



THE KENNEL CLUB  
DOG HEALTH

# Breed Health and Conservation Plan



Newfoundland  
2018

## INTRODUCTION

The Kennel Club launched a dynamic 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 holistic 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 (Section 1 of the BHCP) 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 Coordinator and breed health committee or representatives if applicable. Priorities are agreed and laid out in Section 2. A collaborative action plan for the health of the breed is then agreed and incorporated as Section 3 of the BHCP. This will be monitored and reviewed.

## SECTION 1: EVIDENCE BASE

The Newfoundland is currently a category two breed which indicates that it has one or more Breed Watch points of concern. The particular point of concern listed for the breed in Breed Watch is:

- Conformational defects of the upper and lower eyelids (loose eyelids)

### Demographics

The numbers of new registrations of the breed per year are shown in Table 1, and have remained relatively stable over this time period.

Table 1: Number of breed registered per year between year and year

Year	Number of new registered Newfoundlands	Percentage of breed in the KC registered population per year
2007	957	0.35%
2008	1046	0.38%
2009	898	0.37%
2010	1026	0.40%
2011	862	0.35%
2012	921	0.40%
2013	861	0.38%
2014	981	0.44%
2015	917	0.42%
2016	829	0.36%
2017	764	0.31%

The number of Newfoundlands registered by year of birth between 1980 and 2017 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 (1980-2014) was +16.46 per year (with a 95% confidence interval of +11.45 to +21.07), 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.]

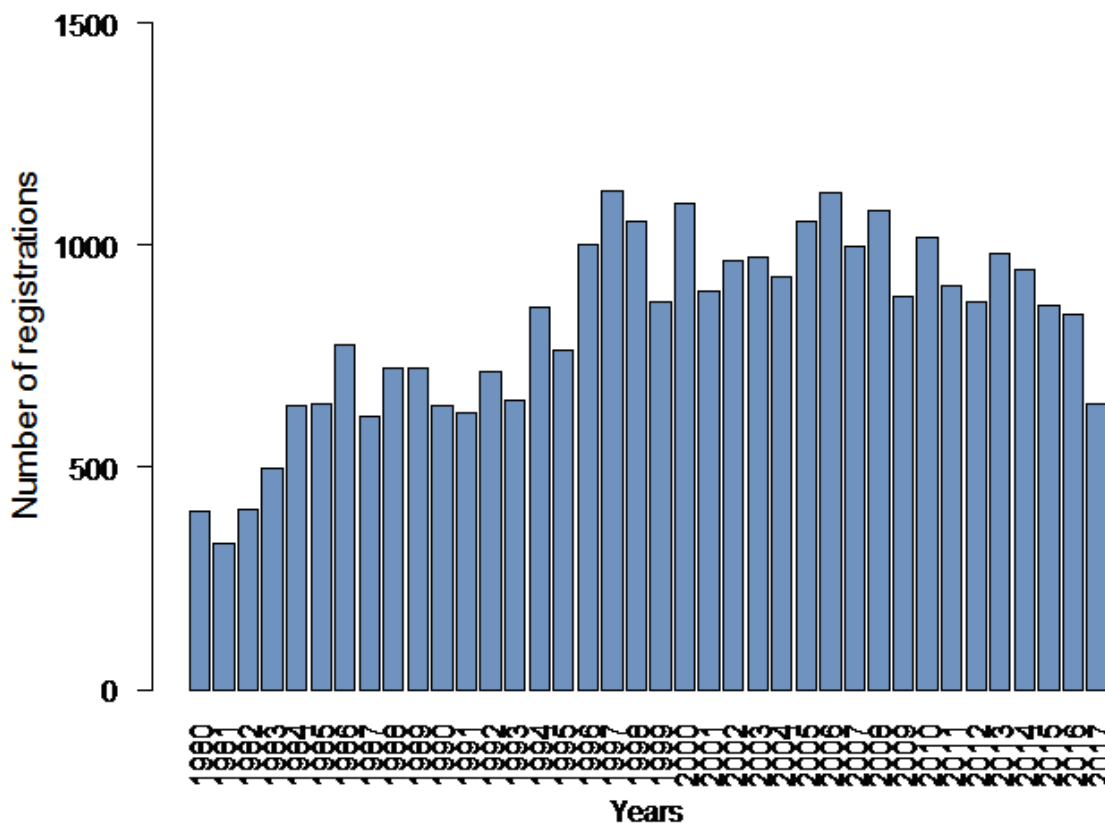


Figure 1: Numbers of registrations of Newfoundlands per year of birth, 1980 – 2017

## 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. However, it may also be useful for United Kingdom (UK) breeders to be aware of conditions occurring in the breed in other countries which have not yet been seen in the UK population, especially given that movement of breeding stock does occur between countries.

### **Cardiovascular conditions**

*Aortic stenosis/subaortic stenosis (SAS):* A review of the medical records of all 195 dogs with a confirmed SAS diagnosed at the University of California-Davis Veterinary Medical Teaching Hospital (VMTH), USA, between July 1967 and December 1991 found the Newfoundland to be the most frequently affected breed with 19.5% of cases (38 dogs of the breed); the odds ratio for the breed was 88.1 (95% C.I. 59.7 – 130) compared to all dogs (Kienle et al, 1994). The breed also appeared to be at increased risk of SAS, with 23 of 241 cases and an odds ratio of 7.0 compared to dogs of other breeds, in comparison with the general hospital population in a retrospective study of the medical records of 976 dogs diagnosed with congenital heart disease at a cardiology clinic in Italy (Oliveira et al, 2011). A more recent study of electronic patient records of 90,004 dogs examined at the VMTH from 1<sup>st</sup> January 1995 to 1<sup>st</sup> January 2010 again found the Newfoundland to be the most frequently affected breed with aortic stenosis, with a breed-specific prevalence of 6.80% compared to a mixed breed-prevalence of 0.15% (Bellumori et al, 2013). A research group at the North Carolina State University in the USA reported that they had identified a mutation in the phosphatidylinositol-binding clathrin assembly protein (*PICALM*) gene associated with the development of SAS in Newfoundlands, with an autosomal dominant inheritance pattern (Stern et al, 2014). However, researchers at the University of Bern in Switzerland subsequently showed that this mutation appears to be a neutral variant, not associated with SAS risk, that occurs at a high frequency in Newfoundlands but is rare or absent in most other dog breeds (Drögemüller et al, 2015).

*Atrial fibrillation (AF):* The Newfoundland has been found to be at increased risk of this arrhythmia in an American case series. In a study of 109 cases of AF from two North American veterinary teaching hospitals, Newfoundlands were over-represented in the group of cases where no structural heart disease or congestive heart failure was present with 19% (5 of 26 dogs) of cases (Menaut et al, 2005). In a subsequent large study of 3,542 cases of AF in the Veterinary Medical Data Base in the USA, the Newfoundland had an odds ratio of 11.60 compared to dogs of all breeds (Westling et al, 2008)

*Dilated cardiomyopathy (DCM)*: DCM is an acquired, usually late-onset disease which affects a number of large and giant breeds including the Newfoundland. In a UK study in which dogs of the breed affected with the condition received regular serial clinical and echocardiographic examinations, and dogs were classed as 'normal' if they had no detectable cardiac abnormalities by eight years of age, pedigree and segregation analyses were most consistent with an autosomal dominant mode of inheritance with incomplete penetrance (Dukes-McEwan and Jackson, 2002). Evaluation of 15 candidate genes, implicated in the disease in humans and in experimental models, for DCM in the Newfoundland found no evidence that any of the genes were involved in the condition in the breed (Wiersma et al, 2008).

*Patent ductus arteriosus (PDA)*: This congenital heart condition involves failure of a foetal blood vessel to close after birth, allowing abnormal blood flow between the aorta and the pulmonary artery. The breed appeared to be at increased risk of PDA, with 13 of 237 cases and an odds ratio of 4.65 compared to dogs of other breeds, in comparison with the general hospital population in a retrospective study of the medical records of 976 dogs diagnosed with congenital heart disease at a cardiology clinic in Italy (Oliveira et al, 2011).

### **Dermatological conditions**

*Atopic dermatitis (atopy)*: A Swedish study investigating the prevalence of atopic dermatitis in an insured population reported the Newfoundland as the eleventh most frequently diagnosed breed with the condition, with 12 claims for the condition out of a total of 1,064 dogs of the breed. Newfoundlands had an incidence of 3.8 cases per 1000 dog years at risk (DYAR), compared to an overall incidence rate of 1.7 cases per 1000 DYAR (Nødtvedt et al, 2006).

