



THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Wire Fox Terrier Evidence Base

CONTENTS

| | |
|--|----|
| INTRODUCTION..... | 3 |
| DEMOGRAPHICS | 3 |
| BREED HEALTH CO-ORDINATOR ANNUAL HEALTH REPORT | 4 |
| BREED CLUB HEALTH ACTIVITES | 5 |
| BREED SPECIFIC HEALTH SURVEYS | 5 |
| LITERATURE REVIEW | 17 |
| INSURANCE DATA..... | 18 |
| PERMISSION TO SHOW | 22 |
| ASSURED BREEDER SCHEME | 22 |
| BREED CLUB BREEDING RECOMMENDATIONS | 22 |
| DNA TEST RESULTS..... | 22 |
| CANINE HEALTH SCHEMES | 23 |
| REPORTED CAESAREAN SECTIONS | 24 |
| GENETIC DIVERSITY MEASURES..... | 25 |
| CURRENT RESEARCH | 27 |
| PRIORITIES..... | 28 |
| ACTION PLAN | 29 |
| REFERENCES | 30 |
| APPENDIX A | 31 |
| APPENDIX B | 37 |



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 Wire Fox Terriers 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 +0.18 per year (with a 95% confidence interval of -3.74 to +4.09) reflecting no significant change in the breed's numbers over this time. As seen in Figure 1, the breed's numbers have remained relatively stable, with these being at approximately 700 dogs registered per year, although these have reduced in the past couple of years.

[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.]

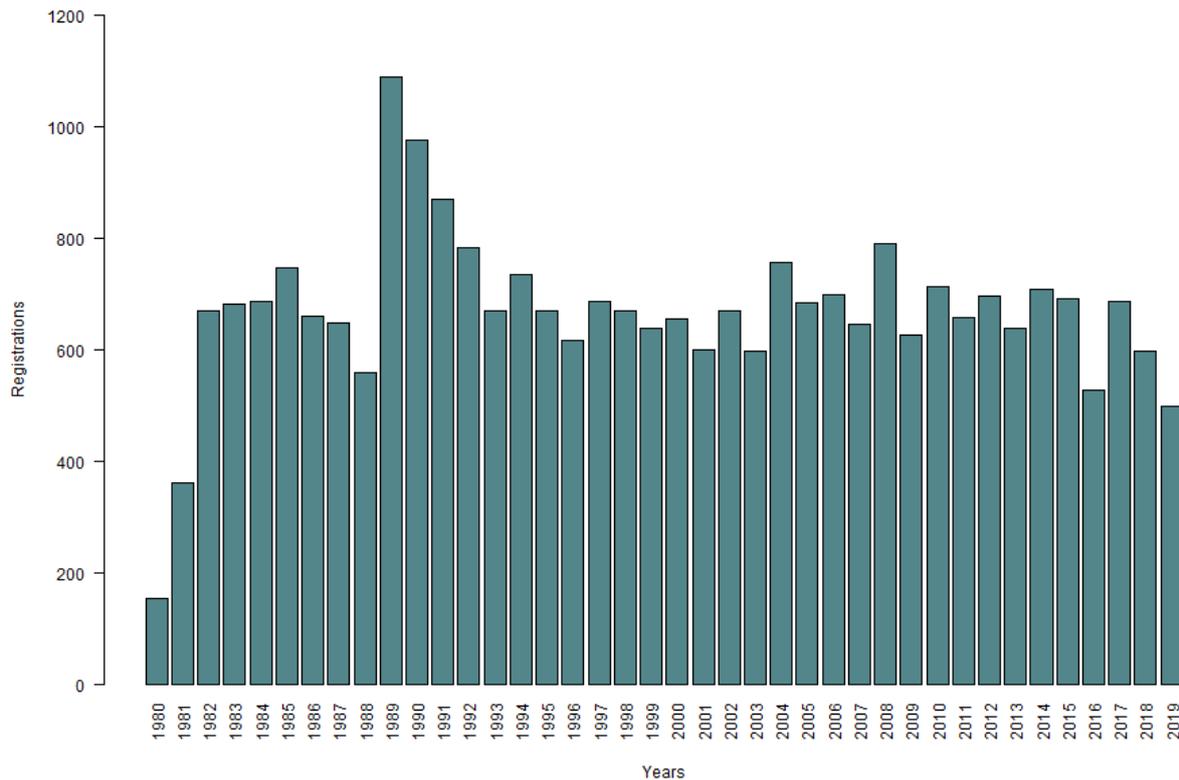


Figure 1: Number of registrations of Wire Fox Terriers per year of birth, 1980 – 2019

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.

No breed health survey was completed in 2018/2019. However, the following conditions are considered by the BHC to be the most important health and welfare issues in Wire Fox Terriers in 2018/2019:

1. Van Den Ende-Gupta Syndrome (VDEGS)
2. Allergic Skin Disease

To help tackle these health and welfare issues the BHC has written the following articles:

- 2018 Wire Fox Terrier Association (WFTA) yearbook article 'The Itchy Dog'. (*appendix A*)
- 2019 WFTA yearbook article 'Wire Fox Terrier Genetic Tests'. (*appendix B*)

(Articles are provided at the end of this document as *appendix A & B*)

Additionally, DNA samples have been provided to the Animal Health Trust for their lab to develop a test for VDEGS.

BREED CLUB HEALTH ACTIVITIES

The Wire Fox Terrier has an active Breed Health Coordinator (BHC) Dr David Hughes MRCVS and a dedicated breed health website page which can be found at: <https://www.wirefoxterrierassociation.co.uk/health>

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Purebred and Pedigree Dog Health Surveys Results 2004 and 2014

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. It is worth noting that the Smooth and Wire Fox Terriers were combined for the 2004 survey and so caution should be taken when interpreting the results; the 2014 however is specific to the Wire Fox Terrier.

2004 Morbidity results: Health information was collected for 115 live Fox Terriers (both breeds) of which 77 (67%) were healthy and 38 (33%) had at least one reported health condition.

The top categories of diagnosis were:

1. **DERMATOLOGIC** (13.2%, 7 of 53 reported conditions)
2. **MUSCULOSKELETAL** (11.3%, 6 of 53 reported conditions)
3. **NEUROLOGIC** (11.3%, 6 of 53 reported conditions)
4. **UROLOGIC** (11.3%, 6 of 53 reported conditions)

The most common specific conditions were undiagnosed skin irritation/ itchy skin (5 reports), seizures/ idiopathic epilepsy (4 cases), bladder infection/ cystitis (3 cases), allergy – unspecified (3 cases), and physical blockage/ stuck puppy during whelping (3 cases).

2004 Mortality results: A total of 44 deaths were reported for Fox Terriers (both breeds). The median age at death was 13 years and 2 months (min = 10 months, max = 17 years 3 months).

The most frequently reported causes of death by organ system or category were:

1. **OLD AGE** (31.8%, 14 of 44 reported deaths)
2. **CANCER** (22.7%, 10 of 44 reported deaths)
3. **TRAUMA** (11.4%, 5 of 44 reported deaths)
4. **CARDIAC** (6.8%, 3 of 44 reported deaths)
5. **UROLOGIC** (6.8%, 3 of 44 reported deaths)

2014 Morbidity results: Health information was collected for 139 live Wire Fox Terriers of which 94 (67.6%) had no reported conditions and 45 (48.2%) were reported to be affected by at least one condition.

The most frequently reported conditions were:

1. **HYPERSENSITIVITY (ALLERGIC) SKIN DISORDER** (8.63% prevalence, 12 cases)
2. **LIPOMA** (5.76% prevalence, 8 cases)
3. **CHRONIC ITCHING** (4.32% prevalence, 6 cases)
4. **OTITIS EXTERNA** (4.32% prevalence, 6 cases)
5. **SKIN (CUTANEOUS) CYST** (4.32% prevalence, 6 cases)
6. **UNSPECIFIED SKIN, EAR OR COAT** (4.32% prevalence, 6 cases)

2014 Mortality results: A total of 19 deaths were reported for the Wire Fox Terriers. The range of age at death for the breed was 0 years to 21 years.

The most frequently reported causes of death by organ system or category were:

1. **OLD AGE** (5 deaths)
2. **BRAIN TUMOUR** (2 deaths)
3. **PANCREATITIS** (2 deaths)
4. **STROKE** (2 deaths)
5. **UNKNOWN** (2 deaths)

Breed-Specific Health Survey Report 2020

During 2020 a breed health survey was launched for Wire Fox Terriers (WFTs). The main aim of this survey was to gain a good overall view of the current health status of the breed. The survey gained support from all around the world with a total of 1,070 WFTs included within the survey. This report has been developed by the Breed Health Co-ordinator.

A brief summary of how many health reports were submitted by country/region is shown in the table below:

| Country/Region | Number of WFT health reports submitted |
|---|--|
| Countries with >10 Health Reports Submitted | |
| <i>UK</i> | 814 |
| <i>USA</i> | 125 |
| <i>Canada</i> | 30 |
| <i>South Africa</i> | 18 |
| <i>Republic of Ireland</i> | 13 |
| Other Regions Not Separately Listed | |
| <i>Europe</i> | 46 |
| <i>Rest of the world</i> | 24 |
| TOTAL RESPONSES | 1070 |

The health survey was completed for **944 live** and **126 deceased WFTs**. From the deceased WFTs, an **average age of death/euthanasia** was calculated as **11.3 years** (with an age range from 2 – 18 years of age). This average age estimate is lower than most figures quoted on the internet for WFTs. This may be a true finding; however, it is also possible this finding may be due to a reporting bias, with those individuals with dogs that died of significant health complications perhaps over-represented within a health survey. Overall, 51.8% of WFTs in the survey were male and 48.2% female.

Causes of death/euthanasia

The top causes of death/euthanasia reported by owners are shown in the table below:

| Top 3 causes of death given for WFTs <u>OVER</u> 11.3 years old (63 dogs) | Percentage (%) of WFT deaths reported due to given condition |
|---|--|
| Tumour/cancer | 28.6 <i>(no specific tumour type/location appeared more common)</i> |
| Old age | 22.2 |
| Degenerative myelopathy (DM) | 12.7 |

| Top 3 causes of death given for WFTs <u>UNDER</u> 11.3 years old (63 dogs) | Percentage (%) of WFT deaths reported due to given condition |
|--|--|
| Tumour/cancer | 49.2 <i>(most frequently reported tumour location was bladder – 6/31)</i> |
| Degenerative myelopathy (DM) | 11.1 |
| Kidney failure | 7.9 |

Tumours/cancer was reported as the leading cause of death/euthanasia for WFTs both above and below the calculated average lifespan calculated from this data set. There were a large number of different locations of tumours given. The only tumour which was reported with a higher frequency than any other was bladder tumours in the dogs under 11.3 years of age. WFTs may be particularly predisposed to tumours/cancer and in the breed may be at particular risk of bladder tumours. However, it is very difficult to draw breed specific conclusions from this with the absence of a database to compare these results to other breeds.

It seems concerning to note the number of dogs with DM as a reported cause of death/euthanasia. There is a genetic test available for DM, however, existing evidence suggests the majority of WFTs carry two copies of the ‘at-risk’ sequence for DM, resulting in difficulties in developing practical breeding strategies to reduce the frequency of the gene with this sequence. Further research is needed on the development of DM to better understand why only some dogs with the at-risk sequence go on to develop DM and what can be done to reduce the prevalence of DM within WFTs.

