THE KENNEL CLUB
Making a difference for dogs

September 2015

Population analysis of the *Portuguese Water Dog* breed

Genetic analysis of the Kennel Club pedigree records of the UK ***Portuguese Water Dog*** population has been carried out with the aim of estimating the rate of loss of genetic diversity within the breed and providing information to guide a future sustainable breeding strategy. The population statistics summarised provide a picture of trends in census size, the number of animals used for breeding, the rate of inbreeding and the estimated effective population size. The rate of inbreeding and estimated effective population size indicate the rate at which genetic diversity is being lost within the breed. However, the number of animals of this breed registered with the Kennel Club per year has not been consistently high enough to allow all intended features of the report to be presented.

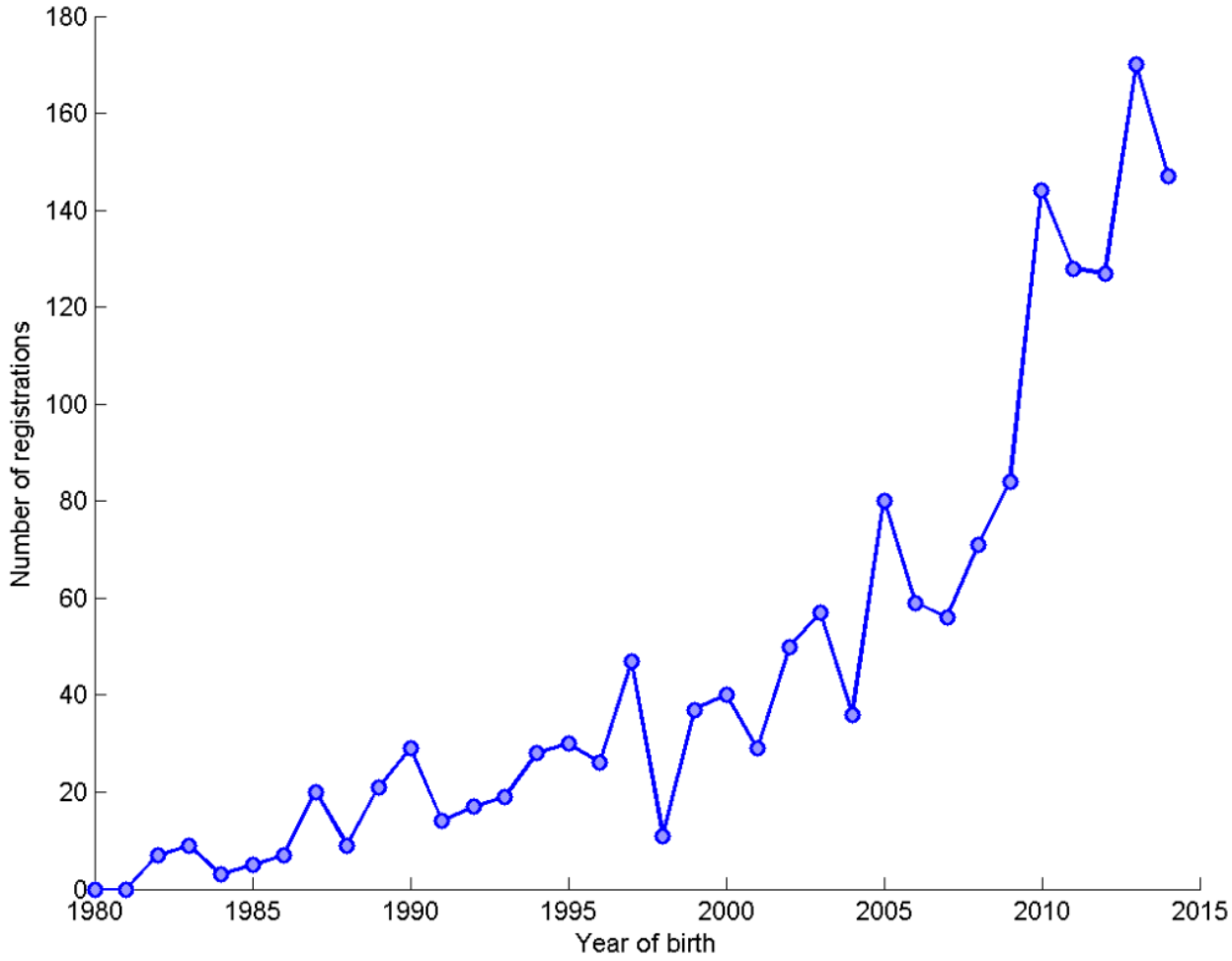
Summary of results

The analysis utilises the complete computerised pedigree records for the current UK Kennel Club registered ***Portuguese Water Dog*** population, and statistics were calculated for the period 1980-2014.

Figure 1: a plot of number of registrations by year of birth, indicative of any changing trend in popularity of the breed.

Breed: ***Portuguese Water Dog***

Figure 1: Number of registrations by year of birth



THE KENNEL CLUB
Making a difference for dogs

September 2015

Table 1: census statistics by year where available, including sire use statistics.

Table 1: by year (1980-2014), the number of registered puppies born, by the number of unique dams and sires; maximum, median, mode, mean and standard deviation of number of puppies per sire; and the percentage of all puppies born to the most prolific 50%, 25%, 10% and 5% of sires.

