THE KENNEL CLUB

Breed Health and Conservation Plan

Pyrenean Mountain Dog

CONTENTS

INTRODUCTION

The Kennel Club launched a new resource for breed clubs and individual breeders – the Breed Health and Conservation Plans (BHCP) project – in September 2016. The purpose of the project is to ensure that all health concerns for a breed are identified through evidence-based criteria, and that breeders are provided with useful information and resources to 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 Pyrenean Mountain Dogs registered by year of birth between 1990 and 2022 are shown in Figure 1.

The trend of registrations over year of birth (1990-2022) was -7.3 per year (with a 95% confidence interval of -8.9 to -5.7), reflecting the overall decrease in the breed's numbers during this time.

[A '95% confidence interval' (C.I.) is a tool used in statistics which shows that we are 95% certain that an estimated number is between the lowest number and the highest number provided.]

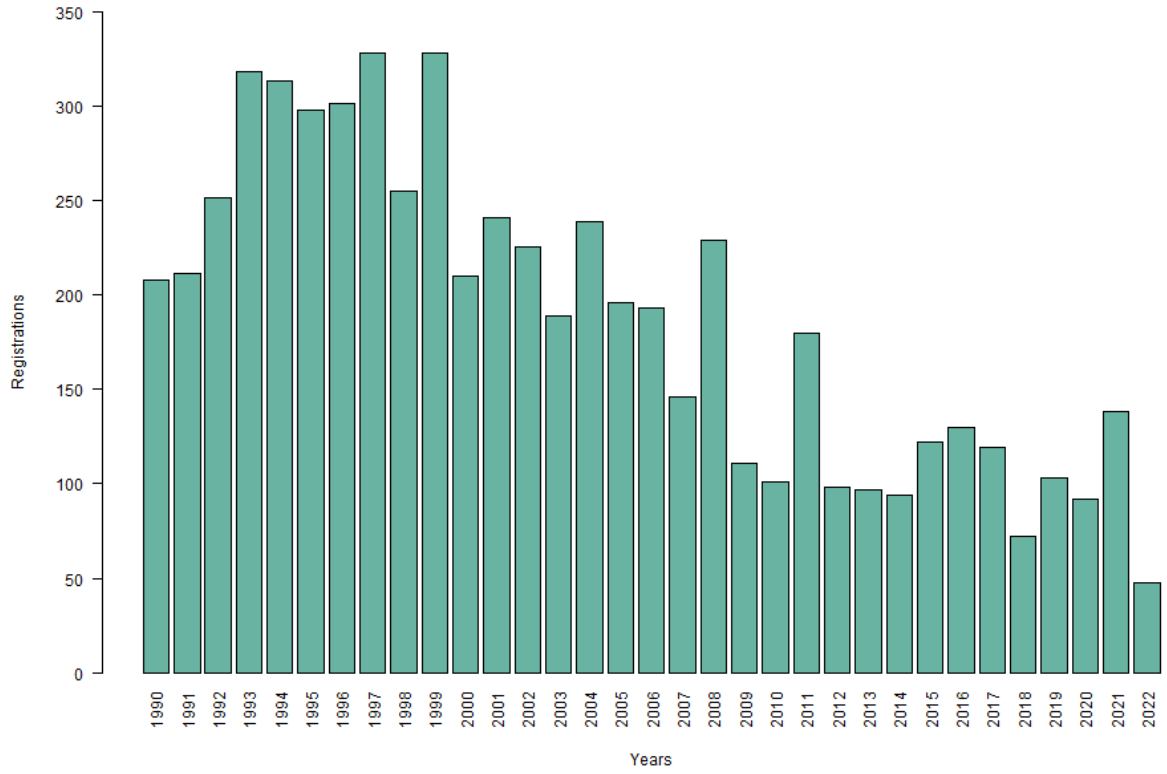


Figure 1: Number of registrations of Pyrenean Mountain Dogs per year of birth, 1990 – 2022.

The number of imported and country of origin are also given in Figure 2 below, with the majority of dogs having been imported from Sweden.

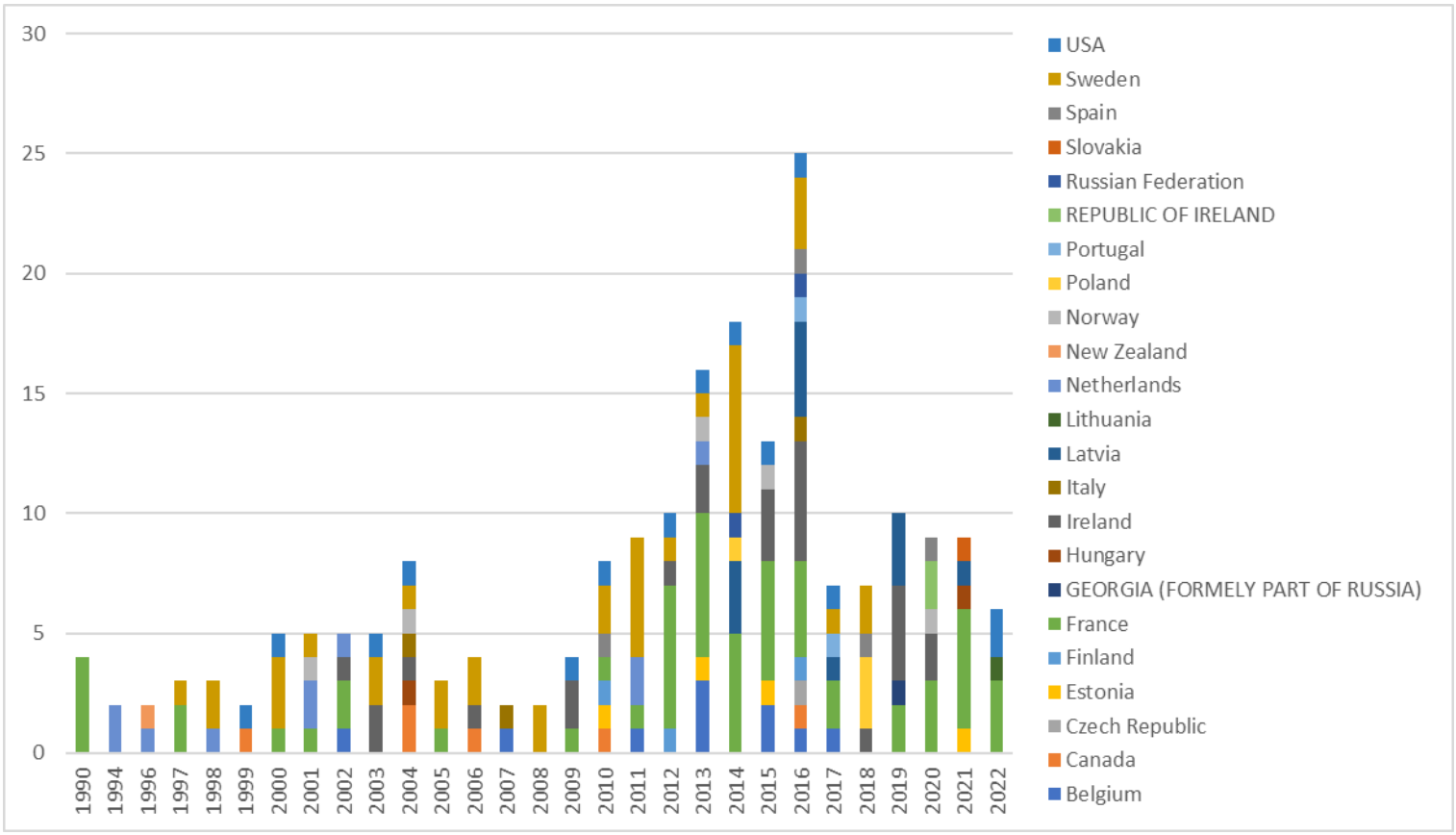


Figure 2: Country of origin for imports registered by the Kennel Club between 1990 and 2022.

