



THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Swedish Vallhund Evidence Base

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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 Swedish Vallhunds registered by year of birth between 1980 and 2019 are shown in Figure 1. The trend of registrations over year of birth (1980-2019) was -0.48 per year (with a 95% confidence interval of -1.03 to +0.06) reflecting the fluctuation in the breed's numbers during this period. The breed is numerically small, with the majority of years seeing no more than 60 dogs registered, with numbers appearing to have peaked in 1993.

[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.]

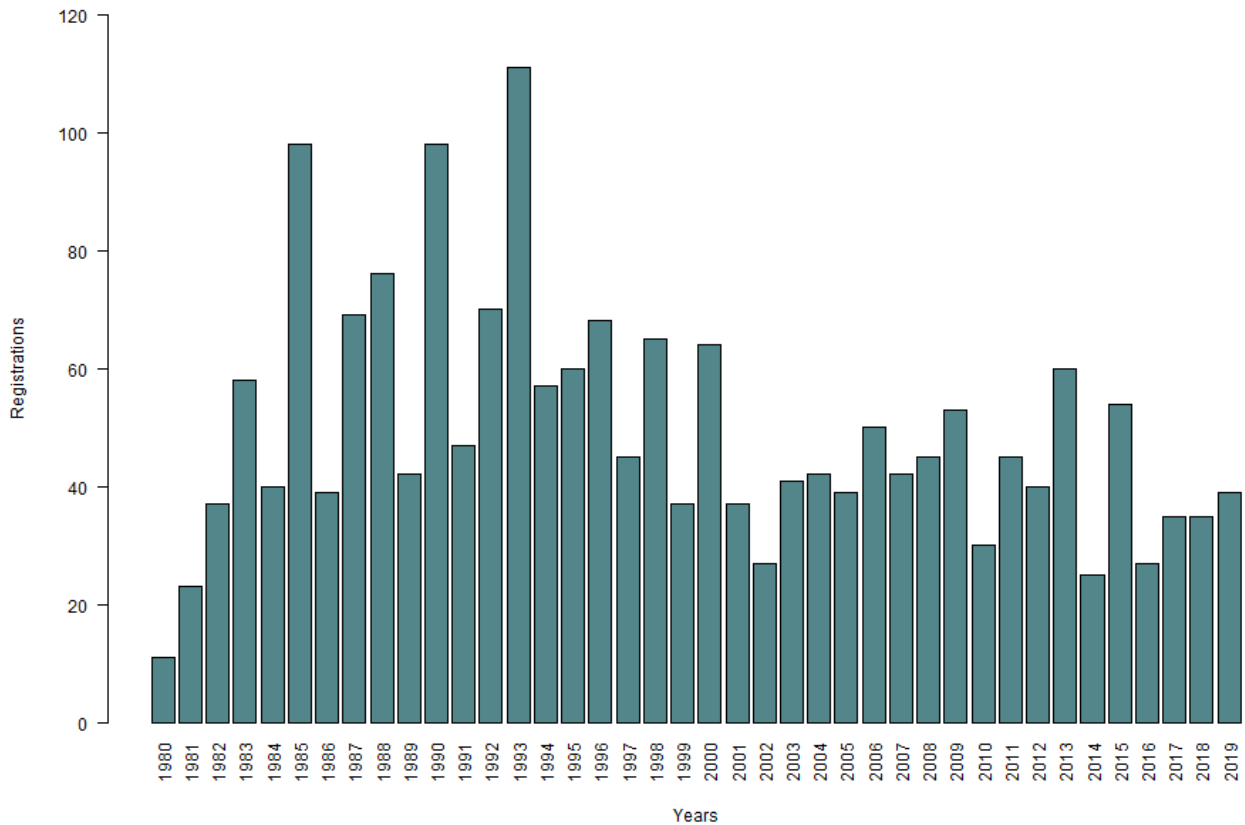


Figure 1: Number of registrations of Swedish Vallhund per year of birth, 1980 – 2019

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 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. Retinopathy
2. Hip dysplasia

In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, the breed aims to have every dog DNA tested for retinopathy and to only use tested dogs for breeding. Regular eye tests on breeding stock and all breeding stock to be hip scored.

BREED CLUB HEALTH ACTIVITIES

The Swedish Vallhund has a health committee, a Breed Health Coordinator (BHC) and a section of the breed club's website dedicated to health (see below).

<http://www.swedishvallhunds.co.uk/index.asp?pageid=399704>

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Purebred and Pedigree Dog Health Surveys 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 49 live Swedish Vallhunds of which 36 (73%) were healthy and 13 (27%) had at least one reported health condition. The top categories of diagnosis were reproductive (21.7%, 5 of 23 reported conditions), musculoskeletal (17.4%, 4 of 23 reported conditions), gastrointestinal (13.0%, 3 of 23 reported conditions), immune mediated (13.0%, 3 of 23 reported conditions), and unknown (8.7%, 2 of 23 reported conditions). The most frequently reported specific conditions were arthritis of the hips (2 reports), unknown (2 reports) and foreign body obstruction (2 reports).

2004 Mortality results: A total of 17 deaths were reported for the Swedish Vallhund. The median age at death was 14 years and 2 months (min = 4 years, max = 18 years and 10 months). The most frequently reported causes of death by organ system or category were old age (41.2%, 7 of 17), cancer (35.3%, 6 of 17), neurologic (11.8%, 2 of 17), cardiac (5.9%, 1 of 17), and other (5.9%, 1 of 17). The most common specific causes of death were old age (4 deaths), heart failure (2 deaths), seizures/ fits (2 deaths), and liver cancer (2 deaths).