Vaccination

Responses to “Has the dog been vaccinated annually?” gave the following results:

| | |
|-----------------|-------|
| Yes | 89.2% |
| No | 10.4% |
| Not Sure | 0.4% |

The phrasing of this particular question was a little challenging to get the most meaningful response. The vast majority of dogs included in this survey have been vaccinated annually. Of the dogs not vaccinated annually most are (or have been) vaccinated but not always as frequently as annually. Responses from this question highlighted some interesting points for discussion. It’s well beyond the scope of this health report to critically evaluate all of the pros and cons of vaccinations but some relevant points are mentioned.

Reasons given for NOT vaccinating annually included:

- Only vaccinate puppies
- Stopped vaccinating senior dogs
- Dogs only vaccinated every 2 or 3 years (annual vaccinations not required)
- Unable to vaccinate dog in 2020 due to COVID-19 restrictions
- Dog(s) are titre tested and then only vaccinated if antibody levels are low
- Dog has autoimmune disorder and so opted to avoid further vaccinations
- Dog(s) not leaving home, so owner considered risk of contracting disease low/negligible

It must be noted that for some countries annual vaccinations are not indicated. Protocols for various countries/regions will not be discussed. Additionally, it is not the purpose of this report to be making specific recommendations on which dogs should be vaccinated and how frequently this should be done. If owners have questions regarding vaccinations, then speaking with your own vet is strongly advised. Dave Hughes (BHC and Veterinary Surgeon) is also happy to discuss more specific advice for individual circumstances.

In the UK there appears to be some misunderstanding regarding vaccinations (highlighted through this survey). Some stated that annual vaccinations are not required or indicated. This is true for parvovirus, distemper and hepatitis (with vaccinations for these diseases now being recommended every 3 years). However, this is not the case for leptospirosis or kennel cough. Leptospirosis vaccinations are still recommended annually and are considered a ‘core vaccination’ in the UK. *In some other countries leptospirosis is not considered a core vaccination.* Kennel cough is not considered a core vaccination in the UK but may still be indicated depending on individual circumstances.

Some WFT owners are now opting to titre test their dogs (for parvovirus, distemper and hepatitis) and only vaccinate when antibody levels fall below a given threshold. For the owners opting to titre test it is important to realise there is no such test available for leptospirosis or kennel cough. This is because antibodies play little part in the immune response against these particular diseases.

For those interested in more detailed vaccination information, the ‘World Small Animal Veterinary Association’ have produced a very comprehensive guide which can be found online at the following web address: <https://wsava.org/wp-content/uploads/2020/01/WSAVA-Vaccination-Guidelines-2015.pdf>

Neutering

Responses to “Is your dog spayed/neutered?” gave the following results:

| | |
|-----------------|-------|
| Yes | 67.6% |
| No | 32.2% |
| Not Sure | 0.2% |

The vast majority of dogs (67.6%) included in this survey were spayed.

Reasons given for spaying/neutering:

- Prevention of unwanted pregnancy
- Following veterinary advice
- Health reasons (preventative and as treatment)
- Prevent unwanted behaviours

Relevant points regarding spaying/neutering

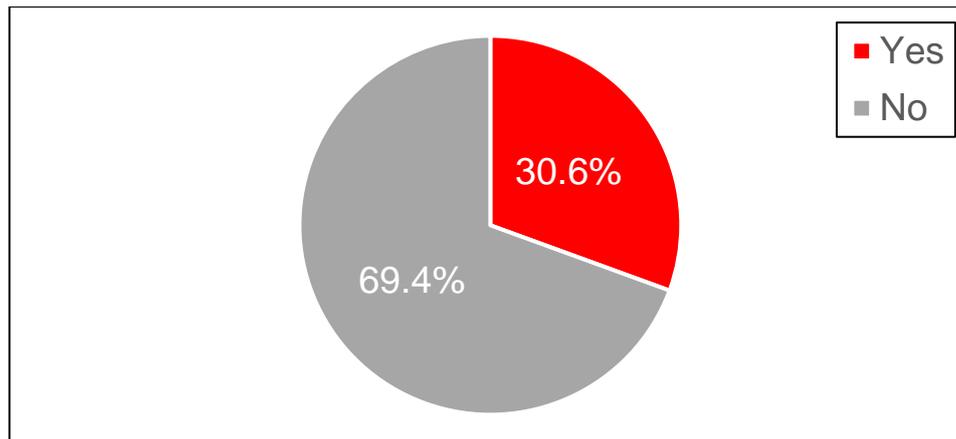
In many situations spaying/neutering is considered part of responsible dog ownership, particularly with respect to preventing unwanted pregnancies. There are also a whole range of health and behavioural pros and cons associated with spaying/neutering – these are best discussed with a veterinary surgeon.

WFTs are a numerically small breed and genetic diversity should be considered. With many WFTs sterilised this may reduce the genetic diversity available within the breed. Obviously, there are a number of other requirements for a suitable breeding WFT (good health, good temperament, sufficient merit etc.) and breeding should not be undertaken without due care and consideration of a whole range of factors. However, for those WFTs with suitable traits for breeding perhaps these dogs should be considered for breeding before being sterilised.

For male WFTs we also have another attractive option for preserving genetic diversity. The option to collect and store frozen semen is becoming more common place in the world of dog breeding. Obviously, dogs need to reach sexual maturity prior to semen production and there are notable collection and storage charges associated with this. However, under some circumstances this does give the possibility of semen collection prior to castration for suitable male WFTs with the option of storing valuable genetic material inevitably.

Skin, coat and eye conditions

The following responses were received in answer to “Has your dog ever suffered from a serious or persistent SKIN, COAT or EAR Condition?”:



Skin, coat and ear conditions were the most reported health issue within this survey with 30.6% of WFTs reported as suffering from one or more problem within this category.

Of those WFTs reported as having a skin, coat or ear condition the following conditions were given:

1. Allergic skin disease (74.3%)
2. Ear disease (23.9%)
3. Condition other than allergic skin disease or ear disease (6.1%; *results included fungal infection, bacterial infection, Cushing's related skin disease, hypothyroid related skin disease, borrelioses, specific parasites, infected hair follicles, chemical burn*)

NOTES:

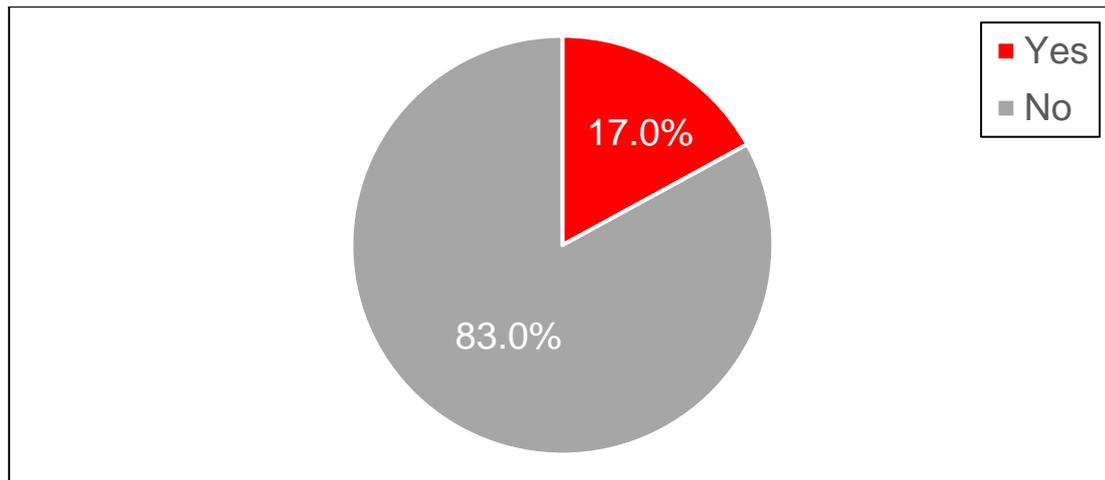
- 11.6% of dogs were reported with both skin and ear conditions
- For 7.6% of dogs there was insufficient information given to determine a specific condition

Relevant points regarding skin, coat and ear conditions

For many involved with WFTs it will come as no surprise that allergic skin disease and ear disease are of notable concern for the breed. It is however somewhat alarming to see just how frequently these conditions have been reported in this survey. At present, much of the advice given to owners to help prevent skin and ear diseases is based on anecdotal evidence at best. Going forward it seems sensible to do a further targeted health survey in these areas to try to identify some of the risk factors which may increase the likelihood of these conditions occurring.

Growths/ tumours

The following responses were received in answer to "Has your dog ever had any abnormal GROWTHS/TUMOURS?":



Abnormal growths/tumours were the 2nd most reported condition in this health survey (17%).

Of those WFTs reported as having an abnormal growth/tumour the most common locations were:

1. Skin (54.9%)
2. Mammary (12.6%)
3. Bladder (6.7%)
4. Mouth (5.5%)

NOTES:

- 4.4% of dogs were reported as having tumours in multiple locations/organs
- For 6.6% of dogs there was insufficient information given to determine a specific tumour location

Relevant points growth/tumours

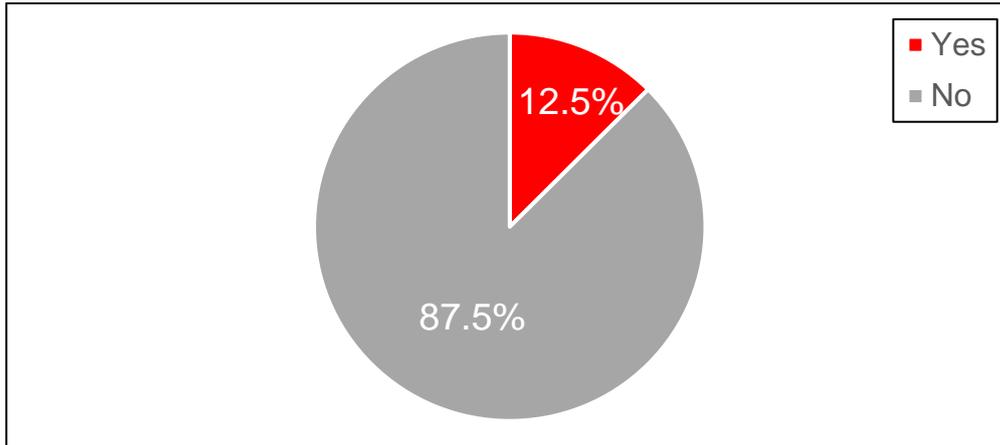
There was insufficient information received to report meaningful results on the number of benign vs malignant (cancerous) tumours received, this is perhaps unsurprising in an owner reported survey. In most instances it would require some guess work to categorise tumours as benign/malignant and guessing is not likely to produce helpful results.

By far the most reported tumour location was skin. However, making direct comparisons by region from these results should be done with caution. It is likely that specific internal tumours are underrepresented as these will only be found through specific work ups by vets, yet skin and mammary tumours are often easily identified by owners.

The relatively high reporting of tumours in WFTs may represent a particular susceptibility of the breed to tumour development, but it is also worth noting that tumours/ growths affect a large proportion of dogs breed-wide and a common cause of death (Adams et al, 2010).

Digestive/ Gastrointestinal conditions

The following responses were received in answer to “Has your dog ever suffered from a serious or persistent DIGESTIVE system condition?”:



Digestive conditions were the 3rd most reported health issue (12.5%).

