



THE KENNEL CLUB  
DOG HEALTH

Glen of Imaal Terrier

Evidence Base

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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 number of Glen of Imaal Terriers registered by year of birth between 1990 and 2020 are shown in Figure 1. The trend of registrations over year of birth (1990-2020) was +0.13 per year (with a 95% confidence interval of -0.54 to +0.79), reflecting a fluctuation in the breed's numbers during this time with no significant trend. It is worth noting the number of Glen of Imaal Terriers registered per year has never exceeded 100 during this period, and as such the breed is formally recognised as a vulnerable native breed due to the consistently small number of dogs registered per year.

[Put simply, 95% confidence intervals (C.I.s) indicate that we are 95% confident that the true estimate of a parameter lies between the lower and upper number stated.]

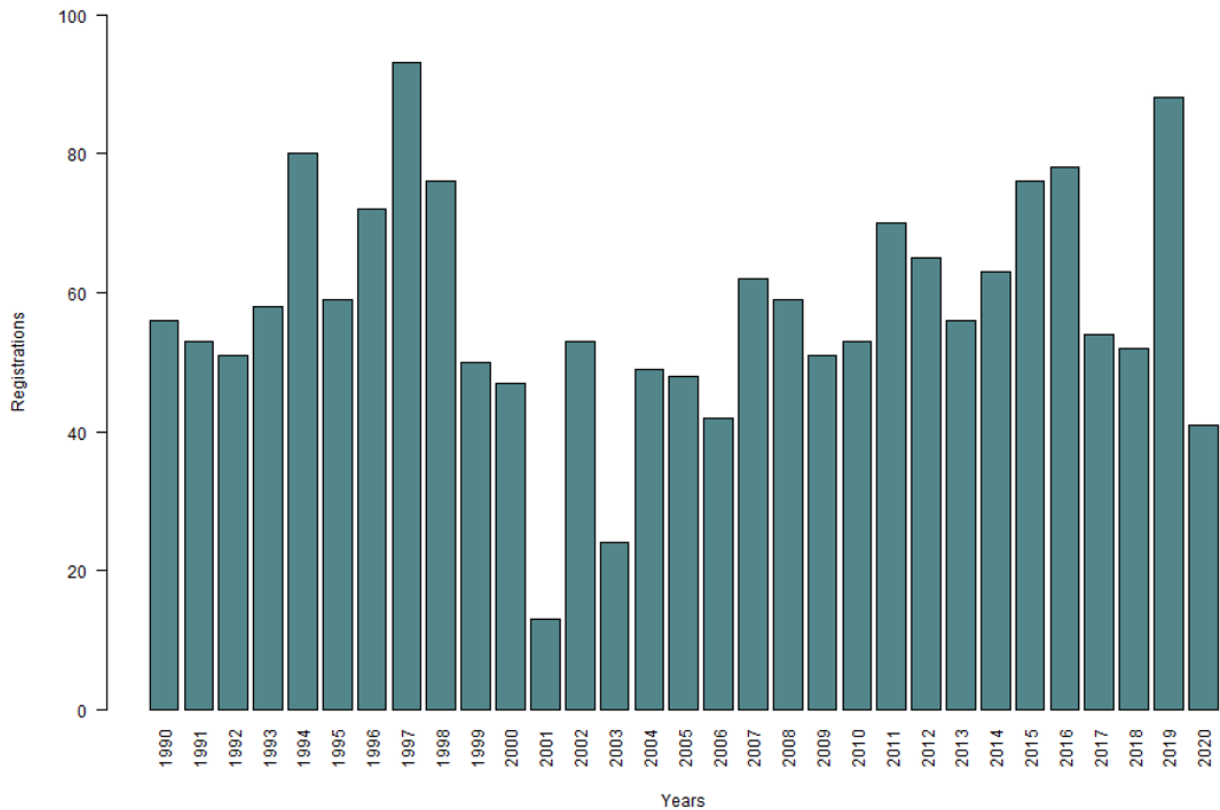


Figure 1: Number of registrations of Glen of Imaal Terriers per year of birth, 1990 – 2020.

## 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 most recent BHC'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. Progressive retinal atrophy (PRA) (crd3)
1. Growth plate disorders
2. Skin issues

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 recommend breeders test for PRA (crd3) prior to breeding, instigated a rolling health report in order to keep up to date at a glance which issues are presenting in the breed, considering recommending further DNA testing before breeding takes place.

## BREED CLUB HEALTH ACTIVITIES

The Glen of Imaal Terrier has two active Breed Health Coordinators (BHC), and webpages dedicated to health on the club websites:

- <http://www.goita.co.uk/Health.html>
- <https://www.e-f-g.co.uk/health>

The breed also has an international DNA archive where owners are recommended to send samples for collation. Further details and how to submit can be found here:

<https://www.goita.co.uk/dna-archive/>

## 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 55 live Glen of Imaal Terriers of which 33 (60%) were healthy and 22 (40%) had at least one reported health condition. The top categories of diagnosis were immune mediated (21.9%, 7 of 32 reported conditions), reproductive (18.8%, 6 of 32 reported conditions), dermatologic (15.6%, 5 of 32 reported conditions), and ocular (9.4%, 3 of 32 reported conditions). The most frequently reported specific conditions with three cases each were atopy, and false pregnancy.

**2004 Mortality results:** A total of six deaths were reported for the Glen of Imaal Terrier. The median age at death was 10 years and 5 months (min = 7 years and 9 months, max = 14 years and 6 months). The causes of death were reported twice for both cancer – unspecified and combinations, and once for both cardiac disease and old age.

**2014 Morbidity results:** Health information was collected for 33 live Glen of Imaal Terriers, of which 18 (54.5%) had no reported conditions and 15 (45.5%) was reported to be affected by one condition. The most frequently reported conditions were hypersensitivity (allergic) skin disorder (12.12% prevalence, 4 cases), alopecia/baldness (6.06% prevalence, 2 cases), flea allergic dermatitis (6.06% prevalence, 2 cases), lipoma (6.06% prevalence, 2 cases), and PRA (6.06% prevalence, 2 cases).

**2014 Mortality results:** A total of just three deaths were reported for the breed and the range of age at death was 5 years to 14 years. The reported causes of death were pancreatic cancer, splenic tumour and traumatic injury.

*Please note that caution should be taken when drawing meaningful conclusions from these data, given the relatively small number of reports for the breed.*

### **Finnish Breed Club Health Survey (2013/14)**

In total, 136 Glen of Imaal Terriers (74 dogs and 62 bitches) were included in the 2013/2014 Finnish Breed Club Health Survey: 113 live dogs and 23 deceased dogs.

The majority of owners described their dog's overall health as excellent (55.9%, 76 of 136).

Of the 136 dogs the following conditions were reported (Table 1).

Table 1: Conditions reported in the Finnish 2013/2014 breed health survey.

<b>Condition</b>	<b>Count/ %</b>
Skin problems – unspecified	57 (41.9%)
Dental calculus	46 (33.8%)
Allergies – unspecified	29 (21.3%)
Benign tumours	28 (20.6%)
Itching	22 (16.2%)
Missing teeth	22 (16.2%)
Urinary tract infection	20 (14.7%)
PRA (affected/ carrier status)	19 (14.0%)
Narrow lower jaw (mandible)	12 (8.8%)
Malignant tumours – unspecified	12 (8.8%)
Renal crystals/ urolithiasis	11 (8.1%)
Recurrent ear infection	11 (8.1%)
Recurrent eye infection	9 (6.6%)
Distichiasis/ ectopic cilia	7 (5.2%)
Hip dysplasia	6 (4.4%)
Tumours – unknown	3 (2.2%)
Heart disease – unspecified	3 (2.2%)
Neurological disease – unspecified	2 (1.5%)
Epileptic spasms	2 (1.5%)

The reported causes of death by organ system or category were tumour/ cancer (n=8), euthanasia/ not diagnosed (n=4), skeletal/ articular disease (n=2), urinary disorder (n=2), euthanasia due to behavioural problems (n=2), and road traffic accident (n=2).