2014 Morbidity results: Health information was collected for 18 live Swedish Vallhunds of which 12 (66.67%) had no reported conditions and 6 (33.33%) were reported to be affected by at least one condition. The most frequently reported conditions were hypersensitivity (allergic) skin disorder (11.1% prevalence, 2 cases), otitis media (11.1% prevalence, 2 cases), and one each for the following: aural (ear) haematoma, hepatic (liver) tumour/ cancer, mammary cancer/ tumour.

2014 Mortality results: A total of just four deaths were reported for the breed. The range of age at death for Swedish Vallhund was 9 years to 17 years. The most causes of death were cancer – unspecified (2 deaths), neurological condition – unspecified (1 death) and old age (1 death).

Swedish Vallhund Society Longevity Survey 2017

The Swedish Vallhund Society launched a survey in 2017 to monitor the longevity in the breed. A summary is provided below, with the full report available at: <https://s3-eu-west-1.amazonaws.com/s3.spanglefish.com/s/22858/documents/longevity-report-2017.pdf>

A total of 42 deaths were reported, with a range of age at death for the Swedish Vallhund being 2 years to 18 years. The median age at death to the closest year was 14 years (Figure 2).

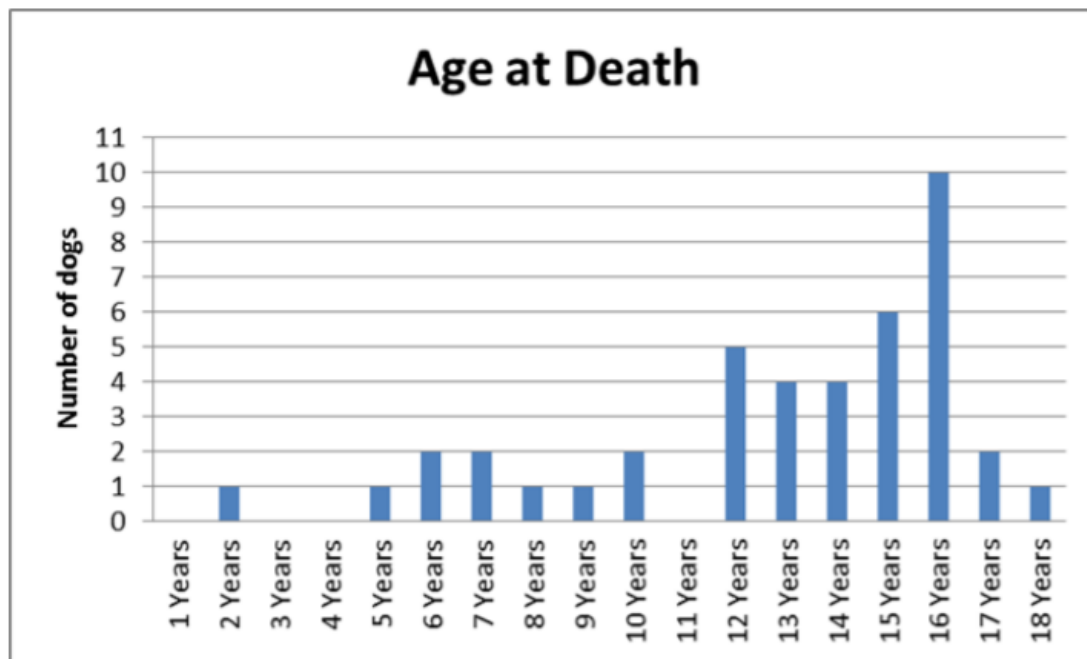


Figure 2: Age of deaths for Swedish Vallhunds reported for as part of the Swedish Vallhund Society 2017 health survey.

The most frequently reported causes of death by organ system or category were old age (47.61%, 20 of 42), cancer/ tumour (14.28%, 6 of 42), epilepsy/ fits (9.52%, 4 of 42), accident (7.14%, 3 of 42), kidney disease/ failure (4.76%, 2 of 42) (Figure 3).