*Pemphigus foliaceus*: An American study was found which suggested that the Newfoundland may be at an increased risk of developing this rare skin condition (Ihrke et al, 1985). However, no more recent studies nor prevalence estimates could be found in the literature.

### **Endocrine conditions**

No scientific references to conditions in this category could be found for the breed.

### **Gastrointestinal conditions**

*Acquired megaesophagus*: The breed has been reported to be at risk of this condition (Gough, Thomas and O'Neill, 2018), which is often secondary to myasthenia gravis or inflammatory myopathy (Evans et al, 2004).

*Exocrine pancreatic insufficiency (EPI)*: The Newfoundland was described as being at increased risk of EPI in an American case series of 635 dogs diagnosed with the condition on the basis of low serum trypsin-like immunoreactivity in a conference presentation (Williams and Minnich, 1990). No more recent reports or prevalence estimates could be found to support this.

*Gastric dilatation-volvulus syndrome (GDV, 'bloat')*: Gastric dilatation-volvulus syndrome (GDV) is an acute, life-threatening condition featuring rapid accumulation of air in the stomach, malposition of the stomach to a varying degree and a rise in intragastric pressure, frequently leading to the development of cardiogenic shock (Glickman et al, 2000). In a study using data from the 2004 Purebred Dog Health Survey, 5.6% of Newfoundlands (15 of 269 deaths) were reported to have died due to GDV; this represented a prevalence ratio for mortality due to the condition of 2.3 (95% C.I. 1.4 - 3.8) compared to dogs of all breeds (Evans et al, 2010).

### **Haematological conditions**

No scientific references to conditions in this category could be found for the breed.

### **Hepatic conditions**

No scientific references to conditions in this category could be found for the breed.

### **Immunological conditions**

No scientific references to conditions in this category could be found for the breed, however myasthenia gravis is considered to have an immune-mediated aetiology.

### **Musculoskeletal conditions**

*Cranial cruciate ligament disease/rupture (CCLR)*: The Newfoundland was reported to be at increased risk of cranial cruciate ligament disease, with an odds ratio of 3.77 (95% C.I. 3.40 – 4.18; 450 cases out of 4,551 dogs of the breed) compared to dogs of all breeds, based on dogs which had attended veterinary teaching hospitals in the USA between 1964 and 2003 (Witsberger et al, 2008). Analysis of medical records of all Newfoundlands treated at Iowa State University College of Veterinary Medicine between 1996 and 2002 found a prevalence of CCLR of 22% (Wilke et al, 2006). The Iowa State authors estimated a heritability of 0.27, via pedigree analysis of 411 recruited dogs of the breed of which 92 were CCLR affected and 319 unaffected, and found a likely recessive mode of inheritance with incomplete penetrance.

*Elbow dysplasia:* Elbow dysplasia is a heritable disease involving different lesions including fragmented coronoid process (FCP), ununited anconeal process (UAP), osteochondrosis dissecans (OCD) and incongruity of the elbow joint, which may occur together and alone leading to osteoarthritis of the joint and forelimb lameness. The Newfoundland was reported to be at elevated risk of FCP, UAP and OCD of the elbow, with breed-associated odds ratio compared to mixed breeds of 10.9, 13.8 and 261.0 respectively (95% C.I. 5.0 – 24.0, 7.1 – 26.8 and 107.1 – 635.8), based on dogs which had attended veterinary teaching hospitals in the USA; these results were based on just 7 cases and 20 non-cases for FCP, 12 cases and 11 non-cases for UAP and 9 cases and 3 non-cases in the breed (LaFond et al, 2002).

*Hip dysplasia:* A study of dogs which had attended veterinary teaching hospitals in the USA between 1964 and 2003 reported an odds ratio for the Newfoundlands compared to all other breeds of 5.77 (95% C.I. 5.35 – 6.21) with 859 of 5,005 (17.16%) dogs of the breed being diagnosed with the condition (Witsberger et al, 2008). Interestingly in this study Newfoundlands were at greater risk of being diagnosed with hip dysplasia and cranial cruciate ligament disease concurrently or subsequently than with either condition alone, with an odds ratio of 10.01 (95% C.I. 8.33 – 12.02, 122 cases out of 4,268 dogs of the breed).

*Inflammatory myopathy:* The Newfoundland was significantly overrepresented in a study of 200 randomly selected cases of inflammatory myopathy submitted from across America to the Comparative Neuromuscular Laboratory, University of California, San Diego, representing 9.5% of the cases but only 0.26% of American Kennel Club registrations (Evans et al, 2004).

*Osteochondrosis (OCD) of the shoulder:* The breed was reported to be at an elevated risk of OCD of the shoulder, with a breed-associated odds ratio compared to mixed breeds of 18.7 (95% C.I. 12.0 – 29.2), based on dogs which had attended veterinary teaching hospitals in the USA; however this result was based on just 27 cases and 24 non-cases in the breed (LaFond et al, 2002).

*Panosteitis:* The Newfoundland was reported to be at elevated risk of panosteitis, with a breed-associated odds ratio compared to mixed breeds of 1.9 (95% C.I. 1.3 - 2.8), based on dogs which had attended veterinary teaching hospitals in the USA; however this result was based on just 31 cases and 113 non-cases in the breed (LaFond et al, 2002).

*Skeletal dysplasia / forelimb anomaly:* This condition, which resembles chondrodysplasia but seems to be less severe, is characterised by short stature and bowed, thickened front legs and appears to be inherited although the mode of inheritance has not been determined. It has been described in the Newfoundland (Young et al, 2006), but no prevalence estimates could be found in the literature.

## Neoplastic conditions

*Osteosarcoma*: Osteosarcoma is the most common histological subtype of primary bone cancer in both dogs and humans. 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 Newfoundland was the eleventh most common breed to be diagnosed with osteosarcoma, with 17 cases in the breed, giving an incidence rate of 22 cases (95% C.I. 11 - 32) per 10,000 DYAR (Egenvall et al, 2007).

A subsequent Norwegian survey of owners of dogs of four breeds including the Newfoundland included 427 dogs of the breed of which four had primary bone tumours; this gave an incidence rate of 11 cases (95% C.I. 3 – 29) per 10,000 DYAR.

## Neurological conditions

*Myaesthesia gravis (MG)*: A possible familial form of this acquired neuromuscular condition, presenting with focal or generalised muscle weakness, was first described in two lineages of the breed in America (Lipsitz et al, 1999). An American study which analysed the records of 1,154 dogs diagnosed with the condition between 1991 and 1995 found a moderately increased risk of developing MG for Newfoundlands of 2.0 (95% C.I. 1.2-3.6) compared to all dogs (Shelton et al, 1998). Genetic analysis of the early onset form of the disease in the breed, affecting individuals before five years of age, found risk and protective loci in the Dog Leukocyte Antigen (DLA) genes on chromosome 12 (Wolf et al, 2017).

## Ocular conditions

*Eversion of the cartilage of the nictitating membrane*: Newfoundlands have been described as overrepresented with this condition in an American paper (Allbaugh and Stuhr, 2013). However, no prevalence estimates could be found in the literature to support this.

*Glaucoma*: A Swiss study reported the Newfoundland to be predisposed to primary glaucoma. In a study of all 428 cases of the condition seen at the University of Zurich Ophthalmology service between 1<sup>st</sup> January 1995 and August 31<sup>st</sup> 2009, six cases were seen in Newfoundlands which was more than would be seen from the general hospital population of the breed (Strom et al, 2011). The mean age at onset was  $6.8 \pm 2.5$  years in the breed.



*Other ocular conditions:* The American College of Veterinary Ophthalmologists (ACVO) consider the Newfoundland to be predisposed to entropion, ectropion, distichiasis, macroblepharon, prolapsed gland of the third eyelid, persistent pupillary membranes, uveal cysts, cataract, retinal dysplasia and progressive retinal atrophy in addition to the aforementioned glaucoma (Genetics Committee of the ACVO, 2016). Between 2010 and 2017, 975 dogs of the breed were examined by the ACVO and prevalence data are shown in Table 2 alongside data from previous years. Overall, 76.1% (742 of 975) of dogs of the breed examined between 2010 and 2017 had healthy eyes unaffected by any disease conditions. However, it is important to bear in mind that the dogs were from America.

