THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Flat Coated Retriever
Evidence Base

BHCP/Version 3/July 2020

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 Flat Coated Retrievers registered by year of birth between 1980 and 2019 are shown in Figure 1.

The 1980 registrations figure appears depressed for all breeds due to registrations moving across to the electronic system from paper files. The trend of registrations over year of birth (1980-2019) was +13.45 per year (with a 95% confidence interval of +7.41 to +19.49), reflecting the overall increase in registrations.

[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.]

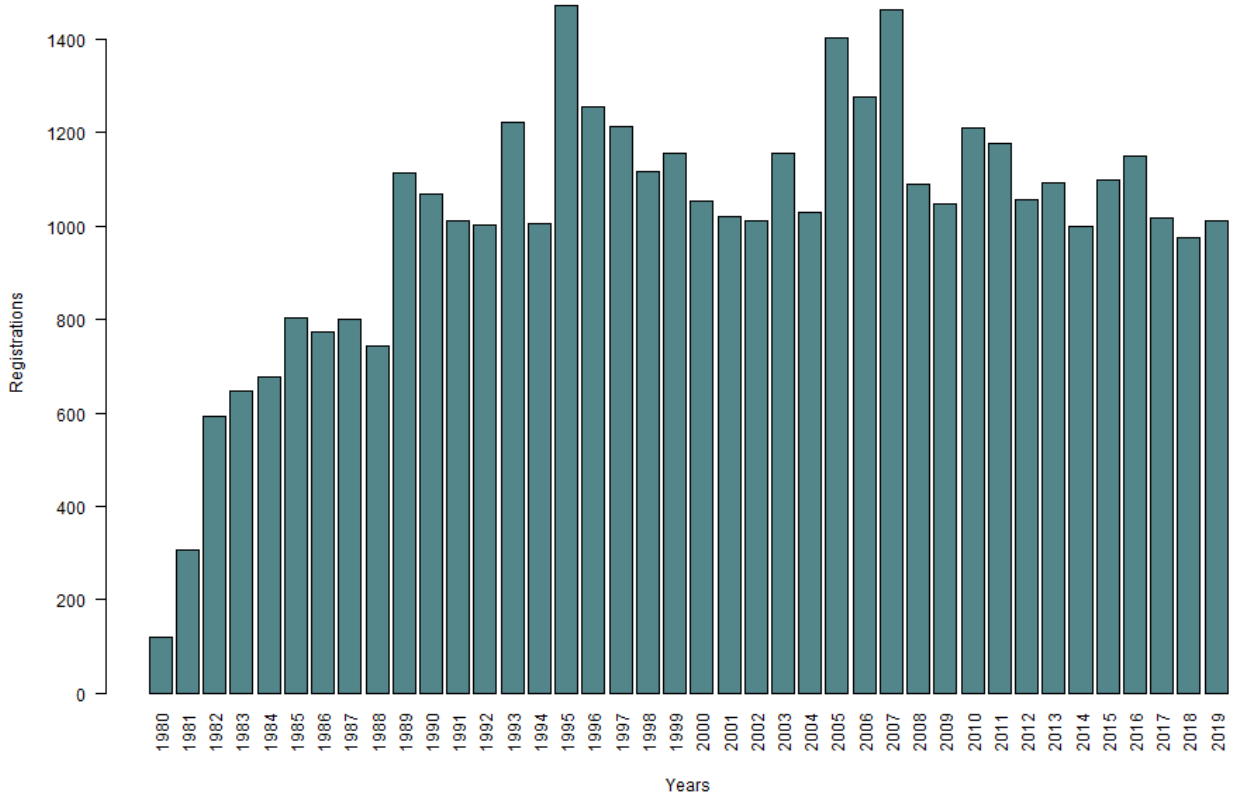


Figure 1: Number of registrations of Flat Coated Retrievers per year of birth, 1980 – 2019

BREED HEALTH CO-ORDINATOR ANNUAL HEALTH REPORT

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

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

1. Neoplasia (cancers) – primarily histiocytic sarcoma
2. Patellar luxation
3. Renal dysplasia

In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, the breed has supported ongoing research into histiocytic sarcoma in conjunction with the University of Cambridge Oncology department, as well as making a financial contribution to the Animal Health Trust (AHT) to fund a pilot project to determine whether a blood test can be used to identify the cancer. The breed have also been continuing to collect data on dogs affected by patellar luxation with the aim to set up a research project, and finally continued to collect data

on dogs affected by renal dysplasia, and encouraging owners to submit DNA samples. Following the closure of the AHT it is hoped this research will continue at the University of Cambridge.

BREED CLUB HEALTH ACTIVITES

The breed has an active Breed Health Coordinator and health sub-committees who lead a number of health testing sessions and health surveys. All four breed clubs have dedicated health pages on their websites.

The breed's Society supports a number of health initiatives in their health strategy, including:

- a cause of death register, with a recently published update (March 2020) available here: https://www.flatcoated-retriever-society.org/images/2020/dobson20.pdf
- DNA banking of affected dogs
- the AHT/KC Give a Dog a Genome project
- screening of patellar luxation at breed championship shows
- group studies to investigate the impact of lifestyle on health
- the popular sire effect
- collection of data in preparation for renal dysplasia research
- cancer research at the University of Cambridge's Veterinary School

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Purebred and Pedigree Dog Health Surveys Results

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

2004 Morbidity results: Health information was collected for 926 live Flat Coated Retrievers of which 549 (59%) were healthy and 377 (41%) had at least one reported health condition. The top categories of diagnosis were musculoskeletal (15.3%, 102 of 666 reported conditions), benign neoplasia (13.1%, 87 of 666 reported conditions), reproductive (12.0%, 80 of 666 reported conditions) and dermatologic (9.8%, 65 of 666 reported conditions). The most frequently reported specific conditions were lipoma (5.3% prevalence, 49 cases), false pregnancy (5.3% prevalence, 30 cases in the 563 female Flat Coated Retrievers in the survey), otitis externa (3.6% prevalence, 33 cases), histiocytoma (3.2%, 30 cases) and GDV (2.3% prevalence, 21 cases).

2004 Mortality results: A total of 610 deaths were reported for the breed. The median age at death for Flat Coated Retrievers was 9 years and 10 months (min = 4

months, max = 16 years and 11 months). The most frequently reported causes of death by organ system or category were cancer (54.3%, 331 of 610 deaths), old age (8.9%, 54 deaths), cardiac (6.2%, 38 deaths) and gastrointestinal (5.9%, 36 deaths). The most frequently reported specific causes of death behind cancer and old age were GDV (3.6%, 22 deaths) and heart failure (2.6%, 16 deaths).

2014 Morbidity results: Health information was collected for 672 live Flat Coated Retrievers of which 376 (56%) were healthy and 296 (44%) had at least one reported health condition. The most frequently reported specific conditions were lipoma (14.6% prevalence, 85 cases), skin (cutaneous) cyst (6.9%, 40 cases), skin cancer/tumour (5.7% prevalence, 33 cases), arthritis (4.5% prevalence, 26 cases) and skin lump (4.3% prevalence, 25 cases). Further analysis of the morbidity results suggested that the Flat Coated Retriever was at increased risk of bone cancer, distichiasis, GDV, lipoma, lymphoma, patellar luxation, skin cyst, skin cancer, skin lump and spondylosis compared to the average risk for dogs of all breeds (Wiles et al, 2017).

