THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Giant Schnauzer

Evidence Base

BHCP/Version 1/Feb 2020

CONTENTS

INTRODUCTION 3
DEMOGRAPHICS 3
BREED HEALTH CO-ORDINATOR ANNUAL HEALTH REPORT 4
BREED CLUB HEALTH ACTIVITIES 5
BREED SPECIFIC HEALTH SURVEYS 17
LITERATURE REVIEW 19
INSURANCE DATA 20
BREED WATCH 24
ASSURED BREEDER SCHEME 24
CANINE HEALTH SCHEMES 25
REPORTED CAESEAREAN SECTIONS 28
GENETIC DIVERSITY MEASURES 29
CURRENT RESEARCH PROJECTS 32
PRIORITIES 33
ACTION PLAN 34
REFERENCES 35

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 support them in making balanced breeding decisions that make health a priority.

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 committee or representatives if 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 and then monitored and reviewed on a regular basis.

DEMOGRAPHICS

The number of Giant Schnauzers 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 2.94 per year (with a 95% confidence interval of 1.43 to 4.45), reflecting a slight increase in the breed's population during this time. The number of registrations for the breed have fluctuated during this time but have never exceeded 350 animals per year.

[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.]

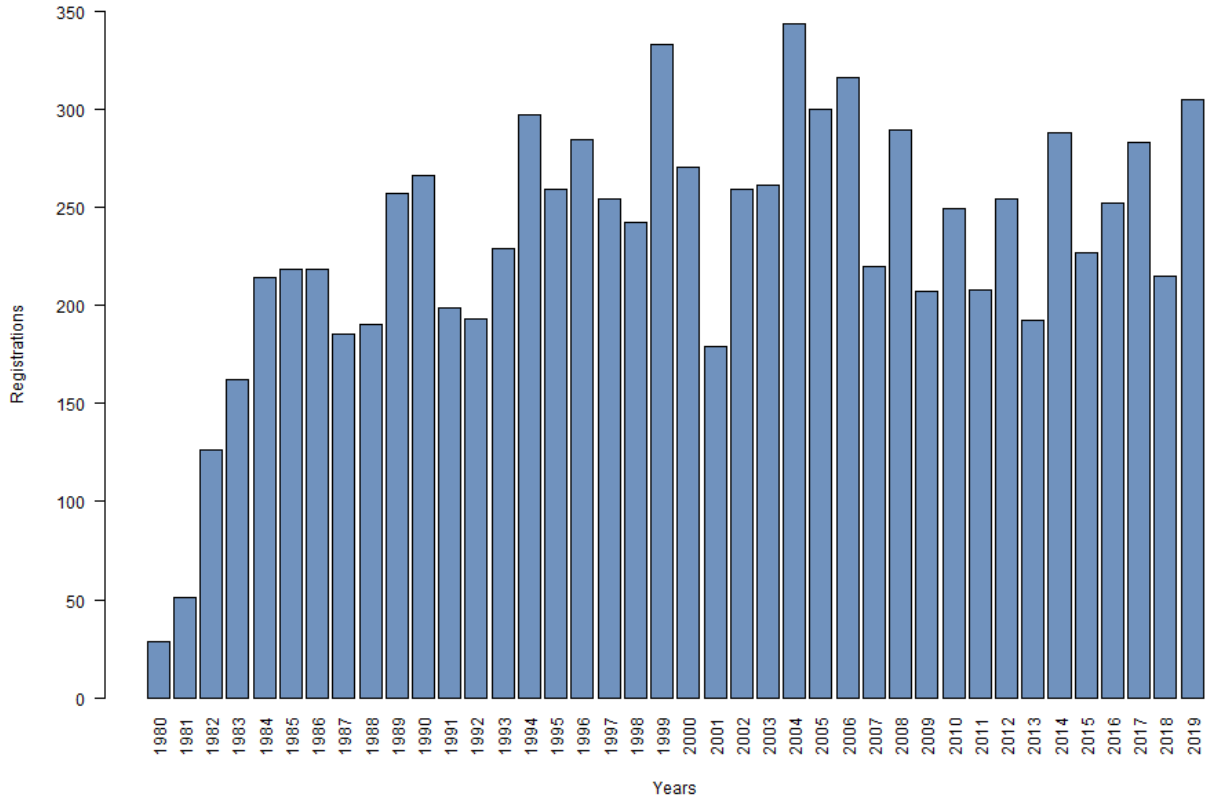

Figure 1: Number of registrations of Giant Schnauzers per year of birth, 1980 - 2019

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 Breed Health Coordinators' 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":

- Cancer
- Epilepsy
- Hereditary cataracts and general eye conditions

In terms of what the breed have done to tackle these concerns the breed have an ongoing reporting survey and are encouraging owners to ascertain the cancer type so that the breed can determine particular types, as well as this owners of affected dogs are encouraged to submit DNA samples to the Animal Health Trust (AHT). The breed have an online seizure reporting study and also encourage owners to submit samples to the AHT and provide information to the BHC for collation of information. Annual eye testing sessions are held for the breed and eye concerns in the breed are continuously monitored.

BREED CLUB HEALTH ACTIVITIES

The breed does not have a health committee/group/council but does have an active Breed Health Coordinator and a health page on the club websites listing health information, as well as this there is also a dedicated Giant Schnauzer health site: http://www.giantschnauzerhealth.org.uk/

Giant Schnauzer Epilepsy/ Seizure Study Report 2020

Epilepsy is the most common long-term neurological disorder experienced by dogs and is described as at least two unprovoked seizures occurring more than 24 hours apart. There is currently no specific diagnostic or DNA test available to determine whether a dog is affected, and the lack of a definitive diagnostic test and the variable age of onset makes it very difficult for breeders to select against the disorder (Rusbridge et al, 2014). The diagnosis is one of exclusion, where veterinary tests are performed in order to rule out any underlying cause, if no cause is found a diagnosis of idiopathic epilepsy is made (epilepsy of unknown origin).

In April 2017 an epilepsy/ seizure study commenced aimed at obtaining information from UK Giant Schnauzer owners. The purpose of the study was to initially identify individual dogs that met with the specific criteria for the AHT's 'Give a Dog a Genome' project (GDG). The AHT selected epilepsy in the Giant Schnauzer as a breed condition for which they would undertake a whole genome sequence. For the research project the AHT required a number of samples from which they would anonymously choose one affected Giant Schnauzer with idiopathic epilepsy. It was also hoped that additional dogs may potentially help with any other future research into the inherited form of epilepsy. The seizure study also served a dual purpose with an aim to try and determine the prevalence of seizures, and potentially highlight any causes and/ or triggers for seizures, any familial links, what treatment is available, and generally provide a better understanding of the nature of seizures/ epilepsy within the breed.

The seizure study was left running for a significant amount of time in order to obtain a sufficient number of participants that may provide an analysis. No time limit was specified for affected dogs, and up to the 1st May 2020, after 3 years, 39 Giant Schnauzers had taken part in the study having seizures/ epilepsy. In addition, one Giant Schnauzer crossbreed from overseas participated and is included in the study figures also. Four of the dogs were entered anonymously without a registered Kennel Club name from overseas, and these have also been included in the study in good faith. The year of birth of reported dogs ranged from 1998-2018 and during this same period 5,052 Giant Schnauzer puppies were registered in the UK. Of the 5,052 puppies registered in the UK only 0.57% (n=29) participated in the seizure study.

However, it was not possible for each individual owner of all dogs to be contacted or reached via advertising, and as such care must be taken interpreting the results as the number of affected dogs that took part in the study is relatively low.

All dogs that took part in the study experienced 2 or more seizures more than 24 hours apart.

A summary of the findings are given below, with the full report available at: http://www.giantschnauzerhealth.org.uk/health-info/epilepsy/seizure-study-reports/

Country of origin

Although the study was advertised in the UK, it was not limited to UK dogs only, 73% (n=29) of the dogs are known to have been bred in the UK, with three of these living in France and one in Cayman Islands. The remaining 27% (n=11) that took part were owned, and thought to have been bred overseas. However, the only overseas advertising would have been via UK social media groups, and therefore does not provide a representation of dogs worldwide.

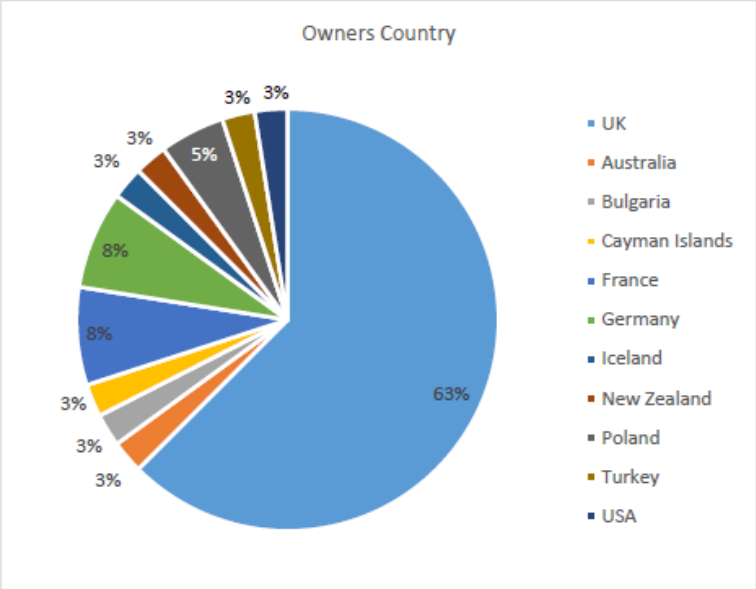

Figure 2: Country of origin of respondents completing the seizure survey.

Gender

Regarding gender, 65% of affected dogs were male, and 35% female, with males being 1.9 times more likely to be affected.

