THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Large Munsterlander Evidence Base

BHCP/Version 1/June 2020

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INTRODUCTION

The Kennel Club launched a new resource for breed clubs and individual breeders – the Breed Health and Conservation Plans (BHCP) project – in September 2016. The purpose of the project is to ensure that all health concerns for a breed are identified through evidence-based criteria, and that breeders are provided with useful information and resources to raise awareness of current health and welfare concerns in their breed, and support them in making balanced breeding decisions.

The Breed Health and Conservation Plans take a complete view of breed health with consideration to the following issues: known inherited conditions, complex conditions (i.e. those involving many genes and environmental effects such as nutrition or exercise levels, for example hip dysplasia), conformational concerns and population genetics.

Sources of evidence and data have been collated into an evidence base which gives clear indications of the most significant health conditions in each breed, in terms of prevalence and impact. Once the evidence base document has been produced it is discussed with the relevant Breed Health Co-ordinator and breed health representatives where applicable. Priorities are agreed based on this data and incorporated into a list of actions between the Kennel Club and the breed to tackle these health concerns. These actions are then monitored and reviewed on a regular basis.

DEMOGRAPHICS

The numbers of new registrations of the breed have been consistently below this threshold (Figure 1), with a peak in popularity in 2004, and then a gradual reduction in registration which has continued to date.

The trend of registrations over year of birth (1980-2019) was 0.57 per year (with a 95% confidence interval of -0.20 to +1.34), reflecting the fluctuation of the breed's numbers overtime.

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

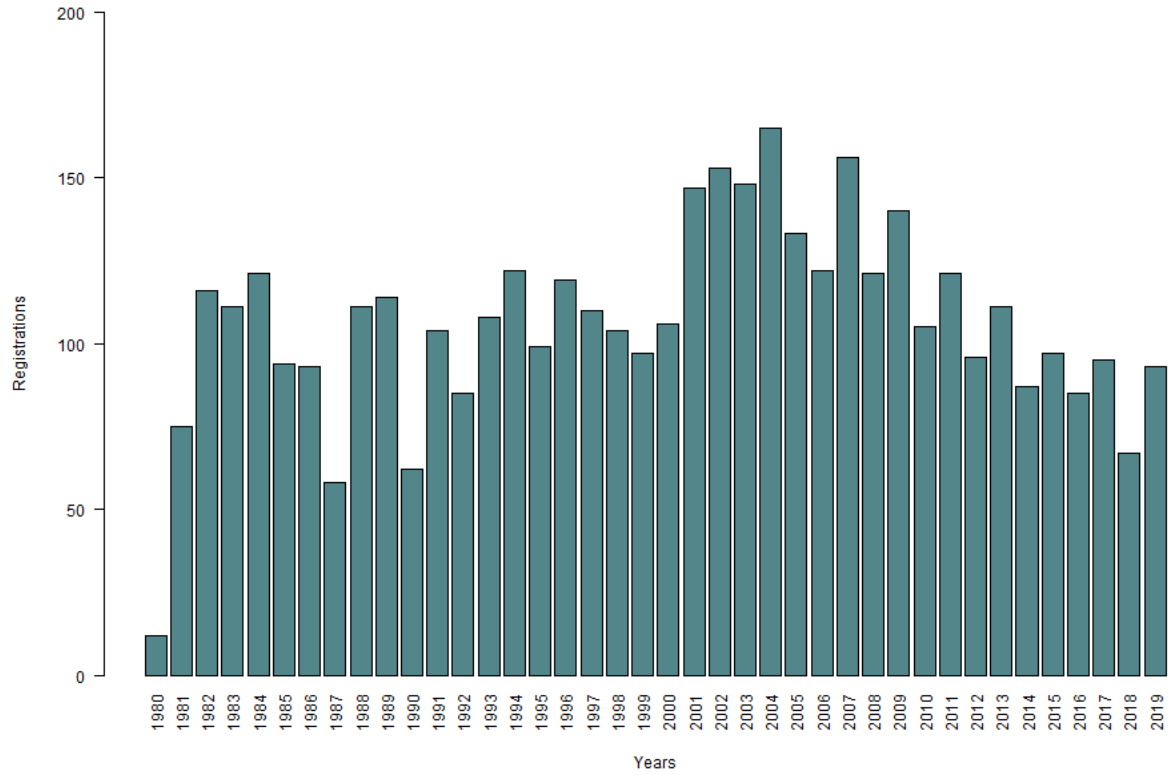

Figure 1: Number of registrations of Large Munsterlanders per year of birth, 1980 – 2019

