SA BOERPERD TELERSGENOOTSKAP
SA BOERPERD BREEDERS' SOCIETY
The Ideal Sporting and Pleasure Horse

2018

Population Report for the SA Boerperd Breeders' Society

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SA STAMBOEK STUD BOOK

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Introduction

Increased selection pressure on many domestic animal species and breeds has led to an increase in production efficiency at the expense of genetic diversity and the survival of many breeds across the world. About 8000 breeds of livestock species have been domesticated, of which 631 are classified as extinct and 1710 are classified as being at risk (FAO, 2011). The concerns with regard to the loss of genetic diversity are however, not only concerned with the extinction of breeds, but also the loss of genetic diversity within breeds. Loss of genetic diversity within breeds can negatively affect adaptation (the ability of a population to respond to natural and human selection) and fitness traits (the capacity to produce fertile offspring). It is therefore necessary to monitor the genetic diversity of breeds to guarantee survival in the long run.

There are several factors that are used as key parameters in monitoring genetic diversity in breeds. These parameters include effective population size, inbreeding levels and average genetic relationships (Groeneveld et al., 2010). Effective management of animal genetic resources depend on comprehensive knowledge of breed characteristics. The availability of pedigree data offers a great opportunity to investigate and assess genetic diversity within a breed. In this study genetic diversity parameters for the Boerperd population in South Africa were investigated. This will give an indication if the population is at risk of losing genetic diversity or not.

Origin & History

The SA Boerperd is a true South African horse breed, with a long and illustrious history. The first phase of its history covers the period from van Riebeeck in 1652 to the Great Trek in 1836. The first horses imported into the Cape colony were Berber-Arabian ponies imported from Java. Infusion of Andalusian and Isabella horses, Persian Arabs, and the original horses from Java, formed the basis of what eventually developed into a recognized breed, known at the time as the Cape Horse. It was known for its sound temperament, bravery, intelligence, endurance, extreme sure-footedness and hardiness. Horse-breeding had developed into a thriving industry, even leading to the exporting of war horses, although many thousands of horses died from African Horse Sickness.

The second phase covered the period 1836 to 1899, from the Great trek to the start of the second Anglo-Boer War. The phenotype and genotype were fixed during this period as other breeds, such as the Flemish Stallions from the Netherlands, as well as Hackneys, Norfolk Trotters and Cleveland Bays, were imported and bred into what eventually become known as the Boerperd.

Photo: Pinterest

The third phase covers the period after the Second Anglo Boer War. The stamina, hardiness and mobility of the Boerperd had been tested and refined during the war years. By the end of the conflict, only the hardiest and those deliberately hidden away by their owners in remote areas beyond the reach of the British, remained. After the war, a formal movement to conserve the Boerperd started. In 1973 the Boerperd Society of SA was established in the town of Memel in the Orange Free State. A constitution was written, and a breed standard was compiled. Horses genotypically and phenotypically suitable for breeding were identified, and a very strict selection policy was adopted. In 1977 the name was changed to the Historic Boerperd Breeders Society and in 1980 the breed was officially recognised by the Department of Agriculture, and subsequently affiliated to the South African Stud Book and Livestock Improvement Association. In 1996 the Historic Boerperd was accorded the status of a fully recognised and indigenous breed by the Registrar of Livestock Improvement. In 1998 the name was changed to SA Boerperd, and it is today one of the truly South African horse breeds. (See Chris Nel, www.SABoerperd.com , for a detailed history). In addition to the growing competitive sports riding sector, horses are increasingly used for patrol and police work, herding, trailing, hunting , endurance and recreational riding.

Data & Methods

Pedigree data of the South African Boerperd population were obtained from SA Stud Book's Logix data base. The total population consisted of 34 384 animals, born between 1948 and 2017, of which 21 088 (61.3%) were female and 13 296 (38.7%) were male. The oldest horse with a known birth date is LANG-CAREL PIET, foaled in 1948.

Population parameters were determined with the German program PopReport (Groeneveld, E., et al., 2009. *Genetics and Molecular Research, 8(3):115*) and the Nordic program EVA (Berg P et al., 2006. *WCGALP, 2006, s.246*), which calculates parameters for monitoring populations for genetic diversity parameters like inbreeding and effective population size, as well as influential animals currently and in the history of the breed. PopRep was developed by the Department of Animal Breeding and Genetics of the Institute of Farm Animal Genetics (FLI). PopRep results are presented in 3 reports, which are also available, and states in detail the methods and results presented in this report. EVA was developed by Peer Berg and Anne Præbel of NordGen. NordGen Farm Animals is a Service and Knowledge Centre for Sustainable Management of farm animal genetic resources (Nordic countries).

Currently Active Breeders & Animals

Figure 1: Distribution of breeders.

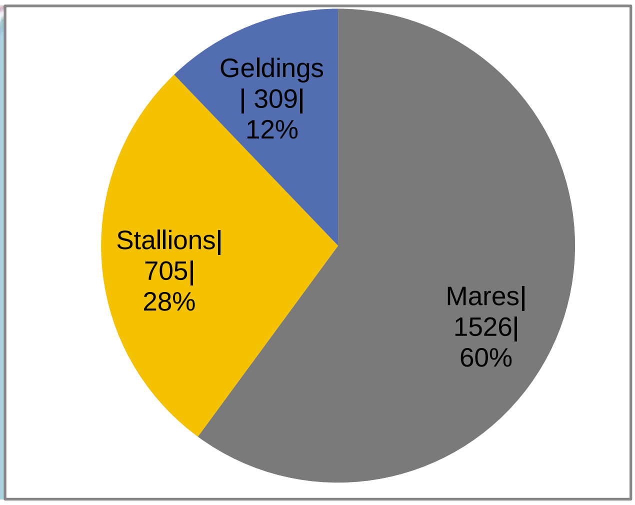
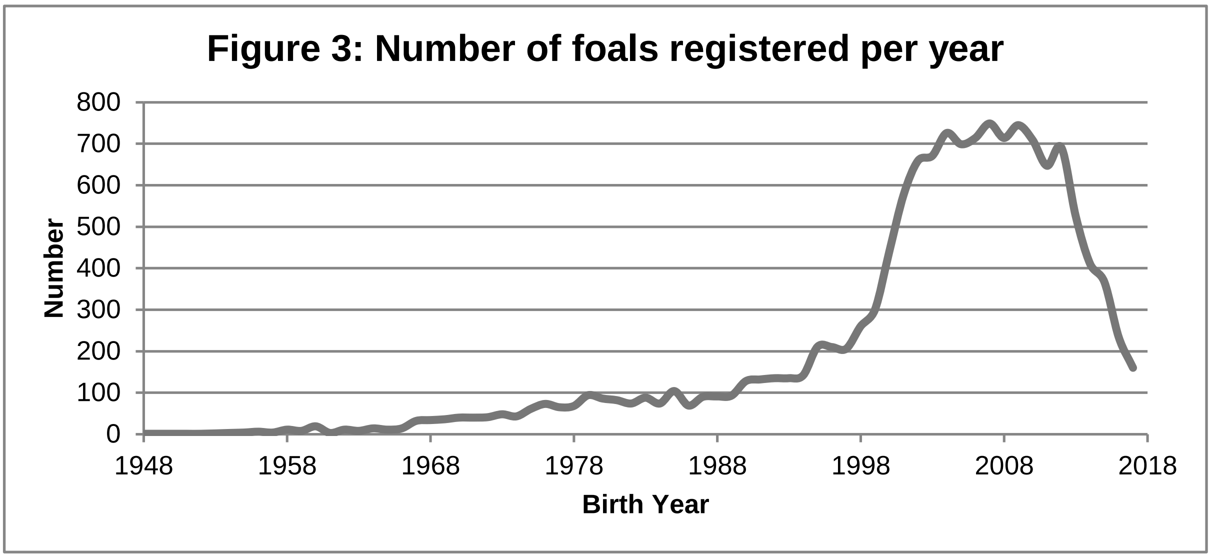