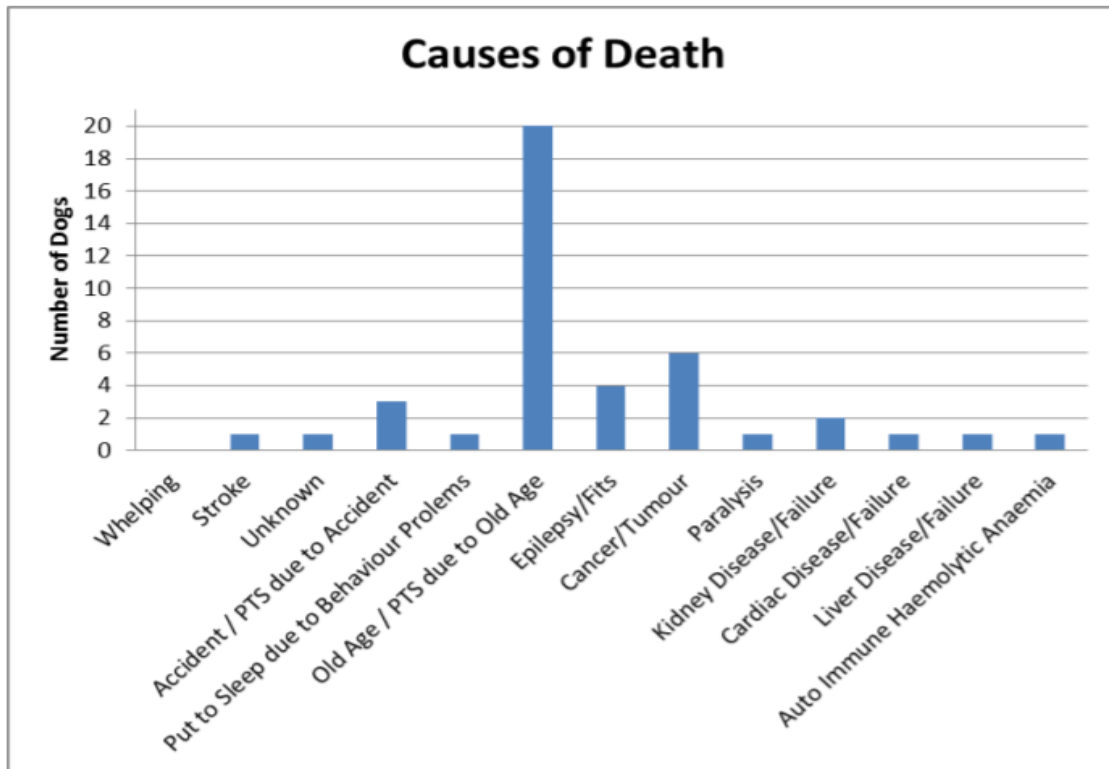


Figure 3: Causes of deaths for Swedish Vallhunds reported for as part of the Swedish Vallhund Society 2017 health survey.

Swedish Vallhund Society Health Survey 2017

Health information was collected for 45 live Swedish Vallhunds of which 35 (77.8%) had no reported conditions and 10 (22.2%) were reported to be affected by at least one condition. A summary is provided below, with the full report available at:

<https://s3-eu-west-1.amazonaws.com/s3.spanglefish.com/s/22858/documents/health-survey-report-2018.pdf>

The most frequently reported conditions were anal gland problems (13.63% prevalence, 3 cases of 22) with the following conditions being reported in equal amounts, allergies (2 cases), cruciate ligament issues (2 cases), dental disease (2 cases), missing teeth (2 cases), and retinopathy (2 cases) (Figure 4).

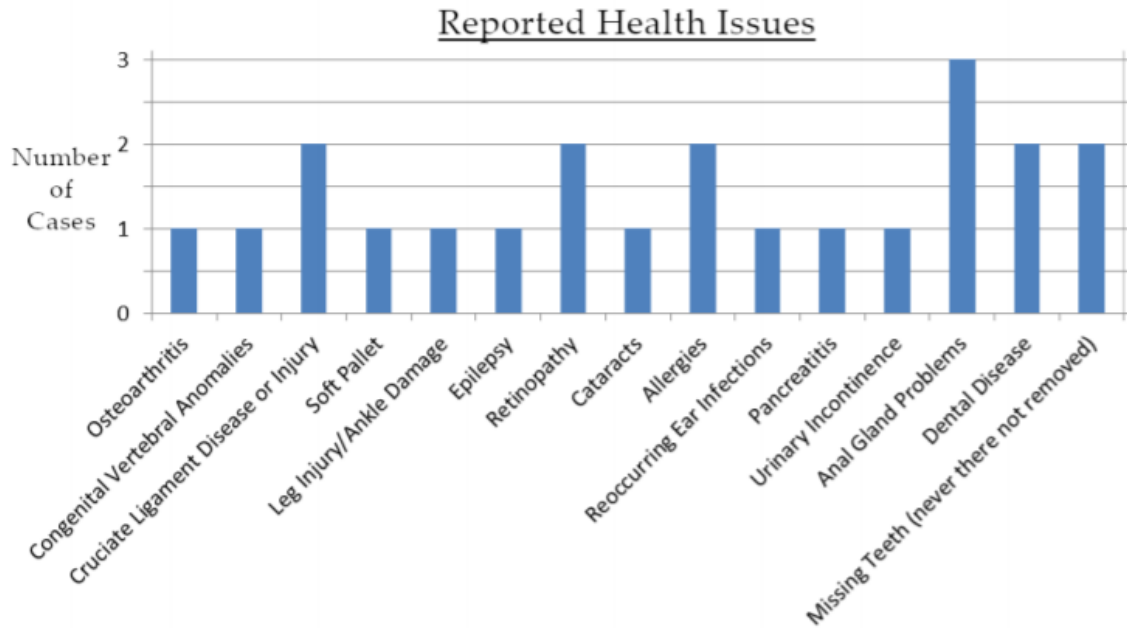


Figure 4: Reported health conditions for Swedish Vallhunds reported for as part of the Swedish Vallhund Society 2017 health survey.

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.

Congenital conditions

Natural bobtail: Many breeds have a natural short tail variation where puppies are born with a variety of tail lengths from no tail up to almost full tail. A dominant gene previously identified in the T-box transcription factor *T* gene (C189G – genes that encode embryonic limb development) is responsible for short tails in the Pembroke Welsh Corgi (Haworth et al. 2001). A subsequent study tested various breeds for this gene and found 17 other breeds also have this gene, the Swedish Vallhund being one of them (Hytonen et al, 2009). All the tested dogs were found to be heterozygous (carriers) for the mutation. The authors also investigated short tail to short tail matings in Swedish Vallhunds and found a 29% reduction in litter size. The authors suggested this confirmed previous findings (Haworth et al, 2001; Indrebø et al, 2007) that the gene is embryonic and early postnatal lethal when homozygous, inducing developmental defects; but when heterozygous it does not cause these issues.

Genetic Diversity

A recent study investigated pedigree data for 12 traditional Swedish breeds from 1980 to 2012, to assess inbreeding and diversity in these breeds (Jansson & Laikre, 2018). For the Swedish Vallhund the study showed a loss in mean inbreeding coefficient over time, with this starting at 6.1% in 1980, rising to a peak in 2000 (9.7%), and then dropping slightly to 9.0% in 2006 and 8.9% in 2012.

