



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

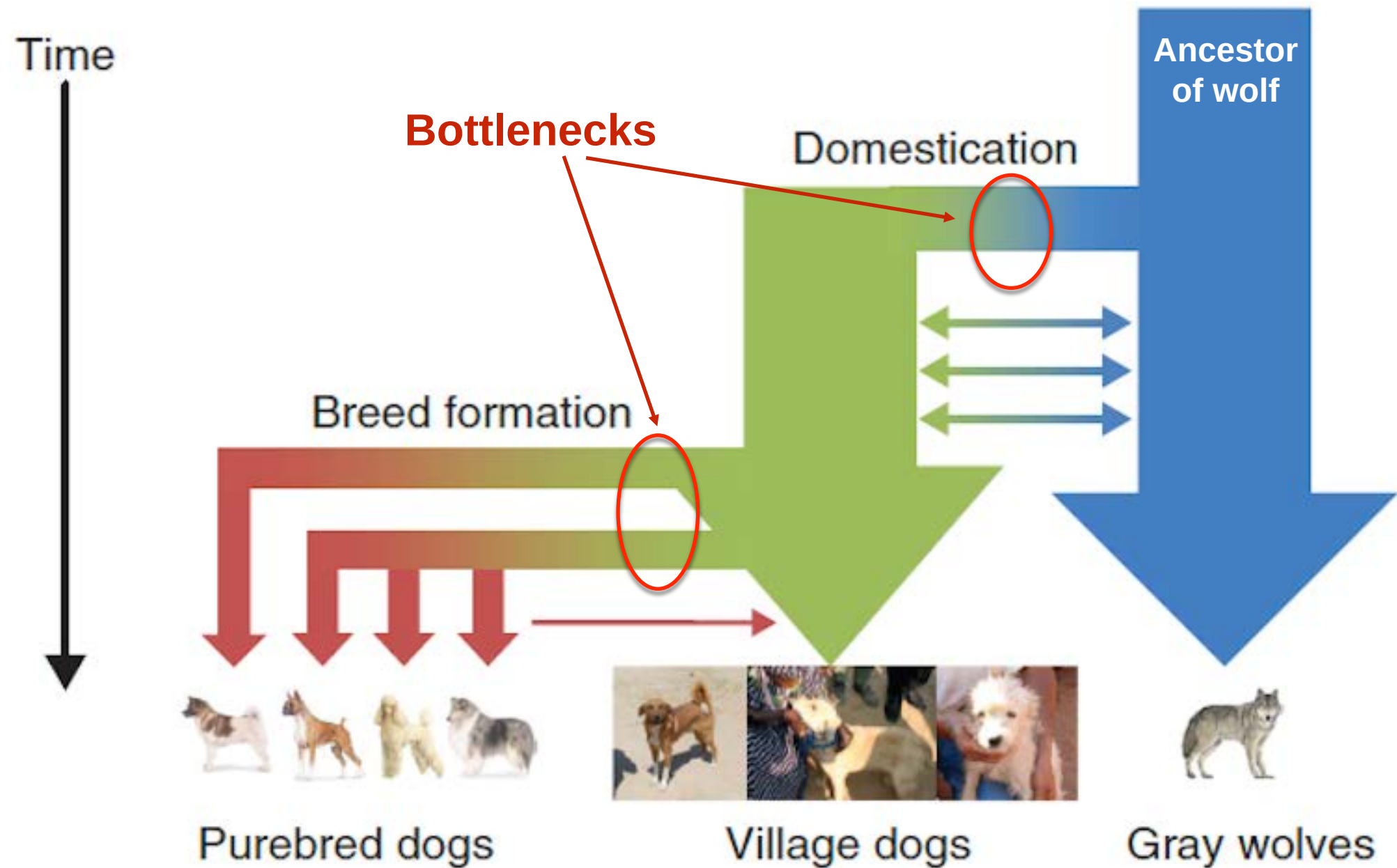
Data graphed & analyzed as

- 1) All dogs
- 2) Dogs with offspring (< 2014)
- 3) “Reference” population (2010-2017)

Dog Domestication



Dog Domestication





The Land Race Dog



Hamza Habib
August 2018

Breed Creation

100 Years

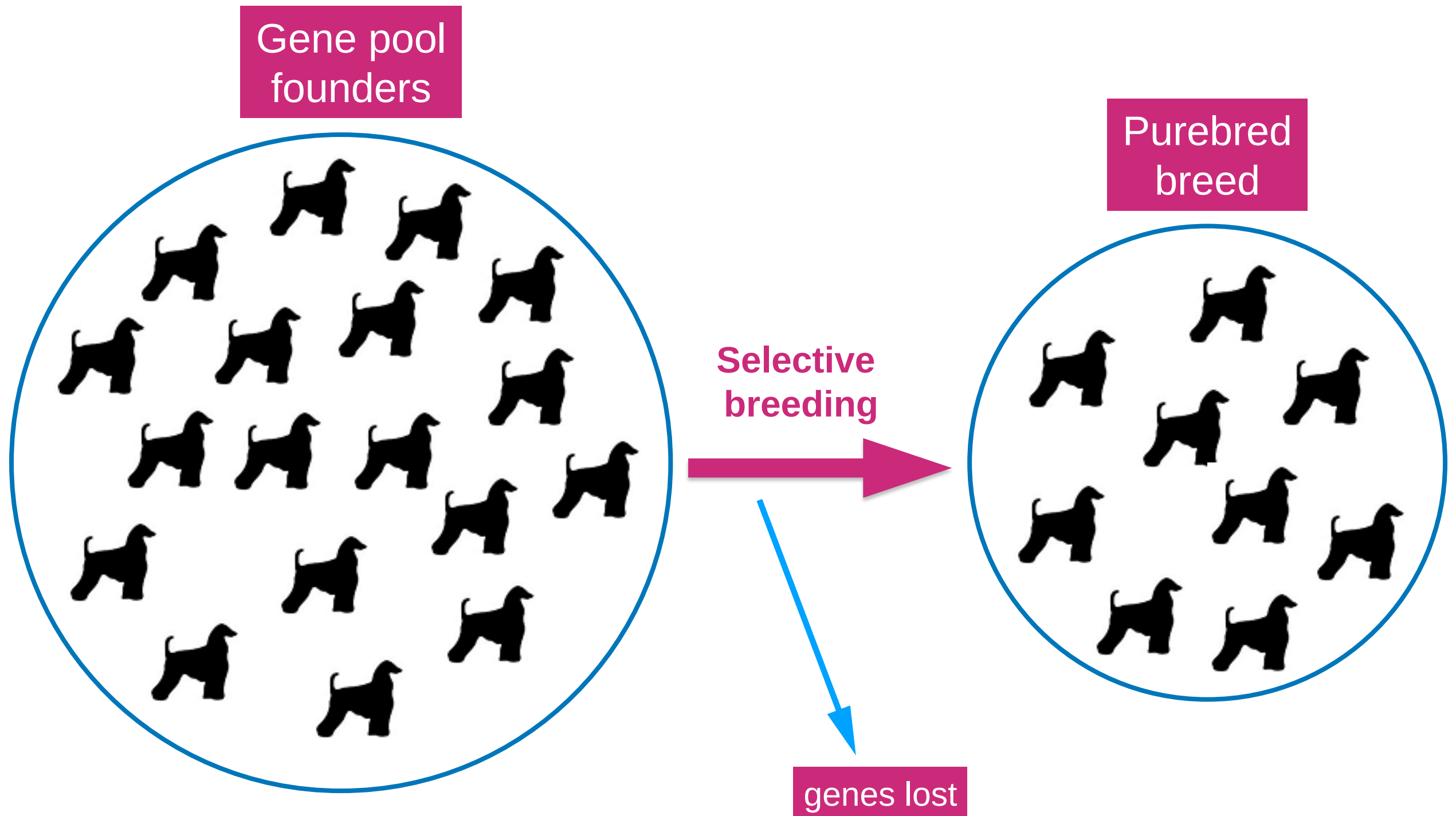


Sirdar of Ghazni



Tarina Adorah Eagle Scout

Breed Development



Genetic Founders

* Genetic founders were of two types

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)
Rani of Ghazni (1923)
Faida of Ghazni (1924)
Danenda of Ghazni (1924)
Zarifa of Ghazni (1925)
Roshini of Ghazni (1925)

First Decade

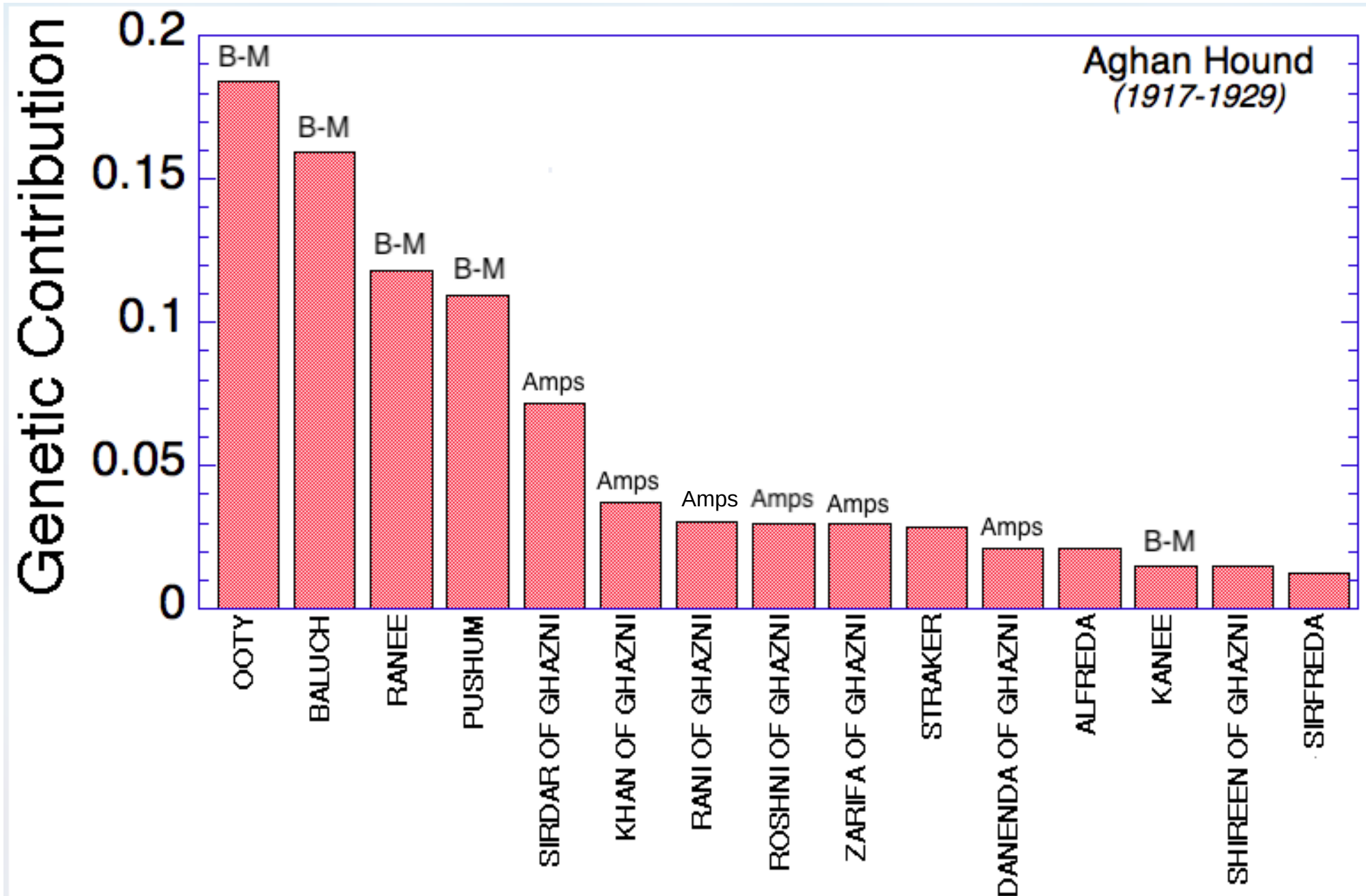
- * Genetic contributions of founders in the first decade
- * Bell-Murray dominates the gene pool

Bell-Murray (desert)

Kanee (1916)
Pushum (1917)
Ranee (1919)
Baluch (1920)
Ooty (1921)

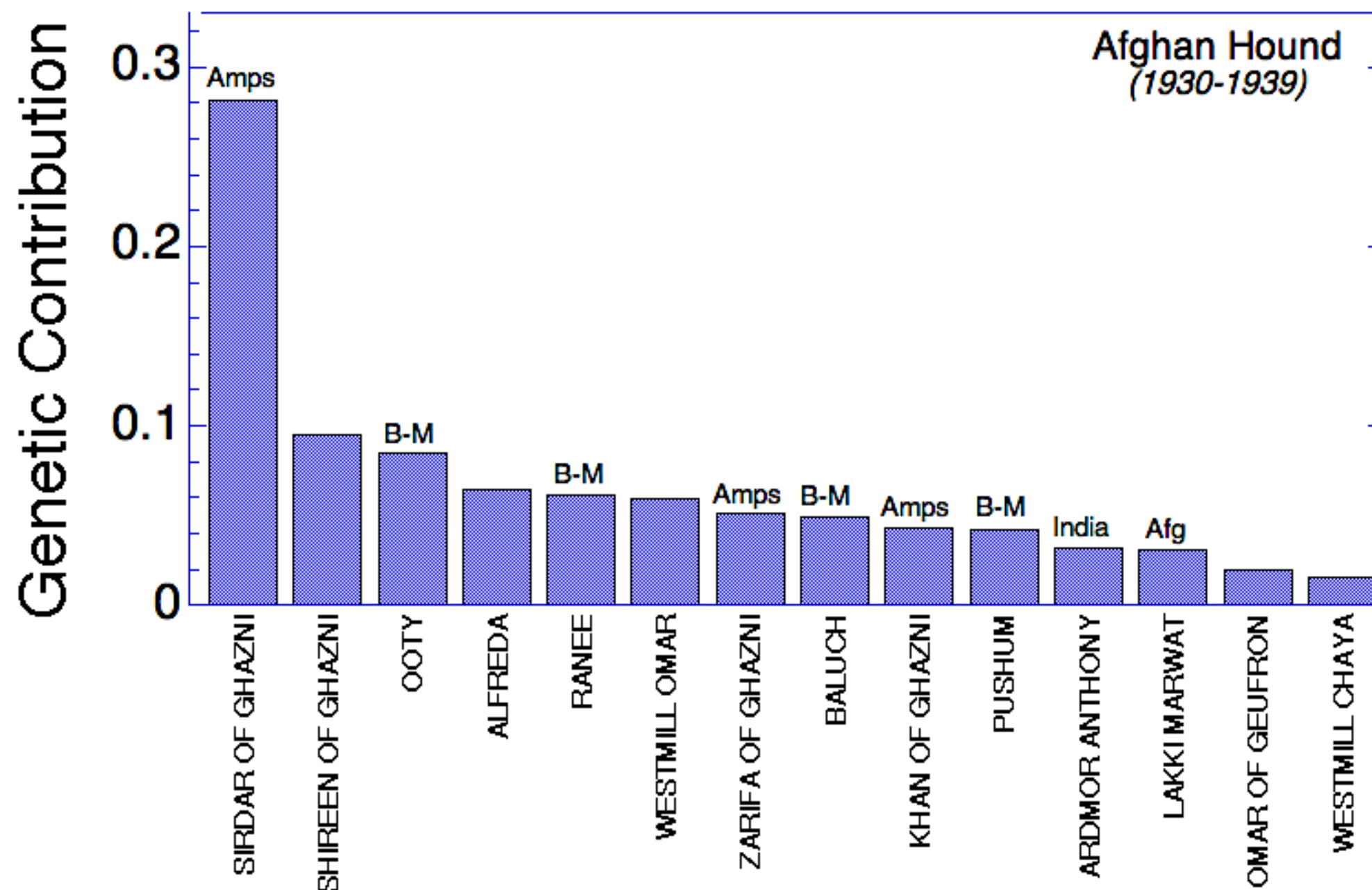
Amps (mountain)

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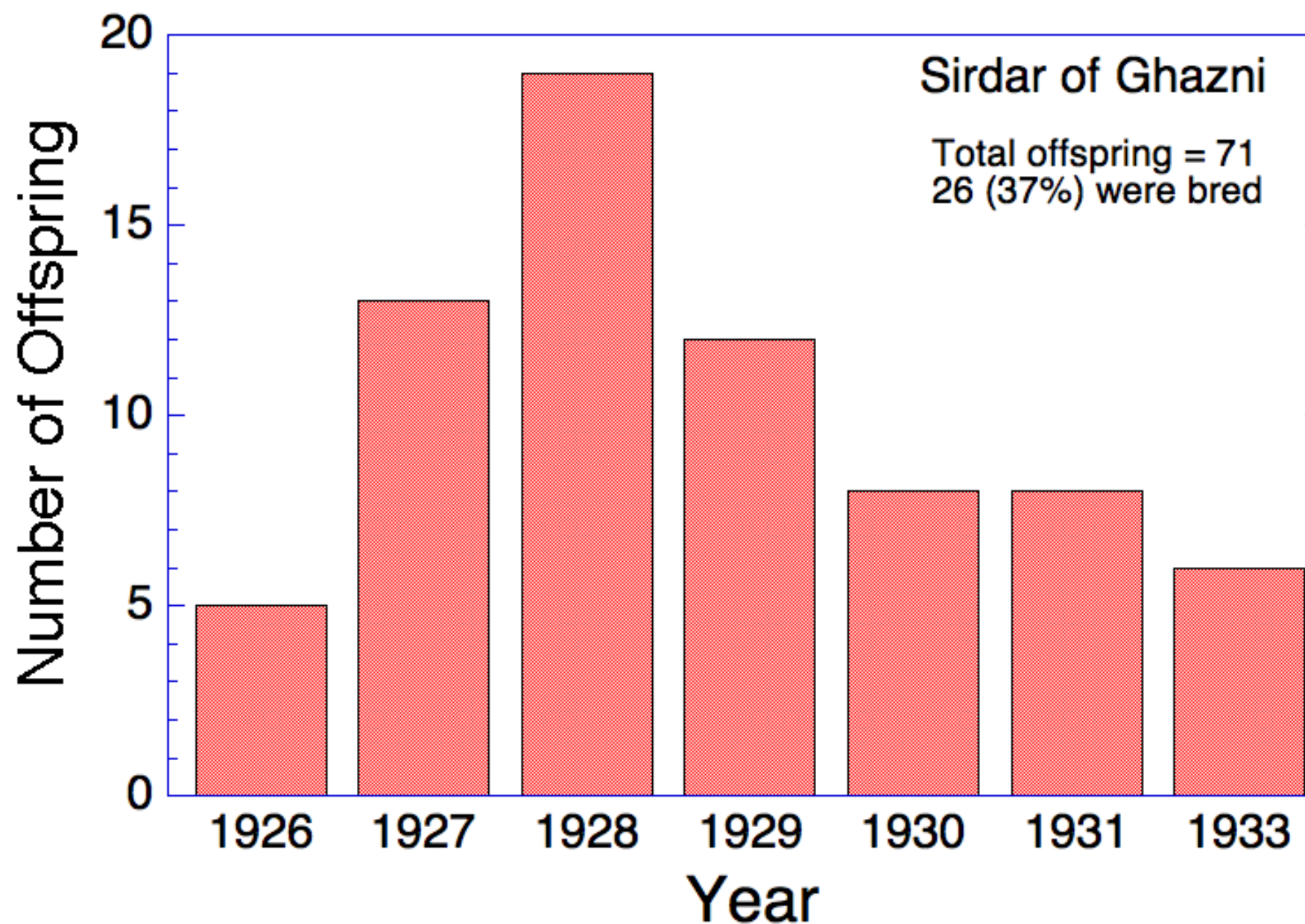
Second Decade