Of the WFTs reported as having a digestive issue the most common conditions were:

1. Food intolerance (38.8%)
2. Pancreatitis 16.4%)

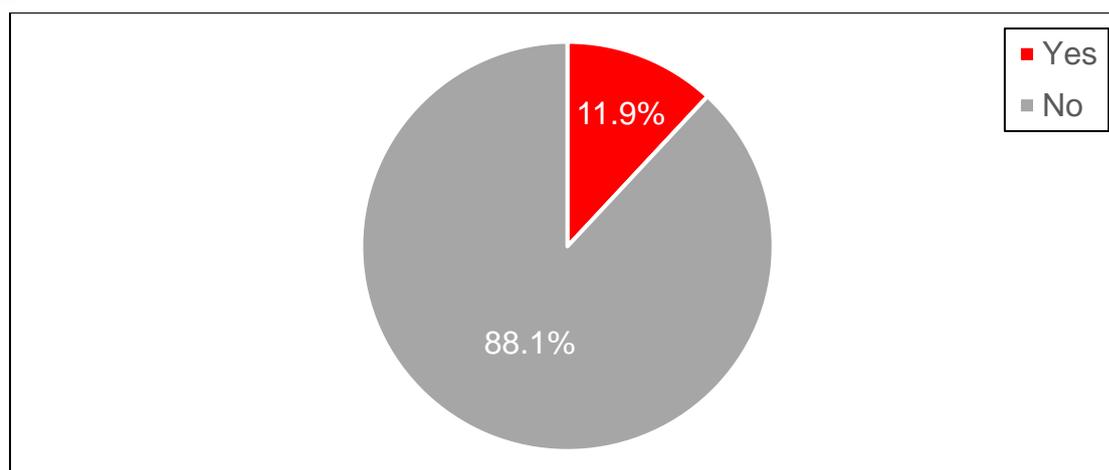
Relevant points on digestive conditions

For many of the dogs included in this survey it was difficult to categorise them as having a specific digestive condition. There were many reports of clinical signs (such as vomiting and diarrhoea) with insufficient information to determine a specific condition. Clearly in such cases there is something going on but conclusions could not be drawn from the information provided.

It is not surprising food intolerance is the most reported digestive condition in WFTs as there seems to be an association with this and allergic skin disease. The high numbers of pancreatitis cases reported are perhaps a concern. A known risk factor for pancreatitis is the feeding of high fat diets. Therefore, it seems sensible to suggest avoiding high fat foods with this breed. Furthermore, obesity is a significant risk factor for the development of pancreatitis, emphasising the importance of maintaining a healthy bodyweight in this breed.

Eye conditions

The following responses were received in answer to “Has your dog ever suffered from a serious of persistent eye condition?”:



Eye conditions were reported in 11.9% of WFTs.

Of the WFTs reported as having an eye condition the most common clinical signs/conditions were:

1. Tear production issues, drainage issues and signs of inflammation of the surface of the eye and surrounding tissues (e.g. conjunctivitis, red eye, hayfever like symptoms) (42.5%)
2. Cataracts (18.1%)
3. Blue/cloudy discolouration of eye (8.7%)
4. Blindness (7.1%)
5. Ingrowing eye lashes (3.9%)
6. Glaucoma (3.9%)
7. Lens luxation (1.6%)

Relevant points for eye conditions

From the owner reports it was very difficult to further separate out many of the conditions so a whole range of potential conditions are grouped above under 'tear production issues, drainage issues and signs of inflammation of the surface of the eye and surrounding tissues'.

Quite a significant proportion of the dogs with eye issues were reported as having cataracts. However, this should be interpreted with caution. Many owners will assume a blue discolouration of the eye is a cataract. While a cataracts will cause a blue discolouration it is not the only cause. Another common cause of blue discolouration to the eye in older dogs is nuclear sclerosis. Nuclear sclerosis is considered a normal age related change and though appearance is similar this is not a cataract. It is not clear from the survey how many dogs had cataracts diagnosed by a vet and how many were owner reported cataracts without a veterinary diagnosis.

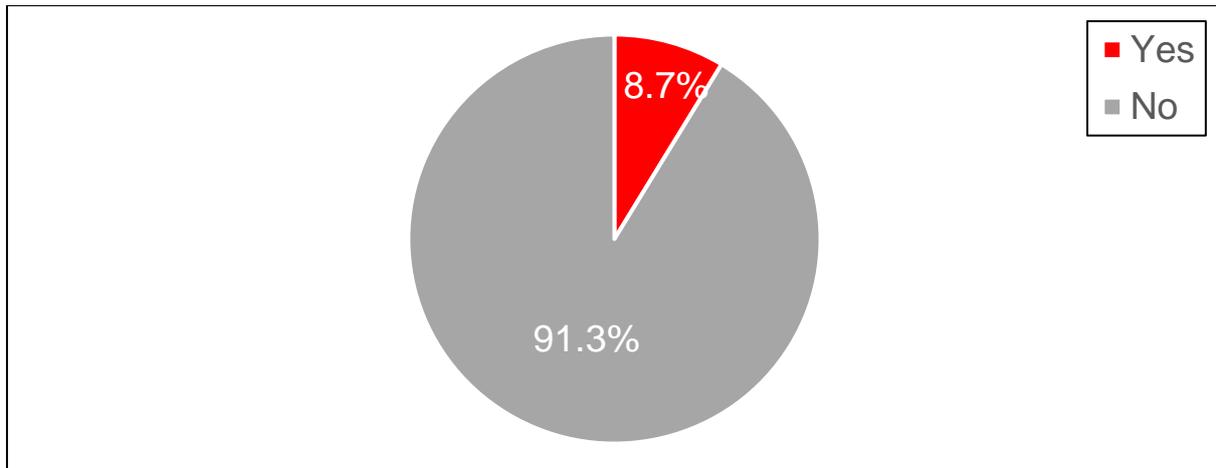
Interestingly only 2/127 dogs with reported eye conditions had lens luxations. Primary lens luxation (PLL) is on the mandatory testing list for assured breeders within the UK, as well as listed as a known condition in the breed on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list. However, both of the reported lens luxation cases occurred following cataracts and therefore are likely to be secondary to this condition rather than primary.

From the owner reports above, it seems rational that we should be recommending WFTs have their eyes screened by qualified veterinary ophthalmologists but with

more focus on other conditions such as cataracts and ingrowing eye lashes (rather than PLL). Where more severe eye disorders are diagnosed it would be prudent to be mindful of these conditions when making breeding plans. In the future there may be genetic tests developed to screen for specific conditions. However, in the absence of genetic tests breeders should be encouraged to avoid breeding from WFTs known to pass on specific eye conditions, particularly if multiple offspring are identified as suffering the same conditions.

Bones, muscles and joint (musculoskeletal) conditions

The following responses were received in answer to “Has your dog ever suffered from a serious of persistent condition affecting bones, muscles or joints (including the jaws)?”:

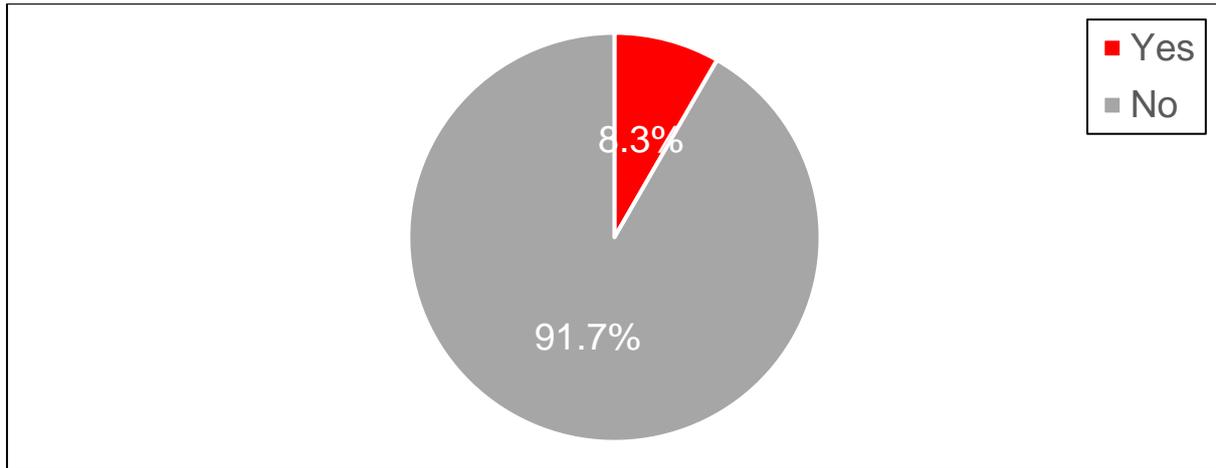


Of the WFTs reported as having bone, muscle or joint issues the most common conditions were:

1. Arthritis (18.2%)
2. Luxating patella (15.0%)
3. Non-specified lameness/stiffness (9.7%)
4. DM (9.7%)
5. Cruciate ligament rupture (7.5%)
6. Legg-Calve-Perthes disease (4.3%)

Dental conditions

The following responses were received in answer to “Has your dog ever suffered from a dental condition?”:

