THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Siberian Husky

Evidence Base

CONTENTS

INTRODUCTION

The Kennel Club launched a new resource for breed clubs and individual breeders – the Breed Health and Conservation Plans (BHCP) project – in September 2016. The purpose of the project is to ensure that all health concerns for a breed are identified through evidence-based criteria, and that breeders are provided with useful information and resources to raise awareness of current health and welfare concerns in their breed, and support them in making balanced breeding decisions.

The Breed Health and Conservation Plans take a complete view of breed health with consideration to the following issues: known inherited conditions, complex conditions (i.e. those involving many genes and environmental effects such as nutrition or exercise levels, for example hip dysplasia), conformational concerns and population genetics.

Sources of evidence and data have been collated into an evidence base which gives clear indications of the most significant health conditions in each breed, in terms of prevalence and impact. Once the evidence base document has been produced it is discussed with the relevant Breed Health Co-ordinator and breed health representatives where applicable. Priorities are agreed based on this data and incorporated into a list of actions between the Kennel Club and the breed to tackle these health concerns. These actions are then monitored and reviewed on a regular basis.

DEMOGRAPHICS

The number of Siberian Huskies registered by year of birth between 1990 and 2019 are shown in Figure 1. The trend of registrations over year of birth (1990-2019) was +20.1 per year (with a 95% confidence interval of -3.9 to +44.1) reflecting the fluctuation in the breed's numbers. Figure 1 clearly shows a rise to a peak in 2009 of approximately 2,300 dogs, but since this time the numbers have continuously declined, with fewer than 500 dogs registered per year as of 2019.

[Put simply, 95% confidence intervals (C.I.s) indicate that we are 95% confident that the true estimate of a parameter lies between the lower and upper number stated.]

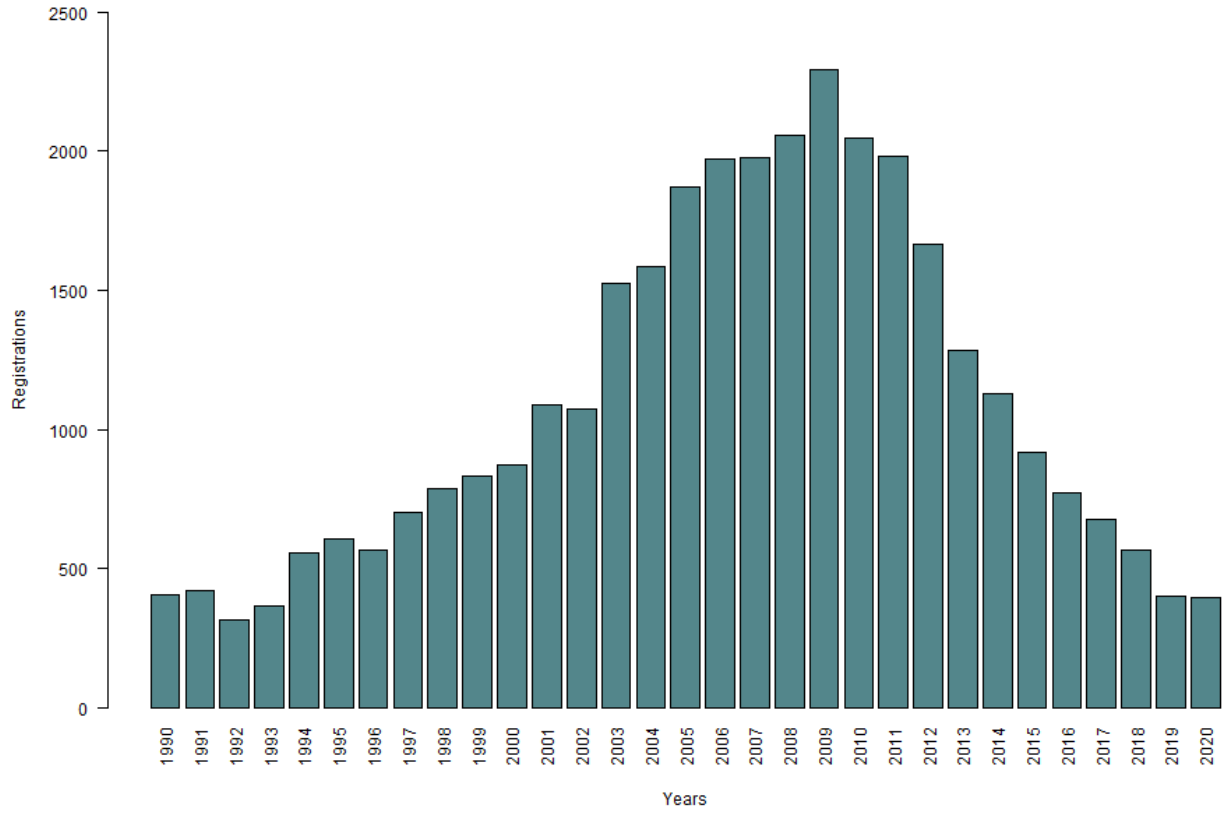

Figure 1: Number of registrations of Siberian Huskies per year of birth, 1990 – 2020.

BREED HEALTH CO-ORDINATOR ANNUAL HEALTH REPORT

Breed Health Co-ordinators (BHCs) are volunteers nominated by their breed to act as a vital conduit between the Kennel Club and the breed clubs with all matters relating to health.

The BHC's Annual Health Report in 2018 and 2019, yielded the following response to 'please list and rank the three health and welfare conditions that the breed considers to be currently the most important to deal with in your breed':

1. Glaucoma
2. Hereditary cataract
3. Epilepsy

In terms of what the breed has done to help tackle these listed health and welfare concerns, the breed has continued to encourage eye screening (including gonioscopy) under the BVA/KC/ISDS Eye Scheme for all breeding dogs.

BREED CLUB HEALTH ACTIVITES

The Siberian Husky has an active Breed Health Coordinator (BHC) and a webpage on the Siberian Husky Club of Great Britain website dedicated to health, which can be found at:

- http://siberianhuskyclub.org.uk/health/

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Purebred and Pedigree Dog Health Survey Results

The Kennel Club Purebred and Pedigree Dog Health Surveys were launched in 2004 and 2014 respectively for all of the recognised breeds at the time, to establish common breed-specific and breed-wide conditions.