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. Elbows and Hips
2. Epilepsy
3. Eyes

In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, research has been carried out into elbow dysplasia by the BHC and conversations have been had with the KC Geneticist, and questions have been sent to the BVA Panel. A short interim statement has been issued and is on the Club website and on the new Health Group Facebook page. This new Breed Health Facebook Group has been set up for LM owners past & present and anyone seriously thinking of getting the breed. Anyone sharing information on this page has agreed that the information can be recorded by the BHC/ admin team for the good of the breed.

With regard to elbows and hips, the research is ongoing into genetics, development and environmental factors contributing to the conditions including diet.

Epilepsy has been discussed with the AHT and the KC Geneticist. It is not a huge problem and the Large Munsterlander Club (LMC) intends that it does not become so through encouraging members and owners not to breed too closely. We will carry out further investigation after the next LMC Health Survey.

With eyes, the club has joined the CRIEDD project and is encouraging all LM owners with dogs older than 8 to test their dogs' eyes, especially if they have been bred on from. The club has applied to the ABS to have elbow scoring and HUU as conditions requiring testing; currently, HUU is only advised and elbows are not mentioned on the KC health testing information for the breed whereas they are compulsory for the LMC (the LMC requires hips and elbows to be scored, eyes to be tested and HUU status to be known. It is forbidden to breed two HUU Carriers together).

The BHC's Annual Health Report 2018, 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. Elbow Dysplasia
2. Hip Dysplasia
3. HUU

In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, the Puppy Register insists on health screening for all of the four conditions listed (the above plus eyes). The BHC also looked at the Club Health Survey from 2016 and started to research the conditions that had the highest scores**.**

BREED CLUB HEALTH ACTIVITES

The LMC has an active Breed Health Co-Ordinator. A new Health Sub-Committee made up of a pet owner, a breeder, a hydrotherapist and physiotherapist, a vet nurse and physiotherapist, a vet and the BHC has been set up and will go into action after the AGM.

The LMC website has a dedicated health page on its website which can be found under 'breed'. The health page on the LMC website can be found here:

http://www.largemunsterlanderclub.co.uk/health.html

After the AGM, a new website will be set up and Health will have a tab of its own. The BHC has also set up a Facebook group dedicated to health for current and past owners of Large Munsterlanders. This year, the breed hope to introduce forms for people to fill in so that we can set up a health database covering a wide range of issues.

There will be another LMC Breed Health Survey soon which will cover the key issues in detail and also will look at age of diagnosis, age of death and reason for death.

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 180 live Large Munsterlanders of which 58% were healthy and 42% had at least one reported health condition. The top categories of diagnosis were musculoskeletal (18.1%, 19 of 105 reported conditions), urologic (11.4%, 12 of 105 reported conditions), reproductive (10.5%, 11 of 105 reported conditions), immune mediated (8.6%, 9 of 105 reported conditions), and ocular (7.6%, 8 of 105 reported conditions). The most frequently reported specific conditions were cruciate ligament rupture (6 cases), bladder infection/cystitis (6 cases), false pregnancy (4 cases), skin irritation/itchy skin (4 cases), and hip dysplasia (4 cases).

2004 Mortality results: A total of 69 deaths were reported for the Large Munsterlander. The median age at death was 11 years and 4 months (min = 1 year 6 months, max = 16 years 7 months). The most frequently reported causes of death by organ system or category were cancer (24.6%, 17 of 69 deaths), old age (11.6%, 8 of 69 deaths), neurologic (10.1%, 7 deaths), trauma (8.7%, 6 deaths), and cardiac (5.8%, 4 deaths).

2014 Morbidity results: Health information was collected for 80 live Large Munsterlanders of which 50 (62.5%) had no reported conditions and 30 (37.5%) were reported to be affected by at least one condition. The most frequently reported conditions were lipoma (6.25% prevalence, 5 cases), elbow dysplasia (5% prevalence, 4 cases), arthritis (3.75% prevalence, 3 cases), food allergy (3.75% prevalence, 3 cases), and unspecified tumour/ cancer (3.75% prevalence, 3 cases).