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 last Breed Health Coordinators' Annual Health Report was received in 2018 which yielded the following top health concerns:

1. Arthritis
2. Osteosarcoma (bone cancer)
3. Osteochondritis dissecans (OCD)

In terms of what the breed have done to tackle these health concerns, the following actions were given: collecting data via the ongoing health survey, as well as continuing to participate in the Give a Dog a Genome project in collecting DNA samples, and engaging in the BHCP project.

BREED CLUB HEALTH ACTIVITIES

The breed has an active Breed Health Coordinator. Information about the rolling health survey, and the survey form, can be found on the website of the Pyrenean Mountain Dog Club of Great Britain. http://www.pmdc.org.uk/breedinfo.htm

Breed health information is also available on the following websites:

- http://www.pmdc.org.uk/breedinfo.html
- http://www.sepmdc.co.uk/
- https://pyreneanmountaindogclubofscotland.webs.com/

There is an American website relating to the health of the breed: http://gpcahealth.org/index.htm

BREED SPECIFIC HEALTH SURVEYS

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: The response rate for the Pyrenean Mountain Dog was less than 15% in the 2004 Purebred Dog Health Survey so a breed-specific report on the survey responses was not prepared. However, responses were received for 114 individual Pyrenean Mountain Dogs and the five most frequently reported conditions are shown in Table 1.

Table 1: Most frequently reported health conditions for 114 Pyrenean Mountain Dogs in the 2004 Purebred Dog Health Survey. The prevalence is the number of cases divided by the total number of responses received for the breed.

Disease condition	Number of cases reported	Prevalence
Pyotraumatic dermatitis (‘hot spot’)	9	7.9%
Otitis externa	8	7.0%
Arthritis	8	7.0%
Panosteitis	5	4.4%
Lipoma	5	4.4%

2004 Mortality results: A total of 66 Pyrenean Mountain Dog deaths were reported. By far the most frequently reported causes of death were cancer (26 cases, 39.4% of deaths) and old age (10 cases, 15.2% of deaths). Median age at death was 9 years and 7 months (minimum 9 months, maximum 16 years).

2014 Morbidity results: Health information was collected for 29 live Pyrenean Mountain Dogs of which 18 (62%) were healthy and 11 (38%) had at least one reported health condition. The most frequently reported specific conditions were

arthritis, otitis media, colitis, cruciate ligament injury and dermatitis (no prevalence data were available for these conditions due to the small sample size).

2014 Mortality results: A total of 4 deaths were reported for the breed. The range of longevity was 1 year to 10 years. The most frequently reported causes of death were epilepsy, leukaemia, old age and old age combinations (no prevalence data were available for these conditions due to the small sample size).

GREAT PYRENEES CLUB OF AMERICA HEALTH SURVEY REPORT 1999

The Great Pyrenees Club of America launched a comprehensive survey of health of the breed in 1988; by 1999, 914 owners had reported on 1701 dogs. Reports had come from every state in the US except North Dakota, and from eight other countries; approximately 100 British dogs were included in the survey.

Morbidity results

In total 454 deaths were reported, due to 27 different causes of death. Those that accounted for more than 1% of deaths are shown in Table 2 below.

Table 2: Causes of death responsible for more than 1% of the 454 deaths detailed in the 1999 GPCA health survey report.

Cause of death	Median age at death (years)	Number of deaths	Percentage
Cancer	7.0	142	31.6%
Old age	12.0	72	16.0%
Accidents	4.6	47	10.5%
Temperament	3.3	41	9.1%
Heart conditions	8.0	34	7.6%
Orthopaedic conditions	2.6	18	4.0%
Bloat	6.2	14	3.1%
Illness/infection	5.0	14	3.1%
Unknown/not stated	4.3	13	2.9%
Birth defect	0.2	10	2.2%
Epilepsy	2.8	10	2.2%
‘Spinal myelopathy’	10.0	6	1.3%
Parvovirus	0.7	5	1.1%
Addison’s disease	2.0	5	1.1%

Morbidity results

Reports of illness in dogs that had died were analysed together with reports of illness in dogs which were reported still to be alive. Many different conditions were reported; as before, those which affected more than 1% of dogs in the survey are shown in Table 3 below.

Table 3: Health conditions affecting more than 1% of 1701 Pyrenean Mountain Dogs reported in the GPCA health survey report 1999. Percentages are calculated out of 1701.

Condition	Number of reported cases	Percentage
Orthopaedic conditions	*351*	*20.6*
Hip dysplasia	98	5.8
Arthritis	86	5.1
Panosteitis	79	4.7
Patellar luxation*	57	3.4
Osteochondritis	36	2.1
Spinal conditions	24	1.4
Eye conditions	*85*	*5.0*
Entropion	25	1.5
Ear conditions	*89*	*5.2*
Impaired hearing	25	1.5
Skin conditions	*322*	*18.9*
Allergies	146	8.6
Hot spots	110	6.5
Ear infections	108	6.4
Pyoderma	31	1.8
Seborrhoea	19	1.1
Endocrine conditions	*142*	*8.3*
Thyroid conditions	77	4.5
Cystitis	34	2.0
Cancers	*136*	*8.0*
Bone cancer	58	3.5
Mammary cancer	45	1.1
Other conditions		
Bloat	28	1.7
Epilepsy	46	2.7

* ‘Patellar luxation’ included 8 cases reported as anterior cruciate injury, ‘football knee’ and torn ligaments, which probably represent a different condition.

There were 898 female and 803 male Pyrenean Mountain Dogs in the survey dataset. Reported reproductive conditions affecting more than 1% of dogs of either sex are shown in Table 4.

Table 4: Reproductive conditions affecting more than 1% of Pyrenean Mountain Dogs reported in the GPCA health survey report 1999. Percentages are calculated out of 898 for females and 803 for males.