2004 Morbidity results: Health information was collected for 797 live Siberian Huskies of which 563 (71%) were healthy and 234 (29%) had at least one reported health condition. The top categories of diagnosis were ocular (18.1%, 67 of 371 reported conditions), dermatologic (14.0%, 52 of 371), reproductive (12.9%, 48 of 371), musculoskeletal (9.2%, 34 of 371), and gastrointestinal (8.6%, 32 of 371). The most frequently reported specific conditions were zinc-responsive dermatosis (5.7%, 21 of 371), kennel cough/ infectious tracheobronchitis (4.9%, 18 of 371), cataracts (4.0%, 15 of 371), persistent pupillary membranes (PPM) (3.8%, 14 of 371), and cryptorchidism/ undescended testicle/ missing testicle (3.2%, 12 of 371).

2004 Mortality results: A total of 129 deaths were reported for the Siberian Husky. The median age at death was 12 years and 7 months (min = 5 months, max = 18 years and 1 month). The most frequently reported causes of death by organ system or category were cancer (31.8%, 41 of 129), old age (16.3%, 21 of 129), neurologic (7.0%, 9 of 129), cardiac (6.2%, 8 of 129), and gastrointestinal (5.4%, 7 of 129). The most frequently reported specific causes of death were old age – unspecified (10.1%, 13 of 129), cancer – unspecified (5.4%, 7 of 129), brain tumour (3.9%, 5 of 129) and disc disease/ intervertebral disc disease (3.1%, 4 of 129).

2014 Morbidity results: Health information was collected for 222 live Siberian Huskies of which 156 (70.3%) had no reported conditions and 66 (29.7%) were reported to be affected by at least one condition. The most frequently reported conditions were persistent diarrhoea (2.7% prevalence, 6 cases), pyometra (2.70% prevalence, 6 cases), skin (cutaneous) cyst (2.7% prevalence, 6 cases), hypothyroidism/ under-active thyroid (2.3% prevalence, 5 cases), colitis (1.8% prevalence, 4 cases), and lipoma (1.8% prevalence, 4 cases).

2014 Mortality results: A total of just 15 deaths were reported for the breed. The range of age at death for the Siberian Husky was 3 years to 15 years. The five most frequently reported causes of death by organ system or category were old age (3 deaths), bone tumour (2 deaths), and hepatic/ liver tumour (2 deaths).

LITERATURE REVIEW

The literature review lays out the current scientific knowledge relating to the health of the breed. We have attempted to refer primarily to research which has been published in peer-reviewed scientific journals. We have also incorporated literature that was released relatively recently to try to reflect current publications and research relating to the breed.

Behaviour

An American study analysed the effect of dopaminergic genes (*DRD4, TH)* following other studies that have suggested a correlation between allele length and activity and impulsivity in the German Shepherd Dog, as well as in humans (Wan et al, 2013). These genes are involved in the production of L-DOPA, a precursor of dopamine, which is involved in the production of adrenaline, as well as the brain's reward system, cognition, movement control and attention. In this study, 145 purebred sled dogs were recruited and underwent genotyping, a behaviour questionnaire (dog ADHD rating scale), and a behavioural test. The authors determined that dogs with a short *DRD4* allele showed greater activity in the behaviour tests, as well as higher ratings of activity-impulsivity in the questionnaire. Similarly, dogs with two short *TH* alleles were marginally more likely to have higher activity-impulsivity and inattention ratings and lower activity – this was more pronounced in European dogs compared to American dogs. Dogs with combined short *DRD4/ TH* alleles were most active out of the other four combinations. The authors also established more variants of the *DRD4* than other breeds previously tested, as well as one allele that to date had only been identified in wolves, supporting the ancient origins of the breed.

Cancers

Thyroid cancer: An American retrospective study reviewed 638 cases of thyroid cancer reported over a 10-year period to determine any breed predisposition (Wucherer & Wilke, 2010). Siberian Huskies made up 16 of these cases (2.5%), with an odds ratio of 2.5 (95% CI 1.51-4.08). Overall, 85% of the tumours reported in the breed were malignant carcinomas and adenocarcinomas. The authors noted that this was the first study which had noted the breed as at risk. Dogs between the age of 10 and 15 years were significantly more likely to present with disease.

Uveal spindle cell tumour: A further American study was undertaken to determine the origin of this form of rare cancer in the eyes of affected dogs (Zarfoss et al, 2007). This cancer appears to be exclusive to dogs with blue eyes. A total of just 13 tumours of this description were included, out of 4,007 canine eye samples. Siberian Huskies and their crosses made up 10 of these tumours, with a median age of 10 years. The authors could not definitively rule out whether the contribution of UV damage factors in development of disease, as well as the cells of origin and how the development of a blue uvea relates to embryonic development. Further work is needed to determine these possible causative factors.

Dermatological conditions

Zinc-responsive dermatosis: An international study reviewed 41 cases of zinc-responsive dermatosis, of which the Siberian Husky was the predominant breed affected, with 31 cases reported in the breed (White et al, 2001). Affected dogs show clinical signs such as alopecia or hair loss, crusty lesions, red or inflamed skin, and itchiness. There are two manifestations of zinc-responsive dermatosis; Syndrome I and Syndrome II. Syndrome I occurs in dogs of all ages that are usually fed a balanced diet. These dogs typically require lifelong zinc supplementation. Syndrome II occurs in younger dogs that are usually fed a diet which is low in absolute zinc concentrations, has high phytate (plant protein) or calcium levels, and/or are fed cereal or soy-based diets. Treatment for these dogs is a balanced diet and temporary zinc supplementation. This study suggested a predisposition for Syndrome I in northern-breed dogs, including the Siberian Husky.

Immunological conditions

Lymphoproliferative disease (LPD): LPD is an umbrella term for a number of immunological disorders, characterised by an abnormal production of immune cells. Some conditions classed under this term can have a cancerous basis. An American study of 1,263 dogs (87 breeds) found that the prevalence of B-cell and T-cell LPD differed among breeds (Modiano et al, 2005). B-cells and T-cells are specific cells which help mediate the immune response within the body. Excluding cases that could not be definitively categorised, across all breeds 61.4% presented with B-cell tumours (753 of 1,226) and 38.6% presented T-cell tumours. By contrast a higher prevalence for T-cell LPD was found in the Siberian Husky (88.9% T cells vs 11.1% B cells, n=9). Interestingly, when breeds were grouped on genetic relatability, the Husky group had an excess of T-cell LPD, suggesting a hereditary basis.