The full report can be found here: [https://glennit.fi/wp-content/uploads/2017/10/Survey\\_748598\\_Health\\_survey\\_of\\_Finnish\\_Glens\\_v2013.pdf](https://glennit.fi/wp-content/uploads/2017/10/Survey_748598_Health_survey_of_Finnish_Glens_v2013.pdf)

### **Worldwide Breed Health Survey (2014)**

This online survey was run over a period of 10 weeks at the end of 2014. A total of 379 responses (178 dogs and 201 bitches) were received for 334 live dogs and 45 deceased dogs. Of these dogs, 128 were UK-resident Glen of Imaal Terriers.

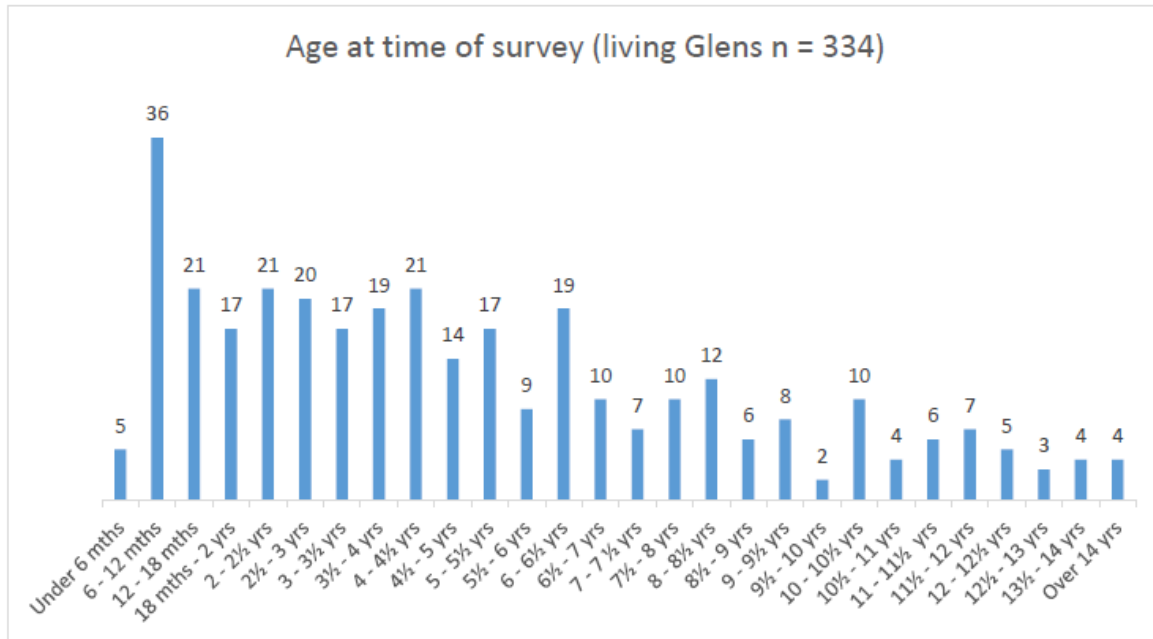


Figure 2: Age of Glens reported for in the survey.

The survey also gathered data on the reasons for neutering and breeding, with 67 neutered males and 93 spayed females. The majority of males were neutered between six and 12 months (n=20). Reasons for neutering males are shown in Figure 3 below.

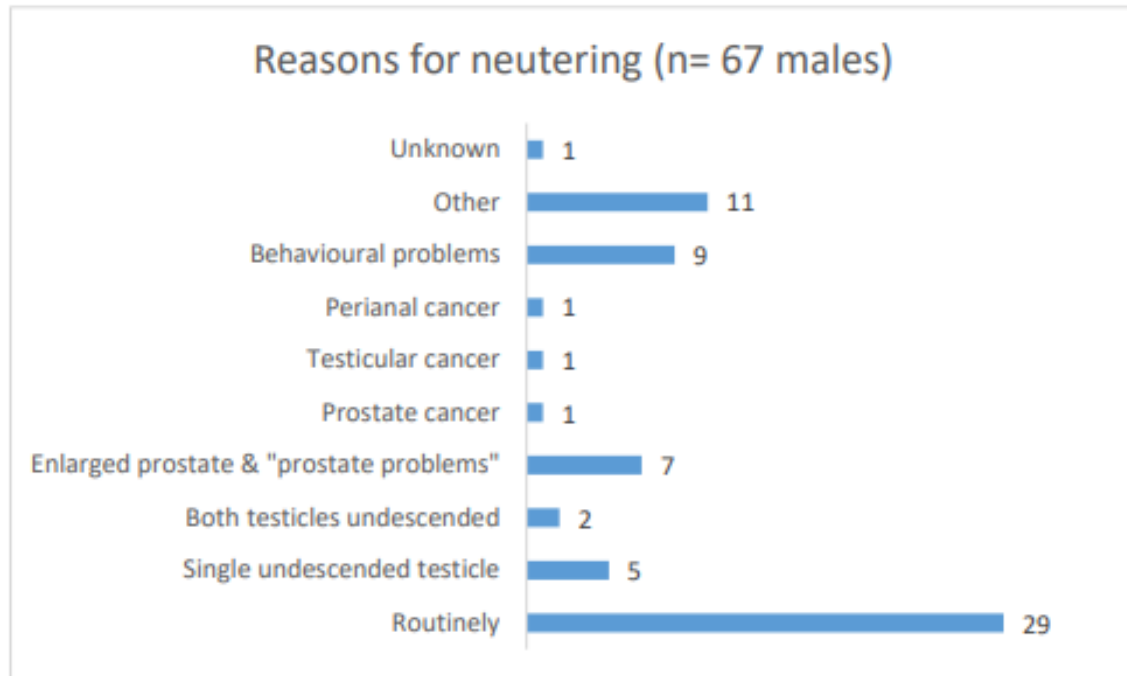


Figure 3: Reported reasons for neutering male Glens.

Other included: no plans for breeding (n=4), conformational issues (n=2), condition of transfer of ownership (n=1), living with other male terrier (n=1), diagnosis of PRA and living with entire bitches (n=1), and PRA carrier (n=1).

Regarding males that had been bred from, 29% (n=52) of males had been used, with most siring one litter (Figure 4). Eighteen dogs were used unsuccessfully (13 used once, five used twice).

