

Summary of Kennel Club Breed Records: Pug 2020

**Author: Cassandra Smith
cassandrasmith.dogs@gmail.com**

Breeding and health testing may have been impacted by the ongoing COVID-19 pandemic

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Methods

Information on pug litters registered by the Kennel Club in 2020 was retrieved from the toy group breed record supplements AX1 – AX4. This included information on the sire and dam of the litter, the date of birth of the litter, the number and colour of the registered puppies, any Caesarean section information (elective or emergency), artificial insemination information, and Kennel Club Assured Breeder (KCAB) information.

Further information was gathered from the Kennel Club database, including: the sex of the puppies, the date of birth of the sire and dam, the grandparents of the litter, the registered coat colour of the parents and grandparents, the coefficient of inbreeding for the litter, the litter count and date of the first litter, and Pug Dog Encephalitis (PDE) DNA testing, Respiratory Function Grading (RFG) testing, eye testing & hip testing results for the parents. For tests which can be repeated, the latest test prior to the birth of the litter was recorded.

Most sections in this summary document classify pug litters as one of two types:

1. Standard colour litters:
 - Litter consists of only standard coloured puppies,
 - Both parents of the litter are a standard colour,
 - All grandparents of the litter are a standard colour.
2. NBS (Non-Breed Standard) colour litters:
 - Any litters with off-standard coloured puppies, parents and/or grandparents.

Dogs with RFG test grades registered in 2020 are similarly classified into NBS and standard colour, looking two generations back for NBS heritage.

The standard colours as currently defined by the Kennel Club are: Fawn With Black Mask, Apricot With Black Mask, Silver With Black Mask, and Black.

Some dogs are registered under an incorrect colour – either as a standard colour when they should be NBS, or vice versa. These were identified by looking at the results of a Google search using the search phrase: “<Registered Name> Pug”. Where there was evidence of this, the corrected colour has been used. Corrections are listed in Appendix I.

Additional health testing results were also retrieved from the results of this search where available. These are listed in Appendix II.

Parents’ results from the two pug health schemes were retrieved from the following:

- <https://www.pughealth.org.uk/wp-content/uploads/2019/12/FiveStarAwardWinners.pdf>
- <https://secureservercdn.net/160.153.138.177/npk.fb8.myftpupload.com/wp-content/uploads/2019/11/November-Health-Results-2019.pdf>

Where a dog had results in both, the achievement with the highest testing criteria was used.

Data summarisation was carried out using Microsoft Excel and RStudio.

Standard Colour: Litter Summary

638 standard colour pug litters were registered with the KC in 2020, consisting of 2,576 puppies. 48.2% (1,241) were dogs and 51.8% (1,335) were bitches.

The most common puppy coat colour was Fawn (51.0%). *Figure 1* shows the breakdown of puppy coat colours in these litters.

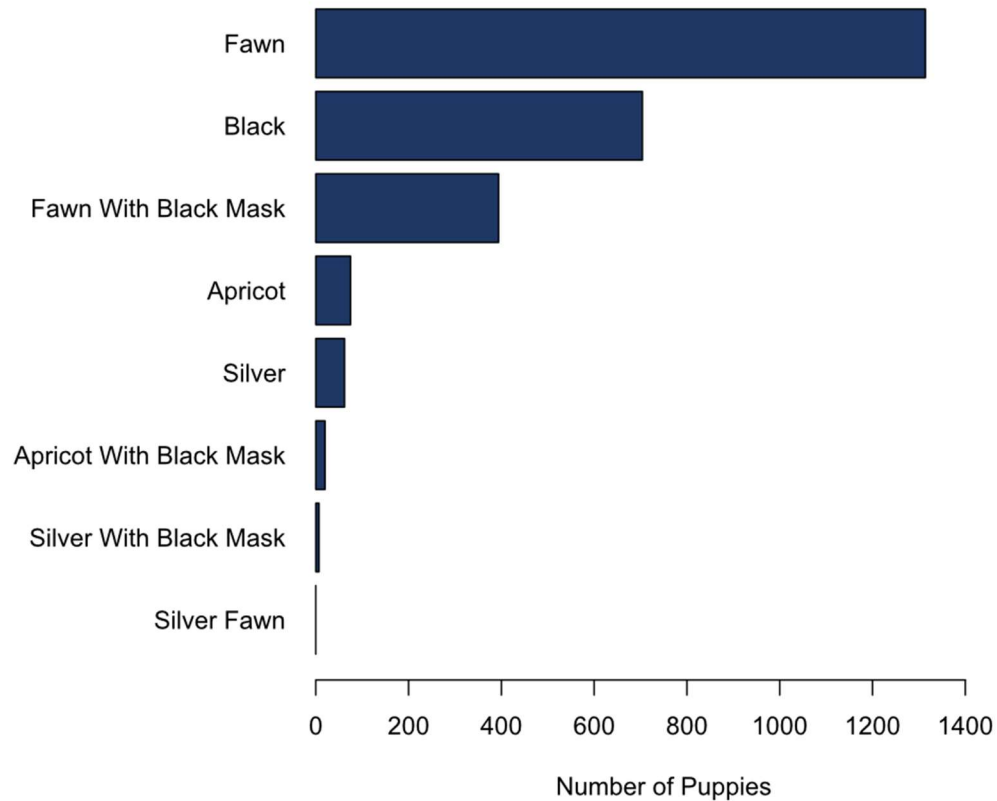


Figure 1. Coat colour of puppies from standard colour litters (n=2,576)

NBS: Litter Summary

733 NBS pug litters were registered with the KC in 2020, consisting of 3,429 puppies. 50.1% (1,717) were dogs and 49.9% (1,712) were bitches.

The most common puppy coat colour was Fawn (33.1%). *Figure 2* shows the breakdown of puppy coat colours in these litters.

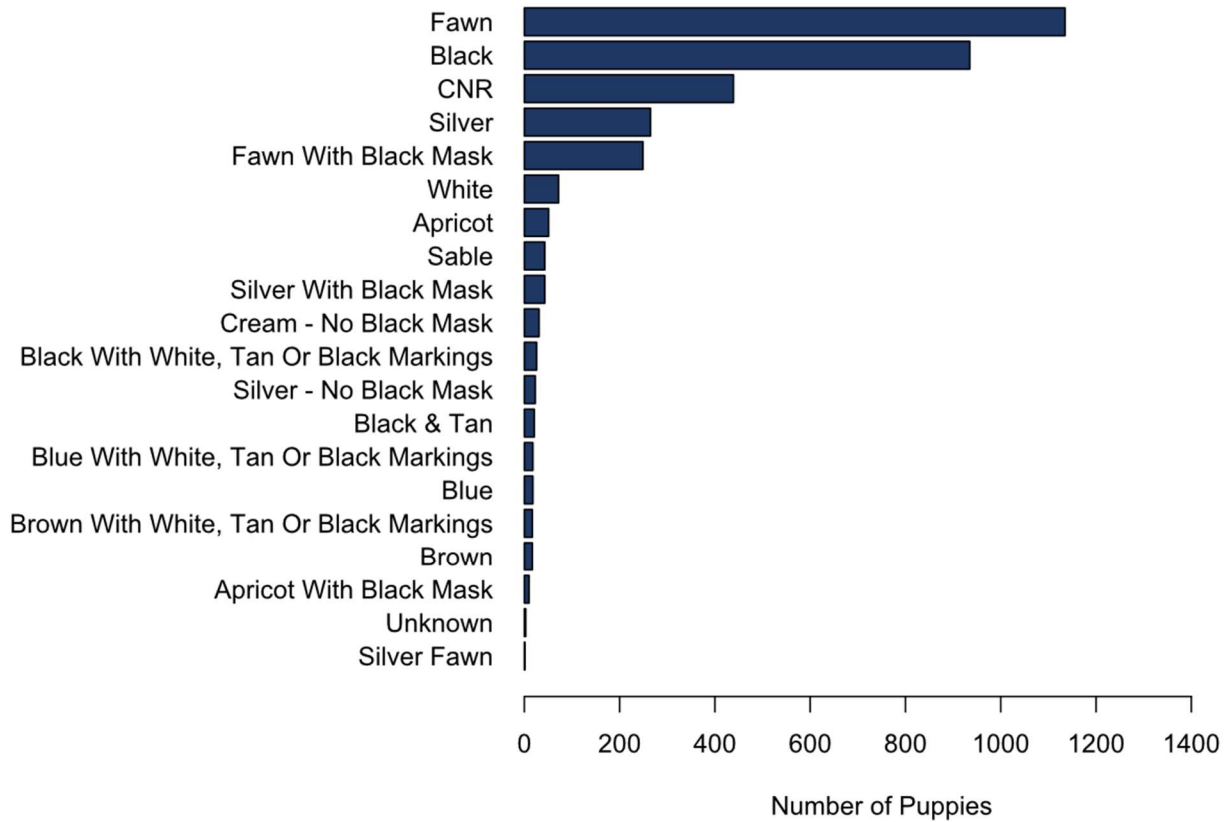


Figure 2. Coat colour of puppies from NBS litters (n=3,429). CNR = Colour Not Recognised.

Standard Colour: Litter Size

The mean number of puppies in standard colour litters was 4, whilst the median was also 4. The distribution of puppy numbers per litter is shown in *Figure 3*.

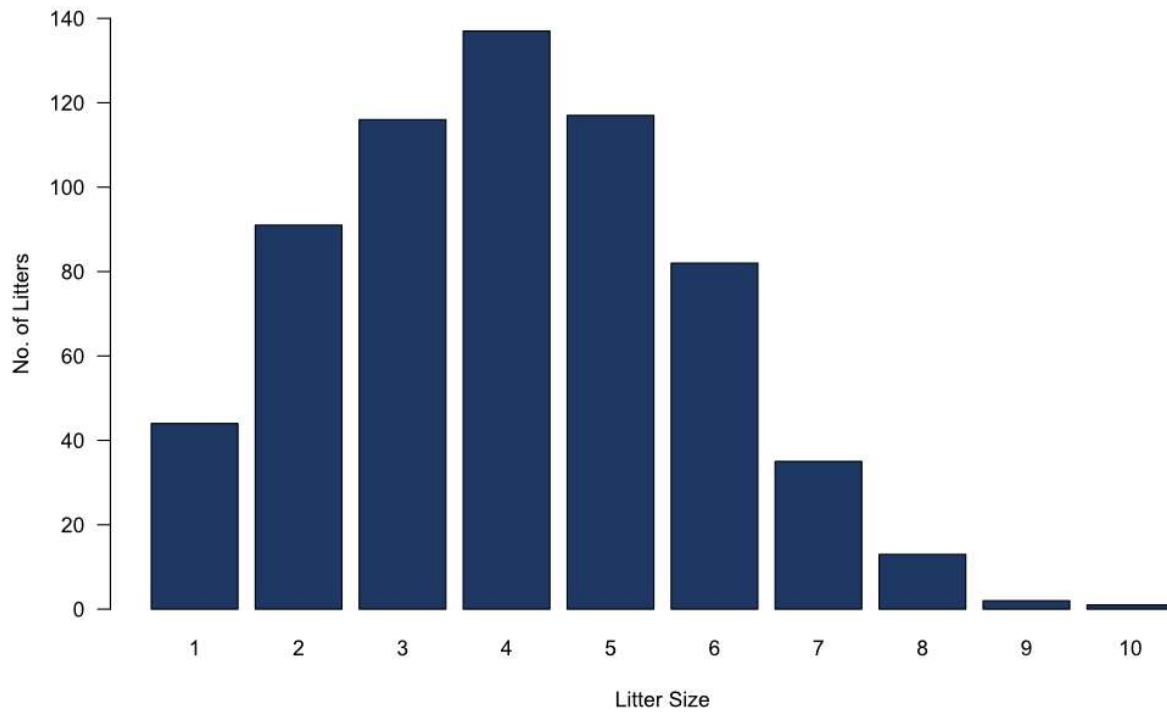


Figure 3. Litter size of standard colour litters (n=638)

NBS: Litter Size

The mean number of puppies in NBS litters was 4.7, whilst the median was 5. The distribution of puppy numbers per litter is shown in *Figure 4*.