Table 2: ACVO examination results for Newfoundlands, 1991 – 2017

Disease Category/Name	Percentage of Dogs Affected		
	1991-1999 (n=867)	2000-2009 (n=1448)	2010-2017 (n=975)
<b>Eyelids</b>			
Macropalpebral fissure	2.0%	6.2%	2.2%
Entropion	6.8%	7.3%	5.9%
Ectropion	5.1%	9.1%	6.1%
Distichiasis	0.8%	0.3%	0.9%
<b>Nictitans</b>			
Third eyelid cartilage anomaly	0.0%	0.8%	0.4%
Prolapsed gland of the third eyelid	0.6%	0.2%	0.1%
<b>Uvea</b>			
Persistent pupillary membranes	0.7%	1.2%	1.2%
Uveal cysts	1.6%	1.3%	2.3%
<b>Lens</b>			
Cataract (all types)	11.9%	6.8%	6.6%
<b>Retina</b>			
Retinal dysplasia (folds)	1.2%	1.0%	0.3%

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

### Reproductive conditions

No scientific references to conditions in this category could be found for the breed.

### Respiratory conditions

*Primary ciliary dyskinesia:* This condition involving structural and/or functional abnormalities of respiratory and other cilia causes a variety of clinical signs including early onset, recurrent respiratory tract infections. It was described in three Newfoundlands in the UK between 1995 and 1997, and pedigree analysis was consistent with a monogenic autosomal recessive pattern of inheritance (Watson et al, 1999). No more recent reports or prevalence estimates could be found in the literature.

## Urological conditions

*Cystinuria*: Analysis of 25,499 uroliths submitted to the Gerald V. Ling Urinary Stone Analysis Laboratory at the University of California-Davis, USA, between January 1985 and December 2006 found that the Newfoundland was at increased risk of developing cystine-containing uroliths, with an odds ratio of 12.6 (95% C.I. 6.9 to 22.6) compared to mixed-breed dogs (Low et al, 2010). The authors noted that the number of cystine-containing uroliths decreased in the most recent years of the study after a DNA test for a mutation which predisposes Newfoundlands to developing cystinuria and cystine uroliths became available. A nonsense mutation in exon 2 of the SLC3A1 gene, with an autosomal recessive mode of inheritance, was found to cause cystinuria in the breed (Henthorn et al, 2000).

*Ectopic ureter*: The Newfoundland appeared to be at increased risk of ectopic ureter in a study of 217 female dogs diagnosed with the condition at 15 North American university veterinary medical teaching hospitals between 1964 and 1981, with an odds ratio of 12.6 (95% C.I. 5.0-29.6) compared to a control population (Hayes, 1984). No more recent reports or prevalence estimates could be found in the literature.

### Purebred/pedigree dog health survey results

**2004 Morbidity results:** Health information was collected for 506 live Newfoundlands of which 267 (53%) were healthy and 239 (47%) had at least one reported health condition. The top categories of diagnosis were musculoskeletal (25.0%, 101 of 404 reported conditions), dermatologic (15.1%, 61 of 404 reported conditions), reproductive (11.1%, 45 of 404 reported conditions), gastrointestinal (6.7%, 27 of 404 reported conditions) and ocular (6.7%, 27 of 404 reported conditions). The most frequently reported specific conditions were pyotraumatic dermatitis (6.5% prevalence, 33 cases), cruciate ligament rupture (5.9% prevalence, 30 cases), hip dysplasia (4.2% prevalence, 21 cases), otitis externa (3.4% prevalence, 17 cases) and undiagnosed skin irritation (2.8%, 14 cases).

**2004 Mortality results:** A total of 269 deaths were reported for the breed. The median age at death for Newfoundlands was 9 years and 8 months (min = 5 months, max = 15 years and 10 months). The most frequently reported causes of death by organ system or category were cancer (27.1%, 73 of 269 deaths), old age (19.3%, 52 deaths), cardiac (16.0%, 43 deaths) and gastrointestinal (6.7%, 18 deaths). Apart from cancer and old age, the most frequently reported specific causes of death were GDV (5.6%, 15 deaths) and heart failure (4.5%, 12 deaths).

**2014 Morbidity results:** Health information was collected for 189 live Newfoundlands of which 104 (55%) were healthy and 85 (45%) had at least one reported health condition. The most frequently reported specific conditions were cruciate disease (7.41% prevalence, 14 cases), entropion (5.82% prevalence, 11 cases), arthritis (4.76% prevalence, 9 cases), elbow dysplasia (4.23% prevalence, 8 cases) and acute moist dermatitis (3.7% prevalence, 7 cases).

**2014 Mortality results:** A total of 53 deaths were reported for the breed. The median longevity for Newfoundlands was 10 years. The most frequently reported causes of death were bone tumours (13.21% proportion, 7 cases), old age (13.21% proportion, 7 cases), cancer – unspecified (11.32% proportion, 6 cases), old age combinations (9.43% proportion, 5 cases), and cardiac heart failure (7.55% proportion, 4 cases).

### VetCompass results

No VetCompass data were available for the Newfoundland.

### Insurance data

#### **UK Agria data**

Insurance data were available for Newfoundlands insured with Agria UK. 'Exposures' are equivalent to one full policy year; in 2016 there were 478 free exposures, 190 full exposures and 334 claims, in 2017 these figures were 469, 222 and 268 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 1<sup>st</sup> October 2016 and 31<sup>st</sup> September 2017, are shown in Table 3 below.

Table 3: Top 10 conditions and number of settlements for each condition between 1<sup>st</sup> October 2016 and 31<sup>st</sup> September 2017 for Newfoundlands insured with Agria UK

<b>Condition</b>	<b>Number of settlements</b>
Cruciate ligament disorders	23
Skin allergy <sup>§</sup>	13
Osteoarthritis/degenerative joint disease	13
Elbow dysplasia	13
Hip dysplasia	12
Incontinence	11
Medial patella luxation	10
Infection or inflammatory disorders - skin	10
Atopy <sup>§</sup>	8
Soft tissue sarcoma	7

<sup>§</sup> 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 morbidity and mortality insurance data were also available from Agria for the Newfoundland. Reported rates are based on dog-years-at-risk (DYAR) which takes into account the actual time each dog was insured during the period (2006-2011). The number of DYAR for the Newfoundland in Sweden during this period was between 200 and 500, so these results should be interpreted with caution.

### Swedish Agria insurance morbidity data

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Newfoundlands in Sweden between 2006 and 2011 are shown in Figure 2. The top specific causes of VCEs were otitis, dermatitis / pyoderma / folliculitis, pain/locomotor signs, pyometra / endometritis and skin tumour.

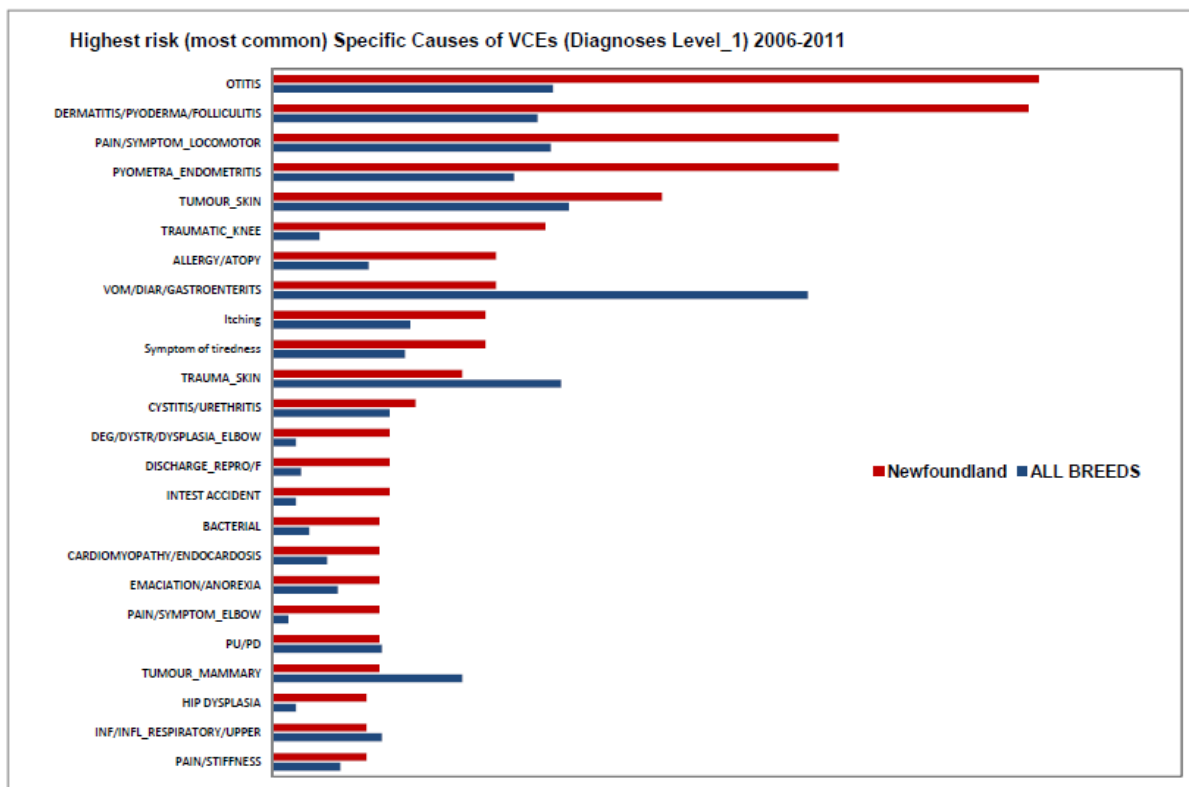


Figure 2: The most common specific causes of VCEs for the Newfoundland compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data.