2014 Mortality results: A total of 225 deaths were reported for the breed. The median age at death for Flat Coated Retrievers was 10 years. The most frequently reported causes of death were cancer - unspecified (19.6%, 144 deaths), bone tumour (10.7%, 24 deaths) and splenic tumour (8.0%, 18 deaths).

2006 FLATCOATED RETRIEVER SOCIETY HEALTH SURVEY

This survey was believed to be the largest survey undertaken investigating the breed's health in the UK, with data collected on 1,229 dogs. In total 351 deaths were recorded, of which 57 had died from cancer; almost half of these dogs (43%) were over ten years old at the time of death. Other reported causes of death included organ failure, old age, gastric torsion and accident. Further information can be found here: http://www.flatcoated-retriever-society.org/images/stories/health/health%20survey%202006.pdf

2011 FLATCOATED RETRIEVER SOCIETY HEALTH SURVEY

Data were received about 878 dogs of the breed. Prevalence estimates of conditions reported in the 2011 are shown in Table 1, alongside those from the 2006 survey.

Table 1: Conditions reported in the 2011 Flat Coated Retriever health survey and their apparent prevalence estimates, alongside those from the 2006 survey.

Condition	2011 survey prevalence	2006 survey prevalence
Benign tumours	25.0%	25.0%
Skin and ear disease	12.0%	7.0%
Arthritis	8.0%	11.0%
Malignant tumours	6.0%	2.5%
Ocular disease	4.0%	4.0%
Food intolerance / allergy	3.4%	4.0%
Other skeletal conditions	3.0%	3.0%
Digestive tract disease	2.5%	2.0%
Gastric torsion / bloat (GDV)	2.3%	3.0%
Organ disease*	2.3%	-
Neurological disease[$]	2.0%	2.0%
Luxating patellae	1.7%	2.0%
Hypothyroidism	1.5%	2.0%
'Other' disease	3.0%	5.0%
Laryngeal paralysis	1.0%	-
Osteochondrosis dissecans (OCD)	<1.0%	<1.0%
Glaucoma	<1.0%	<1.0%

* 94% heart disease, one case renal disease.

[$] 17 dogs; 11 seizures, 4 epilepsy, 2 other neurological deficits.

In addition to the live dogs included in the survey, 300 deaths were reported to have occurred since the 2006 survey. Cancer was again the most frequently reported cause of death, accounting for 54% of deaths. Full results and analysis of the survey can be found here: http://www.flatcoated-retriever-society.org/images/stories/health/anays2011.pdf

A new survey is planned to be launched in 2020.

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 attempted to acknowledge possible limitations of the studies reported, including when the research involved dogs in other countries. Whilst there are often strong links between populations of a breed in different countries, there are also often differences

between the populations and issues seen in one country may not be seen (or may have a different prevalence) in another.

Musculoskeletal conditions

Hip dysplasia: Analysis of hip dysplasia severity and prevalence over time was recently undertaken for Swiss dogs that had participated in hip scoring between 1995 and 2016 (Ohlerth et al, 2019). Of 768 dogs assessed during this time, the proportion of dysplastic dogs fell from 6.0% initially to 2.6% between 2010-16, with the percentage of A-rated individuals (graded with no evidence of dysplasia) rising from 50.0% to 86.6%. This follows the trend seen in a previous paper looking at the prevalence of dysplasia overtime in Finnish dogs (Leppänen and Saloniemi, 1999).

A more recent analysis of UK data from the British Veterinary Association (BVA)/Kennel Club (KC) Hip Dysplasia Scheme found that more than 70% of Flat Coated Retriever dams, and almost 80% of sires, were hip scored. The heritability of hip score in the breed was estimated as 0.28 (s.e. 0.032), which was the lowest of all 15 breeds studied (Lewis et al, 2013).

Patellar luxation: The Flat Coated Retriever was reported to be at elevated risk of patellar luxation, with a breed-associated odds ratio compared to mixed breeds of 2.9 (95% C.I. 1.0 – 8.2), based on dogs which had attended veterinary teaching hospitals in the USA between 1986 and 1995; however this result was based on just nine cases and five non-cases in the breed (LaFond et al, 2002). Between 1990 and 2007, 3,834 Flat Coated Retrievers aged 12 months or older had their stifles graded for patellar luxation by a single certified orthopaedic surgeon using an adapted version of the Putnam scoring system. The prevalence of patellar luxation over this time period was 23.6% (905 dogs affected); 61% of cases involved lateral displacement of the patella (Lavrijsen et al, 2013). The heritability of patellar luxation in the Dutch population of the breed was estimated as 0.17±0.03, suggesting that environmental factors play an important role in the manifestation of the condition.

Spondylosis deformans and diffuse idiopathic skeletal hyperostosis (DISH): This condition affects the entire skeleton and results in ossification of soft tissues, including spinal ligaments and sites of attachment of tendons to bone, resulting in stiffness and pain. A retrospective radiographic study of dogs over one year of age referred to the Utrecht University Veterinary Medical Teaching Hospital between February 2003 and January 2008 revealed an overall prevalence of DISH of 3.8% (78 cases in 2041 dogs). The prevalence of spondylosis and/or DISH in Flat Coated Retrievers was 42.6% (26 cases in 61 dogs of the breed); and the breed had an odds ratio of 2.8 for developing spondylosis and 7.7 for developing DISH compared to dogs of other breeds (Kranenburg et al, 2011)

Neoplastic conditions

Histiocytic sarcoma (HS): A cohort study of 174 British Flat Coated Retrievers, which were healthy and aged between two and seven years of age at the start of the study

in 1996, found that 42.0% (72 dogs) died from confirmed neoplasia and11.6% (20 dogs) died of unconfirmed tumours. Soft tissue sarcoma, especially histiocytic sarcoma, was the predominant cancer type representing 44% (32 dogs) of neoplasms (Dobson et al, 2009). A subsequent study of all cases of soft tissue sarcoma submitted to the ongoing Flat Coated Retriever Cancer Survey (FRCS) at the Department of Veterinary Medicine, University of Cambridge from 1996 to 2009 included data on 180 dogs. The majority (57%, 101 lesions) were primary limb lesions while 26% (47 dogs) had visceral, mainly splenic, lesions with no peripheral primary tumour (Constantino-Casas et al, 2011).

Osteosarcoma: A study of insured Swedish dogs under 10 years old between 1995 and 2002 found 764 dogs were diagnosed with bone tumours between 1995 and 2002. The Flat Coated Retriever was the sixth most common breed to be diagnosed with osteosarcoma, with 75 cases in the breed, giving an incidence rate of 35 cases (95% C.I. 27 - 43) per 10,000 dog years at risk (DYAR); this compared to the rate in all breeds combined of 5.5 cases per 10,000 DYAR (Egenvall et al, 2007).