2014 Mortality results: A total of 19 deaths were reported for the breed. The range of age at death was 1 years 0 months to 15 years 0 months. The most frequently reported causes of death by organ system or category were old age (21.1%, 4 of 19 total no. of deaths), bone tumour (10.5%, 2 of 19 deaths), and gastric tumour (10.5%, 2 of 19 deaths).

Breed-Specific Health Survey 2016

The 2016 Large Munsterlander Club Health Survey was completed for 537 dogs born between 2000 and 2016.

Health information was collected for 537 Large Munsterlanders. The top categories of diagnosis were skin problems/ allergies (33.1%, 157 of 475 reported conditions), orthopaedic (29.7%, 148 of 499 reported conditions), gastrointestinal disorders (29.3%, 142 of 484 reported conditions), eye disorders (19.5%, 91 of 467 reported

conditions), and cancer or tumours of any kind (12.5%, 57 of 456 reported conditions).

The most frequently reported specific conditions were “delicate” tummy (13.4%, 65 dogs), arthritis (10.0%, 50 dogs), “weepy” eyes (9.2%, 43 dogs), environmental allergies (8.8%, 42 dogs), and flea/ mite allergy (6.7%, 32 dogs).

NB: ‘Other’ was the highest ‘cancer or tumours of any kind’ category at 7.9% prevalence and 36 cases and not all these were cancers.

The full report can be found here:
http://www.largemunsterlanderclub.co.uk/uploads/4/9/5/6/49565137/health_survey_-_details.pdf

LITERATURE REVIEW

The literature review lays out the current scientific knowledge relating to the health of the breed. We have attempted to refer primarily to research which has been published in peer-reviewed scientific journals. We have also incorporated literature that was released relatively recently to try to reflect current publications and research relating to the breed.

Black Hair Follicular Dysplasia (BHFD): This condition is characterised by silvery grey hair at birth and progressive alopecia forming in pigmented areas (Von Bomhard et al, 2006). A colony of Large Munsterlander Beagle crosses were bred in America to follow the progression of the disease, with the hair of affected dogs becoming brittle and less dense by 8-12 weeks of age. It is thought that the disease occurs in a simple autosomal recessive mode of inheritance in the breed (Schmutz et al, 1998).

Heritability of Behaviours: An older study of the heritability of hunting behaviours (use of nose, searching ability, retrieval from water, pointing, tracking, desire to work, and co-operation) was measured in several breeds, covered by the North American Versatile Hunting Dog Association (Schmutz and Schmutz, 1998). The authors found that the breed showed phenotypic improvement in these working behaviours overtime following selection based on the scoring system provided by the Association.

Hyperuricosuria: Genomic analysis of Large Munsterlanders was undertaken at the Animal Health Trust (AHT) to determine the allelic frequency of the disease in the breed (Karmi et al, 2010). This was determined to be at 0.14, based on 40 dogs tested, of which 9 were carriers and one dog affected. The estimated number of carriers in the breed was 23.7%. A DNA test is available for the breed.

BREED WATCH

The Large Munsterlander is currently a category one breed, meaning judges judging at championship certificate level are not required to complete mandatory health monitoring forms. No optional health reports have been received for the breed to date.

ASSURED BREEDER SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme there are the following requirements for the Large Munsterlander:

- Hip Scoring
- Eye Testing

It is also recommended that all breeding stock are tested for the following prior to breeding:

- HUU Status through HUU DNA test

The LMC has also recently requested that Elbow Scoring and HUU testing be added to the ABS.

BREED CLUB BREEDING RECOMMENDATIONS

The Large Munsterlander Club requires:

- All dogs being used for breeding to have their hips and elbows scored.
- All dogs being bred must have a current BVA/ECVO/AHT for Hereditary Cataract when mated and annual examination is required.
- Breeders who offer puppies that are the result of Artificial Insemination (AI) or Pet Passport matings must state clearly to prospective purchasers why both parents may not both conform to the UK Health screening requirements as outlined in the LM Club Rules and the Guidelines issued by the Management Committee.
- In the interest of breed health, any member taking their dogs for hip/elbow scoring must submit the plates to the BVA, whatever the likely score of the hips/elbows might be.
- All dogs being bred must be tested for HUU and to be included on the LMC Puppy Register the mating must be Clear X Clear or Clear X Carrier.
- Members/owners must not allow matings between dogs and bitches which do not conform to the colour as defined in the Breed Standard as published by the Kennel Club.
- Members/Owners must not allow a bitch to whelp before she is fully mature.
- Members/Owners must not let a bitch whelp under 12 months between litters. (Maturity is defined as not less than 20 months and not more than 8 years of age)
- Members/Owners must also ensure that stock from which they breed is registered at the Kennel Club and conforms to the Breed Standard.