When relative risk of specific causes of VCEs was compared for the Newfoundland to all breeds, a few interesting findings were reported. The specific causes of VCEs ordered by relative risk are shown in Figure 3. In this analysis, the top specific causes of VCEs ordered by relative risk were entropion, tumour of the upper respiratory tract, arrhythmias, elbow pain or clinical signs, traumatic knee injury and OCD of the elbow.

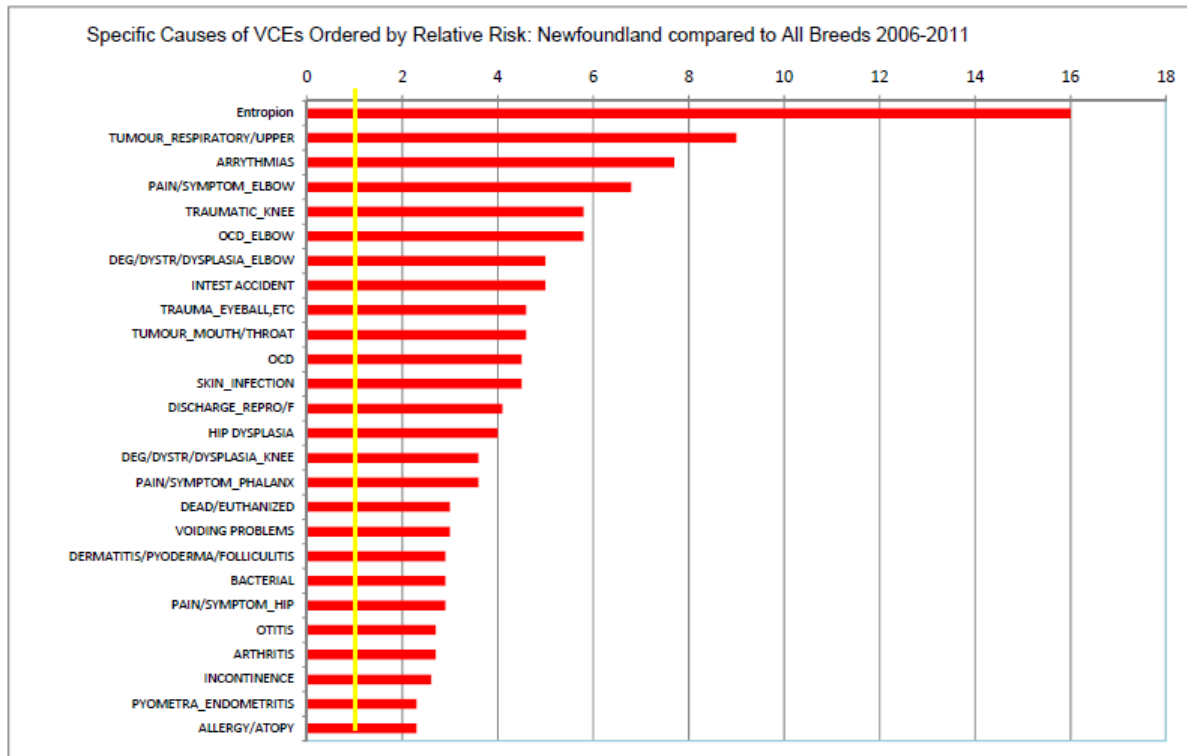


Figure 3: The specific causes of VCEs for the Newfoundland ordered by relative risk compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

### Swedish Agria insurance mortality data

Median age at death for the Newfoundland from Swedish Agria insurance data was 6.0 years for males and 3.4 years for females. Agria has a maximum age to which a dog can be life insured, which varies somewhat across breeds and years. Many owners also choose not to insure their dogs after a certain age, as the cost of the premiums become more expensive. For these reasons the median age at death from the Swedish Agria insurance data is artificially depressed for all breeds compared to that reported from surveys or other sources. The most common specific causes of death or euthanasia for Agria-insured Newfoundlands in Sweden between 2006 and 2011 are shown in Figure 4. The most common specific causes of death were hip dysplasia, traumatic knee injury, 'dead/euthanized', hit by car/train/vehicle and intestinal accident (which includes GDV).

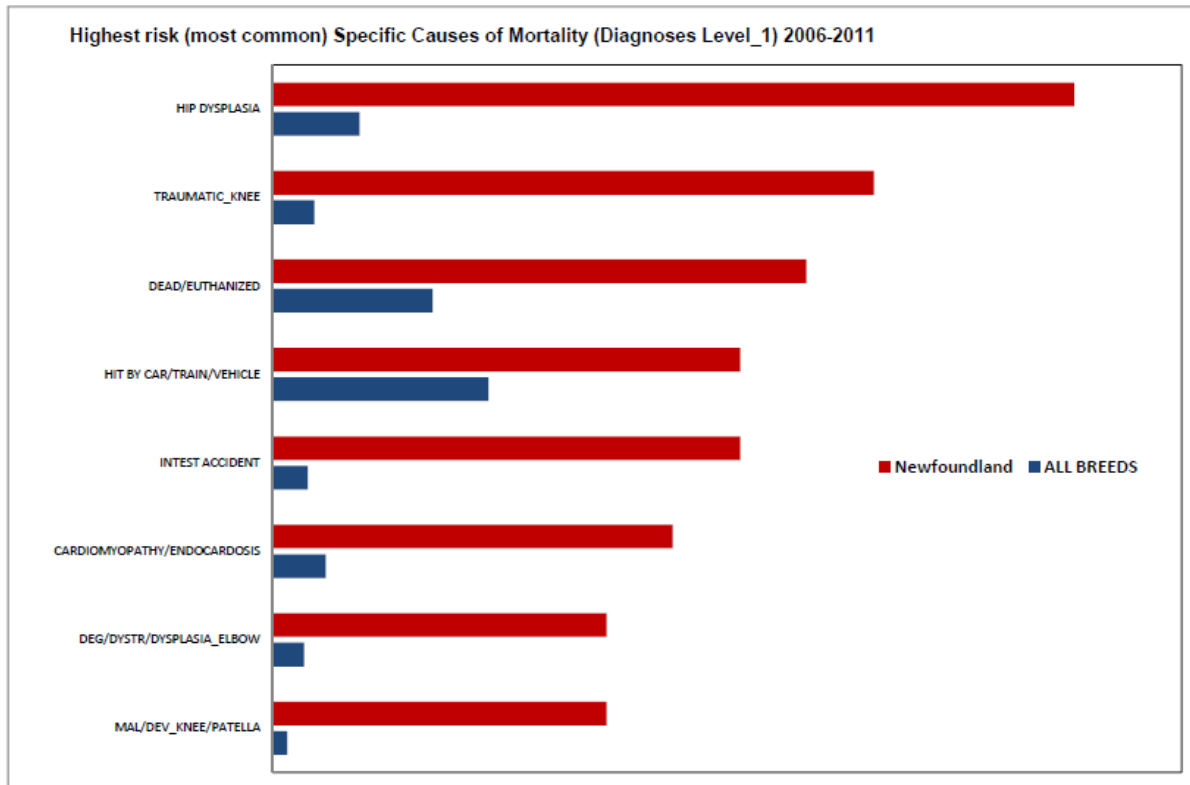


Figure 4: The most common specific causes of death for the Newfoundland compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data.

### Breed-specific health surveys

#### 2006 NORTHERN NEWFOUNDLAND CLUB HEALTH SURVEY

The Northern Newfoundland Club (NNC) undertook a health survey in 2006, in which 138 forms were received relating to 314 live dogs and four deaths. Summary results for the 314 lived dogs are shown in Table 4 below.

Table 4: Health conditions reported in 314 live Newfoundlands in the NNC 2006 Health Survey.