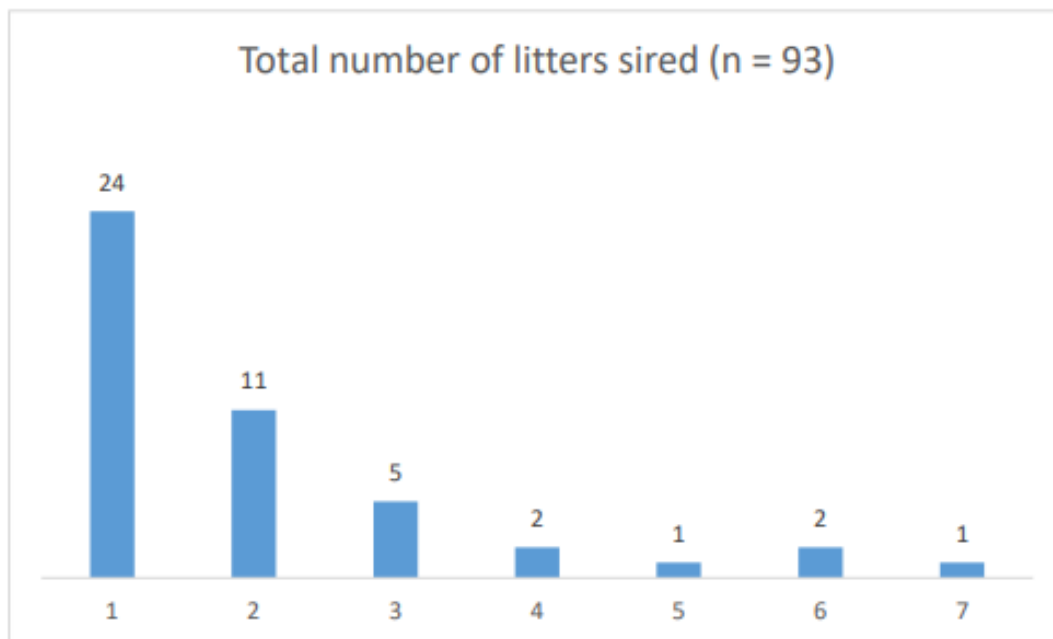


Figure 4: Number of litters sired by dogs reported in the survey.

With respect to females, the data was split into brood bitches (those that had whelped one to three litters and were subsequently spayed) and nulliparous bitches (those that have never whelped).

A total of 37 brood bitches were reported for with the majority being spayed following retirement from breeding (n=19). The remaining reasons are shown in Figure 4 below. The majority of females in this cohort were neutered between five and seven years of age.



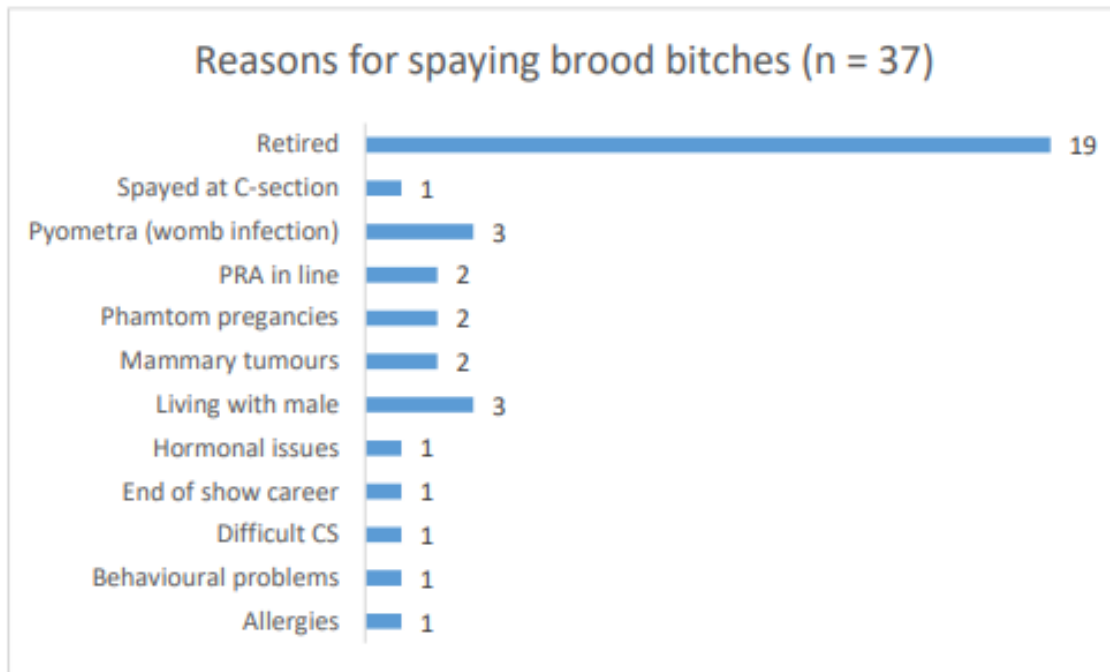


Figure 4: Reported reasons for neutering brood bitches.

With respect to nulliparous bitches, 56 dogs were reported, with the majority of these neutered routinely (Figure 5) and between six and 12 months of age.

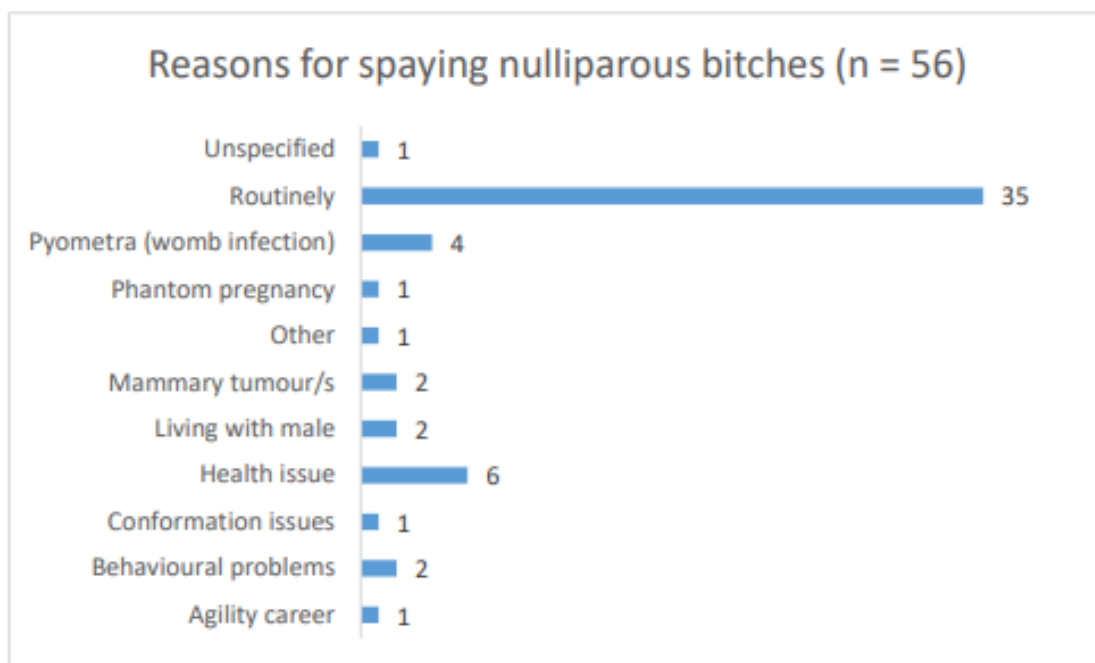


Figure 5: Reported reasons for neutering nulliparous bitches.

As for bitches that had been bred from (39%, n=78), most had whelped one litter (Figure 6). Twenty-nine bitches were used unsuccessfully (16 once, six twice, three thrice, three four times and one five times). From a total of 147 matings, 63% (n=93) were used successfully and the remaining 37% unsuccessful.