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

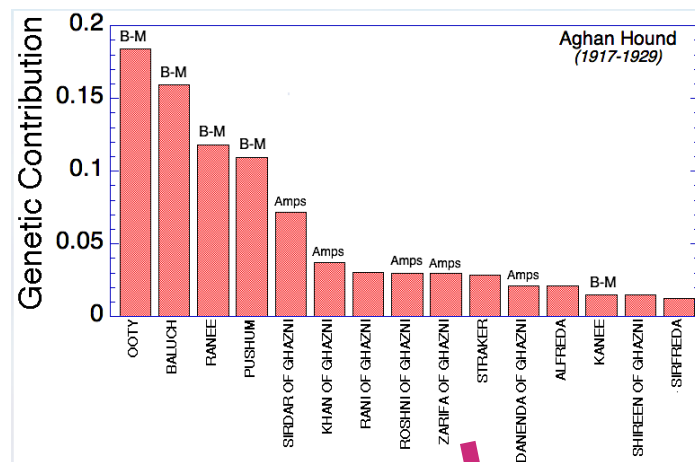
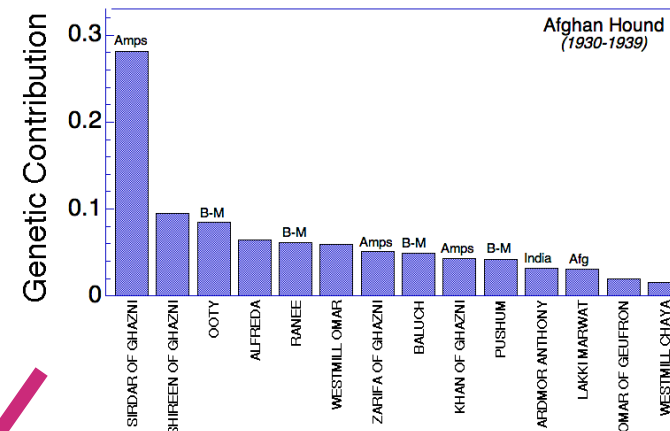
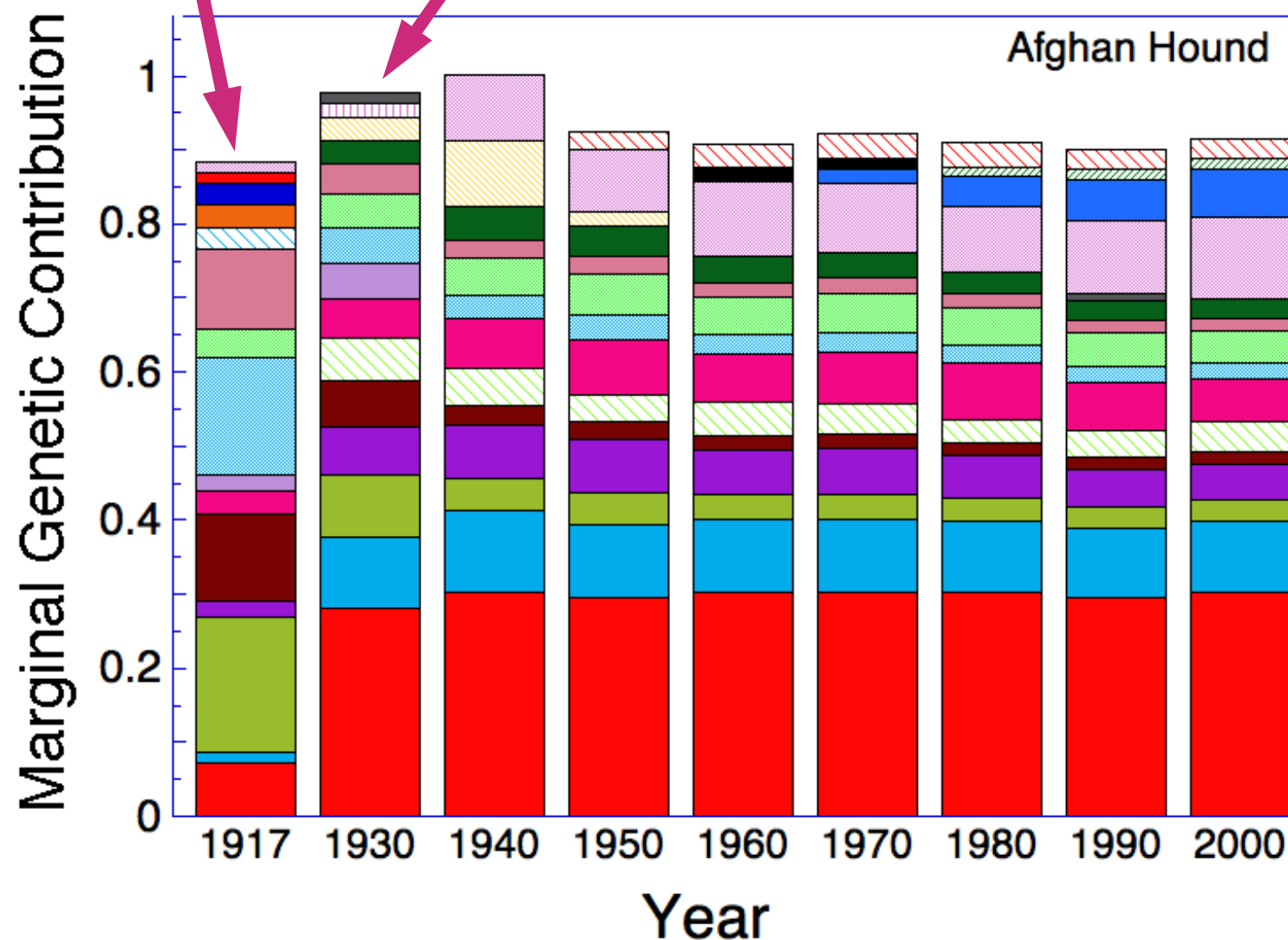