Condition	Number of reports	Prevalence
Gastrointestinal conditions	27	8.60%
Hip conditions	23	7.32%
Heart conditions	13	4.14%
Eye conditions	13	4.14%
Elbow conditions	8	2.55%
Skin conditions	6	1.91%
Cruciate ligament conditions	3	0.96%
Arthritis	2	0.64%
Thyroid conditions	1	0.32%
Addison's disease	1	0.32%

## 2007 NORTHERN NEWFOUNDLAND CLUB HEALTH SURVEY

The NNC undertook another health survey in 2007, in which 374 forms were received relating to 294 live dogs (115 of which had no health conditions) and 80 deaths. Mean age at death was 8.75 years; reported causes of death were cancer (31 deaths, 38.75%), old age (19 deaths, 23.75%), cardiac (19 deaths, 23.75%), gastrointestinal (9 deaths, 11.25%) and orthopaedic conditions (2 deaths, 2.50%). Health conditions reported across both live and dead dogs in this survey are shown in Table 5.

Table 5: Health conditions reported in 374 Newfoundlands in the NNC 2007 Health Survey.

<b>Condition</b>	<b>Number of reports</b>	<b>Prevalence</b>
<i>Cancers</i>	41	10.96%
Bone cancer	18	4.81%
Other cancer	18	4.81%
Lymphoma	5	1.34%
<i>Gastrointestinal</i>	31	8.29%
Bloat	23	6.15%
Colitis	3	0.80%
Pancreatic condition	3	0.80%
Inflammatory bowel disease	1	0.27%
Food intolerance	1	0.27%
<i>Cardiac</i>	40	10.70%
DCM	22	5.88%
SAS	5	1.34%
Pericardial condition	4	1.07%
Other	9	2.41%
<i>Orthopaedic</i>	146	39.04%
Hip dysplasia	46	12.30%
Cruciate ligament conditions	40	10.70%
Elbow conditions	19	5.08%
OCD	18	4.81%
Arthritis	12	3.21%
Other	23	6.15%
<i>Ocular conditions</i>	57	15.24%
Entropion	23	6.15%
Ectropion	7	1.87%
<i>Ear conditions</i>	55	14.71%
<i>Skin conditions</i>	61	16.31%

## 2016 OFA/Newfoundland Club of America Charitable Trust Health Survey

The Newfoundland Club of America Charitable Trust undertook a health survey in 2016 which was administered by the Orthopedic Foundation for Animals (OFA). Data were collected on 2251 dogs of the breed, of which 1456 were still alive and 572 had died. The most frequently reported conditions were atopy – inhalant seasonal or non-seasonal (12.1% prevalence, 272 cases), cancer (11.3% prevalence, 254 cases), hip dysplasia (9.5% prevalence, 214 cases), cruciate ligament rupture of one or both knees (8.8%, 196 cases), food allergies (8.2%, 184 cases) and pyoderma/‘hot spots’ (7.8% prevalence, 175 cases). Full results are available on the OFA website: <https://www.ofa.org/about/educational-resources/health-surveys>

## Visual health check reports/clinical reports/judges’ health monitoring

The Newfoundland is a category 2 breed, meaning all judges of this breed at championship certificate level must complete a mandatory monitoring form following their appointment. The points of concern reported are shown below in Table 6.

Table 6: Judges’ health monitoring reports for 2016 and 2017. Those marked with a \* indicate newly reported points of concern.

<b>Point of concern</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
Conformational defects of the upper and lower eyelids (loose eye lids)	4.50%	1.50%	3.02%
* Excessively small eyes	0.60%	0.12%	0.00%
* Unsound movement	0.40%	0.00%	0.16%
* Weak hind movement	0.40%	0.00%	0.79%
* Unstable hocks	0.00%	0.00%	0.79%
* Misplaced lower canine teeth	0.00%	0.12%	0.00%
*Excessive dewlap	0.00%	0.00%	0.32%
*Incorrect bite	0.00%	0.00%	1.59%
*Incorrect dentition	0.00%	0.00%	0.16%
*Nervous temperament	0.00%	0.00%	0.08%
*Overweight	0.60%	0.23%	0.24%
*Overshot	0.00%	0.10%	0.00%
*Other	0.00%	0.10%	0.00%
<b>Total number of dogs shown</b>	<b>1671</b>	<b>1731</b>	<b>1260</b>

## Breed Club health activities

The breed has an active Breed Health Coordinator, a Joint Health and Longevity Committee and dedicated health pages on each breed club’s website.



## BHC annual report

The 2017 Breed Health Coordinator's Annual Health Report 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 osteosarcoma, 2 heart disease (SAS and DCM) and 3 gastric dilatation volvulus. In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, the breed has continued to engage in health research and education, and organised a health seminar, developed a regulation whereby all club members must comply with the recommended health tests, and provided further education with regard to GDV.

## DNA test results

Under the Kennel Club's Assured Breeder Scheme (ABS), the DNA test for cystinuria (CU) is a requirement. DNA tests are also available for thrombopathia, muscular dystrophy and a mutation associated with degenerative myelopathy, however the results of these tests are not currently recorded by the Kennel Club. DNA test results are only recorded for Official Kennel Club DNA Testing Schemes, such as that for CU, which involve collaboration between the Kennel Club, the breed clubs and the DNA testing facilities.

### Cystinuria (CU)

Results of the DNA test for CU have been recorded since September 2009. It was initially a recommendation under the ABS and became a mandatory requirement in January 2010. The following laboratories test for the condition with results sent directly to the Kennel Club: Animal DNA Diagnostics, Animal Genetics, Laboklin, OptiGen and Paw Print Genetics. The following laboratories also carry out the test but results must be submitted to the Kennel Club via the owner: Antagene, Genetic Technologies (Animal Network), Genindexe, Genomia, Genoscooper (MyDogDNA), HealthGene, PennGen, Pinmoore Animal Lab Services, Van Haeringen and VetGen. The results for dogs which had DNA test results up to 30/07/2018 are shown in Table 7.

Table 7: CU DNA test results held by the Kennel Club for Newfoundlands up to 30/07/2018.

<b>Total number of results</b>	<b>Clear</b>	<b>Carrier</b>	<b>Hereditarily clear</b>
2537	317 (12.5%)	78 (3.1%)	2142 (84.4%)

## Canine Health Scheme results and EBVs

Kennel Club (KC) Assured Breeders are currently required to complete hip scoring under the British Veterinary Association (BVA)/KC Hip Dysplasia Scheme and elbow grading under the BVA/KC Elbow Dysplasia Scheme prior to breeding. Estimate breeding values (EBVs) are available for both hip score and elbow grade for the breed.

### HIPS

A total of 2233 Newfoundlands have gone through the BVA/KC Hip Dysplasia Scheme in the 15 years to the end of 2017, with a median score of 11 (range 0 to 103).

Hip score categories received by Newfoundlands 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 5 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. Further information on these categories can be found here:

[https://www.bva.co.uk/uploadedFiles/Content/Canine Health Schemes/chs-comparison-of-hd-schemes.pdf](https://www.bva.co.uk/uploadedFiles/Content/Canine_Health_Schemes/chs-comparison-of-hd-schemes.pdf).

Over this time period there appears to be a definite reduction in the proportion of Newfoundlands with mild to severe hip dysplasia and an increase in those with normal and borderline scores.

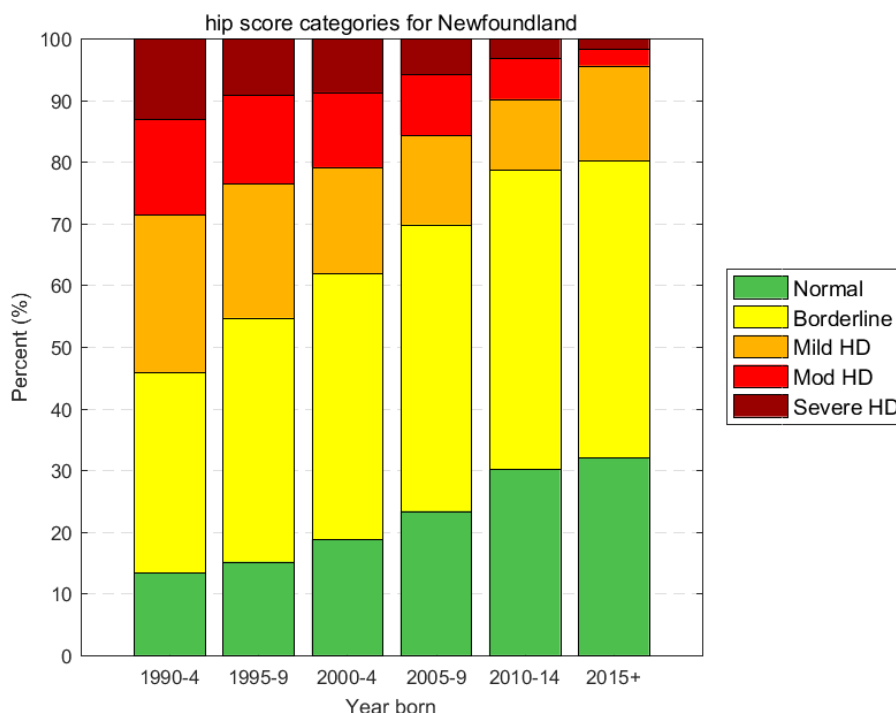


Figure 5 – Hip score categories for Newfoundlands which participated in the BVA/KC Hip Dysplasia Scheme between 1990 and 2016, in 5-year blocks.