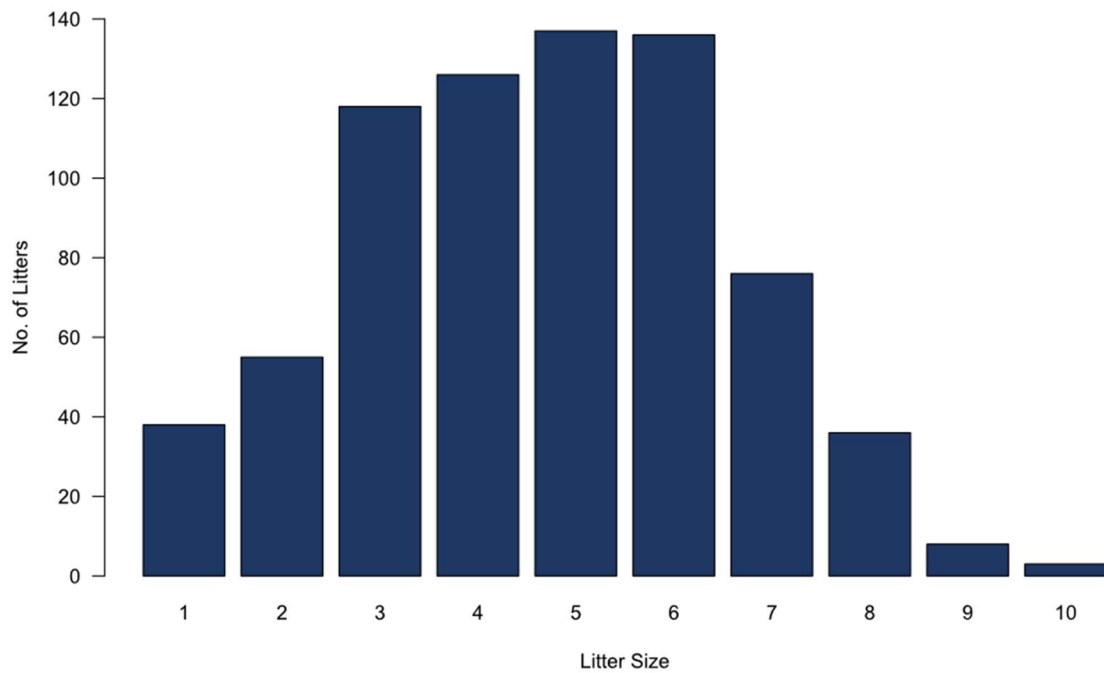


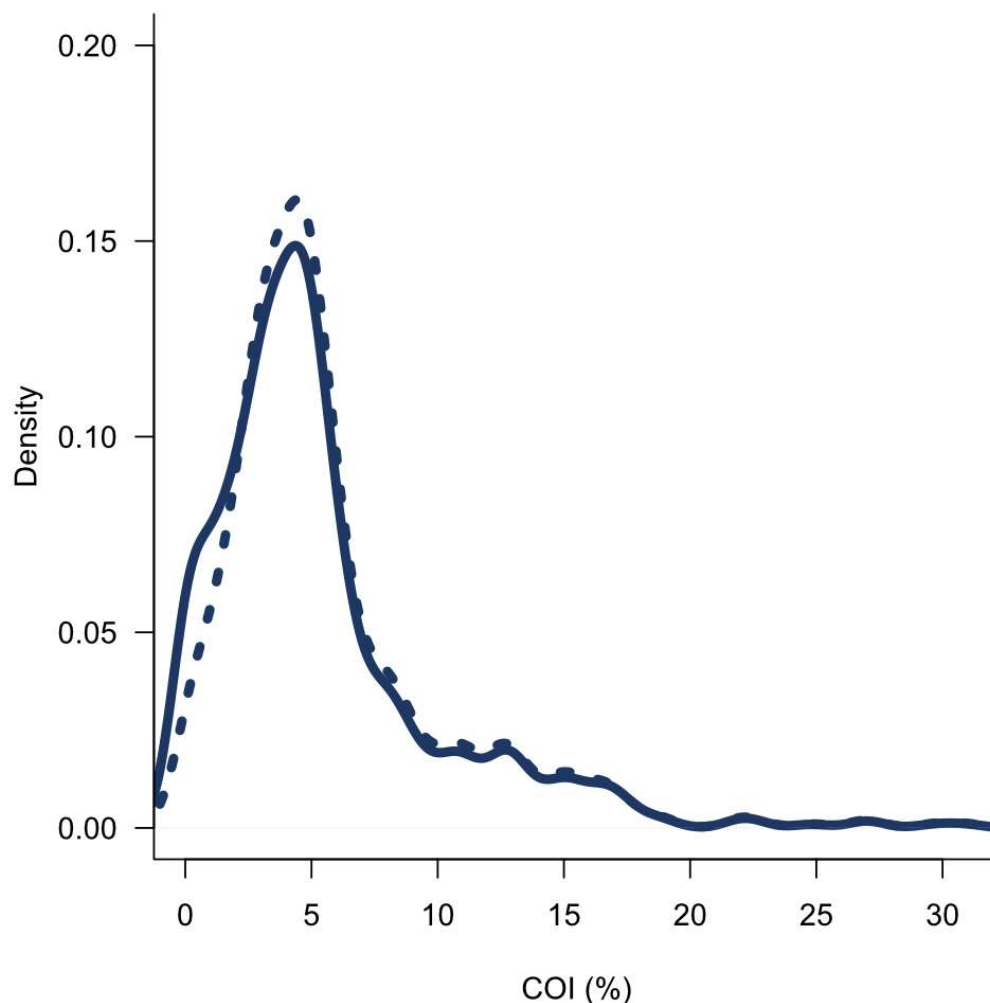
Figure 4. Litter size of NBS litters (n=733)

Standard Colour: Coefficient of Inbreeding

The coefficient of inbreeding (COI) is a measure of estimated inbreeding, expressed as a percentage probability of the same variation being inherited from the sire and the dam. A lower percentage indicates a lower estimated level of inbreeding.

The Kennel Club calculates the COI for each dog using all generations in their database.

The mean COI for these litters was 5.4% and the median COI was 4.4%. The median number of complete generations in this calculation was 7 (range 4 – 10), with at least part of the pedigree extending back a median of 33 generations (range 9 – 37). The solid line in *Figure 5* shows the distribution of COI percentages for these litters.



*Figure 5. Distribution of COI percentages for standard colour litters
solid line = all litters (n=638); dotted line = litters with no imported parents (n=573)*

The highest recorded COI was 30.9%, and 4 litters were recorded with a COI over 25% (the equivalent of a parent/child or brother/sister mating). 479 (75.1%) litters had a calculated COI under 6.5%.

One limitation of the COI calculation is that a reduced number of available generations in a pedigree decreases how informative the calculation may be. For imported dogs, the Kennel Club database may only contain three generations.

Removing litters with one or more imported parents, the mean COI for these litters was 5.9% and the median COI was 4.7%. The median number of complete generations in this calculation was 7 (range 5 – 10), with at least part of the pedigree extending back a median of 33 generations (range 27 – 37). The dotted line in *Figure 5* shows the distribution of COI percentages for these litters.

Figure 6 shows the distribution of litter COIs by the number of complete generations included in the COI calculation.

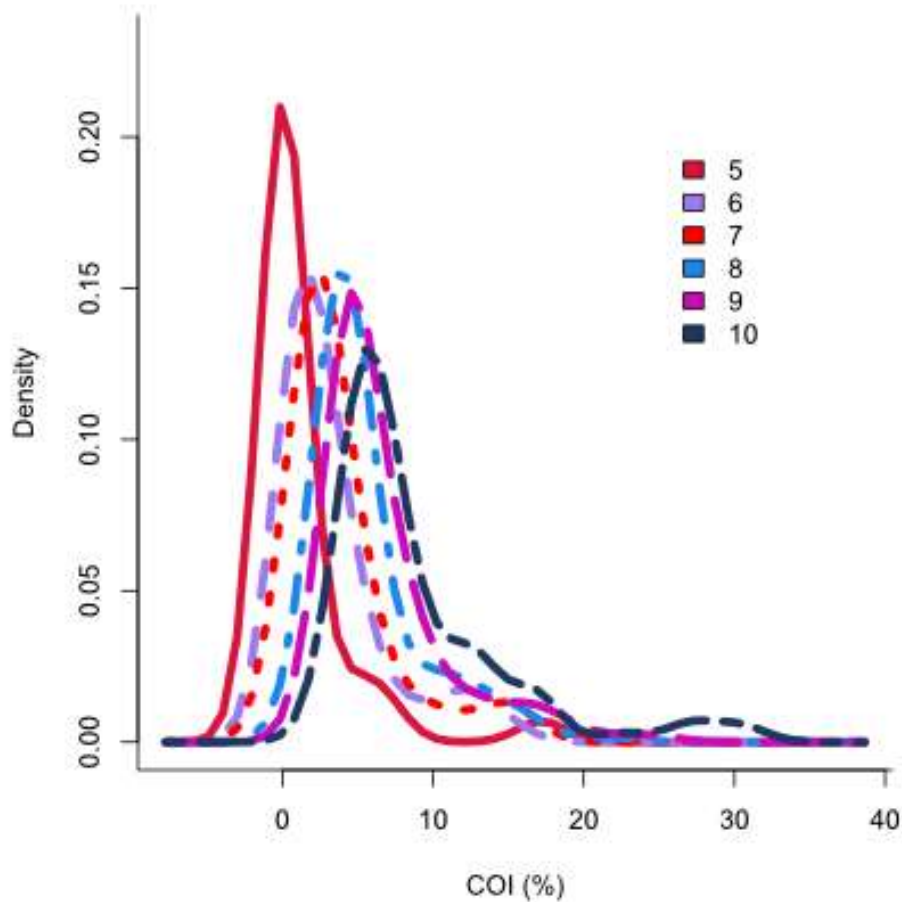
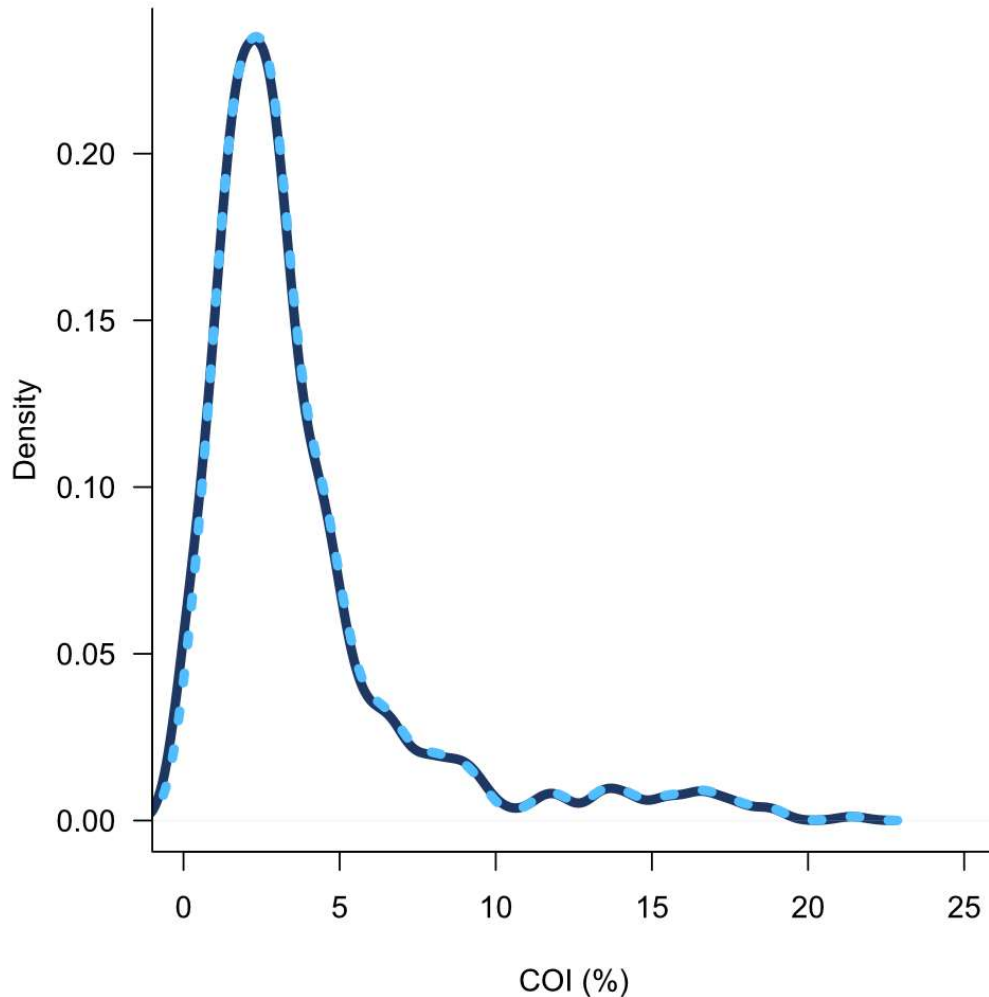


Figure 6 . Distribution of COI percentages for standard colour litters by complete generations

NBS: Coefficient of Inbreeding

The mean COI for these litters was 3.7% and the median COI was 2.7%. The median number of complete generations in this calculation was 6 (range 3 – 35), with at least part of the pedigree extending back a median of 34 generations (range 11 – 37). *Figure 7* shows the distribution of COI percentages for these litters.