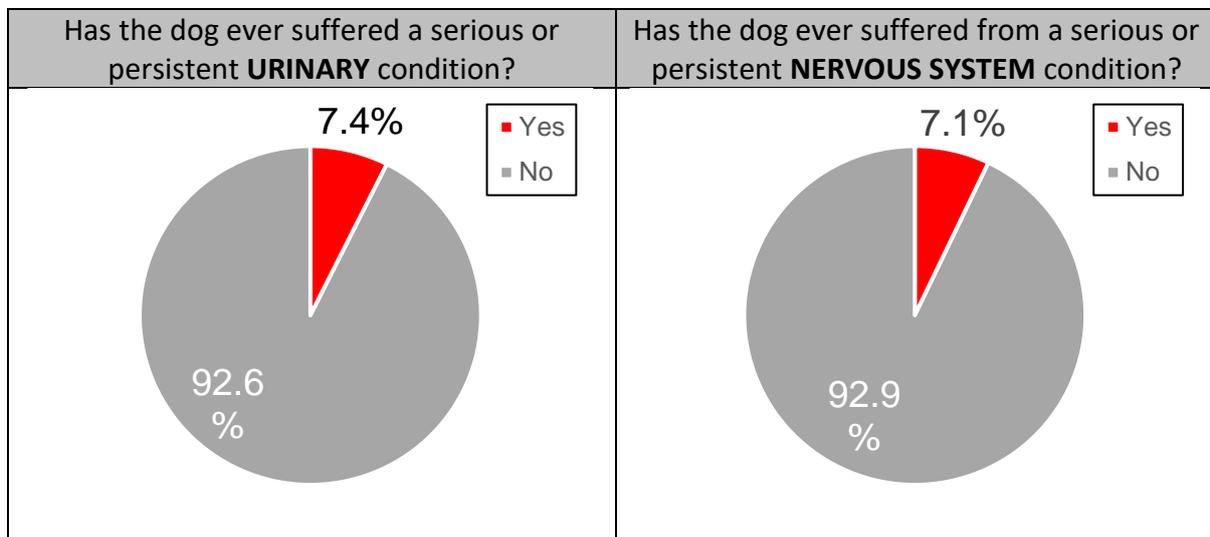


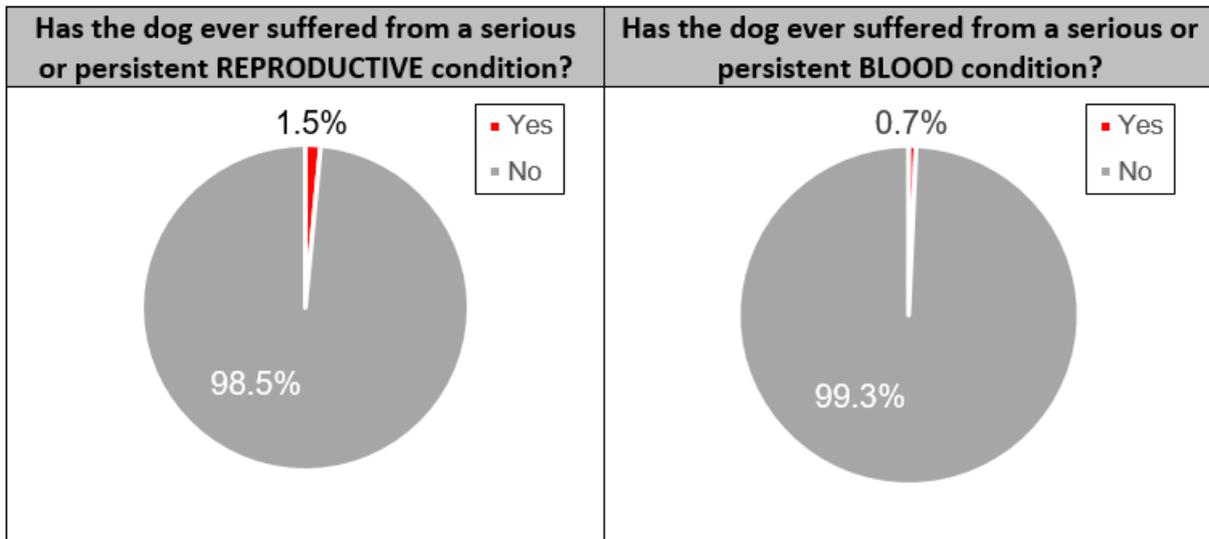
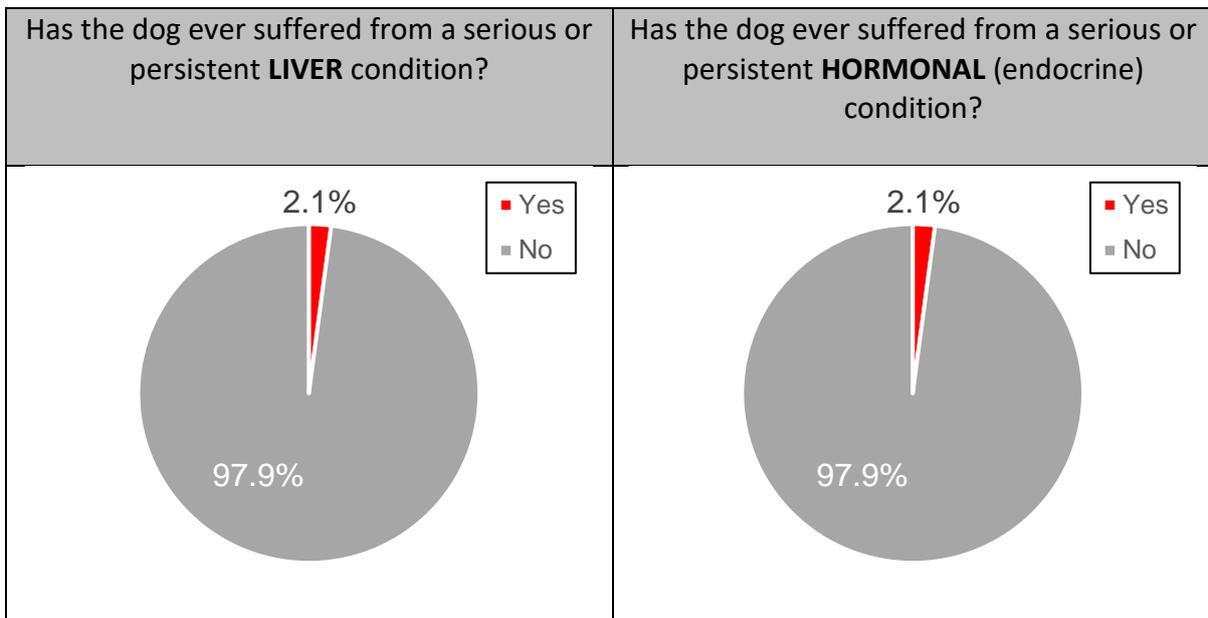
Of the WFTs reported as having a dental issue the most common conditions were:

1. Malocclusions (26.1%) (overshot 15 dogs; undershot 5 dogs; inverted canines 3 dogs)
2. Gum disease (26.1%)
3. Teeth decay, tartar/plaque build-up (12.5%)

Other conditions

The following systems were also reported, with dogs affected at a smaller scale:





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 includes dogs residing within the UK primarily, and literature that was released relatively recently to try to reflect current publications and research relating to the breed.

Dermatological conditions

Demodectic mange: Wire Fox Terriers appear to be predisposed to developing greasy skin and coat. In a study of eight Wire Fox Terriers, *Demodex injai* mite infestation was associated with greasy skin and coat, and may have a contributory role to the manifestation of disease in affected dogs (Ordeix et al. 2009). However, no larger scale papers could be found for the condition in the breed and prevalence data were not available.

Musculoskeletal conditions

Van Den Ende-Gupta Syndrome (VDEGS): This congenital condition manifests in skeletal abnormalities in affected dogs, including misalignment in the jaw and nose and deformed ears, dislocated elbows and patellae, and distorted bowed femurs (Hytönen et al., 2016). A genetic defect causing VDEGS has been identified in Wire Fox Terriers using genome-wide association scanning (GWAS) on four affected dogs and eight controls. A mutation in the *SCARF2* gene was established as associated with disease, at a carrier frequency of 22% across 45 samples analysed. The authors proposed VDEGS as being inherited via an autosomal recessive pattern of inheritance. A DNA test is available for this condition in the breed.

Neurological conditions

Degenerative Myelopathy (DM): In a study across numerous breeds, a mutation with an autosomal recessive pattern of inheritance, with incomplete penetrance, has been identified as being associated with an increase risk to DM (Zeng et al., 2014). In total, 71 of 79 (89.9%) Wire Fox Terriers included in this study carried two copies of the at risk sequence. Further, seven of 79 (8.86%) carried one copy of the mutation. Wire Fox Terriers had the highest prevalence for the at risk mutation of any breed involved in the study; however, a follow up of dogs found to be homozygous for the mutation was not undertaken, which would establish the likelihood of individuals developing disease.

Ocular conditions

Glaucoma: A study in America establishing the prevalence of glaucoma over several decades (1964-2002) noted the Wire Fox Terrier as a breed with a high prevalence of disease, specifically between 1994-2002, at 2.28% (of 997 dogs) (Gelatt &

MacKay, 2004). The authors noted the condition primarily affected middle-aged to older dogs, with an initial age of onset of 6.55 ± 0.94 years. However, it is worth noting that this condition has not been picked up at a similar prevalence in dogs of the breed that have undergone testing as part of the American College of Veterinary Ophthalmologists (ACVO) – page 14.

Primary Lens Luxation (PLL): A mutation associated with PLL, with an autosomal recessive pattern of inheritance, has been identified across many breeds (Gould et al, 2010). This study included 10 Wire Fox Terriers clinically affected with PLL, of which six (60%) of these were identified as carrying two copies of the at risk sequence. The authors noted that due to four dogs not being homozygous for this mutation, the condition may be genetically heterogeneous (meaning there could be other genetic mechanisms leading to onset of disease), or that the condition may have been misdiagnosed in these dogs. No further research has been undertaken on the condition in the breed to date.

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

Swedish Agria Data

Swedish morbidity insurance data were available from Agria for the Fox Terrier (both Wire and Smooth breeds combined). 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) e.g. 1 DYAR is equivalent to one whole year of insurance. The number of DYAR for Fox Terriers in Sweden during this period was between 500 and 1,000, so the results should be interpreted with caution.

Swedish Agria insurance morbidity data

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Fox Terriers (both breeds) in Sweden between 2011 and 2016 are shown in Figure 2.

The top five specific causes of VCEs were vomiting/ diarrhoea/ gastroenteritis, skin trauma, skin tumour, polyuria/ polydipsia (excessive urinating/ drinking), and signs of pain (locomotor system).

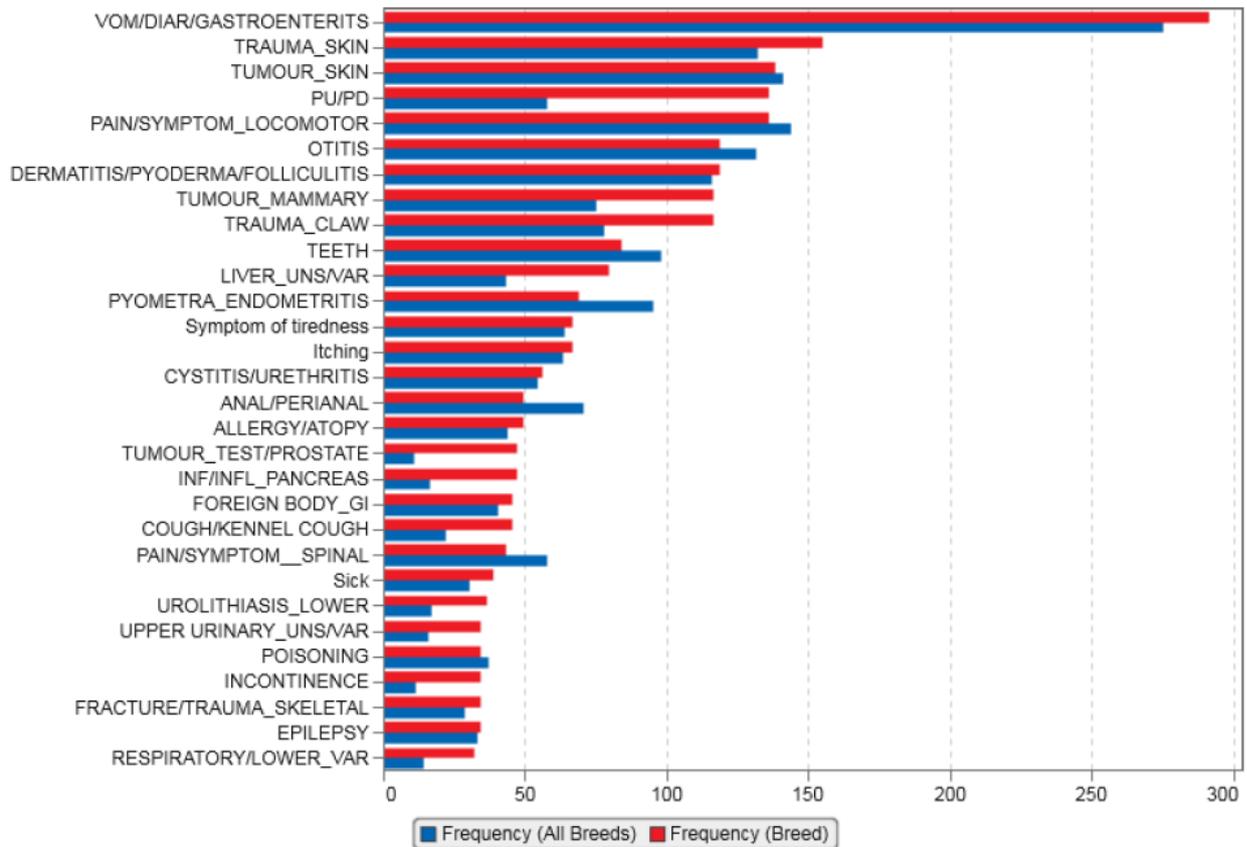


Figure 2: The most common specific causes of VCEs for the Fox Terrier (both breeds) compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

The specific causes of VCEs ordered by relative risk are shown in Figure 3 for Fox Terriers (both breeds). In this analysis, the top five specific causes of VCEs ordered by relative risk were teste/ prostate tumour, anal tumour, heart – unspecified/ various, incontinence and infection/ inflammation of the pancreas. Rare conditions that occur sporadically may appear as a high relative risk; this caveat may well apply to some of these conditions.