Sirdar of Ghazni

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

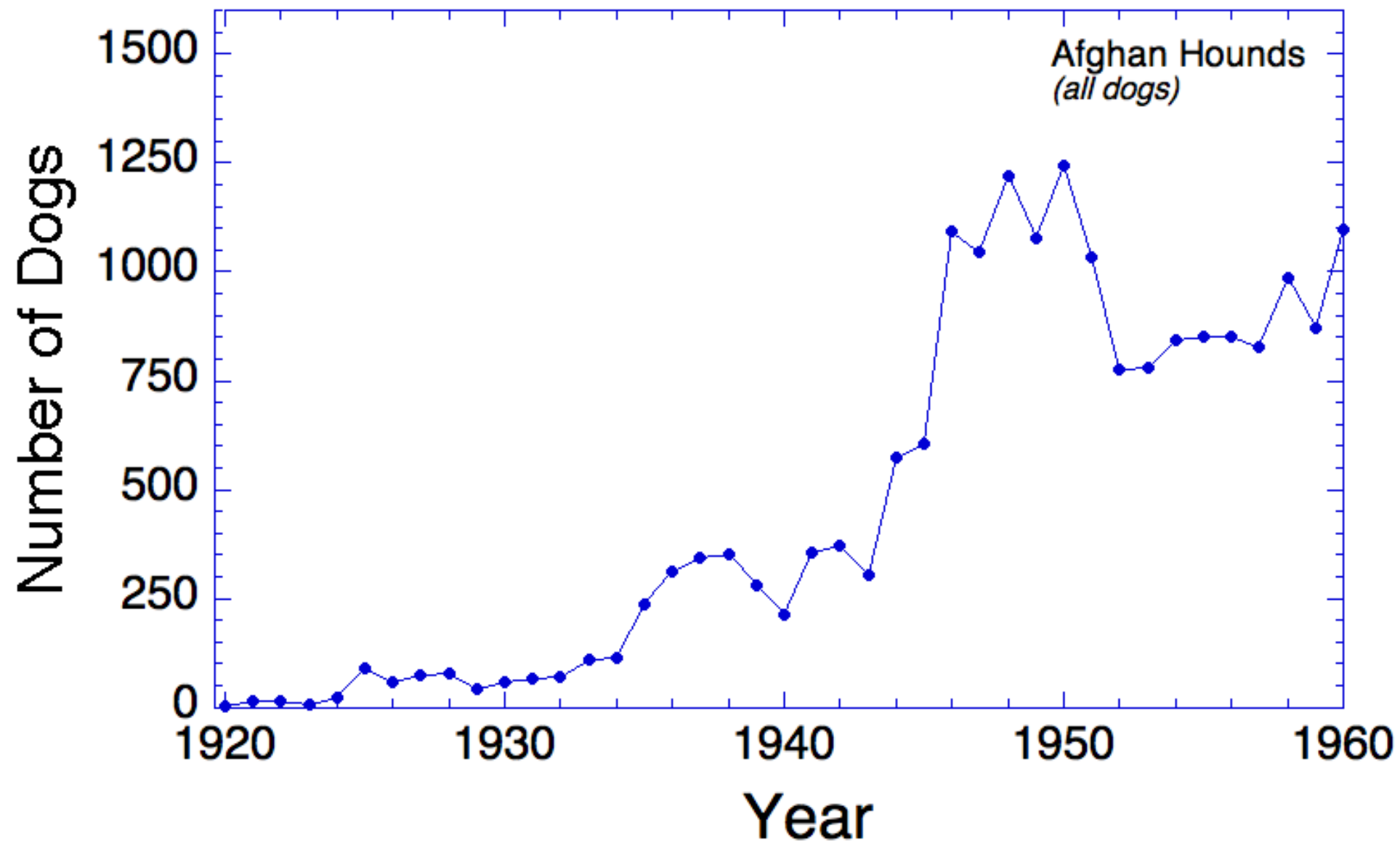


Composition of the Gene Pool



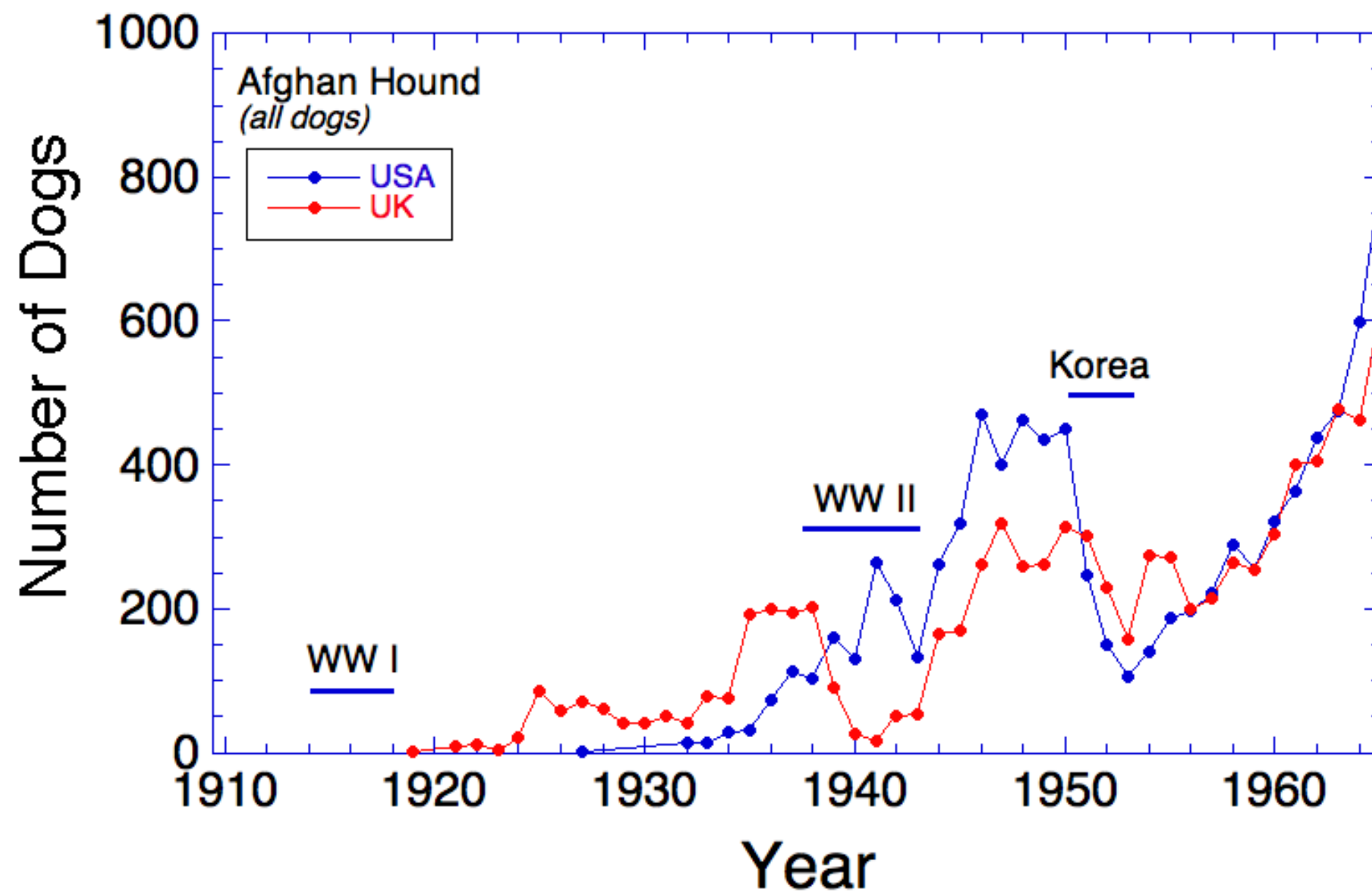
Population Size

* Popularity grew gradually to 1960



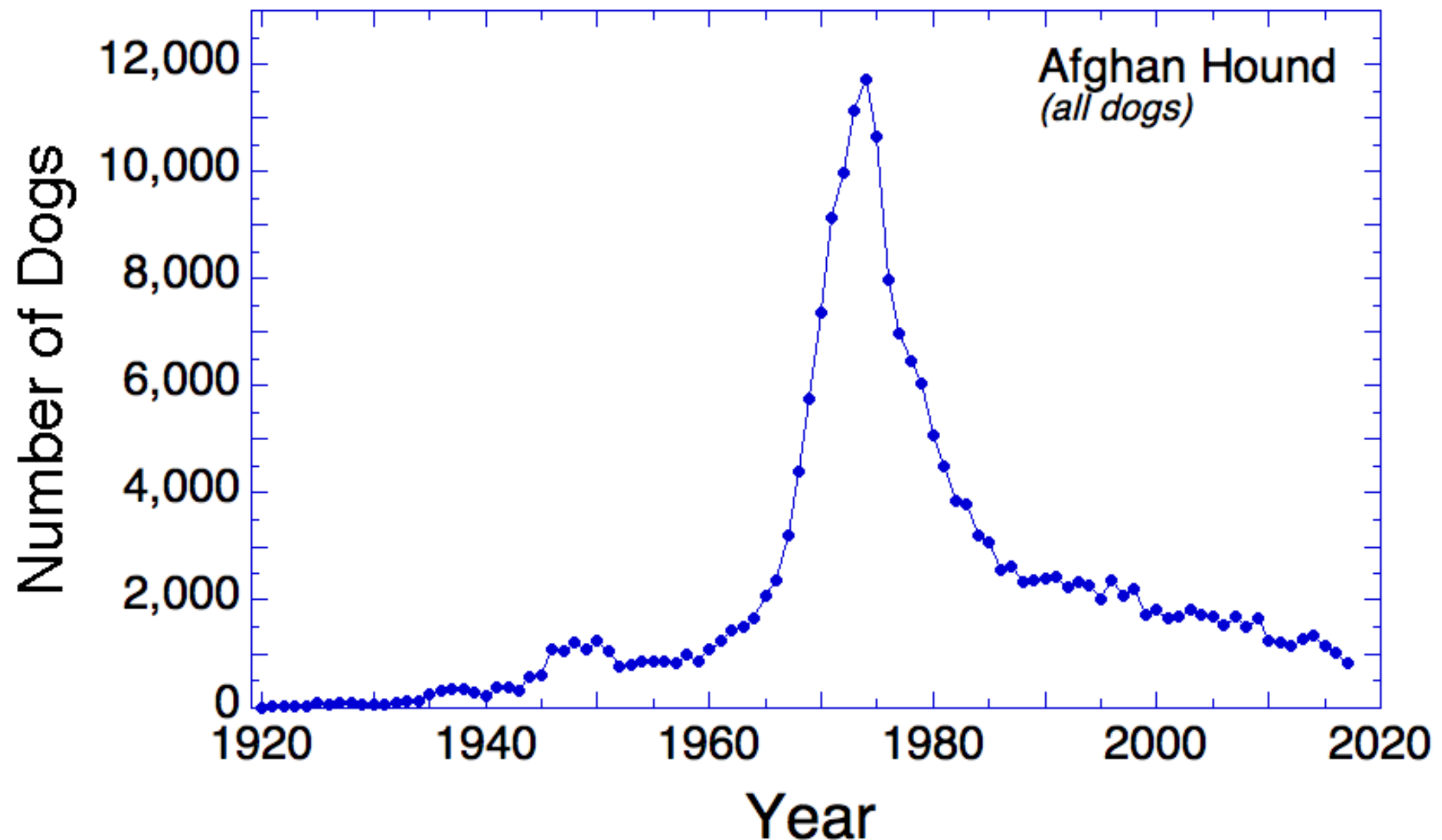
Effects of Wars

* Wars profoundly affected breeding



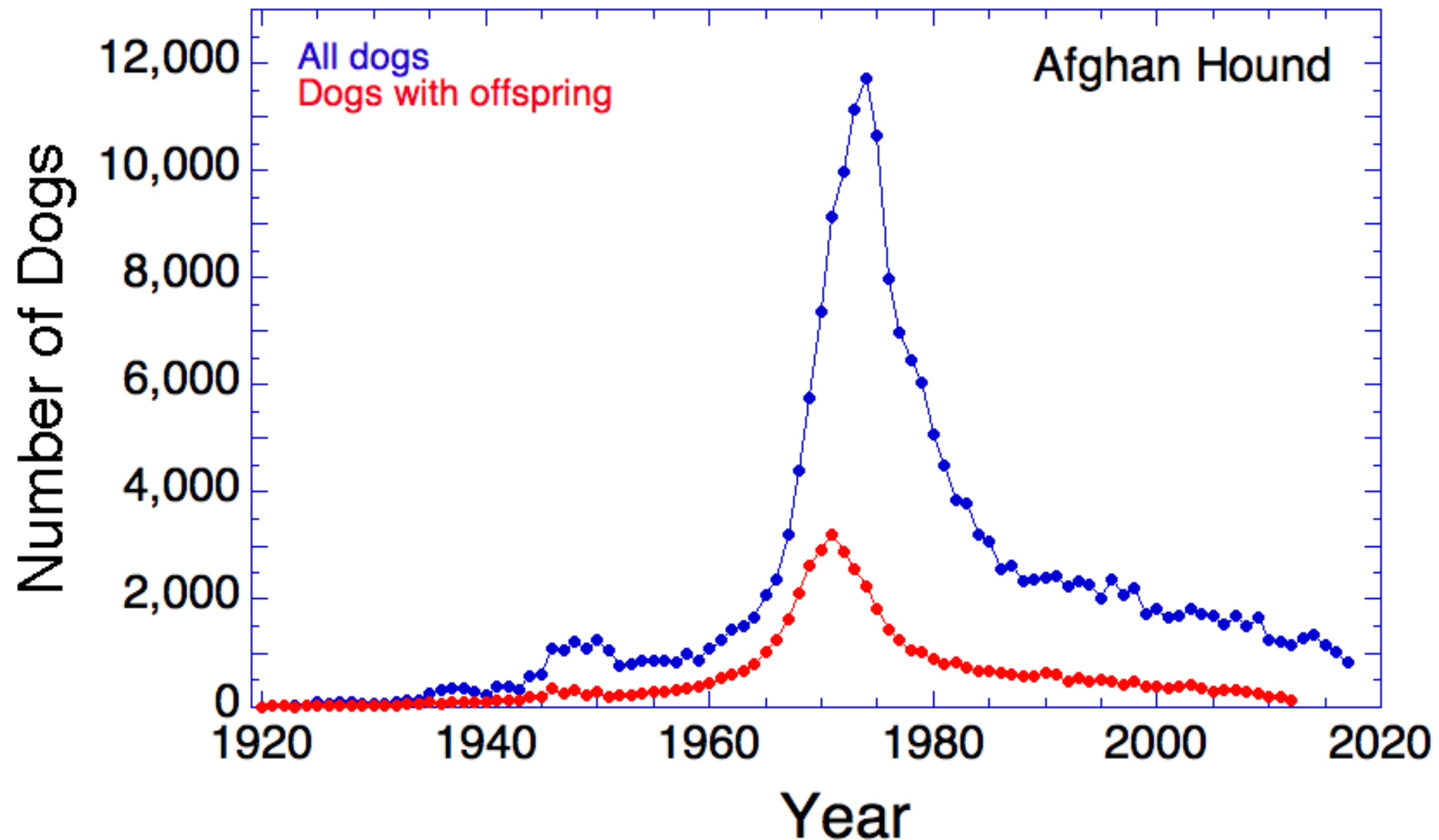
Decline in Popularity

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



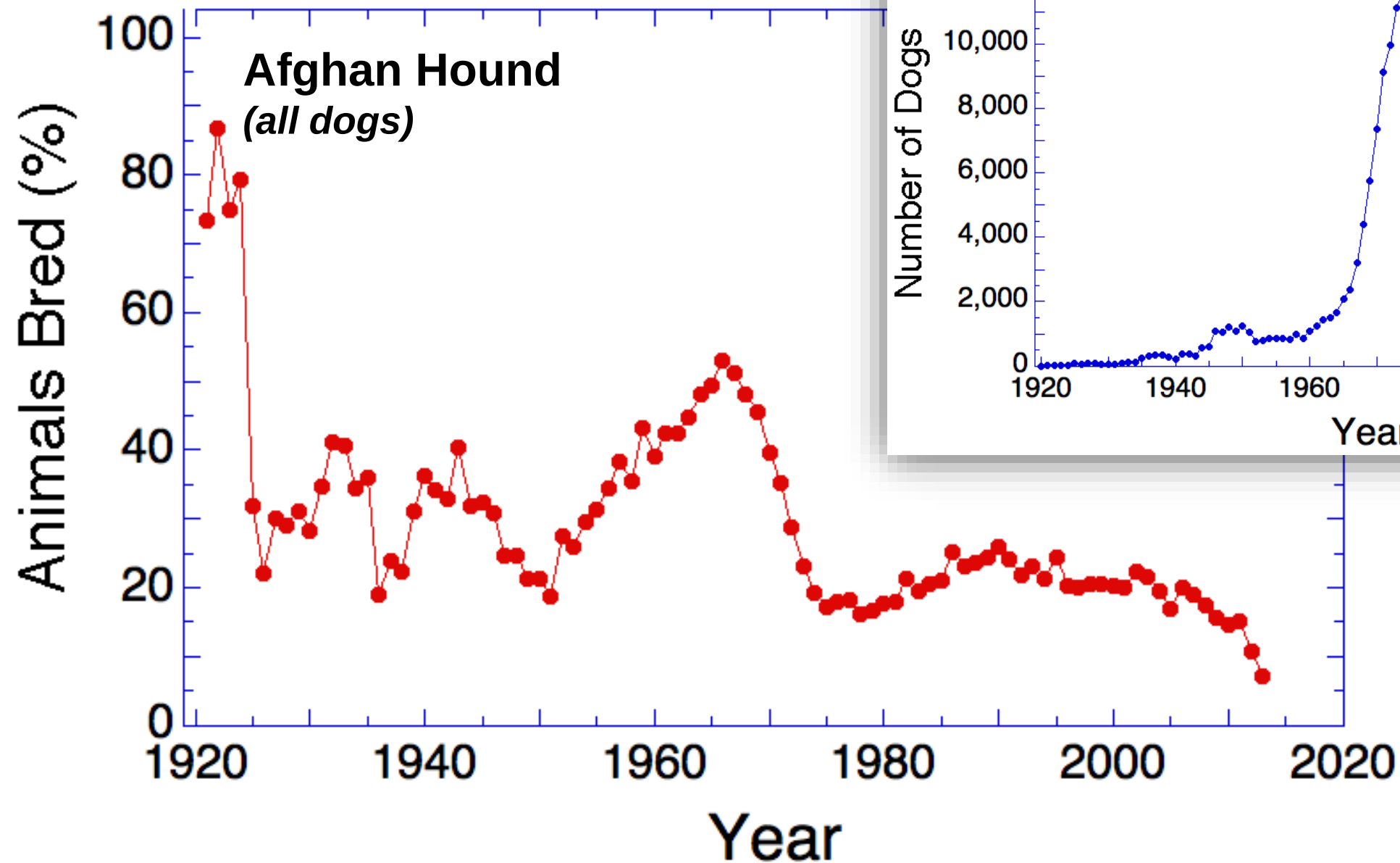
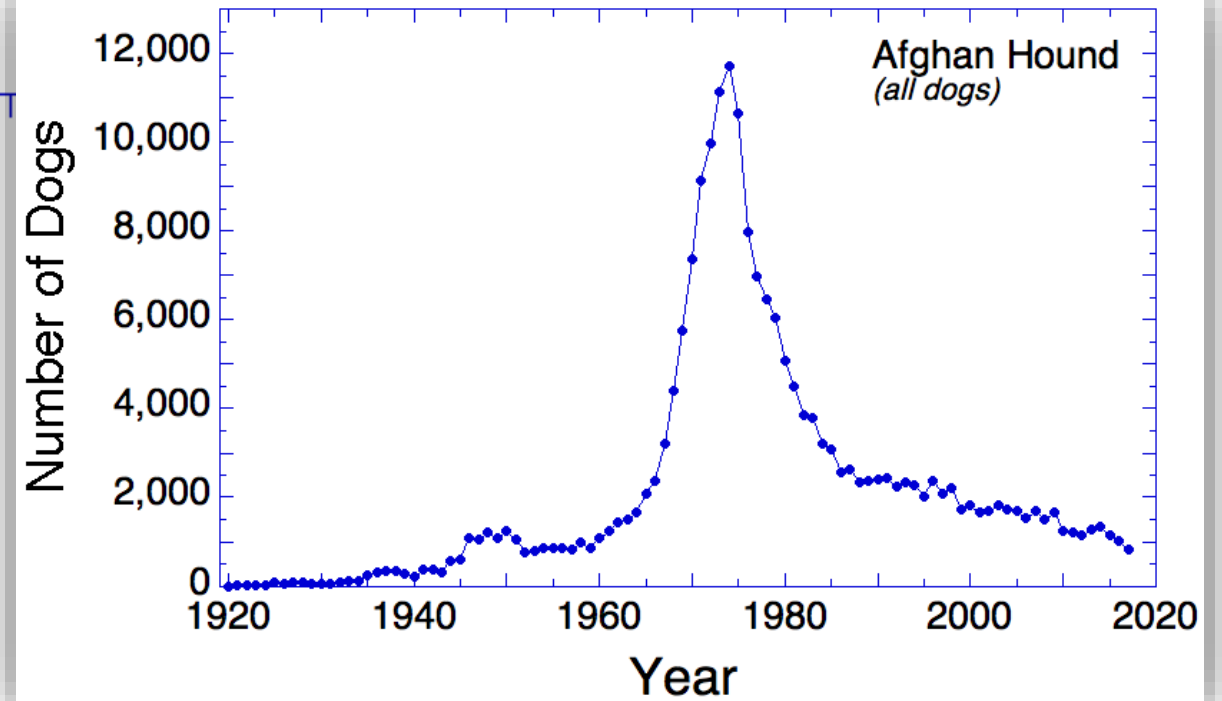
Population Size