EBVs are available for hip scores in this breed. Figure 6 shows the five year rolling trend in EBVs by year of birth in the Newfoundland. It appears that EBVs have generally decreased since 1990. This indicates a generally improving (lowering) genetic risk of hip dysplasia as determined by the BVA/KC hip score, most likely as a result of selection.

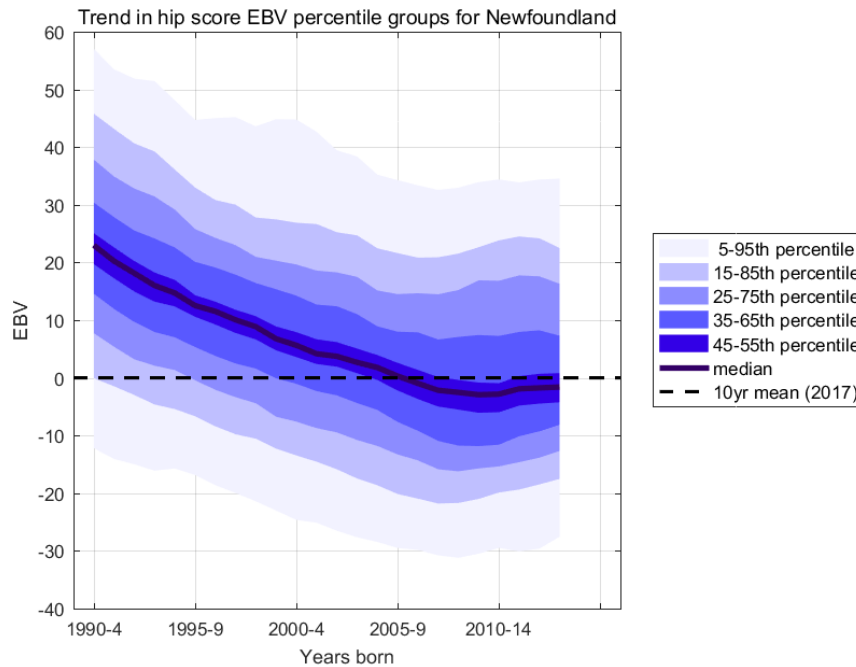


Figure 6: Trend in hip score EBV, with percentile groups, for the Newfoundland for years of birth since 1990.

## ELBOWS

468 Newfoundlands 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 8 below. In total 27% (128 of 468) Newfoundlands scored were diagnosed with some degree of elbow pathology.

Table 8: Elbow scores and number of dogs receiving those scores since 1998 for the Newfoundlands

Elbow score	Number of dogs	Percentage
0	340	73%
1	66	14%
2	38	8%
3	24	5%

Individual elbow scores received by Newfoundlands which participated in the BVA/KC Elbow Dysplasia Scheme between 1998 and the end of 2016 are shown in five year blocks (which can be considered to approximate to a generation) in Figure 7 below. After an initial apparently negative start, there is now evidence of an increase in the number of elbows being scored 0, and a decrease in the number of elbows being scored 3 over this time.

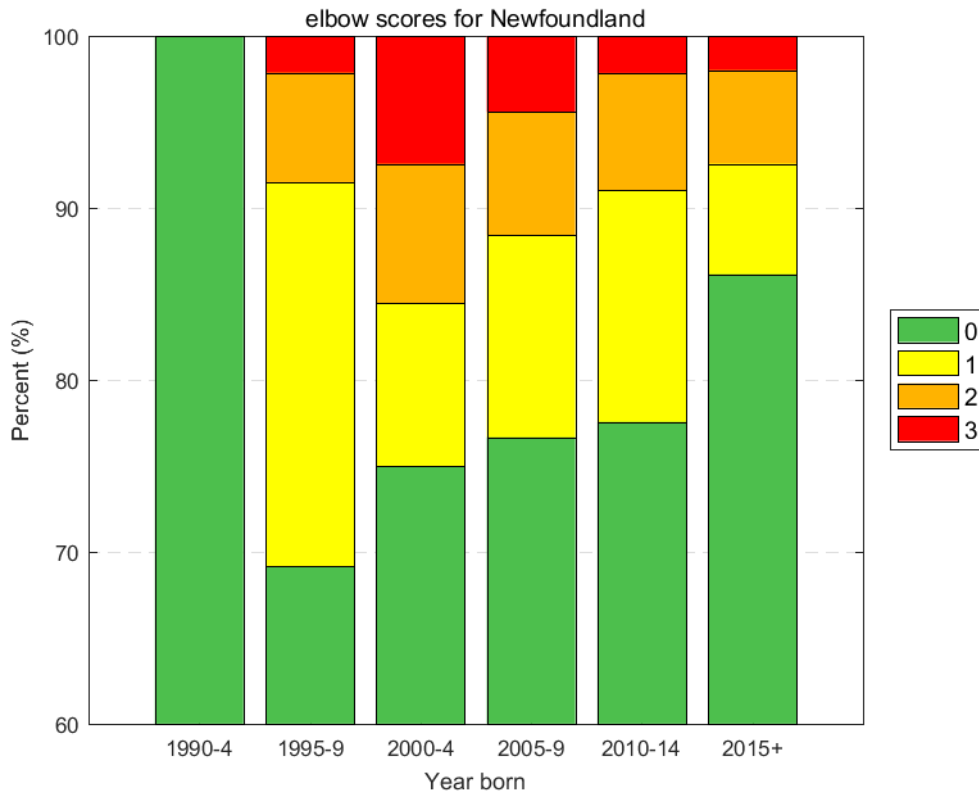


Figure 7 – Elbow scores for Newfoundlands which participated in the BVA/KC Elbow Dysplasia Scheme between 1998 and the end of 2016, in 5-year blocks.

Estimated breeding values (EBVs) are available for elbow score for the Newfoundland. Figure 8 shows the five year rolling trend in EBVs by year of birth in the Newfoundland. It can clearly be seen that EBVs have decreased slightly, indicating an improving (lowering) genetic risk of elbow dysplasia as determined by the BVA/KC elbow score, most likely as a result of selection.

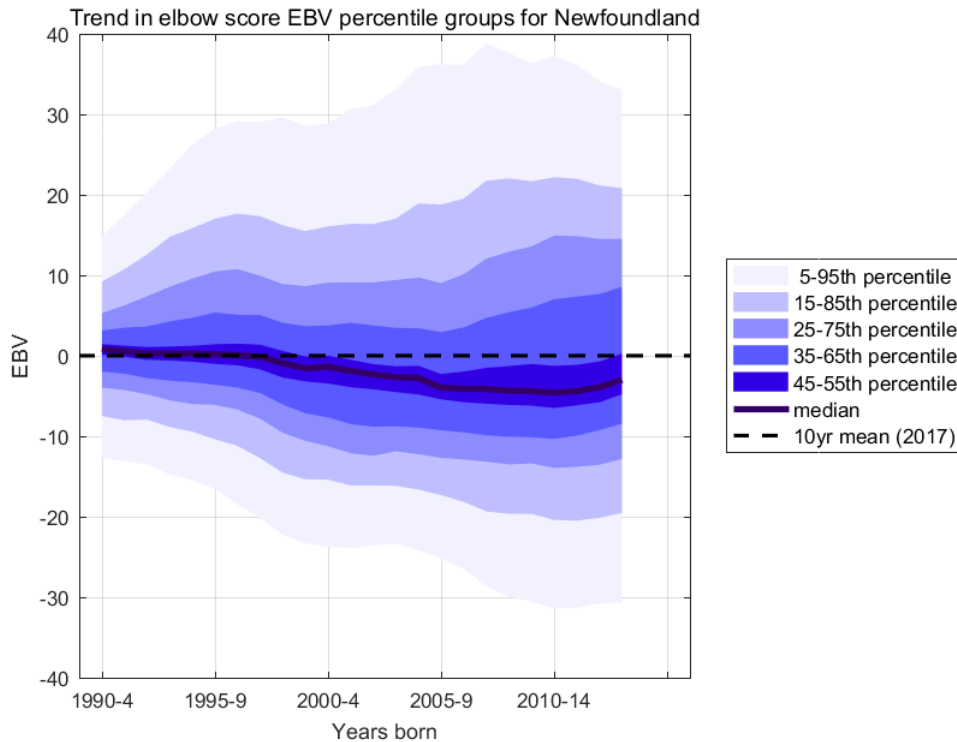


Figure 8: Trend in elbow score EBV, with percentile groups, for the Newfoundland for years of birth since 1990.