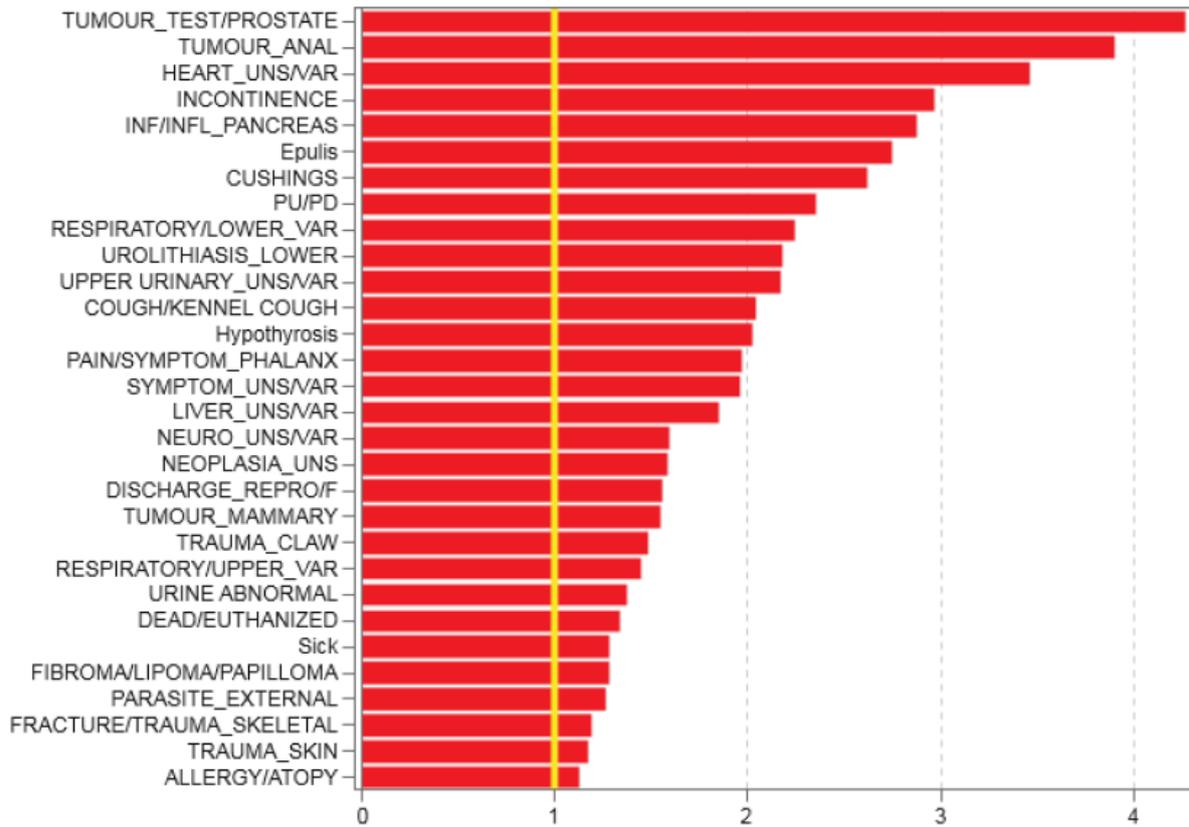


Figure 3: The specific causes of VCEs for the Fox Terrier (both breeds) ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

Further to this, the breed’s morbidity of locomotory problems/ concerns was compared to all breeds (Figure 4). Unspecified/ various locomotor disorders were the most frequent type in the breed, with spinal disorders being the highest specific disorder, followed by disorders of the knee/ patellar.

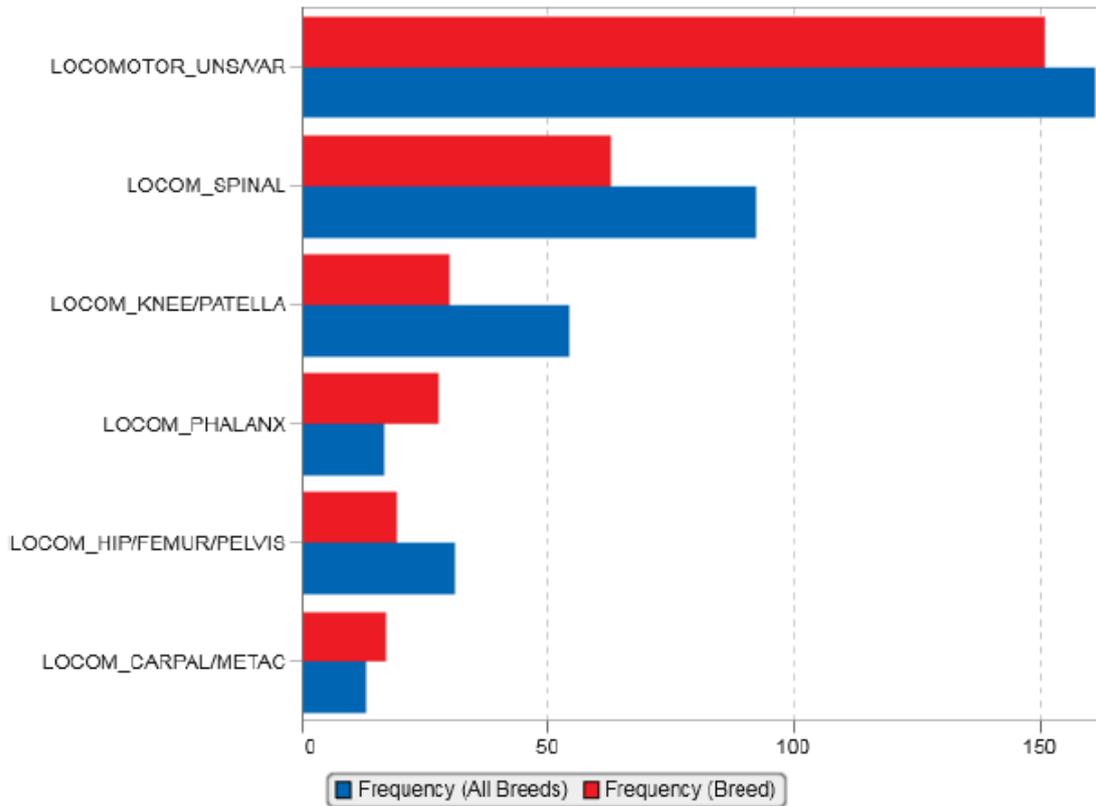


Figure 4: The morbidity of locomotor problems in the Fox Terrier (both breeds) in comparison to all breeds in the Swedish Agria database between 2011-2016.

When the relative risk was considered, the top locomotory disorder was in the phalanx, followed by the carpus/ metacarpus (Figure 5).

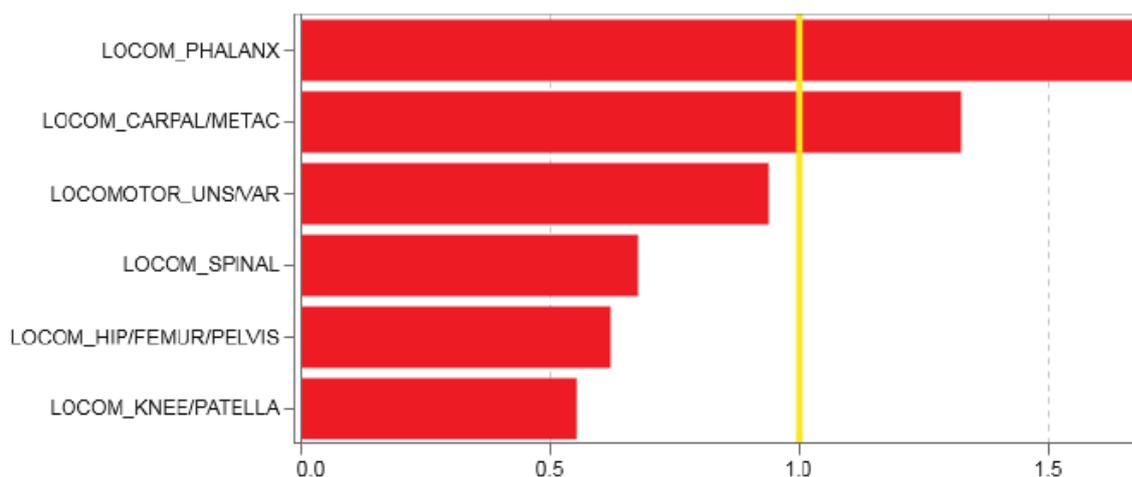


Figure 5: The specific causes of locomotory disorder for the Fox Terrier (both breeds) ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

BREED WATCH

The Wire Fox Terrier 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. In the past five years two PTS has been granted for Wire Fox Terriers (not including neutering), with these being for removal of teeth/ tooth.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme there are the following requirements for the Wire Fox Terrier:

- Eye testing under the British Veterinary Association (BVA)/ KC/ (International Sheepdog Society) ISDS Eye Scheme

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 are currently three DNA tests for this breed, which are:

- DNA test for VDEGS (Laboklin)
- DNA test for Primary Lens Luxation (Animal Health Trust & Laboklin)
- DNA test for Degenerative Myelopathy (Laboklin)

More information about these tests from the Breed Health Co-ordinator can be found in *Appendix B*. At present none of the above DNA tests are recognised by The Kennel Club. The following data have been adapted from MyDogDNA, however the number of dogs tested to give these results were not available.

Table 1: DNA test results for Wire Fox Terriers tested by MyDogDNA to date (July 2020).

| VDEGS | |
|---------------------|--------|
| Genetically at risk | 2.19% |
| Carriers | 38.25% |
| DM | |
| Genetically at risk | 76.98% |
| Carriers | 15.08% |
| PLL | |
| Genetically at risk | <1% |
| Carriers | <1% |

Adapted from: [MyDogDNA](https://www.mydogdna.com/)

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

Only one dog of the breed has been tested to date, with a score of 9.

ELBOWS

No Wire Fox Terriers have been elbow graded to date (July 2020).

EYES

The Wire Fox Terrier is currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for:

- Primary lens luxation (PLL)

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 14 dogs of the breed have been tested under the scheme, of which none were found to be affected by the 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. Since 2012 just one dog has been eye tested, in 2016, with no comments made by the examining ophthalmologist.

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 2 below for conditions affecting over 1% of the examined population. Between 2015 and 2019, 56 Wire Fox Terriers were examined, of which 33.9% (19 of 56 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 2: ACVO examination results for Wire Fox Terriers, 1991 – 2019

| DISEASE CATEGORY/NAME | PERCENTAGE OF DOGS AFFECTED | |
|---|-----------------------------|---------------------|
| | 1991-2014 (n=292) | 2015-2019 (n=56) |
| EYELIDS | | |
| Distichiasis | 2.4% | 3.6% |
| CORNEA | | |
| Corneal dystrophy | 1.0% | 0% |
| UVEA | | |
| Persistent Pupillary Membranes <i>(iris to iris)</i> | 33.5% (30.5%) | 64.3% (60.7%) |
| <i>(iris to lens)</i> | (1.0%) | (3.6%) |
| <i>(iris to cornea)</i> | (1.7%) | (0%) |
| LENS | | |
| Significant cataract (summary) | 9.6% | 7.1% |
| RETINA | | |
| Generalised progressive retinal atrophy (PRA) | 1.4% | 0.0% |

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 3.