* Most dogs did not produce offspring



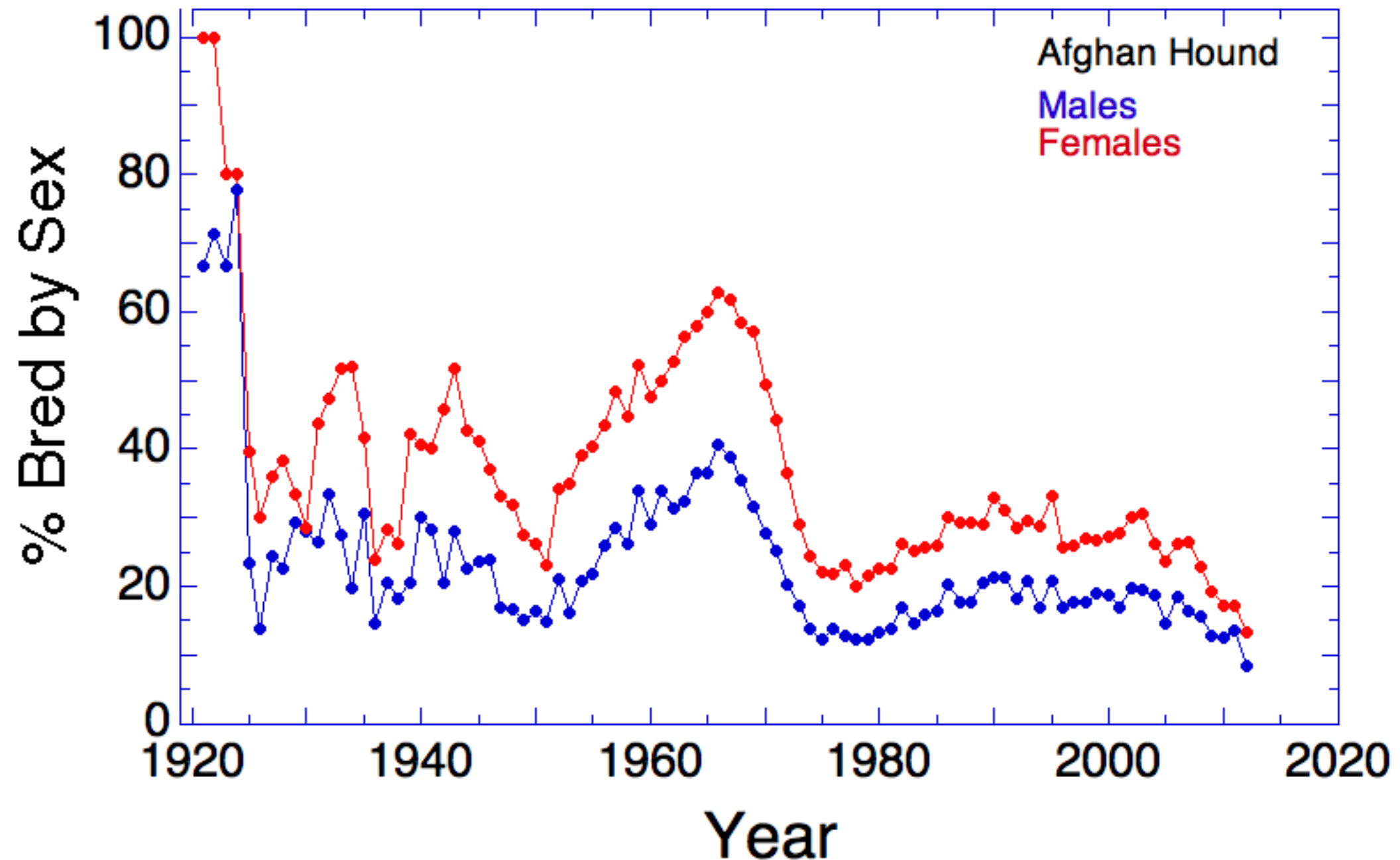
Breeding

- * In general, < 40% of animals are bred
- * Since 1980, < 30%

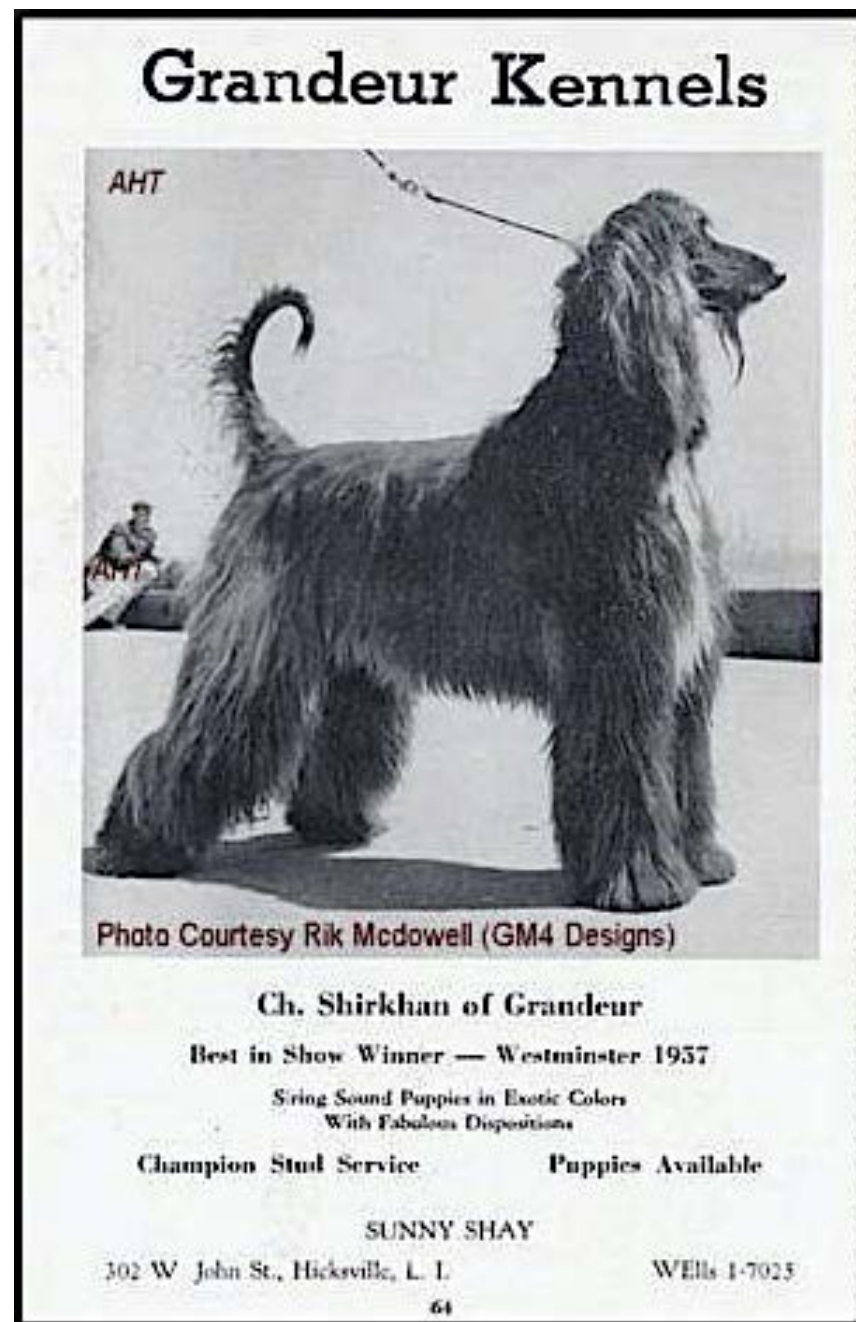


Sires & Dams

* Fewer males than females are bred



Shirkhan of Grandeur

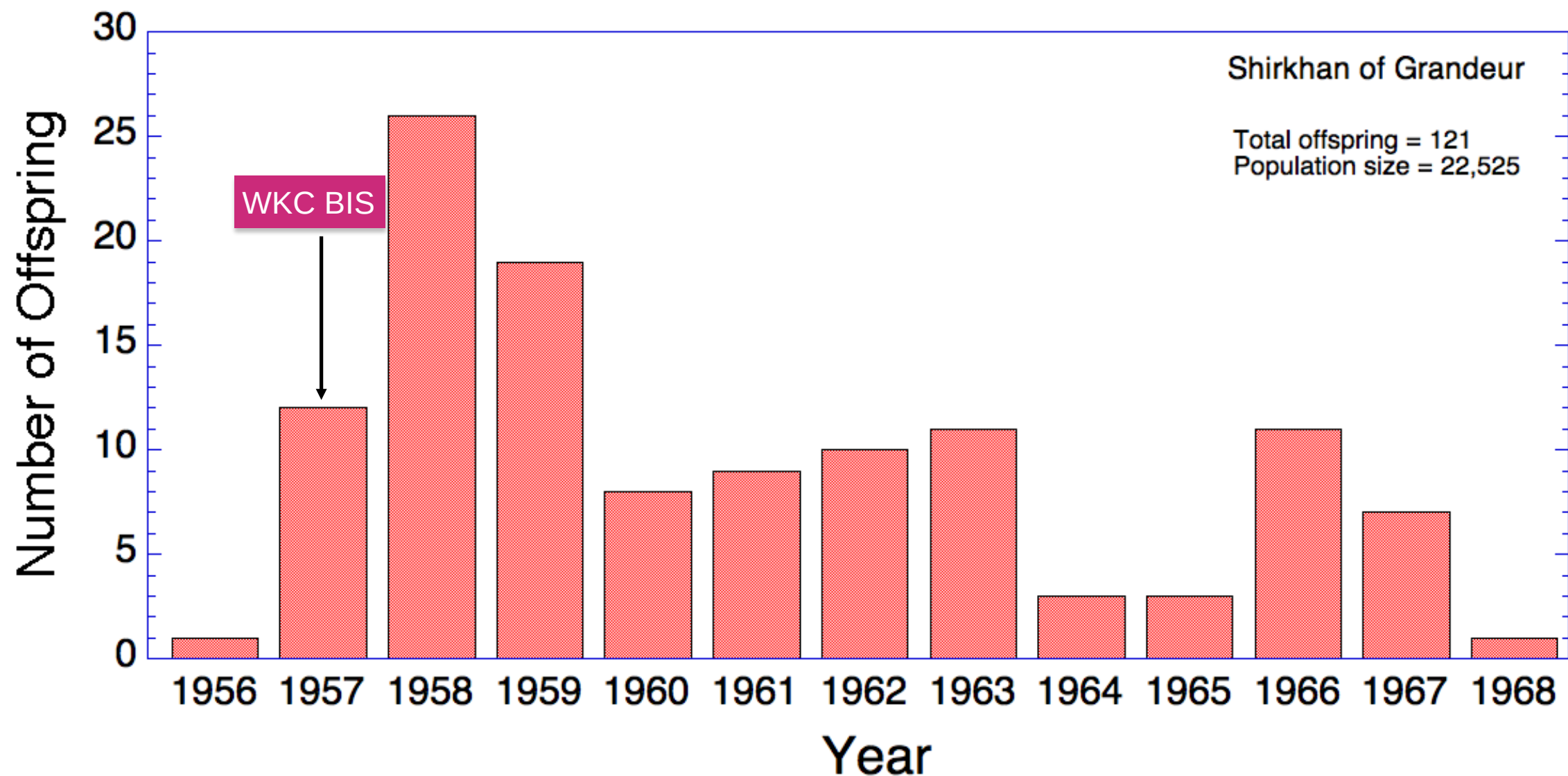


b. 1954

BIS 1957
Westminster Kennel Club

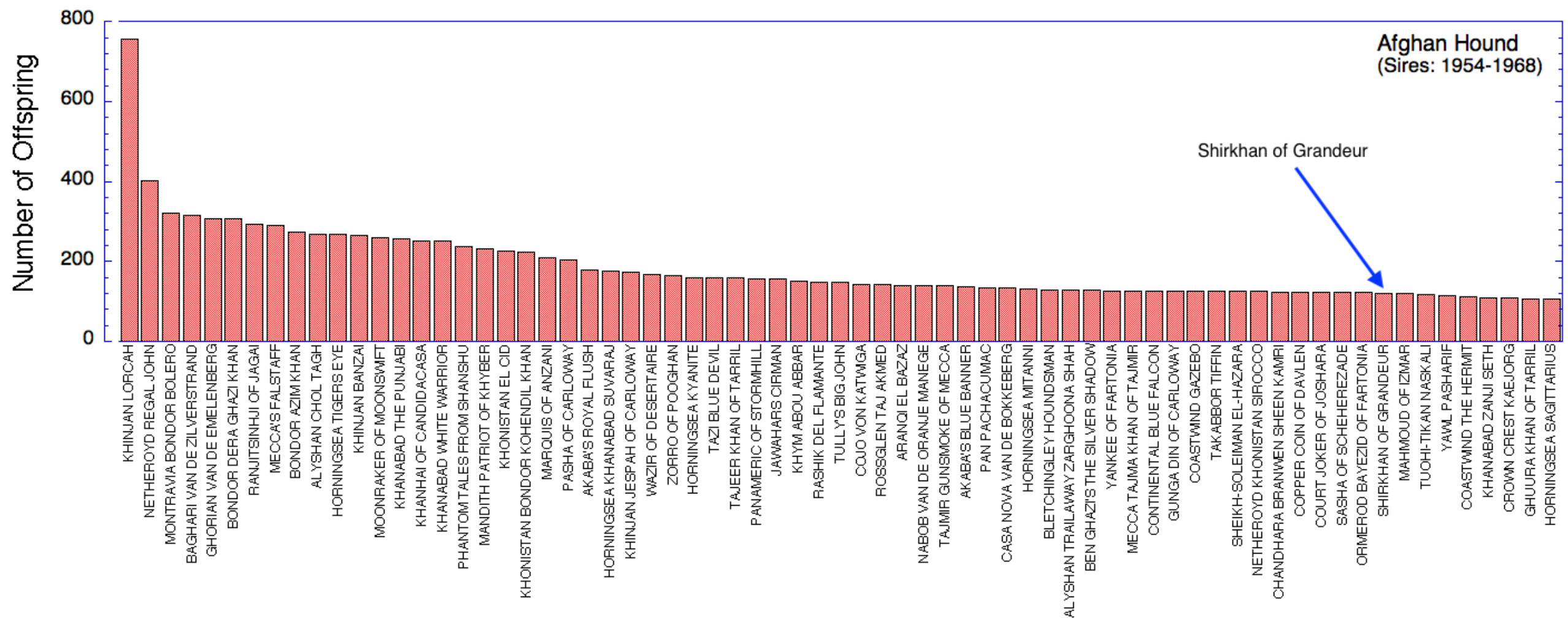
Shirkhan of Grandeur

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



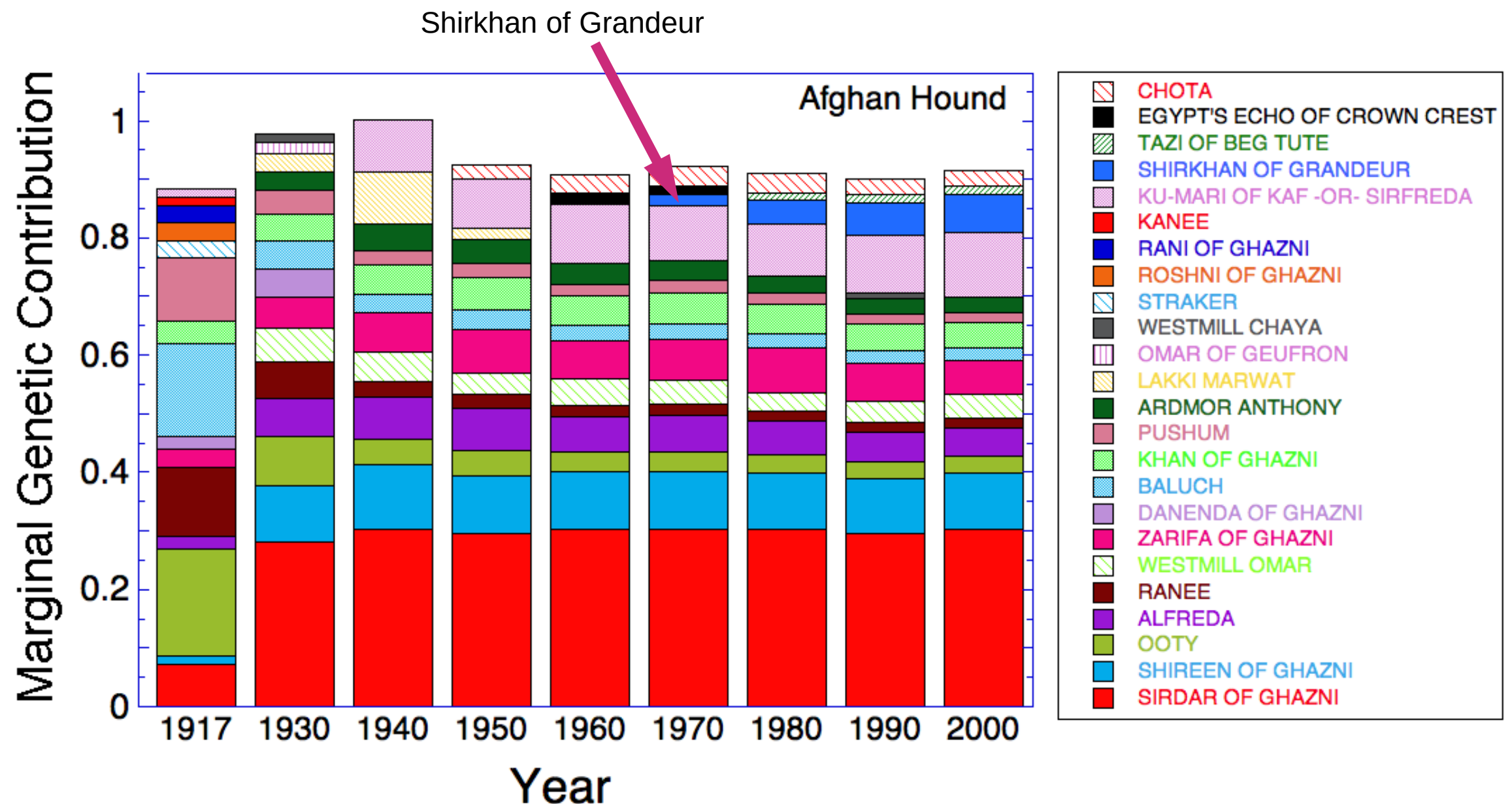
Shirkhan of Grandeur

- * He was NOT a “popular sire”
- * Far down the rankings



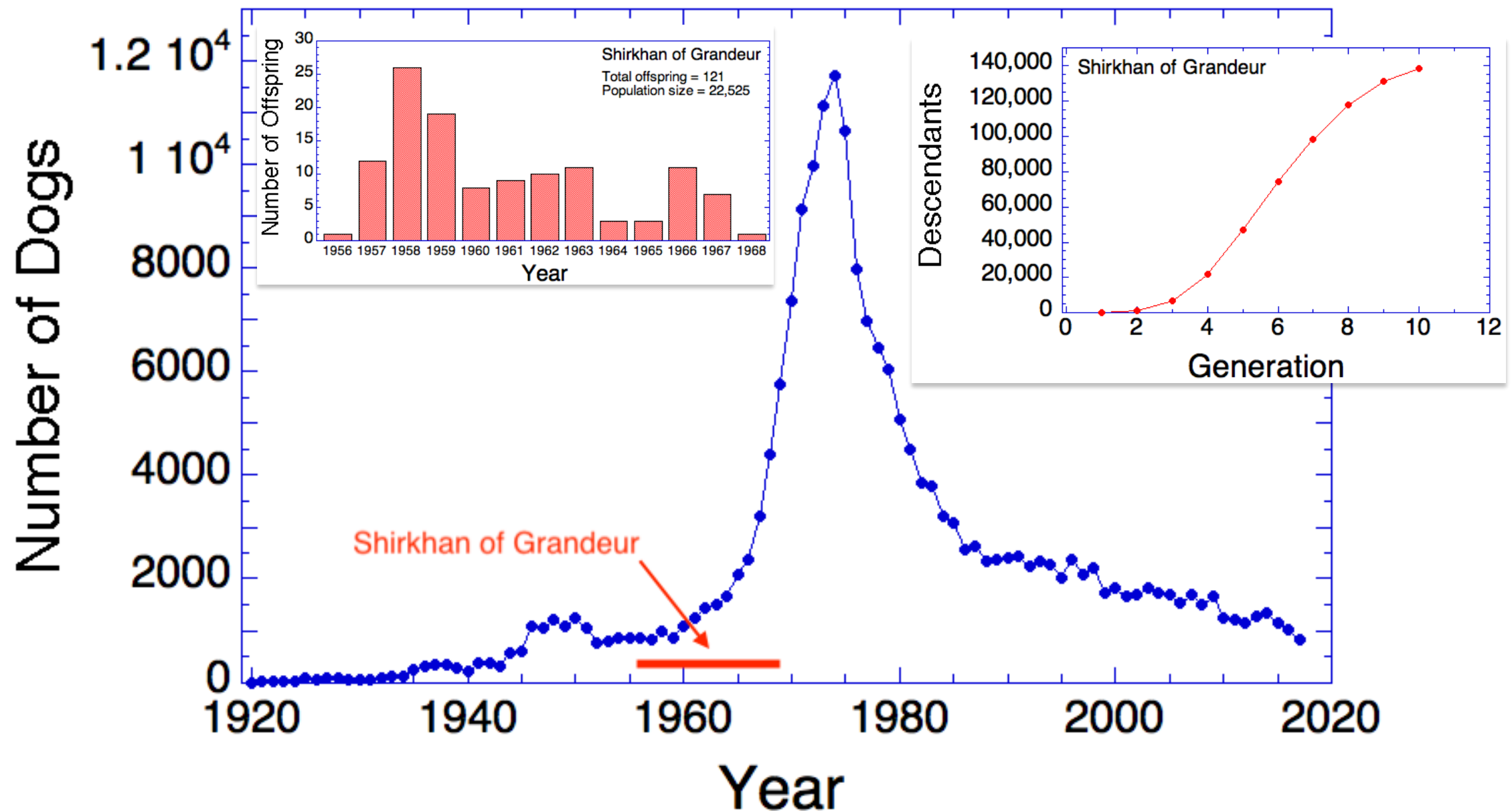
Shirkhan of Grandeur

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



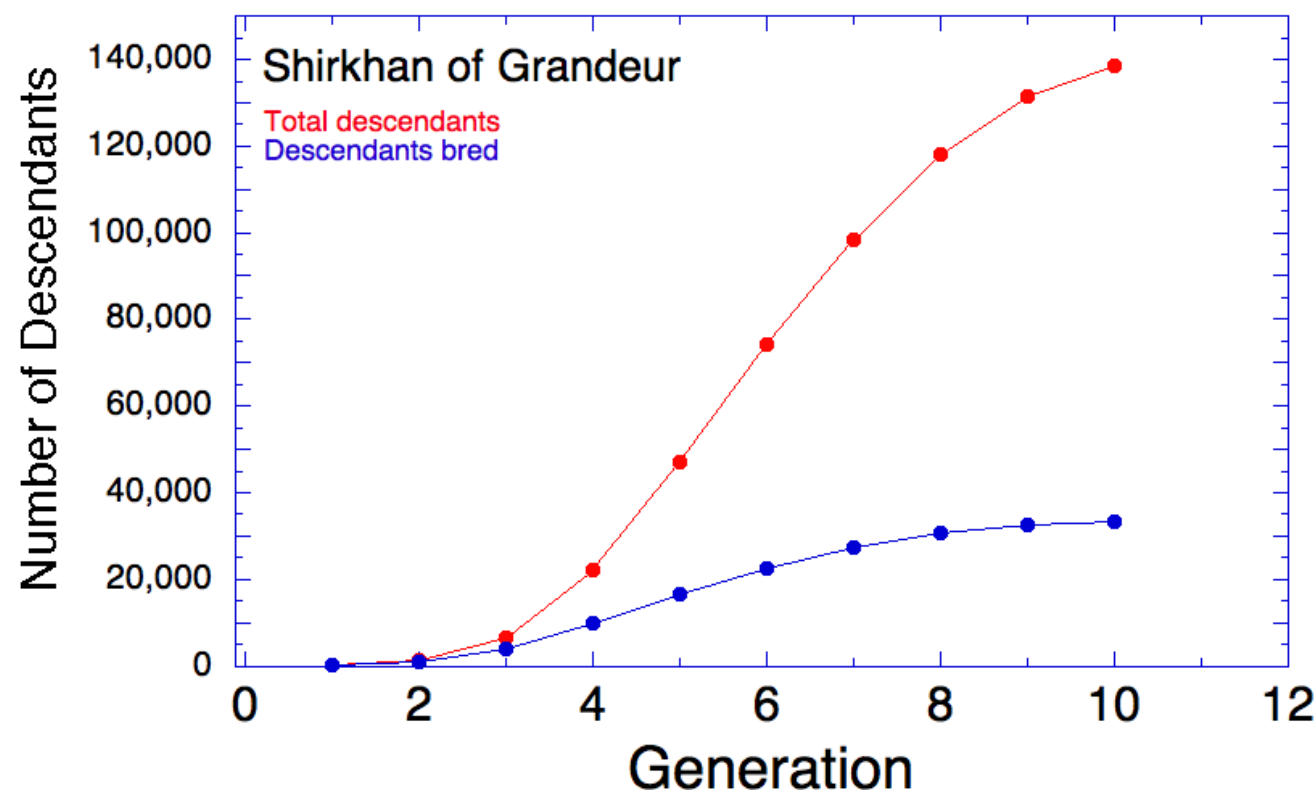
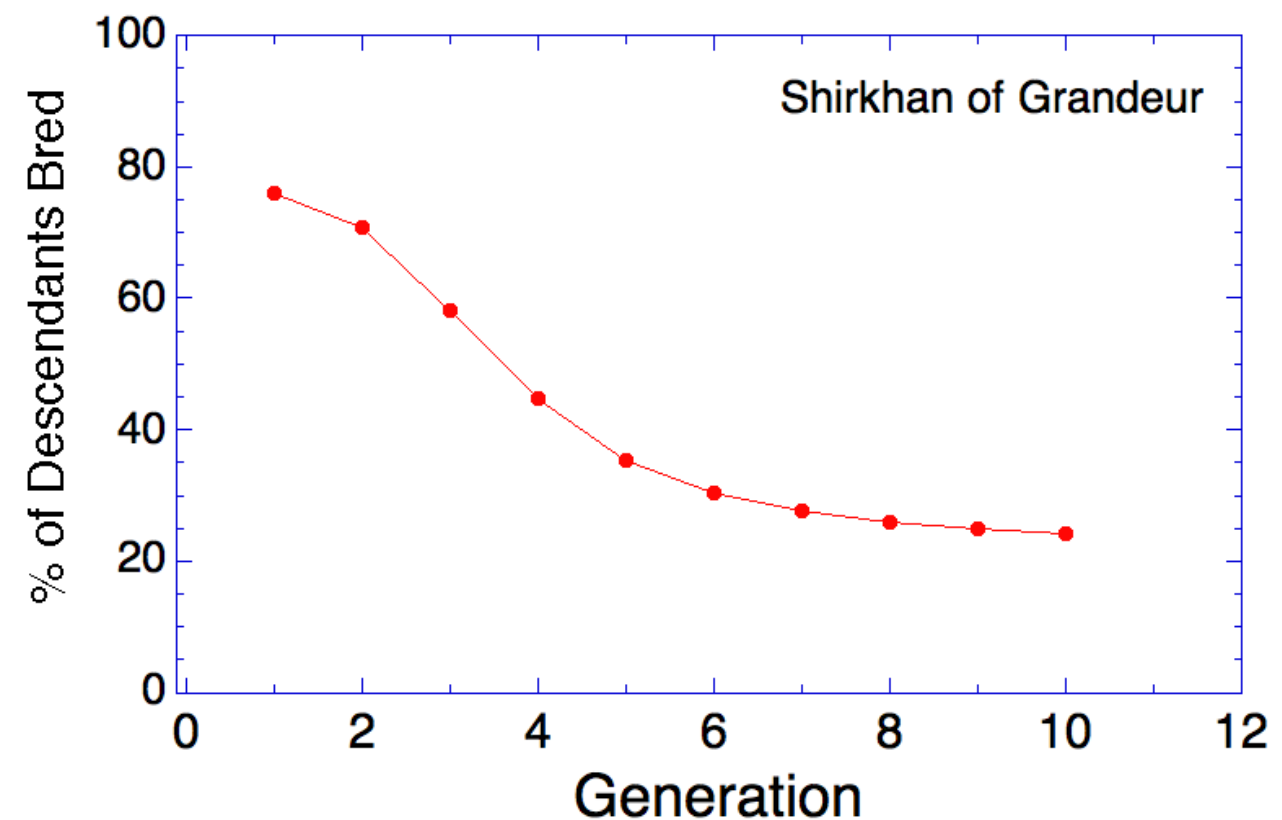
Shirkhan of Grandeur

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

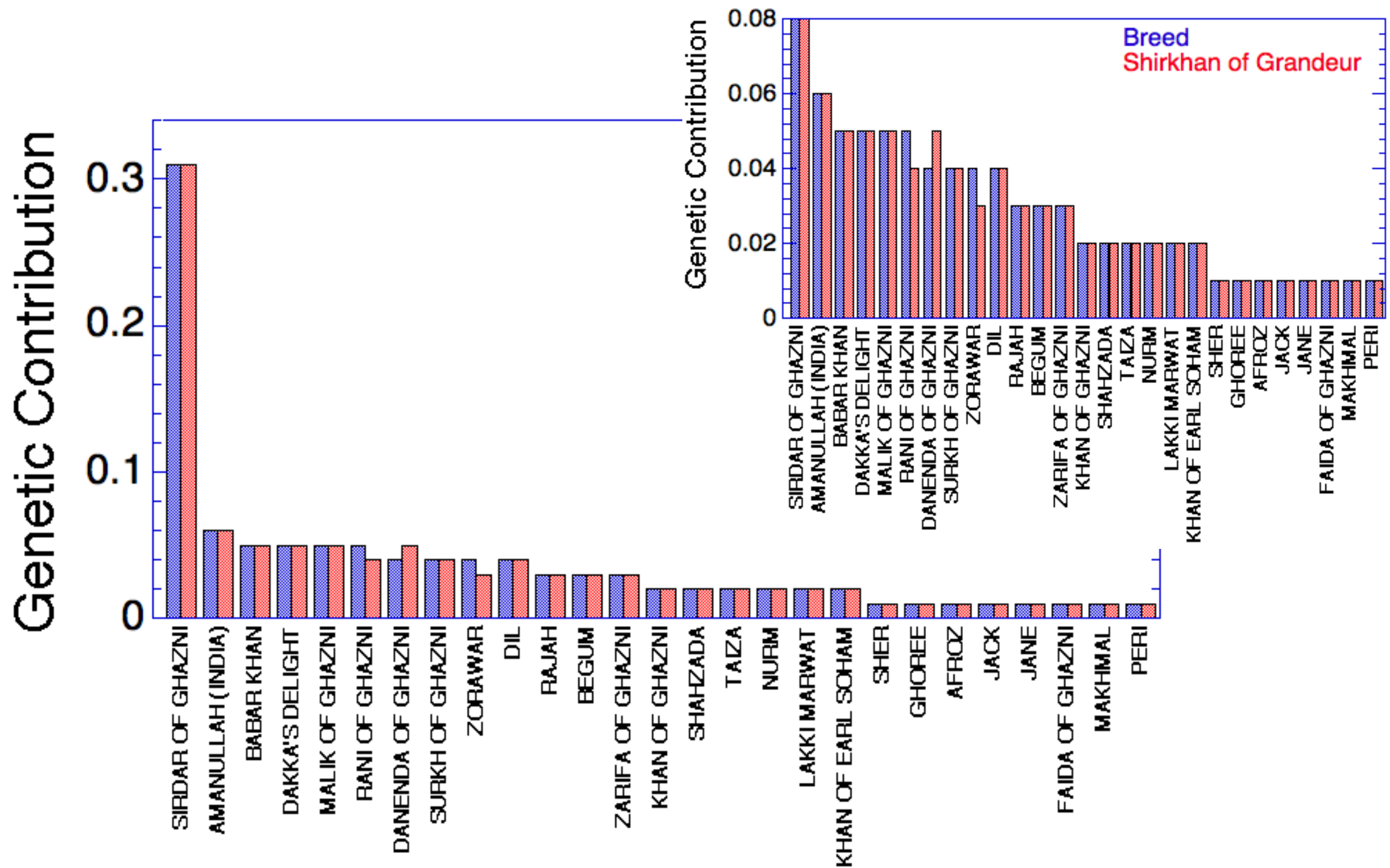


Shirkhan of Grandeur

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



Shirkhan of Grandeur



Inbreeding

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

Advantages:

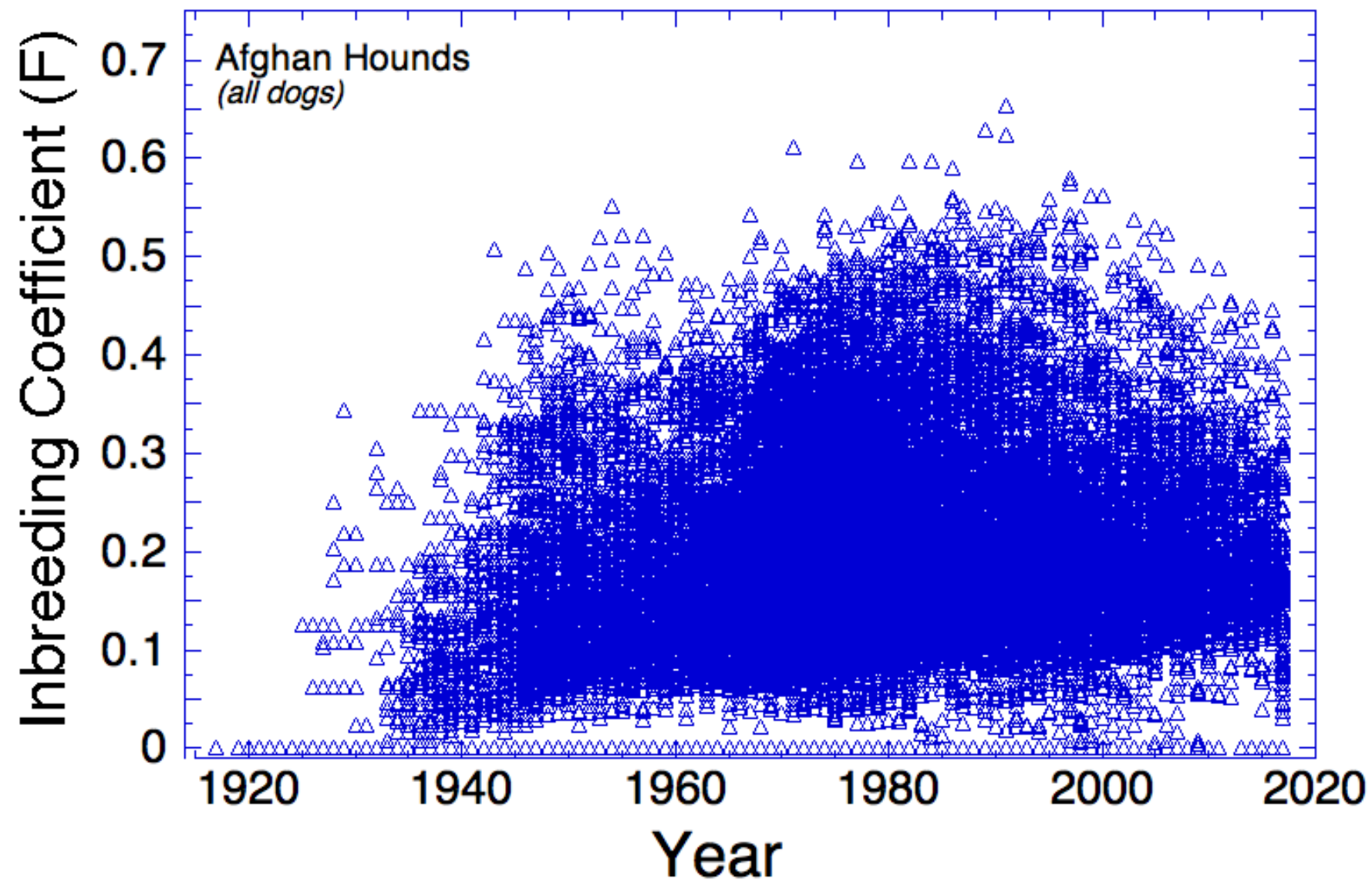
- * increased uniformity
- * increased prepotency
- * fixes genes for type