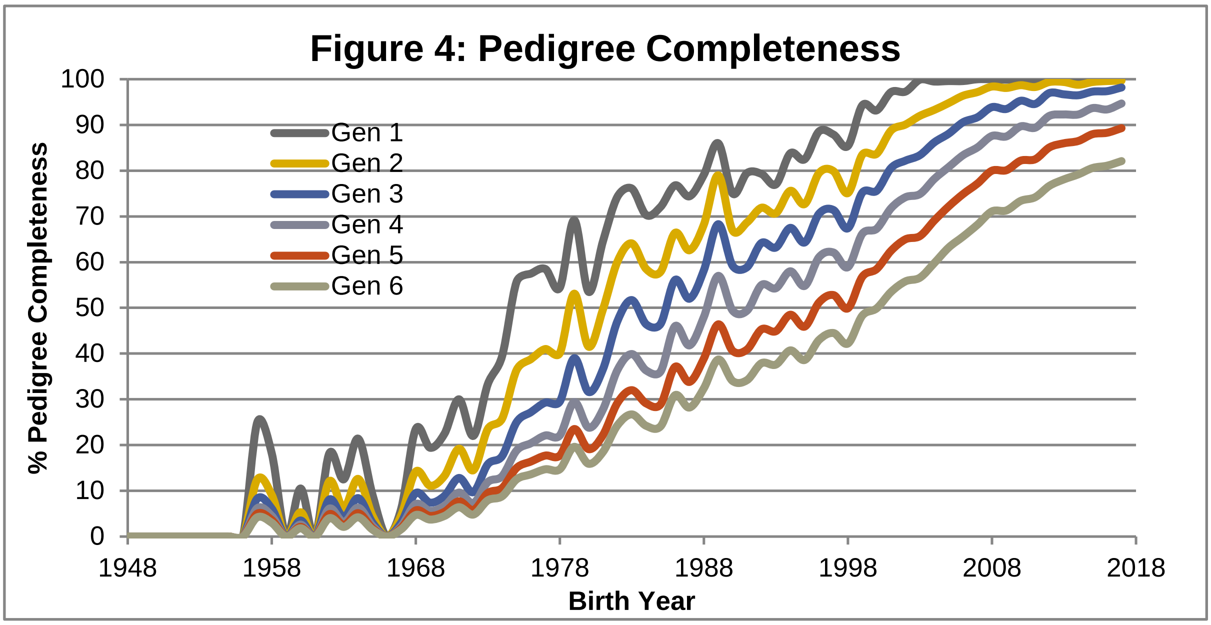
Figure 2: Active Boerperde registered on SA Stud Book's Logix data base as on 10/06/2018.

Currently (10/06/2018), there are 119 active breeders of Boerperde that have 2 540 animals registered with the Boerperd Society at SA Stud Book. The distribution of Boerperd breeders are shown in Figure 1. Figure 2 indicates that there are 1526 mares (60%), 705 stallions (28%) and 309 geldings (12%) active (alive) on the database.



The number of Boerperd foals registered reached a high point of around 700 foals registered between 2004 and 2012 (Figure 3). There has been a steady decline in numbers since then, although not all horses have probably been registered. For 2016 and 2017, only 234 and 160 foals respectively had been registered thus far. The low numbers in the past two years may be due to a real decline in numbers or simply late registrations, or a combination of both. The population parameter reports require a full year's foals to estimate the effect of influential animals on the current population (GC and AGR scores). The effect of influential ancestors was thus calculated on the 3-year-old horses (367 registered Boerperd foals born in 2015), as they are probably more representative of the population than the currently registered 2017-born foals.

Pedigree Completeness



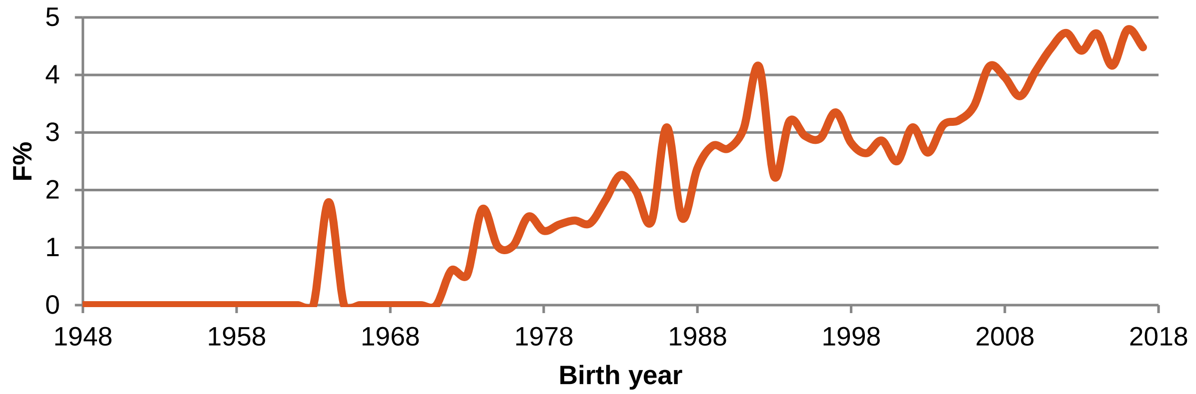
The estimation of inbreeding coefficients is highly dependent on the pedigree completeness of an animal or breed. The more complete the knowledge of an animal's pedigree, the more reliable is its estimate of inbreeding. Groeneveld uses the method of MacCluer et al (1983) to measure pedigree completeness in the breed, which indicates the proportion of known ancestors in each ascending generation. The Figure shows the pedigree completeness for 6 generations deep of the Boerperd population. The average pedigree completeness for animals born within the last 10 years: 1 generation deep (both parents known) = 99.9%; 2 generations deep (grandparents known) = 98.8%; 3 generations deep = 95.5%; 4 generations deep = 90.3%; 5 generations deep = 83.5%; 6 generations deep = 75.2%. This indicates that the inbreeding coefficients and other population parameters can be accurately determined for the population.