Musculoskeletal conditions

Hip dysplasia: Hip dysplasia is a well-known orthopaedic condition affecting several breeds, characterised by loose and lax joints, which overtime result in abnormal wearing of bone and the development of degenerative joint disease. A study undertaken in 2013 assessed the genetic trends for hip and elbow dysplasia across several breeds, including the Siberian Husky (Lewis et al, 2013). This was based on the changes in mean estimated breeding values (EBVs), which are known to be a more accurate tool to base breeding decisions on, rather than on phenotype or hip score alone. The breed showed no statistically significant improvement in hip EBV overtime, however it should be noted that the breed also had the lowest median score of 7.89. The authors also noted that the breed showed a small positive impact from phenotypic selection alone, but that these benefits may have been outweighed by the growing pet population of the breed (at that time) which would require genotypic selection instead of sole selection based on hip score. Further information regarding EBV trends and hip scores are shown on page 12.

Neurological conditions

Polyneuropathy: This condition encompasses a number of neurological disorders manifesting through a dysfunction in peripheral nerves. A US paper looked at seven

case reports of various progressive neuropathies in the breed to decipher the characteristics of this in the breed (Jahns et al, 2020). The affected dogs showed varying degrees of neuropathy, with these including two cases of slowly progressive laryngeal paralysis and megaoesophagus, two cases of slow degeneration without megaesophagus/ laryngeal paralysis, two cases of an acute inflammatory demyelinating neuropathy and one case of sensory neuropathy. These conditions were characterised into two groups, degenerative and inflammatory polyneuropathy. All dogs were young at presentation, with the authors suspecting a hereditary basis due to the relatedness of individuals. Given that similar neuropathies present in other breeds the authors tested the affected dogs for these known mutations (*NDRG1, ARHGEF10, RAB3GAP1*) but found none of these were responsible for disease. Further studies are needed to identify any genetic basis.

Ocular conditions

Cataracts: A cataract is an “opacity”, or loss of transparency of the lens of the eye. The opacity may be confined to a small area of the lens, or it may affect the whole structure, potentially resulting in blindness. Although it can be inherited there are also many other factors for cataract formation; secondary causes include trauma, diabetes mellitus or a complication of other primary ocular diseases such as uveitis and neoplasia.

A recent American paper investigated the characteristics of cataracts in the Siberian Husky, as well as complications due to cataract-correcting surgery (phacoemulsification), in 50 dogs (92 eyes) of the breed (Uhl et al, 2021). The mean age of dogs represented was 3.5 ± 3.3 years (range 0.7-12 years), significantly younger than a group of non-Huskies used as a comparison. A total of 84% of Huskies presented with a hereditary form of cataracts, with a relative risk of 1.6 (95% CI 1.3-2.0). The breed was also found to have an increased prevalence of retinal detachment prior (13%) and post (10%) surgery compared to non-Huskies, although the basis for this is unknown.

Glaucoma/ goniodysgenesis/ pectinate ligament abnormality (PLA): This condition is characterised by an abnormality in the pectinate ligament which results in a build-up of intraocular pressure, leading to damage to tissues within the eye, pain and blindness. An American study assessed the prevalence of breed-related glaucomas between 1964-2002 and determined the Siberian Husky to have a predisposition (Gelatt & MacKay). Between 1994-2002, 1.88% of Siberian Huskies were diagnosed with glaucoma, with this having risen from 0.64% in 1964-73, 0.84% in 1974-83 and 1.13% in 1984-93. Females appeared to be more affected between 1994-2002 with a ratio of 1:1.88. A similar and more recent paper looked at the epidemiology for glaucoma in Switzerland, and also suggested a predisposition for disease, with the breed making up 16.3% of cases (out of 123) (Strom et al, 2011). Of these dogs the mean age at presentation was 5.5 years (± 3.3 years, ranging from 0.1-12.3), with a male to female ratio of 1:1.5. The authors also established a breed prevalence of 5.06%.

X-linked progressive retinal atrophy (XLPRA): Following the identification of a previously unknown form of hereditary retinal disease in the breed, a male Siberian

Husky was mated to several laboratory Beagles, with the progeny mated to an unaffected Beagle male, producing affected male puppies (Acland et al, 1994). Subsequent matings also produced affected puppies and suggested an x-linked mode of inheritance. Subsequent research was undertaken to map the affected gene(s) for the condition, with the *RPGR* gene used as a candidate (Zeiss et al, 2000). However, no disease-causing mutation was found within this gene and the findings suggested a more complex genetic aetiology.

Reproductive conditions

Cryptorchidism (CO)*:* CO is a common congenital defect in which one or both testes fail to descend into the scrotum. Major health concerns of this include reduced fertility and a significantly increased risk of testicular cancer. A study used buccal samples of 156 Siberian Huskies to investigate causal genes for CO in the breed (Zhao et al, 2010). A total of 49 single nucleotide polymorphisms (SNPs – variations of DNA at a particular area of a gene) discovered from 20 candidate genes were investigated. Initial results revealed that seven SNPs in the COL2A1 gene were significantly ($p < 0.05$) or suggestively ($p < 0.10$) associated with CO. However, further analyses showed that only one SNP in this gene remained suggestively significant ($p < 0.10$) on a dataset of related dogs, but not significant on all 156 Siberian Huskies. The researchers could not exclude COL2A1 as a potential candidate gene for CO in Siberian Huskies, however further research is necessary to confirm these results, given the relatively small sample size included in the study.

Respiratory conditions

Bronchiectasis: This inflammatory condition can result in chronic disease within the bronchi in the lungs, causing clinical signs such as coughing, respiratory distress and excessive mucous in the airways. An American retrospective study analysed 289 cases of the disease to determine features of the manifestation, as well as potential risk factors. A total of nine dogs of the breed were affected (3.1%), which was higher than the breed's general population (1.1%), suggesting a predisposition. An odds ratio of 2.86 (95% CI 1.47-5.55) was established for the breed. Older dogs of any breed were also more likely to be affected.

Pneumothorax: This condition has a number of causes but results in an accumulation of air within the pleural spaces (tissues surrounding the lungs), which consequently causes collapse of the lungs and can be life-threatening. An American retrospective study assessed 64 dogs affected with this condition to assess the effectiveness of surgery versus nonsurgical treatment. Dogs that had undergone surgery had a lower recurrence compared to those that had not (3% versus 50%), as well as lower mortality (12% versus 53%). Age and sex were not predisposing factors, however larger bodyweight was greater in the affected dogs (median 29kg versus 18.6kg). The authors also found a predisposition in the Siberian Husky, with the breed making up 12 (19%) of the cases, and being significantly increased compared to the breed's control population (0.8%), with an odds ratio of 28.8 (95% CI 6.4-277.4)

VETCOMPASS

The Kennel Club work closely with VetCompass at the Royal Veterinary College. VetCompass is a broad welfare research programme that collects anonymised clinical information from more than 1,800 UK veterinary practices and includes over 7.5 million dogs. VetCompass research can be used to identify common breed-specific conditions, or condition-specific concerns which affect a range of breeds. Whilst no breed specific VetCompass paper has yet been published for the Siberian Husky, the Siberian Husky is included in the condition-specific studies detailed below.