Disadvantages:

- * lower fertility
- * genetic defects
- * lower fitness (health, lifespan, “vigor”)

Inbreeding

* Significant early inbreeding

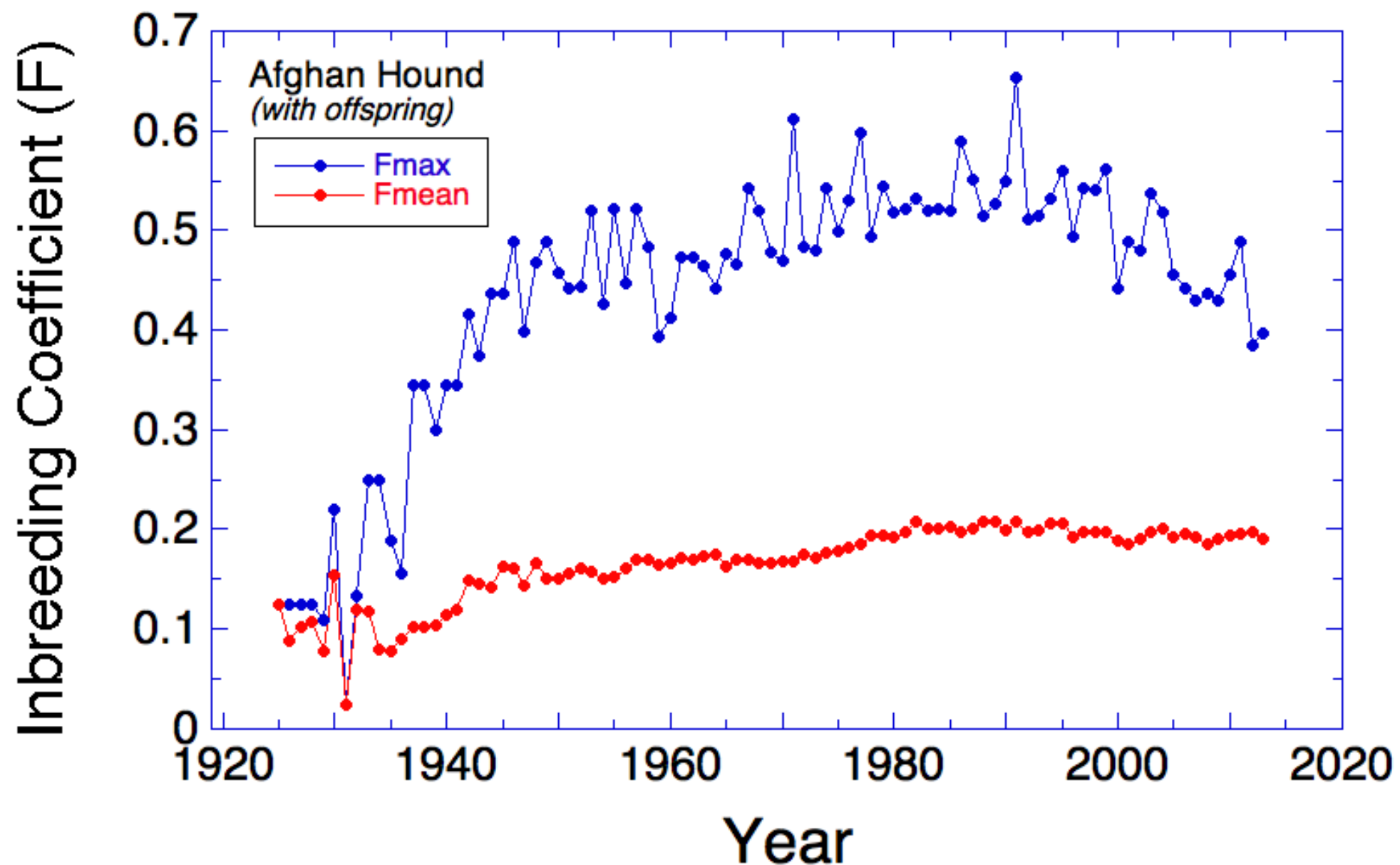


Inbreeding

Since 1950

* Average inbreeding > 15%

* Maximum inbreeding > 40%

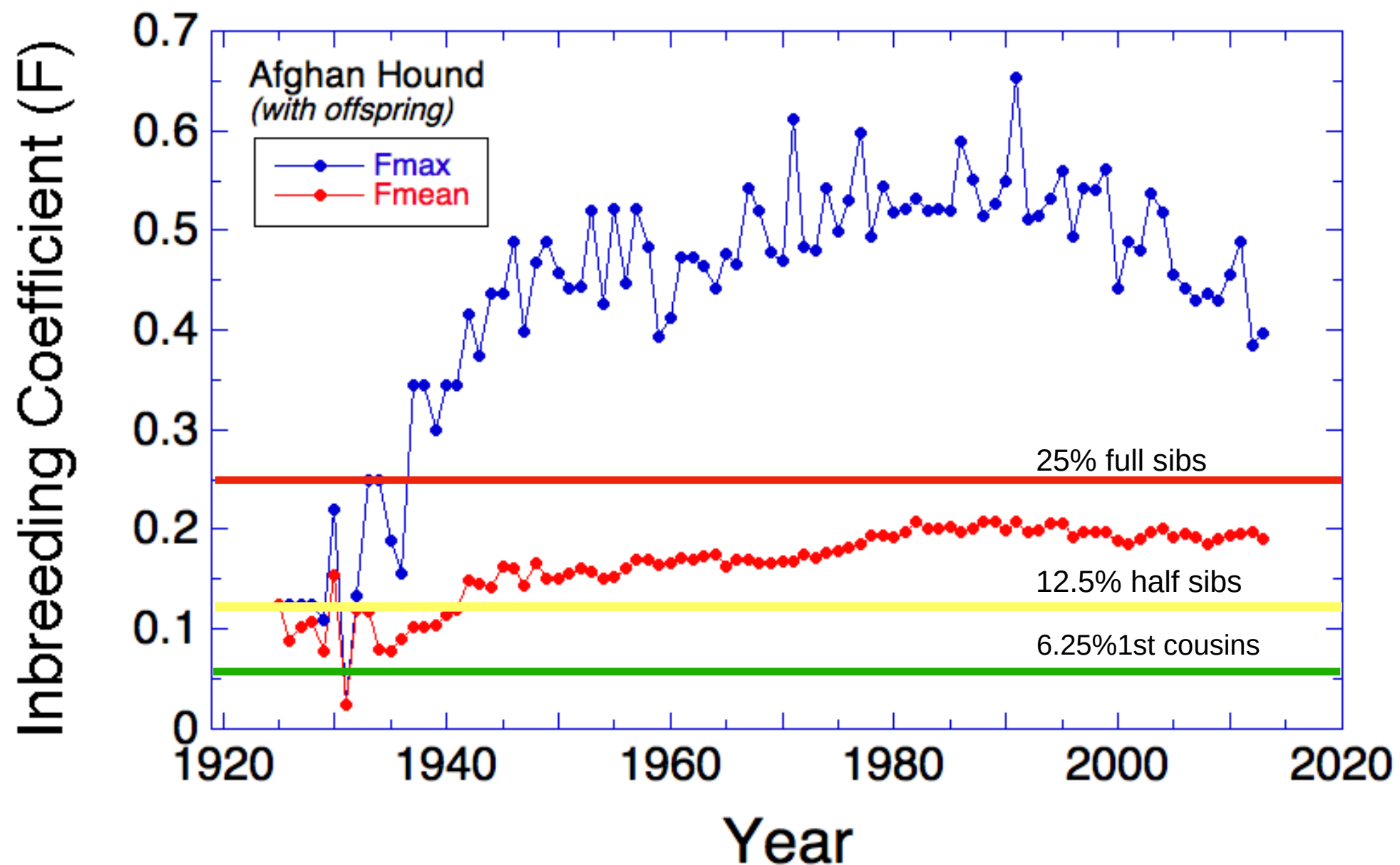


Inbreeding

Since 1950

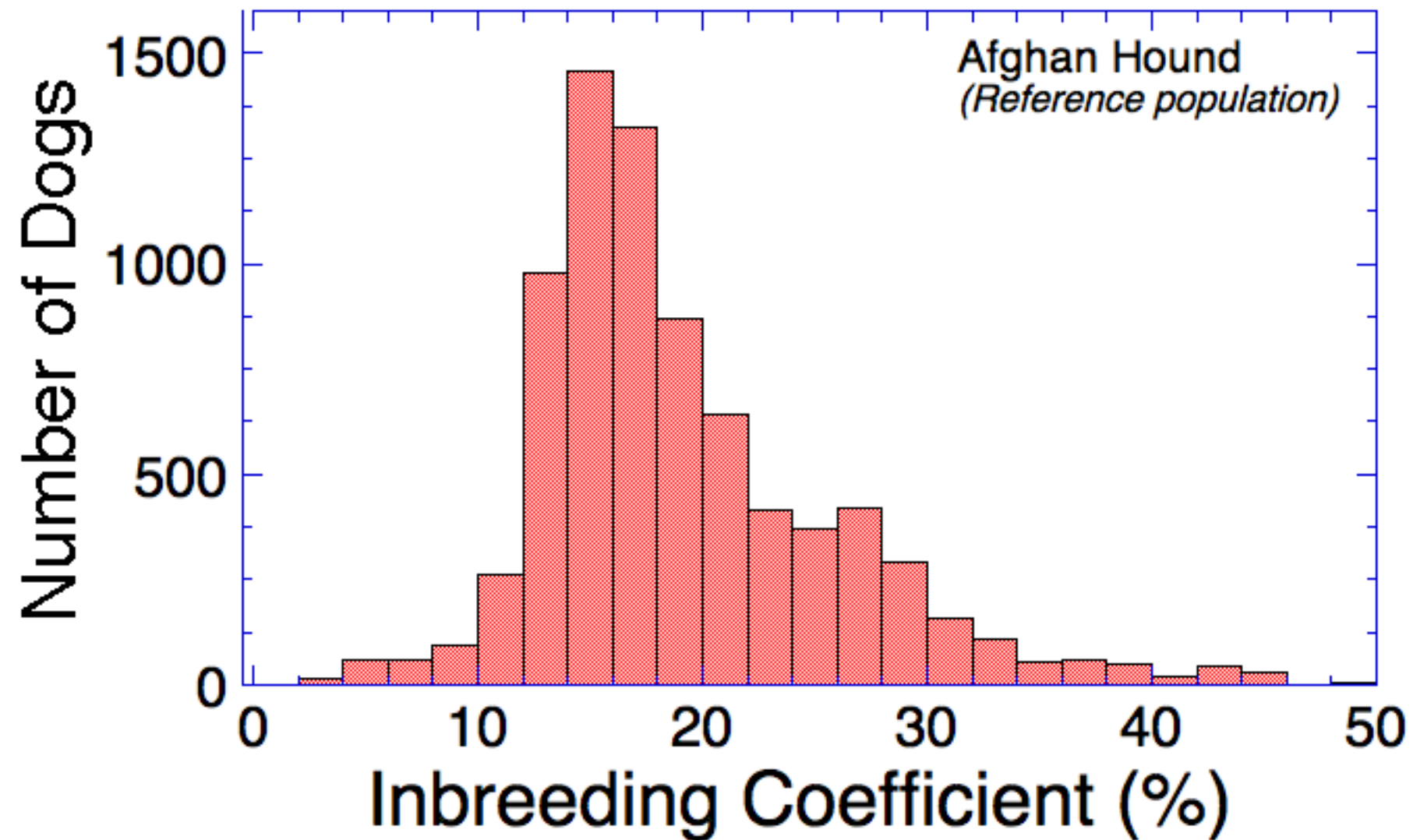
* Average inbreeding > 15%

* Maximum inbreeding > 40%



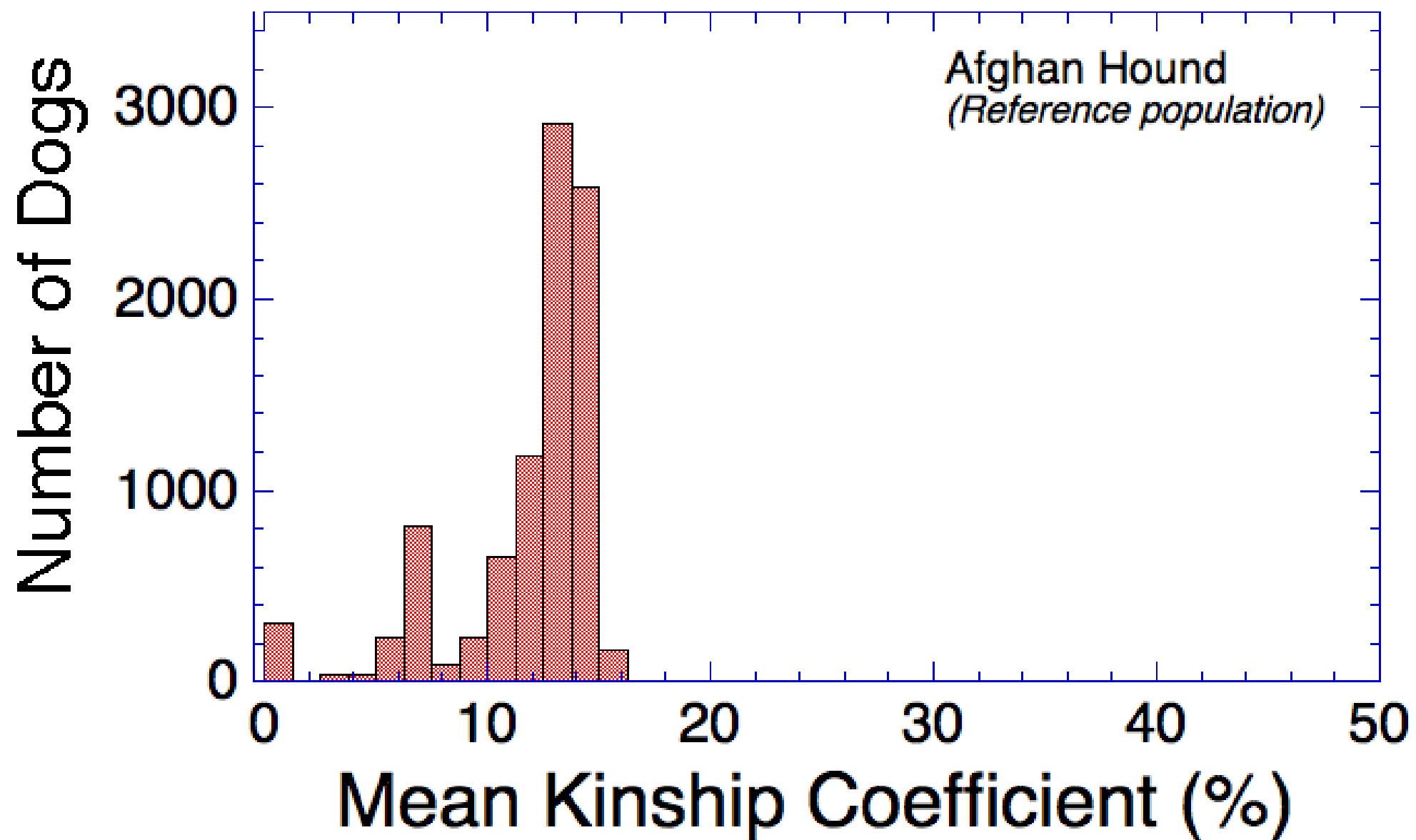
Current Inbreeding

- * Genetic diversity as founder “equivalents”
- * Breed has the diversity of about 8 dogs



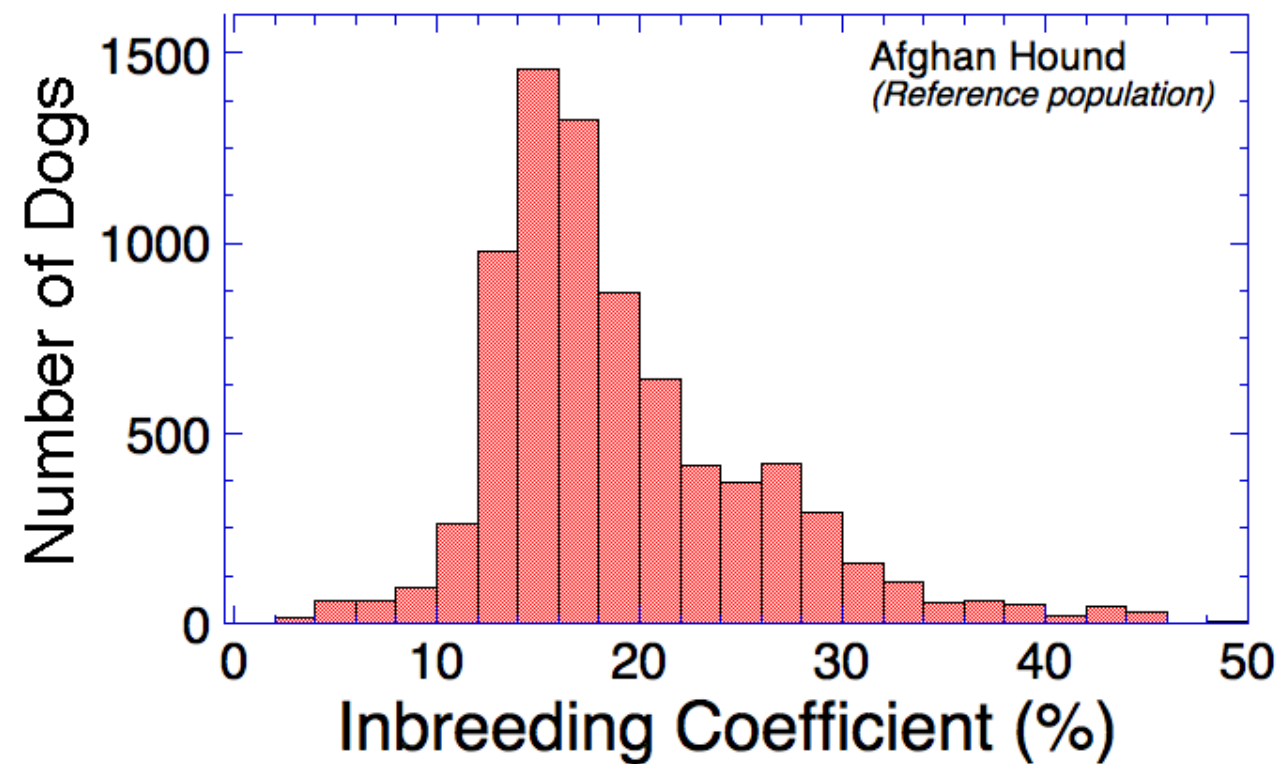
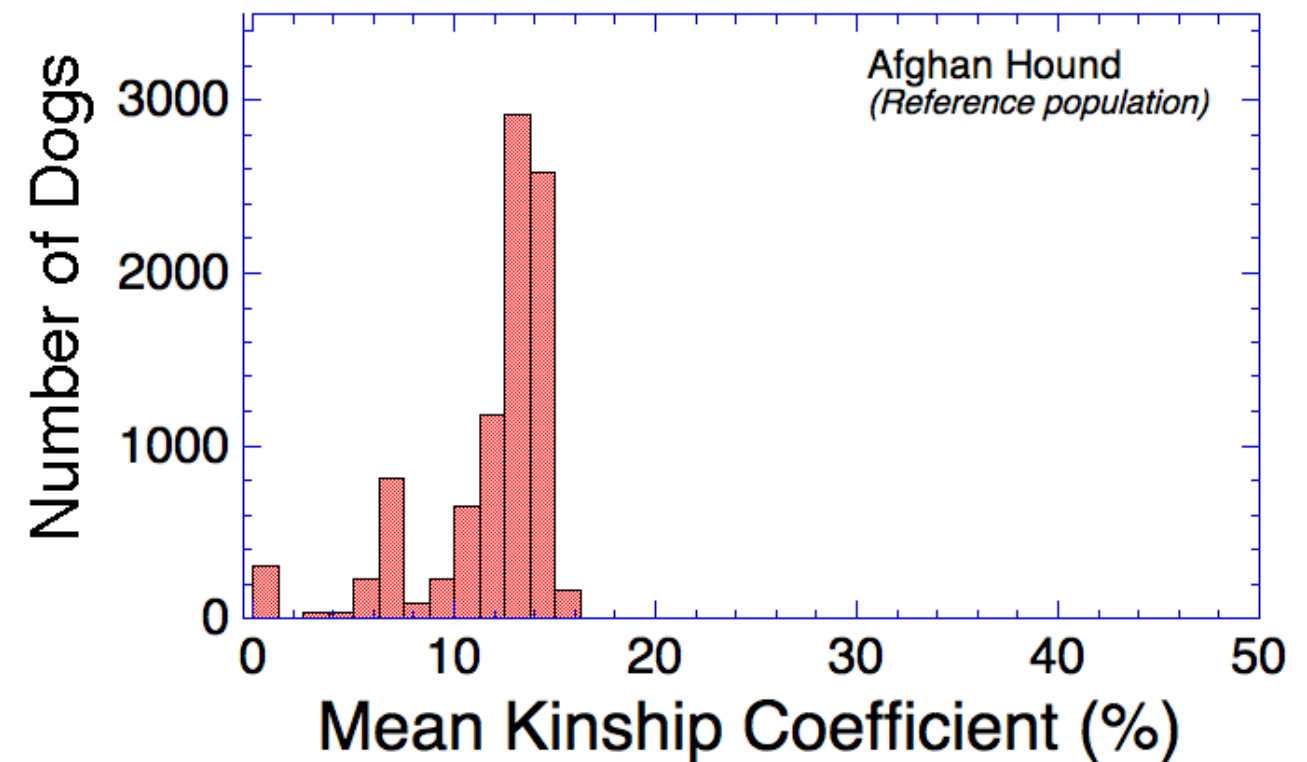
Inbreeding vs Kinship