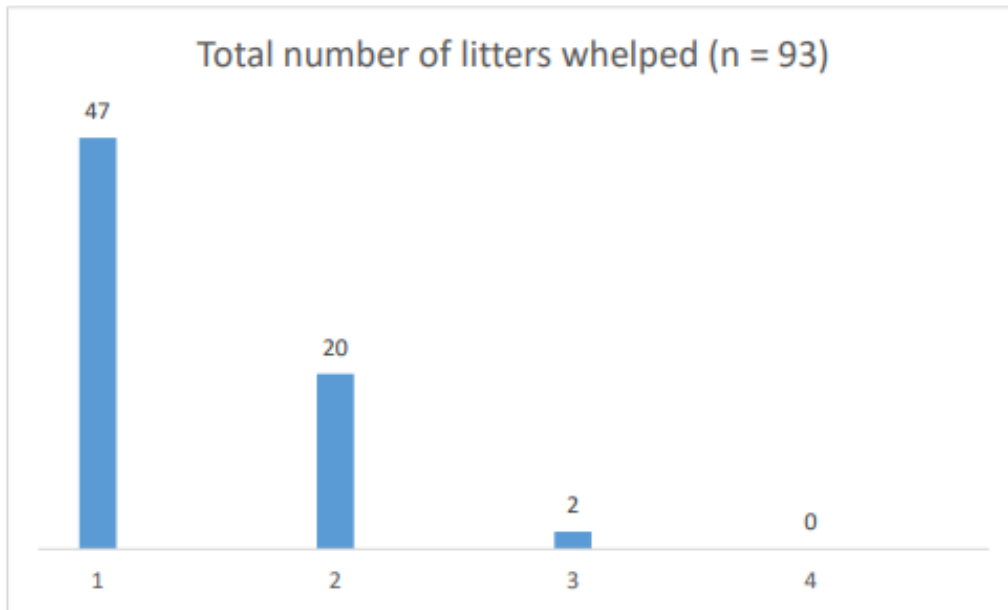


Figure 6: Number of litters sired by bitches reported in the survey.

With regard to the delivery of these litters, the majority were naturally whelped (66%, n=61), 16% via both caesarean and natural, 14% via caesarean section and 4% unspecified. In total 27 c-sections were reported, with 22 being emergency surgeries and five elective. The reasons for c-section are shown in Figure 7 below.

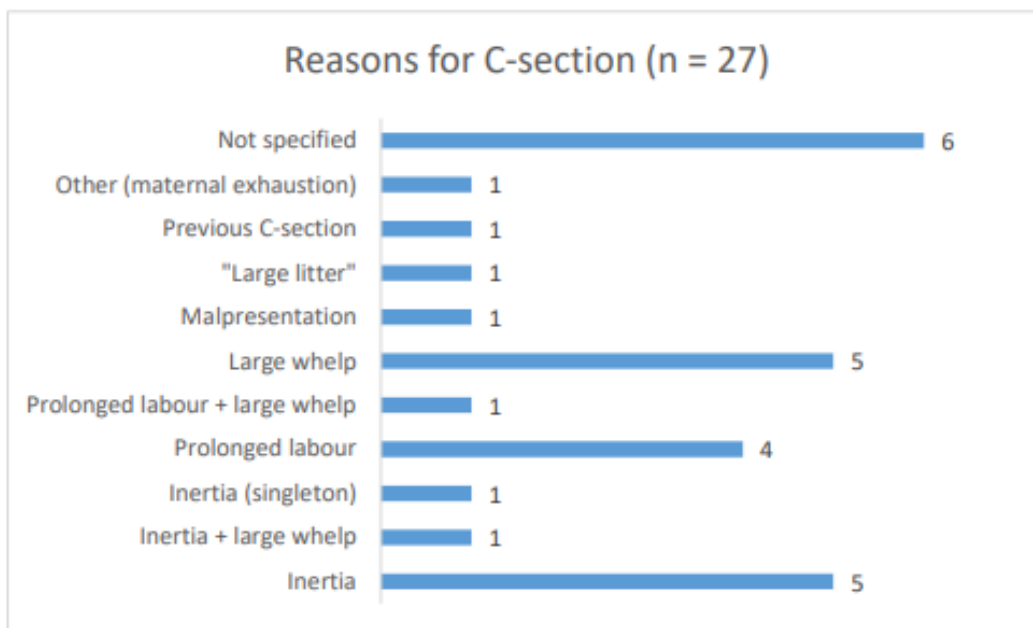


Figure 7: Reasons reported for c-section.

With respect to successful litters, a total of 559 puppies were whelped from 93 litters, with an average of six puppies per litter. From these, 89% of puppies survived, 8% were stillborn and 14% died before eight weeks of age. Regarding congenital deformities, just seven were recorded, with these being umbilical hernia (n=2), cleft

lip/ palate (n=2), and one report for each of the following: tail deformity, not fully formed, and open fontanelle.

With respect to health conditions reported in the survey, a total of 379 dogs were reported for, with the conditions shown in Table 2.

Table 2: Conditions reported in the 2014 worldwide breed health survey.

<b>Category/ condition</b>	<b>Count/ %</b>
<i>Allergies/ intolerance</i>	<i>71 (18.7%)</i>
Food intolerance	45
Grass/ tree pollens allergy	22
Flea allergy	13
Dust mite allergy	11
<i>Surgery (excluding neuter/ cancer removal)</i>	<i>67 (17.7%)</i>
Non-cancerous lump	36
Cyst removal	19
Removal of foreign body from gut	15
Injury/ accident	12
<i>Skin/ coat/ ear</i>	<i>57 (15.0%)</i>
Other conditions	18
Chronic ear infection	11
Recurrent pyoderma	8
Atopic dermatitis	5
Pyotraumatic dermatitis	4
Seborrhoea	2
Alopecia	1
<i>Cancer</i>	<i>38 (10.0%)</i>
Mammary	14
Lymphoma	6
Mast cell	5
Liver	3
Adenocarcinoma	2
Anal gland	2
Fibrosarcoma	2
Testicular	2
Cholangiocarcinoma	1
Colon	1
Haemangiosarcoma	1
Lung	1
Sebaceous gland	1
Squamous cell carcinoma	1
Soft tissue sarcoma	1
Urethral	1
<i>Eye</i>	<i>32 (8.4%)</i>
PRA	14
Cataracts (non-hereditary)	6
Distichiasis	2
Horner's syndrome	1
Astigmatism	1
Optic nerve hypoplasia	1
Retinal dysplasia	1
Cherry eye	1

Cataracts (hereditary)	1
<i>Digestive</i>	<b>29 (7.7%)</b>
Inflammatory bowel disease (IBD)	2
Colitis	2
IBD and pancreatitis	2
Pancreatitis	1
Peptic ulcer	1
Unspecified	1
<i>Musculoskeletal</i>	<b>29 (7.7%)</b>
Arthritis	6
PCDU	4
Disc problems	2
Elbow dysplasia	2
Cruciate ligament rupture	1
Suspected PCDU	1
Hip dysplasia and arthritis	1
PCDU and arthritis	1
ALD (angular limb deformity)	1
<i>Hormonal/ endocrine</i>	<b>14 (3.7%)</b>
Pancreatitis	5
Cushing's disease	5
Addison's disease	2
Diabetes	1
Hypothyroidism	1
<i>Cardiovascular</i>	<b>12 (3.2%)</b>
Mitral valve defect	3
Degenerative heart disease	2
Congenital heart defect	1
Third degree atrioventricular block	1
Cardiomyopathy	1
Aortic stenosis	1
<i>Kidney</i>	<b>8 (2.1%)</b>
Bladder/ kidney stones	5
Chronic renal failure	1
Benign cyst	1
<i>Neurological</i>	<b>5 (1.3%)</b>
Encephalitis	1
Granulomatous meningoencephalitis	1
Spinal stenosis and dementia	1
Idiopathic epilepsy and dementia	1
Idiopathic epilepsy	1
<i>Liver</i>	<b>4 (1.1%)</b>
Intrahepatic shunt	1
Liver dysfunction and enlargement	1
Liver failure	1
Hepatoma	1