Ocular conditions

Primary closed angle glaucoma (PCAG): A UK study of 389 Flat Coated Retrievers with no prior evidence of ocular disease, undertaken at the Animal Health Trust (AHT), suggested that the expected incidence of glaucoma in the breed in the UK was 1% i.e. one case per hundred dogs of the breed (Wood et al, 1998). The degree of pectinate ligament dysplasia (PLD) present was closely associated with the probability that a particular dog would develop glaucoma, and PLD appeared to be highly heritable at 0.7. A subsequent study of Flat Coated Retrievers in the UK (39 dogs) and Switzerland (57 dogs) compared the results of two gonioscopic examinations at least one year and 11 months apart and found progression of PLD grade in 40.6% cases (39 of 96 dogs); all PLD grades either progressed or remained static, no reduction in grade was observed (Pearl et al, 2015). A recent study of 170 dogs of the breed in the UK found that 37.6% (64 dogs) had no PLD, 41.2% (70 dogs) were mildly affected and 21.2% (36 dogs) were moderately affected (Oliver et al, 2016). No dogs of the breed were found to have the most severe grade PLD.

Urological conditions

Renal disease: A recent study of Swedish insurance claim records from 1995-2006 reported an overall incidence of kidney disease of 15.8 (95% C.I. 15.3-16.2) cases per 10,000 dog years at risk (DYAR) for a population of 665,245 dogs; for Flat Coated Retrievers the kidney disease incidence was 27 (95% C.I. 22 - 33) cases per 10,000 DYAR, based on 92 cases in 33,897 DYAR, suggesting that the breed is at increased risk of kidney disease compared with dogs of other breeds (Pelander et al, 2015). Considering 548,346 life insurance policies, the total kidney-related mortality was 9.7 (95% C.I. 9.3-10.2) deaths per 10,000 DYAR; for Flat Coated Retriever the kidney-related mortality was 25 (95% C.I. 19 - 31) deaths per 10,000 DYAR, based on 69 deaths in 27,207 DYAR; again suggesting an increased risk of mortality due to kidney disease compared to dogs of other breeds.

INSURANCE DATA

There are some important limitations to consider for insurance data:

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

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

UK Agria data

Insurance data were available for Flat Coated Retrievers insured with Agria UK. Full policies are available to dogs of any age. Free policies are available to breeders of Kennel Club registered puppies with cover starting from the time the puppy is collected by the new owner; and lasting for five weeks from this time. 'Exposures' are equivalent to one full policy year; in 2017 there were 69 free exposures, 531 full exposures and 780 claims (over both free and full exposures), in 2018 there were 72 free exposures, 481 full exposures and 650 claims.

It is possible that one dog could have more than one settlement (claims which were paid out for) for a condition within the 12-month period shown. The top 10 breed-specific conditions by number of settlements, accumulated from the 72 free and 481 full exposures, between 1st July 2017 and 31st June 2018, are shown in Table 2 below.

Table 2: Top 10 conditions and number of settlements for each condition between 1st July 2017 and 31st June 2018 for Flat Coated Retrievers insured with Agria UK

Condition	Number of settlements
Atopy finding[$]	37
Hypersensitivity (allergic) skin disorder (unspecified) [$]	34
Otitis externa	21
Lameness finding	21
Skin (cutaneous) disorder (unspecified)	20
Lymphoma finding	20
Osteoarthritis (osteoarthrosis degenerative joint disease (DJD))(unspecified)	19
Epilepsy	17
Patellar luxation - medial	15
Neoplasm - skin (cutaneous)	13

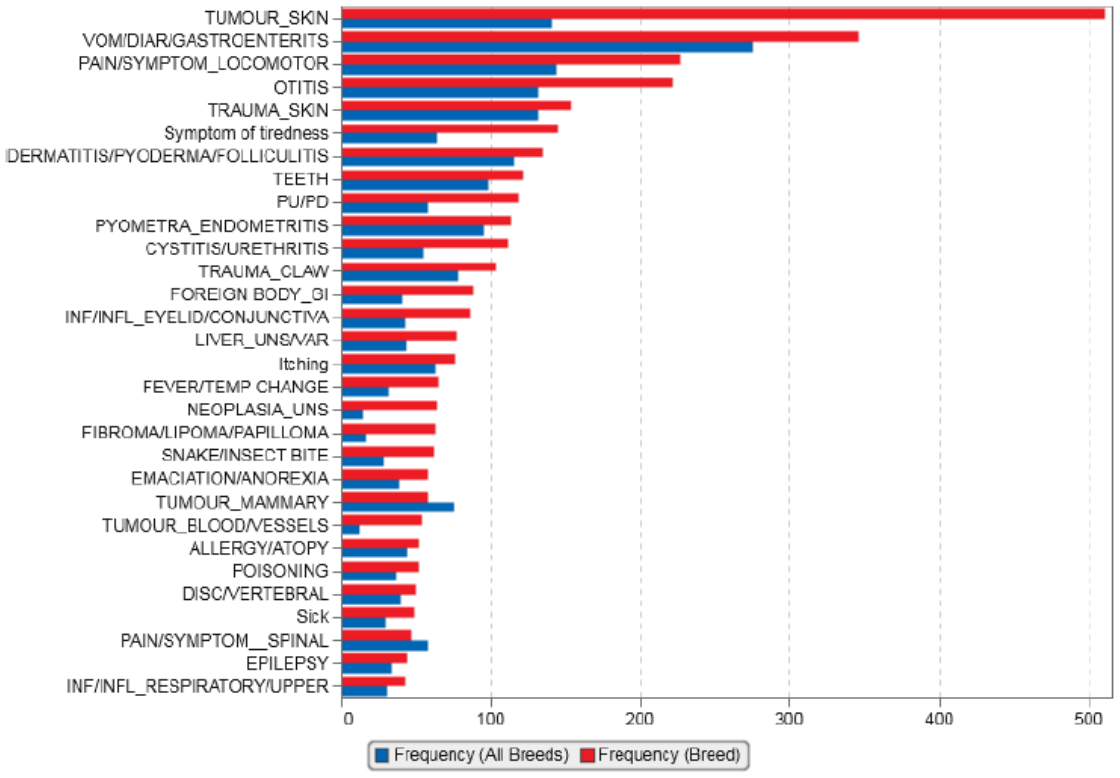
[$] N.B. - Allergy is any exaggerated immune response to a foreign antigen regardless of mechanism. A dog can be allergic without being atopic. Atopy is a genetic predisposition to an exaggerated Immunoglobulin E (IgE)-mediated immune response to allergens in the environment. The treatment of atopy will be different to the treatment of non-atopic allergy.

Swedish Agria insurance morbidity data

Swedish morbidity and mortality insurance data were also available from Agria for the Flat Coated Retriever. Reported rates are based on dog-years-at-risk (DYAR) which take into account the actual time each dog was insured during the period (2011-2016) e.g. one DYAR is equivalent to a whole year of insurance. The number of DYAR for the Flat Coated Retriever in Sweden during this period was between 10,000 and 15,000.

A summary of the findings are given below, with a detailed report available from: https://dogwellnet.com/breeds/additional-breed-resources/breeds-with-swedish-insurance-data-r111/

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Flat Coated Retrievers in Sweden between 2011 and 2016 are shown in Figure 2. The top specific causes of VCEs were skin tumour, vomiting/ diarrhoea/ gastroenteritis, pain/ locomotor signs, otitis, and skin trauma. These top five conditions were the same as the previous analysis undertaken on the breed (2006-2011).