*Figure 7. Distribution of COI percentages for NBS litters
solid line = all litters (n=733); dotted line = litters with no imported parents (n=703)*

The highest recorded COI was 21.4%, and no litters were recorded with a COI over 25% (the equivalent of a parent/child or brother/sister mating). 635 (86.6%) litters had a calculated COI under 6.5%.

Removing litters with one or more imported parents, the mean COI for these litters was 3.8% and the median COI was 2.8%. The median number of complete generations in this calculation was 6 (range 3 – 11), with at least part of the pedigree extending back a median of 34 generations (range 27 – 37). The dotted line in *Figure 7* shows the distribution of COI percentages for these litters.

Standard Colour: Caesarean Sections & AI

10.7% of these litters were delivered by a reported Caesarean section (C-section). Of those litters where natural birth is presumed to have been attempted (i.e., excluding elective C-sections), 7.5% of litters were reported to be delivered by emergency C-section.

Figure 8 shows the proportion of litters reported to have been delivered by C-sections.

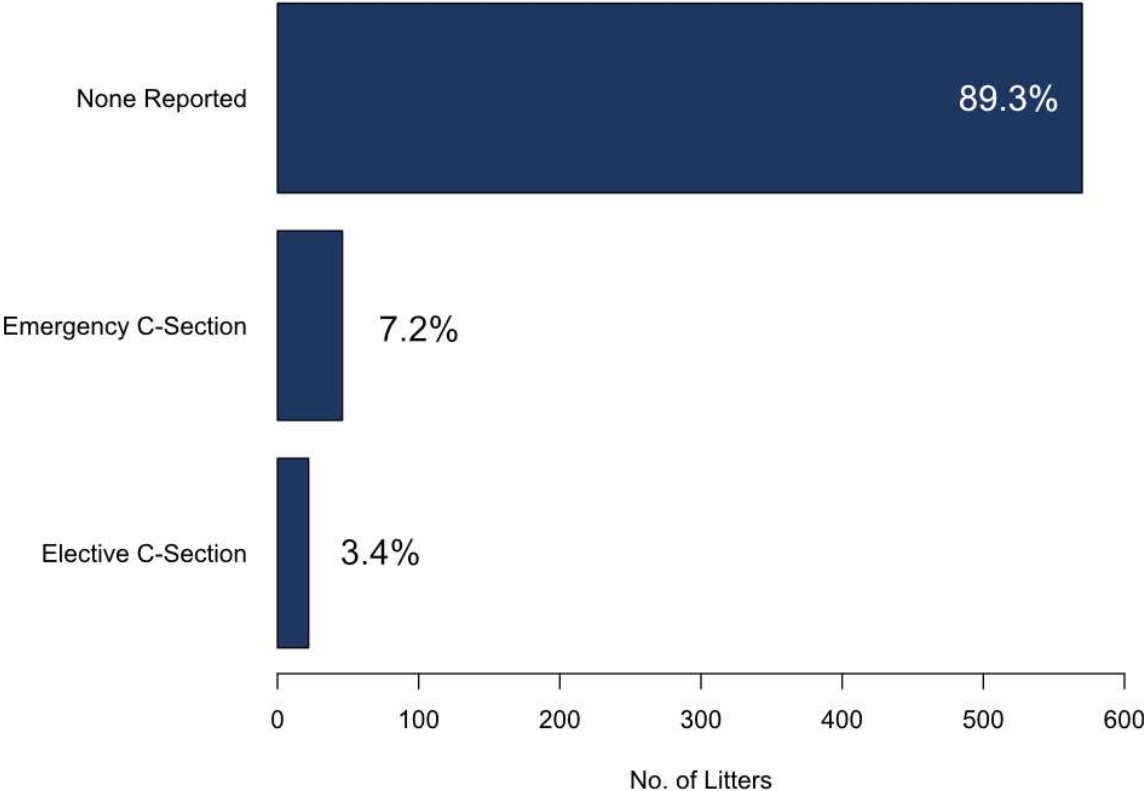


Figure 8. Reported Caesarean section information for standard colour litters (n=638)

No litters were reported to have been conceived by artificial insemination (AI).

NBS: Caesarean Sections & AI

8.5% of these litters were delivered by a reported Caesarean section (C-section). Of those litters where natural birth is presumed to have been attempted (i.e., excluding elective C-sections), 5.6% of litters were reported to be delivered by emergency C-section.

Figure 9 shows the proportion of litters reported to have been delivered by C-sections.

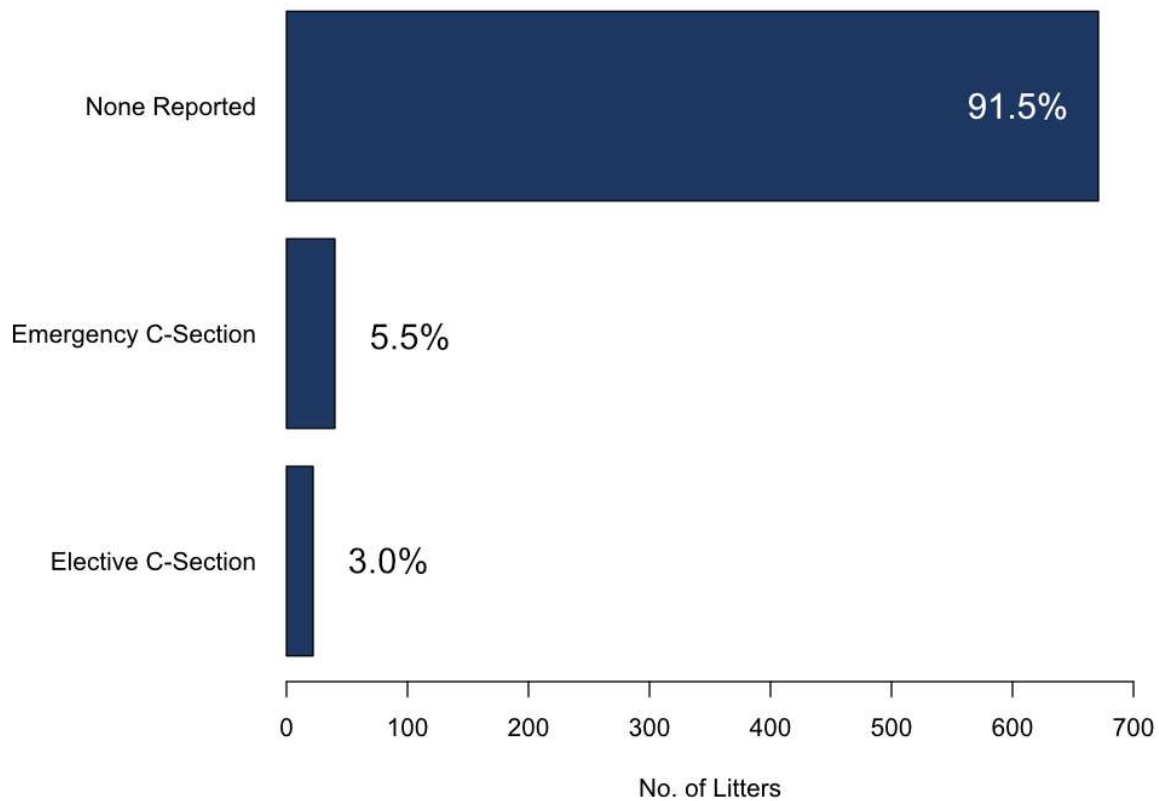


Figure 9. Reported Caesarean section information for NBS litters (n=733)

One litter was reported to have been conceived by artificial insemination (AI).

Standard Colour: Parents

The 638 standard colour pug litters were produced by 349 different sires and 630 different dams, a ratio of 1.8 dams for every sire.

26 of the sires are imports from other countries, whilst 20 of the dams are the same (*Table 1*).

Table 1. Origin of foreign and imported parents of standard colour litters

Country of Origin	No. of Sires	No. of Dams
Belarus	0	1
Germany	1	0
Hungary	2	0
Ireland	5	4
Italy	3	1
Lithuania	0	5
Montenegro	1	0
Norway	2	2
Poland	2	5
Russia	6	0
Ukraine	4	2

NBS: Parents

The 733 NBS pug litters were produced by 361 different sires and 706 different dams, a ratio of 2 dams for every sire.

14 of the sires are imports from other countries, whilst 2 of the dams are the same (*Table 2*).

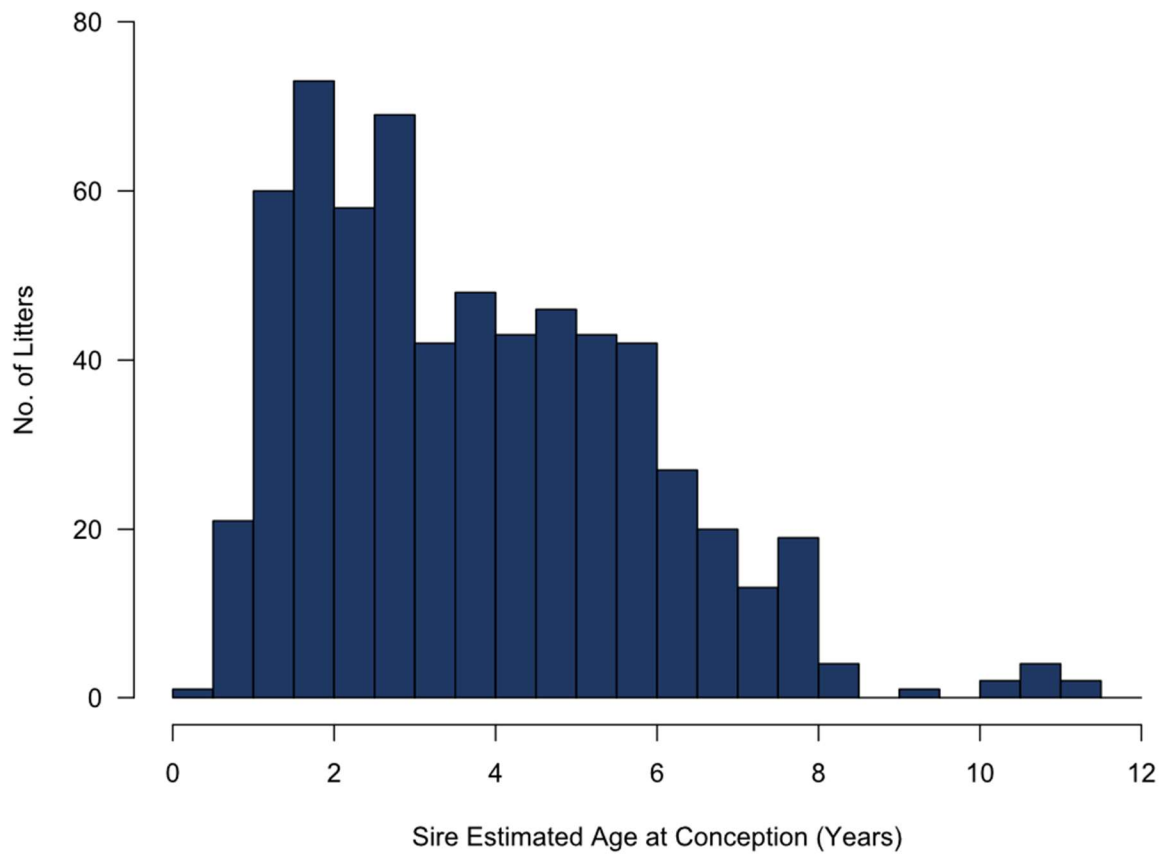
Table 2. Origin of foreign and imported parents of NBS litters

Country of Origin	No. of Sires	No. of Dams
Belarus	1	0
Canada	1	0
Hungary	1	0
Ireland	4	2
Italy	1	0
Russia	1	0
Serbia	1	0
Ukraine	1	0
USA	3	0

Standard Colour: Sire Age

The mean age of sires at the birth of these litters was 3.93 years, whilst the median age was 2.19 years. The maximum age of sire at birth of a litter was 11.30 years, whilst the minimum was 0.65 years.

Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of sires at conception of the litter is 3.76 years, whilst the median age is 2.02 years. Under the same assumption, 155 litters (24.3%) are predicted to have been conceived when the sire was under 2 years of age. *Figure 10* shows the distribution of the estimated age of sires at the conception of the litters.



*Figure 10. Estimated sire age at conception of standard colour litters (n=638)
estimated age at conception = age at birth of litter – 0.17*

112 litters were registered from first-time sires, excluding foreign dogs and imports as they are more likely to have sired a litter abroad, potentially prior to any Kennel Club registered litter. Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of first-time sires at conception of the litter was 2.35 years, whilst the median age was 1.67 years. The maximum age of sire at estimated conception of a litter was 9.43 years, whilst the minimum was 0.48 years.