- * Inbreeding is $>$ Kinship
- * Indicates *preferential* inbreeding



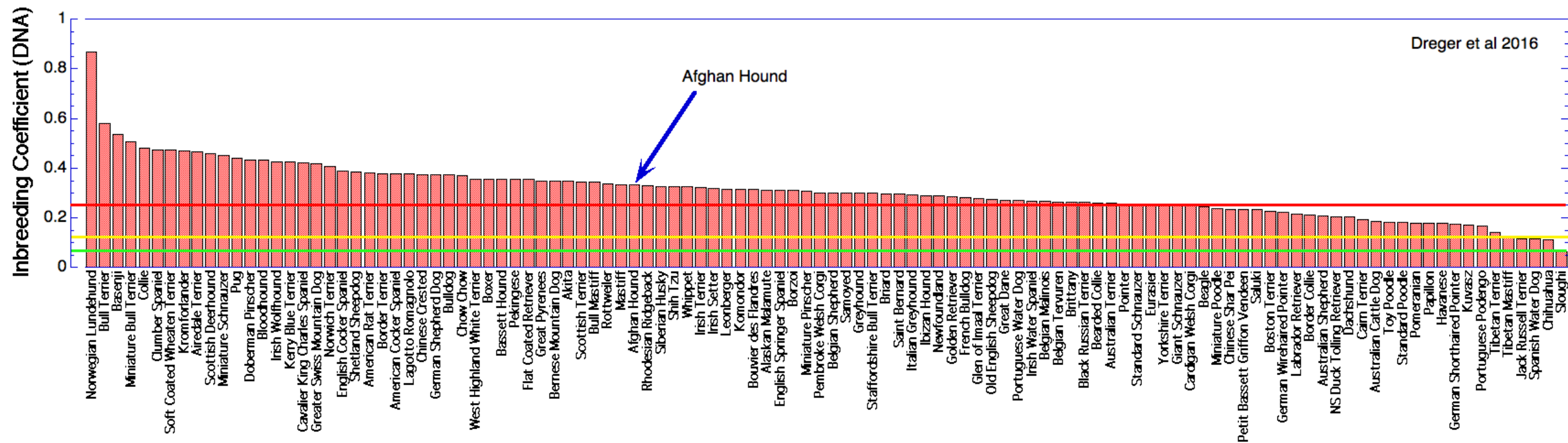
Inbreeding vs Kinship

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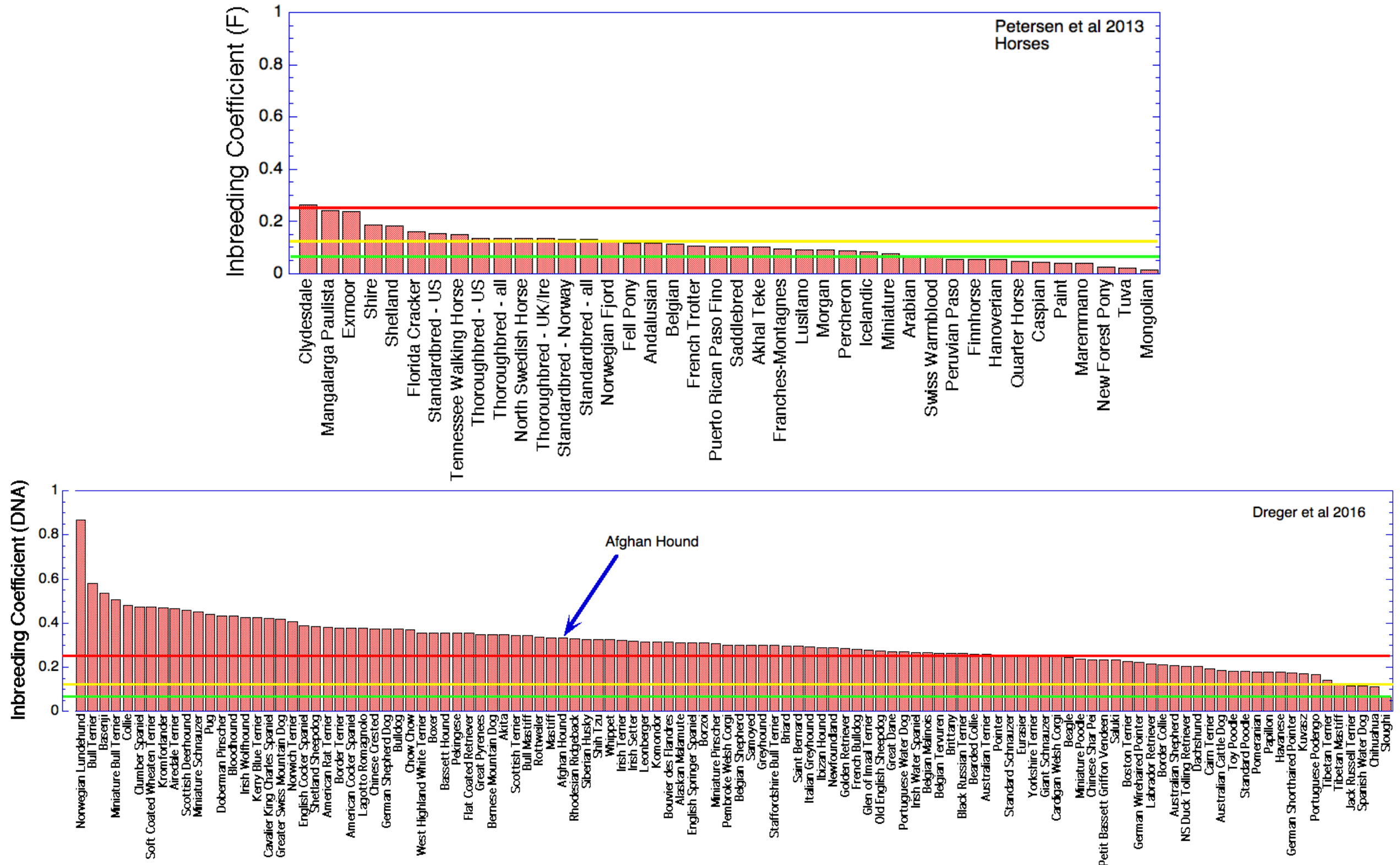


Inbreeding

* Afghan Hound inbreeding ranks in the middle of purebreds

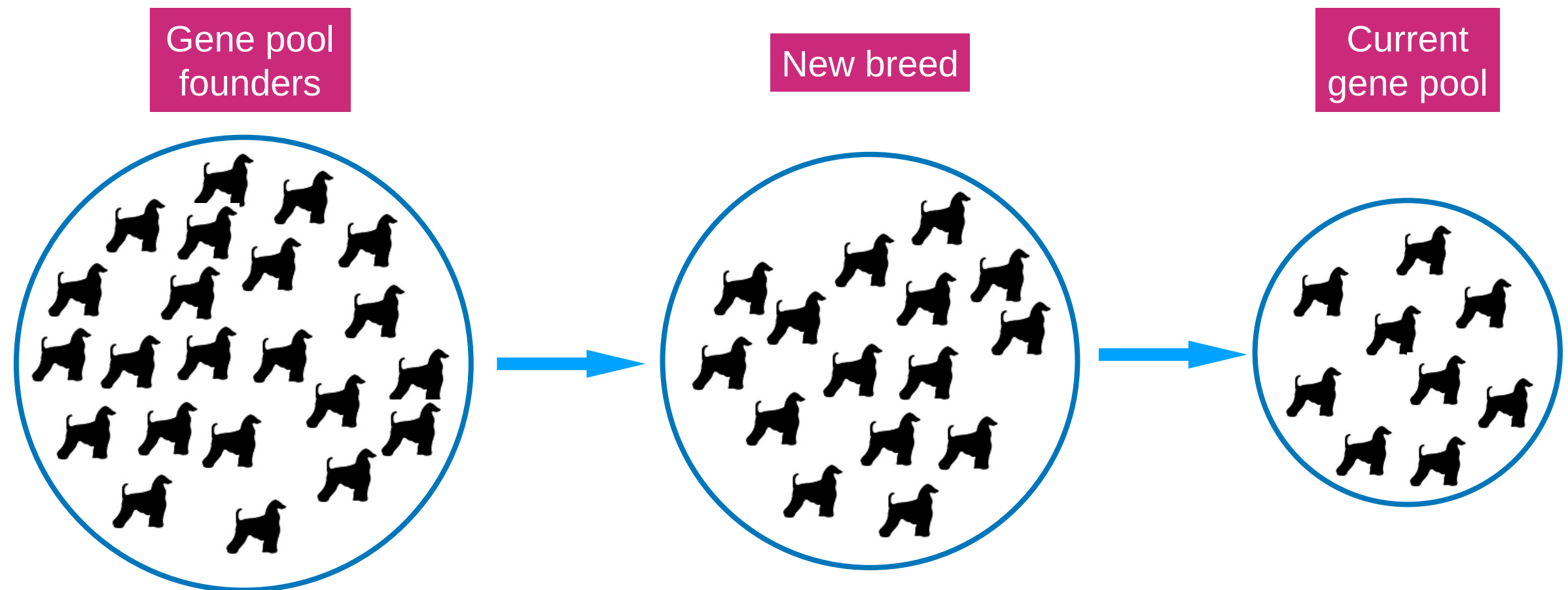


Inbreeding: Dogs vs Horses



Gene Pool Basics

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



How Big is the Gene Pool?

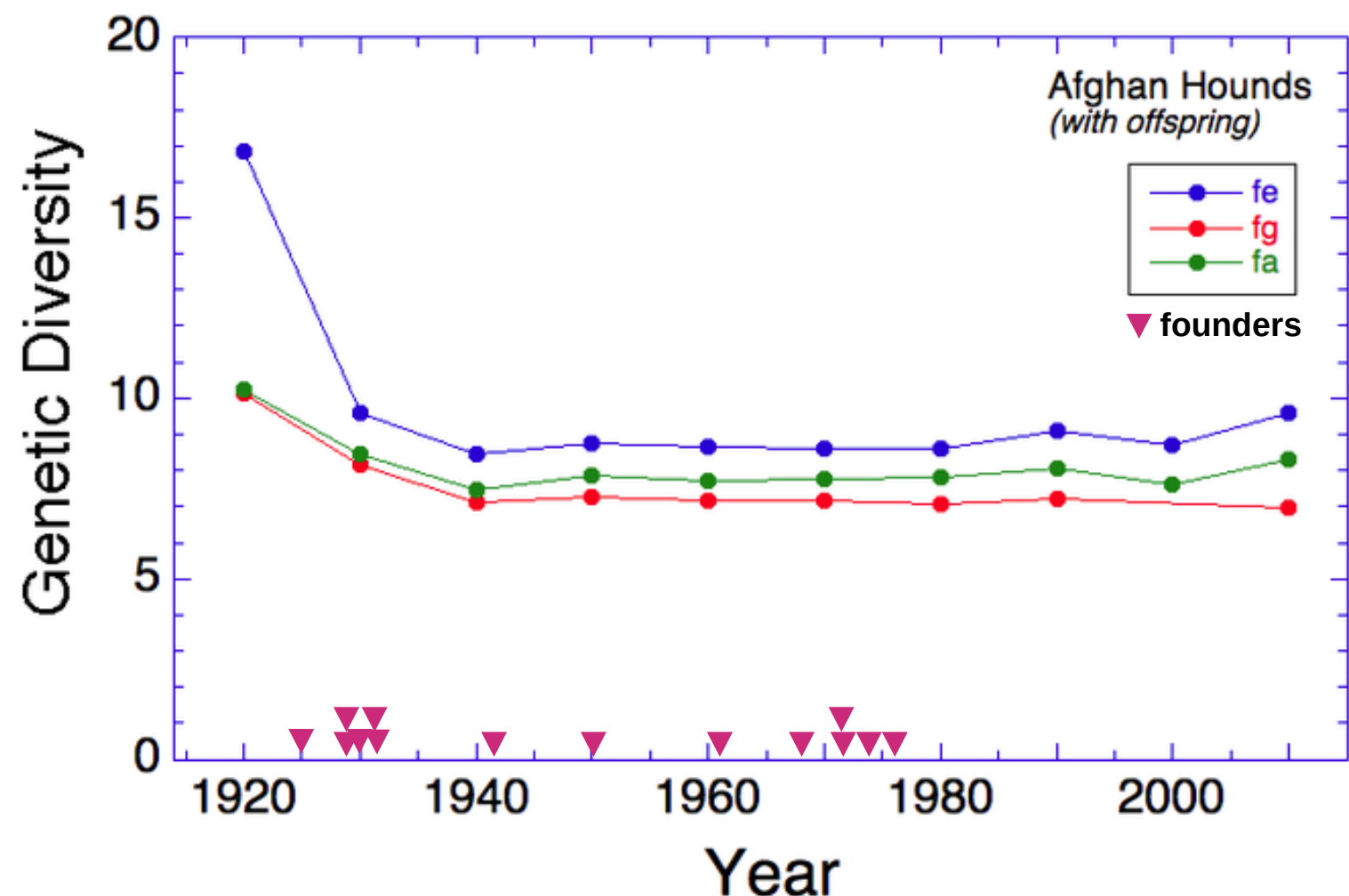
- 1) If a breed is founded on 20 unrelated dogs, the size of the original gene pool is 20
- 3) Unrelated dogs added later also count as founders
- 5) The gene pool of a population will be less than the total number of founder dogs