Endocrine conditions

Diabetes mellitus: An Australian VetCompass study evaluated 134,329 records to assess any risk factors for the manifestation of this disease (Yoon et al, 2020). In total 418 dogs were diagnosed with the diabetes mellitus, representing a total prevalence of 0.35%. The Siberian Husky was found to have a significantly higher odds of disease, with an odds ratio of 6.24 (95% CI 2.51-15.54). The breed have also been found to have an increased odds in a US study (OR = 1.53, Guptil et al, 2003), however no UK based studies have replicated these findings.

Neoplastic conditions

Lymphoma: Lymphoma is a relatively common cancer of the lymphatic system. A VetCompass study of 455,553 dogs under veterinary care at 34 primary-care practices in the UK during 2013, identified 286 cases with a clinical presentation consistent with lymphoma, of which 193 dogs had a laboratory confirmed diagnosis (Pittaway et al, 2019). The overall annual incidence risk estimated was 63/ 100,000 dogs per year (95% C.I. 55.72 - 70.49). The annual incidence risk estimated in laboratory confirmed cases was 42/ 100,000 dogs per year (95% C.I. 36.60 - 48.78).

The breed has previously been identified as a risk factor for diagnosis of lymphoma. The VetCompass paper above references the study by Modiano et al. (2005) that reported the Siberian Husky to be at an increased risk of T-cell lymphoma, however these findings were not replicated in this study.

Ocular conditions

Cataract: A study evaluated medical records of 50 Huskies (92 eyes) and 96 non-Huskies (182 eyes) (Uhl et al, 2021). The mean age at cataract presentation was significantly lower in Huskies (3.5 ± 3.3 years) compared to non-Huskies (9.5 ± 2.9 years) ($p < 0.0001$). With the exception of one traumatic cataract, the aetiology of cataract in all dogs of both groups was either hereditary or diabetes mellitus. A significantly higher percentage of Huskies presented with hereditary cataracts (Huskies = 84%; non-Huskies = 52%) while a significantly higher percentage of non-Huskies presented with diabetic cataracts (Huskies = 16%; non-Huskies = 48%) ($p = 0.0001$).

BREED WATCH

The Siberian Husky is listed as a category 2 breed on Breed Watch, meaning judges are required to complete a mandatory monitoring form following a judging appointment at Championship Certificate level. The points of concern judges are currently required to monitor are:

- Significantly overweight
- Significantly underweight

A report on the percentage of dogs shown that are affected by these visible points of concern are in Table 1.

Due to the lockdown implemented in March 2020 as a result of the COVID-19 pandemic, no shows have been able to take place for the majority of 2020, and therefore these data have been excluded.

Table 1: Percentage of dogs affected by visible points of concern between 2017 and 2019.

Point of Concern	**2017**	**2018**	**2019**
Significantly overweight	0.71%	1.03%	0.15%
Significantly underweight	0.12%	0.92%	0.46%
* Cow hocks	0.18%	0.00%	0.00%
* Nervous temperament	0.12%	0.16%	0.00%
* Other	0.00%	0.27%	0.00%
* Poor muscle tone	0.00%	0.00%	0.15%
* Weak hindquarters	0.83%	0.00%	0.00%
* Weak Pasterns	0.00%	0.05%	0.00%
Total dogs reported for	**1,681**	**1,846**	**1,300**

NB. *As of quarter 4 of 2019 judges are no longer sent reminders to complete their monitoring form, which has resulted in a drop in reports received breed-wide. This is reflected in the fall of total dogs shown in 2019.*

PERMISSION TO SHOW

As of the 1st January 2020 exhibits for which permission to show (PTS) following surgical intervention has been requested will no longer be published in the Breed Record Supplement and instead will be detailed in BHCPs, and a yearly report will be collated for the BHC. In the past five years, three PTS have been granted for the Siberian Husky (not including neutering or caesarean sections), with one being cruciate ligament (rupture), one being hernia repair, and one being removal of a tooth/teeth.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeder Scheme there are the following requirements for the Siberian Husky:

- Hip scoring under the BVA/KC Hip Dysplasia Scheme
- Eye testing under the BVA/KC/ISDS Eye Scheme
- Eye testing – PLA (Gonioscopy)

It is also recommended that all breeding stock are tested for the following prior to breeding:

- Breed club eye testing

BREED CLUB BREEDING RECOMMENDATIONS

The Kennel Club include a breed club breeding recommendation which is detailed under the Assured Breeder Scheme sub-heading above.

DNA TEST RESULTS

There are currently no recognised DNA tests for the Siberian Husky.

Whilst DNA tests may be available for the breed, results from these will not be accepted by the Kennel Club until the test has been formally recognised, the process of which involves collaboration between the breed clubs and the Kennel Club in order to validate the test's accuracy.

CANINE HEALTH SCHEMES AND ESTIMATED BREEDING VALUES (EBV)

All of the British Veterinary Association (BVA)/Kennel Club (KC) Canine Health Schemes are open to dogs of any breed with a summary given of dogs tested to date below.

<u>HIPS</u>

To date (April 2021), 2,845 Siberian Huskies have been hip scored under the BVA/KC Hip Dysplasia Scheme, with a median hip score of 7 (range 0-71). The mean hip score per year of birth for the breed between 2004 and 2019 are given in Figure 2 below, with a notable decrease in mean score during this time. It is worth noting that dogs born in 2019 will be no more than two years of age and will have had fewer years for dysplasia to manifest and are therefore likely to have a lower score.