Table 3: Number and percentage of litters of Wire Fox Terriers 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 | 165 | 0 | 0.00% | 0.15% |
| 2010 | 166 | 0 | 0.00% | 0.35% |
| 2011 | 174 | 0 | 0.00% | 1.64% |
| 2012 | 144 | 2 | 1.39% | 8.69% |
| 2013 | 158 | 4 | 2.53% | 9.96% |
| 2014 | 164 | 4 | 2.44% | 10.63% |
| 2015 | 149 | 4 | 2.68% | 11.68% |
| 2016 | 130 | 4 | 3.08% | 13.89% |
| 2017 | 163 | 4 | 2.45% | 15.00% |
| 2018 | 138 | 3 | 2.17% | 17.21% |
| 2019 | 105 | 6 | 5.71% | 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 **52.1** was reported (estimated using the rate of inbreeding over the period 1980-2019).

An effective population size of 100 or below (inbreeding rate of 0.50% per generation) results in the rate of loss of genetic diversity in a breed/population increasing dramatically (Food & Agriculture Organisation of the United Nations, "Monitoring animal genetic resources and criteria for prioritization of breeds", 1992).

An effective population size of below 50 (inbreeding rate of 1.0% per generation) indicates the future of the breed may be considered to be at risk (Food & Agriculture Organisation of the United Nations, “Breeding strategies for sustainable management of animal genetic resources”, 2010).

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 7. The observed inbreeding coefficient has gradually increased until 2009, after which point it appears to have plateaued and may be beginning to decrease.

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>.

The current annual breed average inbreeding coefficient is ~12.0%

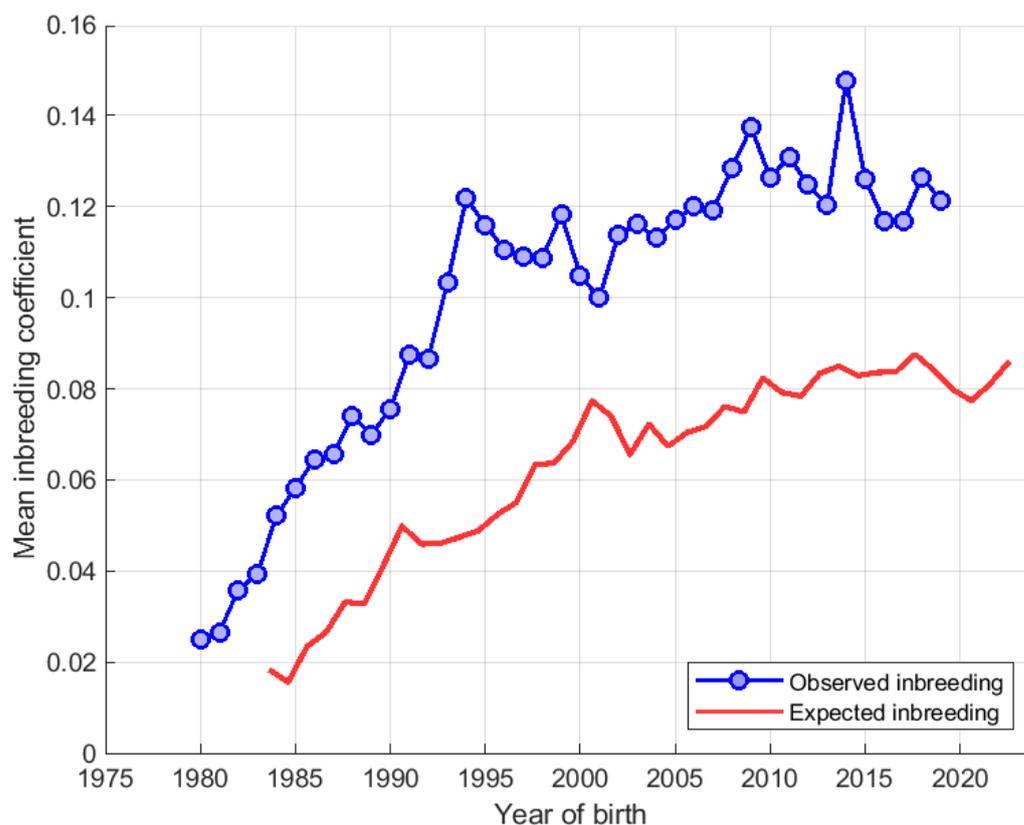


Figure 7: Annual mean observed and expected inbreeding coefficients.

Below is a histogram (‘tally’ distribution) of the proportion of progeny per sire and dam over each of eight 5-year blocks (Figure 8). 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

currently appears to be moderate use of two sires of the breed, with one dog responsible for almost 6% of progeny registered between 2014 and 2019.

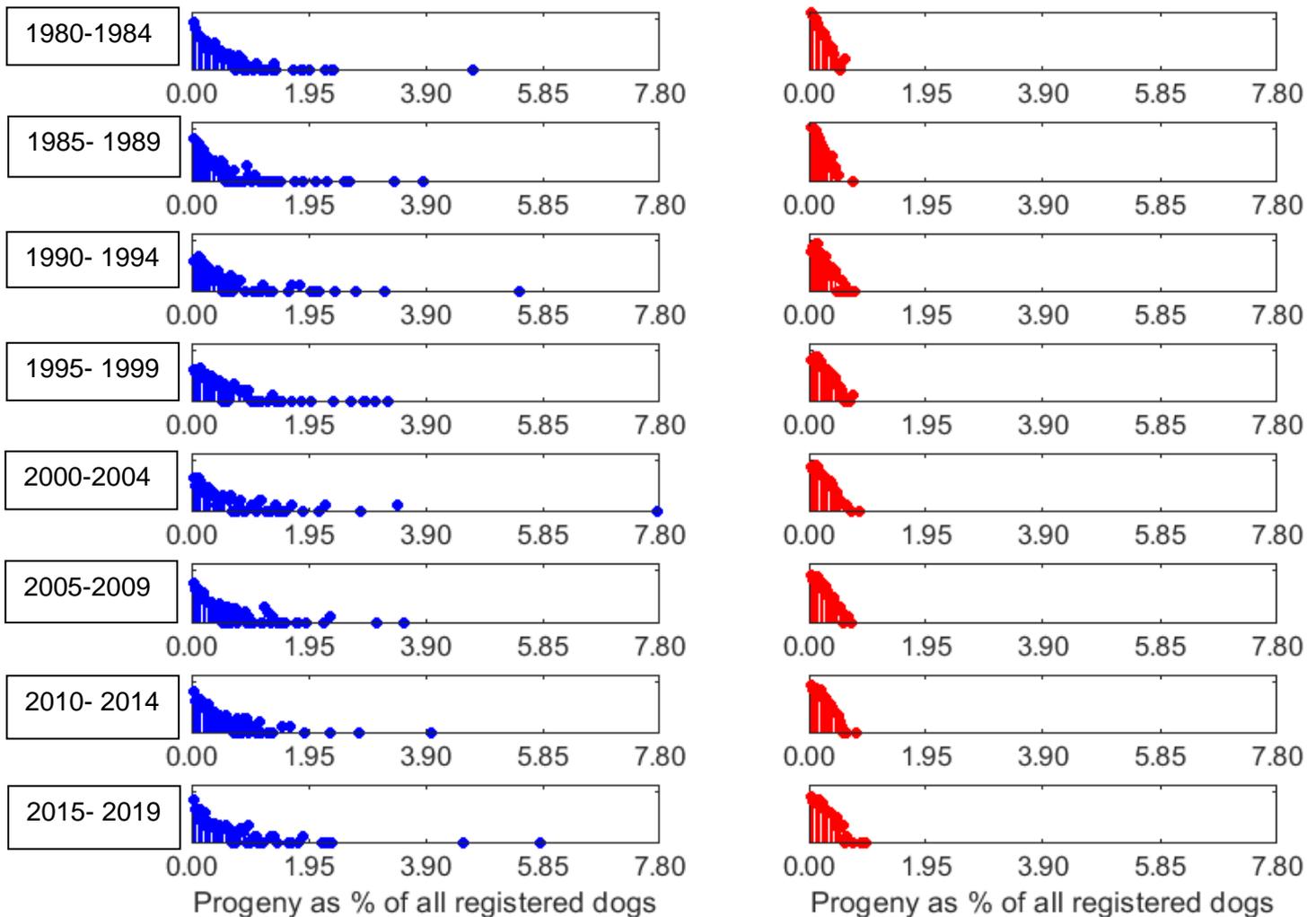


Figure 8: Distribution of the proportion of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2014-19 bottom). Vertical axis is a logarithmic scale

CURRENT RESEARCH

The Wire Fox Terrier has been collaborating with the Animal Health Trust in submitting samples from known affected, carrier and clear dogs, with the aim of developing a DNA test. Following the closure of the AHT it is hoped this research will be reinstated at the University of Cambridge.

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 Wire Fox Terrier were:

- VDEGS
- To collate information on the breed's health

ACTION PLAN

Following the meeting 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 Wire Fox Terrier. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Clubs to consider putting forward a proposal for the recognition of the VDEGS DNA test by the Kennel Club, with the view to having this covered under the Assured Breeder Scheme.
- The Breed Clubs to monitor the incidence of PLL in the breed, and whether there is sufficient evidence to request this condition be removed from Schedule A.
- The Breed Clubs to monitor the incidence of popular sires in the breed.

Kennel Club actions include:

- The Kennel Club to assist in the review of removing PLL from Schedule A for the breed.
- The Kennel Club to develop further guidance on the use of popular sires and associated health concerns as a result of inbreeding depression.
- The Kennel Club to investigate the possibility of developing a breed-wide health survey to compare skin concerns across and within breeds.
- The Kennel Club to investigate the feasibility of developing a DM research study to assess the validity of the DNA test in the breed, and possibilities to reduce allele frequency.