Just two dogs were reported to have experienced their first seizures under the age of six months (although one dog may have been 10 months following subsequent veterinary records) (Figure 3). The majority of dogs (35%, n=14) were between the age of 1 and 2 years, followed by a further 25% between the age of 2 and 3 years. In addition, 15% began having seizures aged 3 to 6 years, and just 10% were reported to start having seizures over the age of 6.

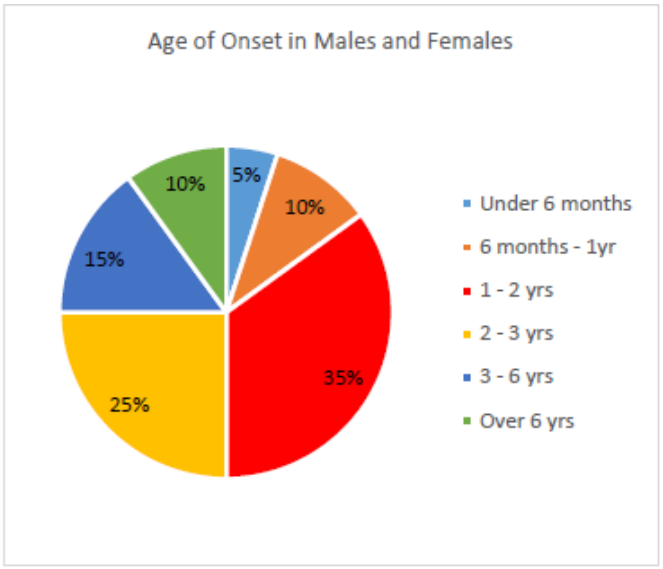

Figure 3: Age of onset of males and females reported for in the study.

When comparing the age of onset between males and females, 29% (n=4) of the female cohort started having seizures under 1 year, compared to 8% (n=2) of the males (Figure 4). The age of onset for the majority of males, 35% (n=9) and also females, 36% (n=5) was between 1 and 2 years. However, more males, 31% (n=8) started having seizures between the age of 2 and 3 years, compared to 14% (n=2) of the females.

The most common age of onset in the female cohort was between 6 months and 2 years, and in the male cohort between 1 and 3 years.

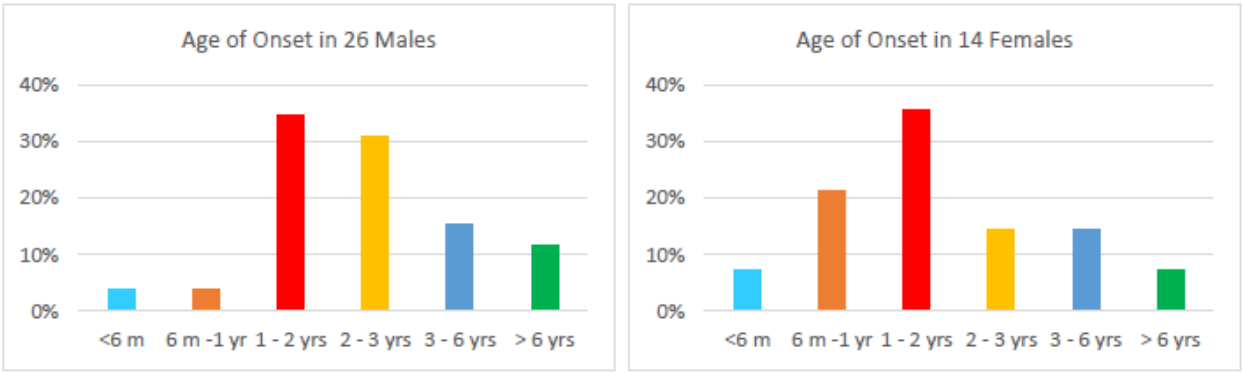

Figure 4: Age of onset of affected dogs categorised by sex.

Neuter status

Regarding neuter status, this was available for 23 (58%) of dogs reported for in the study, of which 74% were neutered, and 26% entire. It was only possible to determine seizure status prior/ after neutering in 10 dogs, in which 80% of dogs (n=8) were reported to start having seizures following being neutered.

Whilst there may be a link with fear phases in this age group, it raises a question as to whether hormonal changes may be associated with the onset of seizures in some Giant Schnauzers. In addition, of the dogs where the neuter status was identified the

majority (74%) were neutered, and the age of onset of seizures also coincided similarly with the most common age of neutering in both males and females. Where it was possible to determine whether seizures started before or after neutering 80% (n=8) started having seizures after castration or spaying.

This also coincides with the findings of a specific study in 2019 investigating associations between neutering and idiopathic epilepsy in Labrador retrievers and Border collies under primary veterinary care in the UK (Van Meervenee et al, 2019). The study used clinical data from VetCompass, and also found that 74% of neutered Labrador Retrievers and Border Collies diagnosed with idiopathic epilepsy were neutered before the onset of seizures. Their study found that neuter status was not associated with the occurrence of cluster seizures, however concluded that intact dogs had the longest survival times and that their results do not support recommendations to neuter dogs with idiopathic epilepsy within an evidence-based treatment plan.

Although the seizure study statistics indicated that neutering may be a possible non-genetic risk factor in some Giant Schnauzers, the sample size for this category is small. Future studies involving a larger sample of neutered dogs, and whether seizures started before or after neutering would be beneficial, along with a more in-depth study related to hormone levels in dogs having seizures.

Cause of death

Of the dogs that took part in the survey 55% (n=22) were currently alive and living with seizures, 28% (n=11) died as a direct result of seizures and 18% (n=7) died of another cause. Of those that died as a direct result of seizures 55% (n=6) were euthanised, and 45% (n=5) died during a seizure, one of which had an underlying heart condition.

The most common age of death (Figure 5) was between the age of 3-4 years, with five dogs (45%) dying at this age.

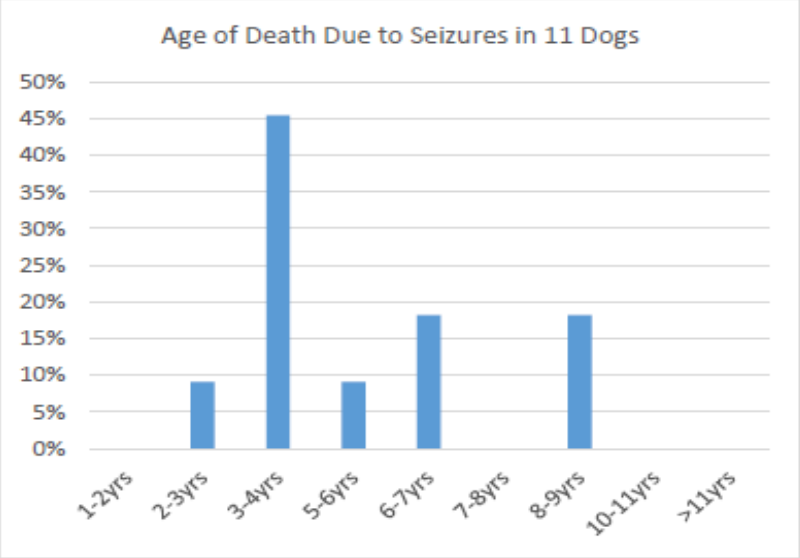

Figure 5: Age of death due to seizures in 11 dogs reported for in the seizure study.

Concerning the dogs that died due to another cause, all dogs died over the age of 6 years, with two dogs dying in each of the following age groups: 6-7 years, 8-9 years and over 11 years. The remaining dog died between 10-11 years. The causes of death were renal failure (n=2), cancer – unspecified (n=2), and one death for each of the following, accident, squamous cell carcinoma of the toe, and spinal degeneration.

Seizure frequency

Overall, 73% (n=29) of the dogs that took part had seizures frequently; the majority of 40% (n=16) had seizures every month, 25% (n=10) every 3 months, 5% (n=2) on a daily basis, and 1 dog on a weekly basis (Figure 6).

The remainder of the dogs had seizures less frequently; 10% (n=4) had seizures more than 1 year apart, 5% (n=2) every 6 months, and 5% (n=2) every year. In 8% (n=3) of the dogs, seizures were reported to have stopped with no further episodes.

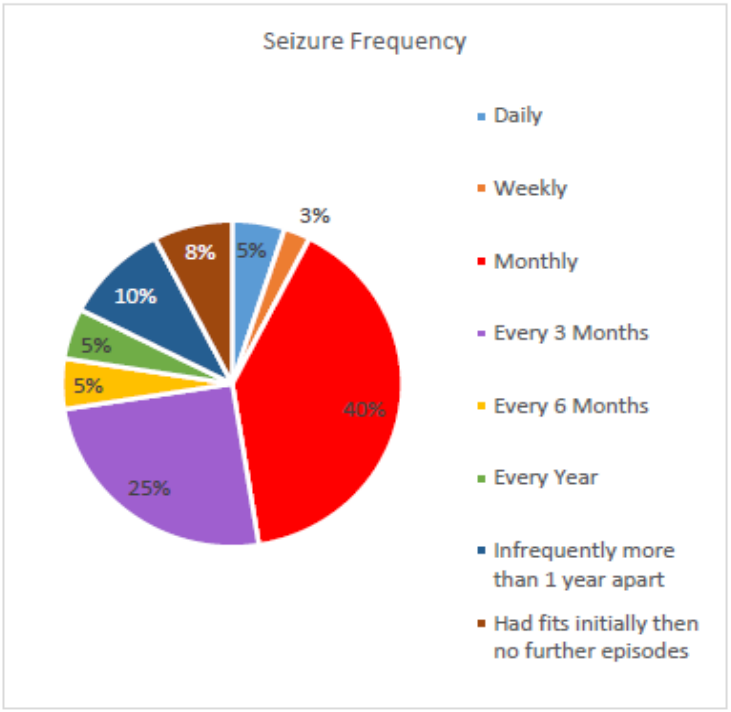

Figure 6: Frequency of seizures in affected dogs reported for in the seizure study.

