ANIMAL GENETIC BIODIVERSITY AND CONSERVATION

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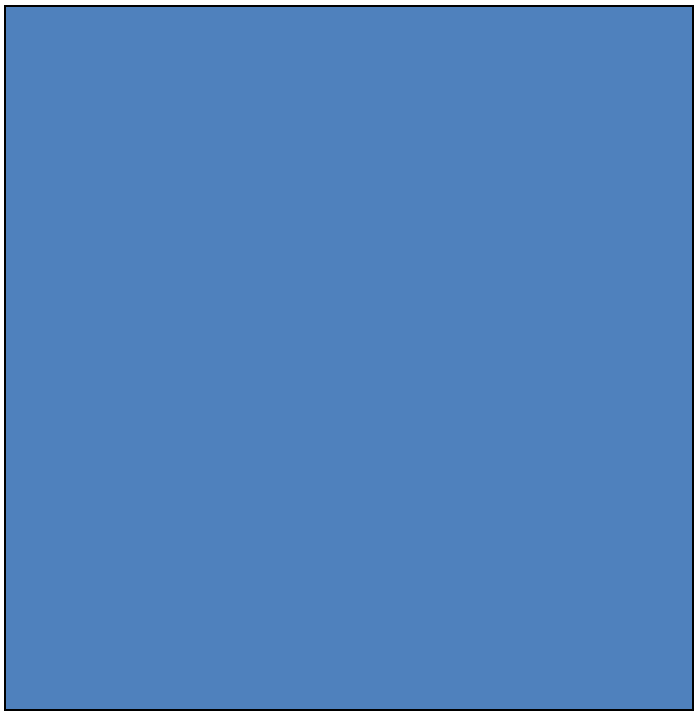
OUTLINE

- Genetic biodiversity
  - meaning
  - nature
- Genetic conservation
  - meaning
    - methods
- Recommendations

Biodiversity:

Who cares?

Which do you like better?



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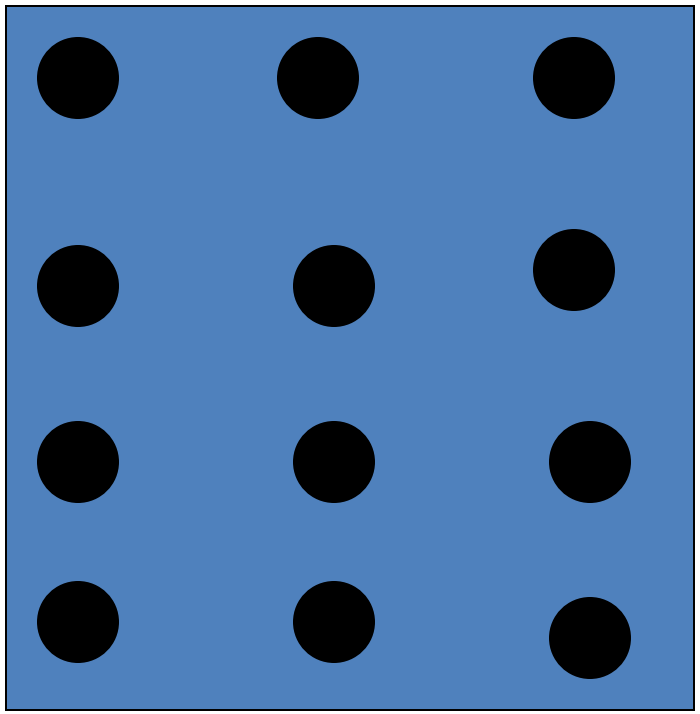