REFERENCES

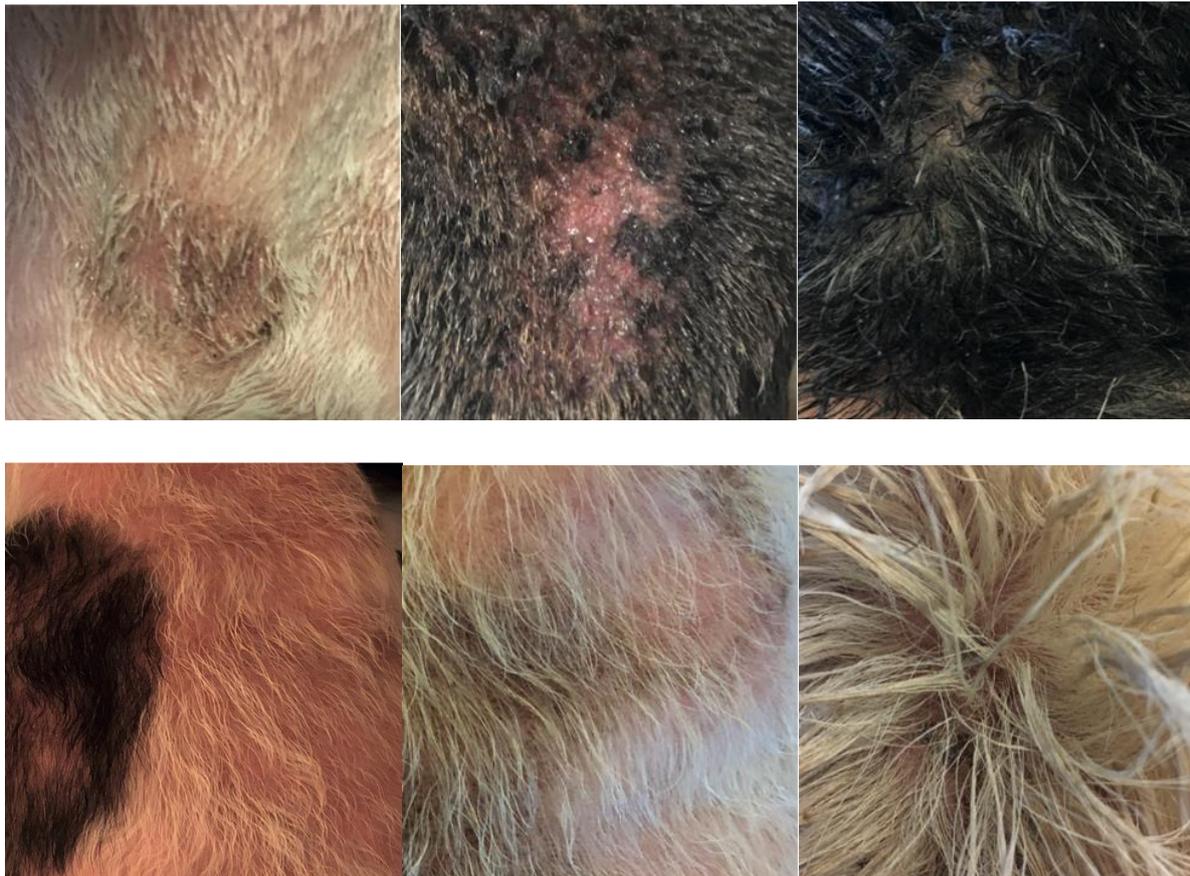
- Gelatt, K.N., MacKay, E.O. (2004) Prevalence of the breed-related glaucomas in pure-bred dogs in North America. *Veterinary Ophthalmology* **7(2)**: 97-111
- Gould, D., Pettitt, L., McLaughlin, B., Holmes, N., Forman, O., Thomas, A., Ahonen, S., Lohi, H., O'Leary, C., Sargan, D. and Mellersh, C. (2011), *ADAMTS17* mutation associated with primary lens luxation is widespread among breeds. *Veterinary Ophthalmology*, 14, pp378–384.
- Hytönen, M.K., Arumill, i M., Lappalainen, A.K., Owczarek-Lipska, M., Jagannathan, V., Hundi, S., Salmela, E., Venta, P., Sarkiala, E., Jokinen, T., Gorgas, D., Kere, J., Nieminen, P., Drögemüller, C. and Lohi, H. (2016) Molecular Characterization of Three Canine Models of Human Rare Bone Diseases: Caffey, van den Ende-Gupta, and Raine Syndromes. *PLoS Genet.* 12(5).
- Mydogdna.com. (2020). [online] Available at: https://www.mydogdna.com/crm/index.html?fbclid=IwAR0ryTKBqovU8sjLjfXHR5h2CIDlqN7_NA_QSnbqXz1y2sXkq6VyWPju71E#en/breeds/519248a83cd390a05200008a/fox_terrierwire/disorders. [Accessed 10 June 2020]
- Ordeix, L., Bardagí, M., Scarampella, F., Ferrer, L. and Fondati A. (2009) Demodex injai infestation and dorsal greasy skin and hair in eight wirehaired fox terrier dogs. *Vet Dermatol.* 20(4), pp.267-272.
- Zeng, R., Coates, J. R., Johnson, G. C., Hansen, L., Awano, T., Kolicheski, A., Ivansson, E., Perloski, M., Lindblad-Toh, K., O'Brien. D. P., Guo, J., Katz, M. L. and Johnson, G. S. (2014) Breed distribution of SOD1 alleles previously associated with canine degenerative myelopathy. *Journal of veterinary internal medicine.* 28(2) pp515–521.

APPENDIX A

The Itchy Dog

By Dr David Hughes MRCVS

This article was inspired by veterinary dermatologist, Dr Rosario Cerundolo's talk 'Common Skin Problems in the Dog' given at the 2018 Kennel Club Breed Health Symposium.



As Dr Cerundolo pointed out, skin disease is one of the most common, if not the most common reason why dog owners seek veterinary advice. Of all of the skin complaints, the number one issue reported by owners is pruritus (a fancy word to describe itching). I can also echo this statement as the most common reason Wire Fox Terrier (WFT) owners contact me regarding health issues is to discuss chronic itching and ear disease (remember the ears are a continuation of the skin). This is also true for the other breeds I have active involvement with (Welsh Terriers and Airedale Terriers).

During his talk, Dr Cerundolo drew our attention to the fact that actually, very little information on skin disease was in the public domain from many animal organisations. This includes The Kennel Club (as pointed out by a very tongue-in-cheek statement and online search by Dr Cerundolo during this KC talk) and the

British Veterinary Association. We have to ask ourselves, why is so little information out there on skin disease? Maybe it is so common in dogs that we come to think of it as normal.

Over the past few years, Van den Ende-Gupta Syndrome (VDEGS), a genetic disease causing a whole host of developmental issues in WFTs, has been a hot topic of conversation among breeders. I will take this opportunity now to point out that there is a new genetic test available for this condition and urge anyone breeding WFTs to strongly consider making use of this test. However, my point is, why are we not giving the same level of attention to itchy dogs? After all, you are far more likely to have an itchy dog than a VDEGS sufferer!

For many WFT owners (and all other breeds for that matter), managing skin problems is an ongoing challenge. I think we often tend to think that a bit of itchy skin is a bit of an inconvenience, however this disease can become so severe that euthanasia becomes a serious consideration. If that isn't reason enough for this condition to warrant significant attention, then I don't know what does!

Although skin disease includes a whole range of issues, for the remainder of this article I will focus on the itchy dog. I realise for some, an article on itchy dogs isn't the most exciting read, however I feel it is extremely important to get some information out there that is hopefully of use and interest to owners. I also hope to inspire a bit of discussion around skin disease and urge the more experienced breeders and owners to help pass on some of their knowledge and management strategies to others struggling with itchy dogs.

WHY IS MY DOG SO ITCHY?

Unfortunately, the list of things that can contribute to itching would be a never-ending list and there can be multiple contributing factors. However, there are broad categories to consider. The categories below are some of the main areas to consider with itchy dogs, but they are by no means an exhaustive list.

Parasites are a significant cause of pruritus, with the fleas being the number one perpetrator. Other parasites such as mites, lice and ticks can also cause itching.

Food intolerance is another area to consider with skin disease. When listening to conversations between pet owners on food intolerance, the focus is often around gluten. This is perhaps unsurprising as pet food companies often promote their food as 'hypoallergenic gluten-free'. In some cases, there may well be a gluten intolerance, however in recent years the thinking has changed somewhat, and it is now believed that the more common food source responsible is protein, largely derived from the meat content (e.g. chicken, beef, fish etc.).

Atopic dermatitis is the second most common allergic skin disease in dogs (behind flea allergic dermatitis). Simply put, atopic dermatitis is an allergic skin disease to anything that isn't caused by fleas or food. Both a genetic susceptibility and environmental factors contribute to the disease. Dogs may have a genetic predisposition to having an inferior skin barrier and an inappropriate immune response. Allergens in the environment can trigger and exacerbate the skin disease, a few examples include, pollens, dust mites, harvest mites, washing powders/detergents, mould spores. During Dr Cerundolo's talk, he informed us that other pets can contribute to the disease. Dogs with atopic dermatitis may be allergic to dandruff from other pets or the feathers from birds (with one of his own cases resolving when the dog owner relocated her chickens). These allergens can trigger itching by direct contact with the skin or via the respiratory system (when breathing in).

The last category to consider is microbes (bacteria, fungi, yeasts etc.). It is important to note that normal animals should have a microbial population on their skin contributing to the normal 'skin flora'. The normal microbes contribute to protection from harmful organisms by outcompeting them for resources on the skin. An invading pathogen might be the primary cause of disease but in many cases, the pathogens are a secondary cause that exacerbates the underlying problem making the dog itchier and sorer. As an example, inflamed skin caused by atopic dermatitis can change the skin conditions and provide the perfect opportunity for an invading pathogen to infect the skin. Another common cause for an infection is a wound, changing the normal structure and integrity of the skin allowing a suitable environment for harmful microorganisms to set up camp! Also, remember some skin diseases, such as the fungal disease ringworm, can pass from your dog to you (and vice-versa) so remember strict hygiene!

DIAGNOSIS

As I hope I have made clear above, a whole range of things can contribute to making a dog itchy. Therefore, it is unsurprising diagnosis is not straightforward. Unfortunately, there is no one test that will always give us the answer, and frustratingly it's often the case that a specific cause isn't found.

Sometimes the diagnosis can be very straightforward. For example, if you see a flea you know your dog has fleas. Your vet might take a sample and look down the microscope, if mites or lice are seen, hey bingo you know the dog has mites or lice! However, it is important to note that just because you don't find a particular parasite it doesn't mean it isn't there. As a result, it is a good idea to treat for skin parasites regardless of findings.

The gold standard method of diagnosing a food intolerance is a food exclusion diet. This usually involves switching to a food with a unique protein source not eaten by the dog before. It is often the case that dogs have been fed multiple protein sources

through their lives (e.g. chicken, fish, beef, lamb) which can make finding a novel protein source challenging. However, sources such as venison, shark or vegetarian diets are available and can be fed if other protein sources have already been used. Hydrolysed diets are also available, these consist of proteins broken down into smaller pieces and are much less likely to cause allergic reactions. An exclusion diet is usually fed for a prolonged period (usually around 8 weeks). It is very important, and I cannot stress enough for this test to be reliable you **MUST ONLY** feed the chosen food. That means all other sources of food should be stopped, including scraps, tip bits, chew bones, cheese to disguise medications etc. This test often fails because owners find it very challenging to limit their dog to just the chosen diet. However, if other sneaky treats are given, how can you know if this is causing your dog to itch or some other issue? If the dog's symptoms resolve on an exclusion diet, and then symptoms reoccur when the old food is re-introduced, this gives confirmation of a food intolerance. However, practically most owners don't wish to reintroduce a food suspected of causing their dog disease, so this step is often missed (quite understandably).

Allergy testing for is available and may be recommended by your vet. However, as stressed by Dr Cerundolo in his talk, the blood tests available are very unreliable (both for environmental and food allergens). This is a statement I have heard time and time again from specialist veterinary dermatologists. With unpredictable results, blood tests are often not very clinically helpful. The blood test for allergies should not be confused with the allergy testing directly on the skin (intradermal tests), which is much more reliable and can be very helpful.

I speak with lots of owners who are very frustrated that their own veterinary surgeon hasn't found a cause for their dog's itching, despite multiple trips to the vets. It may also be confusing why the vet is suggesting a different treatment or management strategy every week. However, this is much more of a reflection of the complexity of skin disease than a failing on the vets' part. Structured and methodical treatments and changes often help path the way to a final diagnosis. The bottom line is to work with your vet and try to follow their advice so together you can get a diagnosis for your dog and treat appropriately.

TREATMENT & MANAGEMENT

Continuing with the theme of this article, in many cases, there is no simple solution or magic bullet! As already mentioned above, tackling and managing itchy dogs needs to be a collaborative effort between owner and vets. My aim here isn't to give the solution for every case but draw attention to some key areas.