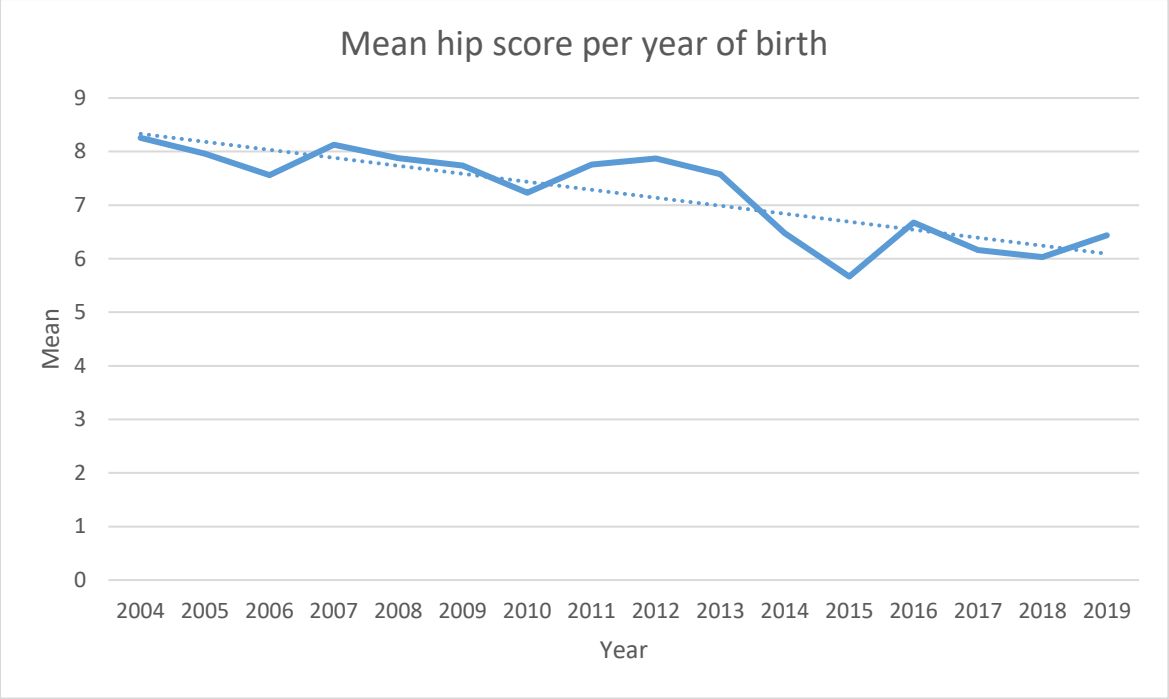

Figure 2: Mean hip score per year of birth for the Siberian Husky between 2004 and 2019.

It is worth noting that the proportion of dogs of the breed with a known hip score has decreased in the past 15 years, which could affect the data supporting the mean hip score given above (Figure 2). The number of known hip scores for the Siberian Husky between 2004 and 2019 are shown in Figure 3 below.

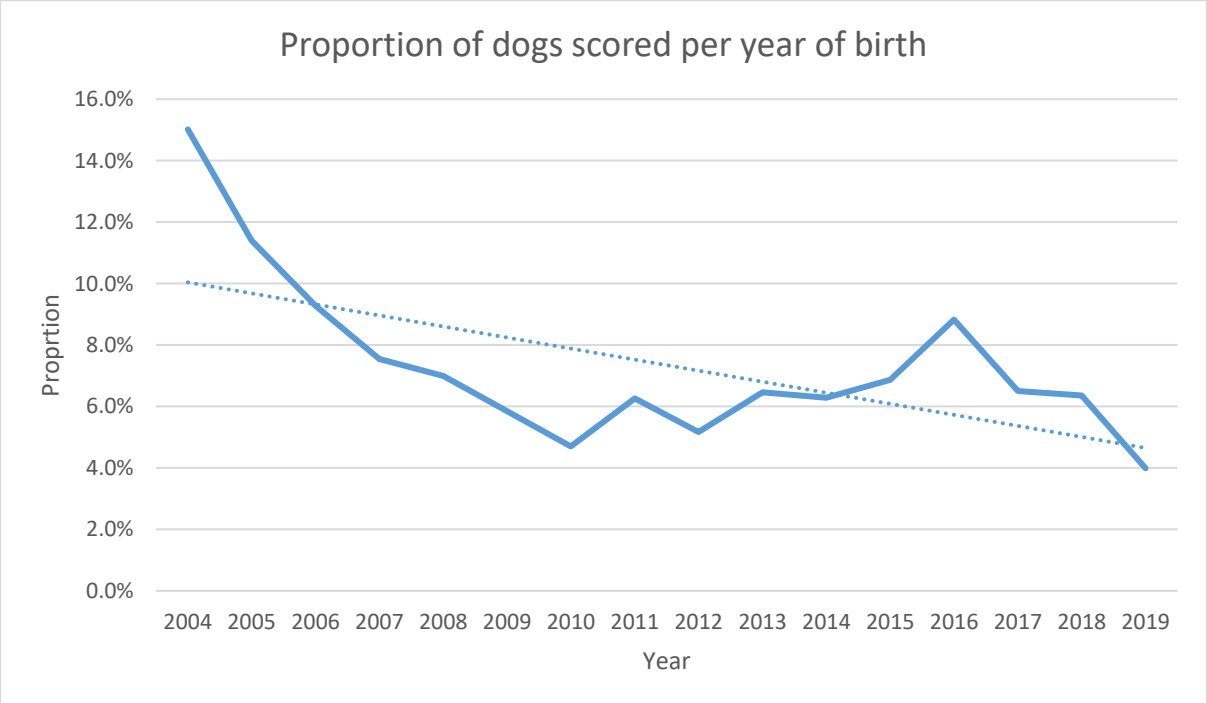

Figure 3: Number of Siberian Huskies hip scored per year between 2004 and 2019.

EBVs are available for hip scores in this breed. Figure 4 shows the four-year rolling mean trend in EBVs by year of birth in the Siberian Husky. Compared to 1990 the latest figures indicate little progress has been made, with the EBVs having increased (worsened) between ~1997 and 2007, but then begin to decline. Whilst this recent decline does indicate an improvement, no discernible genetic improvement can be drawn over this entire period.