- A bitch should have no more than four (4) litters in her lifetime and accordingly no more than four (4) will be accepted onto the Puppy Register.

DNA TEST RESULTS

There is currently one recognised DNA test for this breed, which is:

- DNA test for HUU (Hyperuricosuria)

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 of which involves collaboration between the breed clubs and the Kennel Club in order to validate the test's accuracy.

Laboratories that test for these DNA tests and the methods through which the Kennel Club accept results can be found through: https://www.thekennelclub.org.uk/worldwide-dna-tests/

As a note, as of January 2022 hereditarily clear status will no longer apply after two generations and dogs will need to be retested to confirm the status of that individual. This is to prevent the possibility of misclassification of status and therefore unintentional breeding of affected puppies. Where parentage is confirmed by DNA profile, the major contributor to erroneous status will be removed. Therefore, a less stringent restriction for HUU status is applied where parentage is confirmed by DNA test.

Table 1: DNA test results held by the Kennel Club for Large Munsterlanders up to 01/05/2020.

Clear	Carrier	Affected	Hereditarily clear	Hereditarily carrier	Total Tested
103 (13.4%)	42 (5.5%)	3 (0.4%)	618 (80.3%)	4 (0.5%)	770

CANINE HEALTH SCHEMES AND ESTIMATED BREEDING VALUES

All of the British Veterinary Association (BVA)/Kennel Club (KC) Canine Health Schemes are open to dogs of any breed with a summary given of dogs tested to date below.

HIPS

A total of 338 Large Munsterlanders have been hip tested under the scheme to date (01/05/2020) in the past 15 years, of which the 15-year and 5-year median score were both 8 (range 0 -74 and 0 – 26 respectively).

EBVs are available for hip scores in this breed. Figure 2 shows the five year rolling trend in EBVs by year of birth in the Large Munsterlander. It appears that EBVs have decreased since around 2002. This indicates an improvement in (lowering of)

genetic risk of hip dysplasia as determined by the BVA/KC hip score, most likely as a result of selection.