Condition	Number of reported cases	Percentage
Female reproductive conditions	*188*	*20.9*
Vaginal infection	58	6.4
Irregular heats	51	5.7
Failure to conceive	28	3.1
Whelping difficulties	25	2.8
Pyometra	23	2.6
Caesarean section	22	2.4
Mastitis	17	1.9
Foetal death	15	1.7
Refused male	12	1.3
Fading puppies	11	1.2
Male reproductive conditions	*46*	*5.7*
Abnormal testicles	10	1.3
Lack of interest	8	1.0

A full report on the findings of the survey is available here: http://gpcahealth.org/PDF/1999%20GPCA%20Health%20Survey.pdf

PYRENEAN MOUNTAIN DOG CLUB OF GREAT BRITAIN HEALTH SURVEY

The Pyrenean Mountain Dog Club of Great Britain launched a rolling health survey in 2001. Surveys are welcomed from dogs which are alive and dogs which have died, even some time ago; preliminary analysis of the first 100 forms received included 37 deceased dogs, of which three were born in the 1960s, three in the 1970s, 17 in the 1980s, 67 in the 1990s and five since 2000.

By June 2016, survey forms had been received for 133 dogs (with more than one form for some, as their information was updated). A summary of reported conditions in those 133 Pyrenean Mountain Dogs is shown in Table 5 below.

Table 5: Reported conditions affecting 133 Pyrenean Mountain Dogs reported in the Pyrenean Mountain Dog Club of Great Britain's rolling health survey. Percentages could not be calculated for male and female reproductive conditions as the number of males and females in the survey was not provided.

Condition	**Number of reported cases**	**Percentage**
Cancer	*25*	*18.8*
Bone tumour	10	7.5
Mammary tumour	5	3.8
Muscle tumour	6	4.5
Cardiac conditions	*8*	*6.0*
Heart murmur	4	3.0
Enlarged heart	2	1.5
Ear conditions	*22*	*16.5*
Impaired hearing	7	5.3
Chronic ear infections	7	5.3
Endocrine conditions	*7*	*5.3*
Thyroid condition	5	3.8
Pancreatitis	2	1.5
Female reproductive conditions		
Irregular heats	7	
Pyometra	5	
Vaginal infection	2	
Male reproductive conditions	4	
Testicle abnormality	3	
Lack of interest	1	
Skeletal conditions	*35*	*26.3*
Arthritis	21	15.8
OCD	6	4.5
Panosteitis	2	1.5
Skin conditions	*46*	*34.6*
Chronic hot spots	23	17.3
Allergies	7	5.3
Seborrhoea	3	2.3
Demodectic mange	3	2.3
Pyoderma	2	1.5
Urological conditions	*10*	*7.5*
Cystitis	7	5.3
Stones	2	1.5
Other conditions		
Bloat	5	3.8
Seizures	4	3.0
Anaemia	1	0.8

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.

Cardiovascular conditions

Myocardial infarction (MI): Acute MI is the common form of ischaemic heart disease in humans, but is rare in dogs. When records of the small animal necropsy service of the University of Pennsylvania Veterinary Hospital between December 1985 and August 1994 were searched, 31 cases were found in approximately 4,000 dog post mortem examinations, representing 0.8% of the total. In total 9% of these (3 cases) were in Pyrenean Mountain Dogs, which made up 0.1% of the veterinary hospital's canine population suggesting a possible increased risk compared to dogs of other breeds (Driehuys et al, 1998). No more recent reports nor prevalence estimates could be found in the literature.

Endocrine conditions

Hypoadrenocorticism (Addison's disease): A possible breed predisposition to hypoadrenocorticism, which may suggest a degree of inheritance, was suggested in a recent Canadian study. Medical records of dogs presented to the Veterinary Hospital of the University of March 2005 and October 2014 were reviewed and 100 cases of hypoadrenocorticism were found, giving an overall prevalence of 0.38% (95% C.I. 0.26%-0.50%). The Pyrenean Mountain Dog had the highest prevalence of 9.73% (95% C.I. 9.12%-10.35%; 11 cases in 114 dogs seen during this time period); they were more frequently presented with anaemia, azotaemia and eosinophilia, or with hypotension and cachexia than dogs of other breeds (Decôme et al, 2016).

Haematological conditions

Hereditary thrombopathy (Glanzmann's thrombasthenia (GT) type I): A rare, inherited, intrinsic platelet defect known as type I Glanzmann's thrombasthenia in humans was first described in an eight month old, female Pyrenean Mountain Dog born in 1993 which was presented to Auburn University, Alabama (Boudreaux et al, 1996). Initial presenting signs were chronic epistaxis and a history of gingival bleeding during shedding of deciduous teeth. Two mutations in the gene encoding a platelet membrane glycoprotein were found to be associated with the phenotype (Lipscomb et al, 2000). A DNA test is available.

Musculoskeletal conditions

Hip dysplasia: The breed was reported to be at elevated risk of hip dysplasia, with a breed-associated odds ratio compared to mixed breeds of 3.3 (95% C.I. 1.9 – 5.9), based on dogs which had attended veterinary teaching hospitals in the USA between

1986 and 1995; however this result was based on just 34 cases and 16 non-cases in the breed (LaFond et al, 2002). Analysis of the screening results of the Belgian National Committee for Inherited Skeletal Disorders, affiliated with the Belgian Kennel Club, between 1st January 2002 and 15th June 2006 found a prevalence of hip dysplasia in the Pyrenean Mountain Dog of 23%; however, just 44 dogs of the breed were screened (Coopman et al, 2008).

Osteochondrodysplasia: Disproportionate dwarfism due to this cartilage and bone abnormality was described in five related Pyrenean Mountain Dogs in America (Bingel and Sande, 1994). Pedigree analysis suggested an autosomal recessive mode of inheritance, but to date the mutation has not been identified. No more recent reports, nor prevalence estimates, could be found in the literature.

Osteochondrosis dissecans of the shoulder (OCD): The breed was reported to be at significantly elevated risk of OCD of the shoulder, with a breed-associated odds ratio compared to mixed breeds of 42.7 (95% C.I. 24.4 – 74.8), based on dogs which had attended veterinary teaching hospitals in the USA between 1986 and 1995; however this result was based on just 18 cases and 7 non-cases in the breed (LaFond et al, 2002).

Panosteitis: The breed was reported to be at elevated risk of panosteitis, with a breed-associated odds ratio compared to mixed breeds of 5.3 (95% C.I. 3.5 – 8.0), based on dogs which had attended veterinary teaching hospitals in the USA between 1986 and 1995 ; this result was based on 32 cases and 41 non-cases in the breed (LaFond et al, 2002).

Patellar luxation: The breed was reported to be at significantly elevated risk of patellar luxation, with a breed-associated odds ratio compared to mixed breeds of 64.0 (95% C.I. 22.0 – 185.9), based on dogs which had attended veterinary teaching hospitals in the USA between 1986 and 1995; however this result was based on just 40 cases and only 1 non-case in the breed (LaFond et al, 2002).

Neoplastic conditions

Mast cell tumours (MCT): The Pyrenean Mountain Dog was reported to be at increased risk of mast cell tumours in an Austrian study. More than 140,000 canine skin biopsy samples were submitted to a commercial laboratory in Vienna between 2000 and 2010; 5162 skin tumours were diagnosed, of which 544 from 467 dogs were diagnosed as MCTs giving a standardised incidence rate of 355 cases per 100,000 dogs or 0.35% (Leidinger et al, 2014). The odds ratio for Pyrenean Mountain Dogs was 6.43 (95% C.I. 0.80 – 8.51) compared to all breeds combined; however this was based on just one confirmed MCT and nine skin tumours in the breed.