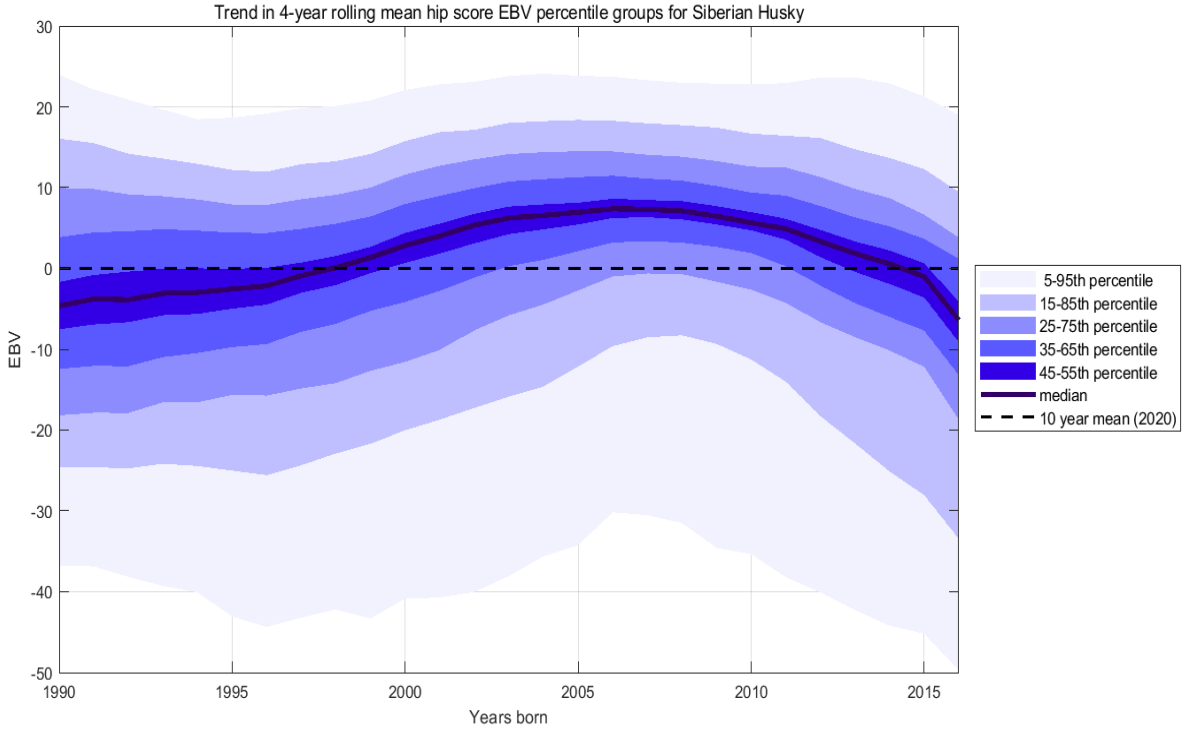

Figure 4. A diagram portraying the trend in hip Estimated Breeding Values for Siberian Huskies between 1990 and 2015.

ELBOWS

To date (April 2021), 24 Siberian Huskies have been elbow graded under the BVA/KC Elbow Dysplasia Scheme, with all grades being 0.

EYES

The Siberian Husky is currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for the following conditions:

- Goniodysgenesis/Primary Glaucoma (G)
- Hereditary Cataract (HC)

KIOD lists the known inherited eye conditions in the breeds where there is enough scientific information to show that the condition is inherited in the breed, often including the actual mode of inheritance and in some cases even a DNA test.

To date (April 2021), 6,639 Siberian Huskies have been tested in the past 20 years. The number of dogs tested per year, and count of those affected by HC are shown in Figure 5 below.

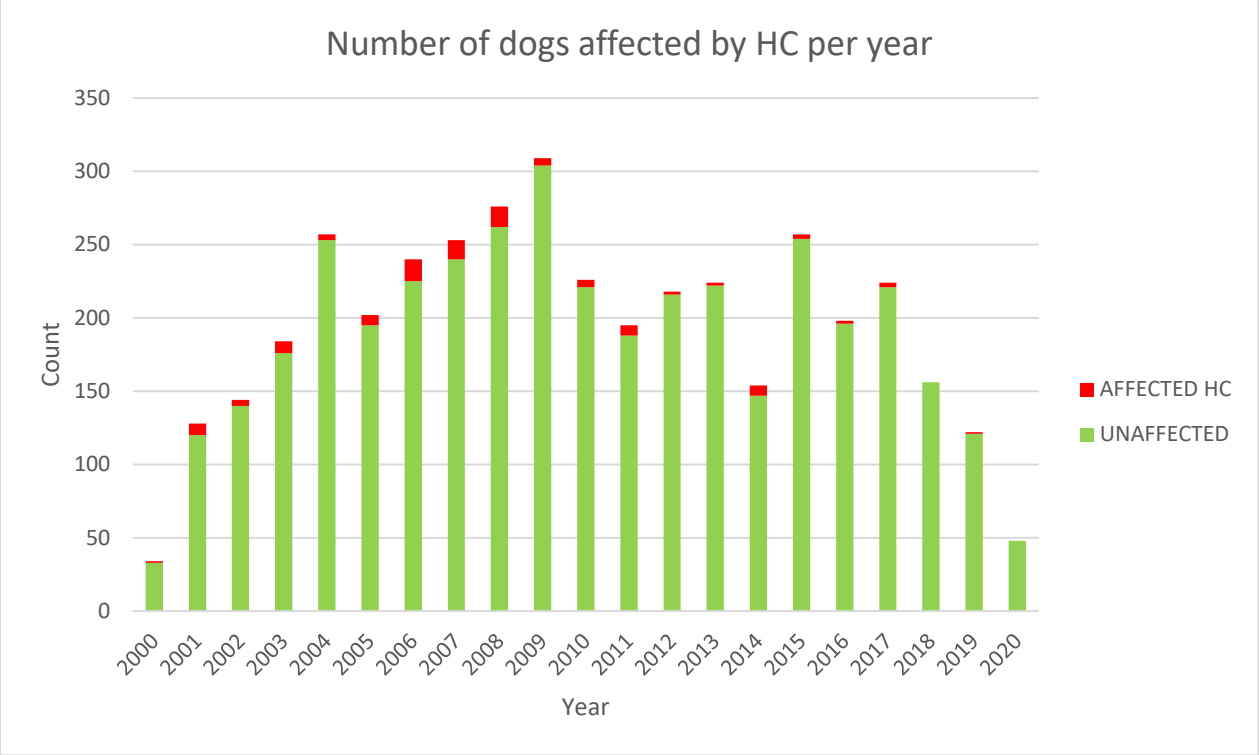

Figure 5: Count of HC reported in the Siberian Husky between 2000 and 2020.

The breed also collate gonioscopy eye test results which are shown in Table 2 below. Grading of pectinate ligament abnormality (PLA) was formally introduced from July 2017, explaining the differences in reporting prior to this date (either goniodysgenesis affected or unaffected). The new system was introduced to give breeders a better understanding of the degree of abnormality their dog was affected by and therefore allow them to make more informed breeding decisions, with PLA a known risk factor in the development of glaucoma. PLA grade 0 or 1 are dogs showing little abnormality and are therefore suitable for breeding.

Table 2: Gonioscopy Reports for Siberian Huskies from January 2000 to January 2019.

Date of Gonioscopy	**Number of Siberian Huskies Tested**				
July 2017 – to date	PLA Grade 0	PLA Grade 1	PLA Grade 2	PLA Grade 3	**Total**
	171 (63.3%)	71 (26.3%)	24 (8.9%)	4 (1.5%)	**270**
Jan 2000 – June 2017	Gonio Unaffected	Gonio Affected	**Total**		
	2,274	176	**2,450**		

Schedule B lists those breeds in which the conditions are, at this stage, only suspected of being inherited. As well as the KIOD list and Schedule B, the BVA record any other conditions affecting a dog at the time of examination, which is incorporated into an annual sightings report. Results of Siberian Huskies tested to date are shown in Table 3 below.