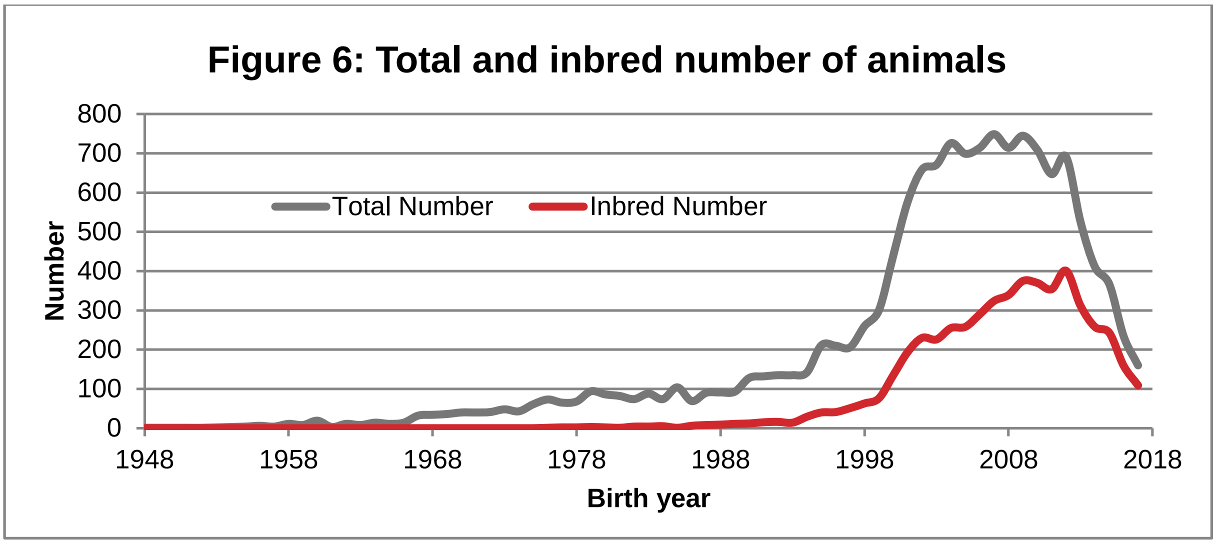
Inbreeding

Inbreeding is the mating of related animals. The genetic consequences of inbreeding are that an offspring receives the same genes from both parents because the parents are related, and the genes came from a common ancestor. Inbreeding in a population is measured by the probability that both copies of a gene came from a common ancestor. This is called the inbreeding coefficient (F). The inbreeding coefficient will be higher when the relationship between the parents is higher – it depends on how closely they are related and how many ancestors they have in common.

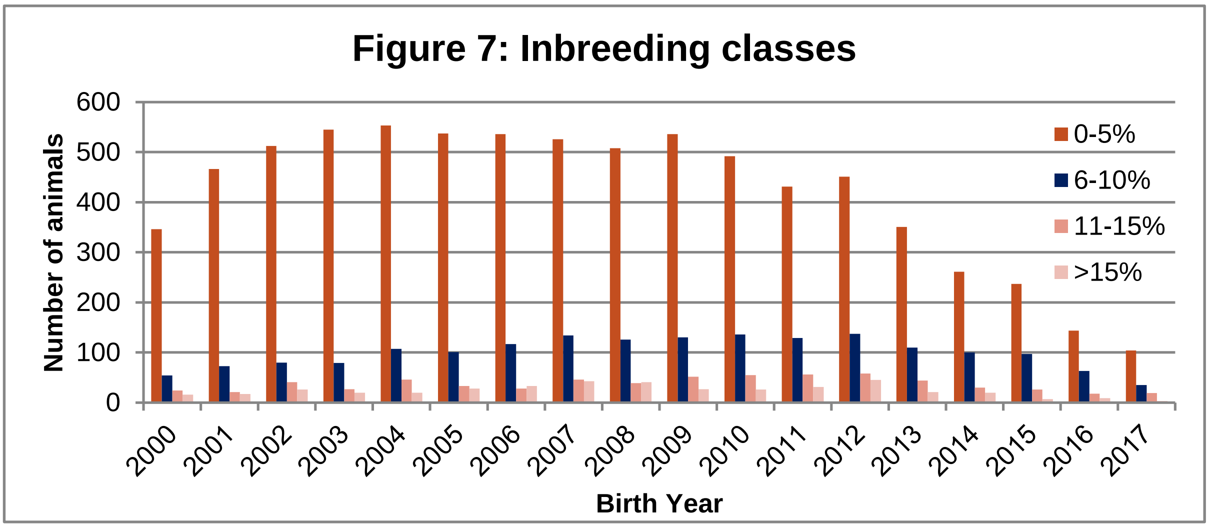
Inbreeding is used in livestock breeding to purify the breed, to concentrate 'good' genes and to increase uniformity in the offspring (Gomez et al., 2008). The danger of inbreeding lies there in that it can gradually decrease productivity, fertility and survivability – a phenomenon known as inbreeding depression. Inbreeding does not affect all traits at the same intensity. Traits associated with fitness (lowly heritable) are affected most, such as survivability, mothering ability, growth and reproduction. It can therefore lead to lower conception rates, more abortions, more stillborn and weak foals and a higher susceptibility to diseases. Generally, the effects of inbreeding can become noticeable at an F value of 0.0625 (6.25%), therefore it is generally recommended that individuals should have inbreeding coefficients of less than 6.25%. The theoretical maximum inbreeding coefficient is 50%. However, it should be noted that not all inbred animals show signs of inbreeding depression.

Figure 5: Average Inbreeding %





From Figures 5 and 6 it can be seen that inbreeding levels and number of inbred animals are increasing. It is recommended that inbreeding levels should be below 6.25%, while the average inbreeding in the Boerperd breed is already approaching 5%. Breeders should therefore avoid inbreeding as far as possible.



With very high pedigree completeness, and a closed population, it can be difficult to keep inbreeding levels within acceptable levels. However, from Figure 7 it can be seen that Boerperd breeders are managing to keep inbreeding coefficients mostly below 6%, but it will increasingly become more difficult to do so. However, there are relatively few animals with very high inbreeding levels.

Inbreeding that occurs over many generations slowly decreases the number of ancestors represented in the population and genetic diversity therefore decreases (Figure 8). Some valuable genes can be lost during this process. To maintain sufficient genetic diversity in a population, it is recommended that long-term inbreeding should not be more than 0.5 – 1% per generation. Inbreeding in the Boerperd population is however increasing, and is calculated at 0.63% per generation. It is not yet dangerously high, but breeders should once again avoid inbreeding as far as possible, in order to maintain genetic diversity.