Ocular conditions

Multifocal retinopathy: This condition was first described in Pyrenean Mountain Dogs in Canada. Forty-four related dogs of the breed were examined ophthalmoscopically, and 19 dogs were found to be affected by multifocal retinopathy giving a prevalence in this small population of 43.2% (Grahn et al, 1998). Pedigree analysis suggested an autosomal recessive mode of inheritance. Two spontaneous mutations in the *VMD2* gene were subsequently identified in affected dogs of the breed (Guziewicz et al, 2007). A DNA test is available.

Reproductive conditions

Pyometra: Analysis of Swedish Agria insurance data, considering female dogs enrolled for both veterinary care and life insurance during 1995 to 2006, estimated the disease incidence of pyometra in 260,000 female dogs. The overall incidence rate for pyometra was 199 cases per 10,000 DYAR (95% C.I. 196-202). The proportion of Pyrenean Mountain Dog bitches that developed pyometra by 10 years of age (derived from Cox proportional hazards regression without independent variables) in this study was 43.0% (158 cases in 524 bitches), ranking the breed 16th out of 110 breeds in terms of breed-specific prevalence (Jitpean et al, 2012). It has been reported that just 8% of bitches in Sweden are spayed, with elective neutering of dogs of both sexes being rare (Egenvall et al, 1999); therefore the incidence of pyometra in all breeds is likely to be significantly higher in the reported study than would be the case in the UK.

Respiratory conditions

Laryngeal paralysis – polyneuropathy syndrome: This condition was described in six young Pyrenean Mountain Dogs in Belgium, all presenting with laryngeal paralysis and concurrent megaoesophagus (Gabriel et al, 2006). All six dogs died or were euthanased by two years of age; pedigree analysis was suggestive of an autosomal mode of inheritance. No prevalence estimates could be found in the literature.

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).

UK Agria data

Insurance data were available for Pyrenean Mountain Dogs insured with Agria UK. 'Exposures' are equivalent to one full policy year; in 2016 there were 65 free exposures, 40 full exposures and 60 claims, in 2017 these figures were 90, 43 and 93 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. The top 10 conditions by number of settlements, for authorised claims where treatments started between 1st October 2016 and 31st September 2017, are shown in Table 6 below.

Table 6: Top 10 conditions and number of settlements for each condition between 1st October 2016 and 31st September 2017 for Pyrenean Mountain Dogs insured with Agria UK

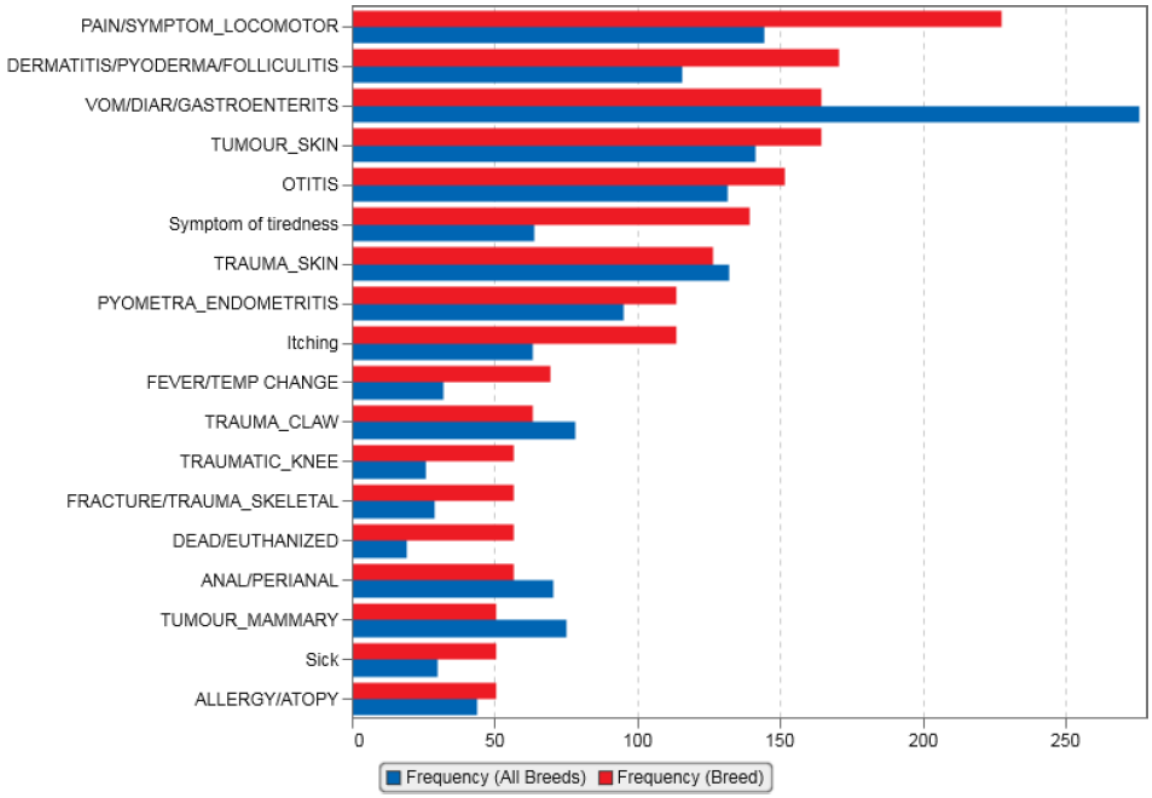
Condition	Number of settlements
Osteosarcoma	27
Seizures, epileptic convulsions	13
Incontinence	12
Muscular spasm	8
Addison's disease	6
Ataxia	4
Chronic gastroenteritis	4
Acute otitis externa	3
Medial patella luxation	2
Acute gastroenteritis	2

Swedish Agria insurance morbidity data

Swedish morbidity and mortality insurance data were also available from Agria for the Pyrenean Mountain Dog. Reported rates are based on dog-years-at-risk (DYAR) which takes into account the actual time each dog was insured during the period (2011-2016) e.g. 1 DYAR is equivalent to a dog insured for one year.

The number of DYAR for the Pyrenean Mountain Dog in Sweden during this period was between 1,000 < 2,500, so the results should be interpreted with caution. The full Swedish insurance results are available through https://dogwellnet.com/, but key findings are reported below.

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Pyrenean Mountain Dogs in Sweden between 2011 and 2016 are shown in Figure 3. The top five specific causes of VCEs were pain/ locomotor signs, otitis and dermatitis/ pyoderma/ folliculitis, vomiting/ diarrhoea/ gastroenteritis, skin tumours and otitis.



Reminder: Categories are shown only if at least 8 animals had the diagnosis.