Figure 11 shows the distribution of the estimated age of first-time sires at the conception of the litters.

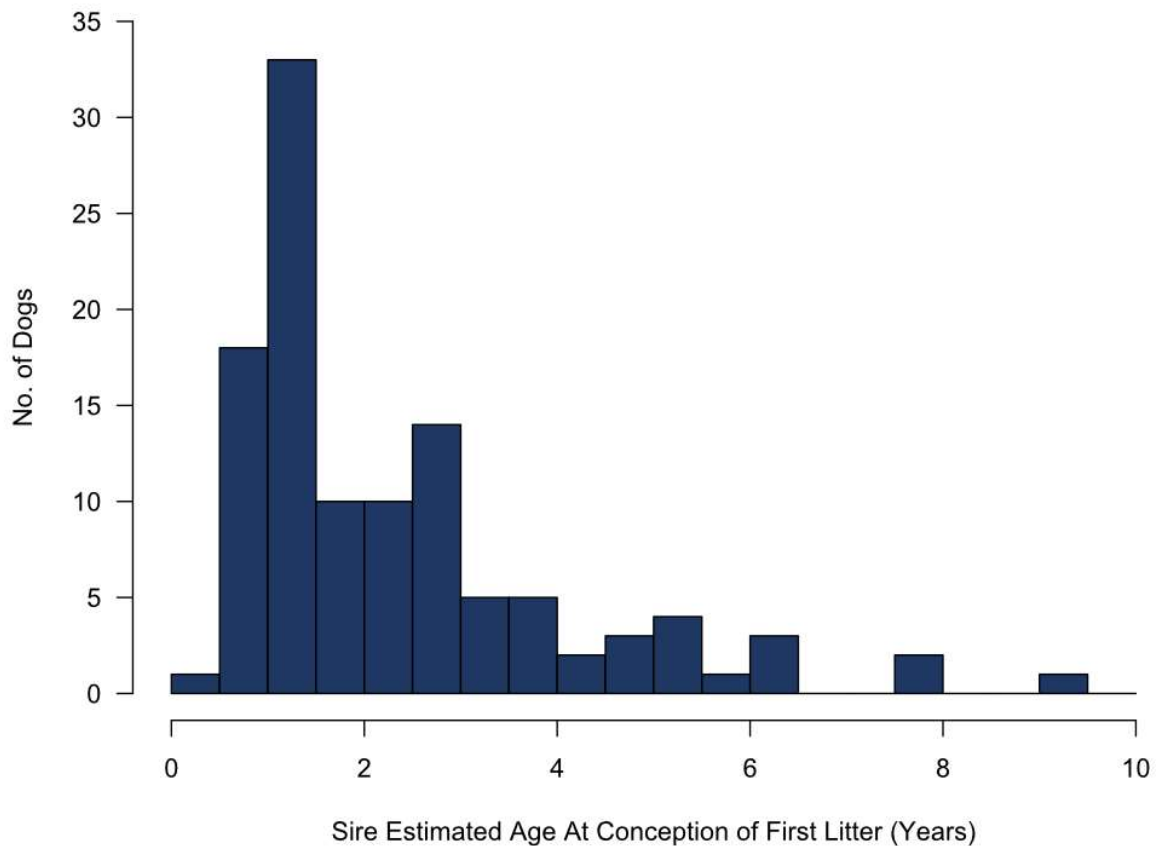
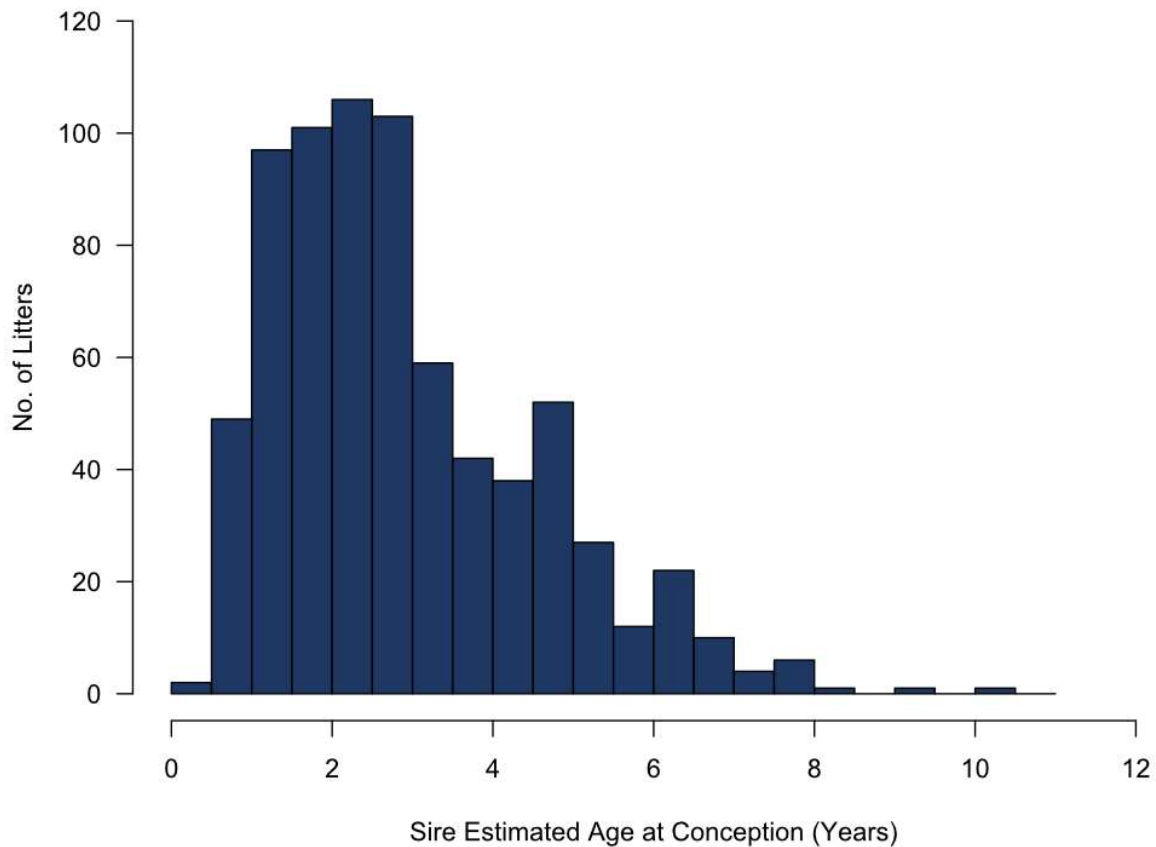


Figure 11. Estimated age at time of conception of first-time sires of standard colour litters, excluding foreign dogs (n=112); estimated age at conception = age at birth of litter – 0.17

NBS: Sire Age

The mean age of sires at the birth of these litters was 3.10 years, whilst the median age was 2.74 years. The maximum age of a sire at birth of a litter was 10.65 years, whilst the minimum was 0.54 years.

Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of sires at conception of the litter is 2.93 years, whilst the median age is 2.57 years. Under the same assumption, 249 litters (34.0%) are predicted to have been conceived when the sire was under 2 years of age. *Figure 12* shows the distribution of the estimated age of sires at the conception of the litters.



*Figure 12. Estimated sire age at conception of NBS litters (n=733)
estimated age at conception = age at birth of litter – 0.17*

144 litters were registered from first-time sires, excluding foreign dogs and imports as they are more likely to have sired a litter abroad, potentially prior to any Kennel Club registered litter. Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of first-time sires at conception of the litter was 1.98 years, whilst the median age was 1.56 years. The maximum age of a sire at estimated conception of a litter was 8.02 years, whilst the minimum was 0.37 years.

Figure 13 shows the distribution of the estimated age of first-time sires at the conception of the litters.

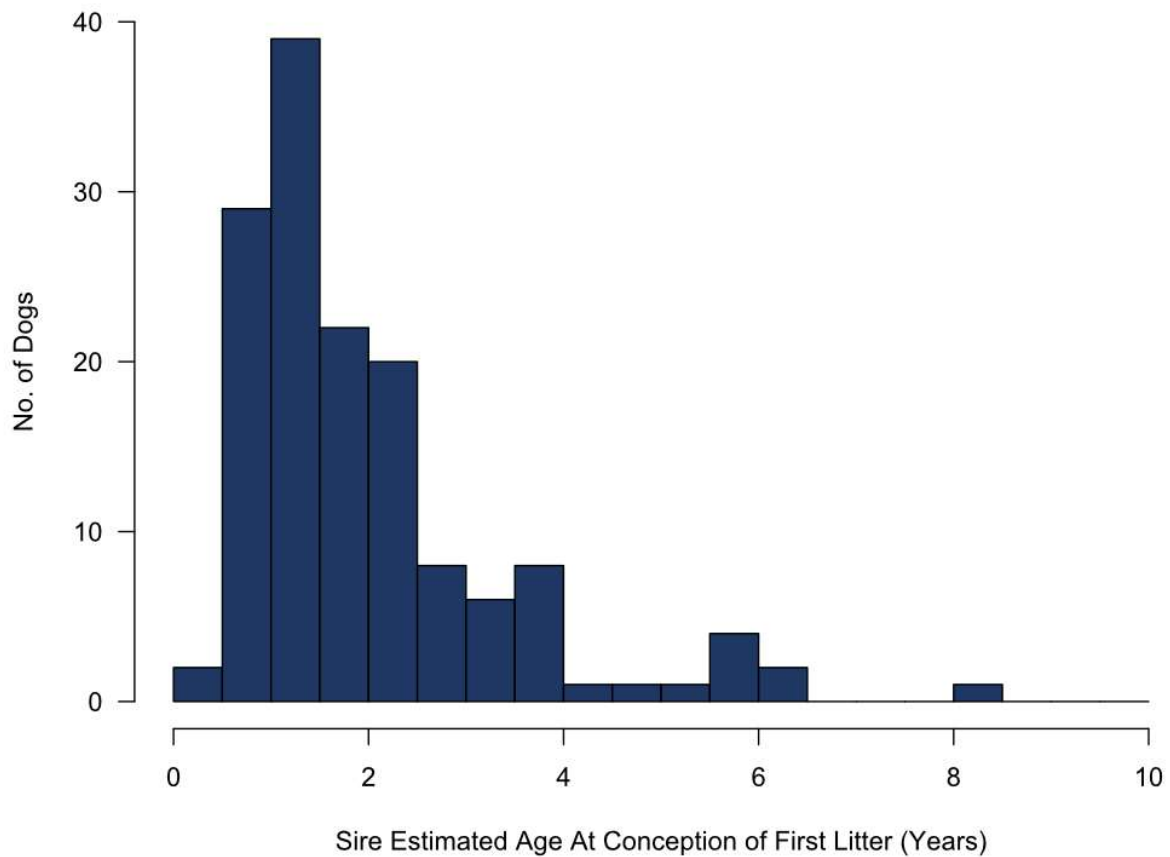
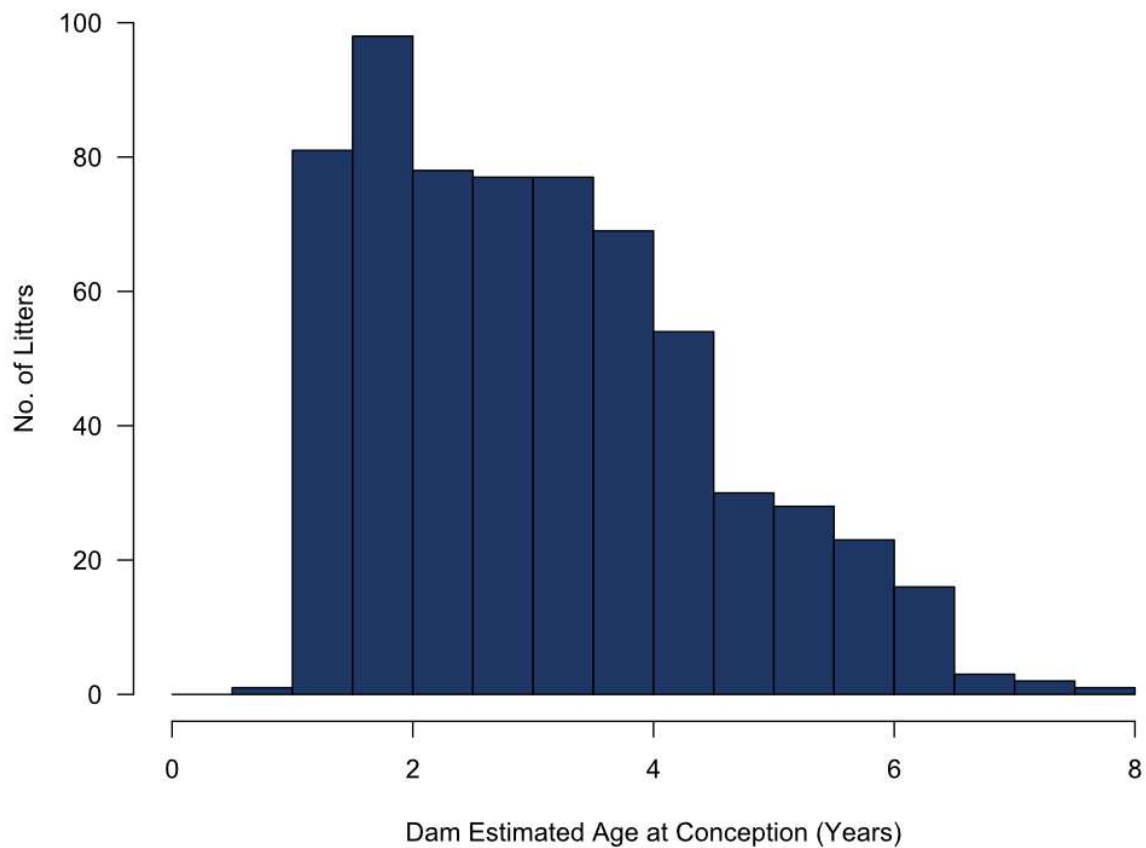


Figure 13. Estimated age at time of conception of first-time sires of NBS litters, excluding foreign dogs (n=144); estimated age at conception = age at birth of litter – 0.17

Standard Colour: Dam Age

The mean age of dams at the birth of these litters was 3.25 years, whilst the median age was 3.07 years. The maximum age of a dam at birth of a litter was 7.95 years, whilst the minimum was 1.17 years.

Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of dams at conception of the litter is 3.08 years, whilst the median age is 2.90 years. Under the same assumption, 180 litters (28.2%) are predicted to have been conceived when the dam was under 2 years of age. *Figure 14* shows the distribution of the estimated age of dams at the conception of the litters.



*Figure 14. Estimated dam age at conception of standard colour litters (n=638)
estimated age at conception = age at birth of litter – 0.17*

352 litters were registered from first-time dams, excluding foreign dogs and imports as they are more likely to have birthed a litter abroad. Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of first-time dams at conception of the litter was 2.34 years, whilst the median age was 2.01 years. The maximum age of the dams at estimated conception of a litter was 6.63 years, whilst the minimum was 1.00 years.

Figure 15 shows the distribution of the estimated age of first-time sires at the conception of the litters.

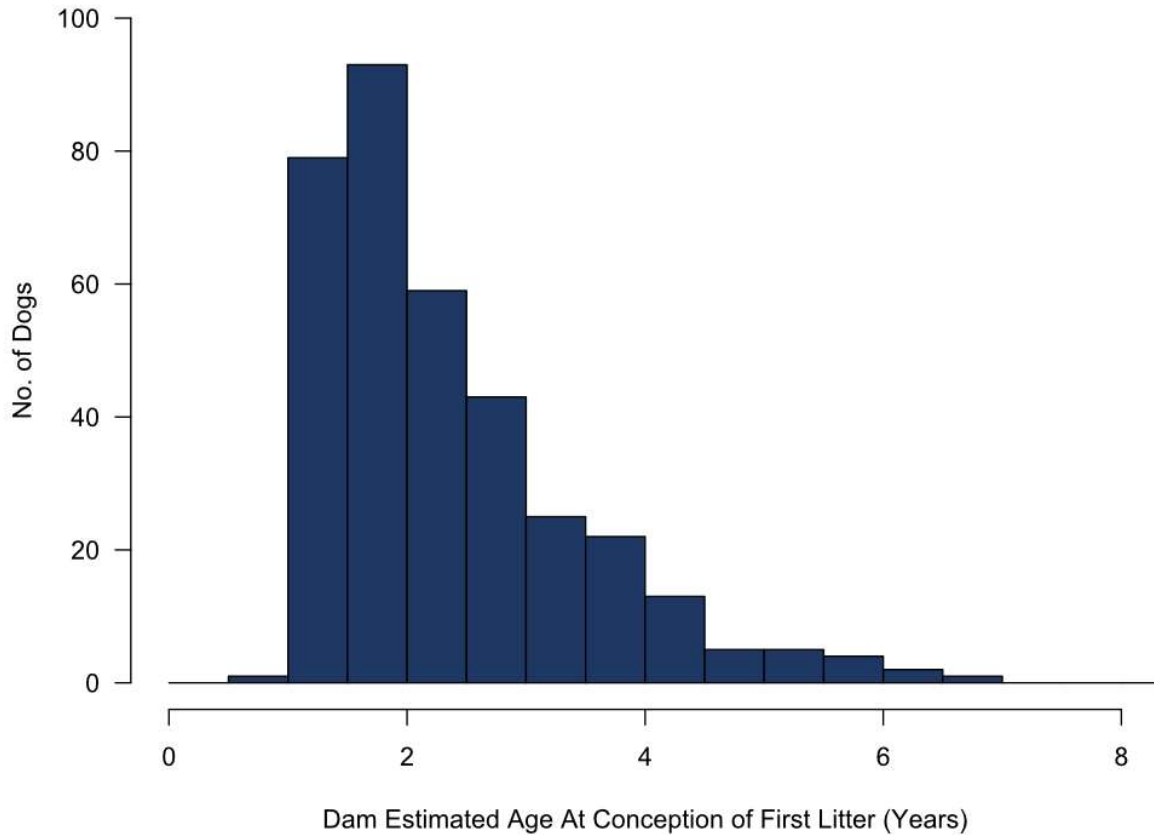
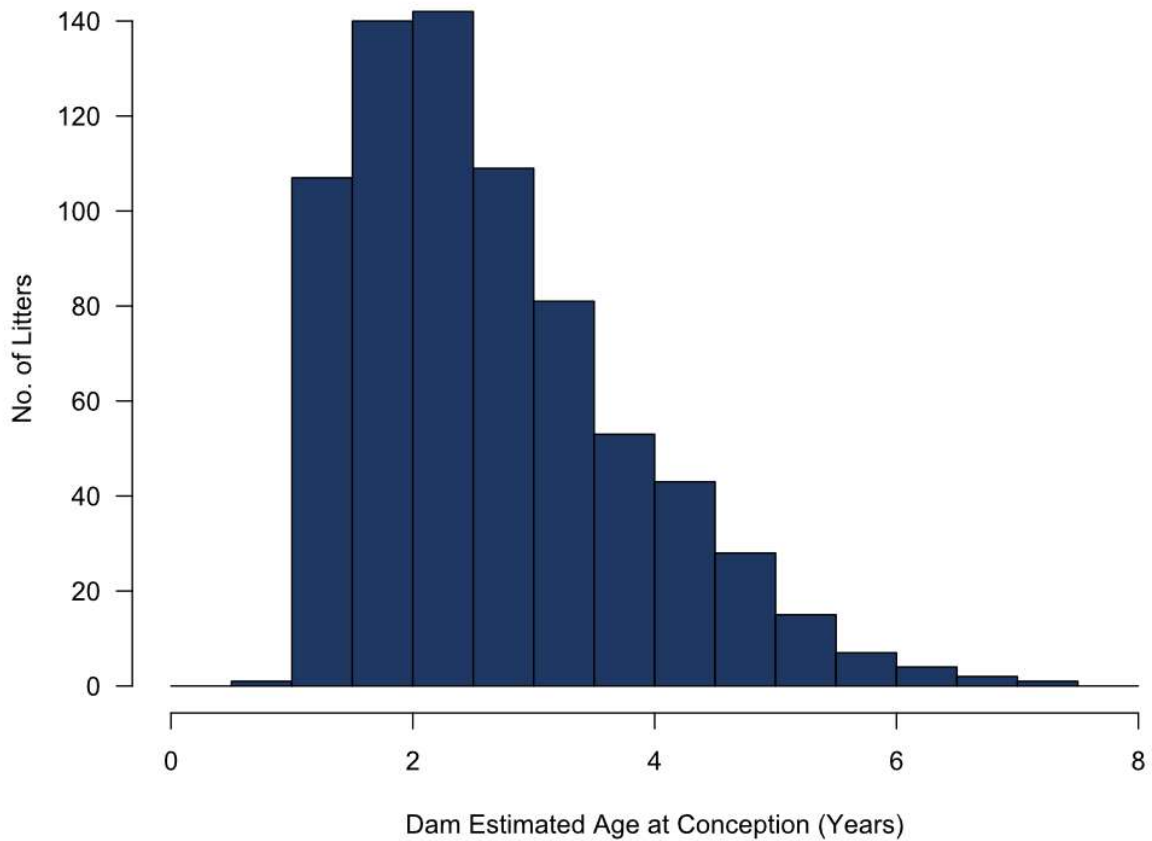


Figure 15 Estimated age at time of conception of first-time dams of standard colour litters, excluding foreign dogs (n=352); estimated age at conception = age at birth of litter – 0.17

NBS: Dam Age

The mean age of dams at the birth of these litters was 2.82 years, whilst the median age was 2.61 years. The maximum age of dams at birth of a litter was 7.53 years, whilst the minimum was 1.16 years.

Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of dams at conception of the litter is 2.65 years, whilst the median age is 2.44 years. Under the same assumption, 248 litters (33.8%) are predicted to have been conceived when the dam was under 2 years of age. *Figure 16* shows the distribution of the estimated age of dams at the conception of the litters.



*Figure 16 Estimated dam age at conception of NBS litters (n=733)
estimated age at conception = age at birth of litter – 0.17*

464 litters were registered from first-time dams, excluding foreign dogs and imports as they are more likely to have birthed a litter abroad. Assuming a gestation time of approximately 60 days (or 0.17 years), the predicted mean age of first-time dams at conception of the litter was 2.23 years, whilst the median age was 2.01 years. The maximum age of dams at estimated conception of a litter was 7.36 years, whilst the minimum was 0.99 years.

Figure 17 shows the distribution of the estimated age of first-time dams at the conception of the litters.

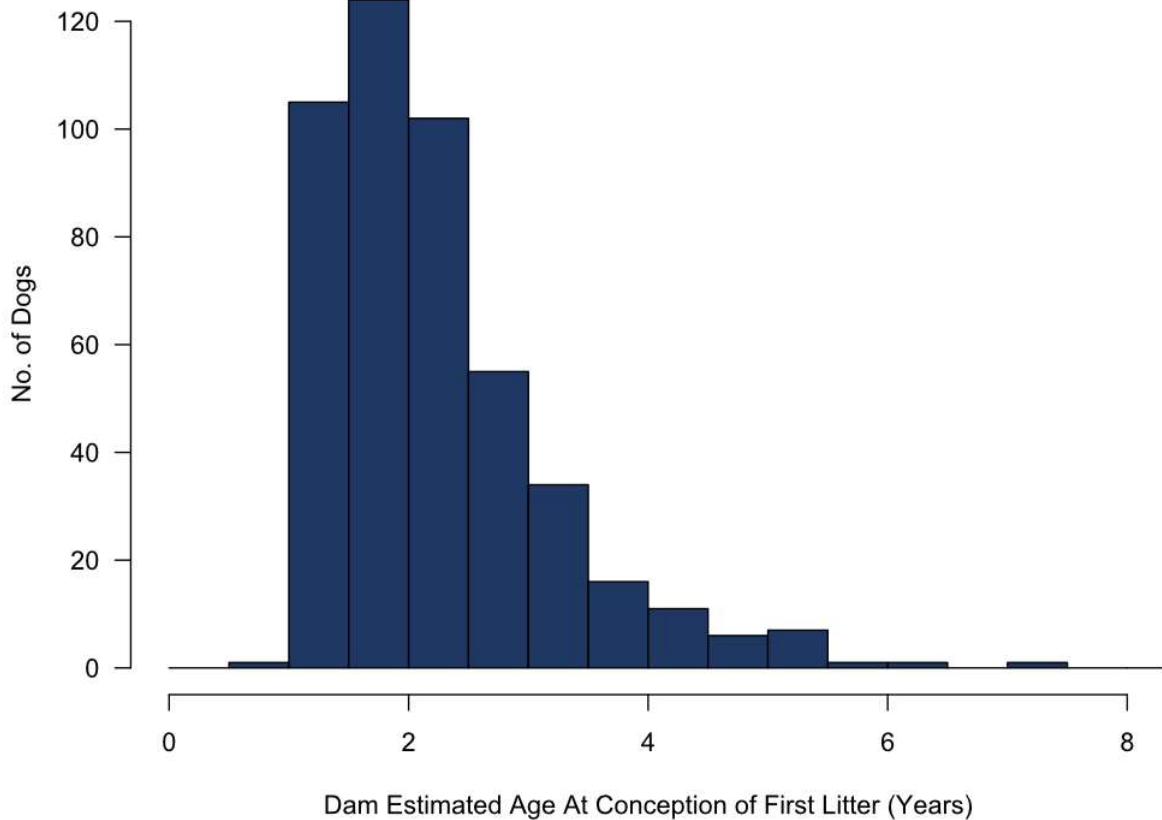


Figure 17 Estimated age at time of conception of first-time dams of NBS litters, excluding foreign dogs (n=464); estimated age at conception = age at birth of litter – 0.17

Popular Sires

Table 3 lists sires with ten or more litters registered in 2020.

