that time, the ISAA Breeding Review and Compliance Committee (BRCC) raised the breeding age of males to 12 months. The ISIC recommends avoiding mating with individuals (both males and the bitches) who are less than 24 month of age. To read the complete ISIC Breeding Recommendation for the Icelandic Sheepdog, please visit our website's ISIC section or Breeder's Corner. Note: The breeding age for females has been and remains at 24 months.

Question #2: (please circle one)

A: I support Dr. Sundgren's recommendation and would like the BRCC to raise the approved breeding age for males to 24 months.

B. I do not agree with Dr. Sundgren and wish for the breeding age to remain at 12 months.

C. I support Dr. Sundgren's recommendation but would like to see the BRCC raise the approved breeding age more slowly, so recommend that they raise the approved breeding age for males to 18 months.

D: Other _____

Conclusion #3: The third significant conclusion warns against overuse of any one male in our population.

“Based on these definitions, a male of the USA breeding stock should, if the population was closed within USA, not have more offspring than 19 and if possible not more than 7, which is about a maximum of 2 litters and twice that number of grandchildren. Added to this report is a list of those males classified as matadors in the US breeding population.

In the world, the population of the Icelandic Sheepdog is treated as one coherent breeding population. There are, therefore, only three matadors and all of them registered in Denmark. If an effective cooperation with exchange of breeding dogs is organized between the ISIC member countries, the maximum acceptable production of offspring from a male is 79 and the recommended maximum is 28. Thus, such cooperation will open for a more intensive use of the better males without the risk of too rapid loss of genetic variation in the entire breed.

Please observe that the maximum amount of progeny is reduced compared to an earlier report due to the rather dramatic shortening average generation intervals in the breed both internationally and in the USA.”

Supplemental information regarding conclusion #3: 102 puppies were born in the United States in 2008. 15 puppies were imported to the U.S. in 2008.

Question #3: (please choose one)

The maximum amount of progeny for any male in the U.S. should be:

- A. 7 or two litters, whichever is greater.
- B. 19 or two litters, whichever is greater.
- C. 28
- D. Remain the same. 8 Litters or 50 puppies, whichever is greater.
- E. Other: please specify.

Your participation is greatly appreciated.

Please answer the questions and return your responses
via email to isaabod@gmail.com
or your responses via mail to:

ISAA Secretary
Shellie Greyhavens
14099 Robinson Ridge Road
Athens, OH 45701-4847

Thank you from your ISAA BOD!