The study also showed a loss in the proportion of founder alleles, beginning in 1980 at 67.5%, which decreased sharply to 38.6% in 1990, and continued to decline to 21.5% in 2012. This was a parallel trend to the proportional loss seen in the other 11 breeds analysed. Similarly, a decline in founder allelic variation was seen in the breed, with the number of founder genome equivalents in living animals being 8.83 in 1980. This figure dropped to 6.62 in 1990, then again to 5.57 in 2000, and continued at a slower rate to 5.44 in 2012.

For the Swedish Vallhund the study gave an average effective population size of 62.4, which is just above the critical point of 50, where the future of the breed would be considered to be at risk. The authors noted that the rate of inbreeding and loss of variation was unnecessarily extensive considering the size of the breed, however this study was based on pedigrees alone and genomic studies are also needed to confirm these trends.

Ocular conditions

Retinopathy: Between 2005 and 2011 a total of 324 Swedish Vallhunds from seven countries were clinically examined for a form of PRA with 113 showing clinical signs of retinopathy (Cooper et al 2014). This study determined that the retinopathy found in the Swedish Vallhund was a new form of PRA, with variation in the on age of onset and disease progression, even in related dogs. The authors felt that genetic and/or environmental disease modifiers may be responsible for this variation within clinically affected dogs and is most likely inherited in an autosomal recessive manner.

The study also characterized the progression on the disease and the authors propose three stages:

- Stage 1 – affected dogs show diffuse multifocal discoloration of the tapetal fundus with no clinical signs of vision loss (age range 1.9 months - 17.8 years).
- Stage 2 – retinal degeneration with multifocal, geographic thinning originating at the edges and spreading throughout the tapetal fundus, with the majority of dogs reported with no vision loss, although some dogs with advanced thinning were reported to experience mild to moderate night blindness (age range 1.1 - 12.6 years).
- Stage 3 –diffuse retinal thinning affecting most of the tapetal fundus. These dogs were reported with loss of night-vision and impaired day vision, with some having reporting total blindness (age range 9.2 to 15.4 years).

In 2014 a genome wide association analysis (GWAS) was performed on 18 retinopathy affected dogs and 10 healthy ones (Ahonen et al, 2014). Whilst no causal mutation gene was found the results showed an association with over-expression of *MERTK*.

Subsequently to this, a further study replicated these findings in a UK Swedish Vallhund population with a total of 24 dogs with retinopathy and 97 control dogs (Everson et al, 2017). Whole genome sequencing (WGS) of an affected Vallhund was also used with the aim to find a causal mutation. This similarly identified a mutation in *MERTK* which when compared to 49 dogs of other breeds was not found to be present in any of these dogs. Analysis established a strong statistical association with retinopathy, with this later replicated in the original Finnish study set. Combining both studies the mutation was found to have a ~20-fold increased risk in developing retinopathy and an odds ratio of 23.41 (95% CI 10.99 – 49.86). As such this was considered to be a strong candidate for a causative mutation, however the authors noted further research is needed to confirm this. A DNA test for this mutation was developed for the breed (page x).

INSURANCE DATA

There are some important limitations to consider for insurance data:

- Accuracy of diagnosis varies between disorders depending on the ease of clinical diagnosis, clinical acumen of the veterinarian and facilities available at the veterinary practice
- Younger animals tend to be overrepresented in the insured population
- Only clinical events that are not excluded and where the cost exceeds the deductible excess are included

However, insurance databases are too useful a resource to ignore as they fill certain gaps left by other types of research; in particular they can highlight common, expensive and severe conditions, especially in breeds of small population sizes, that may not be evident from teaching hospital caseloads.

Swedish Agria Data

Swedish morbidity and mortality insurance data was also available from Agria for the Swedish Vallhund. Reported rates are based on dog-years-at-risk (DYAR) which take into account the actual time each dog was insured during the period (2011-2016). The number of DYAR for Swedish Vallhunds in Sweden during this period was 5,000<10,000.

The full Swedish insurance results are available through <https://dogwellnet.com/>, but key findings are reported below.

Swedish Agria insurance morbidity data

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Swedish Vallhunds in Sweden between 2011 and 2016 are shown in Figure 5. The top five specific causes of VCEs were vomiting/ diarrhoea/ gastroenteritis, clinical signs of pain during locomotion, polyuria/ polydipsia (excessive urination/ thirst), teeth disorder and liver – unspecified/ various.