Figure 3: The most common specific causes of VCEs for the Pyrenean Mountain Dog compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. NB 'Great Pyrenees' is the name used for the breed for Agria in Sweden.

When relative risk of specific causes of VCEs was compared for the Pyrenean Mountain Dog to all breeds, the top specific causes of VCEs ordered by relative risk were dead/ euthanised, traumatic knee injury, signs of tiredness, fever/ temperature change and fracture/ trauma - skeletal (Figure 4).

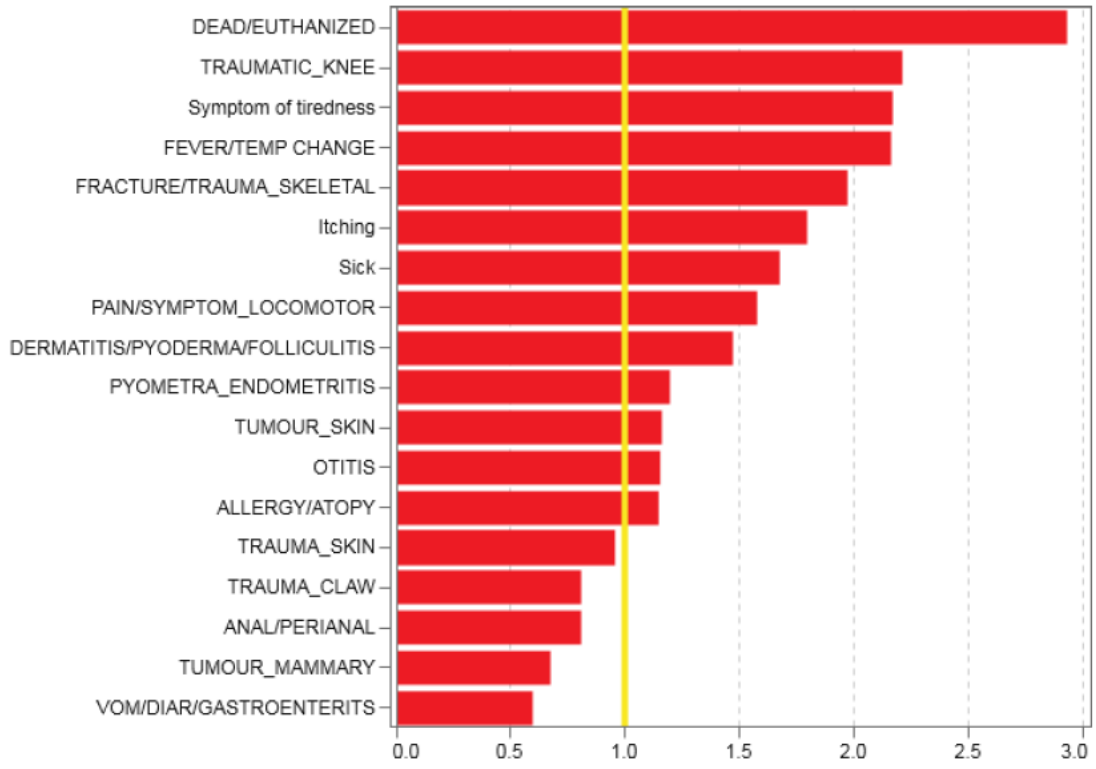


Figure 4: The specific causes of VCEs for the Pyrenean Mountain Dog ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds. NB 'Great Pyrenees' is the name used for the breed for Agria in Sweden.

BREED WATCH

As a category two breed judges' health monitoring forms are mandatory for judging appointments at championship certificate level. Table 7 below shows the percentage of dogs for 2017 - 2022 who were affected by points of concern noted by judges.

Unfortunately, due to the COVID-19 pandemic and the lack of shows due to a national lockdown, there are little data for 2020 and so these have not been included. Further, from this time, The Kennel Club have been unable to send reminders to judges, which has resulted in a clear drop in monitoring form submissions. This is clearly reflected in the number of dogs reported from 2021.

Update (Nov 2023) – The Kennel Club are currently reviewing the entirety of Breed Watch, and have taken a number of recommendations to the Board. Following approval, these recommendations will begin to be implemented from January 2024.

Table 7: Judges' health monitoring reports for 2017 - 2022. Those marked with a * indicate newly reported points of concern.

Point of concern	2017	2018	2019	2021	2022
Unstable hocks	-	2.5%	2.2%	na	-
Weak hindquarters	1.3%	4.9%	3.7%	na	-
* Significantly underweight	0.3%	0.3%	-	na	-
Significantly overweight	-	0.8%	-	na	-
* Other	0.2%	0.2%	-	na	-
Total number of entries	**622**	**595**	**600**	**0**	**62**

ASSURED BREEDERS SCHEME

It is currently required that all Assured Breeders complete the following on their breeding stock:

- Hip scoring under the British Veterinary Association (BVA)/ KC Hip Dysplasia Scheme

There are currently no recommendations for Assured Breeders.

DNA TEST RESULTS

There are no DNA tests recognised by the Kennel Club at this time. Whilst other DNA tests may be available for the breed results from these will not be accepted by the Kennel Club until the test has been formally recognised; the process involves collaboration between the breed clubs and the Kennel Club in order to validate the test's accuracy.

CANINE HEALTH SCHEME RESULTS AND ESTIMATED BREEDING VALUES

All the BVA/KC Health Schemes are open to dogs of any breed, and the results for Rottweilers which have been presented for assessment under the Hip, Elbow and Eye Schemes are shown below.

HIPS

A total of 237 Pyrenean Mountain Dogs born in the last 15 years have gone through the BVA/KC Hip Dysplasia Scheme to date (Nov 2023), with a 15 year median of 9 (range 0-54) and five year median of 7 (range 0-25). The mean hip score for the breed per year of birth is shown in Figure 5 below, with a gradual improvement seen during this period of time. The degree of fluctuation will be a result of the relatively few dogs tested per year.

It is worth noting that scores for later years will reflect younger dogs (e.g. dogs born in 2019 will be no more than 2 years of age) and therefore these will have had fewer years for disease to manifest and a generally lower mean score.

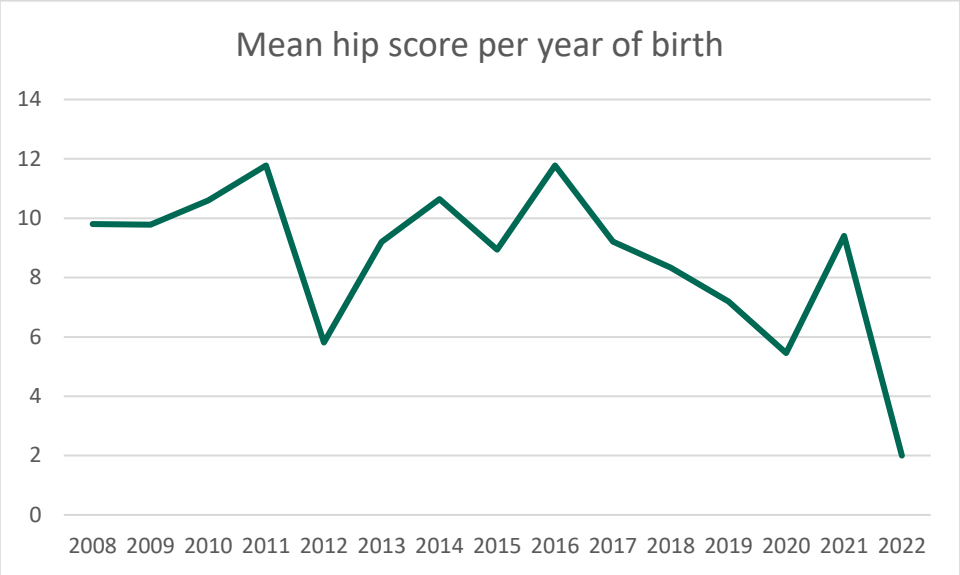


Figure 5: The mean hip score for the Pyrenean Mountain Dog between 2004 and 2019.