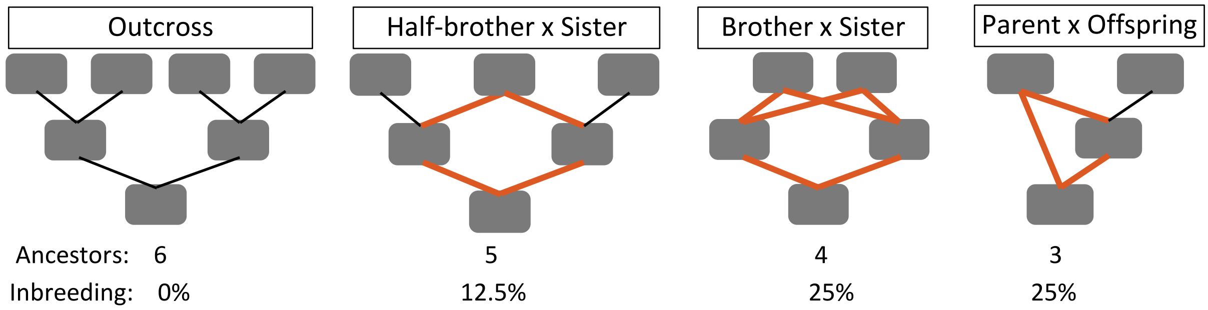


Figure 8: Mating of related animals cause inbreeding to rise and a decrease of the number of ancestors (and genetic diversity). This could lead to a situation where fewer (and only related) animals are available as parents.

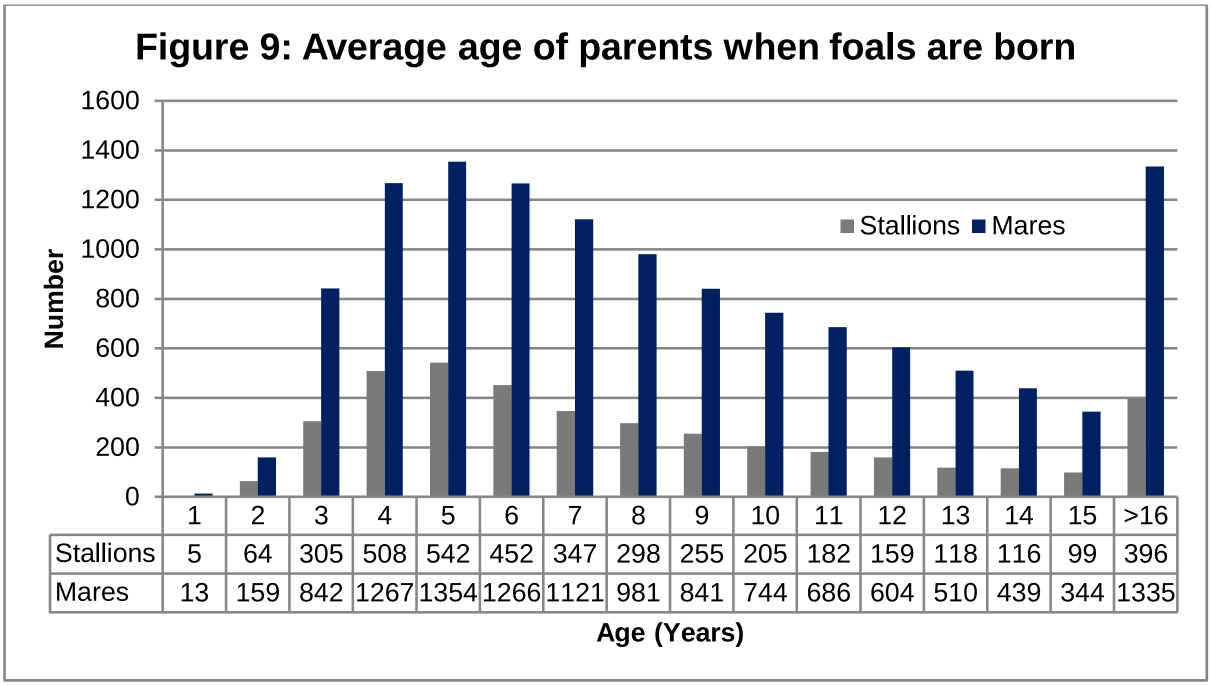
As levels of inbreeding and rate of inbreeding are increasing, care should be taken that the situation does not become a problem in future. Breeders should avoid inbreeding. Inbreeding can be avoided by increasing the number of individuals contributing to the next generation. The easiest way to do this is to increase the number of unrelated stallions used as sires. Closely related animals should also not be mated. It is recommended that matings where the stallion and mare share more than one common grandparent should be avoided, as the inbreeding coefficient would then be more than 6.25%. This will minimize inbreeding in the short term, but will have no effect if the of animals available as parents, is either too little or too related. In general, limitations should be placed on the level of inbreeding caused by stallions selected into the mating programme.

Effective Population Size

The effective population size is defined as the size of an idealized population which would give rise to the rate of inbreeding in the population under consideration (Wright, 1923). The rate of loss of genetic diversity over time depends on the effective population size which is linked to age structure and mean generation interval of the breeding animals (Engen et al, 2005). In animal breeding, it is recommended to maintain an effective populations size (Ne) of at least 50 (short-term fitness) to 100 (long-term fitness) that corresponds to a rate of inbreeding of 0.5 to 1% per generation (FAO, 1998, Bijma, 2000). There are various methods to estimate effective population size, and the effective population size of the Boerperd population is estimated at between 60 and 79 (Groeneveld). The effective population size indicates that short term fitness is probably acceptable, but that efforts should be made to use (relatively) unrelated stallions to increase the effective population and therefore long term survival.

Age Structure

The average age for Boerperd sires is 9.2 years and for dams is 10.2 years. Most stallions and mares are 4-5 years old when progeny are born (Figure 9). Quite a number are older than 16 years, indicating longevity. (The total number of sires and dams is not the sum of the sire and dam columns but rather the total number of sires and dams occurring in all years. This figure will tend to be smaller than the sum from the years, as the same sire or dam may show up in multiple years).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>16
Stallions	5	64	305	508	542	452	347	298	255	205	182	159	118	116	99	396
Mares	13	159	842	1267	1354	1266	1121	981	841	744	686	604	510	439	344	1335

Generation Interval

Generation interval is one of the key factors affecting the rate of genetic progress and therefore the genetic structure of the population. As a general rule, the shorter the generation interval the more rapid is the genetic change in the population holding other factors constant. Generation interval can be defined as the average age of the parents at the birth of their selected offspring (Falconer & Mackay, 1996). In the evaluation of generation interval, an offspring is considered selected if it has produced at least one offspring. The average generation interval for the Boerperd population in South Africa is 9.2 years, with 9 years for males and 9.5 years for females. The average generation interval is 8 to 12 years for horse breeds (Lasley, 1978, *Genetics of Livestock Improvement*; Pjontek et al., 2012. *Czech J. Anim. Sci., 57, 54–64*).

