Assessing the Genetic Health of the Afghan Hound: Breeding Strategies for the Future

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Genetic Data Analysis

Based On Pedigree Databases
1) Jim Coudriet (deceased) & Peter van Arkel
2) Afghan Hound International

Conventions
Data graphed & analyzed as
1) All dogs
2) Dogs with offspring (< 2014)
3) “Reference” population (2010-2017)
Dog Domestication
Dog Domestication

Bottlenecks

Ancestor of wolf

Time

Breed formation

Domestication

Purebred dogs

Village dogs

Gray wolves

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The Land Race Dog
Breed Creation

100 Years

Sirdar of Ghazni

Tarina Adorah Eagle Scout
Breed Development

Gene pool founders

Selective breeding

Purebred breed

genes lost
Genetic Founders

* Genetic founders were of two types

<table>
<thead>
<tr>
<th>Bell-Murray (desert)</th>
<th>Amps (mountain)</th>
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<td>Kanee (1916)</td>
<td>Afroz (1923)</td>
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<td>Pushum (1917)</td>
<td>Khan of Ghazni (1923)</td>
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<td>Ranee (1919)</td>
<td>Shahzada (1923)</td>
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<td>Baluch (1920)</td>
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<td>Ooty (1921)</td>
<td>Rani of Ghazni (1923)</td>
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<td>Faida of Ghazni (1924)</td>
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<td>Danenda of Ghazni (1924)</td>
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<td>Roshini of Ghazni (1925)</td>
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First Decade

* Genetic contributions of founders in the first decade
* Bell-Murray dominates the gene pool

Bell-Murray (desert)
- Kanee (1916)
- Pushum (1917)
- Ranee (1919)
- Baluch (1920)
- Ooty (1921)

Amps (mountain)
- Afroz (1923)
- Khan of Ghazni (1923)
- Shahzada (1923)
- Sirdar of Ghazni (1923)
- Faida of Ghazni (1924)
- Danendra of Ghazni (1924)
- Zarifa of Ghazni (1925)
- Roshini of Ghazni (1925)
Second Decade

* Genetic contributions of founders in the second decade
* Sirdar of Ghazni dominates the gene pool
Sirdar of Ghazni

* Offspring amount to 10% of breed to 1933
* First popular sire

Total offspring = 71
26 (37%) were bred

Year:

- 1926: 5
- 1927: 7
- 1928: 18
- 1929: 12
- 1930: 8
- 1931: 8
- 1933: 4
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Population Size

* Popularity grew gradually to 1960
Effects of Wars

* Wars profoundly affected breeding
Decline in Popularity

* HUGE popularity in 1970s
* Breeding declined dramatically after 1975
* Production of animals continues to decline

![Graph showing the decline in popularity of Afghan Hound (all dogs) from 1920 to 2020.](chart.png)
Population Size

* Most dogs did not produce offspring
In general, < 40% of animals are bred.
Since 1980, < 30%
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Sires & Dams

* Fewer males than females are bred

![Graph showing the percentage of Afghan Hound males and females bred over years from 1920 to 2020.](image)
Shirkhan of Grandeur

b. 1954

BIS 1957
Westminster Kennel Club
Shirkhan of Grandeur

* Won BIS at WKC in 1957
* Popularity as a stud surged in 1958 & 1959

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Shirkhan of Grandeur

* He was NOT a “popular sire”
* Far down the rankings
Shirkhan of Grandeur

- Genetic contributions stable until about 1970
- Shirkhan of Grandeur affects the gene pool from the 1970s
Shirkhan of Grandeur

* Offspring spread over 12 years
* 121 offspring but < 1% of population
* Just before 1970s explosion
Shirkhan of Grandeur

* Of 121 offspring, 92 (76%) were bred
* Breeding was not limited to “pick of the litter”
Shirkhan of Grandeur

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Inbreeding is the creation of homozygosity through the breeding of related dogs.