- * 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





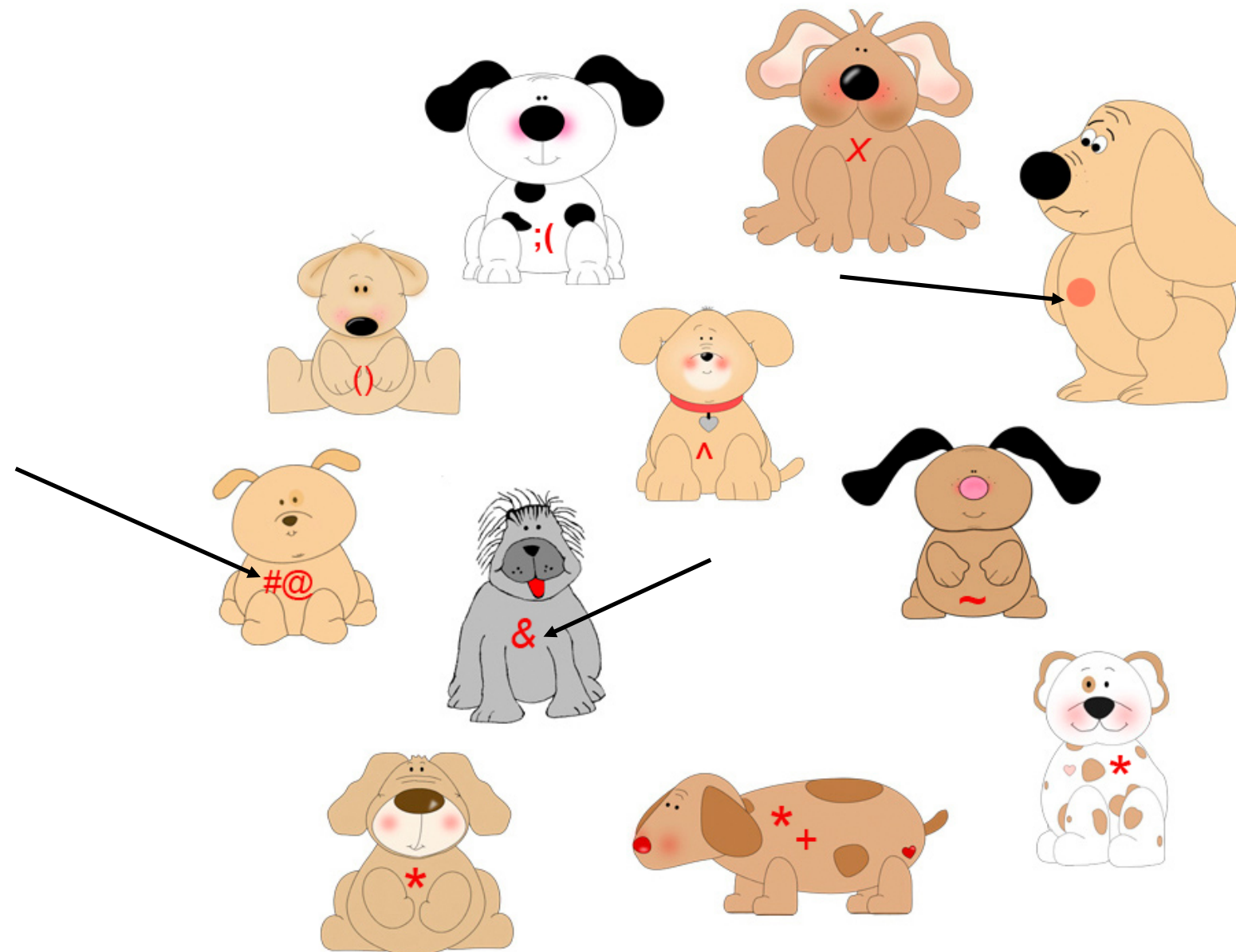
Losing Genetic Diversity

Selective breeding

- * not all animals are bred
- * some produce more offspring than others

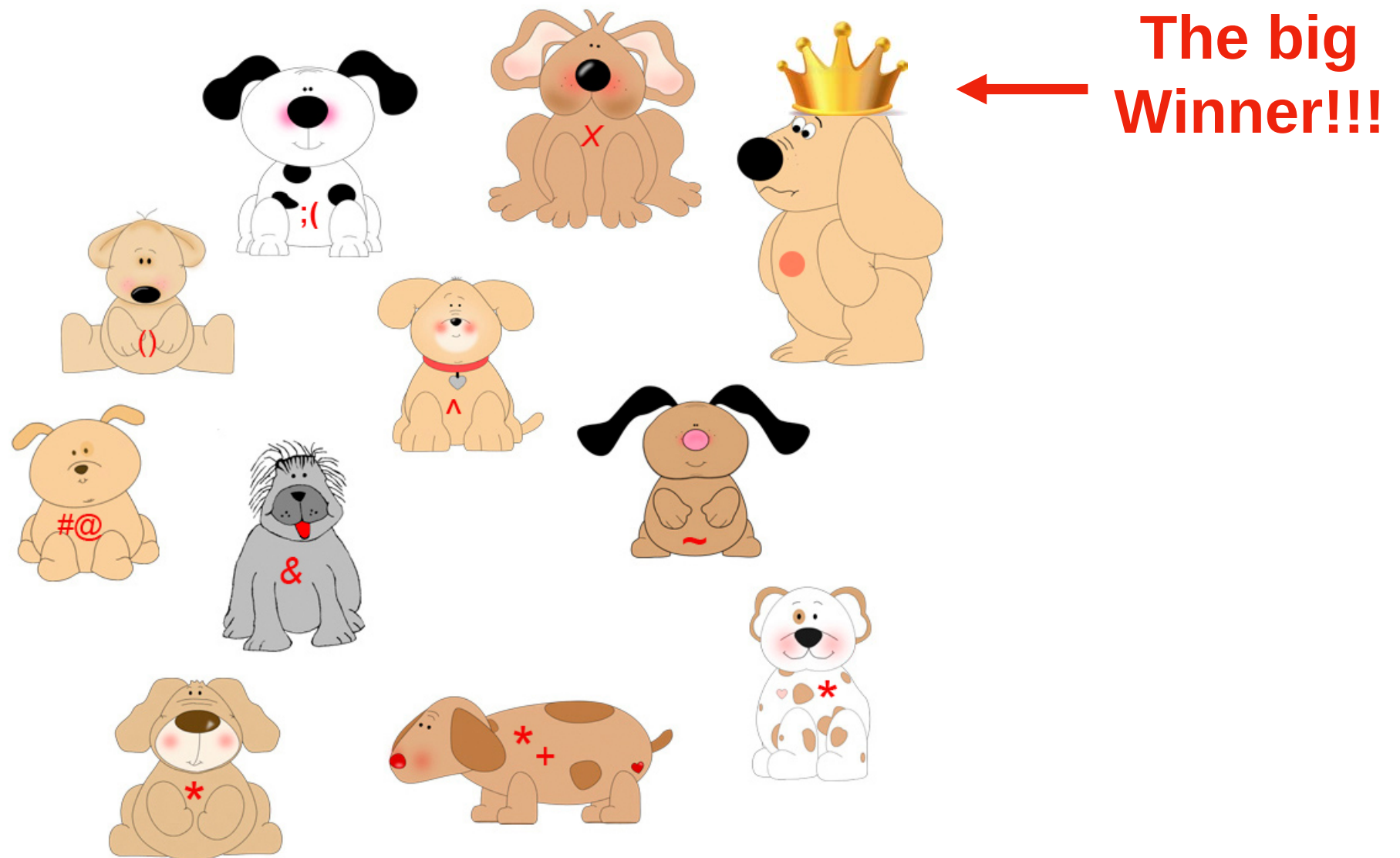
Selective Breeding: Popular Sires

Every dog has mutations



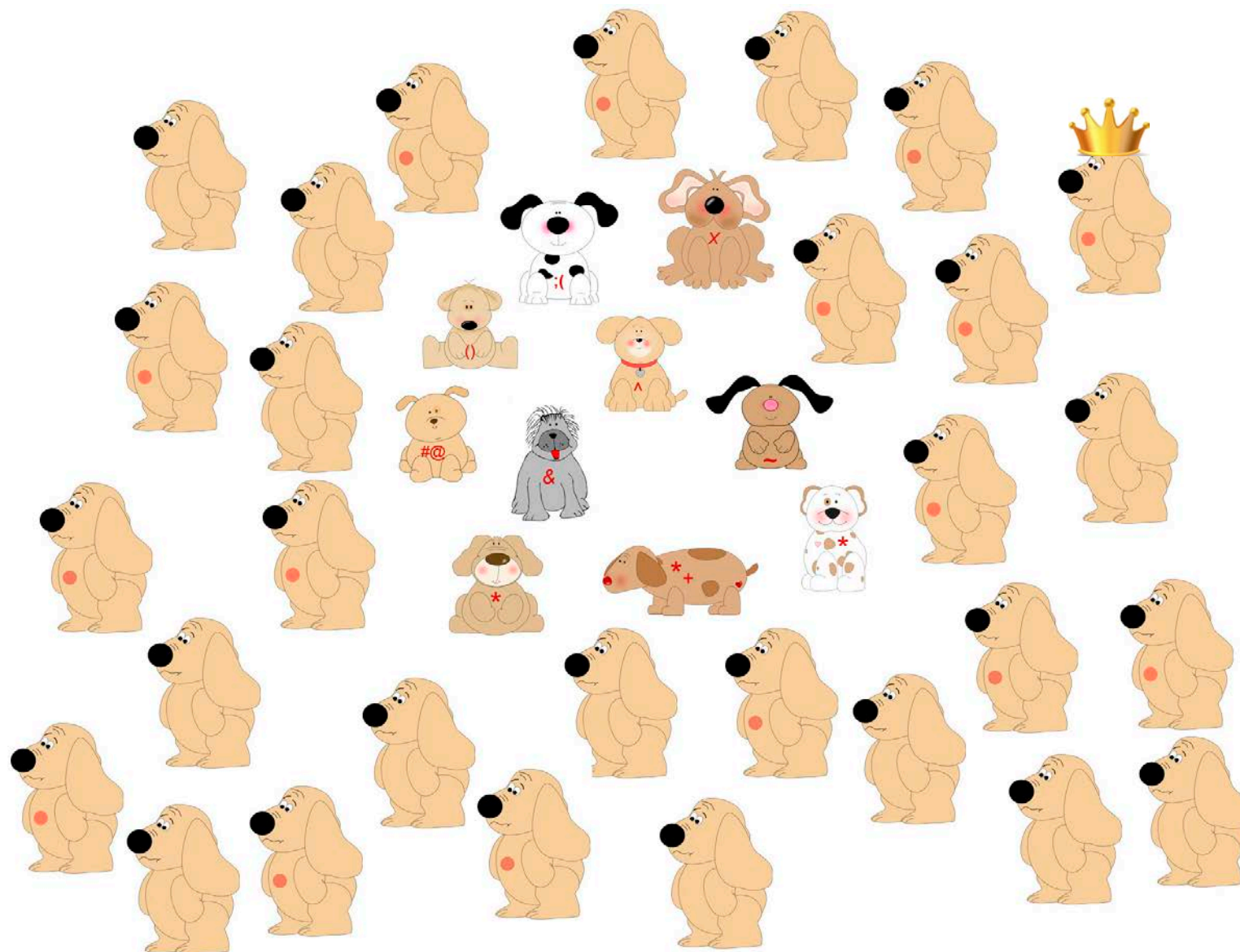
Popular Sires

Hank wins the Big Show!



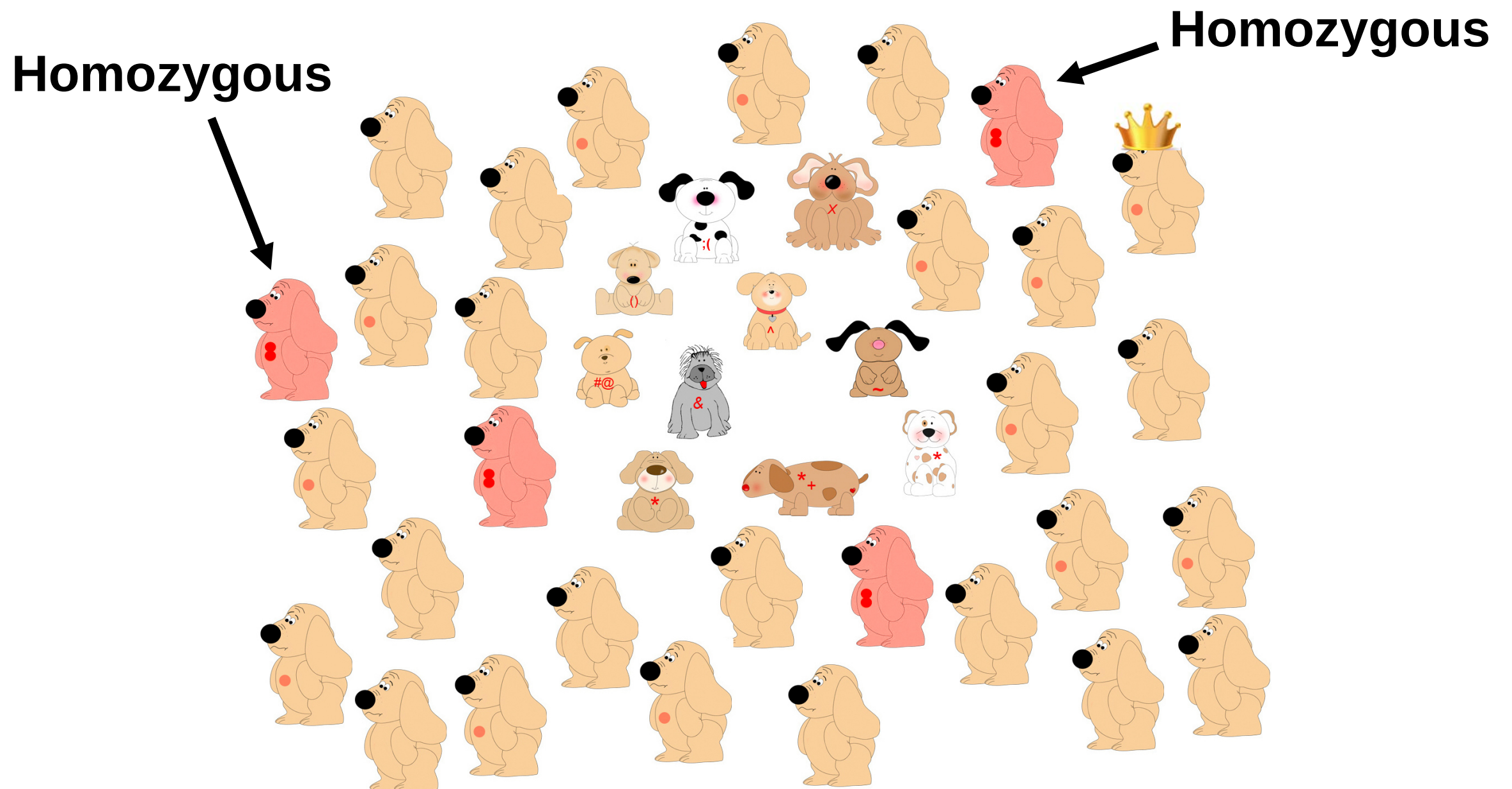
Popular Sires

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



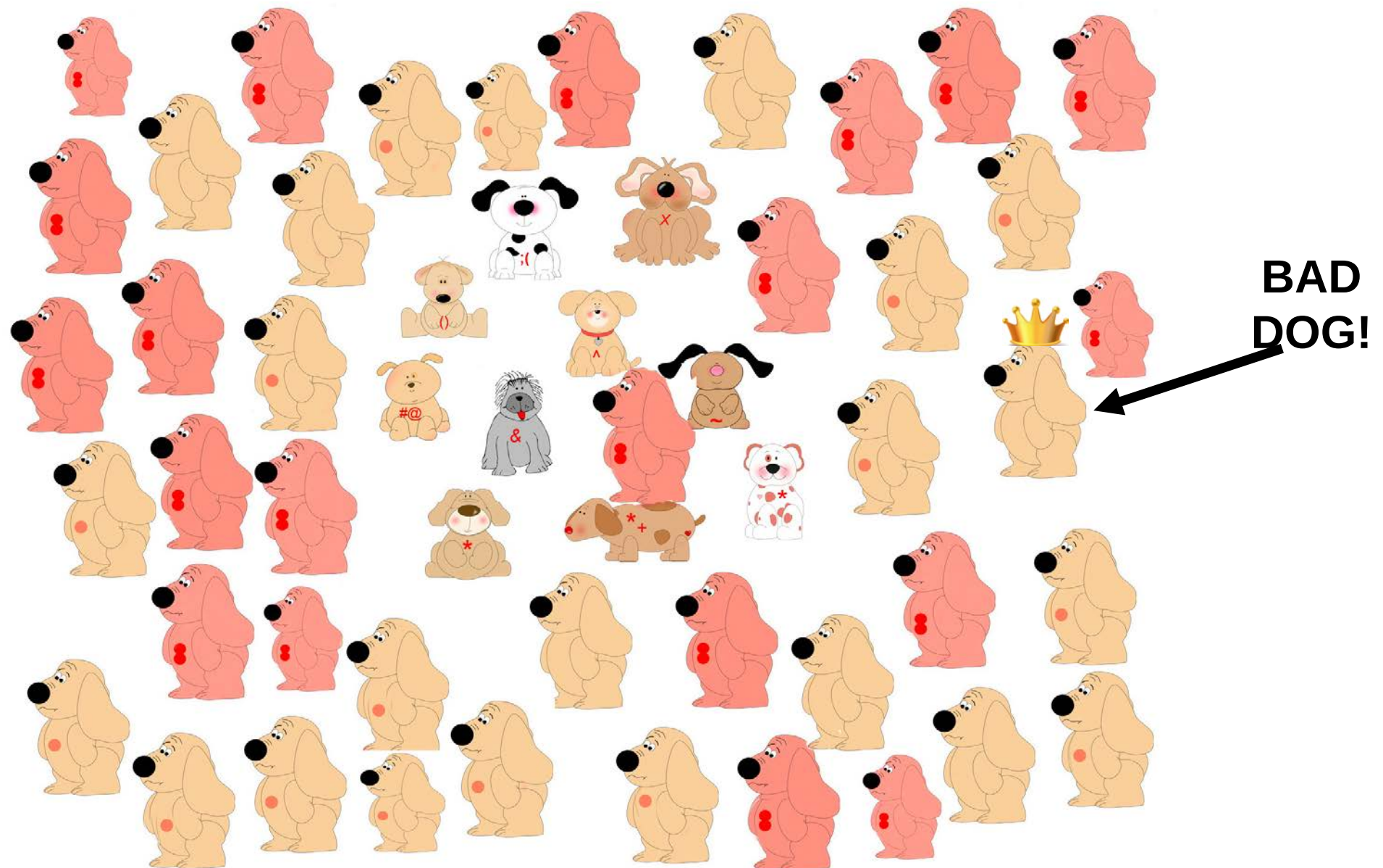
Popular Sires

- * A few puppies have a new disease
- * The crisis looms...

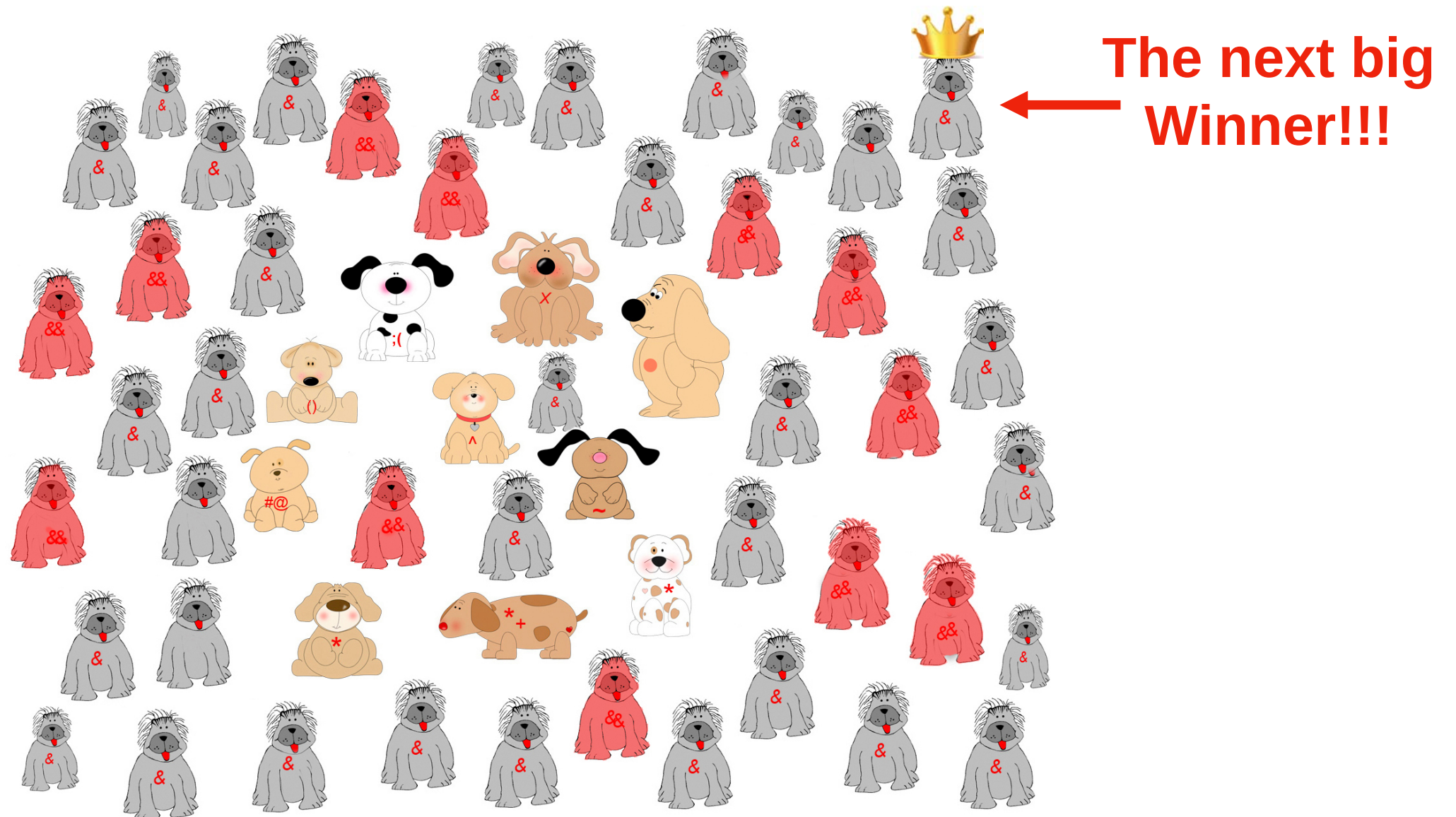


Popular Sires

- * OMG, the breed has a genetic disorder
- * It's all Hank's fault!