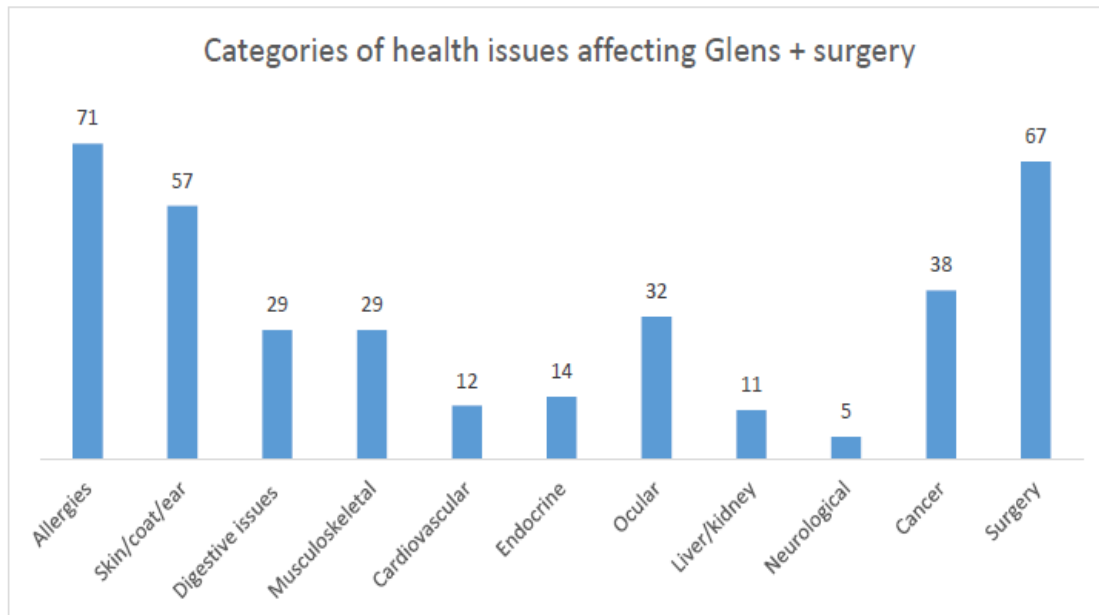


Figure 8: Reported conditions by organ system/ category.

Cause of death was also collected for 45 deceased dogs, with a median age at death of 10 - 10.5 years. The reported causes of death are shown in Figure 9.

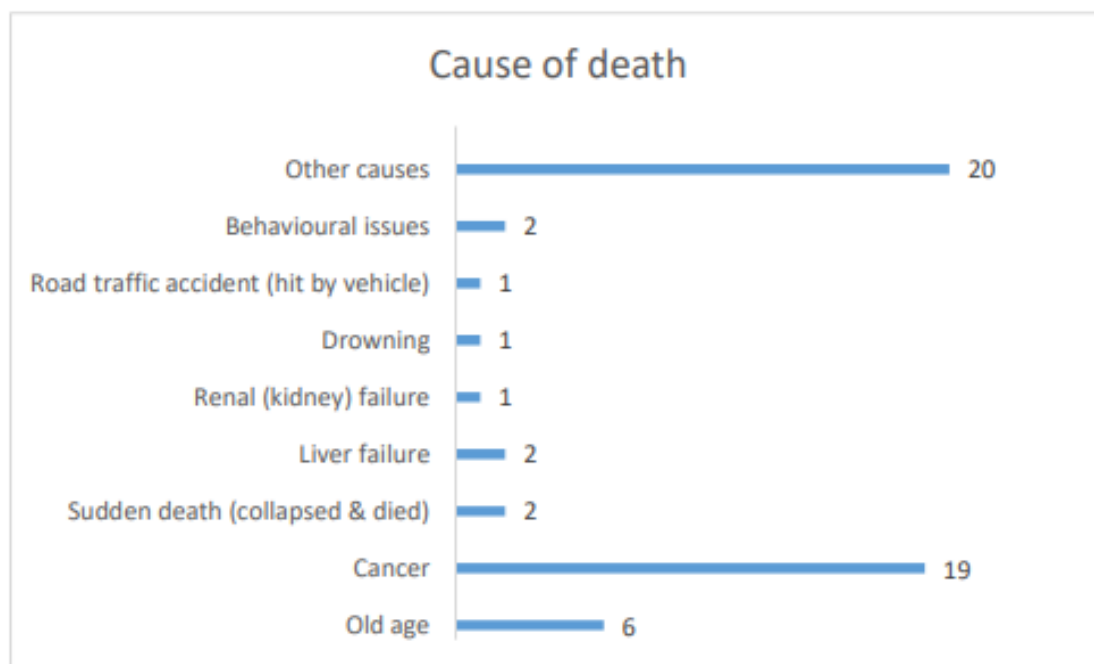


Figure 9: Reported causes of death in the health survey.

Other reported conditions include one report for each: diabetes, encephalitis, ruptured splenic tumour, Cushing's disease, granulomatous encephalitis, pancreatitis/ IBD/ hepatoma, acute pancreatitis, pancreatic – unspecified, grand mal seizure, septicaemia, biliary obstruction, secondary to tumour, accident, and surgery.

The full report can be found here: [https://42d3983e-05e7-47b4-b9a0-452731383626.filesusr.com/ugd/7fc889\\_263ba8bb0ad04f3c8276c67f9eb3781d.pdf](https://42d3983e-05e7-47b4-b9a0-452731383626.filesusr.com/ugd/7fc889_263ba8bb0ad04f3c8276c67f9eb3781d.pdf)

### **OFA Health Survey (ongoing from October 2012)**

To date (Sept 2021), 349 Glen of Imaal Terriers (166 dogs and 167 bitches) have participated in the OFA Health Survey: 254 live dogs and 81 deceased dogs.

The majority of owners described their dog's overall health as excellent (60.2%, 210 of 323). When asked is their dog has had significant health problems, 76 (21.8%) answered 'Yes' and 255 (73.1%) answered 'No'.

Of the 332 dogs with health information reported for the top conditions are shown in Table 3.

Table 3: Conditions reported by organ system in the OFA health survey.

<b>Condition</b>	<b>Count/ %</b>
Cancers/ tumours	72 (20.6%)
Allergies	68 (19.5%)
Skin disorders	49 (14.0%)
Gastrointestinal disorders	30 (8.6%)
Orthopaedic disorders	26 (7.4%)
Dental disorders	25 (7.2%)
Temperament	24 (6.9%)
Eye disorders	22 (6.3%)
Kidney/ urinary disorders	21 (6.0%)
Reproductive disorders	15 (4.3%)
Miscellaneous	15 (4.3%)
Endocrine/ hormonal disorders	12 (3.4%)
Cardiovascular disorders	10 (2.9%)
Liver disorders	10 (2.9%)
Ear disorders	8 (2.3%)
Neurological and/or muscular disorders	7 (2.0%)
Blood/ lymph disorders	7 (2.0%)
Immunological disorders	5 (1.4%)
Respiratory disorders	1 (0.3%)

The most commonly reported age at death was 10-13 years of age (10.3%, 36 of 82).

*N.B. The OFA numbers should be viewed with some caution, as this survey is ongoing and may include multiple (repeat) entries for individual dogs whose health status has changed over the years*

The full report can be found here: [https://www.ofa.org/health-surveys#api\\_summary](https://www.ofa.org/health-surveys#api_summary)

## **UK Breed Club Health Survey (2018)**

This survey was carried out by the Glen of Imaal Terrier Association (GOITA) and Glen of Imaal Terrier Enthusiasts and Fanciers Club (EFC) over six months in 2018. A total of 111 responses were received for 90 live and 21 deceased Glen of Imaal Terriers.

The most frequently reported medical conditions were hypersensitivity (allergic) skin disorder (11 cases), seasonal alopecia (7 cases), unspecified cancer (7 cases), skin lesions (4 cases), unspecified skin issue (4 cases), and food intolerance (4 cases).

The mean age at death was 11 years and 6 months (min = 4 years, max = 16 years). The most common causes of death by organ system or category were cancer, renal injury, splenic mass/ bleed, pancreatic mass/ pancreatitis, hepatic mass, Cushing's disease (diagnosed or suspected), eye ulcers, blindness, diabetes, inflammatory bowel disease, acute nerve pain and old age.