Similarly, the proportion of registered dogs with a known hip score per year of birth was analysed over time, with this having overall decreased, following a peak in 2012 (Figure 6). It is important to consider that this figure may rise, as dogs born more recently may not yet have reached the age for breeding or maturity for pre-breeding tests.

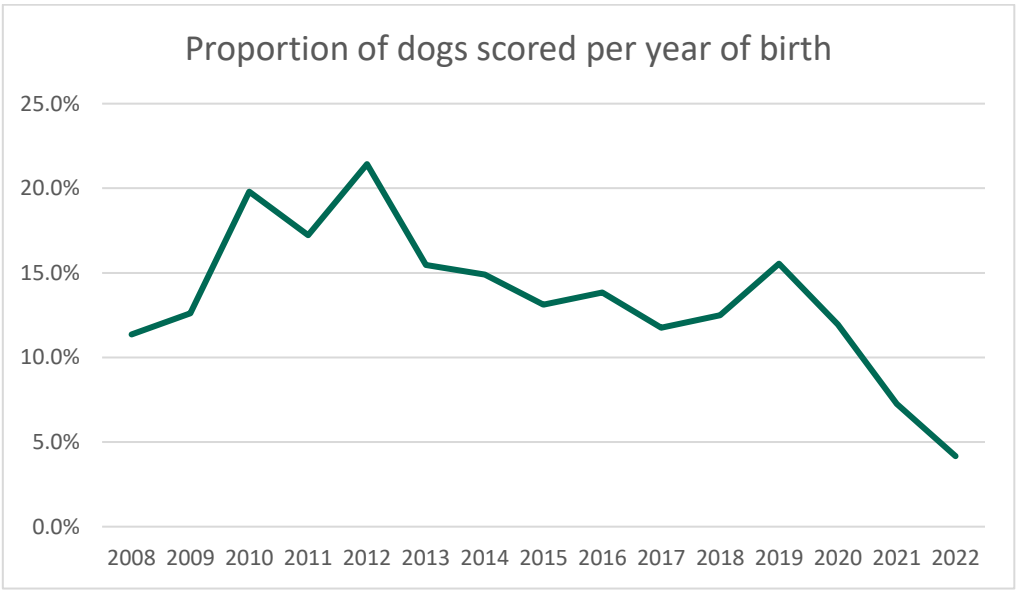


Figure 6: The proportion of Pyrenean Mountain Dogs with a known hip score per year of birth.

ELBOWS

In total 44 Pyrenean Mountain Dogs born have been elbow scored as part of the BVA/KC Elbow Dysplasia Scheme in the past 15 years; all 52 dogs received an elbow grade of zero.

EYES

The breed is not currently on the Known Inherited Ocular Diseases List (KIOD - formally known as Schedule A prior to the 1st January 2020). 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.

However, the BVA still records the results of dogs of other breeds which have participated in the scheme in an annual sightings report. Just three dogs of the breed were presented to an Eye Panellist for examination under the scheme between 2012 and 2021, and no conditions were noted.

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (AVCO)

Between 2018 and 2022, 145 dogs of the breed were examined by the ACVO and prevalence data are shown in Table 8 alongside data from previous years. Overall, 64.1% of dogs of the breed examined between 2018 and 2022 had healthy eyes unaffected by any disease conditions. However, it is important to note that the dogs were from America.

Table 8: ACVO examination results for Pyrenean Mountain Dogs (Great Pyrenees), 1993 – 2022.

Disease Category/Name	Percentage of Dogs Affected	
	1993-2017 (n=1,294)	**2018-2022** (n=145)
Eyelids		
Entropion	1.2%	0.0%
Distichiasis	1.2%	0.7%
Cornea		
Corneal dystrophy	1.2%	0.7%
Uvea		
Anterior chamber cyst	0.1%	1.4%
Persistent pupillary membranes (iris to iris)	25.3%	23.4%
Persistent pupillary membranes (iris to lens)	1.0%	0.0%
Uveal cysts	0.5%	3.0%
Fundus		
CMR/ CMR-like retinopathy	0.0%	2.1%
Lens		
Cataract (significant)	10.7%	7.6%
Retina		
Retinal dysplasia (geographic)	1.2%	0.0%
Retinopathy	0.6%	2.1%

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.

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 9.

Table 9: Number and percentage of litters of breed registered per year and number of caesarean sections reported per year, 2012 to 2022.

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)
2012	11	1	9.1%	8.7%
2013	12	1	8.3%	10.0%
2014	12	1	8.3%	10.6%
2015	17	2	11.8%	11.7%
2016	14	0	0.0%	13.9%
2017	15	3	20.0%	15.0%
2018	9	2	22.2%	17.2%
2019	13	2	15.4%	15.7%
2020	13	2	15.4%	16.8%
2021	18	2	11.1%	16.5%
2022	8	0	0.0%	12.0%

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 82.5 was reported (estimated using the rate of inbreeding over the period 1980-2014).

An effective population size of less than 100 (inbreeding rate of 0.50% per generation) leads to a dramatic increase in the rate of loss of genetic diversity in a breed/population (Food & Agriculture Organisation of the United Nations, “Monitoring animal genetic resources and criteria for prioritization of breeds”, 1992). An effective population size lower than 50 (inbreeding rate of 1.0% per generation) indicates the future of the breed many 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 1980-2014 are shown in Figure 7. As with most breeds, the rate of inbreeding was at its highest in this breed in the 1980s and 1990s. This represents a ‘genetic bottleneck’, with genetic variation lost from the population. However, since the mid-2000s the rate of inbreeding has been negative, implying moderate replenishment of genetic diversity (possibly through the use of imported animals).

The UK quarantine laws requiring immigrant dogs to spend a six month period at quarantine kennels were relaxed in 2000 with the introduction of the Pet Passport scheme. It may be expected that the number of dogs imported to the UK after this

date would have increased, and the use of apparently more distantly related migrant animals for breeding might explain the negative rate of inbreeding more recently. 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 **2.6**%.