Family size

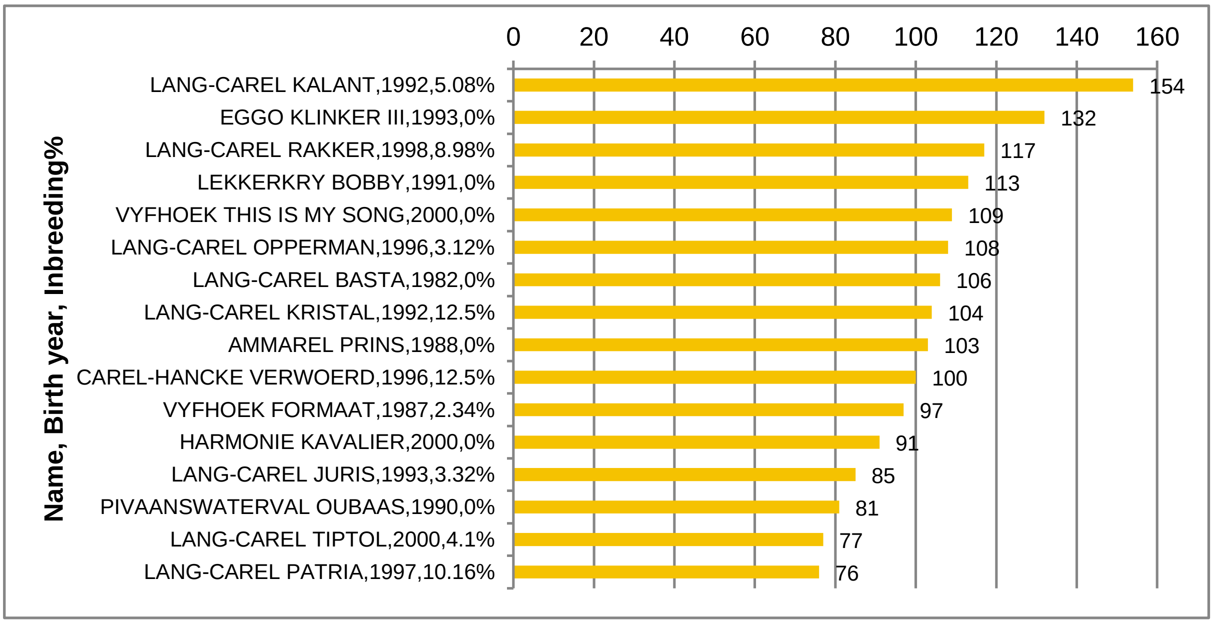
It is also important to know how many progeny did parents have and which parents made an important contribution in the breed. However, the total number of progeny per parent is not as important as the number of progeny per parent that were again selected to become parents. Family size refers to the number of offspring of an individual that become breeding individuals in the next generation (Falconer & Mackay, 1996). Progeny per sire ranged between 1 and 154 with an average of 12 (SD 17.1). An average of 6 (SD 7.9) progeny per sire were selected to become parents themselves, ranging between 1 and 64. Mares have on average 3 foals (SD 2.8) ranging between 1 and 17 foals. On average, 2 foals per dam (SD 1.7) will be selected to become parents, ranging between 1 and 13.

Important animals in the breed

It is also important to identify animals that have made major genetic contributions to the breed. They are identified by the animals with the most offspring in the breed, the most selected offspring in the breed, and the highest Additive Genetic Relationship (AGR) and Genetic Contribution (GC).

Stallions with the most registered foals

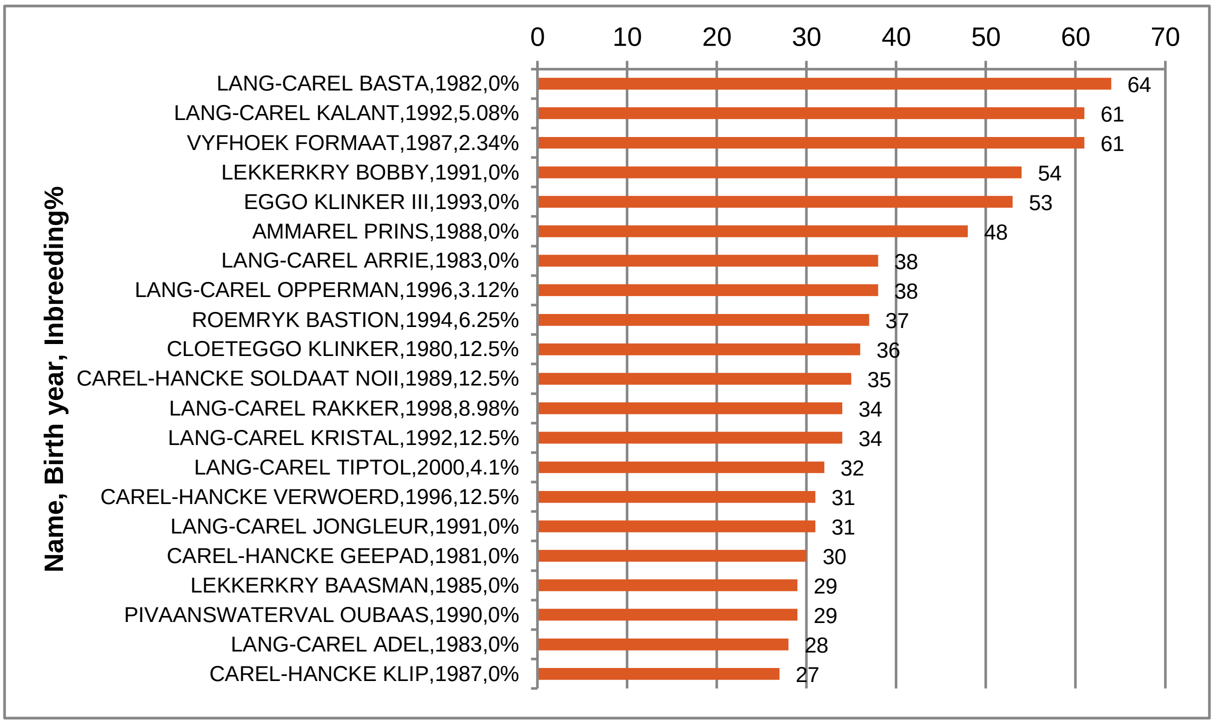
There are 10 stallions that had 100 or more registered foals. The stallion with the most registered foals (154), is Lang-Carel Kalant, foaled in 1992 and 5.08% inbred. He is the son of Lang-Carel Adel.