Table 3 Sires with ten or more litters registered in 2020.

Registered Name	No. 2020 Litters	Standard Litters	NBS Litters
Bright Brilliant Ikaros	17	9	8
Changing Of The Colours	17	5	12
Brucey Bogs With Budarthur	15	11	4
Many Roads Travelled Hermes For Mathewsstaff	14	0	14
Mr Banderas	14	0	14
Kensteen Flashy	13	0	13
Paradiz Ronado Dream Maker-FV At Melharco	13	11	2
Kenaiteen Head Over Heels	12	2	10
Top Gun	12	0	12
Kenquince Half Pint At Glasstown	10	9	1
Kind Edward Jacket Potato With Headcandy	10	6	4
Roxmarr Napoleon	10	10	0

Table 4 lists the ten sires with at least one 2020 litter, with the highest number of total registered litters (up to the last litter registered in 2020).

Table 4. Sires with the most total litters to the end of 2020

Registered Name	Total Litters
Britishglory Captain Jack	132
Pearlysioux On Broadway	94
Changing Of The Colours	76
Bell Tyson Kawasaki King	66
Many Roads Travelled Hermes For Mathewsstaff	66
Penny Lanes Lad	63
Ruuicha Special News	54
Paradiz Ronado Dream Maker-FV At Melharco	54
Super Stanley Of Clairants	50
Roxmarr Midnight Express To Headcandy	49

Health Testing

The Kennel Club currently recommends pug breeders use the following schemes and tests:

Priority:

- Respiratory Function Grading (RFG) scheme,

Important:

- Hemivertebrae checked by x-ray of dog over 12 months of age
- Patella testing
- Participation in one of the pug health schemes (Five Star health scheme or National Pug Health scheme)
- Risk-based DNA test for pug dog encephalitis (PDE),
- Check COI.

Kennel Club Assured Breeders (KCAB) must currently use the RFG scheme to test their breeding dogs. This requirement was introduced in November of 2019, with a six-month grace period, so not all litters from KCAB breeders in the 2020 breed record supplements had to hit this requirement.

62 standard colour litters and 5 NBS litters were produced under the KCAB scheme.

Standard Colour: PDE Risk-Based DNA Testing

Pug Dog Encephalitis (PDE) is a progressive disease caused by inflammation of the brain, which is usually fatal. Symptoms can include seizures, impaired movement, and blindness.

PDE in pugs is believed to be recessively inherited, but other factors influence the development of this condition. This means if at least one parent has tested clear or is hereditary clear for the PDE variant all puppies from that litter should be safe from PDE. However, not all dogs with two copies of the PDE variant will show symptoms (estimated 12.5% affected).

Table 5 shows the available testing results for the standard colour litters. Dogs classified as 'No Result' may be tested, but the result is not publicly available. Hereditary results are combined with their tested counterparts (e.g., hereditary clear dogs are combined with clear tested dogs).

Table 5. PDE testing results for the parents of standard colour litters (n=638)

		Sire			
		Increased Risk (2)	Minimal Risk (1)	Minimal Risk (0)	No Result
Dam	Increased Risk (2)	0	0	1	0
	Minimal Risk (1)	0	2	11	3
	Minimal Risk (0)	1	4	27	12
	No Result	0	1	154	422

210 (32.9%) of standard colour pug litters had at least one parent carrying no copies of the PDE variant, meaning all puppies were at minimal risk. For 422 (66.1%) litters, no public PDE test results were available for either parent. (Note: the PDE test was only approved by the Kennel Club in November 2019).

Two litters were produced from two carrier parents, putting the offspring at risk of PDE. For one of these litters, neither of the parents were tested at the time of birth of the litter; for the other, the sire had been tested but the dam had not.

For four litters, public PDE testing results were only available for one parent, who was a carrier for the PDE variant. These litters were also potentially at risk for PDE, depending on the PDE status of the second parent.

NBS: PDE Risk-Based DNA Testing

Table 6 shows the available PDE testing results for the NBS litters. Dogs classified as ‘No Result’ may be tested, but the result is not publicly available. Hereditary results are combined with their tested counterparts (e.g., hereditary clear dogs are combined with clear tested dogs).

Table 6. PDE testing results for the parents of NBS litters (n=733)

		Sire			
		Increased Risk (2)	Minimal Risk (1)	Minimal Risk (0)	No Result
Dam	Increased Risk (2)	0	0	0	1
	Minimal Risk (1)	0	0	1	2
	Minimal Risk (0)	0	0	4	7
	No Result	0	0	64	654

76 (10.4%) of NBS pug litters had at least one parent carrying no copies of the PDE variant, meaning all puppies were at minimal risk. For 654 (89.2%) litters, no public PDE test results were available for either parent. (Note: the PDE test was only approved by the Kennel Club in November 2019).

No litters with confirmed risk of PDE were identified.

For an additional three litters, public PDE testing results were only available for one parent, who had been tested as either Increased Risk (2) or Minimal Risk (1). These litters were potentially at risk for PDE, depending on the PDE status of the second parent.

Standard Colour: Pug Health Schemes

There are two available pug health schemes:

1. Five Star Health Scheme

This scheme encourages five different tests, and five different levels can be achieved, dependent on the results from these tests.

Table 7. Current criteria for the pug Five Star Health Scheme.

Level	Age	Assessment
Green	1 year	<ul style="list-style-type: none"> • Submission of non-invasive visual health assessment
Bronze	1 year	<ul style="list-style-type: none"> • Submission of non-invasive visual health assessment • Breathing assessed under the Respiratory Function Grading scheme • PDE tested • Patella tested
Silver	1 year	<ul style="list-style-type: none"> • Submission of non-invasive visual health assessment • Breathing assessed under the Respiratory Function Grading scheme – Grade 0, 1 or 2 • PDE tested • Patella tested – maximum grade 1/1
Gold	2 years	<ul style="list-style-type: none"> • Submission of non-invasive visual health assessment • Breathing assessed under the Respiratory Function Grading scheme – Grade 0, 1 or 2 (tested over 2 years) • PDE tested • Patella tested – maximum grade 1/1
Platinum	2 years	<ul style="list-style-type: none"> • Spinal x-ray clear of hemivertebrae, certified by Dick White Referrals • Submission of non-invasive visual health assessment • Breathing assessed under the Respiratory Function Grading scheme – Grade 0 or 1 (tested over 2 years) • PDE tested • Patella tested – maximum grade 1/1 • Spinal x-ray clear of hemivertebrae, certified by Dick White Referrals

2. National Pug Health Scheme

The current scheme consists of three levels: gold, silver, and bronze (see *Table 8*).

Table 8. Current criteria for the National Pug Health Scheme

Level	Age	Assessment
Bronze	1 year	<ul style="list-style-type: none">• Health assessment form completed (includes heart auscultation, breathing assessment, scoring of patella luxation, and grading of health of eyes, skin, and ears)• Not awarded if:<ul style="list-style-type: none">· Referred to a cardiologist (heart abnormality found),· Eye conditions detrimental to dog's health,· Signs of aggression
Silver	1 year	<ul style="list-style-type: none">• Hold bronze certificate• PDE tested• Spinal x-ray clear of hemivertebrae• Breathing assessed under the Respiratory Function Grading scheme – Grade 0, 1 or 2
Gold	1 year	<ul style="list-style-type: none">• Patella grade better than 3• Hold bronze and silver certificates• Breathing assessed under the Respiratory Function Grading scheme – Grade 0 or 1• Patella grade 0 or 1

The level a dog has achieved in either health scheme may have different meaning depending on when it was awarded, if the criteria of the health scheme have since changed.

Table 9 summarises the health scheme levels achieved by parents of standard colour litters.

Table 9 Pug Health Scheme results for the parents of standard colour litters (n=638); 5* = Five Star Health Scheme; NPHC = National Pug Health Scheme; Numbers in brackets indicate the number of individual dogs with litters in the row/column

			Sire							No Result (324)	
			Platinum 5* (0)	Gold 5* (1) NPHS (6)		Silver 5* (1) NPHS (2)		Bronze 5* (0) NPHS (12)	Green 5* (2)		
Dam	Platinum	5* (2)	0	0	0	1	1	0	0	0	0
	Gold	5* (0)	0	0	0	0	0	0	0	0	0
		NPHS (1)	0	0	0	0	0	0	1	0	0
	Silver	5* (1)	0	0	0	0	0	0	0	0	1
		NPHS (4)	0	0	3	0	0	0	0	0	1
	Bronze	5* (0)	0	0	0	0	0	0	0	0	0
		NPHS (9)	0	0	1	0	2	0	2	0	4
Green	5* (3)	0	0	1	0	0	0	0	2	0	
No Result	(610)	0	2	21	3	0	0	20	9	563	

No litters were produced from two parents tested to the highest level in either of the two health schemes.

88% of litters were produced from parents who had not achieved any result in either pug health scheme, meaning 12% had at least one parent tested to some level. Five litters were produced from parents who were both tested to the silver level in either health scheme, which is the first level in both schemes where graded testing results impact ability to achieve that level.

NBS: Pug Health Schemes

Currently, both pug health schemes are restricted to only breed standard colour pugs. This reduces the likelihood of NBS litters having parents tested under the health scheme.

Table 10 summarises the health scheme levels achieved by parents of NBS litters.

Table 10 Pug Health Scheme results for the parents of NBS litters (n=733); 5* = Five Star Health Scheme; NPHC = National Pug Health Scheme; Numbers in brackets indicate the number of individual dogs with litters in the row/column

			Sire								
			Platinum	Gold		Silver		Bronze		Green	No Result
			5* (0)	5* (0)	NPHS (2)	5* (0)	NPHS	5* (0)	NPHS (1)	5* (1)	(357)
Dam	Platinum	5* (0)	0	0	0	0	0	0	0	0	0
	Gold	5* (0)	0	0	0	0	0	0	0	0	0
		NPHS (0)	0	0	0	0	0	0	0	0	0
	Silver	5* (0)	0	0	0	0	0	0	0	0	0
		NPHS (0)	0	0	0	0	0	0	0	0	0
	Bronze	5* (0)	0	0	0	0	0	0	0	0	0
		NPHS (0)	0	0	0	0	0	0	0	0	0
	Green	5* (0)	0	0	0	0	0	0	0	0	0
No Result	(706)	0	0	5	0	0	0	1	8	719	

98% of litters were produced from parents who had not achieved any result in either pug health scheme, meaning 2% had at least one parent tested to some level. No litters were produced from parents who were both tested to the silver level in either health scheme, which is the first level in both schemes where graded testing results impact ability to achieve that level.

Standard Colour: Respiratory Function Grading Scheme

The Respiratory Function Grading (RFG) scheme was developed in association with the University of Cambridge to assess breathing in three breeds known to suffer from brachycephalic obstructive airway syndrome (BOAS), including the pug. BOAS is a respiratory condition seen in short-headed (brachycephalic) dogs.

Trained assessors listen to the dog's breathing whilst they are relaxed. The dog is then moved at a fast pace for three minutes, and the breathing assessed again. Dogs are graded between 0 and 3 (see *Table 11* for explanation).

Table 11. Respiratory Function Grading scheme grades

Grade	Meaning
0	Clinically unaffected and free of respiratory signs of BOAS
1	Clinically unaffected, but with mild respiratory signs linked to BOAS
2	Clinically affected, with moderate respiratory signs of BOAS which may require treatment
3	Clinically affected, with severe respiratory signs of BOAS which requires treatment

The RFG scheme was officially launched in February 2019 with scores before this (from assessments by the scheme developers at the University of Cambridge) added to the database on request.

Table 12 shows the RFG testing results of each parent prior to the birth of the litter. 12.6% of litters had at least one tested parent, with sixteen litters (2.5%) meeting the current criteria for lowest risk of BOAS, as documented in the Breeding Advice on the Kennel Club website. Eleven litters had at least one parent tested as grade 2 (clinically affected with moderate respiratory symptoms) before the birth of the litter, with none tested as grade 3.