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

Figure 2: The most common specific causes of VCEs for the Flat Coated Retriever compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

When relative risk of specific causes of VCEs was compared for the Flat Coated Retriever to all breeds, the top specific causes of VCEs ordered by relative risk were heart tumour, haemangiosarcoma, liver tumour, tumour of the lower respiratory tract and distichiasis/ trichiasis. Rare conditions that occur sporadically may appear as a high relative risk; given that a number of the conditions in Figure 3 do not appear in Figure 2, this caveat may well apply to these conditions.

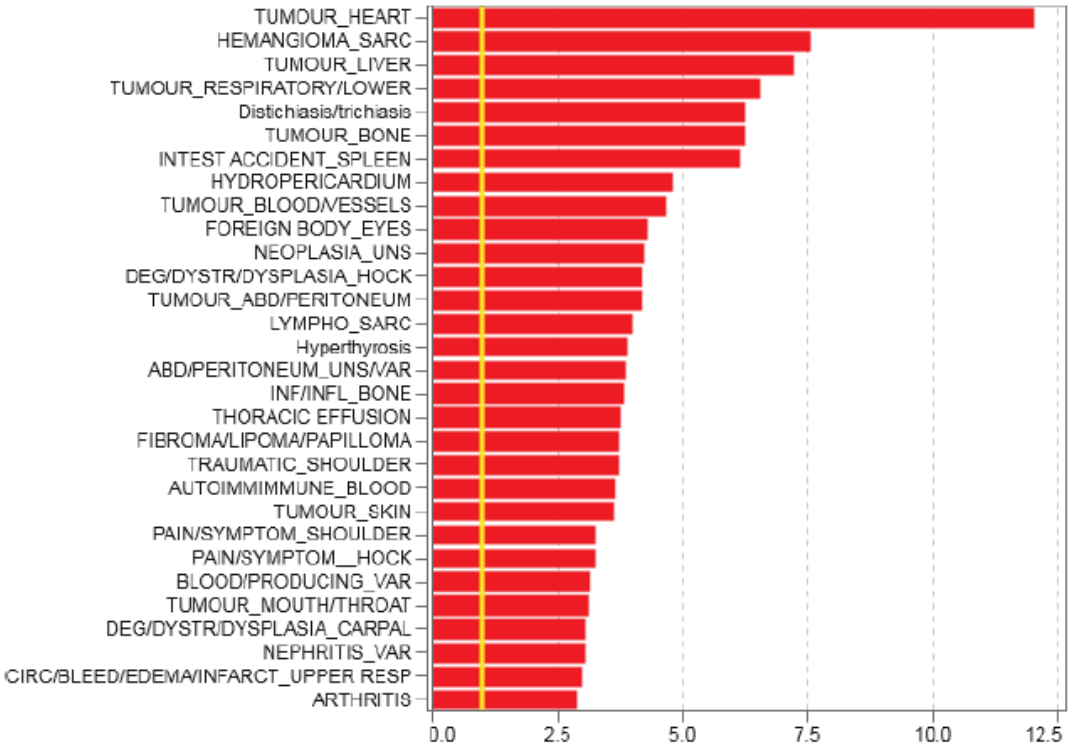


Figure 3: The specific causes of VCEs for the Flat Coated Retriever ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

Further to this, the breed's relative risk of morbidity of locomotory problems/ concerns was compared to all breeds (Figure 4). Locomotor signs in the scapula had the highest relative risk for the breed, and interestingly knee/ patellar the lowest.

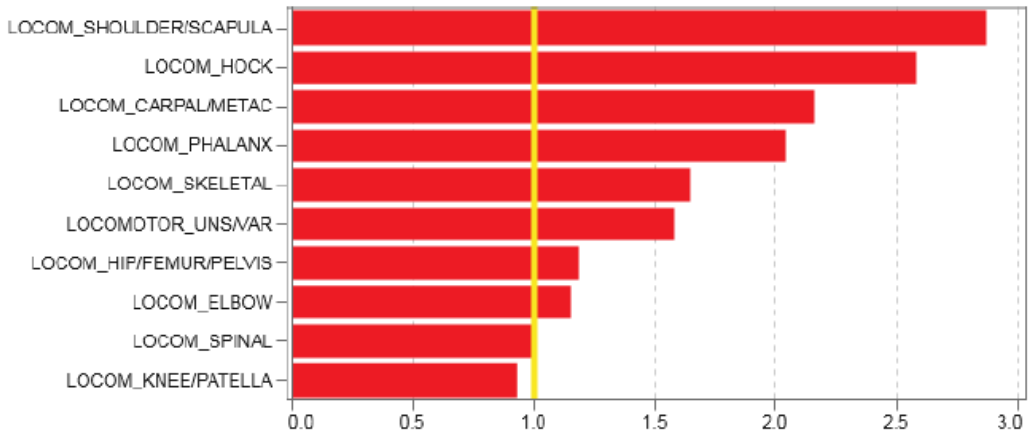
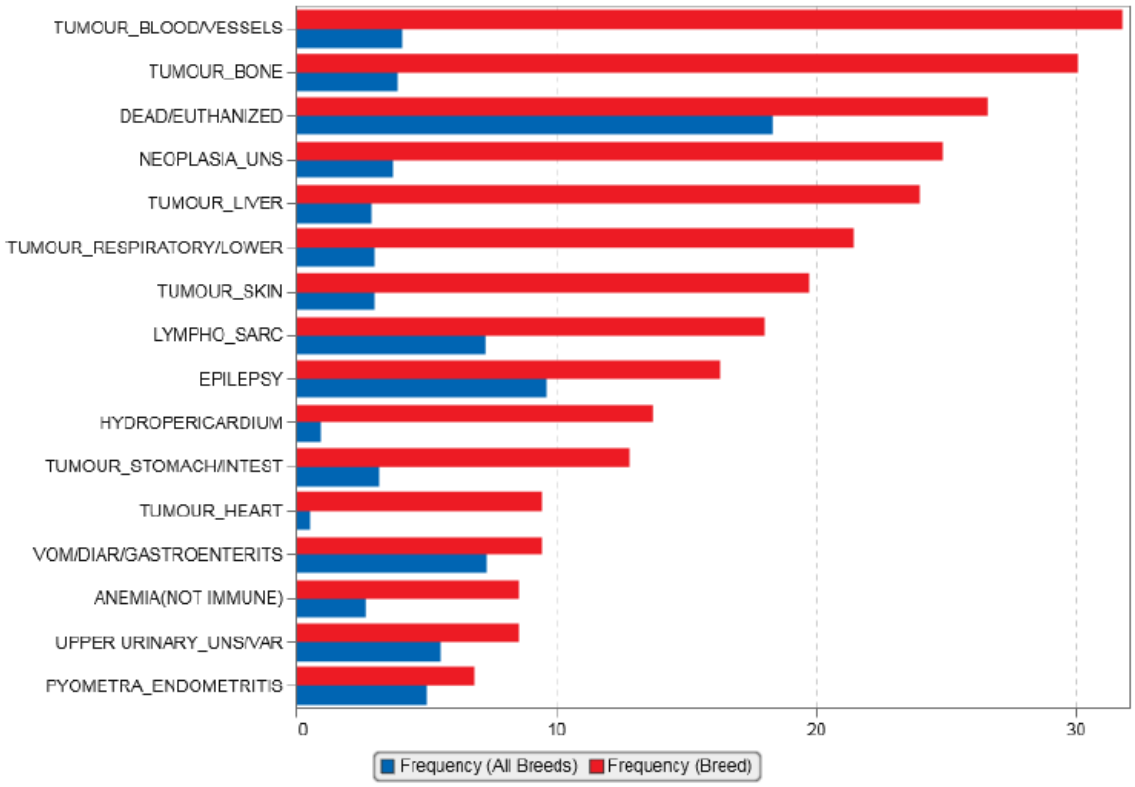


Figure 4: The relative risk of morbidity of locomotor problems in the Flat Coated Retriever in comparison to all breeds in the Swedish Agria database between 2011-2016.