Logix Pedigree of Lang-Carel Kalant, showing that he is inbred to Lang-Carel Eggo.

Stallions with the most offspring selected as parents

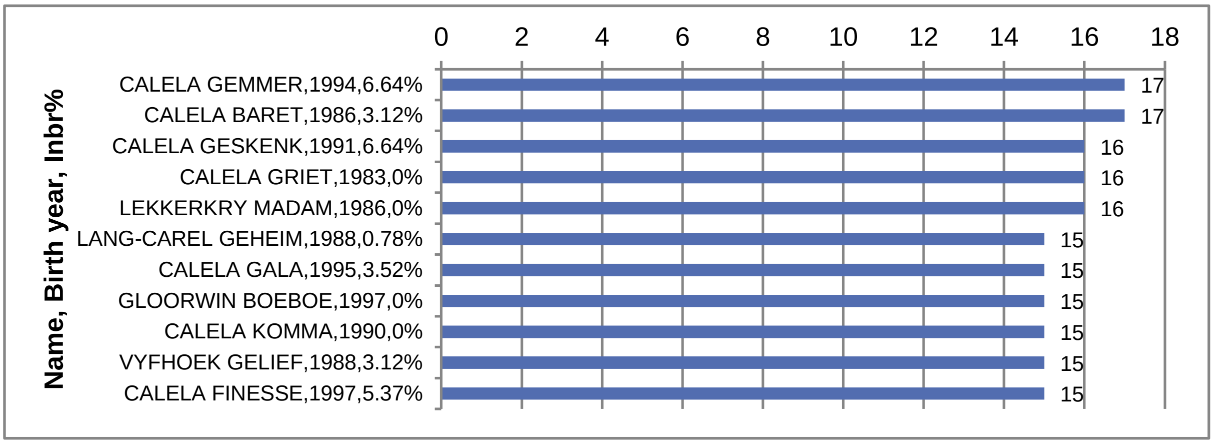
Even though a stallion may have many registered foals, it does not necessarily mean that he has the largest genetic contribution in the breed, as the number of offspring selected as parents will have a greater influence. The stallions with the most offspring that became parents are as follows:



The stallion with the most offspring selected to become parents, namely 64, is Lang-Carel Basta, the maternal grandsire of Lang-Carel Kalant.

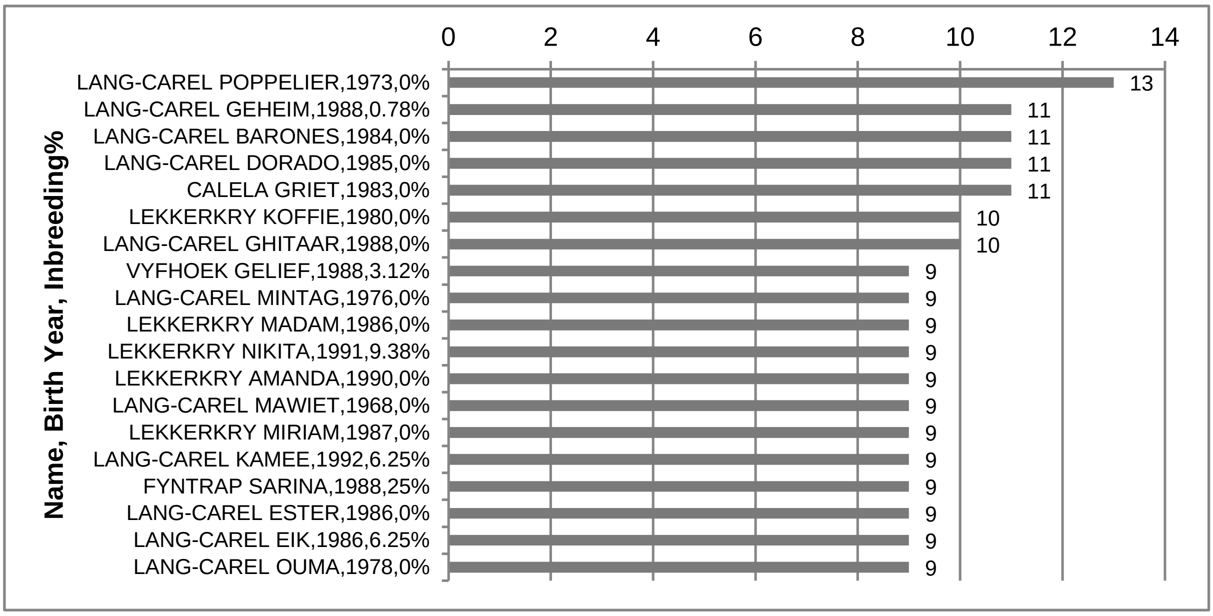
Mares with the most foals

The two mares with the most registered foals are Calela Gemmer and Calela Baret with 17 foals each.



Mares with the most offspring selected as parents

However, the mare that had all 13 her foals selected to become parents is Lang-Carel Poppelier, foaled in 1973. She has a AGR score of 8.12% and a GC score of 3.6% in the breed.



Naam	Rekenaar nr.	Geslag	Lab. Nr.	Registrasienommer	Afdeling	Geboortedatum	Vaar:
LANG-CAREL NORA	0011344132	F	53470	ELC95-146B	B	12/11/1995	CALELA GEORGE
LANG-CAREL KOMEET	0010931194	M	HB 25/98	358F3	B	01/12/1992	LANG-CAREL HAVANA
LANG-CAREL IVOOR	0010930675	M	79917	293F3	B	12/10/1990	VYFHOEK MOSTERT
LANG-CAREL GRANDIE	0011023926	F	-	1156F3	B	28/10/1988	LANG-CAREL ARRIE
LANG-CAREL FORTUIN	0010930386	M	-	249F3	B	08/11/1987	LANG-CAREL BASTA
LANG-CAREL EIK	0011006475	F	53207	975F3	B	28/10/1986	LANG-CAREL AMOK
LANG-CAREL DENIM	0011005915	F	79896	873F3	B	28/09/1985	CLOETEGGO SKITTER
LANG-CAREL BAKGAT	0010929982	M	-	187F2	A	31/10/1984	CLOETEGGO AFHEUP
LANG-CAREL ASTRANT	0011005006	F	-	699F3	B	04/10/1983	LANG-CAREL EGGO
LANG-CAREL AKKER	0011023785	F	-	680F3	B	17/11/1981	LANG-CAREL EGGO
LANG-CAREL PARDON	0011023660	F	-	544F3	B	21/10/1979	CLOETEGGO SKITTER
LANG-CAREL MAKSIM	0010929073	M	-	113F2	A	22/11/1978	
LANG-CAREL PRESIDENT	0011002946	M	-	114F2	A	20/09/1977	LANG-CAREL EGGO PRESIDENT

The Logix report (Enquiries->Animal information -> Progeny) of Lang-Carel Poppelier's 13 foals that were all selected to become parents.