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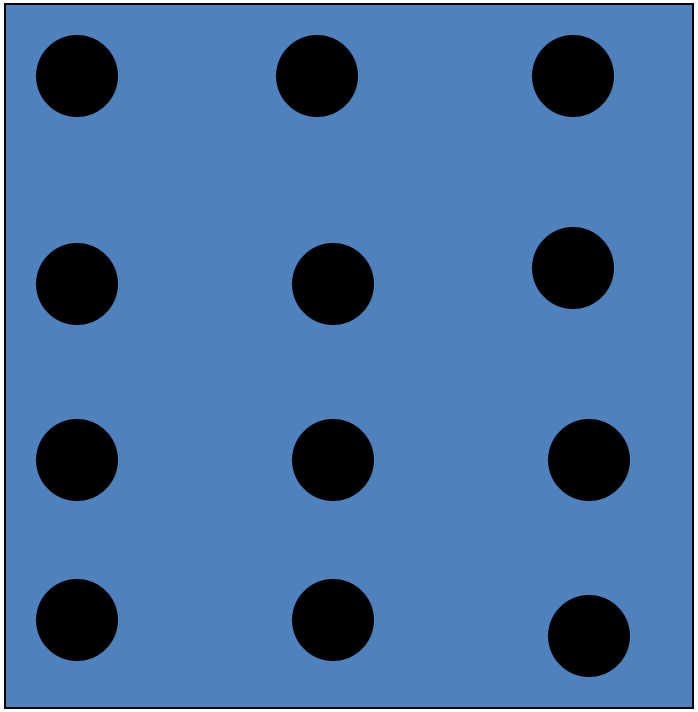
Which do you like better?



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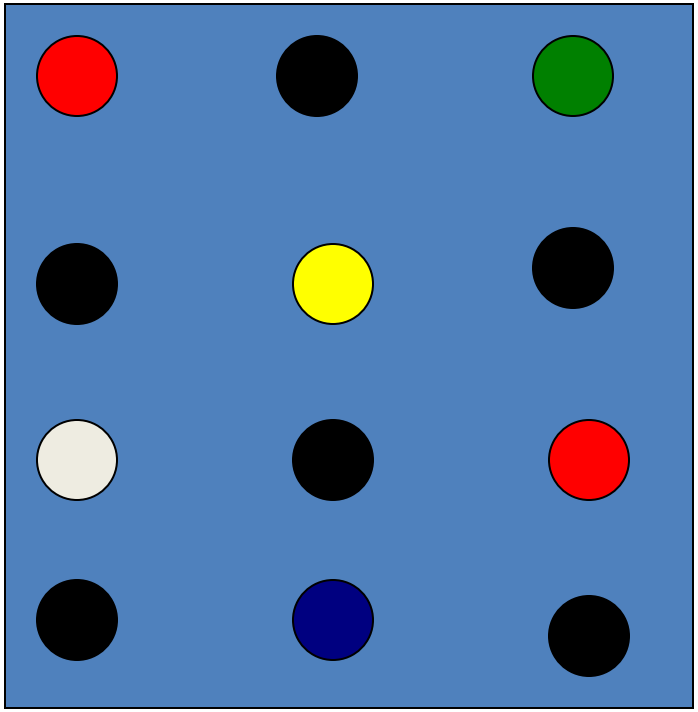

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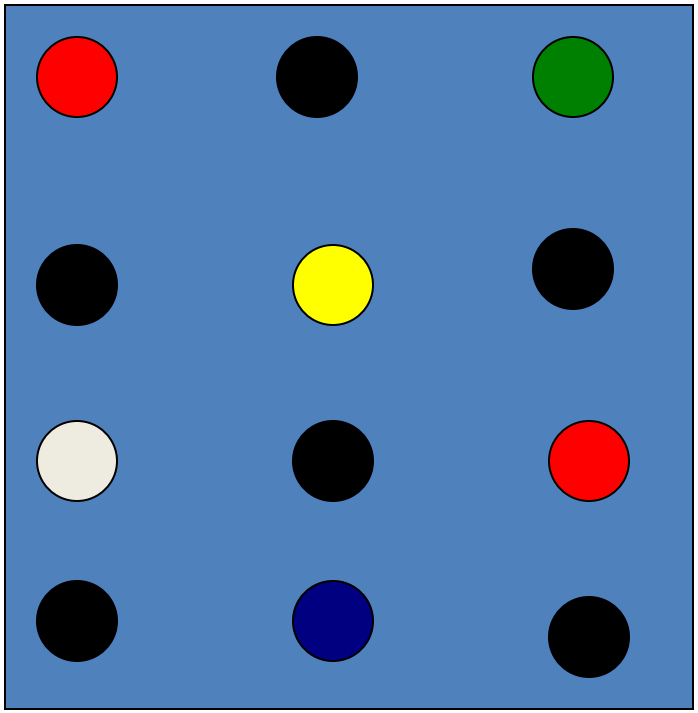