Parasite control plays an important part in treating and managing skin diseases. There are a whole range of products for treating parasites with varying success rates. It's important to realise the products on the shelf in pet stores are not the same

as licensed veterinary products. I know people often turn to pet shop products as they tend to be cheaper to purchase than veterinary products. However, as one of the senior lecturers used to say throughout my veterinary training, 'the cheapest treatment is the one that works first time!' It's all well and good using cheaper products but if they don't work it's going to cost more in the long run as you will then have to pay for a vet product later and your dog may end up suffering even longer than necessary with its itchy skin. The other aspect of purchasing pet shop products is that you don't get the professional advice from experienced veterinary professionals to give the most appropriate, targeted treatment.

Fleas can live for prolonged periods in the environment. Therefore, if fleas are found or suspected, it is very important to also treat the environment the dog lives in to prevent re-infestation (e.g. with household flea sprays). Also, remember to treat all other pets in the household.

With chronic skin cases it is often a case of trying to work out what is causing the problem and trying to avoid the triggers (much easier said than done I know!). But try to think strategically when the problem occurs. Is there a seasonal pattern to the problem making things like pollen and harvest mites a potential cause? Does it occur every time you wash the dog's bed making you think the washing powder might be to blame? Have you used shake and vac on the carpet and then the dog got itchy feet? Does the dog seem to get worse on certain foods? The list could go on forever, but in short, you need to try to think when the problem occurred, try to link it to things the dog might have come in contact with, and where possible remove the triggering cause. Sometimes a diary of flare-ups can be a useful tool in ongoing cases.

Bathing dogs can help to manage pruritus if done appropriately, but excessive bathing should be avoided to prevent ongoing disturbance to the normal skin flora unless directed to do so by your vet. For a WFT with healthy skin, I would not bath the body coat to prevent altering the correct wiry texture of the coat unless it was dirty (they do love rolling in fox poo!) but would bath and condition the furnishings (face hair, leg hair and underline). However, for itchy dogs, weekly or fortnightly bathing can help to manage the skin. Washing the coat can help to remove any potential allergens that may be on the skin and keep the skin clean to help reduce the likelihood of a secondary infection. Your vet may prescribe a veterinary shampoo for this which can be very successful in helping manage skin problems. In mild cases, I find dog tea tree shampoo can help too (human shampoo is not recommended). It's important to make sure that after applying shampoo to the coat it is rinsed out really thoroughly; if any shampoo is left in the coat this can itself aggravate the skin. I would also strongly recommend thoroughly drying the coat after to prevent a prolonged moist environment (which potentially could promote harmful bacterial growths on the skin).

When chronic cases cannot be managed with the above treatments and management changes, immunosuppressive drugs can be incorporated to help manage the severity of the problem. There are many drugs available and this is an area best discussed with your own vet to choose a product most suited to you and your pet's circumstances. It's important to point out that these drugs are not a cure and, in many cases, become a permanent ongoing treatment to manage the severity of your dog's skin disease.

SUMMARY

To summarise, I think it is fair to say that itchy skin is very common in all breeds, including WFTs, and there are a huge number of causes and contributing factors. Parasite treatment plays an important part in keeping our dogs healthy. Where triggers are suspected they should be avoided wherever possible. For ongoing cases, immunosuppressive drugs can be used to reduce the severity of skin disease. And as I final note, I really hope this article gets you all chatting about skin disease and passing on a few nuggets of wisdom in the successful management of itchy skin.

Dr David Hughes MRCVS

APPENDIX B

Wire Fox Terrier Genetic Tests

By Dr David Hughes MRCVS

There are many tests available for genetic conditions across the many recognised Kennel Club breeds. Specifically related to the Wire Fox Terrier (WFT), there are three genetic tests people have approached me repeatedly to discuss:

- **Van Den Ende Gupta Syndrome (VDEGS)**
- **Primary Lens Luxation (PLL)**
- **Degenerative Myelopathy (DM)**

All 3 of the above conditions have an autosomal recessive pattern of inheritance. This means both parents have to carry at least one copy of the mutated gene to produce an affected/at risk puppy.

In my opinion, the condition of priority for WFT breeders at this time is VDEGS. Concerning PLL and DM, I would not actively promote testing for reasons I hope will become clear through this article.

VAN DEN ENDE GUPTA SYNDROME (VDEGS)

What is VDEGS?

Sometimes referred to as 'mungo puppies' colloquially by people involved with WFTs, VDEGS is a genetic condition causing a wide range of physical abnormalities.

Visible abnormalities with VDEGS affected dogs



HEAD

- Very pronounced undershot bite
- Deformed upper jaw, with narrow beaked nose (with or without cleft palate)
- Misaligned nose
- Small eyes with underdeveloped eyelids
- Prominent deformed ears



BODY

- Weedy, long bones through feet often turned at an extreme angle
- Dislocated elbow and patella
- Thighbone distorted (bowed shape)
- May present with contracted limb muscles

Information on the VDEGS test

This is a very reliable test and I would urge anyone breeding to make use of the test. AFFECTED puppies are generally very apparent from the physical abnormalities described above. Therefore, the genetic test available is mainly to identify CLEAR and CARRIER dogs in a breeding program.

This test is available through various laboratories. I have ordered kits through Laboklin, where testing costs £54, although I believe the test may be available through other labs at a lower cost. All the required materials and paperwork are provided within the kit. A swab is provided in the kit to collect cells by brushing on the inside of the cheek to collect a few cells. Prior to swabbing the mouth, no food should be given for at least 2 hours before sample collection as this may contaminate the sample.

Breeding strategies depending on results

Breeding AFFECTED

- With the physical abnormalities, particularly of the head, I would anticipate many VDEGS AFFECTED puppies die within days of birth due to an inability to suckle properly. Therefore, most probably don't live long enough to reproduce.
- Where VDEGS AFFECTED dogs do live to adulthood, the physical abnormalities are very apparent, I would hope no breeder would consider these animals to have sufficient merit to be included within a breeding program.

Breeding CARRIER to CARRIER

- Statistically, 1/4 puppies are likely to be AFFECTED with VDEGS, 1/2 puppies will be CARRIERS and 1/4 will be CLEAR. In my opinion, this breeding combination

should be avoided as it is unnecessary and unethical to knowingly risk producing VDEGS AFFECTED puppies.

Breeding CARRIER to CLEAR

- Statistically, 1/2 puppies will be CARRIERS and 1/2 CLEAR of VDEGS
- As WFTs are a numerically small breed with a limited gene pool, a practical strategy would be to include CARRIERS within a breeding programme but only to breed to other WFTs which are tested as CLEAR.
- Completely removing CARRIERS from a breeding program may have detrimental consequences. There is a large body of evidence that a reduction in genetic diversity is connected to an increased risk of genetic disorders.
- Reducing the proportion of CARRIERS within the breed should be a long-term goal to help maintain an adequate level of genetic diversity within the breed.
- Puppies born to parents of this combination should be tested to identify if they are CLEAR or CARRIERS.

Breeding CLEAR to CLEAR

- All puppies born to this combination will be hereditary CLEAR - further genetic testing of progeny is not required.

PRIMARY LENS LUXATION (PLL)

What is it?

A genetic defect which results in luxation (abnormal displacement) of the lens in the eye, typically around 4-7 years of age. This condition can then be a precursor to glaucoma (an increased pressure in the eye) a painful condition for the dog in question.

Information on the PLL test

Many of you may have heard me chatting about this condition, it is my belief at this time that WFTs do not appear to have the mutated gene responsible for this disease. I suspect historically breeds/cross breeds have been misidentified as WFTs and this mistake has been passed through the literature. In the absence of convincing evidence that the condition occurs within the breed, I would not consider it a high priority to test for PLL. If anyone knows of or has had a WFT with this condition could they please contact me. I have been involved with several WFTs tested for PLL - all have tested CLEAR.

**NOTE: This is NOT the advice I would give regarding Welsh Terriers (another breed I am actively involved with) as it DOES occur within that breed, potentially leading to the necessity of eye removal!*

DEGENERATIVE MYELOPATHY (DM)

What is DM?

Progressive physical changes occur within the spinal cord which cannot be visibly seen, typically in dogs 8 years old and over.

Visible clinical signs with DM affected dogs

Early stages

- Progressive weakness of hindlimbs
- Easily fall over - poor balance, can be seen to sway in the rear
- Feet scraping on the floor when walking
- Knuckling of paws upon walking which may result in worn nails

Late stages

- Weakness in front limb
- Muscle wastage
- Pressure sores and unable to rise
- Urinary and faecal incontinence
- Difficulty breathing



Leg braces or a cart can help with mobility during early stages of DM

Although clinical signs may strongly indicate DM a definitive diagnosis can only be made upon examination of the spinal cord under a microscope post-mortem.

Information on the DM test

It is important to acknowledge the genetic test available for DM is an indicator of risk of development of this disease rather than a definitive test identifying affected animals. Dogs with the genetic sequence identified as increased risk for DM are more likely to develop the condition. However, even dogs without the at-risk sequence may develop DM.

It is clear our understanding of DM is insufficient to completely understand the development of the disease and other factors must be at play – possibly other genetic components and/or environmental components?

It should be noted that the research was based across a very large number of breeds and therefore conclusions were drawn across the breeds rather than on a breed-specific basis. Within the study, 90% of WFT's resulted in having 2 copies of the at-risk genetic sequence. WFTs had by far the greatest proportion of dogs tested as having 2 copies of the at-risk sequence of any breed involved in the study. This is quite alarming to read and with such a high proportion of WFTs tested as being at-risk, it leaves no practical breeding strategies, as doing so could cause the downfall of the breed through a genetic bottleneck.

It is also worth looking at our dogs in the real world and not just results published in the literature. Although this disease does occur within the breed, there are far fewer WFTs affected with the disease than the at-risk genetic sequence would suggest.

It can be suggested that for WFTs actively testing should be avoided for DM to prevent genetic bottlenecking through selective breeding. Especially when DM is a condition we have incomplete information on the development of the condition. If in time it becomes apparent DM is a significant health and welfare concern in our breed this recommendation may change.

CONCLUSION

I hope through this article I have encouraged other breeders to make use of the VDEGS genetic test. Several breeders have already been making use of the test and hope these breeders continue to do so in the future and help promote its importance to other breeders.

At this time, I would not recommend using the tests available for PLL and DM. If anyone reading this article has any experience of these diseases within WFTs I would be very grateful to hear from you.

Wishing you and your dogs the best of health for 2020.

David Hughes MRCVS

Please direct any health-related correspondence to email:
health@wirefoxterrierassociation.co.uk

REFERENCES

Hytönen MK, Arumilli M, Lappalainen AK, Owczarek-Lipska M, Jagannathan V, Hundi S, Salmela E, Venta P, Sarkiala E, Jokinen T, Gorgas D, Kere J, Nieminen P, Drögemüller C, Lohi H. Molecular Characterization of Three Canine Models of Human Rare Bone Diseases: Caffey, van den Ende-Gupta, and Raine Syndromes. *PLoS Genet.* 2016 May 17;12(5)

AHT DNA Testing. (2020). AHT DNA testing- Primary Lens luxation (PLL) Canine DNA test. [online] Available at: <https://www.ahtdnatesting.co.uk/tests/primary-lens-luxation-pll/> [Accessed 6 Feb. 2020].

Zeng R, Coates JR, Johnson GC, Hansen L, Awano T, Kolicheski A, Ivansson E, Perloski M, Lindblad-Toh K, O'Brien DP, Guo J, Katz ML, Johnson GS. Breed distribution of SOD1 alleles previously associated with canine degenerative myelopathy. *J Vet Intern Med.* 2014 Mar-Apr;28(2):515-21