Swedish Agria insurance mortality data

The most common specific causes of death or euthanasia for Agria-insured Flat Coated Retrievers in Sweden between 2011 and 2016 are shown in Figure 5. The most common specific causes of death were tumour of the blood/ vessels, bone tumour (osteosarcoma), dead/ euthanised, neoplasia – unspecified, and liver tumour.



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

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

When relative risk of specific causes of death was compared for the Flat Coated Retriever to all breeds, the top specific causes by relative risk were heart tumour, hydropericardium, liver tumour, tumour of the blood/ vessels and bone tumours (Figure 6). Again, as mentioned for Figure 3 conditions that occur sporadically may appear as a high relative risk.

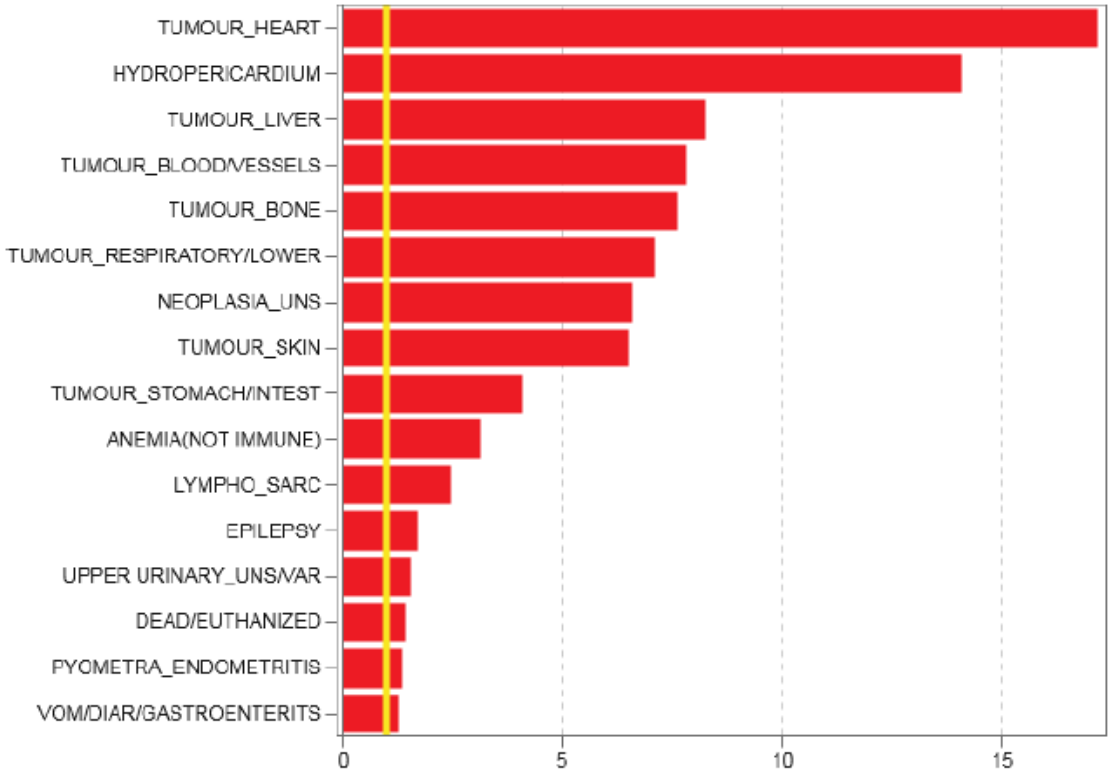


Figure 6: The relative risk of death in the Flat Coated Retriever in comparison to all breeds in the Swedish Agria database between 2011-2016.

BREED WATCH

The Flat Coated Retriever is currently listed as a category 1 breed on Breed Watch, meaning there are currently no listed visible points of concern for judges to report on when judging at championship certificate level. No optional reports have been received from judges since Breed Watch began.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme there are the following requirements for the Flat Coated Retriever:

- Hip scoring under the British Veterinary Association (BVA)/ Kennel Club Hip Dysplasia Scheme
- Eye testing (Gonioscopy) for pectinate ligament abnormality (PLA) (gonioscopy) current advice is to test at 1, 4 and 7-8 yrs of age

It is also recommended that the following are undertaken:

- Eye testing under the BVA/KC/ International Sheepdog Society (ISDS) Scheme
- Bitches under two years of age not to produce a litter
- Bitches not to produce more than three litters in their lifetime
- Bitches not to produce more than one litter within a 12-month period

BREED CLUB BREEDING RECOMMENDATIONS

The majority of Breed Clubs recommend members abide by the following breeding terms:

- A breeder will only breed from those Flatcoats believed to be clear from any known serious hereditary defects and which are not suffering from any acute problems. To this effect all breeding stock, including imported dogs, should have had their hips radiographed and scored and their eyes examined for Goniodysgenesis, Hereditary Cataract and progressive Retinal Atrophy under the BVA/KC health schemes, or adopt as a minimum standard the requirements and recommendations of the ABS.
- Bitches should not be bred from until at least two and half years old.
- Normally no bitch should be expected to produce more than three litters.
- There should be at least a year between each litter bred from a bitch.

Further, the Flatcoated Retriever Society note that extensive use of any particular stud dog is actively discouraged.

DNA TEST RESULTS

There are currently no DNA tests recognised by the Kennel Club for the Flat Coated Retriever.

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 SCHEMES AND ESTIMATED BREEDING VALUES

The BVA/ KC schemes are available to all UK dogs, with the results of KC registered Flat Coated Retrievers shown below. Estimated breeding values (EBVs) are available for the breed for hip scores.

HIPS

A total of 3,129 Flat Coated Retrievers have gone through the BVA/KC Hip Dysplasia Scheme in the 15 years to date (16/04/2020), with the 15 and five year median scores being 7 (range 0 to 84).