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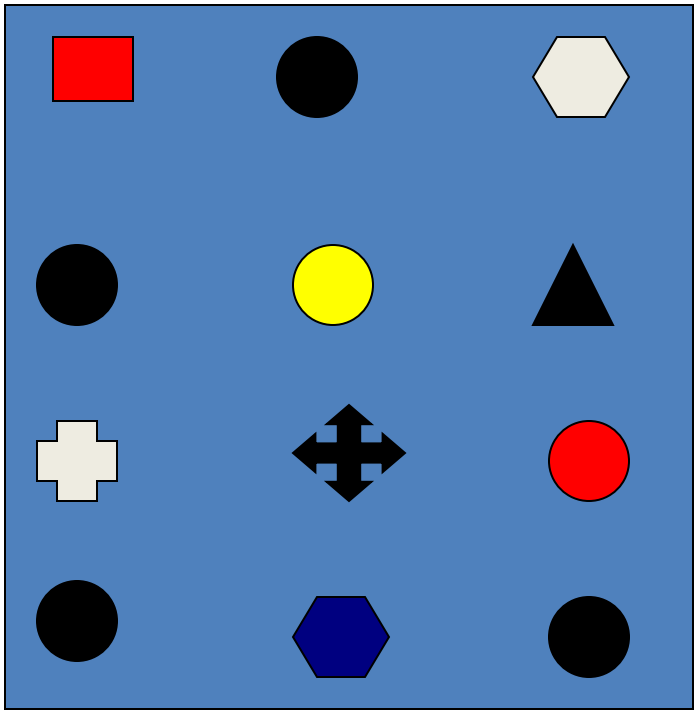

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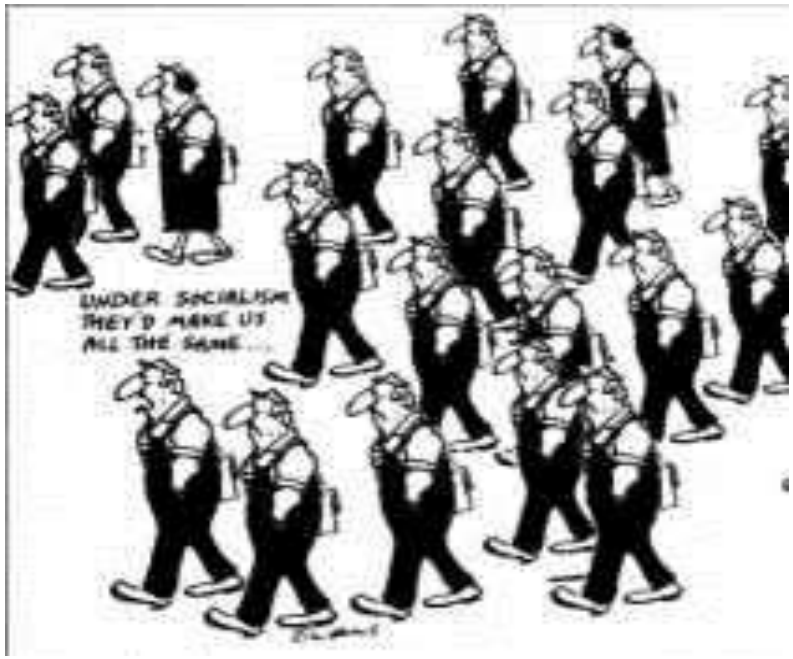
Which do you like better?



A

B

Which do you like better?

A

B

Which do you like better?

A

B

What do you think biodiversity means?

BIODIVERSITY

- BIO = LIFE
- DIVERSITY = VARIETY
- BIODIVERSITY = SPECIES DIVERSITY/SPECIES RICHNESS

There are 3 components of biodiversity

1. **<u>Diversity of genes</u>**
   Chihuahuas, beagles, and rottweilers are all the same species —but they're not the same because there is variety in their genes.