## EYES

The breed is not currently on Schedule A or B for any condition under the BVA/KC/International Sheep Dog Society (ISDS) Eye Scheme. Schedule A 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. Schedule B lists those breeds in which the conditions are, at this stage, only suspected of being inherited. However, the BVA still records the results of dogs of other breeds 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 9.

Table 9: Reports on Newfoundlands which have participated in the BVA/KC/ISDS Eye Scheme since 2012

Year	Number seen	Comments
2012	3 adults 0 litters	1 – cataract (other)
2013	4 adults 0 litters	2 – ectropion 2 – entropion
2014	1 adult 0 litters	No comments
2015	2 adults 0 litters	1 – entropion 1 – nuclear cataract
2016	6 adults 0 litters	1 – nuclear cataract

### Breed club breeding recommendations

The breed club recommendations listed on the Kennel Club website are: breed club heart testing, bitches under two years are not to produce a litter and bitches over seven years are not to produce a litter.

Breed club members are required to undertake the following health testing:

- BVA/KC Hip scoring
- BVA/KC Elbow grading
- Cystinuria DNA testing (Vetgen, Optigen or Laboklin)
- All breeding stock to be heart tested by Colour Flow Echo Doppler, by a Veterinary Cardiovascular Society member, and only heart tested clear dogs to be bred from.

### 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. In addition, 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 10.

Table 10: Number and percentage of litters of Newfoundlands registered per year and number of caesarean sections reported per year, 2007 to 2017.

Year	Number of litters registered	Number of C-sections	Percentage of C-sections
2007	160	0	0.00%
2008	164	0	0.00%
2009	149	0	0.00%
2010	166	0	0.00%
2011	145	4	2.76%
2012	121	18	14.88%
2013	146	17	11.64%
2014	135	21	15.56%
2015	128	13	10.16%
2016	126	18	14.29%
2017	95	7	7.37%

### 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 276.3 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).

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 9. The rate of inbreeding in this breed has remained relatively steady over the whole period and within levels thought to be sustainable. This means that genetic variation within the breed appears to be being maintained. 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 5.3%. This value is calculated each June and represents the average inbreeding coefficient of all dogs of the breed registered between January and December of the previous year i.e. in 2016.

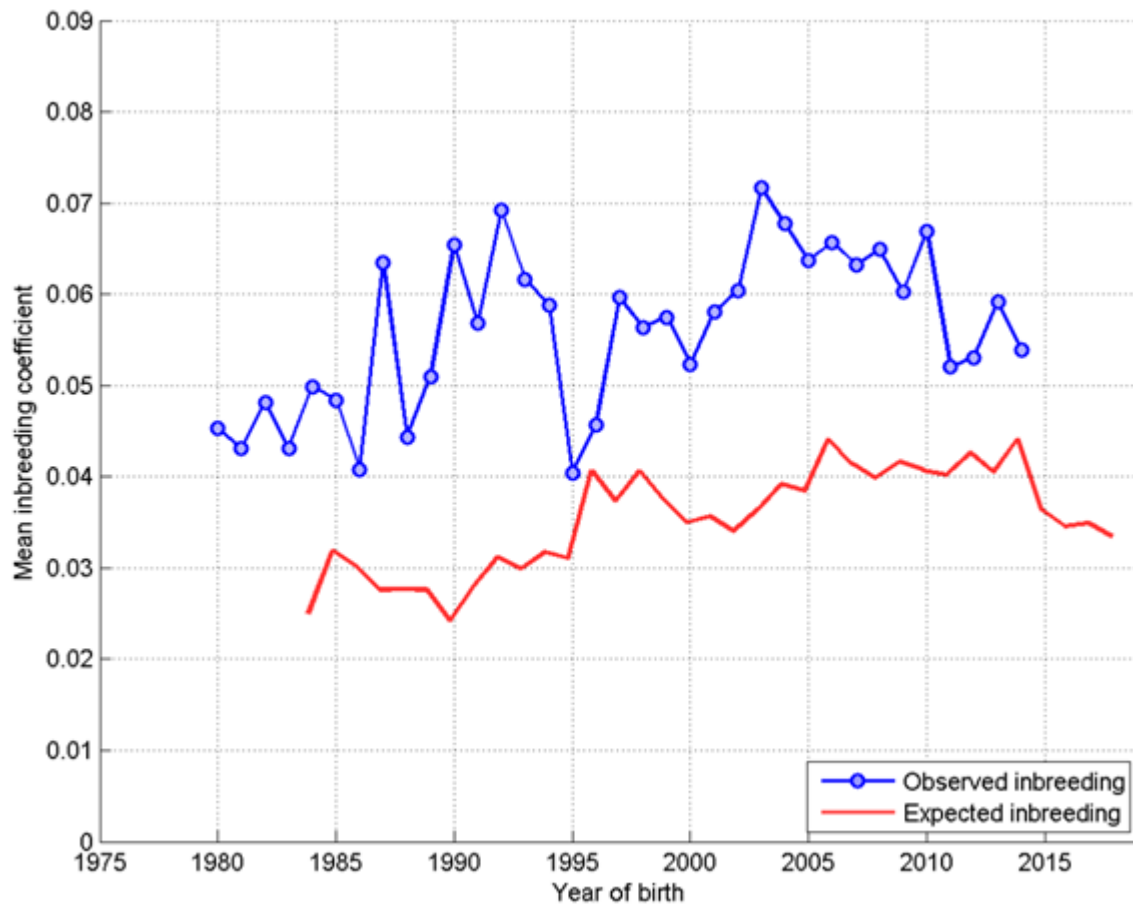


Figure 9: Annual mean observed and expected inbreeding coefficients.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven five-year blocks (Figure 10). 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 extensive use of popular dogs as sires in this breed (the 'tail' of the blue distribution in Figure 10).