Hip score categories received by Flat Coated Retrievers which participated in the BVA/KC Hip Dysplasia Scheme between 1990 and 2017 are shown in five year blocks (which can be considered to approximate to a generation) in Figure 7 below. The categories correspond to those assigned under the FCI (Europe)'s hip grading scheme; for one hip, a 'normal' hip scores 0-3, borderline scores 4-8, mild HD scores 9-18, moderate HD scores 19-30 and severe HD represents a score greater than 30. A comparison of the schemes can be found through clicking here (page 135). Over this time period there appears to have been a definite increase in the proportion of Flat Coated Retriever receiving normal hip scores and a corresponding decline in those receiving borderline, mild, moderate and severe scores.

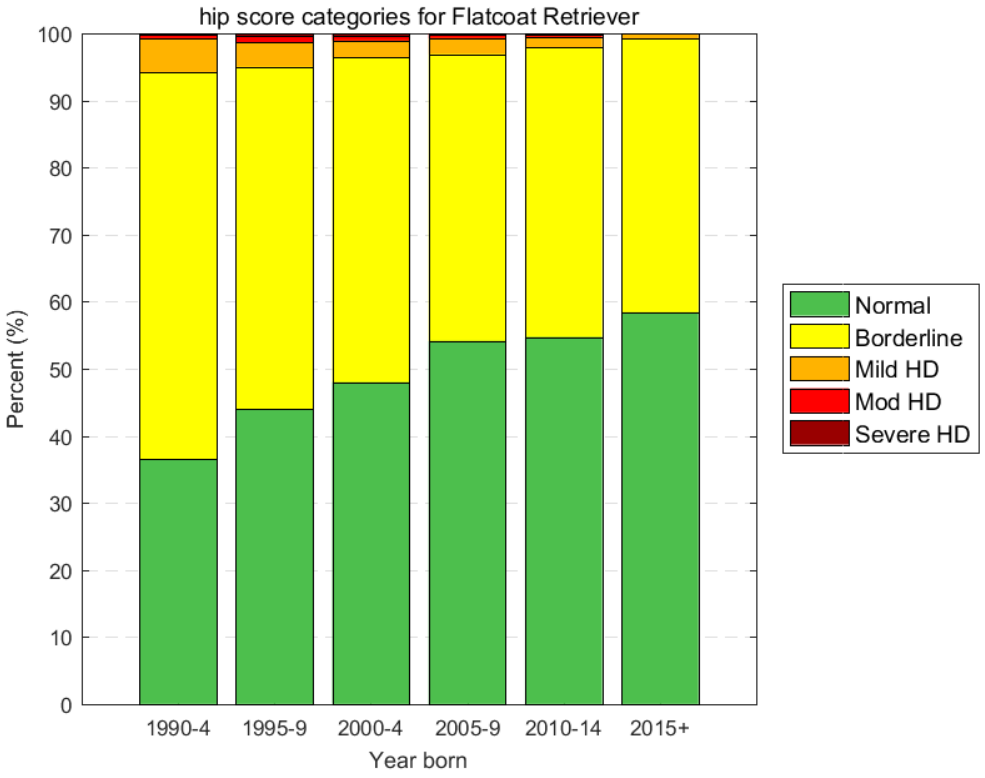


Figure 7: Hip score categories for Flat Coated Retrievers which participated in the BVA/KC Hip Dysplasia Scheme between 1990 and 2016, in 5-year blocks.

Estimated Breeding Values (EBVs) are available for hip scores in this breed. Figure 8 shows the five year rolling trend in EBVs by year of birth in the Flat Coated Retriever. It appears that EBVs have decreased very slightly since 1990. This indicates a very slight improvement in (lowering of) genetic risk of hip dysplasia as determined by the BVA/KC hip score, most likely as a result of selection, but suggests that selection in this area is not intense.

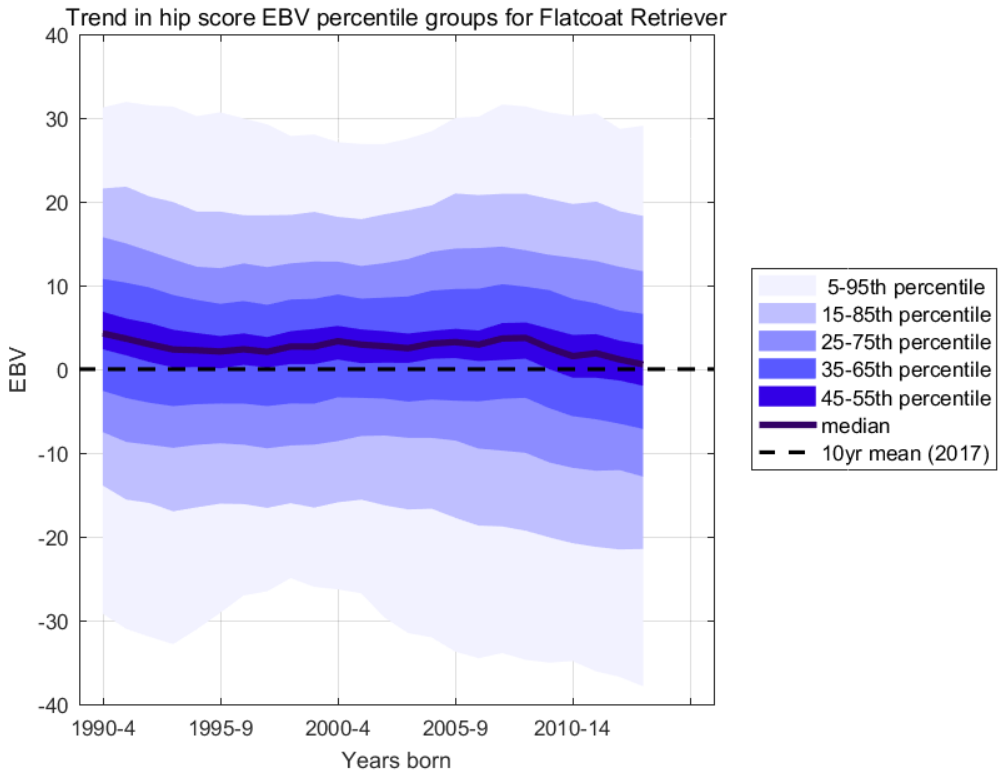


Figure 8: Trend in hip score EBV, with percentile groups, for the Flat Coated Retriever for years of birth since 1990.

ELBOWS

In total 536 Flat Coated Retrievers have been elbow scored as part of the BVA/KC Elbow Dysplasia Scheme since the scheme launched in 1998; the scores received are shown in Table 4 below. Just 1.9% (9 of 536) Flat Coated Retrievers scored were diagnosed with some degree of elbow pathology.

Table 4: Elbow scores and number of dogs receiving those scores since 1998 for the Flat Coated Retrievers

Elbow score	Number of dogs	Percentage
0	526	98.1%
1	5	1.0%
2	2	0.4%
3	3	0.6%

EYES

The Flat Coated Retriever is currently on the BVA/KC/ISDS the Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for:

- Pectinate ligament abnormality (PLA)/ glaucoma (G)

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.

Since 1st July 2017, 'G' has been replaced with PLA, for which a grade is assigned from 0 (unaffected) to 3 (severely affected). The results collated by the BVA for gonioscopy examinations undertaken in Flat Coated Retrievers from 1st January 2007 to 31st March 2020 are shown in Table 5.

Table 5: Gonioscopy Reports for Flat Coated Retrievers from Jan 2007 to March 2020.