Chihuahua

Beagle

Rottweilers

There are 3 components of biodiversity

2. Diversity of number of species

For example, monkeys, dragonflies, and meadow beauties are all different species.

Saki Monkey

Golden Skimmer

Meadow Beauty

ECOSYSTEM DEFINITION

“ A self-contained community of microorganisms, animals and plants, that interact with each other and with their physical environment.”

eg a rock pool

Genetic diversity

- Heritable variation within and between populations of organisms
- Encoded in the sequence of 4 base-pairs that make up DNA
- Arises by mutations in genes and chromosomes

Genetic Diversity

- Very small fraction of genetic diversity is outwardly expressed
- Estimated 10^9 different genes across the Earth's biota
- Represents a largely untapped genetic library

Genetic Diversity

- Genetic diversity is the foundation for all higher levels of biodiversity
- Genetic diversity provides the recipe for populations and species, which in turn form communities and ecosystems
- Genetic variation enables evolutionary change and artificial selection

- Genetic diversity represents the heritable variation within and between populations of organisms.
- The populations may be entire species or a specific collection of individuals within a species such as a breed, strain, line, herd/flock etc.
- The diversity ultimately resides in the variations in the sequence of the four base pairs, which, as components of nucleic acids, constitute the genetic code.
- New genetic variation arises in individuals by gene and chromosome mutations and, in organisms with sexual reproduction, is spread through the population by recombination

Genetic Diversity

- Genetic diversity may have direct economic value (genes for disease resistance, biologically active compounds)
- But effective conservation for whatever purpose depends upon accurate, thoughtful assessment of genetic diversity
- Preservation of genetic diversity is usually a high priority in conservation programs

Breed Characteristics

- Morphological
- Geographical distribution
- Relative significance
- Homogeneity
- Relationships between breeds

"Diversity Analysis"

Diversity Analysis

1. Phenotypic Characterization
   - Observable attributes

   Aims:

   a) Identify distinct breed populations
   b) Describe breed characteristics
   c) Describe production environment

Diversity Analysis

2. Molecular Genetic Characterization
   - Genetic relationships

   Aims:

   a) Describe genetic relationships within breeds
   b) Describe genetic relationships between breeds

Significance of Molecular Genetic Characterization

1. Assess genetic constitution of breeds
    a) Diversity
    b) Admixture or subdivision
    c) Inbreeding
    d) Introgression
    e) Assortative mating

- Today's livestock biodiversity is the fruit of a two–stage process.
- First there was domestication, then
- 2nd there was breed differentiation.
- Both involved genetic change and are thus both evolutionary and cultural processes
- theme1_3.ppt

The need for conservation

- Economic potential
- Scientific use
- Cultural interest

CONSERVATION METHODS

- *In situ* conservation is the maintenance of live populations of animals in their adaptive environment or as close to it as is practically possible.
- For domestic species the conservation of live animals is normally taken to be synonymous with *in situ* conservation.

Ex situ

- involves the conservation of plants or animals in a situation removed from their normal habitat.
- collection and freezing in liquid nitrogen of animal genetic resources in the form of living semen, ova or embryos. It may also be the preservation of DNA segments in frozen blood or other tissues.

Comparison bet. 2 methods

	Ex Situ	In Situ
COST - initial set up cost	relatively high	low-high
- maintenance cost	low	rel low-high
GENETIC DRIFT - initial	relatively high	low
- annual	none	moderate-high
Applied to all species	no	yes
Safety/reliability	good-bad	moderate
Local access	mod-poor	mod-good
International access	good	not good
Population Monitoring	none	good
Environmental adaptation	none	good
Selection for use	none	good

Source : FAO, 1992

	Cattle		Sheep		Pigs		Poultry	
	m	f	m	f	m	f	m	f
Size of breeding unit	10	26	22	60	44	44	72	72
No. of breeding animals entering each year	10	5	22	12	44	18	72	72