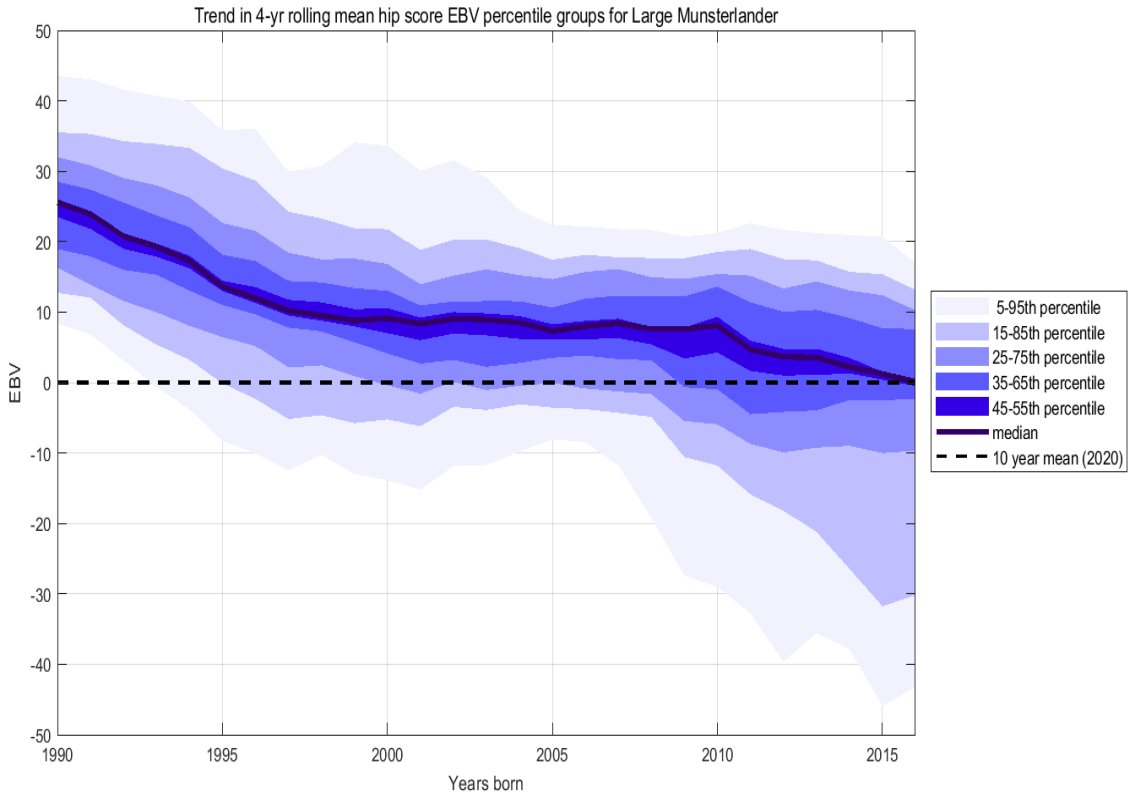

Figure 2: Trend in hip score EBV, with percentile groups, for the Large Munsterlander for years of birth since 1990.

ELBOWS

A total of 260 Large Munsterlanders have been elbow graded since the scheme began, with the total graded shown in the Table 2 below. Overall, 20.4% of dogs have had some form of elbow dysplasia.

Table 2: Elbow grade results of all Large Munsterlanders elbow graded to date (June 2020).

Grade	Number Graded
0	207 (79.6%)
1	34 (13.1%)
2	14 (5.4%)
3	5 (1.9%)

EYES

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

- Hereditary Cataracts (HC)

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.

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 in the past 10 years are shown in Table 3.

Table 3: Sightings reports for Large Munsterlanders' eyes examined since 2012.

Year	Number Seen	Comments
2012	51 adults	2 – nuclear cataract 3 – posterior polar subcapsular (PPSC) cataract 1 – hyaloid remnant
2013	32 adults	1 – distichiasis 1 – persistent hyperplastic primary vitreous (PHPV) 3 – nuclear cataract 2 – other cataract 1 – GPRA-like appearance
2014	44 adults	1 – distichiasis 1 – persistent pupillary membrane (PPM) 2 – PPSC 2 – other cataract
2015	39 adults 1 litters	4 – other cataract 1 – multifocal retinal dysplasia 8 puppies – PPM
2016	30 adults	6 – other cataract
2017	41 adults	1 – distichiasis 2 – PPM 3 – post cataract 3 – nuclear cataract
2018	32 adults	2 – nuclear cataract
2019	*Awaiting report*	

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.
- It is acknowledged that the reporting from veterinarians is increasing year on year, which is reflected across all breeds.

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 4.

Table 4: Number and percentage of litters of Large Munsterlanders 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	15	1	6.67%	0.15%
2010	16	1	6.25%	0.35%
2011	12	0	0.00%	1.64%
2012	13	4	30.77%	8.69%
2013	12	1	8.33%	9.96%
2014	11	1	9.09%	10.63%
2015	13	1	7.69%	11.68%
2016	10	5	50.00%	13.89%
2017	12	1	8.33%	15.00%
2018	12	1	8.33%	17.21%
2019	12	1	8.33%	15.70%

GENETIC DIVERSITY MEASURES

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of

genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the 'gene pool' of the breed. In the population analysis undertaken by the Kennel Club in 2015, an estimated effective population size of **59.8** was reported (estimated using the rate of inbreeding over the period 1980-2014).

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

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 3. 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 6.0%.