Of the dogs with infrequent seizures, three owners reported environmental associations, including a full moon, thunderstorms, fireworks, change in routine (e.g. going on holiday), and air pressure. Further, two reported triggers such as flea treatments or stress.

Veterinary diagnosis

The majority of the dogs, 93% (n=37), attended a veterinary practice due to seizures, with only 8% (n=3) of the dogs not seeing a vet at all. Of these three dogs, all had infrequent seizures more than a year apart, or had seizures initially which then stopped. Most of the dogs seen by a vet had normal blood results 73% (n=27), and 14% (n=5) were reported as abnormal; one had kidney problems and Addison's

disease, and another had hypothyroidism - otherwise the abnormal result was not specified. The majority of urine test results were also found to be normal in 73% (n=27). Of those that attended a veterinary practice 11% (n=4) received no tests at all.

In total, 12 dogs underwent a MRI scan, of which 10 received a normal result, and two had an abnormality – however this was not specified. All nine dogs that had a cerebrospinal fluid (CSF) analysis were found to be normal.

The most common diagnosis was idiopathic epilepsy (38%, n=14) or epilepsy (35%), followed by possible epilepsy/ to observe (14%), hereditary epilepsy (5%), stress/ anxiety related seizures (5%) and one dog seizures.

Treatment

In terms of treatment, 55% (n=22) received prescription medication, 40% no treatment, and 5% herbal/ homeopathic.

Owners indicated if the treatment they were giving had been effective (Figure 7). Improvement was seen in 50% (n=12) of the dogs. Of these 25% (n=6) said the treatment had been effective and 25% (n=6) said there had been a partial improvement. Those who reported a partial response noted either a slight reduction in the number of seizures or the intensity. Further, 38% (n=9) of the owners indicated their dog showed no improvement at all with treatment, and 13% (n=3) of the owners stated it was too soon to tell.

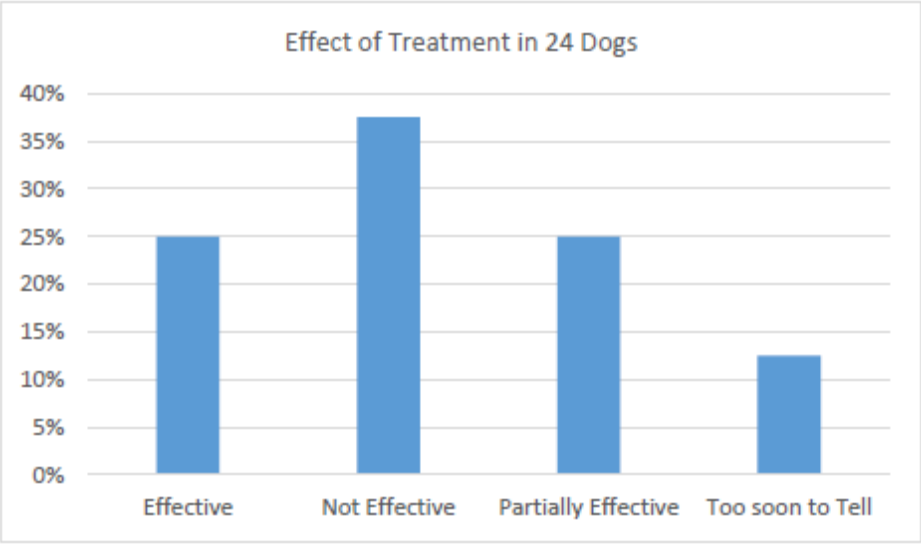

Figure 7: Percent of respondents that reported on the effectiveness of treatment in their dog.

For the dogs that were reportedly seen to have improved following treatment, the following drugs were used in either isolation or combination, Phenobarbitone, Imepitoin, Prozoc (for anxiety induced seizures), Diazepam, Levetiracetam and potassium bromide. Use of these drugs in isolation or combinations were also seen to partially improve seizure occurrence in six dogs, with the addition of Gabapentin and CBD oil also seen to partially improve seizure status. However, nine dogs

treated with the drugs above were found to show no improvement, with the addition of homeopathic remedies and laser acupuncture.

Activity at time of seizures

Owners were asked to identify what their dog was doing at the time a seizure occurred, with a number of owners reporting the same dog may have seizures under different circumstances.

In total, 46% (n=19) of the dogs had seizures whilst resting and equally 46% (n=19) whilst sleeping. The next most common activity involved stressful situations in 15% (n=6) dogs, followed by 13% (n=5) dogs where no pattern could be identified. Further, 10% (n=4) had seizures when out walking, 5% (n=2) when over excited and one dog when exercising. Of the 10% (n=4) recorded as 'Other', one owner commented seizures occurred during clipping/ grooming, which could be either noise or vibration sensitivity or a stress reaction, although the participant stated the same dog did have seizures at other times also. One owner commented that seizures occurred after vomiting. In addition, an owner stated seizures occurred just being outside.

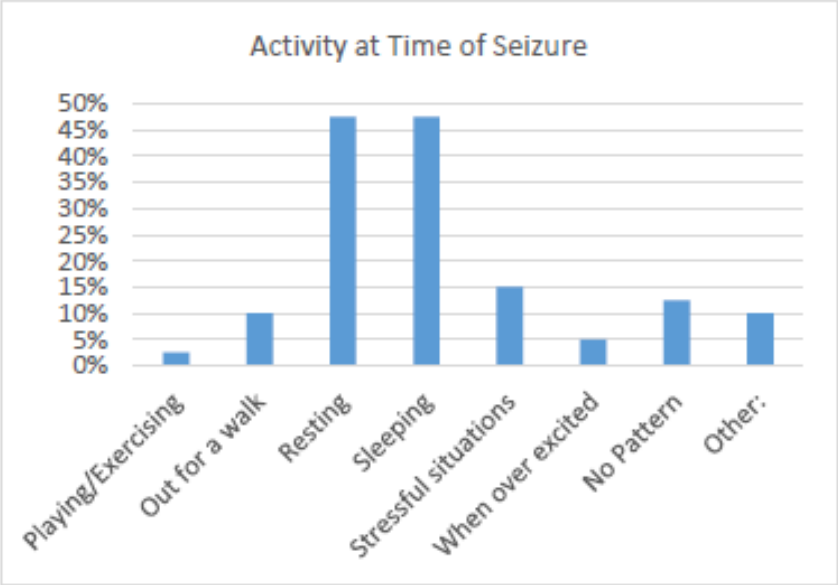

Figure 8: Activity at time of seizure in affected dogs.

In total, 50% of owners reported that their dog may have seizures at more than one time of day, with 40% of owners reporting seizures occurring at seemingly random times. However, 55% reported that their dog's seizures occurred during the night, compared to 30% reporting a seizure in the afternoon.

The RVC developed an epilepsy tracker app which a few owners downloaded and used to map seizure activity and medication requirements via mobile phone or tablet. The app contains information about epilepsy, diagnostic methods and practical advice on what to do in the event of a seizure. It can also remind owners when medication is due, and includes a seizure diary for recording episodes, pre- and post-ictal behaviour, duration and severity rating. A link to information about the app

can be found at:https://www.rvc.ac.uk/news-and-events/rvc-news/rvc-pet-epilepsy-tracker-app

Almost a third of owners were able to ascertain specific events that may trigger a seizure to occur. The ability to recognise potential triggers may facilitate management of the condition in some dogs by avoiding exposure to known triggers and environmental influences. However, a large number of owners stated that seizures were experienced on random occasions with no obvious triggers noted.

Behaviour

Overall, 73% of owners reported no behavioural disorders between seizures. Of those that did, 10% (n=4) described their dog as anxious/ stressed, 5% affected by loud noises, 5% general deterioration in personality, and one dog exhibiting each of the following: drowsiness, snappy, ataxic/ balance disorder.

In terms of pre-ictal behaviour (period before a seizure begins), 13% (n=5) displayed signs of stress/ anxiety, two dogs showed each of the following: became hyperactive, became clingy or sought out their owner, two vomited or had digestive problems, and one dog found a place to hide. However, since a lot of dogs were reported as having seizures whilst resting or sleeping the pre-ictal phase may be unnoticed.

Some dogs, 10%, had an overly anxious or stressed general disposition which also included noise sensitivity, and 15% of owners reported seizures to be triggered by stress, such behavioural comorbidities have previously been highlighted in epileptic dogs (Shihab et al, 2011). Specific stressful situations that were noted to be a trigger included a change in routine, moving house, other dogs in season, or situations where a loud noise preceded a seizure such as low flying aircraft, thunder and fireworks.

Additional health issues

A total of 25% (n=10) owners reported additional health conditions, with three dogs having more than one additional health issue. The most common additional illness was cancer recorded by five of the owners, with one dog also having hypertriglyceridemia. Further, two of the dogs had kidney problems, one of which also had Addison's disease. Other additional reports included: incontinence in a male after neutering and onset of seizures, a heart condition (aortic stenosis), hypothyroidism, and another individual also had spinal degeneration as well as stress eczema (Figure 9).