The full report can be found here: [https://5d386a32-f20d-4cbc-88a1-192c8f296ef8.filesusr.com/ugd/9394e6\\_b73524c2a89043f1b921505f65d84aac.pdf](https://5d386a32-f20d-4cbc-88a1-192c8f296ef8.filesusr.com/ugd/9394e6_b73524c2a89043f1b921505f65d84aac.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. Given the breed's numerically small numbers unfortunately there are very few relevant published papers.

### **Ocular conditions**

*Progressive retinal atrophy (PRA)*: PRA is an inherited retinal disease associated with gradual loss of vision. Crd3 is one of several recognised cone rod dystrophies (crd), in which the clinical signs are not usually present until two years of age, and in some cases can develop much later in life. This late onset form of PRA has been described in the Glen of Imaal Terrier. Sequence analysis revealed a unique mutation (deletion of exons 15 and 16 in *ADAM9*) associated with PRA (crd3) in the Glen of Imaal Terrier (Kropatsch et al, 2010; Goldstein et al, 2010). Since the discovery of this mutation in 2010, DNA testing for PRA (crd3) has been available for the breed and is currently a requirement for members of the Assured Breeders Scheme.

## **BREED WATCH**

The Glen of Imaal Terrier is a category one breed, meaning judges are not required to complete mandatory monitoring forms following an appointment as championship certificate level. To date no optional reports have been received for the breed.



## PERMISSION TO SHOW

As of the 1<sup>st</sup> January 2020 exhibits for which permission to show (PTS) following surgical intervention has been requested will no longer be published in the Breed Record Supplement and instead will be detailed in BHCPs, and a yearly report will be collated for the BHC. In the past five years, no reports have been received for the Glen of Imaal Terrier (excluding neutering or caesarean sections).

## ASSURED BREEDERS SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme (ABS) there are the following requirements for the Glen of Imaal Terrier:

- DNA testing for PRA (crd3)
- Eye testing under the BVA/KC/ISDS Eye Scheme

There are currently no recommendations for this breed within the ABS.

## BREED CLUB BREEDING RECOMMENDATIONS

The Kennel Club include the breed club breeding recommendations which are detailed under the Assured Breeders Scheme sub-heading above. Further the breed clubs recommend the following:

- Bitches should not be bred from before the age of two
- Bitches should not be bred from after the age of seven
- PRA CRD3 testing should be undertaken every third generation
- DNA testing for locus B (brown gene)
- DNA testing for degenerative myelopathy

## DNA TEST RESULTS

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

- PRA (crd3)

Laboratories that test for this DNA test and the methods through which the Kennel Club accept results can be found on the Kennel Club's Breed A-Z (<https://www.thekennelclub.org.uk/search/breeds-a-to-z/>)

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.

The test was introduced for the breed in 2010, with some 566 dogs having been tested to date. Results recorded for these are shown in Table 4.



Table 4: PRA (crd3) DNA test results for the Glen of Imaal Terrier

Clear	Carrier	Affected	Hereditarily Clear
88 (15.5%)	61 (10.8%)	1 (0.2%)	416 (73.5%)

The 3-year mean mutation frequency for tested dogs is shown in Figure 10 below. The trend has shown a significant reduction in frequency in tested dogs overtime, with this being at 0.9% as of 2016-18, showing that breeders are successfully breeding away from the mutation. It is important to remember that carriers will not present with disease and should still be used as part of breeding, particularly given the breed’s small genetic pool (page 21).

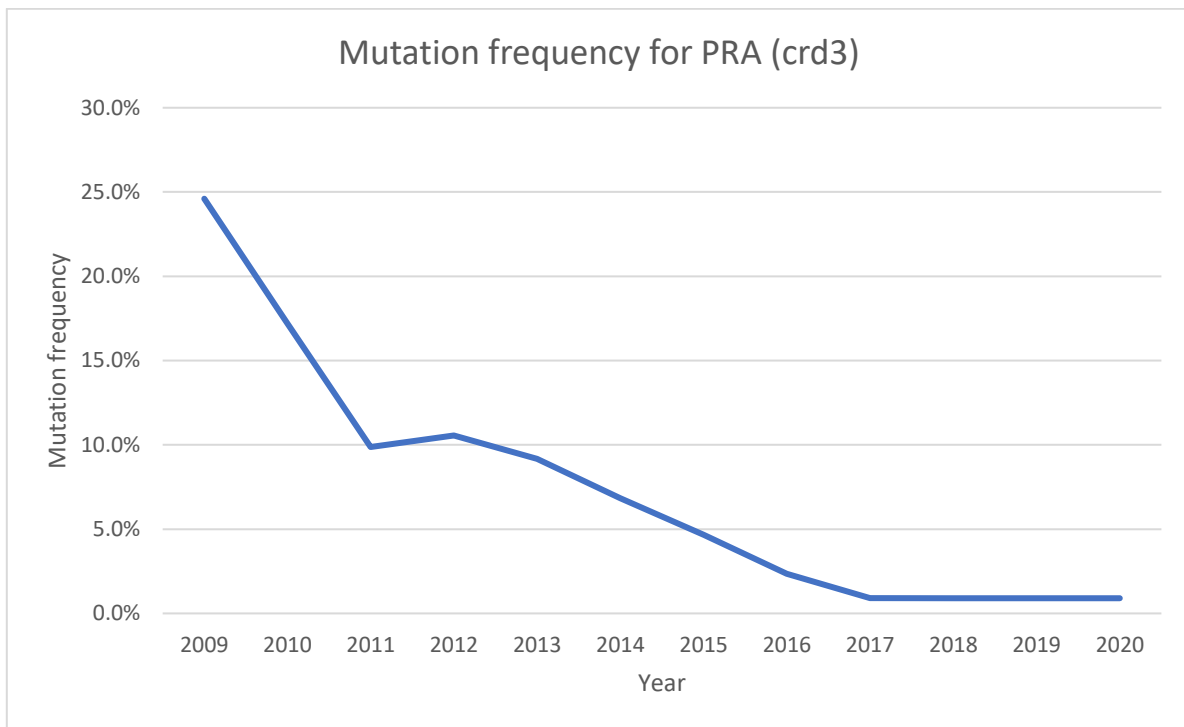


Figure 10: 3-year mutation frequency for PRA (crd3) in the Glen of Imaal.

However, there is a caveat to consider, in that the presence of dogs with hereditary status, which make up the majority of results particularly in later years (average 76.5% during 2018-20), will cause a downward bias in mutation frequency. Therefore, whilst the initial findings can be acknowledged, it is important to consider this may change overtime and is not an absolute reflection.

As a note, as of January 2023 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 HC status is applied where parentage is confirmed by DNA test.

## CANINE HEALTH SCHEMES

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

To date (Sept 2021), eight Glen of Imaal Terriers have been hip scored under the BVA/KC Hip Dysplasia Scheme, with a median hip score of 14 (range 8-19).

### ELBOWS

To date (Sept 2021), two Glen of Imaal Terriers have been elbow graded under the BVA/KC Elbow Dysplasia Scheme, both being grade 0.

### EYES

The Glen of Imaal Terrier is currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for the following condition:

- PRA

KIOD lists the known inherited eye conditions in the breeds where there is enough scientific information to show that the condition is inherited in the breed, often including the actual mode of inheritance and in some cases even a DNA test.

To date (Sept 2021), 209 Glen of Imaal Terriers have been eye screened, of which 5 (2.4%) were affected by PRA. The count of dogs tested per year and those tested as affected are shown in Figure 11 below.