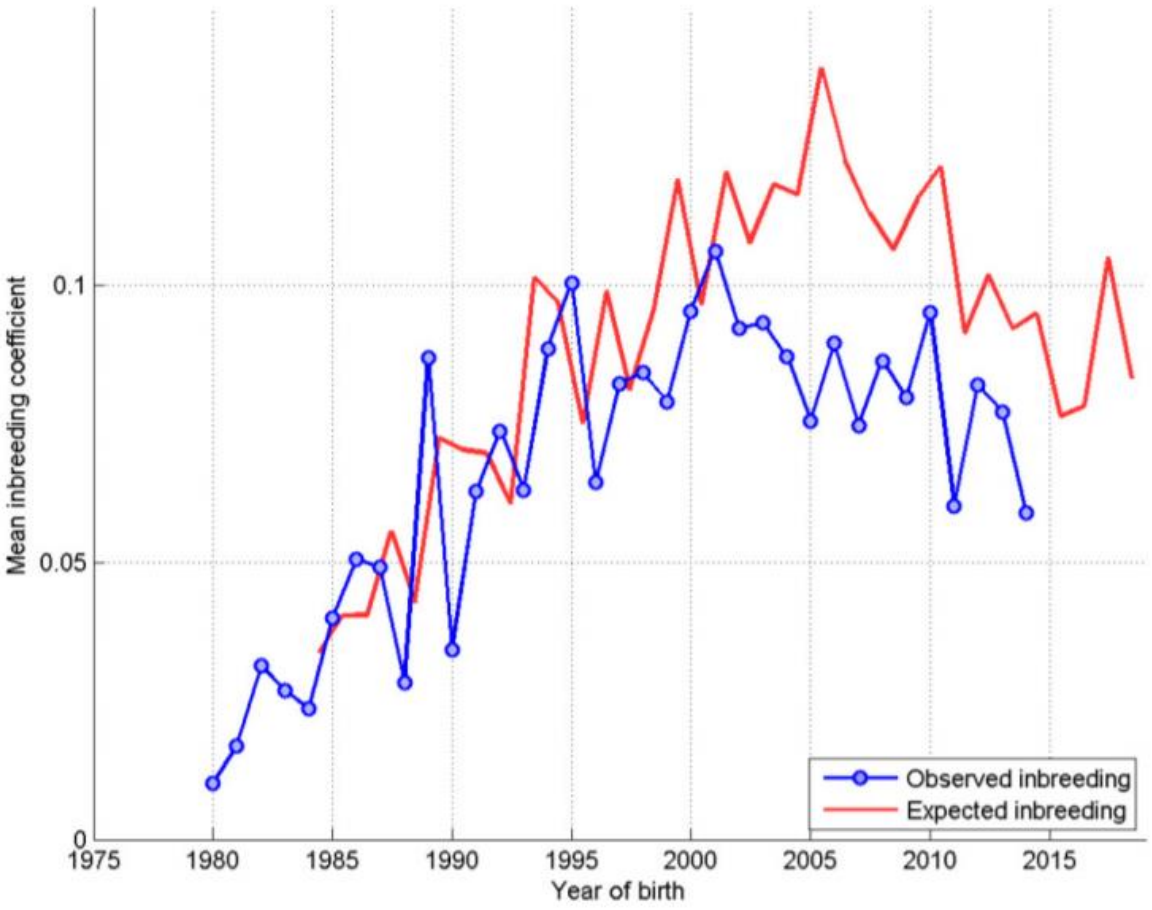

Figure 3: Annual mean observed and expected inbreeding coefficients.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven 5-year blocks (Figure 4). 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).