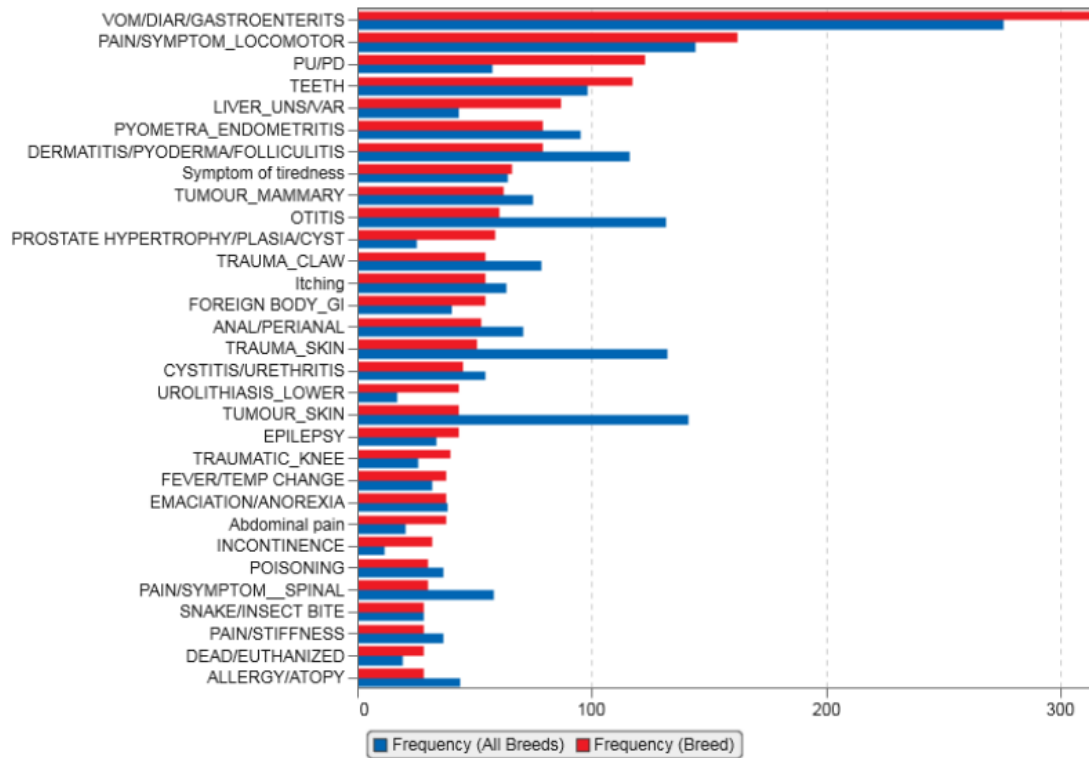


Figure 5: The most common specific causes of VCEs for the Swedish Vallhund compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

The specific causes of VCEs ordered by relative risk are shown in Figure 6 for the Swedish Vallhunds. In this analysis, the top five specific causes of VCEs ordered by relative risk were degeneration/ dystrophy of the knee, traumatic hernia, Cushing's disease, infection/ inflammation of the liver and incontinence. Rare conditions that occur sporadically may appear as a high relative risk; which may apply to some of these conditions.

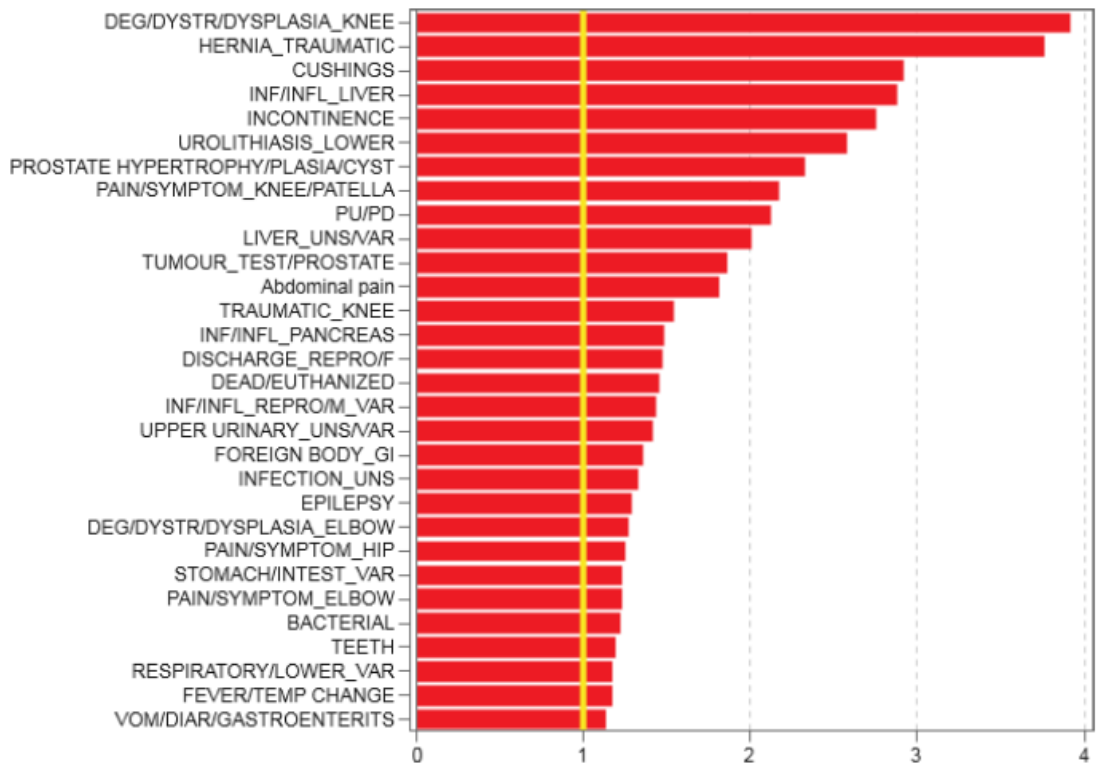


Figure 6: The specific causes of VCEs for the Swedish Vallhund ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

BREED WATCH

The Swedish Vallhund is a category one breed, meaning judges are not required to complete mandatory monitoring forms following an appointment as championship certificate level. To date no optional reports have been received for the breed.

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. Two reports have been received for the breed in the past five years (excluding neutering or caesarean sections) with both being for the removal of teeth/tooth.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme there are the following requirements for the Swedish Vallhund:

- BVA/KC Hip Dysplasia Scheme
- Eye testing

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

- DNA test - retinopathy

BREED CLUB BREEDING RECOMMENDATIONS

There are not currently any Breed Club breeding recommendations listed on the Kennel Club's website for the breed.

DNA TEST RESULTS

There is currently one recognised DNA test for this breed, which are:

- DNA test for retinopathy

The test was formally recognised by the Kennel Club in March 2017, with results published for this test from this point onwards. Whilst other DNA tests may be available for the breed, results from these will not be published 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.