Source : FAO, 1989

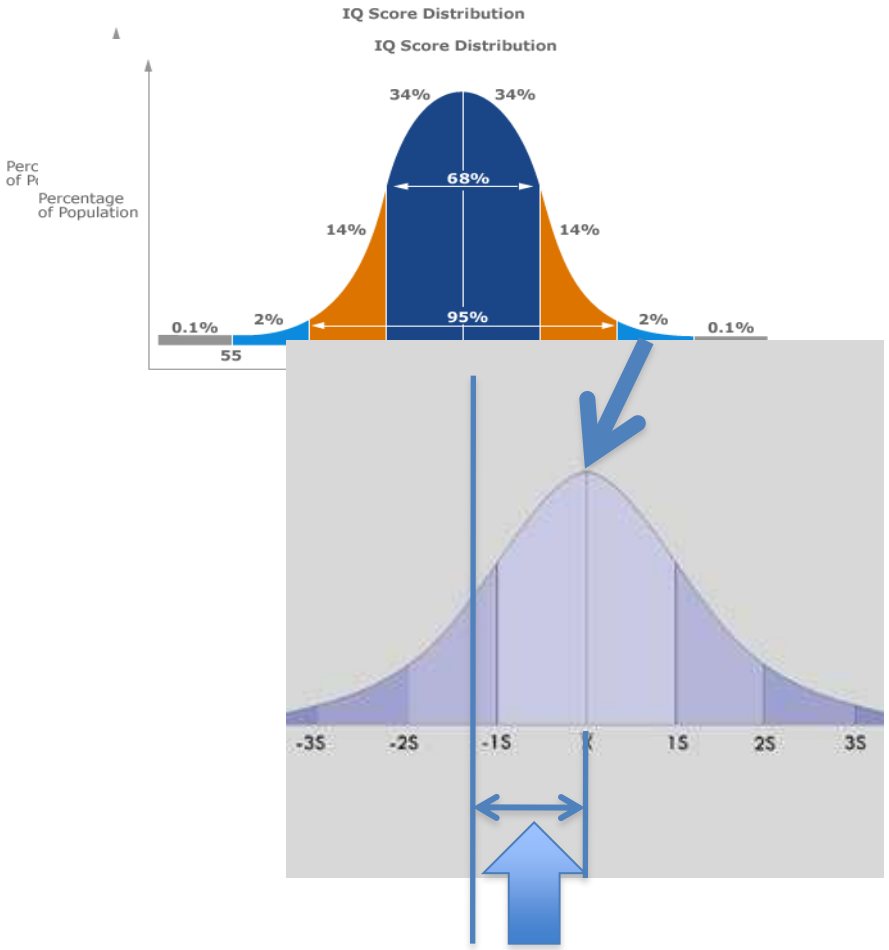
Effective population size

- **The larger the population size the more is the opportunity for obtaining more of the superior individuals to be selected as parents.**
- **Effective population size is defined by the number of the males and females in the population as**

$$N_e = (4N_mN_f)/(N_m + N_f)$$

For a herd of 500 males and 500 females, N_e = 1000

For a population of 5 males and 995 females, N_e = 20



Selection differential

Small Breeding Programmes - Recommendation

- Begin with an adequate sized sample of animals who should ideally be unrelated, non-inbred and fertile. They should represent the range of genetic types found within the population. If possible a sample of at least 50 males and 50 females should be included.
- Expand the population as rapidly as possible, to a minimum effective population size of 500 animals (see section 4.3.5).
- Maximize the effective population size (Ne). To achieve this ensuring that as many animals as possible contribute offspring to the next generation. Effective population size may be enhanced by:
  - Equalizing the sex ratio.
  - Standardizing the litter size.
  - Standardizing the longevity.

- Equalize the representation of the founders, (i.e. the animals in the original sample). It is important that as many of these founder animals as possible are represented in each generation.
- Manage inbreeding, in most cases the best strategy is to keep inbreeding to a minimum. There are situations in sublined populations where alternative strategies might be chosen
- Subdividing the population may be a useful option (see section 4.5.5). In particular this strategy may help to control the possible spread of disease between conservation herds.