* The cycle begins again





Losing Genetic Diversity

1) Selective breeding

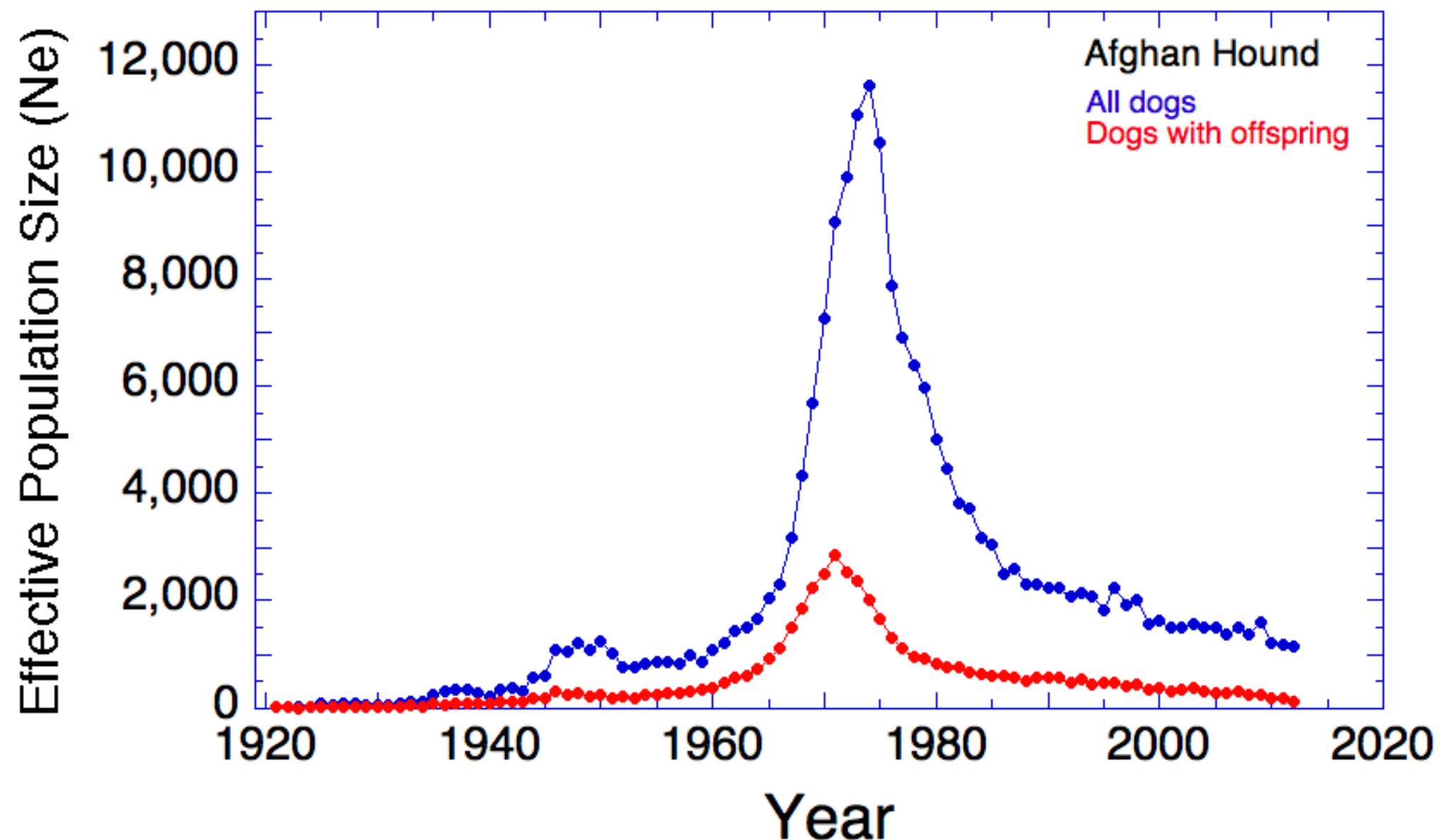
- * only a few animals are bred
- * popular sires

2) Alleles lost by chance (“genetic drift”)

- * faster in a smaller population

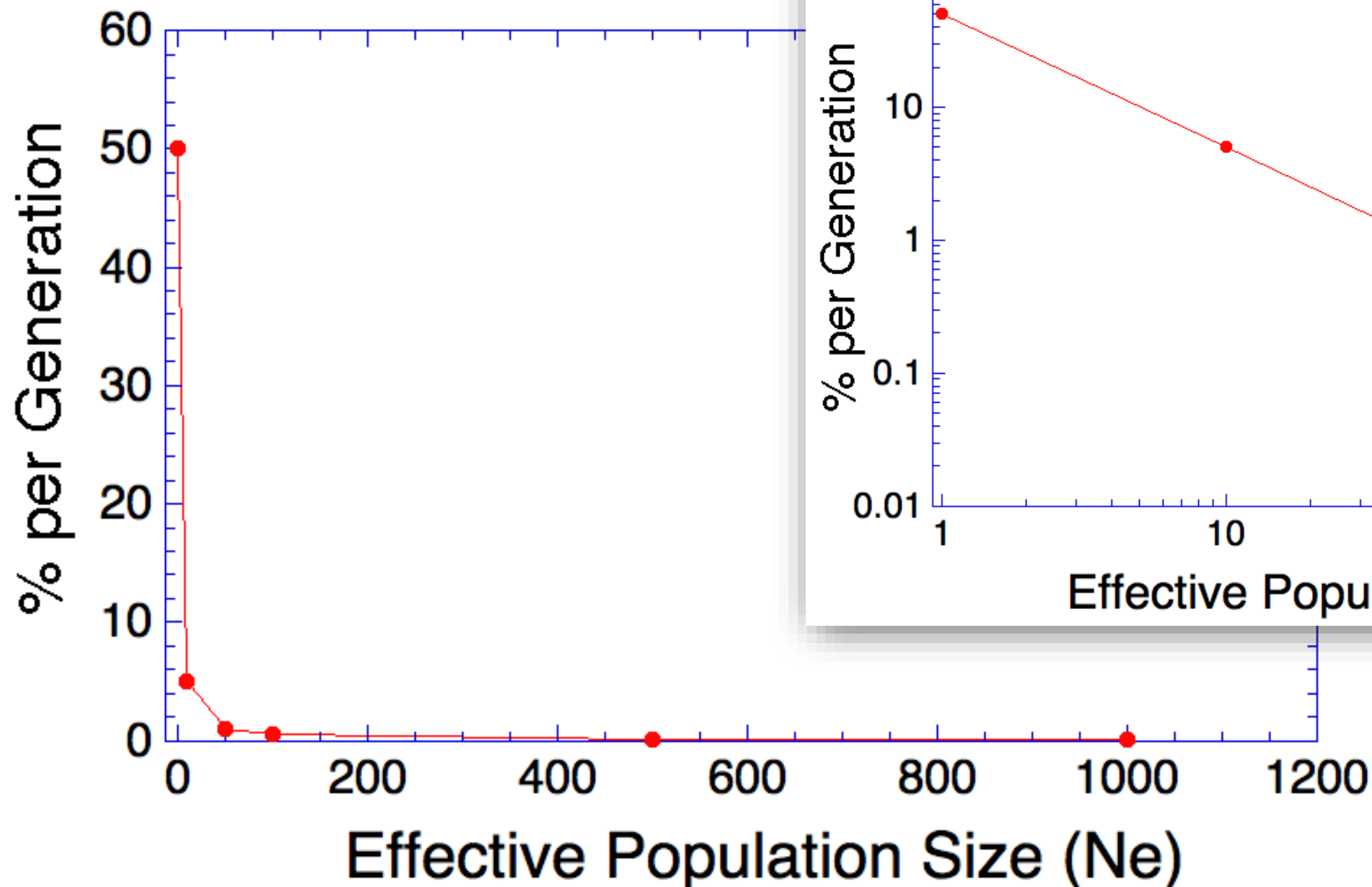
Effective Population Size

- * N_e is the “genetic” population size
- * Depends on the number of breeding animals



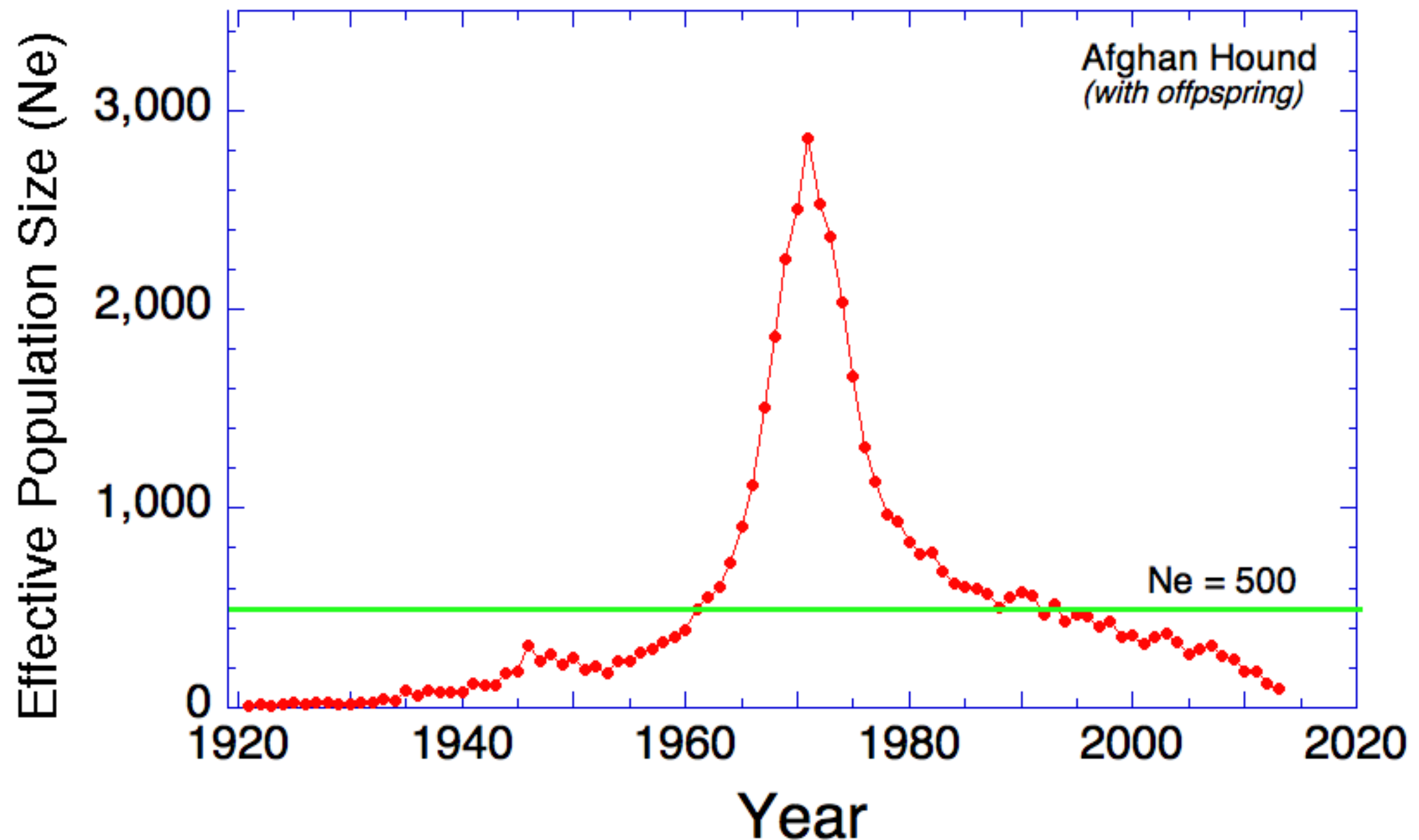
Effective Population Size

* Rate of inbreeding increases as N_e gets smaller



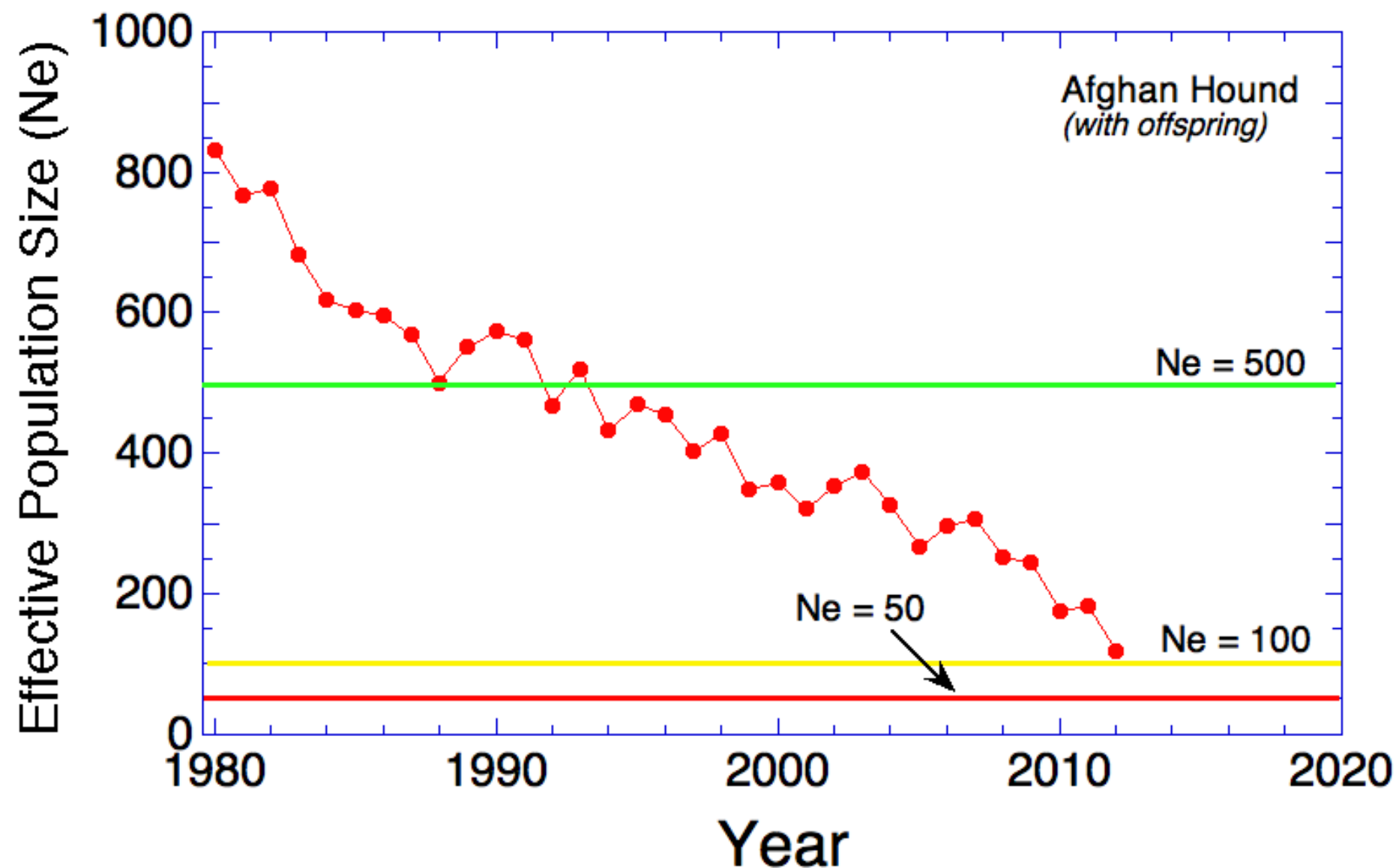
Effective Population Size

* Sustainable population size is $N_e = 500$



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**

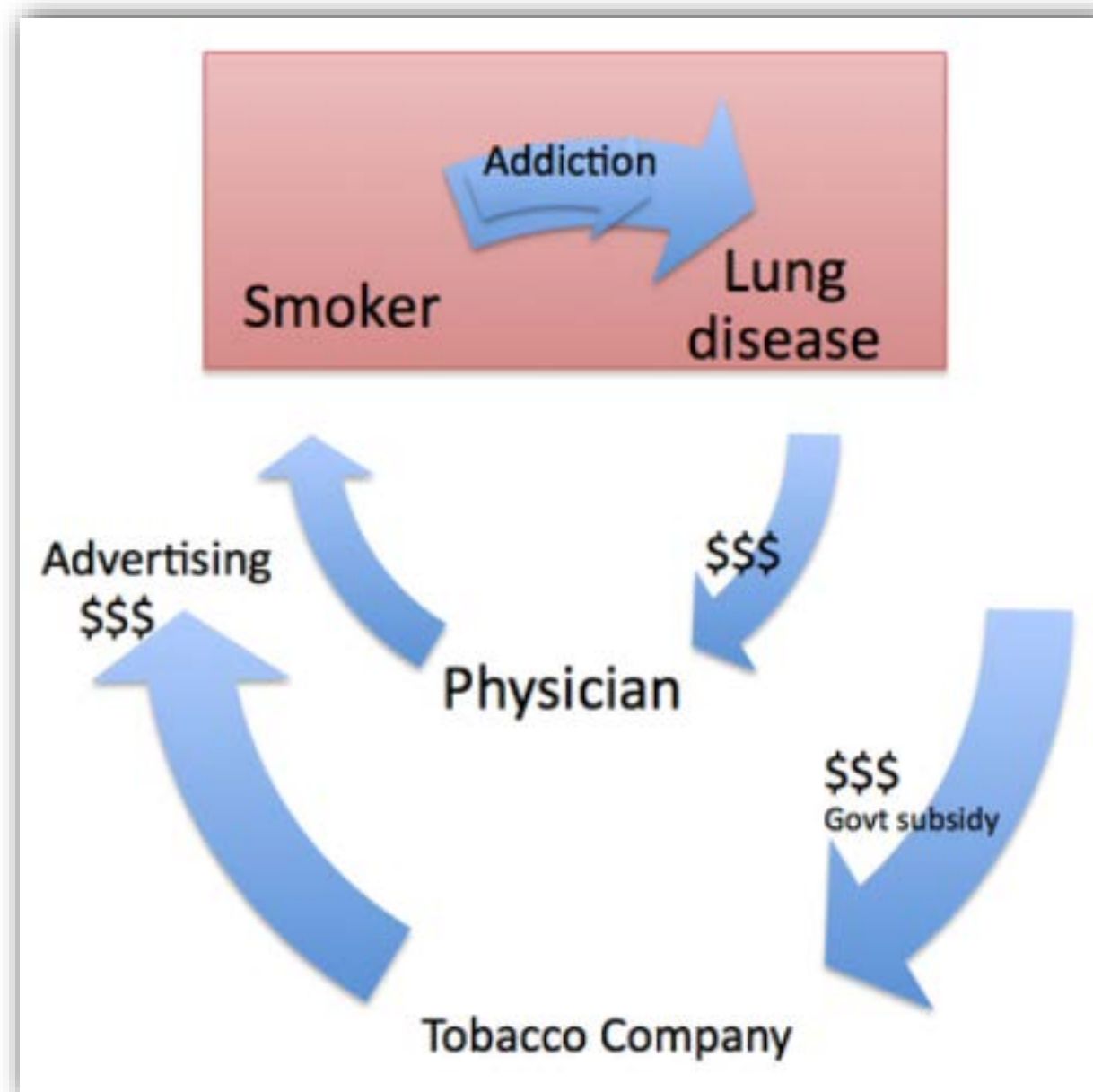
- Expensive**
- Slow**
- Does not solve the problem**

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

- Inexpensive**
- Fast**
- Solves the problem**

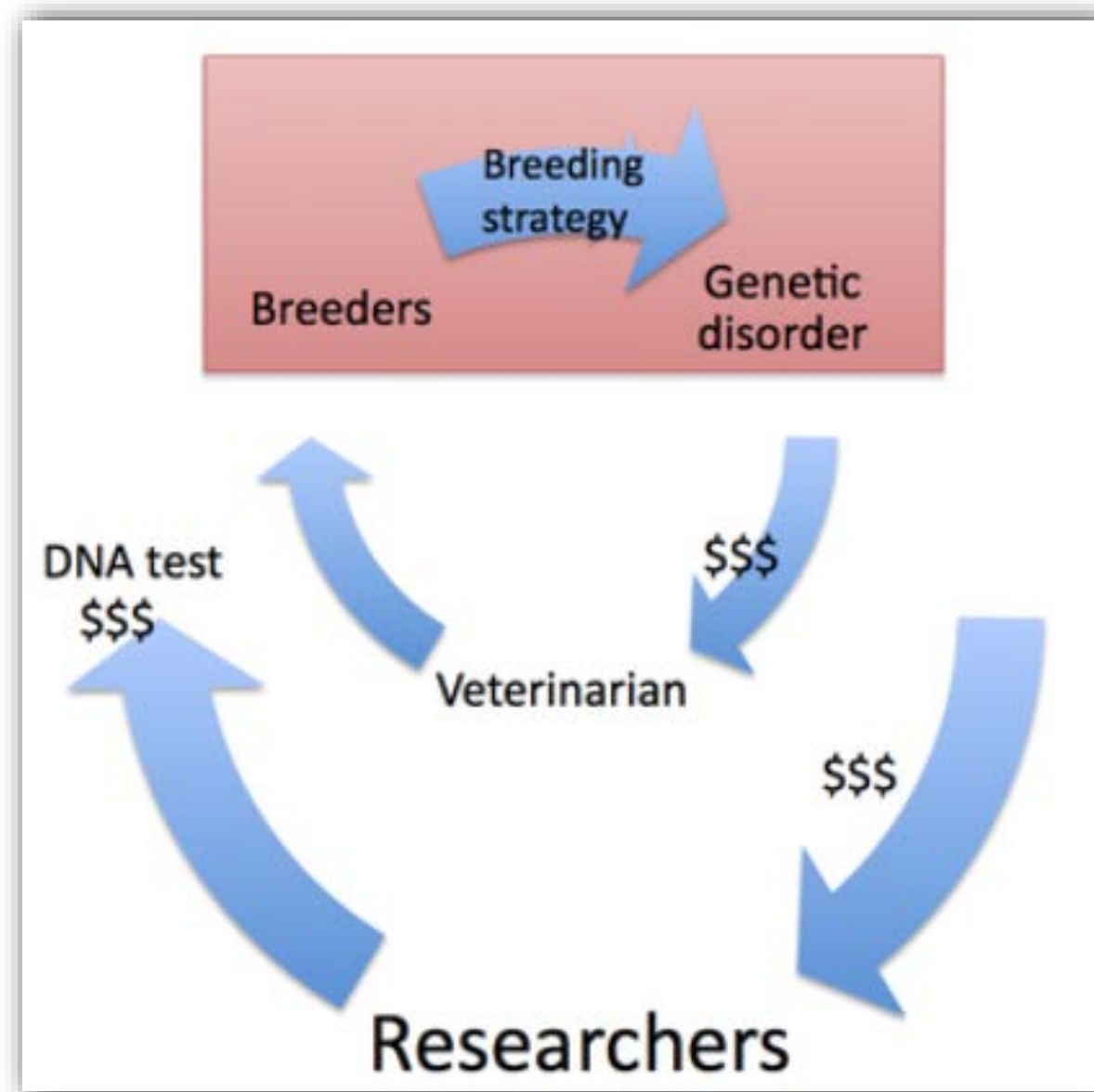
An Example: Curing Cancer

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