year	#born	#dams	#sires	puppies per sire					%puppies sired by most prolific sires			
				max	median	mode	mean	sd	50% sires	25% sires	10% sires	5% sires
1980	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1981	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1982	7	1	1	7	7	7	7	0	n/a	n/a	n/a	n/a
1983	9	2	2	8	4.5	1	4.5	4.95	n/a	n/a	n/a	n/a
1984	3	1	1	3	3	3	3	0	n/a	n/a	n/a	n/a
1985	5	3	3	3	1	1	1.67	1.15	n/a	n/a	n/a	n/a
1986	7	2	2	6	3.5	1	3.5	3.54	n/a	n/a	n/a	n/a
1987	20	3	3	10	8	2	6.67	4.16	n/a	n/a	n/a	n/a
1988	9	4	3	5	2	2	3	1.73	n/a	n/a	n/a	n/a
1989	21	5	4	8	5.5	8	5.25	3.2	n/a	n/a	n/a	n/a
1990	29	7	6	8	5	1	4.83	2.64	n/a	n/a	n/a	n/a
1991	14	3	3	9	3	2	4.67	3.79	n/a	n/a	n/a	n/a
1992	17	4	4	8	4	4	4.25	2.87	n/a	n/a	n/a	n/a
1993	19	3	3	8	7	4	6.33	2.08	n/a	n/a	n/a	n/a
1994	28	5	5	9	6	6	5.6	2.51	n/a	n/a	n/a	n/a
1995	30	7	6	11	3.5	2	5	4.15	n/a	n/a	n/a	n/a
1996	26	4	4	10	7.5	1	6.5	4.04	n/a	n/a	n/a	n/a
1997	47	9	7	23	5	1	6.71	7.72	n/a	n/a	n/a	n/a
1998	11	4	4	8	1	1	2.75	3.5	n/a	n/a	n/a	n/a
1999	37	9	7	14	3	1	5.29	5.74	n/a	n/a	n/a	n/a
2000	40	10	9	20	1	1	4.44	6.23	n/a	n/a	n/a	n/a
2001	29	6	4	10	9	9	7.25	4.19	n/a	n/a	n/a	n/a
2002	50	11	10	17	2.5	1	5	5.4	88	70	34	34
2003	57	14	13	18	1	1	4.38	4.91	89.47	56.14	31.58	31.58
2004	36	8	7	10	5	1	5.14	3.67	n/a	n/a	n/a	n/a
2005	80	18	15	24	5	1	5.33	6.09	90	62.5	43.75	30
2006	59	12	11	22	4	1	5.36	6.5	91.53	69.49	37.29	37.29
2007	56	15	15	10	3	1	3.73	3.06	87.5	55.36	30.36	17.86
2008	71	14	11	13	7	1	6.45	4.97	87.32	52.11	18.31	18.31
2009	84	12	11	13	8	7	7.64	3.64	72.62	41.67	15.48	15.48
2010	144	25	20	26	1.5	1	7.2	8.75	93.06	72.22	33.33	18.06
2011	128	21	16	49	5.5	1	8	11.82	87.5	67.97	51.56	38.28
2012	127	23	16	41	4	1	7.94	10.69	92.91	68.5	49.61	32.28
2013	170	26	19	26	8	1	8.95	6.89	80	52.35	27.65	15.29
2014	147	23	19	22	7	1	7.74	6.85	84.35	57.82	29.25	14.97