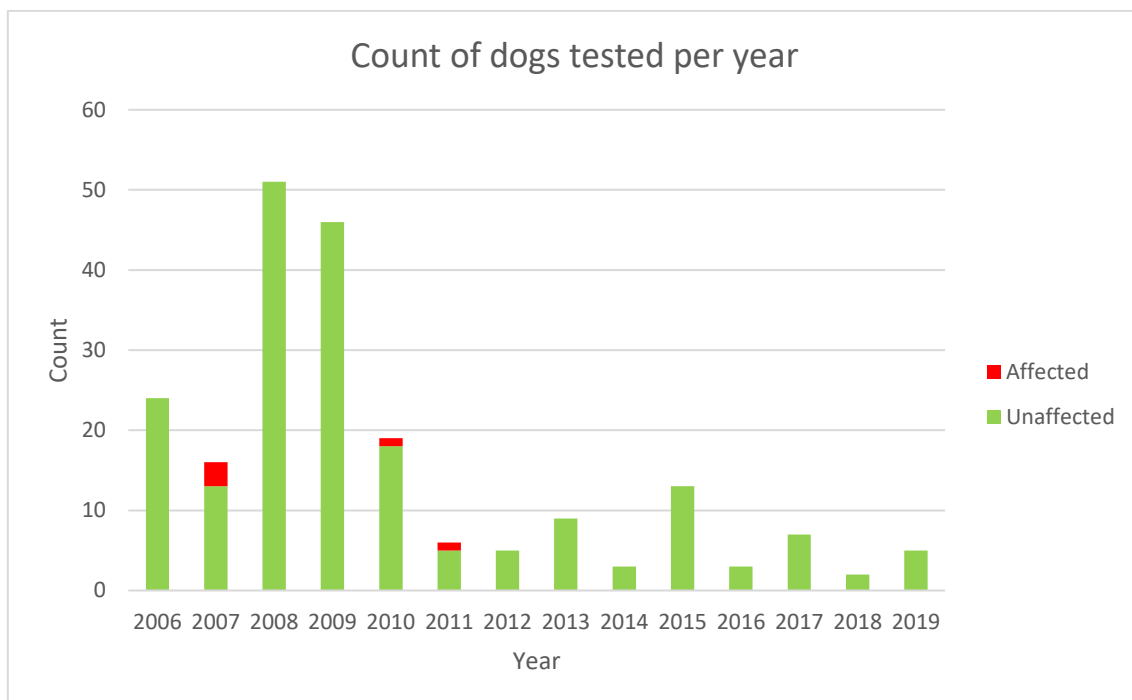


Figure 11: Count of Glens eye tested per year under the BVA/KC/ISDS Eye Scheme.

As well as the KIOD list, the BVA record any other conditions affecting a dog at the time of examination, which is incorporated into an annual sightings report. Results of Glen of Imaal Terriers tested between 2012 and 2018 are shown in Table 5 below. The reports for 2019 onwards are still pending.

Table 5: Reports on Glen of Imaal Terriers that have participated in the BVA/KC/ISDS Eye Scheme between 2012-2018.

Year	Number Tested	Comments
2012	6 Adults 0 Litters	2 – primary lens luxation 1 – other cataract 1 – generalised progressive retinal atrophy (GPRA)-like appearance
2013	9 Adults 0 Litters	No comments
2014	4 Adults 0 Litters	1 - trichiasis
2015	15 Adults 1 Litter	No comments
2016	3 Adults 0 Litters	No comments
2017	7 Adults 0 Litters	No comments
2018	1 Adult 0 Litters	No comments

### AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 6 below for conditions affecting over 1% of the examined population. Between 2015 and 2019, 192 Glen of Imaal Terriers were examined, of which 82.3% (158 of 192 dogs) were found to be unaffected by any eye condition.

Whilst it is important to note that these data represent dogs in America, the organisation tend to examine a higher number of dogs than that in the UK, and therefore are a valuable source of information.

Table 6: ACVO examination results for Glen of Imaal Terriers, 1991 – 2019

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n=583)	2015-2019 (n=192)
<b>Eyelids</b>		
Distichiasis	3.6%	3.1%
<b>Uvea</b>		
Persistent pupillary membranes, lens pigment foci/ no strands	0.0%	1.0%
<b>Lens</b>		
Cataract, suspect not inherited/ significance unknown	9.1%	4.7%
Significant cataracts (summary)	5.0%	6.2%
<b>Retina</b>		
Retinal dysplasia, folds	1.0%	0.5%
Generalized progressive retinal atrophy (PRA)	3.9%	0.5%

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

## 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.
- In all breeds, there was an increase in the number of caesarean sections reported from 2012 onwards, as the Kennel Club publicised the procedure to vets.

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 7.

Table 7: Number of Glen of Imaal Terrier litters registered per year, and number and percentage of caesarean sections reported per year, 2009 to 2020.

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	13	0	0.0%	0.15%
2010	16	0	0.0%	0.35%
2011	13	1	7.7%	1.64%
2012	18	2	11.1%	8.69%
2013	13	3	23.1%	9.96%
2014	15	1	6.7%	10.63%
2015	19	1	5.3%	11.68%
2016	16	3	18.8%	13.89%
2017	14	0	0.0%	15.00%
2018	11	0	0.0%	17.21%
2019	18	3	16.7%	15.70%
2020	7	0	0.0%	14.41%

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

An effective population size of less than 100 (inbreeding rate of 0.50% per generation) leads to a dramatic increase in the rate of loss of genetic diversity in a breed/population (Food & Agriculture Organisation of the United Nations, "Monitoring animal genetic resources and criteria for prioritization of breeds", 1992).

An effective population size of below 50 (inbreeding rate of 1.0% per generation) indicates the future of the breed may be considered to be at risk (Food & Agriculture Organisation of the United Nations, "Breeding strategies for sustainable management of animal genetic resources", 2010).

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated 'random mating') over the period 1980-2014 are shown in Figure 12. Overall, the rate of observed inbreeding has increased during the period analysed, however there has been large amounts of fluctuation due to the small number of animals registered per year.

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://cgjournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4>.