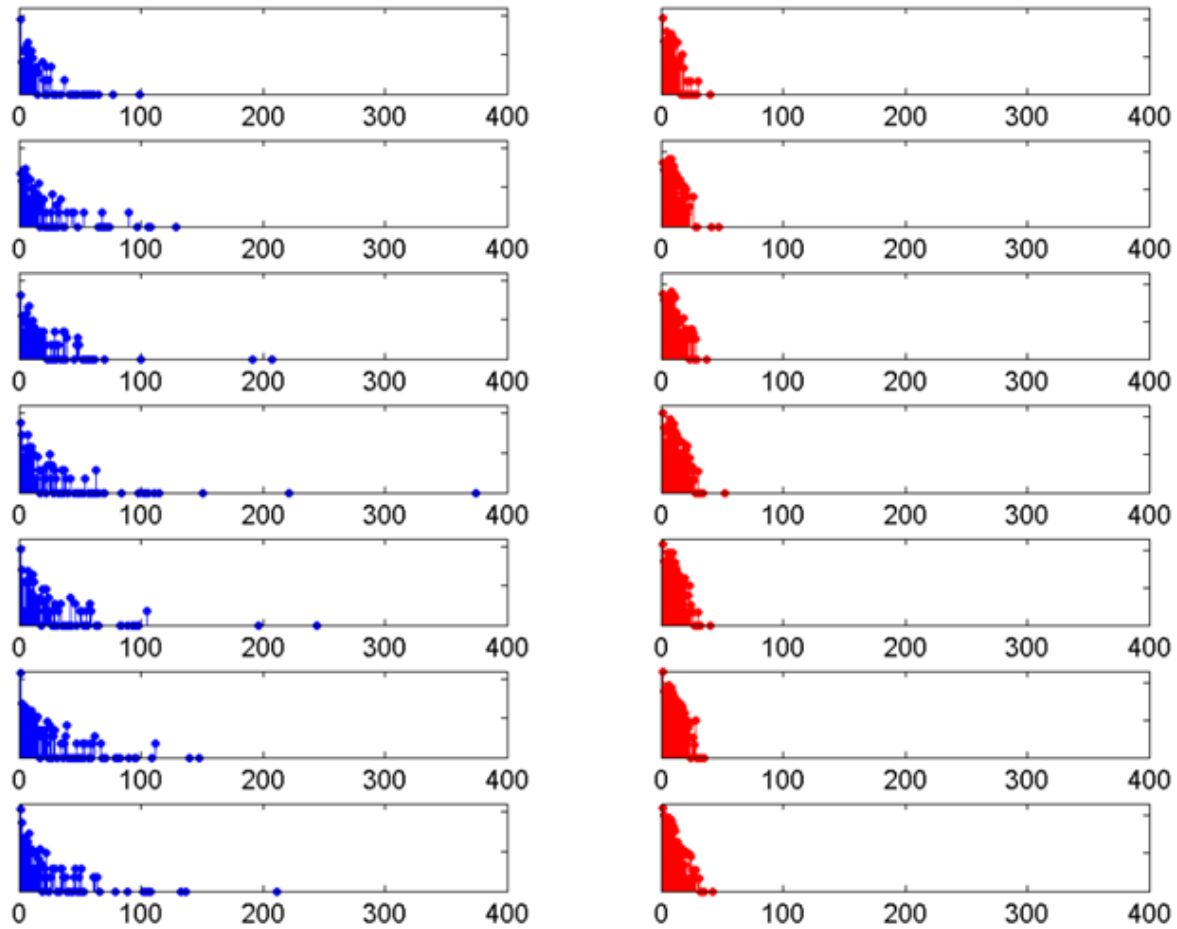


Figure 10: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-14 bottom). Vertical axis is a logarithmic scale.

### Current research projects

The Newfoundland 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 elbow dysplasia, laryngeal paralysis and osteosarcoma. DNA from an individual affected with osteosarcoma has been sequenced.

Research into the genetics of SAS in the breed continues at the North Carolina State University College of Veterinary Medicine.

## SECTION 2: PRIORITIES

A meeting was held with Newfoundland breed club representatives on 22nd August 2018 to discuss Section 1 of the BHCP and agree the priority issues for the health of the breed.

The literature review highlighted DCM in the breed; this was discussed at length as was the work undertaken with Veterinary Cardiovascular Society members and the current heart testing in place in the UK, which is currently administered by the Newfoundland breed clubs. A reference was made to a bio-markers product which the Dobermann breed club and other breeds have been involved with. Cardiologists involved with heart testing in Newfoundlands have said that the incidence of subaortic stenosis (SAS) in the breed appears to be decreasing, but there are no statistics available to confirm this currently. The breed representatives were not aware of any cases of atrial fibrillation in the breed in the UK; the references to the condition in the breed originated from the USA. It was noted by the breed that they felt they had seen an increase in PDA (patent ductus arteriosus).

The breed noted and accepted the reference to skin conditions and further commented on the impact a large heavy coat can have on skin and the potential link to skin problems. It was felt that the true prevalence of skin conditions such as 'hot spots' or atopy was likely to be higher than suggested in the evidence base, as experienced owners of the breed in particular were able to manage the conditions without veterinary involvement. However, the breed representatives were unaware of any cases of one of the conditions found in the literature review, pemphigus foliaceus; the paper mentioning this was an old, American study. It was further noted that large and excessive coats were becoming an increasing problem and concern from a welfare perspective.

It was noted that gastric dilatation volvulus/bloat (GDV) was a significant problem in the breed and the breed had made many attempts to educate owners on how to avoid bloat and protect their dog from bloat symptoms. A discussion on prophylactic gastropexy and other treatments highlighted some concerns; it was generally considered a number of environmental factors affected whether a dog would suffer from bloat.

The breed representatives were aware of some cases of exocrine pancreatitis insufficiency, and also pancreatitis (the chronic form of which can lead to EPI). Megaoesophagus cases had only been seen in association with myaesthesia gravis, discussed under neurological conditions.

Cruciate ligament disease was noted as a big concern to the breed clubs and further suggestion of the effects of neutering early was discussed. Research is being undertaken particularly in America to investigate the possible effects of neutering across a range of breeds and that this may highlight some breed specific concerns. It was noted that treatment of cruciate ligament rupture varied and therefore further

research may advance our understanding of the condition. Hip and elbow dysplasia were noted as concerns in the breed however the use of KC/BVA Canine Health Schemes has seen a reduction in the prevalence of these conditions. It was noted that breeders do use the schemes and breed clubs promote the canine health schemes. Osteochondrosis (OCD) was believed by the breed clubs to have seen a reduction in prevalence and this may partly be due to education available to owners. The breed representatives were unaware of any cases of inflammatory myopathy in Newfoundlands in the UK.

Osteosarcoma was noted as a concern for the breed clubs; current participation in the Give a Dog a Genome at the Animal Health Trust is underway with future plans to focus on osteosarcoma in the breed, with the hope that this may develop some further understanding on the condition. Concern was also raised about the incidence of cancers in the breed in general.

The only neurological condition found in the literature review was myaesthesia gravis, and the breed representatives were aware of cases of the condition occurring in the UK.

It was noted that no significant prevalence of eye concerns had been found in the breed. Breed clubs had organised a talk from the Chief Eye Panellist on eye concerns and following some discussion after the talk it was suggested that revision of the breed standard wording relating to eye confirmation may reduce the prevalence of adnexal-related eye conditions. The possible breed predisposition to primary glaucoma mentioned in the literature review had been discussed prior to the meeting with members of the Eye Panel Working Party, who had seen only a handful of cases in the breed between them. The Chief Eye Panellist suspected that gonioscopy of a number of Newfoundlands may reveal variation in the appearance of the pectinate ligament; pectinate ligament abnormalities in other breeds have been shown to be associated with primary glaucoma. Although there is no evidence at the moment to suggest that this is an issue in UK Newfoundlands, it is something that breeders should bear in mind particularly when importing European dogs as the report originates from Switzerland.

The respiratory condition found in the literature review was primary ciliary dyskinesia, described in three dogs of the breed in the mid to late 1990s. The breed representatives were unaware of any further cases since that time.

Urological conditions in the literature review were cystinuria and ectopic ureter. Breeders are very aware of cystinuria and the DNA test for the causal mutation is being well used; no carrier to carrier matings have occurred since the DNA test became available. One recent case of ectopic ureter in a young female Newfoundland was mentioned, but this was not felt to be a common condition in the breed.

The results of the 2004 and 2014 Purebred and Pedigree Dog Health Surveys generally supported the findings of the literature review, as did the insurance data although medial patellar luxation noted in the UK Agria data was something of a surprise. Data gathered in the breed-specific health surveys included in the evidence base also mirrored the findings of the literature review.

When reviewing the judges' health monitoring section, the breed representatives felt very strongly that the newly reported points of concern relating to the mouth (especially 'misplaced lower canine teeth') came from non-breed specialist judges who were not familiar with what is normal for a Newfoundland.

As noted above, definite improvement was shown in the data from the BVA/KC Hip and Elbow Dysplasia Schemes.

Genetic diversity measures were discussed, it was noted that this was being managed well and was being maintained at reasonable levels, although there is evidence of popular sire use which is known to be associated with an increased rate of loss of genetic diversity.

The group agreed from the evidence presented and their own experience that osteosarcoma, heart conditions (especially DCM and SAS), GDV, cruciate ligament disease and elbow dysplasia were the priorities for the Newfoundland, with clotting disorders to be monitored.

### SECTION 3: ACTION PLAN

- The Kennel Club to investigate thrombopathia DNA testing and provide feedback to the breed clubs.
- The breed health coordinator to supply correct wording for the breed club breeding recommendations, to be amended on the Kennel Club's website.
- The breed clubs to discuss whether a breed watch point of concern relating to excessive coat would be helpful, and what would be appropriate wording.
- The breed clubs to continue to promote Hip and Elbow Dysplasia Scheme participation and use of the associated EBVs.
- The breed clubs to continue to promote heart testing.
- The Kennel Club and breed clubs to monitor the ongoing osteosarcoma research.
- The Kennel Club to keep the breed clubs informed regarding the potential cruciate ligament disease research at the University of Surrey.
- The Kennel Club to explore possibilities with the breed clubs and the Veterinary Cardiovascular Society for formalisation of a heart testing scheme.
- The Kennel Club will review progress with the Newfoundland breed club representatives in late 2019.

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