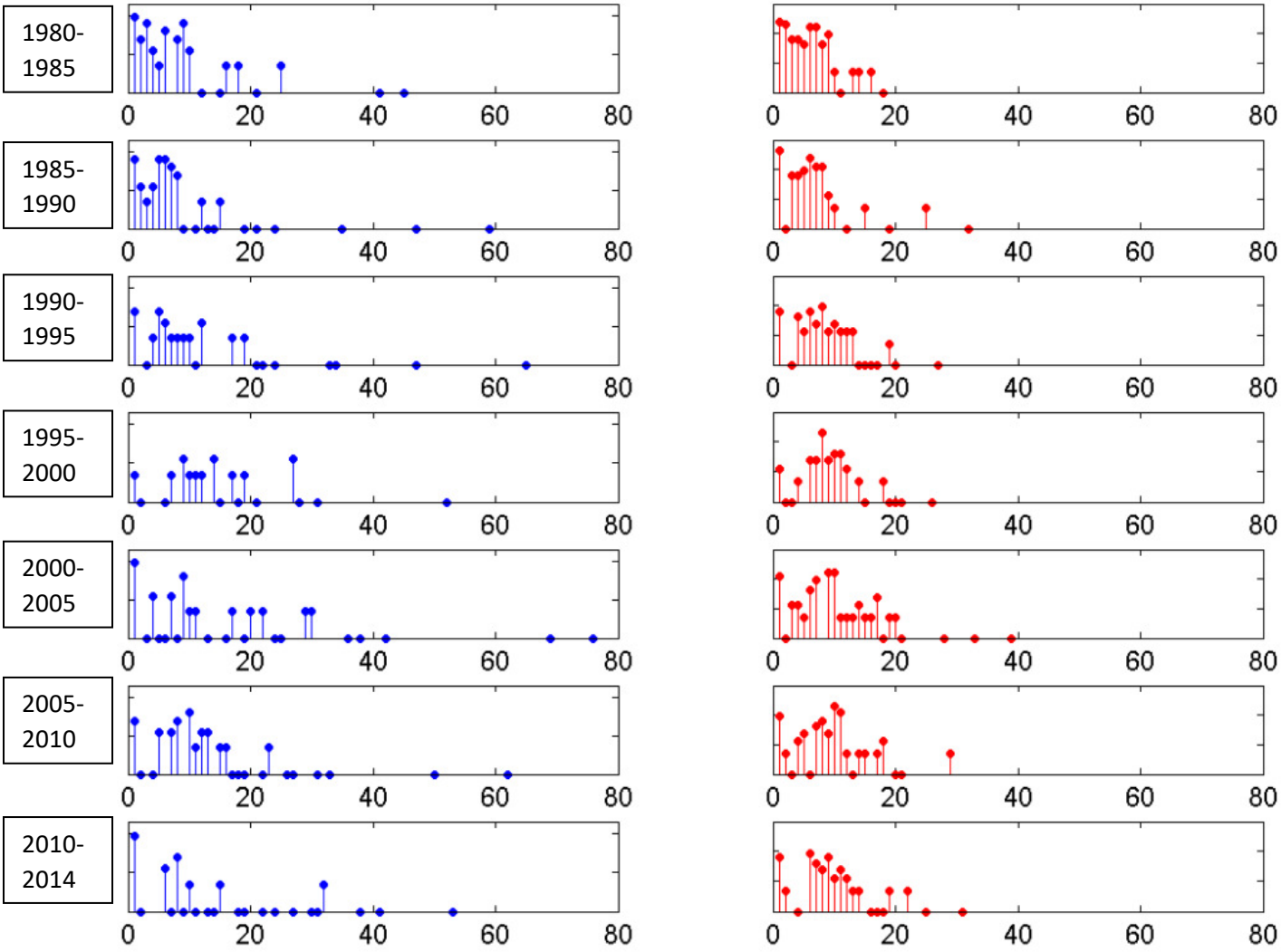

Figure 4: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-14 bottom). Vertical axis is a logarithmic scale.

CURRENT RESEARCH

The breed is currently involved in:

- the CRIEDD (consortium to research inherited eye diseases in dogs) with the Animal Health Trust (AHT)
- Give a Dog a Genome (AHT)

- Elbow research and the effect of genetic and environmental factors on the clinical manifestation of both hip & elbow dysplasia, which is being undertaken by the BHC. Many research papers have been read and a presentation has been made to the LMC management committee. An interim health statement has been made about not breeding too closely and taking care with environmental factors from gestation to when the growth plates close. These environmental factors include exercise, weight and diet, particularly with the level of calcium as well as the percentage ratio to phosphorus in the diet. This statement has gone onto the LMC website under Health and onto the Health Facebook Group for LM Owners past and present. It will be updated when more research has been carried out and more answers are given.

PRIORITIES

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

- Elbow and hip dysplasia
- Epilepsy
- Eyes

ACTION PLAN

Following correspondence between the Kennel Club and the breed regarding the evidence base of the Breed Health & Conservation Plans, the following actions were agreed to improve the health of the Large Munsterlander. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Club to develop a new health survey, with the Kennel Club to assist in dissemination

- The Breed Club to continue to encourage owners to hip, elbow and eye test dogs

Kennel Club actions include:

- The Kennel Club to take the ABS proposals from the Breed Club to the next sub-group meeting and feedback the group's decision

- The Kennel Club to raise the elbow queries put forward by the breed with the BVA

- The Kennel Club to repeat the population analyses for the breed

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