Table 12 RFG testing results of parents, prior to the birth of standard colour litters (n=638)

		Sire				
		0	1	2	3	Untested
Dam	0	3	1	1	0	4
	1	5	4	0	0	3
	2	0	2	1	0	4
	3	0	0	0	0	0
	Untested	25	24	3	0	558

Sires of 69 standard colour litters were assessed under the RFG scheme before the birth of the litter, with dams of 28 standard colour litters assessed. Both parents were assessed for 17 litters.

Figure 18 shows the results of the 52 tested pugs with litters, as well as the age of the dog at the assessment.

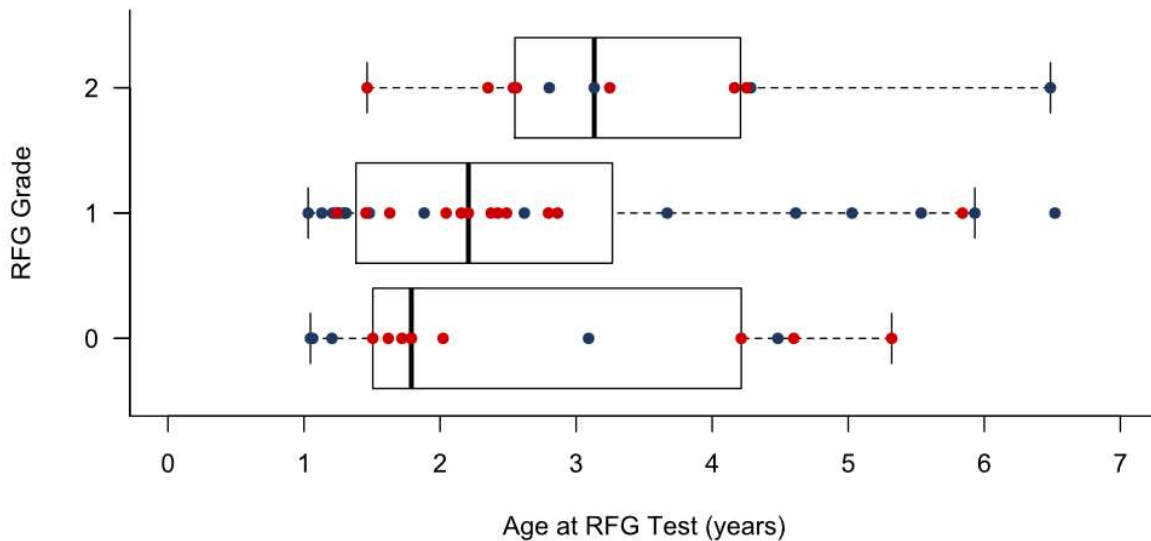


Figure 18 Respiratory Function Grading scheme results for dogs with standard colour litters
blue = dogs (n=24), red = bitches (n=28)

The mean age of these dogs at time of RFG assessment was 2.8 years, with the median age of 2.4 years. The oldest assessed dog was 6.5 years at time of RFG assessment, with the youngest being 1 year.

NBS: Respiratory Function Grading Scheme

Table 13 shows the RFG testing results of each parent prior to the birth of the litter. 2.0% of litters had at least one tested parent, with two litters (2.5%) meeting the current criteria for lowest risk of BOAS. One litters had at least one parent tested as grade 2 before the birth of the litter, with none tested as grade 3.

Table 13 RFG testing results of parents, prior to the birth of NBS litters (n=733)

		Sire				Untested
		0	1	2	3	
Dam	0	0	0	0	0	0
	1	0	1	0	0	1
	2	0	1	0	0	0
	3	0	0	0	0	0
	Untested	8	3	0	0	719

Sires of 13 NBS litters were assessed under the RFG scheme before the birth of the litter, with dams of 3 NBS litters assessed. Both parents were assessed for 2 litters.

Figure 19 shows the results of the six tested pugs with litters, as well as the age of the dog at the assessment.

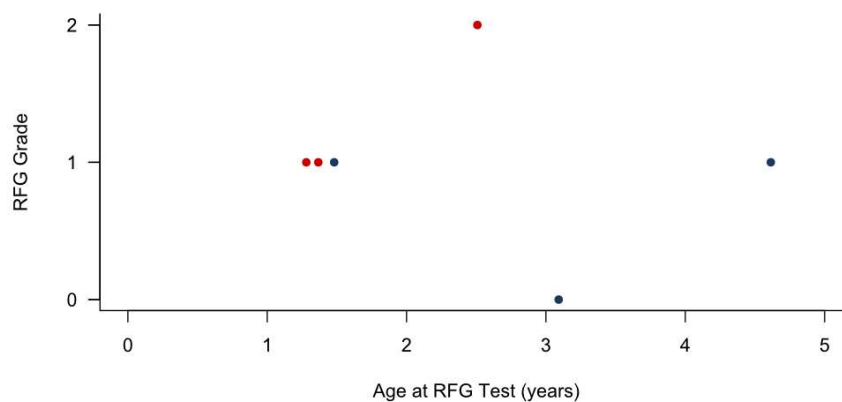


Figure 19 Respiratory Function Grading scheme results for dogs with NBS litters
blue = dogs (n=3), red = bitches (n=3)

The mean age of these dogs at time of RFG assessment was 2.4 years, with the median age of 2.0 years. The oldest assessed dog was 4.6 years at time of RFG assessment, with the youngest being 1.3 years.

RFG Scheme Results 2020

Breed record supplements also containing official health testing results for the relevant breeds. It is therefore possible to summarise all RFG scheme results reported in 2020 for pugs.

Figure 20 shows the results of RFG scheme assessments reported in 2020. 83.7% of results were Grade 0/1, which are described as clinically unaffected.

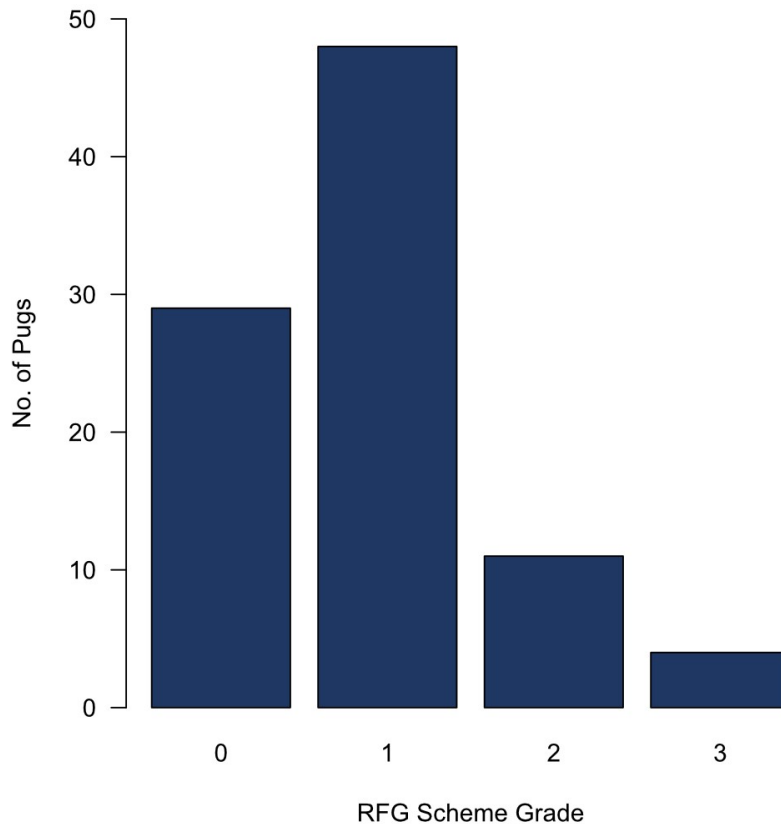


Figure 20 Pug RFG scheme results reported in 2020 breed record supplements (n=92).

Figure 21 shows the breakdown of grading results by age of the pug at time of grading, as well as showing which tested pugs have recent NBS colour heritage. The mean age of these dogs at time of RFG assessment was 2.9 years, with the median age of 2.3 years. The oldest assessed dog was 9.7 years at time of RFG assessment, with the youngest being 0.8 years.

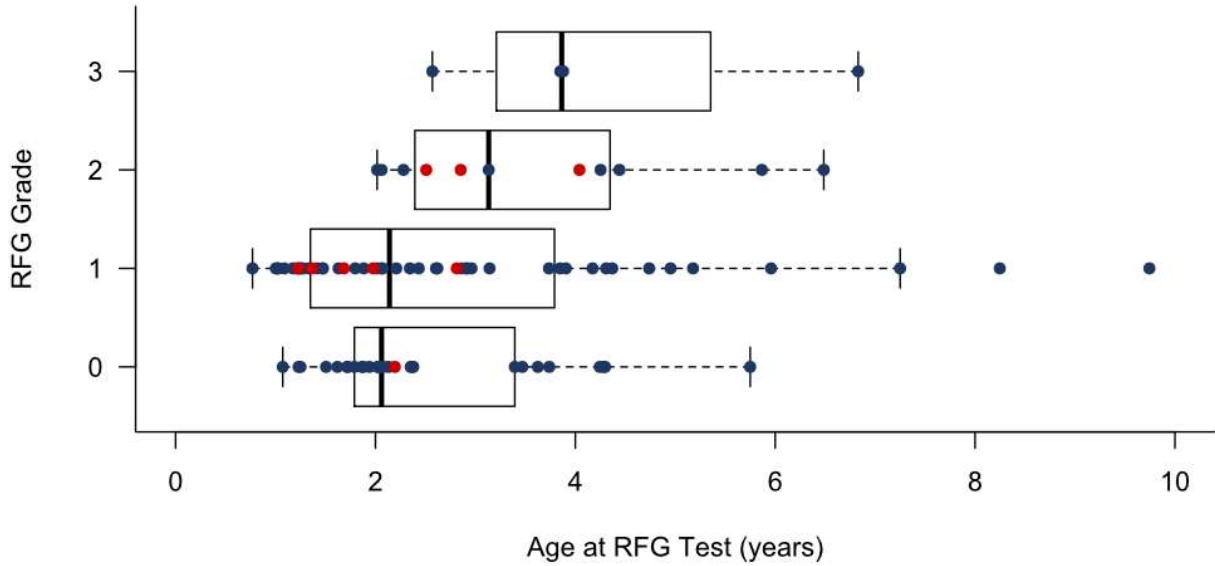


Figure 21 Pug RFG scheme results recorded in the 2020 breed record supplements
 blue = standard colour (n=83), red = NBS colour (n=9)

Additional Health Testing Results

Some pugs have also been tested under additional health testing schemes recorded by the Kennel Club.

Four pugs with litters in 2020 have been eye tested under the BVA/KC/ISDS eye screening scheme, which screens for hereditary eye disease and assesses general eye health. An additional pug had results for eye screening added in 2020.

The BVA/KC hip dysplasia scheme is a method of scoring abnormal hip development. As dogs age the hip joint deteriorates, which may lead to loss of function, pain, discomfort, stiffness and/or lameness. Hip dysplasia is a complex disorder, influenced both by genetics and the environment (e.g. diet).

Each of the two hip joints is given a score between 0 and 53, based on nine aspects of the hip. The total hip score is the combination of these two scores, with a lower hip score meaning a lower degree of hip dysplasia. Dogs must be one year of age and are scored once in their lifetime.

Four pugs with litters registered in 2020 had BVA/KC hip dysplasia scheme testing results, with an additional dog tested in 2020. Results are shown in *Table 14*.

Table 14 BVA/KC hip testing scheme scores for pugs with registered litters in 2020 or tested in 2020.