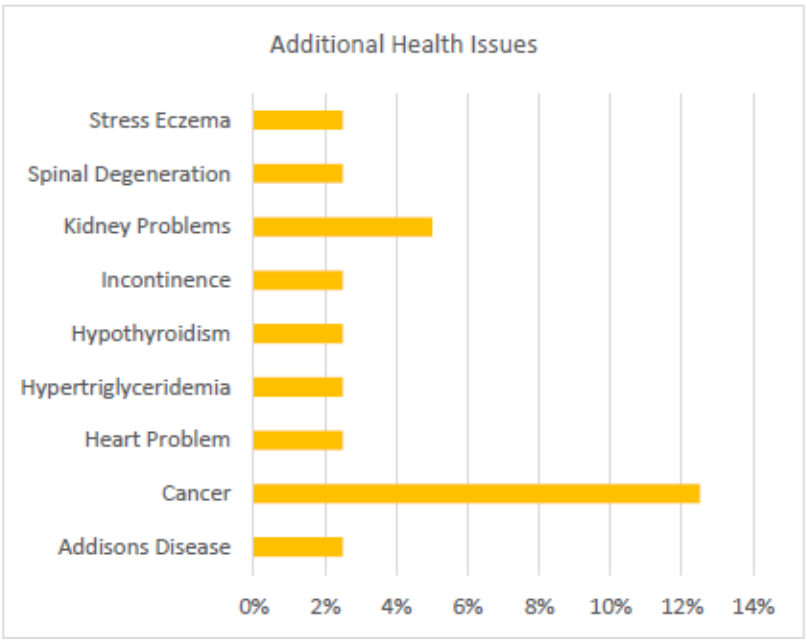

Figure 9: Additional health conditions reported in dogs affected by seizures.

Preventative treatment

Most dogs 75% (n=30) were vaccinated every year for distemper, hepatitis and parvovirus, followed by 13% (n=5) which were vaccinated once only. Additionally, one of the dogs were vaccinated every five years and a further one never received a vaccination at all. Further, 13% (n=5) were vaccinated once only, and just three dogs were vaccinated every 3 years as per the Veterinary Medicines Directorate (VMD) authorised vaccinations schedule for dogs (Assets.publishing.service.gov.uk, 2018.). Regarding Leptospirosis vaccination, 40% of dogs received this vaccination every year. In addition, three dogs received the vaccine just one, and two were reported to receive this every 3-5 years.

The VMD states that for the majority of UK authorised dog vaccines the re-vaccination interval for the core vaccines canine distemper (CDV), canine parvovirus (CPV) and canine adenovirus (CAV) is at least every three years. These authorised re-vaccination schedules are in accord with the WSAVA Guidelines which state “revaccination (booster) at either 6 months or 1 year of age, then not more often than every 3 years”. There have been some anecdotal reports of adverse events following the use of Leptospira vaccinations, with the VMD advising owners to discuss and agree a vaccination programme for their animals. This should be based on the local epidemiological circumstances and balanced with potential risks.

Regarding flea treatment, 65% of dogs were treated regularly, with these being either monthly or every 3-6 months. In addition, 15% (n=6) were reported to having received no treatment, and a further six just when treatment was required. The most commonly used active ingredient in flea treatments was Imidacloprid (28%), followed by Fipronil (20%), Isoxazoline (18%), Moxidectin (15%), Permethrin (8%), Exspot

(8%) and Indoxacarb (3%). One owner used tea tree oil as a treatment. It is worth exploring further any association between seizure status and flea treatments as this has been anecdotally reported as a potential risk factors. Some brands, of which the above are components of their products, carry warnings of potential neurological signs as an adverse reaction.

When considering worming, 8% were treated only as puppies, however the majority of dogs were treated every 3 months (43%), annually (10%) and every 6 months (13%). A further 23% were only treated if required. Drontal (20%) and Milbemax (20%) were the most common known dewormer.

Diet

Diet is often thought to be a potential trigger in some dogs, 68% of those having seizures were fed a complete dry kibble diet and 18% were fed raw or pre-prepared raw food. However, without further research it was not possible to determine any common dietary associations, such as nutritional content or whether foods contained similar preservatives, grains etc. as 26 different brands were used and individual varieties were not specified. It has previously been suggested that diet can have a role to play in epilepsy, in particular depending on how specific epileptic drugs interact with components of diet – however further research is needed to determine any association.

The RVC also stated that small changes to the diets of dogs with hard-to-treat epilepsy has the potential to reduce the number of seizures and improve the quality of life for affected dogs and their owners. A recent study carried out by the RVC showed that an oil, which contains a specific type of fat known as medium-chain triglyceride (MCT) could have beneficial effects when given as a supplement to a dog's existing diet. Overall, the RVC research found that in 17 out of 28 dogs seizure frequency significantly reduced with the addition of MCT oil, and had an improved quality of life (Berk et al, 2020). However, further investigation into any links between diet in the breed need to be undertaken before drawing strong conclusions, and it important to consider that this study was based on a small number of dogs.

Prevalence/ Incidence

Prevalence and incidence are difficult to determine since all surveys were based on voluntary completion and, as such, may be subject to under-recording and/ or self-selection bias. The Canine Epilepsy Research Group at the RVC had no specific information regarding epilepsy in the Giant Schnauzer, with just one or two study participants in a handful of epilepsy treatment papers. The lack of RVC information relating to the breed simply reflects the relatively small population in the UK overall compared to other breeds.

However, two independent UK health surveys, with the largest number of responses for Giant Schnauzers, both reported similar prevalence data. The UK Schnauzer Breed Clubs 2013/ 2014 Joint Schnauzer Breeds Health Survey reported a prevalence of 4% (n=11) out of 275 live Giant Schnauzers (see results on page 19). The Kennel Club's Health Survey 2014 found the prevalence to be 3.7% (3/82 live dogs) (page 18). The prevalence of epilepsy in the general dog population is not truly known but significant studies have estimated it to be 0.6–0.8% (Hulsmeyer et al, 2015), therefore the prevalence in the Giant Schnauzer appears to be slightly above that of all dogs in general.

With the information obtained from the seizure study it was possible to identify the number of new cases per year compared to the number of UK puppy registrations, in order to determine the incidence of epilepsy. To provide a more accurate picture of the current status, those born and registered in the UK over the previous 10 years; 2009-2018 (n=19) dogs, were compared against Kennel Club puppy registrations for the same period (2,194), indicating an incidence of 0.9% (see Table 1).

Table 1: Percentage of Giant Schnauzer puppies that were reported as affected by seizures per year of birth.

Year	Pups Registered	Affected	% Affected
2009	214	2	0.9%
2010	228	4	1.8%
2011	214	1	0.5%
2012	221	2	0.9%
2013	187	3	1.6%
2014	242	4	1.7%
2015	188	2	1.1%
2016	243	0	0.0%
2017	238	0	0.0%
2018	219	1	0.5%

Therefore, whilst 3.7 - 4% of the population may be living with epilepsy the seizure study shows that the risk of a puppy developing epilepsy was 0.9%.

Inheritance and breeding

In order to determine whether a possible inheritance pattern could be identified, in addition to any potential breeding advice, pedigree diagrams were drawn using Pedigree Draw online software from three groups of dogs.

An example of a pedigree diagram from one group of dogs is shown below in Figure 10. Males are represented by a square and females by a circle, the diagram shows one generation progressing to the next. The pedigree chart demonstrates the complexity due to inbreeding, since many dogs have multiple litters and are interrelated with different breeding partners.

In Figure 10 below, dogs linked with the same letter are the same dog often mated to another breeding partner e.g. male ‘A’ is linked to male ‘A’ since they identify the same dog. The males labelled ‘F1’ and ‘F2’ are actually brothers, however, due to the complexity of the diagram, it is difficult to show their relationship. The colour key shows the status of the seizures. Those with a diagonal line are thought to have died prematurely. The dogs shown on the diagram also share a number of common ancestors that each go back to the popular dogs that were used to shape the breed in the past. And as such, this further adds to the complexity since there are a larger number of unaffected healthy dogs that also go back to the same ancestry.

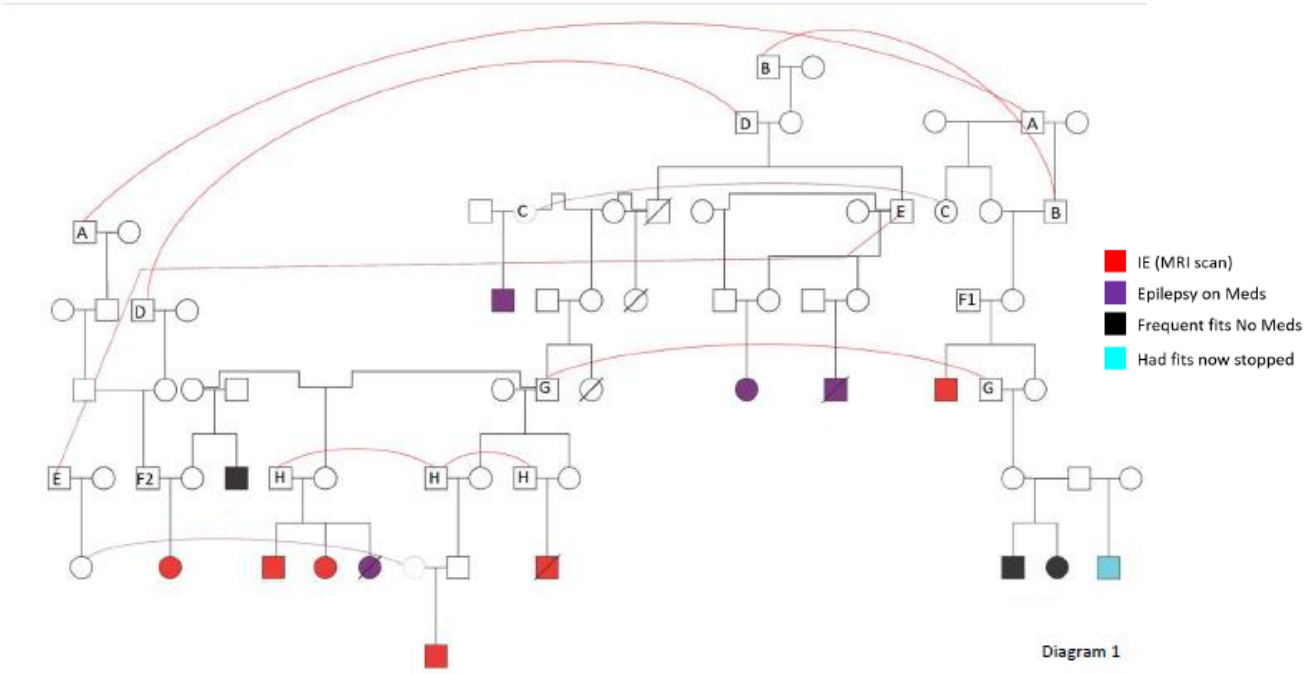

Figure 10: An example of pedigree analysis that was undertaken as part of the seizure study.