Influential animals

The most influential animals in a breed are determined by the Additive Genetic Relationsip (AGR) and the Genetic Contribution (GC). Both these scores are related to one another and to the inbreeding of the animal. The official definitions are listed below.

Genetic Contribution (GC)

The proportion of the genes of the foals born in a specific year (2015) that are expected to derive by descent from a **specific ancestor** is known as the genetic contribution of the specific ancestor. It relates to the development of the pedigree over generations and gives an indication of how the ancestor may influence the population. (J. A. Woolliams, P. Bijma, B. Villanueva, 1999. GENETICS 153 (2) 1009-1020). Animals have common ancestors when their common ancestor was popular enough to have multiple offspring, which, possibly after some generations, resulted in the birth of both parents. The more popular a breeding animal was in the past, the larger the chance that two potential parents have this ancestor in common. The more animals share that common ancestor, the larger the chance that mating two animals will result in an inbred offspring. In other words, there is a relation between the long term genetic contribution of an animal to the population and the rate of inbreeding in the population. The genetic contribution is a measure of the level of relatedness between animals in a population because of a shared common ancestor.

Table 1: Animals with the highest Genetic Contribution (GC) in the breed.

	Name	Sex	BYear	Sire	Dam	F%	AGR	GC
1	LANG-CAREL ROBYN	M	1960	CLOETEGGO BISMARK I	CLOETEGGO GROOT VOS	0	8.97	8.53
2	LANG-CAREL EGGO	M	1977	CLOETEGGO EGGO 2	LANG-CAREL SIX	0	11.18	8.01
3	LANG-CAREL ADEL	M	1983	LANG-CAREL EGGO	LANG-CAREL POUPIE	0	12.74	7.83
4	LANG-CAREL BASTA	M	1982	LANG-CAREL EGGO JAS	LANG-CAREL BLYDSKAP	0	11.89	7.82
5	CLOETEGGO EGGO 2	M	1951	CLOETEGGO EGGO I		0	8.02	7.76
6	LANG-CAREL POUPIE	F	1967			0	6.49	6.49
7	LANG-CAREL SIX	F	1958	CLOETEGGO MARITZ	LC OU GEEL MERRIE	0	6.32	5.89
8	LANG-CAREL EGGO JAS	M	1969	CLOETEGGO KLINKER	CLOETEGGO	0	6.68	5.47
9	CLOETEGGO KLINKER	M		CLOETEGGO EGGO I	CLOETEGGO KAT	0	5.16	5.16

The two stallions with the highest genetic contribution in the current 3-year-old horses is Lang-Carel Robyn and Lang-Carel Eggo, which have a genetic contribution of 8.53% and 8.01% respectively. The animals with the highest direct influence (more than 5%) in the South African Boerperd breed is dominated by Lang-Carel / Cloeteggo animals, of which most are related to one another, although none are inbred. They have high AGR scores as well.

Additive Genetic Relationship (AGR)

The additive genetic relationship reflects what proportion of their DNA (alleles) animals share because they have common ancestor(s). Additive genetic relationships are calculated from the pedigree. In this report, the AGR was estimated relative to 3-year Boerperd foals (born in 2015). The additive genetic relationship is an estimate of the proportion of alleles that the foals born in 2015 have in common because of **one or more common ancestor(s)** (https://wiki.groenkennisnet.nl/). The 50 animals with the highest AGR scores are listed in Table 2.

Table 2: Boerperd ancestors with the highest AGR (Additive Genetic Relationship) to the 367 registered foals born in 2015 (current 3-year olds). GC score (Genetic Contribution) as well as Inbreeding % (F%) are also shown.

	Name	Sex	BYear	Sire	Dam	F%	AGR	GC
1	LANG-CAREL KRISTAL	M	1992	LANG-CAREL ADEL	LANG-CAREL ASTRANT	12.5	13.52	3.24
2	LANG-CAREL ADEL	M	1983	LANG-CAREL EGGO	LANG-CAREL POUPIE	0	12.74	7.83
3	LANG-CAREL WOEMA	M	2003	LANG-CAREL BASTA	LANG-CAREL OBSESSIE	4.69	12.22	2.25
4	LANG-CAREL RAKKER	M	1998	LANG-CAREL KRISTAL	LANG-CAREL KAMEE	8.98	11.91	2.01
5	LANG-CAREL BASTA	M	1982	LANG-CAREL EGGO JAS	LANG-CAREL BLYDSKAP	0	11.89	7.82
6	LANG-CAREL EGGO	M	1977	CLOETEGGO EGGO 2	LANG-CAREL SIX	0	11.18	8.01
7	LANG-CAREL ASTRANT	F	1983	LANG-CAREL EGGO	LANG-CAREL POPPELIER	0	11.07	2.84
8	LANG-CAREL DORADO	F	1985	LANG-CAREL BASTA	LANG-CAREL KWARTEL	0	10.56	2.09
9	VYFHOEK VYFSTER	M	2010	VYFHOEK FLAMBOJANT	LANG-CAREL JOVIAAL	13.28	10.55	2.59
10	LANG-CAREL JONGLEUR	M	1991	LANG-CAREL ADEL	LANG-CAREL BARONES	0	10.46	2.30
11	LANG-CAREL ARRIE	M	1983	LANG-CAREL EGGO	LANG-CAREL TENDELE	0	10.25	3.33
12	LANG-CAREL JURIS	M	1993	LANG-CAREL ECHO	LANG-CAREL DORADO	3.32	10.09	1.94
13	LANG-CAREL BLYDSKAP	F	1975	CLOETEGGO EGGO 2	LANG-CAREL POUPIE	0	9.27	4.04
14	LANG-CAREL JOVIAAL	F	1991	LANG-CAREL ADEL	VYFHOEK FYNTRAP	3.12	9.25	2.04
15	LANG-CAREL ROBYN	M	1960	CLOETEGGO BISMARK I	CLOETEGGO GROOT VOS	0	8.97	8.53
16	VYFHOEK FORMAAT	M	1987	LANG-CAREL ARRIE	VYFHOEK TRIX	2.34	8.88	2.91
17	LANG-CAREL OPPERMAN	M	1996	AMMAREL PRINS	LANG-CAREL DENIM	3.12	8.74	2.49
18	LANG-CAREL DENIM	F	1985	CLOETEGGO SKITTER	LANG-CAREL POPPELIER	0	8.17	2.10
19	LANG-CAREL POPPELIER	F	1973	LANG-CAREL ROBYN	LANG-CAREL LITA 18	0	8.13	3.61
20	LANG-CAREL GEORGE	M	1973	LANG-CAREL ROBYN	LANG-CAREL BESSIE	0	8.05	3.48
21	CLOETEGGO EGGO 2	M	1951	CLOETEGGO EGGO I		0	8.02	7.76
22	LANG-CAREL KWARTEL	F	1981	LANG-CAREL GEORGE	LANG-CAREL PATRYS	0	7.14	2.63
23	AMMAREL PRINS	M	1988	LANG-CAREL VALK	LANG-CAREL PROSA	0	6.81	2.75
24	LANG-CAREL EGGO JAS	M	1969	CLOETEGGO KLINKER	CLOETEGGO	0	6.68	5.47
25	LANG-CAREL POUPIE	F	1967			0	6.49	6.49
26	IMPALA ANKER	M	1971	LANG-CAREL ROBYN	LANG CAREL DAWN F1	0	6.44	2.61
27	CALELA GEORGE	M	1983	LANG-CAREL GEORGE	CALELA ERICA	0	6.37	2.02
28	VYFHOEK MOSTERT	M	1975	LANG-CAREL BISMARK	VYFHOEK VENUS	0	6.34	2.09
29	LANG-CAREL SIX	F	1958	CLOETEGGO MARITZ	LC OU GEEL MERRIE	0	6.32	5.89
30	LANG-CAREL TENDELE	F	1978	IMPALA ANKER	LANG-CAREL PATRYS	0	6.00	1.95
31	LANG-CAREL VALK	M	1975	LANG-CAREL ROBYN	LANG-CAREL DUIF	0	5.95	1.95
32	LANG-CAREL BARONES	F	1984	CLOETEGGO AFHEUP	CLOETEGGO DIAMANT KOL 8	0	5.87	2.28
33	CLOETEGGO KLINKER	M	1980	CLOETEGGO AFHEUP	CLOETEGGO 10	12.5	5.68	2.49
34	LANG-CAREL BISMARK	M	1972	CLOETEGGO BISMARK 2	LANG-CAREL SIX	0	5.24	1.81
35	CLOETEGGO KLINKER	M		CLOETEGGO EGGO I	CLOETEGGO KAT	0	5.16	5.16
36	CLOETEGGO AFHEUP	M	1970	CLOETEGGO KLINKER	CLOETEGGO SKEELOOG	0	5.16	3.44