Date of Gonioscopy	Number of Flat Coated Retrievers Tested				
	PLA Grade 0	PLA Grade 1	PLA Grade 2	PLA Grade 3	Total
July 2017 – March 2020	310	196	37	5	548
Jan 2007– June 2017	Gonio Unaffected	Gonio Affected	Total		
	2,171	99	2,195		

Schedule B has been incorporated into an annual sightings reports, which records the results of conditions not listed on KIOD for dogs which have participated in the scheme. The results of Eye Scheme examinations of the breed which have taken place since 2012 are shown in Table 6.

Table 6: Reports on dogs of the breed which have participated in the BVA/KC/ISDS Eye Scheme since 2012

Year	Number seen	Comments
2012	329 adults 1 litter	16 – distichiasis 6 – retinopathy 4 – persistent pupillary membranes (PPM) 1 – entropion 1 – ectropion 1 – persistent hyperplastic primary vitreous (PHPV) 1 – other cataract 1 – recessed optic discs
2013	311 adults 0 litters	21 – distichiasis 11 – PPM 7 – other cataract 3 – ectropion 1 – corneal lipid deposition 1 – nuclear cataract 1 – posterior polar subcapsular cataract (PPSC) 1 – posterior segment coloboma 1 – eyelid mass 1 – micropunctum
2014	271 adults 0 litters	10 – distichiasis 2 – ectropion 2 – PPM 2 – PPSC 1 – PHPV
2015	287 adults 0 litters	10 – distichiasis 4 – nuclear cataract 3 – abnormal pigment deposition (APD) 3 – other cataract 2 – PPSC 2 – posterior segment coloboma 2 – entropion 1 – ectropion 1 – corneal lipid deposition 1 – PPM
2016	211 adults 0 litters	8 – distichiasis 3 – focal retinopathy 2 – PPSC 2 – other cataract 1 – PHPV
2017	273 adults 0 litters	No comments
2018	317 adults 0 litters	1 – PPSC 3 – post cataract 1 – GPRA-like appearance
2019	*Awaiting report*	

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Between 2015 and 2019, 1,716 dogs of the breed were examined by the ACVO and prevalence data are shown in Table 7 alongside data from previous years. Overall, 58.8% (1,009 of 1,716) of dogs of the breed examined between 2015 and 2019 had healthy eyes unaffected by any disease conditions. However, it is important to bear in mind that the dogs were from America and therefore the data may not be representative of UK dogs. Only conditions affecting more than 1% of the population are shown in the table below.

Table 7: ACVO examination results for breed, 1991 – 2019

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n=8,243)	**2015-2019** (n=1,716)
Eyelids		
Distichiasis	12.6%	13.0%
Uvea		
Persistent pupillary membranes (iris to iris)	2.3%	4.3%
Persistent pupillary membranes (lens pigment foci/ no strands)	0.5%	3.3%
Lens		
Cataract (significant)	3.2%	4.7%

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

BREED CLUB PATELLAR SCREENING SCHEME

The Flat Coated Retriever Society have launched a patellar screening scheme from 2010 with a total of 169 dogs tested to date, of these 48.5% were found to be clear of any disease of clinical significance with regard to their patellae.

REPORTED CAESAREAN SECTIONS

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

There are some caveats to the associated data;

- It is doubtful that all caesarean sections are reported, so the number reported each year may not represent the true proportion of caesarean sections undertaken in each breed.
- These data do not indicate whether the caesarean sections were emergency or elective.

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 8.

Table 8: Number and percentage of litters of breed 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	170	0	0.00%	0.15%
2010	182	0	0.00%	0.35%
2011	187	2	1.07%	1.64%
2012	158	8	5.06%	8.69%
2013	159	3	1.89%	9.96%
2014	156	4	2.56%	10.63%
2015	160	10	6.25%	11.68%
2016	175	16	9.14%	13.89%
2017	137	6	4.38%	15.00%
2018	157	16	10.19%	17.21%
2019	143	2	1.40%	15.70%

GENETIC DIVERSITY MEASURES

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the ‘gene pool’ of the breed. In the population analysis undertaken by the Kennel Club in 2020, an estimated effective population size of **106.90** was reported (estimated using the rate of inbreeding over the period 1980-2019).

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).

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated ‘random mating’) over the period 1980-2020 are shown in Figure 7. 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 2000 the rate of inbreeding has flattened and began to decrease, implying maintenance of genetic diversity (possibly through the use of imported animals). It should be noted that, while animals imported from overseas may appear completely unrelated, this is not always the case. Often the pedigree available to the Kennel Club is limited in the number of generations, hampering the ability to detect true, albeit distant, relationships. For full interpretation see Lewis et al, 2015 https://cgejournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4.

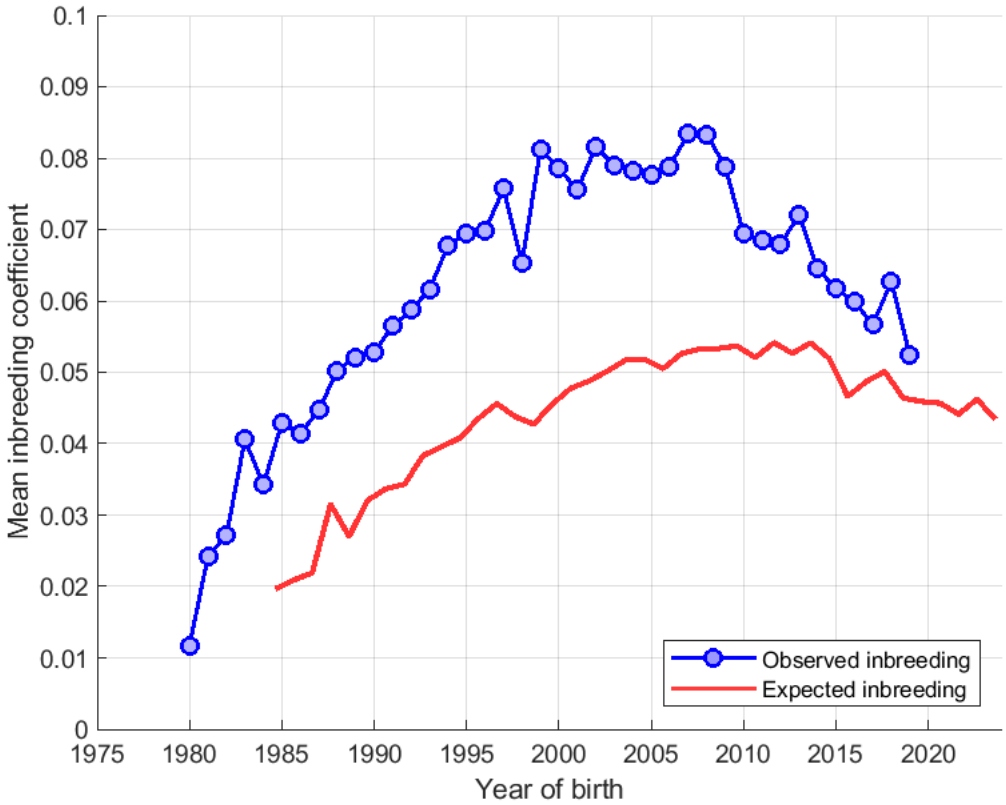


Figure 7: Annual mean observed and expected inbreeding coefficients.