Laboratories that test for these DNA tests and the methods through which the Kennel Club accept results can be found through:

<https://www.thekennelclub.org.uk/worldwide-dna-tests/>

As a note, as of January 2022 hereditarily clear status will no longer apply after two generations and dogs will need to be retested to confirm the status of that individual. This is to prevent the possibility of misclassification of status and therefore unintentional breeding of affected puppies. Where parentage is confirmed by DNA profile, the major contributor to erroneous status will be removed. Therefore, a less stringent restriction for HC status is applied where parentage is confirmed by DNA test.

Table 1: DNA test results for Swedish Vallhunds tested for Retinopathy to date (July 2020)

Clear	Carrier	Affected	Hereditarily Clear	Hereditarily Carrier	Hereditarily Affected	Total Tested
44 (19.7%)	96 (41.2%)	23 (9.9%)	23 (9.9%)	43 (18.5%)	4 (1.7%)	233

CANINE HEALTH SCHEMES

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.

HIPS

In total 198 dogs of the breed have been hip scored since 2000, with the mean hip score for the breed being 9.7 as of 2019. The mean hip score for dogs of the breed between 2004 and 2019 are given in Figure 7 below, which shows a very slight decline in mean score during this time. However, it is important to note that the mean will fluctuate per year especially given the small numbers of dogs tested, for example the maximum tested per year was 24 dogs in 2007, and the minimum just six dogs in 2017.

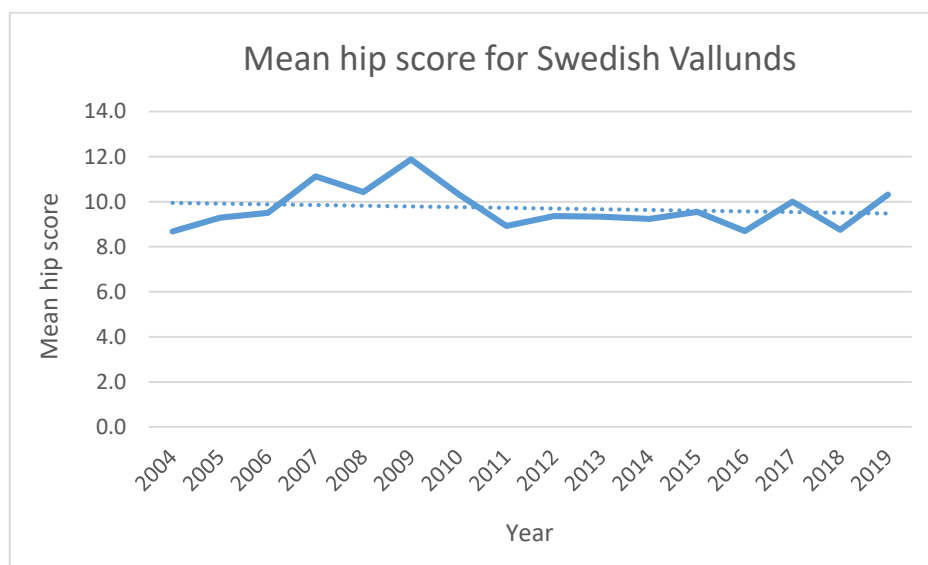


Figure 7: Mean hip scores for Swedish Vallhunds hip scored between 2000 and 2019.

The proportion of dogs registered per year with a known hip score also appears to be declining in the breed, with this being at just 6.6% in 2019 (Figure 8).

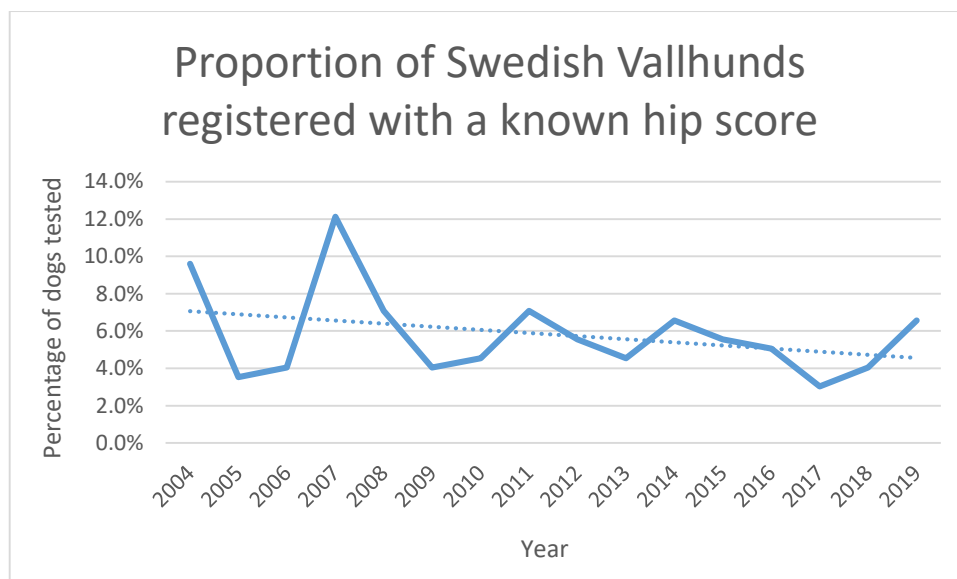


Figure 8: Proportion of Swedish Vallhunds with a known hip score between 2000 and 2019.

ELBOWS

Two Swedish Vallhunds have been elbow graded under the BVA/KC Elbow Dysplasia Scheme, one receiving a grade of 0 and the other receiving a grade of 1.