Sex	Left Hip	Right Hip	Total
Dog	14	12	26
Bitch	16	14	30
Dog	8	7	15
Bitch	9	8	17
Bitch	15	10	25

Appendix I: Colour Corrections

Registered Name	Registered Colour	Corrected Colour	Source
Handsome Chico	Fawn	NBS (White)	https://www.pets4homes.co.uk/classifieds/2174169-kc-reg-silver-pug-puppy-for-sale-newcastle-upon-tyne.html
King Of Lions	Fawn	NBS (Pink)	https://www.facebook.com/permalink.php?id=102993784875218&story_fbid=139640771210519
Little Monster Cash	Silver	NBS (White)	https://www.pets4homes.co.uk/classifieds/1465159-little-monster-cash-york.html
Lord Lauda	Silver	NBS (Platinum)	https://www.pets4homes.co.uk/classifieds/1710818-captain-pugwash-outstanding-platinum-pug-stud-dog-wrexham.html
Mandanna White Lightening	Silver	NBS (White)	https://www.pets4homes.co.uk/classifieds/2979481-kc-registered-white-male-pug-puppies-glenrothes.html
Many Roads Travelled Hermes For Mathewsstaff	Silver	NBS (Platinum)	https://www.pets4homes.co.uk/classifieds/2180391-kc-reg-pde-clear-platinum-pug-birmingham.html
Mr Pinkster At Dezinerbullz Essex	Fawn	NBS (Pink)	https://www.pets4homes.co.uk/classifieds/1904482-stunning-kc-registered-pugs-from-pde-clear-parents-leeds.html
Percy Prince	Fawn	NBS (Pink)	https://www.pets4homes.co.uk/classifieds/2931488-pink-pug-stud-milkshake-best-quality-pink-boy-ongar.html
Pink Floyd At Dezinerbullz Essex UK	Fawn	NBS (Pink)	https://www.pets4homes.co.uk/classifieds/1895947-pink-carrier-pug-male-birkenhead.html
Platinum Pink Rolex	Fawn	NBS (Pink)	https://www.pets4homes.co.uk/classifieds/2101664-blue-eyed-pink-pug-pink-rolex-no-pde-wallasey.html
Pugaboos Platinum Plonker	Silver	NBS (Platinum)	https://www.pets4homes.co.uk/classifieds/1036320-kc-reg-female-pug-pups-wingate.html
Pugaboos Platinum Showgirl	Silver	NBS (Platinum)	https://www.pets4homes.co.uk/classifieds/1793956-stunning-kc-registered-pug-puppies-redcar.html
Puggelpom Talk Of The Town	Silver	NBS (Chinchilla)	https://www.pets4homes.co.uk/classifieds/993989-kc-reg-pug-boy-last-one-ready-now-heywood.html
Silver Bullet Lad	Silver	NBS (Platinum)	https://www.pets4homes.co.uk/classifieds/2604101-gorgeous-pug-puppies-morpeth.html
The Original Pink Panther	Fawn	NBS (Pink)	https://www.pets4homes.co.uk/classifieds/2400820-beautiful-pink-girl-pde-clear-cardiff.html
Tripleaces Pugsy Malone	Fawn	NBS (Lilac Fawn)	https://www.pets4homes.co.uk/classifieds/3039056-1-7-beautiful-pug-puppy-left-nottingham.html

Appendix II: Additional Health Testing Results

Registered Name	PDE	Source
Abifinstar Despina At Skabeat	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2187273-pug-puppies-for-sale-wigan.html
Afterglow Vandross At Flashnik	Minimal Risk (0)	https://www.champdogs.co.uk/dog/60047
Angel's Charm Almaz	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/3069695-small-stunning-proven-fawn-boy-newton-abbot.html
Bailey Bruiser	Minimal Risk (0)	https://www.champdogs.co.uk/dog/72102
Bilohka Bomber Command	Minimal Risk (0)	https://www.ukpets.com/for-stud/dogs/bilohka-bomber-command-crufts-qualified-for-life-58246
Blacobby Enid Nightshade	Minimal Risk (0)	https://www.champdogs.co.uk/dog/70328
Briddish Callin Baton Rouge	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1603705-beautiful-bitch-puppy-available-malvern.html
Britishglory Blacksmith	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2596207-kc-registered-black-pug-fareham.html
Britishstars Black Beauty	Minimal Risk (1)	https://www.pets4homes.co.uk/classifieds/2776619-two-girl-stunning-quality-pug-puppies-available-grays.html
Calaquendi Cause Celebre Avec Ragemma	Minimal Risk (0)	https://www.champdogs.co.uk/dog/61215
Calaquendi Nebuchadnezzar	Minimal Risk (0)	https://www.champdogs.co.uk/dog/64032
Conquell At A Glance	Minimal Risk (0)	https://www.champdogs.co.uk/dog/57818
Conquell Dare To Dream	Minimal Risk (1)	https://www.champdogs.co.uk/dog/69487
Cressypugz Entire Galaxy	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2906682-kc-chocolate-5-generation-pug-puppies-birmingham.html
Duke Vom Furstentum Lippe	Minimal Risk (0)	https://www.champdogs.co.uk/dog/64728
Eastonite Apricot Percy At Lexiluk	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1771935-all-puppies-sold-gillingham.html
Eastonite Billy Wizz	Minimal Risk (0)	https://www.champdogs.co.uk/dog/54981
Eastonite Woo Hoo	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1642828-eastonite-woo-hoohealth-tested-stud-stoke-on-trent.html
Edgbury I'm Your Man	Minimal Risk (0)	https://www.champdogs.co.uk/dog/66296
Edgbury Midnight Ziva	Minimal Risk (0)	https://www.champdogs.co.uk/dog/66651
Eva Solo Puccini By Luterpugs	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2824326-ready-now-pug-puppy-black-boy-champion-lines-liverpool.html
Flaikwell Jaq Dunit	Minimal Risk (0)	https://www.champdogs.co.uk/dog/73889
Flashnik's My Boy Lollipop	Minimal Risk (0)	https://www.champdogs.co.uk/dog/60046
Fudgeybowwow Saturn	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2819421-only-1-girl-left-kc-pug-puppies-dunmow.html
Gerafi All That Jazz At Twirlytops	Minimal Risk (1)	https://www.champdogs.co.uk/dog/65141
Grelleson Genesis	Minimal Risk (0)	https://www.champdogs.co.uk/dog/69659
Headcandy Starlite Express	Minimal Risk (0)	https://www.champdogs.co.uk/dog/72053
Jaudette Mr Clever	Minimal Risk (0)	https://www.champdogs.co.uk/dog/72535
Jaudette Mr Daydream	Minimal Risk (0)	https://www.champdogs.co.uk/dog/68071
Jaudette Princess Jasmine	Minimal Risk (0)	https://www.champdogs.co.uk/dog/58271

Registered Name	PDE	Source
Judamie Precious Beginings For Milucksin	Minimal Risk (0)	https://www.champdogs.co.uk/dog/75150
Kenquince Half Pint At Glasstown	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1509435-gorgeous-health-tested-proven-fawn-boy-for-stud-st-helens.html
Kenquince Made Of Steel	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2595983-stunning-kg-reg-pug-puppies-sunderland.html
Kensteen Plum	Minimal Risk (0)	https://www.champdogs.co.uk/dog/76484
Kind Edward Jacket Potato With Headcandy	Minimal Risk (0)	https://www.champdogs.co.uk/dog/70613
Kirsty And Sheps Pride	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2025303-pugs-ready-for-homing-9th-september-accrington.html
Kymclara Pinky Dinky Doo At Rewbiehill	Minimal Risk (0)	https://www.champdogs.co.uk/dog/66487
Little May	Minimal Risk (1)	https://www.champdogs.co.uk/dog/65566
Made In Chelsea	Minimal Risk (1)	https://www.champdogs.co.uk/dog/60097
Madjax Precocious	Minimal Risk (0)	https://www.champdogs.co.uk/dog/75279
Magical Minnie Of Dreamankh	Minimal Risk (0)	https://www.champdogs.co.uk/dog/65784
Many Roads Travelled Hermes For Mathewsstaff	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2180391-kc-reg-pde-clear-platinum-pug-birmingham.html
Mathewsstaff Candy Cane	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2162671-beautiful-kc-reg-pde-clear-ready-now-birmingham.html
Messi Like Lionel	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2499681-five-generation-kc-pedigree-pug-puppies-bournemouth.html
Migang Mustang	Minimal Risk (0)	https://www.champdogs.co.uk/dog/64900
Moulain Captain Pugwash For Lanebern	Minimal Risk (0)	https://www.champdogs.co.uk/dog/57512
Mr Banderas	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2649432-mr-banderas-chelmsford.html
My Cutie Pie	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2604101-gorgeous-pug-puppies-morpeth.html
Number One Lenny	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2906996-handsome-proven-stud-welling.html
Oakleyloves Honest Love	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2128703-quality-kc-pug-puppies-1-black-boy-left-oswestry.html
Paradiz Ronado Dream Maker-FV At Melharco	Minimal Risk (0)	https://www.champdogs.co.uk/dog/70194
Percy Prince	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2931488-pink-pug-stud-milkshake-best-quality-pink-boy-ongar.html
Platinum Pink Rolex	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2101664-blue-eyed-pink-pug-pink-rolex-no-pde-wallasey.html
Portlycharm Hesperis With Boynhams	Minimal Risk (0)	https://www.champdogs.co.uk/dog/57547
Poseidon Polly Of Dreamankh	Minimal Risk (0)	https://www.champdogs.co.uk/dog/52913
Pretty Posie	Minimal Risk (0)	https://www.champdogs.co.uk/dog/72013
Ragemma Dream On Eivisah	Minimal Risk (0)	https://www.champdogs.co.uk/dog/58618
Ragemma Strictly Solo	Minimal Risk (0)	https://www.champdogs.co.uk/dog/49598
Rhodenash Angel O'Mine Avec Anzhela	Minimal Risk (1)	https://www.champdogs.co.uk/dog/60245
Rhodenash Kotten Klyde	Minimal Risk (0)	https://www.champdogs.co.uk/dog/59515
Rhodenash Stealer Of Hearts Avec Anzhela	Minimal Risk (0)	https://www.champdogs.co.uk/dog/63007

Registered Name	PDE	Source
Rhodenash Wildest Dream At Readstone	Minimal Risk (0)	https://www.champdogs.co.uk/dog/77562
Roxmarr Dark And Stormy	Minimal Risk (0)	https://roxmarr.webs.com/
Roxmarr Dark Knight At Sunlea	Minimal Risk (0)	https://www.champdogs.co.uk/dog/74778
Roxmarr Midnight Express To Headcandy	Minimal Risk (0)	https://www.champdogs.co.uk/dog/70612
Roxmarr Napoleon	Minimal Risk (0)	https://www.champdogs.co.uk/dog/67428
Rozeldogue Whats Occurin	Minimal Risk (0)	https://www.champdogs.co.uk/dog/63697
Ruuicha Love Me Do For Melharco	Minimal Risk (0)	https://www.facebook.com/melharcopug/posts/ruuicha-love-me-do-at-melharco-ruuicha-vera-x-ruuicha-special-newshv-clearpatell/1782739445384590/
Ruuicha Special News	Minimal Risk (0)	https://www.champdogs.co.uk/dog/58095
Sephina All Shook Up At Eivisah	Minimal Risk (0)	https://www.champdogs.co.uk/dog/49095
Shardlow Midnight Cowboy Of Cazhmir	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1663288-quality-health-tested-black-kc-reg-pug-pups-bridgend.html
Sheonypug Moonlight Dreamer	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/1220083-fawn-pug-for-stud-leeds.html
Sherm Von Clumpville	Minimal Risk (0)	https://www.champdogs.co.uk/dog/54764
Silver Bullet Lad	Minimal Risk (0)	https://www.pets4homes.co.uk/classifieds/2604101-gorgeous-pug-puppies-morpeth.html
Silvestre Zipadeedoodah	Minimal Risk (0)	https://www.champdogs.co.uk/dog/69753
Snugglepug Black Stanley	Minimal Risk (0)	https://www.champdogs.co.uk/dog/49542
Snugglepug Knows Best At Jaudette	Minimal Risk (0)	https://www.champdogs.co.uk/dog/49539
Snugglepug Look At Me Now With Thunderail	Minimal Risk (1)	https://www.champdogs.co.uk/dog/70213
Snugglepug Serenity Jaudette	Minimal Risk (0)	https://www.champdogs.co.uk/dog/62565
Snugglepug Still Looking For Thunderail	Minimal Risk (0)	https://www.champdogs.co.uk/dog/45305
Super Stanley Of Clairants	Minimal Risk (0)	https://www.champdogs.co.uk/dog/59494
Superlapug's Mr Bombastic	Minimal Risk (0)	https://www.champdogs.co.uk/dog/73620
Superlapug's Supremo Latte	Minimal Risk (0)	https://www.champdogs.co.uk/dog/64871
Sweet Starlight Dream	Minimal Risk (0)	https://www.champdogs.co.uk/dog/60012
Teaseltail Night Shift Of Dreamankh	Minimal Risk (0)	https://www.champdogs.co.uk/dog/74580
Telquel Little Lola	Minimal Risk (0)	https://www.champdogs.co.uk/dog/73600
Tussilago's Little Atom	Minimal Risk (1)	https://www.champdogs.co.uk/dog/68369
Twirlytops Abracadabra	Minimal Risk (0)	https://www.champdogs.co.uk/dog/65537
Twirlytops Little Mo	Minimal Risk (0)	https://www.champdogs.co.uk/dog/71532
Twirlytops Unpredictable	Minimal Risk (0)	https://www.champdogs.co.uk/dog/68712
Zobear Sweet Candy	Minimal Risk (0)	https://www.champdogs.co.uk/dog/69793
Zobear's About The Base	Minimal Risk (0)	https://www.champdogs.co.uk/dog/64096