Table 3: Reports on Siberian Huskies that have participated in the BVA/KC/ISDS Eye Scheme since 2012.

Year	Number Tested	Comments
2012	231 Adults 1 Litter	2 – distichiasis 5 – corneal lipid deposition 4 – persistent pupillary membranes (PPM) 1 – other cataract 2 – choroidal hypoplasia
2013	231 Adults 1 Litter	4 – corneal lipid deposition 2 – PPM 4 – other cataract
2014	158 Adults 1 Litter	8 – corneal lipid deposition 5 – PPM 5 – other cataract
2015	273 Adults 3 Litters	1 – distichiasis 7 – corneal lipid deposition 1 – nuclear cataract 6 – other cataract 1 – post segment coloboma 1 – multifocal retinal dysplasia (MRD) 2 – chorioretinopathy 1 – iris hypoplasia
2016	208 Adults 2 Litters	No comments
2017	233 Adults 1 Litter	5 – corneal lipid deposition 1 – PPM 1 – generalized progressive retinal atrophy (GPRA)-like appearance 34 – pectinate ligament dysplasia (PLD) grade 0 19 – PLD grade 1 10 – PLD grade 2
2018	166 Adults 1 Litter	1 – PPM 2 – persistent hyperplastic primary vitreous (PHPV)
2019	*Awaiting report*	
2020	*Awaiting report*	

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 4 below. Between 2015 and 2019, 6,381 Siberian Huskies were examined, of which 80.6% (5,141 of 6,381 dogs) were found to be unaffected by any eye condition. Conditions that affect over 1% of the examined population were included in Table 3.

Whilst it is important to note that these data represent dogs in America, the organisation tend to examine a higher number of dogs than that in the UK, and therefore are a valuable source of information.

Table 4: ACVO examination results for the Siberian Husky, 1991 – 2019.

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n=36,428)	**2015-2019** (n=6,381)
Eyelids		
Distichiasis	1.0%	1.3%
Cornea		
Corneal dystrophy	2.7%	1.7%
Uvea		
Persistent pupillary membranes, iris to iris	2.4%	2.7%
Lens		
Cataract, unspecified	1.6%	0.0%
Cataract, suspect not inherited/significance unknown	1.8%	2.4%
Significant cataract (summary)	9.5%	6.7%

Adapted from: https://www.ofa.org/diseases/eye-certification/blue-book

REPORTED CAESAREAN SECTIONS

When breeders register a litter of puppies, they are asked to indicate whether the litter was delivered (in whole or in part) by caesarean section. In addition, veterinary surgeons are asked to report caesarean sections they perform on Kennel Club registered bitches. The consent of the Kennel Club registered dog owner releases the veterinary surgeon from the professional obligation to maintain confidentiality (vide the Kennel Club General Code of Ethics (2)).

There are some caveats to the associated data;

- It is doubtful that all caesarean sections are reported, so the number reported each year may not represent the true proportion of caesarean sections undertaken in each breed.
- These data do not indicate whether the caesarean sections were emergency or elective.
- In all breeds, there was an increase in the number of caesarean sections reported from 2012 onwards, as the Kennel Club publicised the procedure to vets.

The number of litters registered per year for the breed and the number and percentage of reported caesarean sections in the breed for the past 10 years are shown in Table 5.

Table 5: Number of Siberian Husky litters registered per year, and number and percentage of caesarean sections reported per year, 2009 to 2019.

Year	Number of Litters Registered	Number of C-sections	Percentage of C-sections	*Percentage of C-sections out of all KC registered litters (all breeds)*
2009	419	2	0.48%	0.15%
2010	373	0	0.00%	0.35%
2011	360	2	0.56%	1.64%
2012	306	20	6.54%	8.69%
2013	234	13	5.56%	9.96%
2014	217	17	7.83%	10.63%
2015	167	16	9.58%	11.68%
2016	142	15	10.56%	13.89%
2017	121	6	4.96%	15.00%
2018	102	15	14.71%	17.21%
2019	74	6	8.11%	15.70%

GENETIC DIVERSITY MEASURES

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the 'gene pool' of the breed. In the population analysis undertaken by the Kennel Club in 2020, an estimated effective population size of **N/A** was reported (estimated using the rate of inbreeding over the period 1990-2019).

Where the rate of inbreeding is negative the effective population size is denoted 'N/A'. This indicates that at this time, the effective population size for the Siberian Husky is increasing.

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated 'random mating') over the period 1990-2019 are shown in Figure 6. Since 2017, the observed inbreeding coefficient trend has decreased, implying breeders have been carefully selecting mates to restore the diversity in the breed. The blurring of the expected inbreeding is due to a limited amount of information, with the true value expected to be within this range.

It should be noted that, while animals imported from overseas may appear completely unrelated, this is not always the case. Often the pedigree available to the

Kennel Club is limited in the number of generations, hampering the ability to detect true, albeit distant, relationships.

For full interpretation see Lewis et al, 2015 https://cgejournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4.