Below is a histogram (‘tally’ distribution) of the proportion of progeny per sire and dam over each of 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). There appears to be moderate use of popular dogs as sires in this breed, with two sires still siring approximately 6.1% of the population between 2015 – 2019 (the ‘tail’ of the blue distribution in Figure 8).

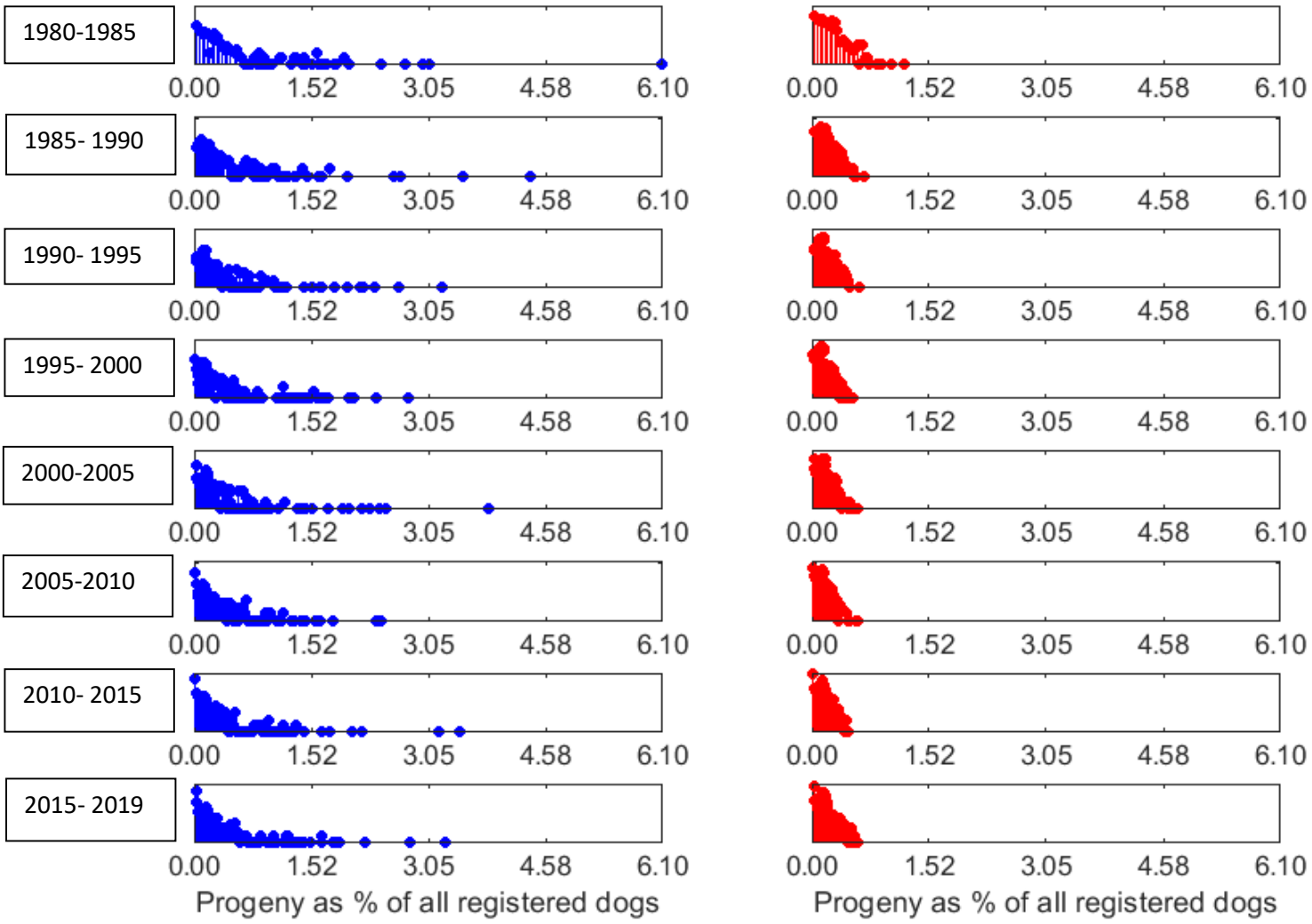


Figure 8: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2015-19 bottom). Vertical axis is a logarithmic scale.

CURRENT RESEARCH

The Flat Coated Retriever is one of the breeds in the AHT's Give a Dog a Genome project; the health conditions given as concerns for the breed were dilated cardiomyopathy, histiocytic sarcoma and renal dysplasia. DNA from an individual affected with histiocytic sarcoma has been sent for sequencing, and the data will be shared with Benoit Hedan at Rennes and Jane Dobson at the University of Cambridge. Following the closure of the AHT in June 2020 it is hoped that this research will continue at the University of Cambridge. This also applies to research that has been undertaken to date at the AHT investigating glaucoma in the breed.

Histiocytic sarcoma research continues at the University of Cambridge, and at the USA National Institute of Health, Bethesda, Maryland.

PRIORITIES

A meeting was held with Flat Coated Retriever breed club representatives on 9th August 2018 to discuss the evidence base of the BHCP and agree 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 Flat Coated Retriever were:

- Histiocytic sarcoma
- Glaucoma
- Epilepsy
- Patellar luxation

Dilated cardiomyopathy, cruciate ligament disorders, renal disease and genetic diversity were agreed to be kept at watch.

ACTION PLAN

Following the meeting between the Kennel Club and the breed, the following actions were agreed to improve the health of the Flat Coated Retriever.

Breed Club actions include:

- The breed clubs to continue to encourage owners to report to the breed's cause of death register. – **ONGOING**
- The breed clubs to encourage breeders to consider the potentially harmful consequences arising from the use of popular sires and the impacts on genetic diversity. – **ONGOING**
- The breed clubs to continue to encourage participation in the BVA/KC Hip and Elbow Dysplasia Schemes. – **ONGOING**
- The breed clubs to undertake another breed health survey with the Kennel Club to assist in dissemination.
- The breed clubs to continue to encourage participation in the breed's patellar assessment scheme. – **ONGOING**
- The breed clubs to monitor and record the prevalence of neoplasia in the breed and to encourage and consider any research that is available

Kennel Club actions include:

- Dr Lewis to examine the data collected to date under the patellar assessment scheme, if sufficient data exists. Input may be sought from Dr Dylan Clements at the University of Edinburgh. – **ONGOING**
- The Kennel Club to monitor any available research for neoplasia in the breed and keep the breed updated. – **ONGOING**
- The Kennel Club to involve the breed in any research studies investigating patellar luxation.
- The Kennel Club to raise queries on behalf of the breed regarding the BVA/KC/ISDS eye scheme.
- The Kennel Club to update the breed as to any advancements made with the Veterinary Cardiologist Society heart schemes.
- The Kennel Club to discuss the possibility of a VetCompass study for the breed with Dr Dan O'Neill. – **ONGOING**
- The Kennel Club to assist in analysing the group study data.

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