Advantages:
* increased uniformity
* increased prepotency
* fixes genes for type

Disadvantages:
* lower fertility
* genetic defects
* lower fitness (health, lifespan, “vigor”)
Inbreeding

* Significant early inbreeding

Inbreeding Coefficient (F)

Year

Afghan Hounds
(all dogs)
Inbreeding

Since 1950
* Average inbreeding > 15%
* Maximum inbreeding > 40%
Inbreeding

Since 1950
* Average inbreeding > 15%
* Maximum inbreeding > 40%

- 25% full sibs
- 12.5% half sibs
- 6.25% 1st cousins

Afghan Hound (with offspring)
Current Inbreeding

* Genetic diversity as founder “equivalents”
* Breed has the diversity of about 8 dogs
Inbreeding vs Kinship

* Inbreeding is > Kinship
* Indicates preferential inbreeding
Inbreeding vs Kinship

* Inbreeding is > Kinship
* Indicates *preferential* inbreeding

![Inbreeding vs Kinship Graphs](image)
Inbreeding

* Afghan Hound inbreeding ranks in the middle of purebreds
Inbreeding: Dogs vs Horses
Gene Pool Basics

- Closed stud book = Closed gene pool
- Genes are lost but not replaced
- The gene pool can *only* get smaller

Gene pool

Gene pool founders

New breed

Current gene pool
How Big is the Gene Pool?

1) If a breed is founded on 20 unrelated dogs, the size of the original gene pool is 20.

3) Unrelated dogs added later also count as founders.

5) The gene pool of a population will be less than the total number of founder dogs.

* Founder dogs: 13 Murray-Bell and 8 Ghazni.
* About 15 additional founders from 1930-1976.
Loss of Genetic Diversity

* Genetic diversity as founder “equivalents”
* Breed has the diversity of about 9 dogs

fe - effective number of founders
fg - founder genome equivalents
fa - effective number of ancestors

![Graph showing genetic diversity over time for Afghan Hounds.](image)
Losing Genetic Diversity

Selective breeding
* not all animals are bred
* some produce more offspring than others
Selective Breeding: Popular Sires

Every dog has mutations
Popular Sires

Hank wins the Big Show!

The big Winner!!!
Popular Sires

* Hank is health tested
* Hank has dozens of lovely puppies
* Each has half of his mutations
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Popular Sires

* A few puppies have a new disease
* The crisis looms…
Popular Sires

* OMG, the breed has a genetic disorder
* It’s all Hank’s fault!
Popular Sires

* The cycle begins again

The next big Winner!!!
Losing Genetic Diversity

1) Selective breeding
   * only a few animals are bred
   * popular sires

2) Alleles lost by chance ("genetic drift")
   * faster in a smaller population
Effective Population Size

* Ne is the “genetic” population size
* Depends on the number of breeding animals
Effective Population Size

* Rate of inbreeding increases as Ne gets smaller

![Graph showing the relationship between effective population size (Ne) and inbreeding rate.](image)

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Effective Population Size

*Sustainable population size is Ne = 500

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How big should Ne be?

* Sustainably breeding population: 500
* Minimum size: 100
* Emergency: 50
What About Genetic Disorders?

* progressive retinal atrophy
* cataracts
* autoimmune disorders
* dilated cardiomyopathy
* diabetes insipidus
* hypothyroidism
* chylothorax
* hip dysplasia
* mucopolysaccharidosis
* cancer
* laryngeal paralysis
* von Willebrand’s disease
Usual Responses to Genetic Disorders

- Study the disease
- Look for the genes
- Depend on DNA tests

- Expensive
- Slow
- Does not solve the problem

- Reduce inbreeding (homozygosity)
- Minimize loss of genetic diversity
- Avoid popular sires

- Inexpensive
- Fast
- Solves the problem
An Example: Curing Cancer

The simple solution
* DON’T Smoke *
Curing Dogs

The simple solution

* DON’T Inbreed *
Preserving the Afghan Hound

**Perils:**
* Declining effective population size
* High inbreeding
* Small gene pool
* Popular sires
* Genetic disorders
Breeder Goals

Perils:
* Declining effective population size
* High inbreeding
* Small gene pool
* Genetic disorders

Responses:
* Minimize loss of genetic diversity
  - Avoid multiple litters
  - Avoid repeat breedings
  - Breed 2 or 3 pups per litter (vs 1)

* Reduce inbreeding
  - Select parents that are less related
  - NO popular sires!

* Improve & protect the gene pool
  - Use available genetic diversity
  - Replace lost genetic diversity
Genetic Management

Key Features

* Maintain a complete pedigree database
* Perform a regular genetic evaluation
* Design a strategy for genetic introduction
  - COO dogs
* Properly manage genetic disorders
Thank you