- Conservation by utilization

 - eg. Siquijor native cattle

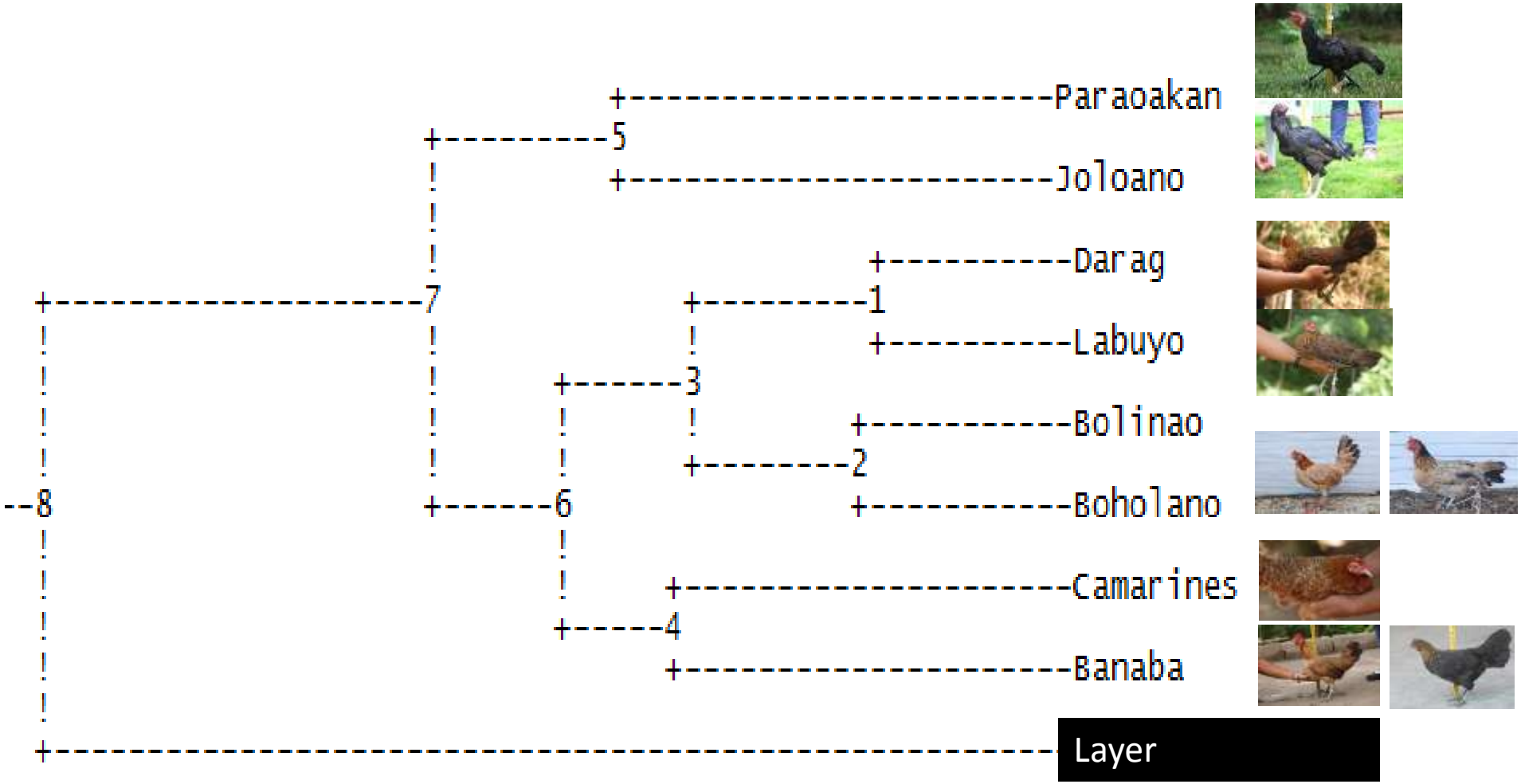


Figure 1. Unweighted Pair Group Method using arithmetic Average (UPGMA) tree of the 8 genetic groups of Philippine Native Chicken and 1 commercial breed based on the Nei's (1972) genetic distance