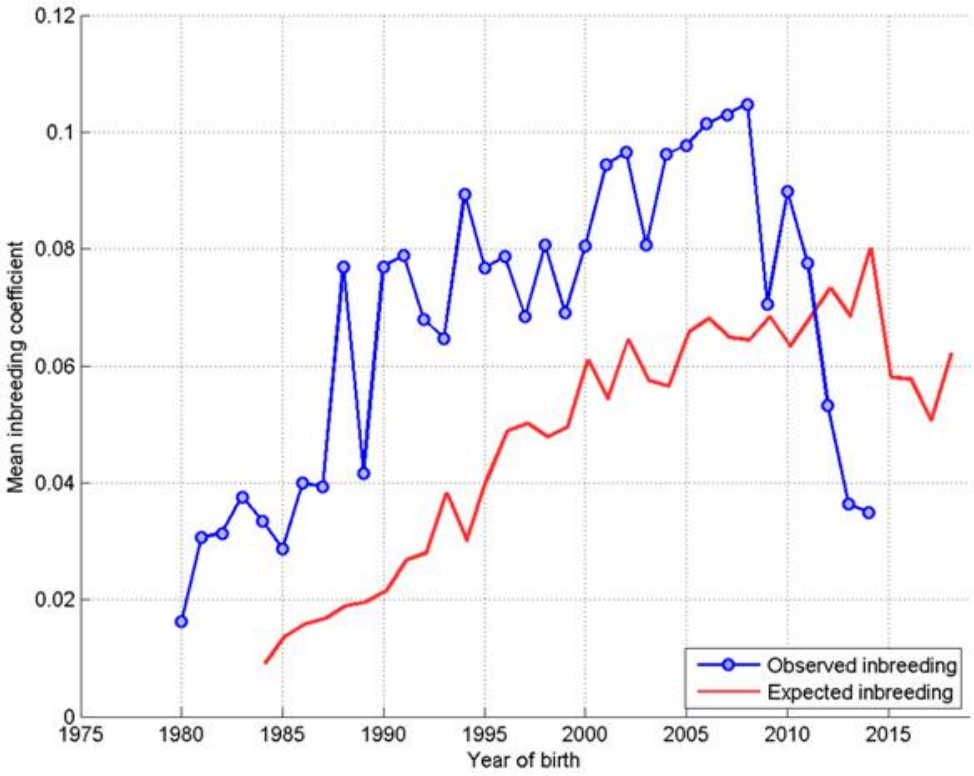


Figure 7: Annual mean observed and expected inbreeding coefficients.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven five-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). It appears that the extensive use of popular dogs as sires has eased a little (the 'tail' of the blue distribution shortening in Figure 8).

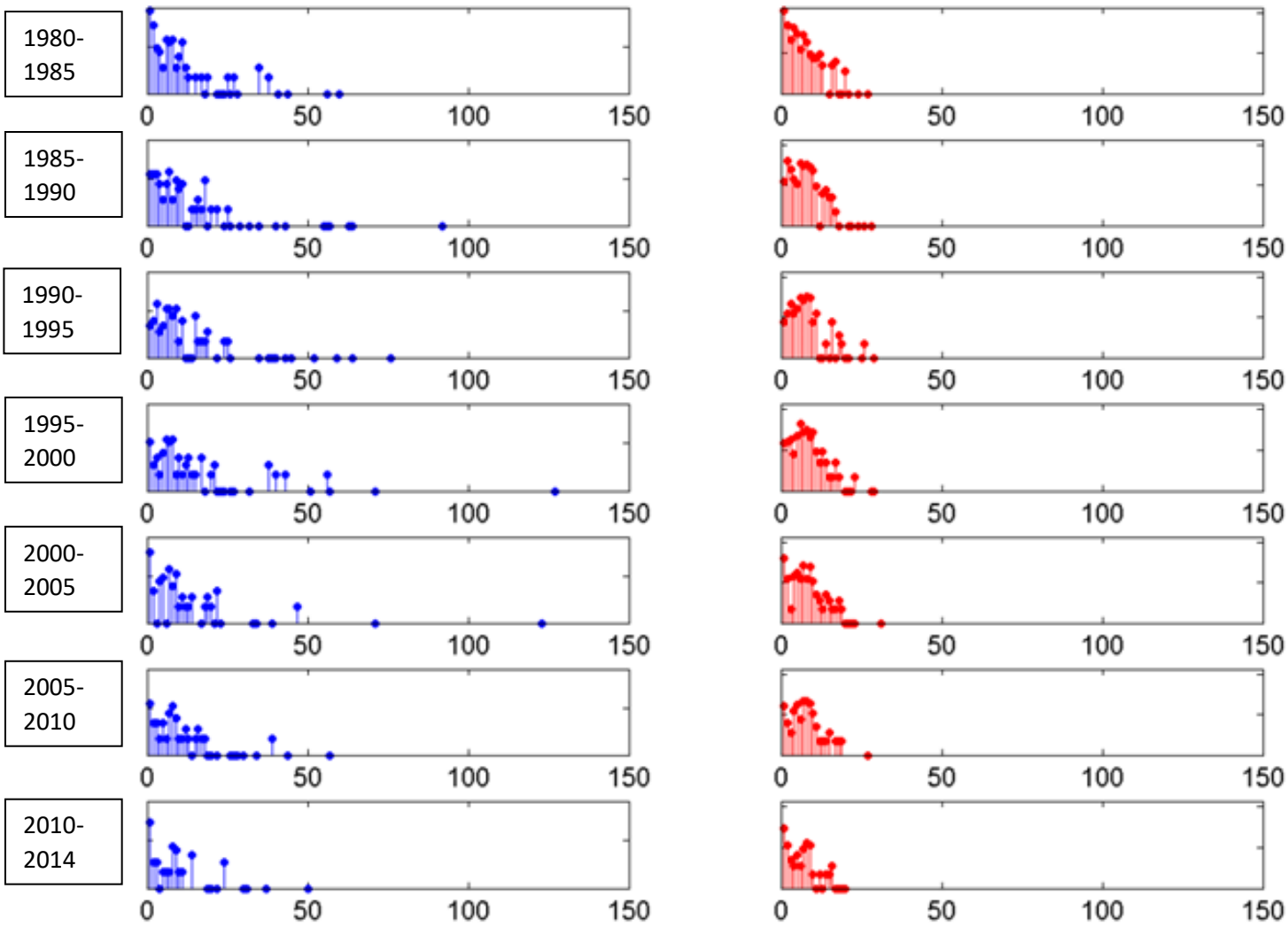


Figure 8: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-14 bottom). Vertical axis is a logarithmic scale.

CURRENT RESEARCH PROJECTS

The Pyrenean Mountain Dog is one of the breeds in the AHT's Give a Dog a Genome project; the health conditions given as concerns in the breed were arthritis, chronic hot spots and osteosarcoma. It is intended to sequence a dog of the breed affected with osteosarcoma, dependent on successful quality control processes. It is hoped that following the closure of the AHT in 2020 this work can continue as part of the Kennel Club's Genetic Centre now at the University of Cambridge.

The AHT is also the UK partner in the Canine Epilepsy Research Consortium, and stores DNA samples from confirmed epileptic Pyrenean Mountain Dogs (and dogs of other breeds) which can be shared with other researchers in the consortium.