Epilepsy is a difficult condition about which to give breeding recommendations. In most breeds, idiopathic epilepsy (now defined as two or more unprovoked seizures at least 24 hours apart with no identifiable caused other than a suspected genetic origin) is considered likely to be a complex condition affected by many genes and also environmental effects. For complex conditions, breeding decisions in many ways become about risk management. However, how much risk any particular mating represents is hard to define at this stage. As shown in the pedigree diagrams the picture is complicated. Do the different presentations of "affected" dog e.g.

seizures more than 1 year apart versus frequent seizures requiring medication represent different degrees of severity of the same condition, or do they actually represent different conditions? At this stage these questions are not confirmed.

Regarding breeding advice, it is difficult to advise without further research. However, the current recommendation is to avoid a repeat mating which has previously produced puppies that have gone on to be diagnosed with idiopathic epilepsy.

Regarding breeding later on in life to ensure the dog is not affected, the information provided by the age of onset analysis may be useful in determining the minimum age after which the risk of developing epilepsy may begin to reduce. In females the incidence appears to reduce slightly after the age of 2 years and in males after the age of 3 years; in both males and females the risk is reduced further after the age of 6 years. However, the statistics also show that seizures have been known to occur beyond these ages in some cases and therefore provides no guarantee. Consideration should also be given to dogs producing epilepsy when mated to more than one breeding partner, and whether it is wise to continue breeding from a dog associated with multiple instances of epilepsy.

The inbreeding coefficients of those affected vary from as high as 20% in a number of dogs down to 0.6%. This shows that utilising a breeding strategy based solely on a low inbreeding coefficient may not necessarily suffice. Consideration for the health status of dogs on both sides of the pedigree is also required in order to manage the risk, even though breeding mates may appear to be unrelated.

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 reported for 113 live Giant Schnauzers of which 63 (56%) were healthy and 50 (44%) had at least one reported health condition. The top disease conditions by organ system/category for the breed were: urologic (12.6%, 13 of 103 reported conditions), dermatologic (10.7%, 11 of 103 reported conditions), musculoskeletal (10.7%, 15 conditions), and gastrointestinal (9.71%, 10 conditions). The most frequently reported specific conditions were hypothyroidism (6 cases) bladder infection/ cystitis (5 cases), and four cases of other, false pregnancy/ pseudopregnancy and incontinence – unspecified.

2004 Mortality results: A total of 39 Giant Schnauzer deaths were reported. The median age of death was 10 years (min = 8 months, max = 16 years and 11 months). The top causes of death by organ system/category for the breed were: cancer (41.0%, 16 deaths), cardiac (15.4%, 6 deaths), cerebral vascular (10.3%, 4 deaths) and old age (10.3%, 4 deaths). The most specific cause of death was stroke/ cerebral vascular infarction (4 deaths).

2014 Morbidity results: Health information was reported for 82 live Giant Schnauzers of which 49 (59.8%) reported no conditions and 33 (40.2%) had at least one reported health condition. The most frequently reported specific conditions were skin (cutaneous) cyst (8 cases, 11.11% proportion), lipoma (6 cases, 8.33% proportion), skin lump (4 cases, 5.56%), and urinary incontinence (4 cases, 5.56%).

2014 Mortality results: A total of 17 deaths were reported; the top causes of death were reported to be lymphoma (3 deaths), and 2 cases for bone tumours, cancer – unspecified, and unknown.

Joint Schnauzer Breeds Health Survey

The Joint Schnauzer Health Survey, organised by The Giant Schnauzer Club, The Miniature Schnauzer Club, The Northern Schnauzer Club and The Schnauzer Club of Great Britain have held regular health surveys from 2009 for the three Schnauzer varieties with each year accumulated from the previous to give an ongoing picture of breed health.

From the most recent report (2013 – 2014) responses were received from 148 owners, which represented 275 dogs. When asked for cause of death the most commonly reported problems were cancer – unspecified (29 cases), other (15 cases), gastrointestinal (10 cases), and old age (9 cases), out of 88 total deaths. With regard to reported health concerns, these are summarised in the table on the next page (Table 2).

Table 2: Summary of Reported Health and Welfare Concerns for Giant Schnauzer Owners

Condition	Number Affected	Percentage of Dogs
Timid	36	13.1%
Aggressiveness	18	6.55%
Other	11	4.00%
Epilepsy	11	4.00%
Bladder	10	3.64%
Gastrointestinal	8	2.91%
Hypothyroidism	8	2.91%
Noisiness	8	2.91%
Autoimmune	4	1.45%
Cancer – unspecified	4	1.45%
Eye problems	3	1.09%
Testicles	2	0.73%
Blindness	2	0.73%
Heart	2	0.73%
Destructive	2	0.73%
Teeth/Mouth	2	0.73%

The breeds are currently undergoing the fourth joint health survey, with responses being collected on the Schnauzer Health Survey website: http://www.schnauzerhealthsurvey.org.uk/

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.

It is worth taking into account that although studies including the Giant Schnauzer have a small sample size and a small number of the breed represented, this breed makes up a numerically very small percentage of the overall dog population. For example, in 2018 out of 250,611 Kennel Club registrations only 211 (0.08%) of these registrations were Giant Schnauzers.

Cancers

Squamous cell carcinoma of the digit (SCCD): This is form of cancer has been detailed in the breed from at least 1989 (Paradis et al, 1989). Potential haplotypes for the breed were compared with two other breeds, with dogs originating from the USA, with 536 variants available (Karyadi et al, 2013). A linkage disequilibrium region of a SNP (single nucleotide polymorphism) at the *KITLG* locus was found to

be present in all 28 cases of Giant Schnauzer assessed and 12 of the 13 unrelated controls, indicating that the breed may be fixed for this region. An odds ratio of 22.7 (95% CI 16.0 – 32.3) was established for the breed.

A French study noted that dark haired dogs comprised the majority of their dataset, with 92% (n=105) having dark colouration (Belluco et al, 2013). As well as this, 75.2% of affected dogs were of a large and giant breed, and the forelimbs were affected twice as much as that of the hind limbs. Schnauzers were one of two most commonly affected breeds, although they did not specify whether these were Giant, Standard or Miniatures.

Endocrine Conditions

Autoimmune lymphocytic thyroiditis: An investigation into dog leucocyte antigens (genes that encode proteins found on the surface of cells that act in regulating the immune system) found two potential antigens, one of which appears to act as a genetic risk factor for thyroid disease, and the other protective for disease (Wilbe et al, 2010). Dogs that carried the haplotype (DLA-DRB1*01201/DQA1*00101/DQB1*00201) had an increased risk, with an odds ratio of 6.5 (99% CI 1.1 – 136) and those that carried a different (DLA-DRB1*01301/DQA1*00301/DQB1*0050) had a much lower risk of 0.3. Other breeds that carried the first haplotype also were more likely to become affected by thyroiditis.

Gastrointestinal Conditions

Gastric-dilatation volvulus/ bloat: A study in 2010 looked at the Kennel Club's 2004 Purebred Dog Health Survey, specifically with regard to bloat (Evans & Adams, 2010). Whilst no deaths in the Giant Schnauzer were due to bloat, there were two cases (out of 113 live dogs) reportedly affected, giving a breed prevalence of 1.8%. However, caution must be taken with this due to the small number of dogs involved.

Ocular Conditions

Progressive retinal atrophy: A DNA test was developed for the breed and recognised by the Kennel Club in 2019 following genome sequencing of two PRA-affected siblings and their unaffected parents (Hitti et al, 2019). The disease was established to be inherited in an autosomal recessive manner through a mutation in the *NECAP1* gene.

INSURANCE DATA

UK Agria 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 UK insured population.
- Only clinical events that are not excluded and where the cost exceeds the deductible excess are included (O'Neill et al, 2014)

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 (Egenvall et al, 2009).

Insurance data were available for Giant Schnauzers insured with Agria UK. 'Exposures' are equivalent to one full policy year; in 2017 there were 129 free exposures, 36 full exposures and 28 claims, in 2018 (up to June) these figures were 125 , 32 and 15 respectively. Full policies are available to dogs of any age. Free policies are available to breeders of Kennel Club registered puppies and cover starts from the time the puppy is collected by the new owner; cover under free policies lasts for five weeks from this time. It is possible that one dog could have more than one settlement for a condition within the 12-month period shown.

Conditions by number of settlements, for authorised claims where treatments started between July 2017 and June 2018, are shown in Table 3 below.

Table 3: Top 10 conditions and number of settlements for each condition between 1st July 2017 and 31st June 2018 for Giant Schnauzers insured on full policies with Agria UK

Condition	**Number of settlements**
Mass lesion - gingival (gum)	3
Neurological (nervous system) disorder (unspecified)	2
Bite injury	2
Gastroenteritis	2
Squamous cell carcinoma - cutaneous (skin) digit	1
Neoplasm - skin (cutaneous)	1
Lipoma (site unspecified)	1
Hypothyroidism	1
Urinary bladder functional disorder	1
Atopy finding	1

Swedish Agria data

Swedish morbidity and mortality, insurance data were available from Agria for the Giant Schnauzer. 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. one DYAR is equivalent to one full year of insurance. The number of DYAR for the Giant Schnauzer during this period was 2,500 < 5,000. Therefore, due to the relatively small number of DYAR the results below should be interpreted with caution.