Generation interval: the mean average age (in years) of parents at the birth of offspring which themselves go on to reproduce.

Mean generation interval (years) = 4.76

Estimated effective population size: the rate of inbreeding is used to estimate the effective population size of the breed. 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 breed in question. It may be thought of as the size of the 'gene pool' of the breed.

Below an effective population size of 100 (inbreeding rate of 0.50% per generation) the rate of loss of genetic diversity in a breed/population increases dramatically (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 many be considered to be at risk (Food & Agriculture Organisation of the United Nations, "Breeding strategies for sustainable management of animal genetic resources", 2010).

Where the rate of inbreeding is negative (implying *increasing* genetic diversity in the breed), effective population size is denoted 'n/a'.

Estimated effective population size = n/a

NB - this estimate is made using the rate of inbreeding over the whole period 1980-2014

THE KENNEL CLUB
Making a difference for dogs

September 2015

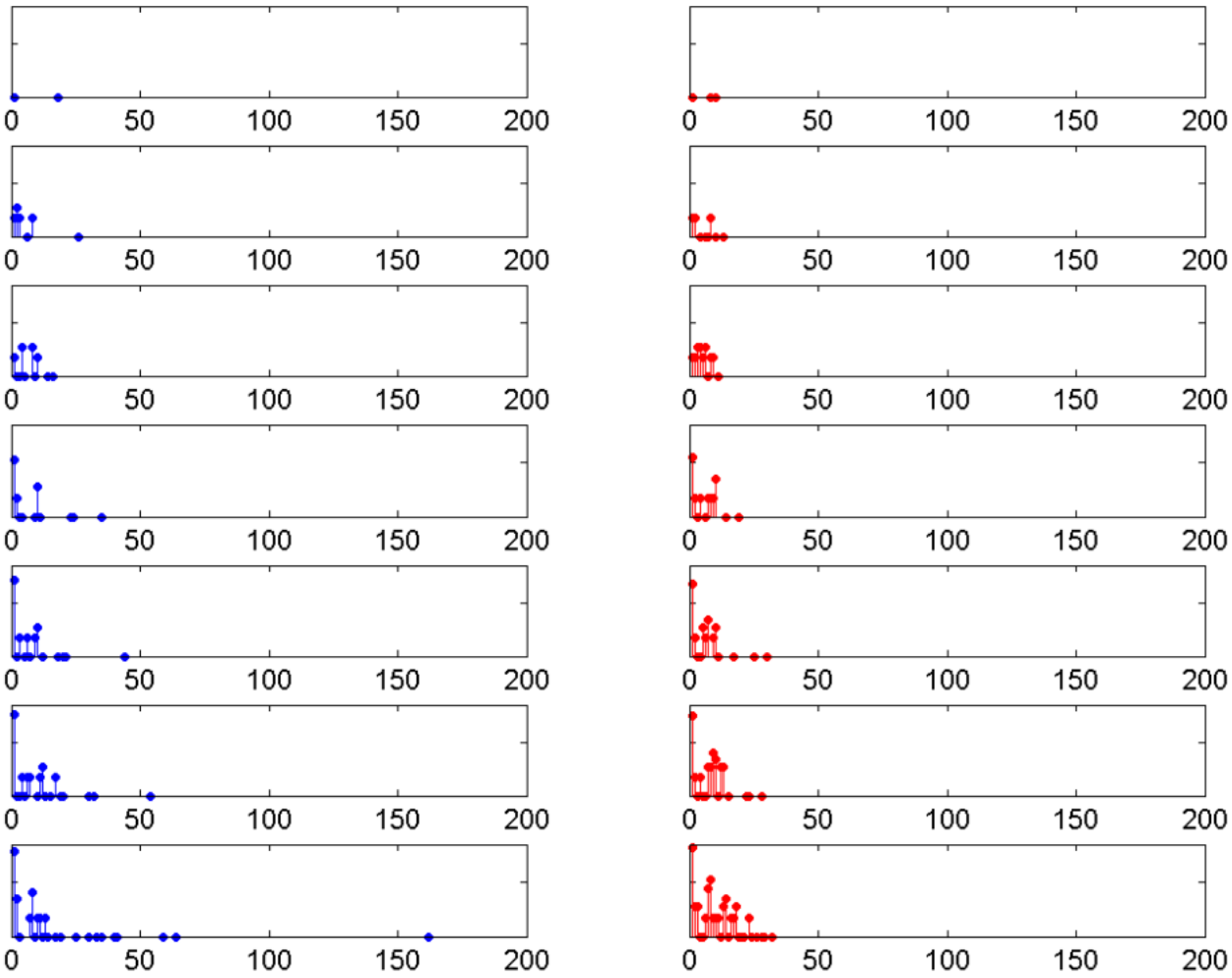
Table 2: a breakdown of census statistics, sire and dam usage and indicators of the rate of loss of genetic diversity over 5 year periods (1980-4, 1985-9, 1990-4, 1995-9, 2000-4, 2005-9, 2010-14). Rate of inbreeding and estimated effective population size for each 5-year block can be observed.