The Great Pyrenees Club of America has also been taking part in several projects as part of the American Kennel Club's Canine Health Foundation research. These include the following:

- The effects of early life experience on working dog temperament and cognition
- The role of NF-kappaB in cell death with regard to osteosarcoma
- Breed specific reference ranges for thyroid testing
- Prevalence of *Bartonella* spp. infection in dogs with cardiac and splenic haemangiosarcomas within and between geographic locations
- Developing a next generation sequencing diagnostic platform for tick-borne diseases
- Clinical trial for evaluation of propranolol and doxorubicin in the treatment of canine haemangiosarcoma

PRIORITIES

A meeting was held with the Pyrenean Mountain Dog breed representatives in March 2021 to discuss the updated evidence base of the BHCP and review the priority issues and action plan for the breed.

It was agreed from the information provided that the following conditions remain the priorities for the Pyrenean Mountain Dog:

- Osteosarcoma
- Arthritis
- Osteochondrodysplasia
- Hot spots and other skin conditions

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

Breed Club actions include:

- The breed clubs to review their code of ethics.
- The breed clubs to review whether any amendments to the Breed Watch point of concern 'significantly overweight' should be made.
- The Breed Health Coordinator to make an application for further recommendations under the Assured Breeder Scheme.
- The breed to republish the breed puppy pack.
- The breed to investigate relaunching the health survey using an online format, with the Kennel Club to assist in development and dissemination, where needed.
- The breed to review the general husbandry and care information on the club websites, with this to include exercise guidance.

Kennel Club actions include:

- The Kennel Club to investigate the possibility of splitting the caesarean section data into emergencies, elective and unknown, and adding a column to compare the breed with all breeds. – **COMPLETE**
- The Breed Health Coordinator and the Kennel Club to monitor the progress and outcome of the Give a Dog a Genome project for the breed. – **COMPLETE** (*this action has been marked as complete given the closure of the AHT)*
- The Kennel Club to review the breed's population analysis. - **ONGOING**
- The Kennel Club to look at launching a breed-wide skin survey. – **ONGOING**

REFERENCES

Bingel, S.A. and Sande, R.D. (1994) Chondrodysplasia in five Great Pyrenees. *Journal of the American Veterinary Medical Association* **205** (6): 845-848

Boudreaux, M.K., Kvam, K., Dillon, A.R., Bourne, C., Scott, M., Schwartz, K.A. and Toivio-Kinnucan, M. (1996) Type I Glanzmann's thrombasthenia in a Great Pyrenees dog. *Veterinary Pathology* **33**: 503-511

Coopman, F., Verhoeven, G., Saunders, J., Duchateau, L. and Van Bree, H. (2008) Prevalence of hip dysplasia, elbow dysplasia and humeral head osteochondrosis in dog breeds in Belgium. *The Veterinary Record* **163**: 654-658

Decôme, M. and Blais, M.-C. (2016) Prevalence and clinical features of hypoadrenocorticism in Great Pyrenees dogs in a referred population: 11 cases. *Canadian Veterinary Journal* **58** (10): 1093-1099

Driehuys, S., Van Winkle, T.J., Sammarco, C.D. and Drobatz, K.J. (1998) Myocardial infarction in dogs and cats: 37 cases (1985-1994). *Journal of the American Veterinary Medical Association* **213**: 1444-1448

Egenvall, A., Hedhammar, Å, Bonnett, B.N. and Olsson, P. (1999) Survey of the Swedish dog population: Age, gender, breed, location and enrolment in animal insurance. *Acta Veterinaria Scandinavica* **40**: 231-240

Egenvall, A., Nødtvedt, A., Penell, J., Gunnarsson, L. and Bonnett, B.N. (2009) Insurance data for research in companion animals: benefits and limitations. *Acta Veterinaria Scandinavica* 51: **42** http://www.actavetscand.com/content/51/1/42 [Accessed 09/10/18]

Gabriel, A., Poncelet, L., Van Ham, L., Clercx, C., Braund, K.G., Bhatti, S., Detilleux, J. and Peeters, D. (2006) Laryngeal paralysis-polyneuropathy complex in young related Pyrenean mountain dogs. *Journal of Small Animal Practice* **47** (3): 144-149

Genetics Committee of the American College of Veterinary Ophthalmologists (2015) Ocular disorders presumed to be inherited in purebred dogs, Ninth Edition. https://www.ofa.org/wp-content/uploads/2018/01/Bluebook-v9-2016.pdf [Accessed 25/07/18]

Grahn, B.H., Philibert, H., Cullen, C.L., Houston, D.M., Semple, H.A. and Schmutz, S.M. (1998) Multifocal retinopathy of Great Pyrenees dogs. *Veterinary Ophthalmology* **1**: 211-221

Guziewicz, K.E., Zangerl, B., Lindauer, S.J., Mullins, R.F., Sandmeyer, L.S., Grahn, B.H., Stone, E.M., Acland, G.M. and Aguirre, G.D. (2007) Bestrophin gene mutations cause canine multifocal retinopathy: a novel animal model for best disease. *Investigative Ophthalmology & Visual Science* **48** (5): 1959-1967

Jitpean, S., Hagman, R., Ström Holst, B., Höglund, O.V., Pettersson, A. and Egenvall, A., (2012) Breed variations in the incidence of pyometra and mammary tumours in Swedish dogs. *Reproduction in Domestic Animals* **47** (Suppl. 6): 347-350

LaFond, E., Breur, G.J. & Austin, C.C. (2002) Breed Susceptibility for Developmental Orthopedic Diseases in Dogs. *Journal of the American Animal Hospital Association* **38**: 467-477

Leidinger, E.F., Freeman, K., Kirtz, G., Hooijberg, E.H. and Sick, K. (2014) Breed related odds ratio and anatomic distribution of canine mast cell tumours in Austria. *Tierärztliche Praxis Kleintiere* **42**: 367-373

Lewis, T.W., Abhayaratne, B.M. and Blott, S.C. (2015) Trends in genetic diversity for all Kennel Club registered pedigree dog breeds. *Canine Genetics and Epidemiology* **2**:13 https://doi.org/10.1186/s40575-015-0027-4 [Accessed 31/07/2018]

Lipscomb, D.L., Bourne, C. and Boudreaux, M.K. (2000) Two genetic defects in α_{IIb} are associated with Type I Glanzmann's Thrombasthenia in a Great Pyrenees dog: a 14-base insertion in exon 13 and a splicing defect of intron 13. *Veterinary Pathology* **37**: 581-588

O'Neill, D.G., Church, D.B., McGreevey, P.D., Thomson, P.C. and Brodbelt, D.C. (2014) Approaches to canine health surveillance. *Canine Genetics and Epidemiology* **1**: 2 https://doi.org/10.1186/2052-6687-1-2 [Accessed 09/10/18]

Strain, G.M. (2004) Deafness prevalence and pigmentation and gender associations in dogs breeds at risk. *The Veterinary Journal* **167**: 23-32