A summary is given below, with the full findings available at: https://dogwellnet.com/

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Giant Schnauzers in Sweden between 2011 and 2016 are shown in Figure 11. The top five specific causes of VCEs were claw trauma, skin tumours, vomiting/ diarrhoea/ gastroenteritis, skin trauma and symptoms of pain on locomotion.

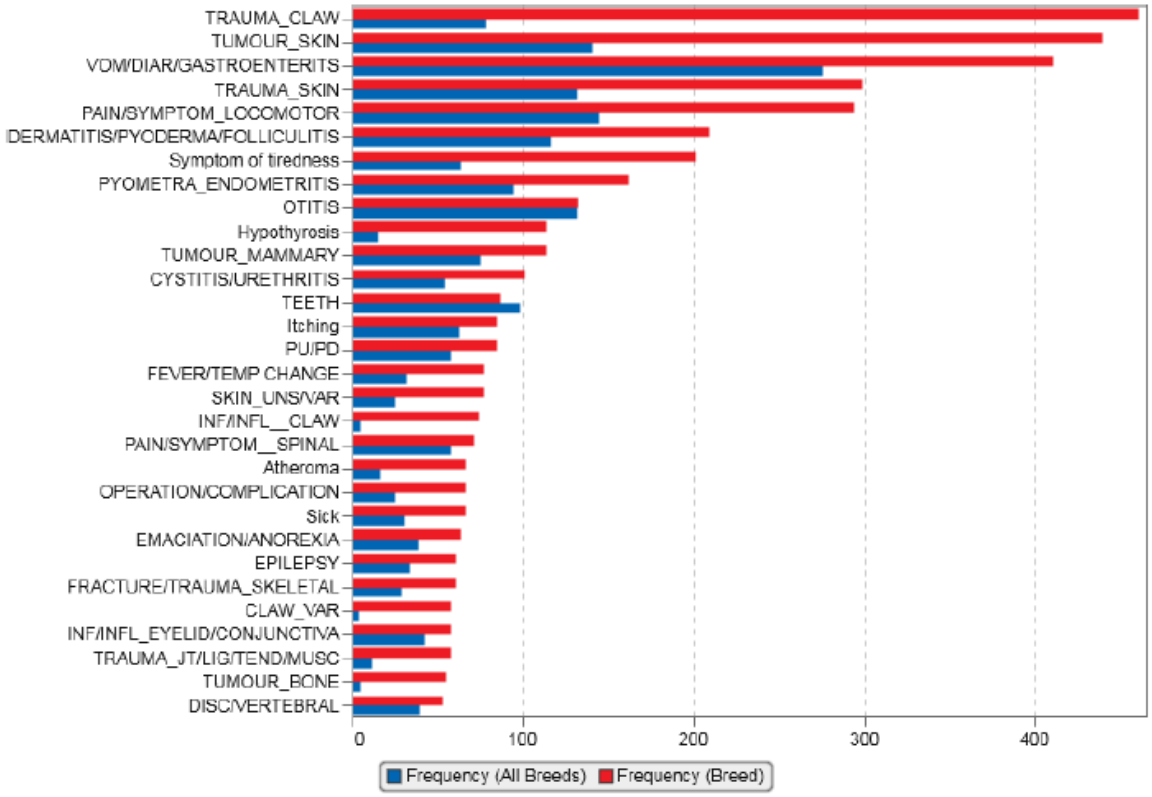

Figure 11: The most common specific causes of VCEs for the Giant Schnauzer compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

The specific causes of VCEs ordered by relative risk for Giant Schnauzers are shown in Figure 12. In this analysis, the top specific causes of VCEs ordered by relative risk were claw – various, infection and/ or inflammation of the claw, infection and/ or inflammation of the bone, bone tumour, claw – various, and hypothyrosis.

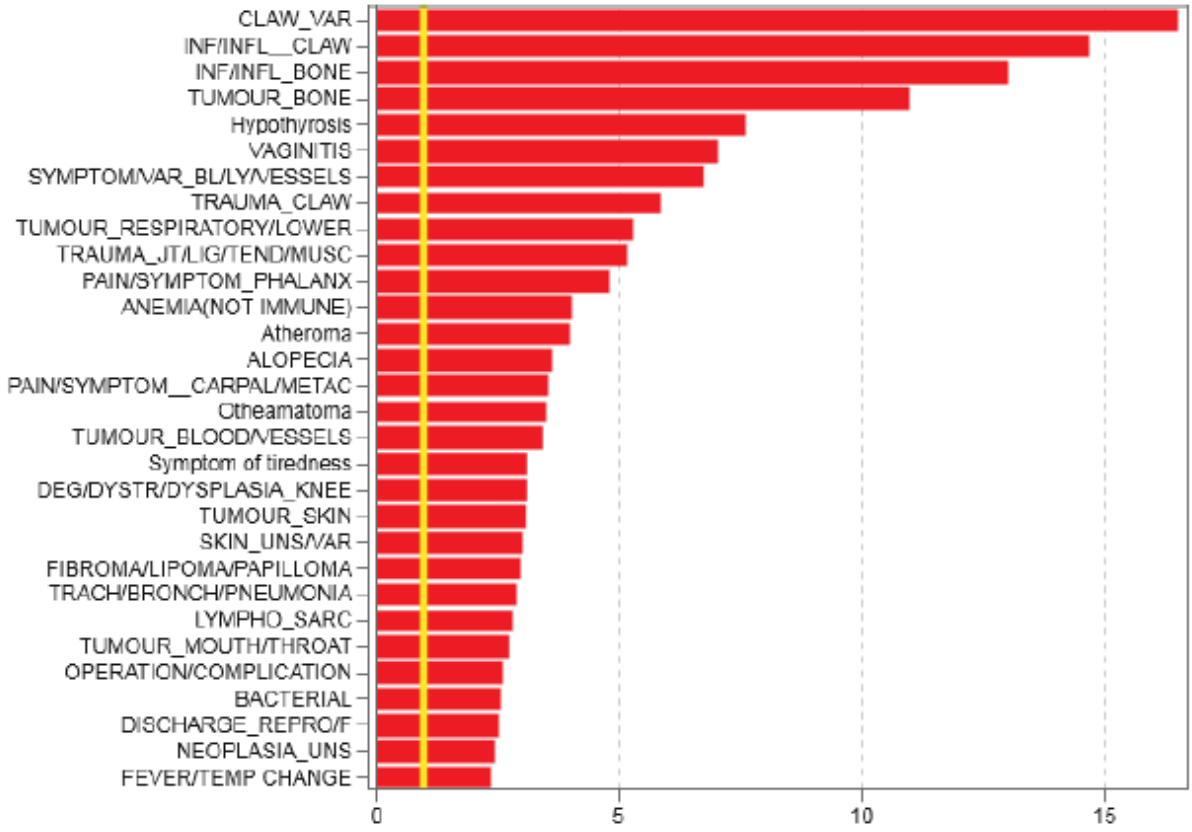

Figure 12: The specific causes of VCEs for the Giant Schnauzer ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

Swedish Agria insurance mortality data

Two specific causes of death or euthanasia for Agria-insured Giant Schnazuers in Sweden between 2011 and 2016 are shown in Figure 13. These were epilepsy and skin tumours. It is possible that there were more causes of death reported but during this analysis, only reported deaths where more than eight dogs died due to that condition are shown.

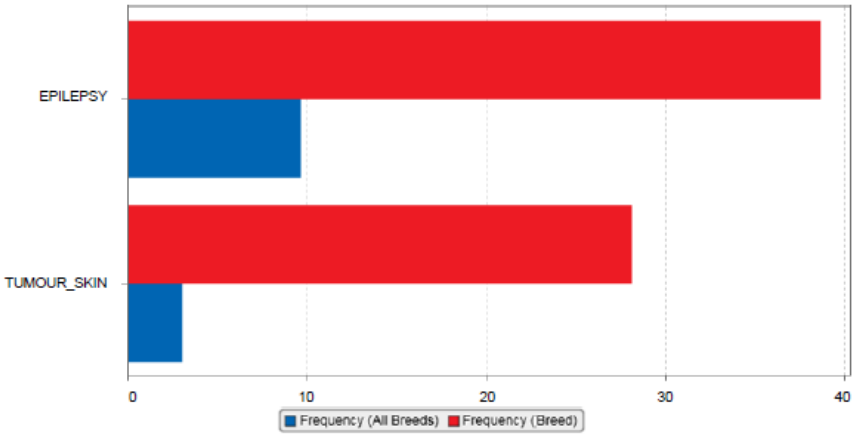

Figure 13: The most common specific causes of death for the Giant Schnauzer compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

The causes of death, skin tumours and epilepsy, by relative risk for Giant Schnauzers are also shown in Figure 5.

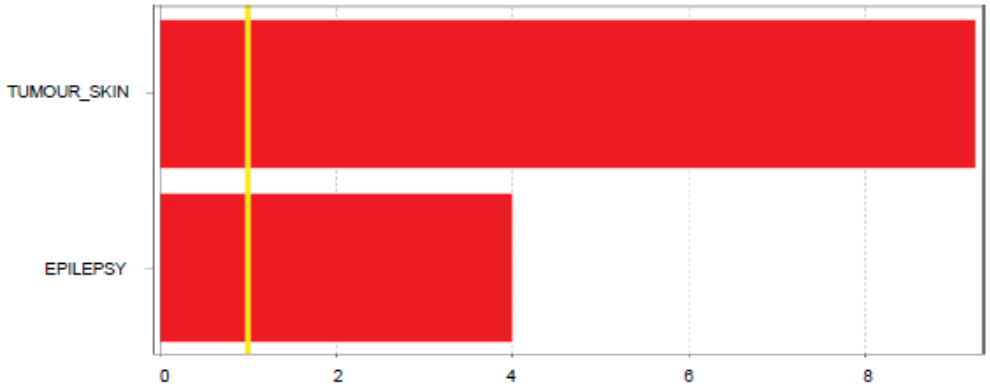

Figure 14: The most common specific causes of death for the Giant Schnauzer compared to all breeds by relative risk in Sweden between 2011 and 2016, from Swedish Agria insurance data.