EYES

The Swedish Vallhund is currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for the following condition:

- Breed-specific retinopathy (BR)

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.

A total of 11 Swedish Vallhunds have been tested in the past 20 years, of which all were found to be unaffected by this condition.

Schedule B has been incorporated into an annual sightings reports, which records the results of conditions not listed on KIOD for dogs which have participated in the scheme. Results of Swedish Vallhunds tested to date are shown in Table 2 below.

Table 2: Sightings reports for Swedish Vallhunds tested since 2012.

2012	20 adults	1 – PPM 1 – Retinopathy
2013	28 adults	3 – Other cataract 1 – Central PRA-like lesions 1 – Retinopathy
2014	6 adults	2 – Chorioretinopathy
2015	26 adults	6 – GPRA-like appearance
2016	15 adults	No comments
2017	7 adults	No comments
2018	15 adults	No comments
2019	<i>Awaiting report</i>	

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 3 below, for conditions affecting more than 1% of the examined population. Between 2015 and 2019, 422 Swedish Vallhunds were examined, of which 48.6% (205 of 422 dogs) were found to be unaffected by any eye condition.

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 3: ACVO examination results for Swedish Vallhund, 1991 - 2019

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n=1,279)	2015-2019 (n=422)
EYELIDS		
distichiasis	2.7%	0.9%
CORNEA		
corneal dystrophy	1.3%	1.7%
UVEA		
persistent pupillary membranes, iris to iris	16.9%	22.3%
persistent pupillary membranes, lens pigment foci/no strands	0.3%	1.7%
LENS		
Significant cataracts (summary)	6.2%	8.1%
VITREOUS		
vitreal degeneration	3.2%	2.6%
RETINA		
retinal dysplasia, folds	1.6%	1.2%
generalized progressive retinal atrophy (PRA)	3.4%	0.7%
retinopathy	2.7%	4.5%

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 4.

Table 4: Number and percentage of litters of Swedish Vallhund registered per year and number 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	5	0	0.00%	0.15%
2010	10	0	0.00%	0.35%
2011	6	0	0.00%	1.64%
2012	6	0	0.00%	8.69%
2013	11	3	27.27%	9.96%
2014	5	1	20.00%	10.63%
2015	6	0	0.00%	11.68%
2016	6	2	33.33%	13.89%
2017	8	2	25.00%	15.00%
2018	4	1	25.00%	17.21%
2019	4	0	0.00%	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 1980-2019). N/A implies a restoration of genetic diversity overall during this period. However, it is important to note that the Kennel Club database is limited to UK pedigrees and so alternative databases or research contradicting this estimation should be taken into account.

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated 'random mating') over the period 1980-2020 are shown in Figure 10. The observed inbreeding coefficient for the breed has gradually decreased following a peak in 1998, implying breeders have been carefully selecting mates and restoring the diversity in the breed. The current annual breed average inbreeding coefficient is ~4.5%.

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://cgjournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4>.

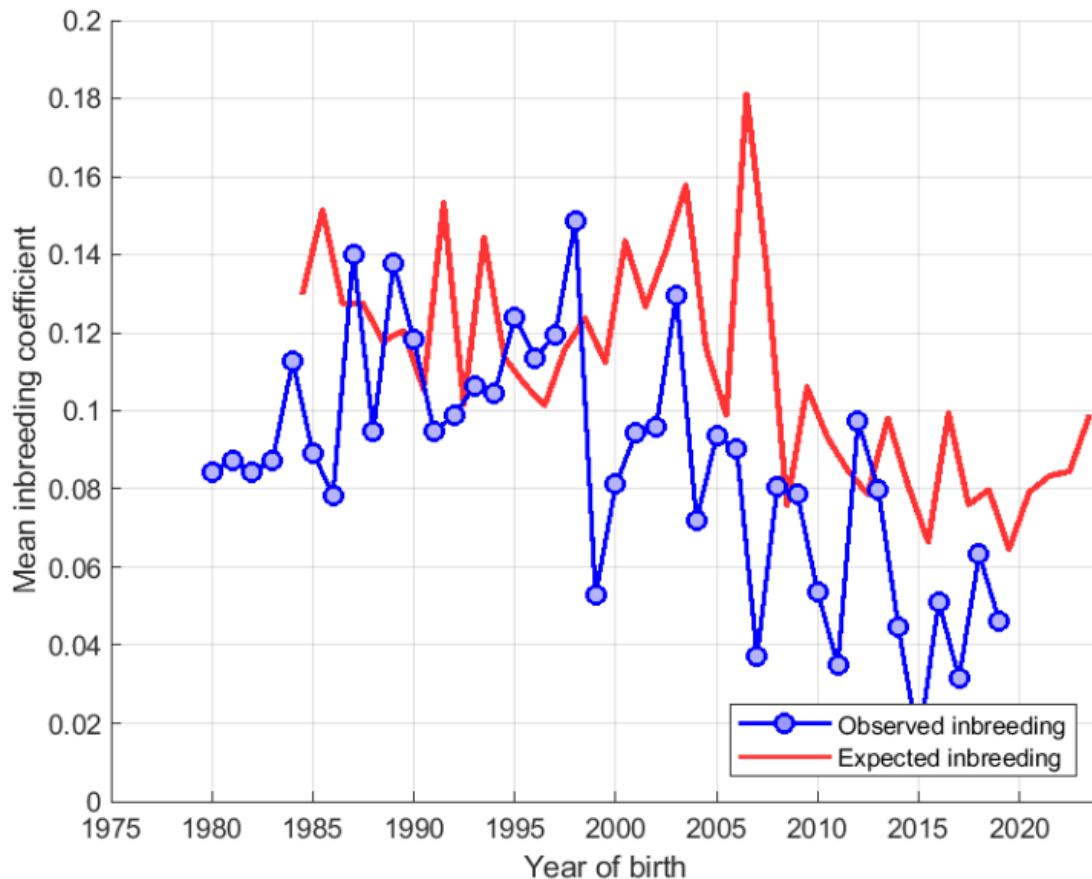


Figure 10: Annual mean observed and expected inbreeding coefficients

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven 5-year blocks (Figure 11). 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). There is evidence of several popular sires in the breed, with one dog responsible for almost 25% of puppies registered in the past five years. Continued use of such dogs, and their immediate relatives, will result in rapid loss of diversity from the breed.