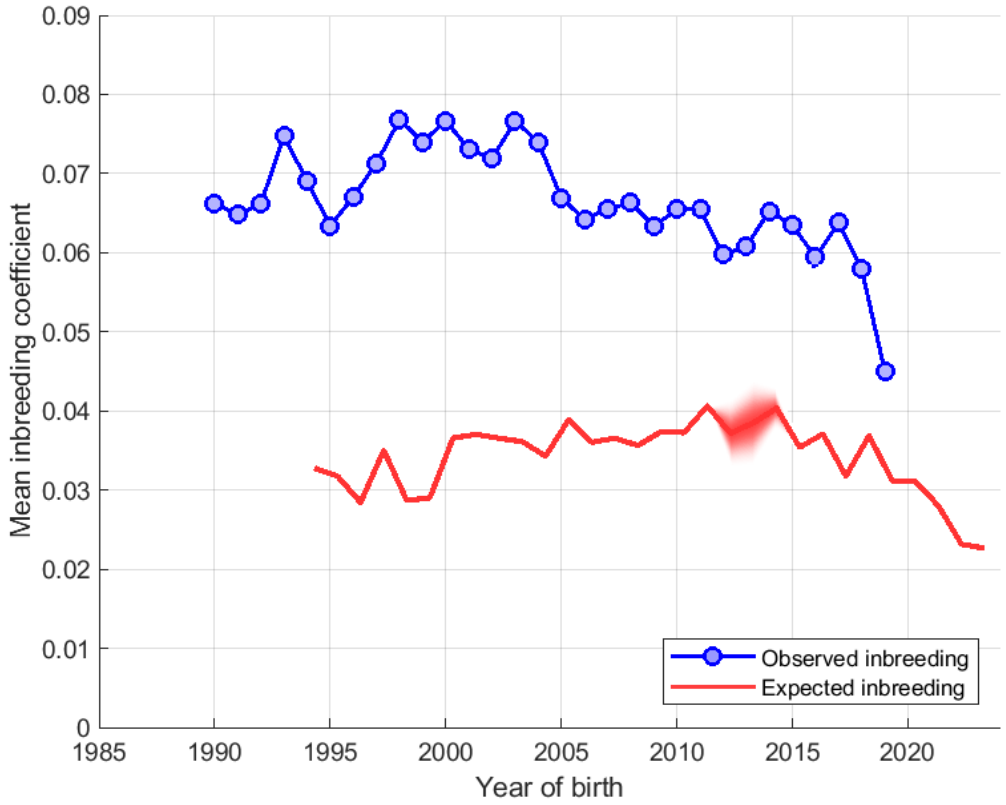

Figure 6: Annual mean observed and expected inbreeding coefficients.

The current breed average inbreeding coefficient for the Siberian Husky is **4.5%**

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of six 5-year blocks (Figure 7). A longer 'tail' on the distribution of progeny per sire is indicative of 'popular sires' (few sires with a very large number of offspring, known to be a major contributor to a high rate of inbreeding). Throughout the period analysed, there is evidence of several popular sires being used in the breed, particularly more recently, with one sire responsible for 5.3% of progeny registered between 2015 and 2019. This is expected given the fall in the breed's numbers, however should be monitored to prevent a rapid rise in loss of genetic diversity.

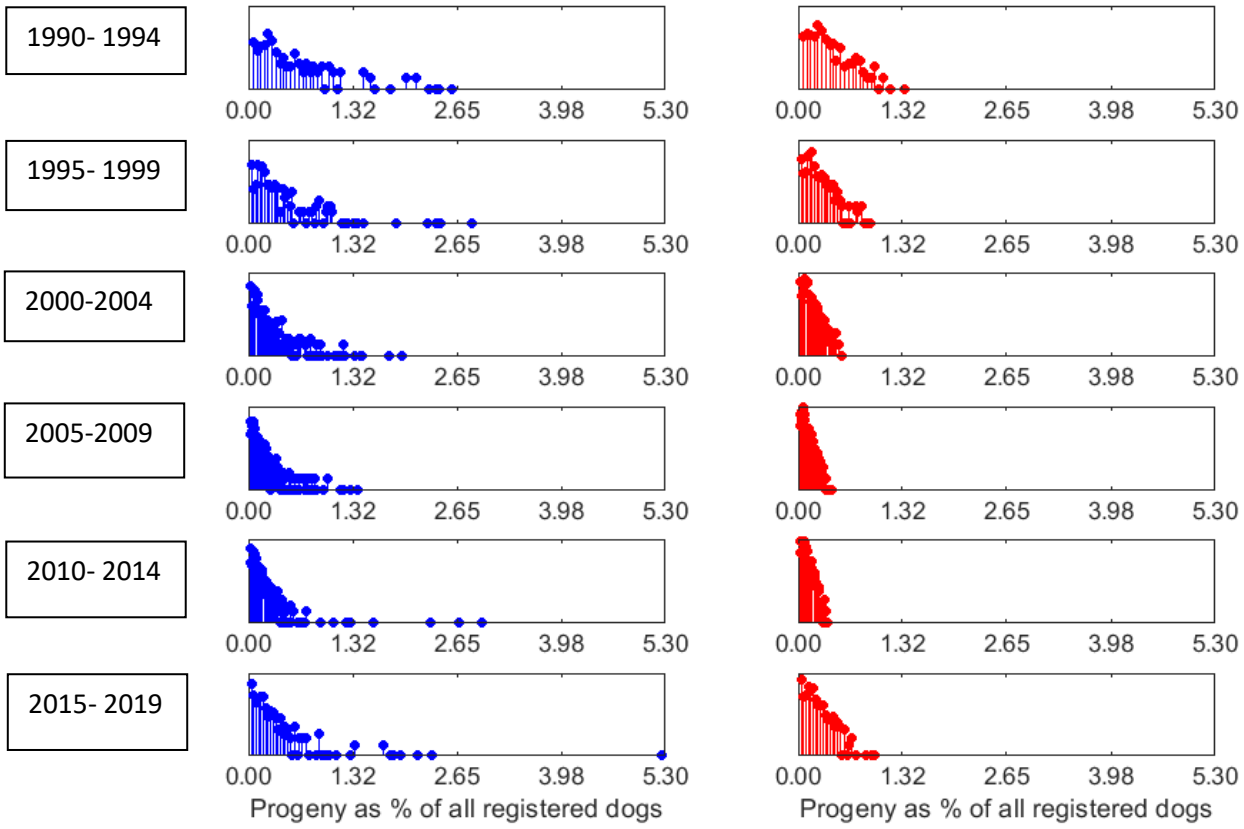

Figure 7: Distribution of the proportion of progeny per sire (blue) and per dam (red) over 5-year blocks (1990-5 top, 2015-19 bottom). Vertical axis is a logarithmic scale.

CURRENT RESEARCH

The breed are not involved in any active research at this time.

PRIORITIES

Correspondence between the breed representatives and the Kennel Club was undertaken in May 2021 to discuss the evidence base of the BHCP and agree the priority issues for the health of the breed. The group agreed from the evidence base that the priorities for the Siberian Husky were:

1. Glaucoma
2. Hereditary Cataract

ACTION PLAN

Following the correspondence between the Kennel Club and the breed regarding the evidence base of the Breed Health & Conservation Plans, the following actions were agreed to improve the health of the Siberian Husky. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Clubs to continue to encourage hip scoring for all breeding stock
- The Breed Clubs to continue to encourage eye screening (including gonioscopy) for all breeding stock
- The Breed Clubs to undertake a breed health survey, with the Kennel Club to assist in development and dissemination
- The Breed Clubs to continue to monitor the use of popular sires and raise awareness of the importance of considering genetic diversity when breeding

Kennel Club actions include:

- The Kennel Club to assist with the development and dissemination of a breed health survey
- The Kennel Club to produce a piece on the importance of considering genetic diversity and popular sires when breeding, specifically for numerically small breeds
- The Kennel Club to provide analysis for UK insurance data for the breed

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