BREED WATCH

The Giant Schnauzer is a category 1 breed; therefore judges do not need to submit a mandatory health monitoring form when judging this breed at championship certificate level. To date no optional reports for the breed have been reported.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme it is required that all breeding stock undergo the following prior to breeding:

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

There are also the following recommendations currently available for the breed:

- Hip score all breeding stock under the BVA/KC Hip Dysplasia Scheme
- Eye test litter screening under the BVA/KC/ISDS Eye Scheme

DNA TEST RESULTS

The following DNA tests are accepted by the Kennel Club:

- progressive retinal atrophy – prcd (prcd – PRA)
- dilated cardiomyopathy (DCM)
- PRA5 (recognised as of August 2019)

A list of laboratories that provide the test can be found through clicking here: https://www.thekennelclub.org.uk/worldwide-dna-tests/

As a note, as of January 2022 hereditarily clear status will no longer apply after three 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 biggest contributor to mistaken status will be removed. Therefore, where parentage is confirmed by DNA test the status can be prolonged for the subsequent generation.

To date (26/02/2020) 170 DNA test results have been received for the breed. The results of these test results are shown in Table 4 below.

Table 4. DNA Test Results for Giant Schnauzers tested to date.

DNA Test	Affected	Carrier	Clear	Hereditary Clear	Total Tested
prcd-PRA	0	0	17	35	52
DCM	0	0	21	85	106
PRA5	0	0	8	4	12

CANINE HEALTH SCHEMES

Participation in the BVA/KC Canine Health Schemes are open to dogs of any breeds regardless of whether the scheme comes under an ABS requirement or recommendation. Estimated Breeding Values (EBVs) cannot be calculated currently due to the very small numbers of Giant Schnauzers which have participated in the schemes to date.

HIPS

A total of 185 Giant Schnauzers have participated in the BVA/KC Hip Dysplasia Scheme since the scheme began (up until August 2020), of which 65 were tested in the past 5 years. From this, a 15 year and 5 year median score of 10 (range 0-46 for the past 5 years, and 0-58 in the past 15 years) were established. The 3-year rolling mean hip scores for the breed over the past 15 years are shown in Figure 15. Overall, the mean score has reduced over this time period, however there is a wide degree of fluctuation due to the small numbers of the breed tested per year.

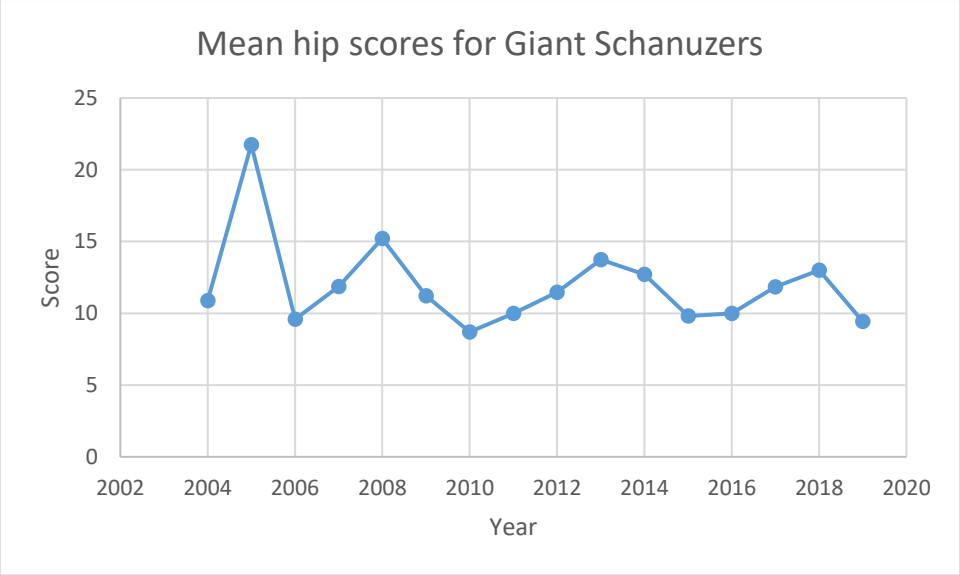

Figure 15: Rolling mean hip scores for Giant Schnauzers from 2004 to 2019.

ELBOWS

A total of 55 Giant Schnauzers have been elbow scored as part of the BVA/KC Elbow Dysplasia Scheme since the scheme launched in 1998, with 52 of these scoring a 0 and only 3 scoring 1.

EYES

The Giant Schnauzer is currently on the Known Inherited Ocular Diseases (KIOD) List (formally known as Schedule A prior to the 1st January 2020) for hereditary cataracts under the BVA/KC/International Sheep Dog Society (ISDS) Eye Scheme. The 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, 1,019 eye examination results have been recorded by the BVA, with the results for these dogs shown in Table 5 below.

Table 5: Eye test results for Giant Schnauzers tested under the BVA/KC/ISDS Eye Scheme

Eye Test Result	**Number Tested**
Affected HC	16
Unaffected	1003
Total	**1,019**

Schedule B has been replaced with sightings reports, which are in place to monitor any emerging or existing eye conditions in the breed. The results of Eye Scheme sightings reports of Giant Schnauzers which have taken place since 2012 are shown in Table 6.

The BVA/ KC Eye Panel Working Party will continuously monitor the incidence of current and emerging eye concerns and make regular updates to both the KIOD list and the sightings reports.

Table 6: Sightings reports on Giant Schnauzers which have participated in the BVA/KC/ISDS Eye Scheme since 2012.

Year	Number seen	Comments
2012	28 litters	7 litters MRD affected (8 out of 47 puppies)
2013	27 litters	7 litters MRD affected (12 out of 50 puppies)
2014	19 litters 70 adults	8 litters MRD affected (10 out of 72 puppies) 1 - Corneal lipid deposition 1 – PPM 1 – nuclear cataract 4 – other cataract 3 – MRD 3 – chorioretinitis (inactive)
2015	24 litters 84 adults	8 litters MRD affected (20 out of 76 puppies) 1 – distichiasis 4 – PPM 1 – afferent pupillary defect 3 – PHPV 2 – other cataract 1 – MRD 1 – scrolled third eyelid 3 – chorioretinitis 1 – HC
2016	20 litters 63 adults	4 litters MRD affected (6 out of 28 puppies) 4 - PHPV (litters) 1 – PHPV 4 – other cataract 2 – GPRA-like appearance
2017	28 litters 69 adults	4 litters MRD affected (6 out of 29 puppies) 2 - PHPV (litters) 1 – corneal lipid deposition 2 – PPM 3 – PHPV 1 – post capsular cataract 2 – PPSC cataract 2 – post cataract 1 – nuclear cataract 2 – MRD-like appearance
2018	19 litters 83 adults	2 litters MRD affected 2 – posterior polar subcapsular cataract 1 – nuclear cataract
2019	*Awaiting report*	

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (AVCO)

Throughout 2015 to 2019, 318 Giant Schnauzers were examined for ocular disorders under ACVO. The resultant prevalence data is shown in Table 7 below, alongside that for previous time periods. Overall, 78.3% (249 of 318 dogs) of Giant Schnauzers examined between 2015 and 2019 had normal eyes unaffected by any 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 can be a valuable source of information.

Table 7: ACVO examination results for the Giant Schnauzer, 1991 - 2019

Disease Category/Name	**Percentage of Dogs Affected**	
	1991-2014 (n=1,052)	**2015-2019** (n=318)
Uvea		
Persistent pupillary membranes (iris to iris)	3.1%	4.1%
Persistent pupillary membranes (lens pigment foci/ no strands)	0.6%	1.9%
Lens		
Cataract (significant)	6.3%	5.7%
Retina		
Retinal dysplasia – folds	2.3%	1.6%

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

REPORTED CAESEAREAN 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.

Table 8: Number and percentage of litters of Giant Schnauzers 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	41	0	0.0%	0.15%
2010	37	0	0.0%	0.35%
2011	29	0	0.0%	1.64%
2012	34	4	11.76%	8.69%
2013	27	4	14.81%	9.96%
2014	32	3	9.38%	10.63%
2015	22	3	13.64%	11.68%
2016	31	3	9.68%	13.79%
2017	30	4	13.33%	14.92%
2018	26	4	15.38%	16.98%
2019	36	4	11.11%	15.70%

GENETIC DIVERSITY MEASURES

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the 'gene pool' of the breed. In the population analysis undertaken by the Kennel Club in 2015, an estimated effective population size of **100** was reported (estimated using the rate of inbreeding over the period 1980-2014).

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

Annual mean observed inbreeding coefficients (showing loss of genetic diversity) and mean expected inbreeding coefficients (from simulated 'random mating') over the period 1980-2014 are shown in Figure 17. The rate of inbreeding for the breed appears to be on the decrease, implying increased awareness of genetic diversity when breeders are considering mates for their dog. For full interpretation see Lewis

et al, 2015 https://cgejournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4.