Table 2: by 5-year blocks, the mean number of registrations; for sires the total number used, maximum, mean, median, mode, standard deviation and skewness (indicative of the size of the 'tail' on the distribution) of number of progeny per sire; for dams the total number used, maximum, mean, median, mode, standard deviation and skewness of number of progeny per dam; rate of inbreeding per generation (as a decimal, multiply by 100 to obtain as a percentage); mean generation interval; and estimated effective population size.

years	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014
mean #registrations	3.8	12.4	21.4	30.2	42.4	70	143.2
Total #sires	2	11	16	20	34	45	55
Max #progeny	18	26	16	35	44	54	162
Mean #progeny	9.5	5.6364	6.6875	7.55	6.2353	7.7778	13.018
Median #progeny	9.5	3	6.5	2.5	1.5	3	3
Mode #progeny	1	2	4	1	1	1	1
SD #progeny	12.021	7.2287	4.453	9.5503	8.8251	10.538	25.069
Skew #progeny	0	2.2464	0.55078	1.6231	2.6459	2.408	4.2183
Total #dams	3	11	21	27	37	53	83
Max #progeny	10	13	11	19	30	28	32
Mean #progeny	6.3333	5.6364	5.0952	5.5926	5.7297	6.6038	8.6265
Median #progeny	8	6	5	4	4	6	7
Mode #progeny	1	1	3	1	1	1	1
SD #progeny	4.7258	3.9818	2.809	4.7819	6.6108	6.2706	8.0361
Skew #progeny	-0.56732	0.35136	0.35805	0.88519	2.1078	1.2771	0.94211
Rate of inbreeding	0	0.21391	0.043076	-0.09541	-0.03719	0.016371	0.040934
Generation interval	4.6301	5.5491	4.6913	4.1754	5.0206	4.8092	4.3083
Effective pop size	n/a	2.3374	11.607	n/a	n/a	30.542	12.215

Figure 3: a histogram ('tally' distribution) of number of progeny per sire and dam over each of the seven 5-year blocks above. A longer 'tail' on the distribution of progeny per sire is indicative of 'popular sires' (few sires with a large number of offspring, known to be a major contributor to a high rate of inbreeding).

Figure 3: 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.



Comments

As can be seen from figure 1, the number of animals of this breed registered with the Kennel Club has risen in recent years. This increase in numbers is likely to have been accomplished with use of migrant animals for breeding. The small initial population size and influence of migrant animals mean there may be large fluctuations in the rate of inbreeding and effective population size.

There appears to be emerging evidence of popular dogs used as sires in this breed (the 'tail' of the blue distribution 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.