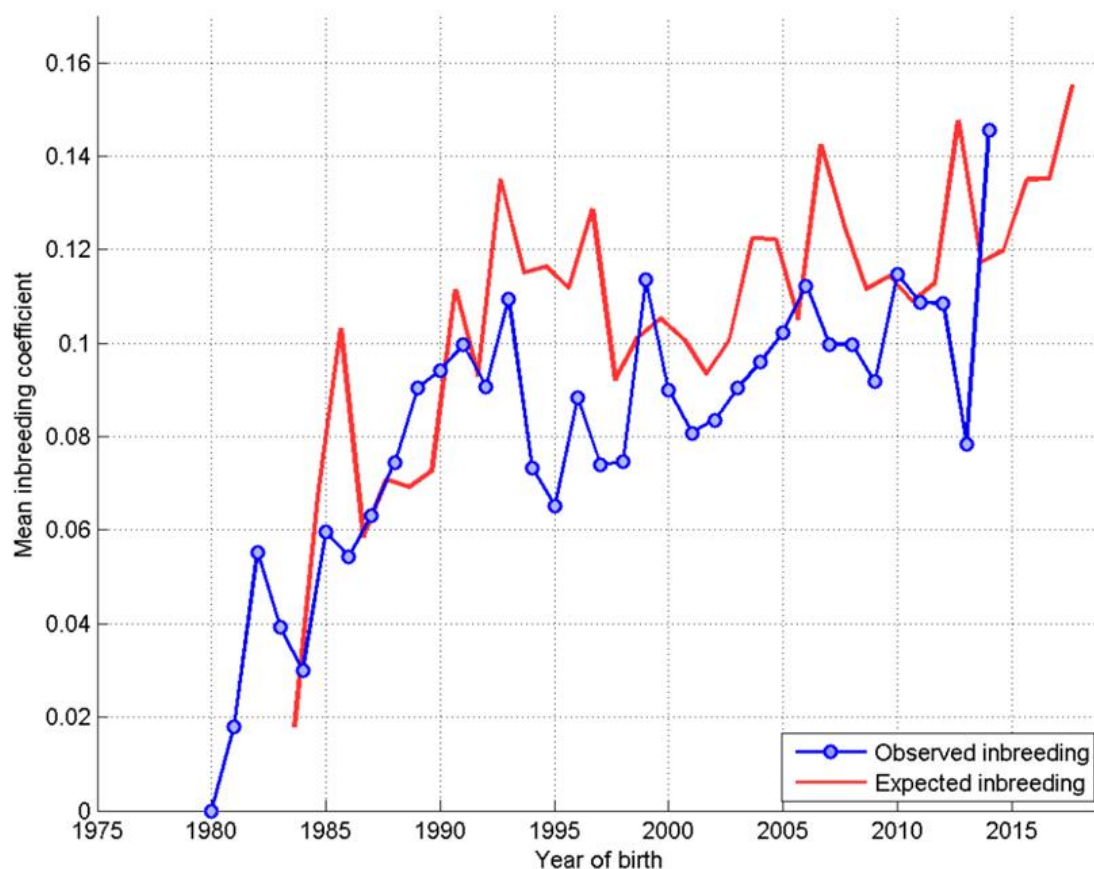


Figure 12: Annual mean observed and expected inbreeding coefficients.

The current annual breed average inbreeding coefficient is **8.6%**.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven 5-year blocks (Figure 13). 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). Throughout the period analysed, there is evidence of several popular sires being used, however this appears to be slightly more under control in recent years and it is acknowledged that this is difficult to avoid given the breed's small numbers.



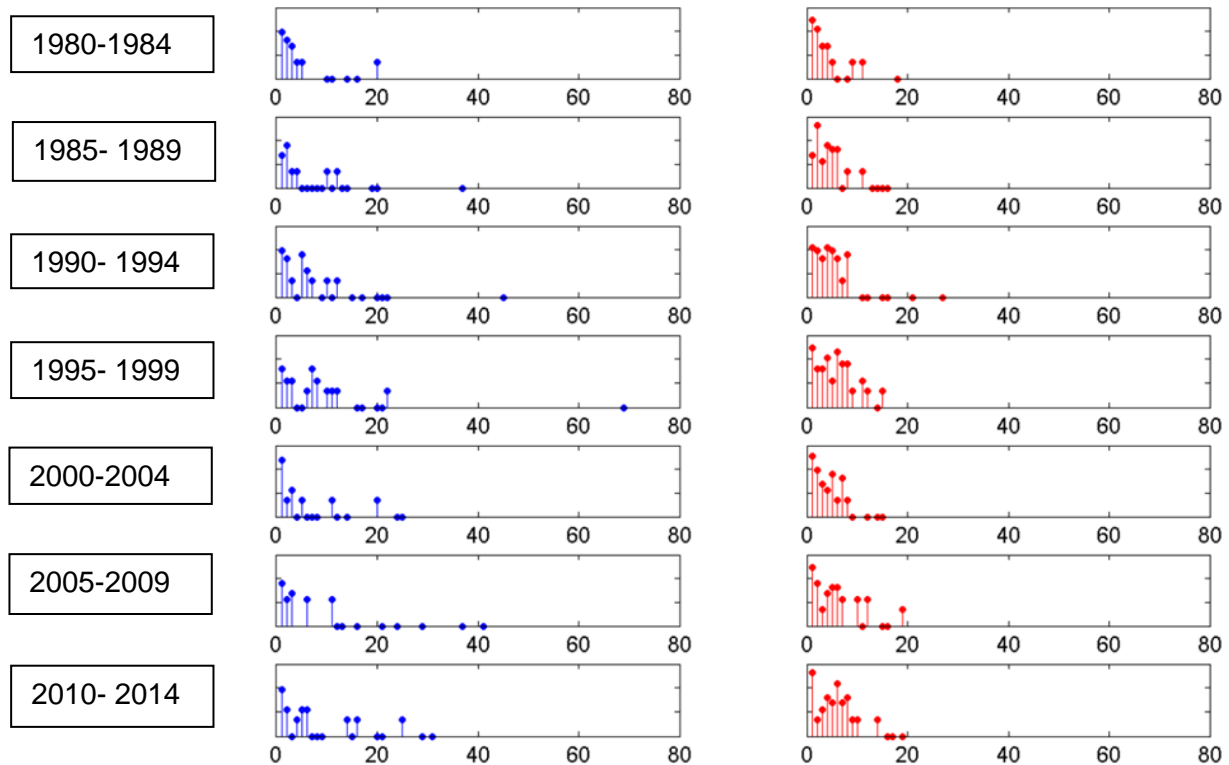


Figure 13: Distribution of the proportion of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-4 bottom). Vertical axis is a logarithmic scale

## CURRENT RESEARCH

The breed launched a Rolling Health Survey in January 2020.

Prior to the closure of the Animal Health Trust (AHT) samples were stored for the breed as part of DNA banking. It is hoped that this storage can continue now that the KC Genetics Centre team have moved to the University of Cambridge.

A new scoring scheme has been launched in Finland to determine the degree of elbow incongruity in chondrodysplastic (short-legged) breeds, including the Glen of Imaal (Pulkkinen et al, 2020). This in theory will allow breeders to determine any presence of PCDU (premature closure of the distal ulna) and secondary arthritis. The scheme is in its infancy and breeding advice is not yet available. The breeding database can be found below, as well as classification of grades under the scheme.

- <https://www.kennelliitto.fi/tietoa-meista/uutiset/olkanivelen-osteokondroosi-ja-matalaraajaisten-koirien-kyynarnivelen-inkongruenssilausuntojen-kirjaaminen-jalostustietojarjestelmaan-alkaa>
- <https://www.kennelliitto.fi/en/media/4637>

## PRIORITIES

Correspondence between the breed representatives and the Kennel Club was undertaken in September 2021 to discuss the evidence base of the BHCP and agree the priority issues for the health of the breed. The group agreed from the evidence base that the priorities for the Glen of Imaal Terrier were:

- PRA (crd3)
- Growth plate disorders/ PCDU

At watch:

- Allergies
- Genetic diversity
- Degenerative myelopathy
- Brown gene (locus B)



## **ACTION PLAN**

Following the 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 Glen of Imaal Terrier. Both partners are expected to begin to action these points prior to the next review.

### **Breed Club actions include:**

- The Breed Clubs to update the Kennel Club on findings from the rolling health survey, and the Kennel Club to share the link on the breed's A-Z page
- The Breed Clubs to continue to monitor the use of popular sires and raise awareness of the importance of considering genetic diversity when breeding
- The Breed Clubs to continue to encourage eye and DNA testing for PRA, and encourage the use of carriers to prevent further reduction in the breed's gene pool
- The Breed Clubs to consider putting forward a proposal for the addition of "excessively bowed legs" or "unsound movement" for Breed Watch to raise awareness of incorrect conformation
- The Breed Clubs to monitor the incidence of allergies in the breed
- The Breed Clubs and Kennel Club to monitor the uptake of the Finnish INC scheme and its relevance for determining elbow incongruity in the breed and providing breeding advice

### **Kennel Club actions include:**

- The Kennel Club to update the population analysis
- The Kennel Club to produce a piece on the importance of considering genetic diversity and popular sires when breeding, specifically for numerically small breeds
- The Kennel Club to assist the breed in the relevance of other DNA tests available for the breed and whether there is benefit in formally recognising these
- The Kennel Club to monitor research projects and findings with respect to allergies and skin complaints

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