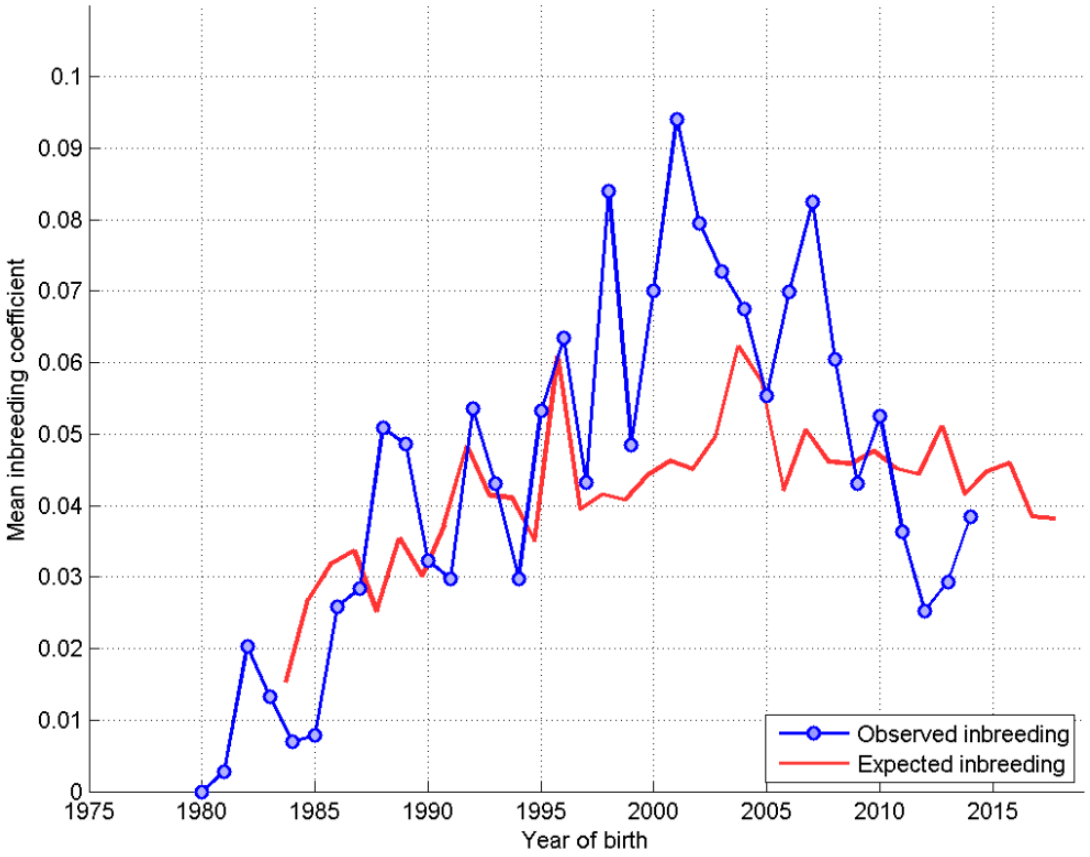

Figure 17: Annual mean observed and expected inbreeding coefficients

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven 5-year blocks (Figure 18). 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). It appears that the extensive use of popular dogs as sires is still prevalent in the breed, although it has reduced since the early 1990s.

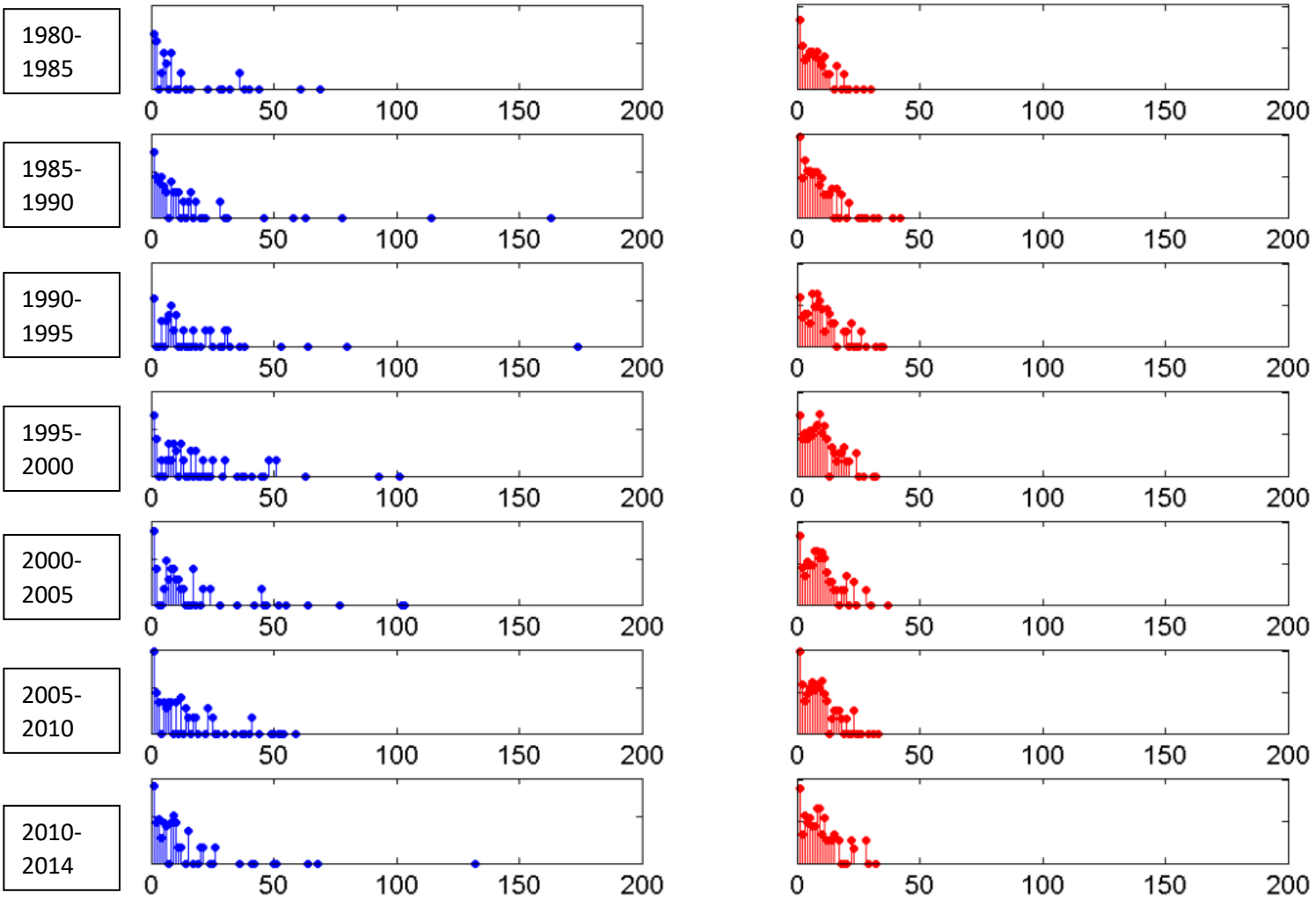

Figure 18: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-14 bottom). Vertical axis is a logarithmic scale.

The Breed Health Co-ordinator also regularly undertakes analysis on the breed's genetic diversity, key findings are reported below, with the full report available here: http://www.giantschnauzerhealth.org.uk/breed-analysis/

The latest report found that despite an average downward trend of 31% in the number of litters born overtime (2000-18) the average litter size has been increasing, with an overall increase of 18%, potentially indicating that fertility may not have been impacted by reduced genetic diversity. When measuring effective population size overtime from 2000-18 this value was found to stay below 70, and as of 2014 has stayed below 50, with a reduction in 33% over the period of 18 years. The analysis

also noted that there has been a continued decrease in the number of males and females used in breeding overtime, but a rise in imported dogs that are being used in breeding programmes, with evidence that several imported sires are being used on a frequent basis, which will contribute to the popular sire effect

CURRENT RESEARCH PROJECTS

The breed have submitted samples from five dogs affected by idiopathic epilepsy to the Animal Health Trust's Give a Dog a Genome project, with epilepsy given as the breed's chosen condition to investigate. The breed have also been undertaking a seizure study, which identified five dogs which met the GADAG criteria for inclusion:

- The dog had at least two seizures which occurred 24 or more hours apart.
- The first seizures occurred when the dog was between six months and six years of age.
- A vet performed examinations and found the dog to be normal between seizures.
- Blood and urine test results were all returned normal.
- Magnetic Resonance Imaging (MRI) analysis was found to be normal.
- Testing found that cerebrospinal fluid (CSF) was normal.

An anonymous DNA sample has been selected for sequencing, with the sequencing data generated processed and analysed by the AHT. Additional analysis of the data to attempt to identify any variants that contribute to epilepsy is underway with the aim to share sequence data with other researchers.

PRIORITIES

Correspondence was undertaken between the Kennel Club and the Breed Health Co-ordinator in May 2020 to review the evidence base of the BHCP and appropriate actions to tackle the priority issues for the health of the breed. The group agreed from the information provided and their own experience that the priorities for the Giant Schnauzer were:

- Cancers
- Epilepsy
- Hereditary cataracts and general eye conditions

It was decided that the following conditions would be kept at watch:

- Hypothyroidism
- prcd-PRA
- DCM
- PRA5

ACTION PLAN

Following 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 Giant Schnauzer. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Clubs and Kennel Club to monitor research in squamous cell carcinoma.
- The Breed Clubs to continue to encourage owners to undergo the BVA/KC Hip Dysplasia Scheme.
- The Breed Clubs to consider putting forward a proposal for the available DNA tests to be a recommendation under the Assured Breeder Scheme.
- The Breed Clubs to continue to collect data on dogs affected by seizures, with the Kennel Club to assist in recruiting further dogs.

Kennel Club actions include:

- The Kennel Club to collaborate with the breed in developing a mortality reporting database, which can be posted on the Breed Information Centre/ breed club websites.
- The Kennel Club to repeat the population analysis for the breed.
- The Kennel Club to investigate whether the Giant Schnauzer can be included in the University of Nottingham thyroid study.
- The Kennel Club to investigate producing the proportion of litters eye screened per year.

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