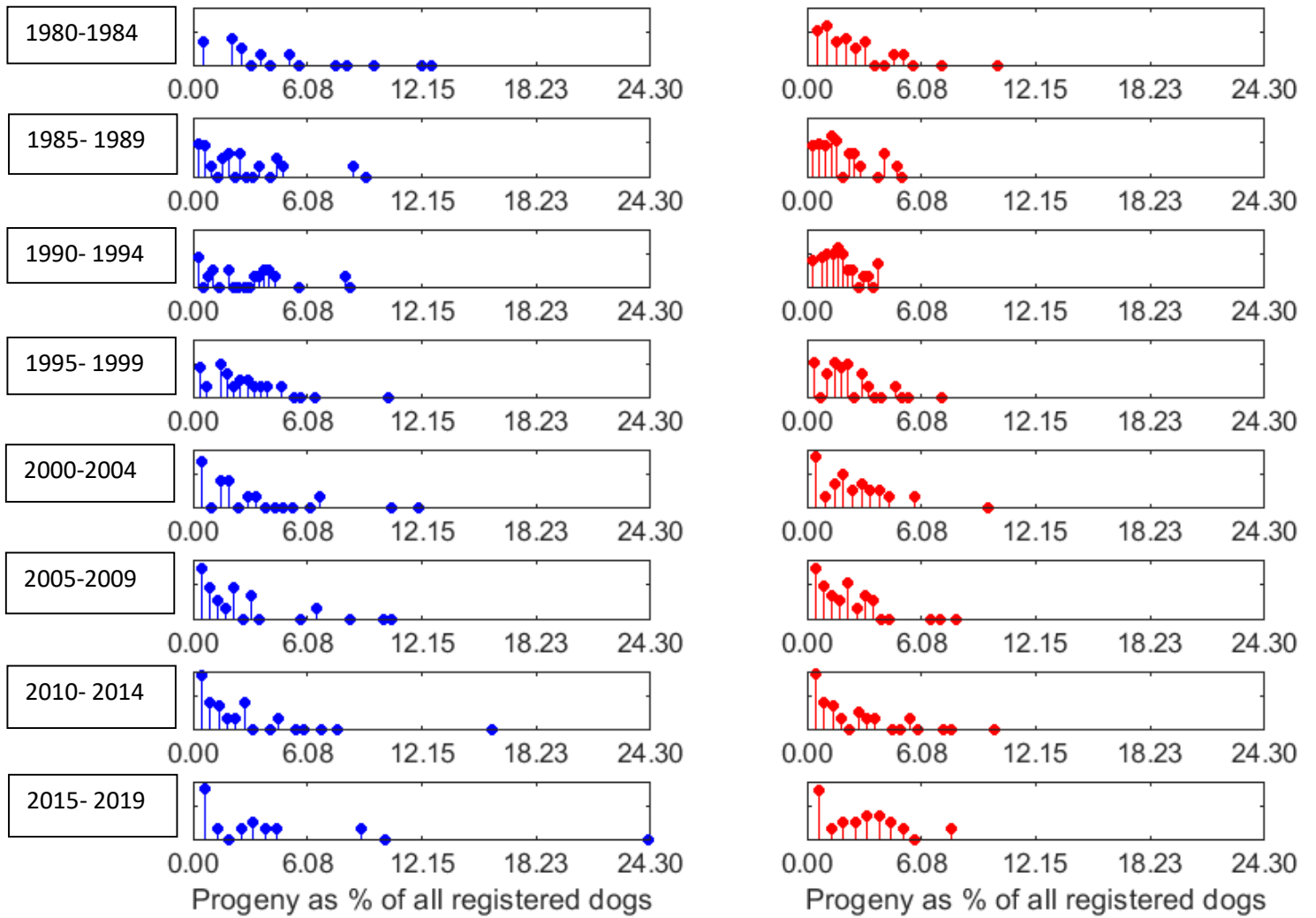


Figure 11: Distribution of the proportion of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2015-19 bottom). Vertical axis is a logarithmic scale

CURRENT RESEARCH

To date there are no current research projects that the breed are involved with.

PRIORITIES

Correspondence between the breed representatives and the Kennel Club was undertaken in July 2020 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 Swedish Vallhund were:

- Hips
- Retinopathy

At watch:

- Diversity
- Lack of detailed health information

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 Swedish Vallhund. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Club will continue to encourage its member breeders to hip score.
- The Breed Club will continue to encourage its members to eye test and DNA test, and will propose at the next AGM changing the eye exam from advised to mandatory.
- The Breed Clubs to encourage any owners of dogs who are DNA clear/ carrier and have been diagnosed as having retinopathy to take part in any ongoing research into the condition.
- The Breed Club to put additional information regarding genetic diversity on its website.
- The Breed Club to design and run a new survey in 2020/ 2021.

Kennel Club actions include:

- The Kennel Club to assist in disseminating the health survey to owners.
- The Kennel Club to provide mutation frequency analysis for the breed with regard to retinopathy.

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