	Name	Sex	BYear	Sire	Dam	F%	AGR	GC
37	CLOETEGGO GROOT VOS	F				0	4.91	4.91
38	EGGO KLINKER III	M	1993	CLOETEGGO KLINKER	BOKFONTEIN FLEUR	0	4.81	2.74
39	VYFHOEK TRIX	F	1979	VYFHOEK MOSTERT		0	4.61	1.91
40	CLOETEGGO BISMARK I	M				0	4.50	4.50
41	CLOETEGGO EGGO I	M		CLOETEGGO FORT	BOUWER BESSIE	0	4.40	4.40
42	CLOETEGGO MARITZ	M				0	3.81	3.81
43	CALELA EGGO JOB	M	1958	CLOETEGGO BISMARK	CLOETEGGO PRINSES	0	3.78	3.45
44	LANG-CAREL PATRYS	F	1962	CALELA EGGO JOB	MARITZ	0	3.60	2.29
45	LC OU GEEL MERRIE	F				0	2.94	2.94
46	CLOETEGGO	F				0	2.73	2.73
47	CAREL-HANCKE GEEPAD	M	1981	CAREL-HANCKE SIERAAD	CAREL-HANCKE NOOI	0	2.68	2.22
48	CLOETEGGO BISMARK	M				0	2.38	2.38
49	CLOETEGGO BISMARK 2	M	1968		CLOETEGGO BONTRUG 2 NR 4	0	2.35	2.32
50	PIVAANSWATERVAL OUBAAS	M	1990	PIVAANSWATERVAL SCOTCH	PIVAANSWATERVAL JANRI ONA	0	2.15	2.01

The most successful and influential stallion, which through himself as well as his sons and also daughters forming lines of their own, is Lang-Carel Kristal, foaled in 1992. Their contribution is 13.52% of the genes in the current 3-year-old.

According to Chris Nel (SA Boerperd Breed History; www.saboerperd.com), there are 8 recognisable bloodlines in the Boerperd. Many of these ancestors still has a direct genetic contribution to the current 3 year old horses, as can be seen from Table 2. Although the influential animals in the breed is dominated by the Lang-Carel / Cloeteggo animals, some of the other lines (Calela, Carel-Hancke, Pivaanswaterval, Vyfhoek(?)) also have influential ancestors, and although related originally, it should be maintained as separate lines if possible. Should inbreeding become too high in some lines, one solution would be to introduce limited highly selected stallions from one of the founder breeds of the Boerperd, so as to increase genetic diversity, rather than losing the line by crossing it with other lines. Some crossing between lines is however also permissible.

Photographs: www.saboerperd.com

Summary

Genetic diversity parameters for the South African Boerperd breed.

Trait	Boerperd	OK?	Recommen-ded range	Comments
Numbers registered/year	±700		-	Declining?
Pedigree completeness	>90%	✓	>80%	Genetic diversity parameters and inbreeding estimates are accurate
Average inbreeding	4-5%	✓	<6.25%	Still acceptable but increasing
Rate of inbreeding	0.63	✓	<0.5-1%	Still acceptable but should be lowered
Effective population size:				Effective population size should be increased by limiting inbreeding or creating / maintaining lines
Short term survival	60 - 79	✓	>50	
Long term survival		?	>100	
Generation interval	9.2 years	✓	8-12 years	Average
Age Structure: Sires	9.2 years	✓		
(avg age) : Dams	10.2 years	✓		
Family size*: Sires	12(154)/6 (64)	✓		Stallion: Lang-Carel Basta, 1982
Dams	3 (17) / 2 (13)	✓		Mare: Lang-Carel Poppelier, 1973
Highest AGR	13.52	✓		Lang-Carel Kristal, 1992
Highest GC	8.53	✓		Lang-Carel Robyn, 1960

*Family size: Average number of foals per parent (max number of foals) / average number of foals selected to become parents (max number of selected foals)

The South African Boerperd population has acceptable genetic diversity at this stage. The Boerperd population has high levels of pedigree completeness, as the breed was closed in 2002 (www.saboerperd.com), indicating that genetic diversity parameters can be accurately determined. Generation interval, age structures and family sizes are within norms. However, breeders should be alerted to avoid inbreeding. Inbreeding is still within acceptable levels at this stage, but is increasing and the rate of inbreeding per generation is also increasing. The South African Boerperd population seems safe for short term survival, but to ensure long term survival, breeders should bring down the rate of inbreeding per generation. Breeders should ensure that close relatives are not mated and ensure that the 8 identified bloodlines (www.saboerperd.com) be kept separate and as intact as possible, with minimal mating across lines to keep inbreeding within lines relatively low.