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Q5(a)

Balanced and transient genetic polymorphism

UPSC Civil Services Mains 2022 · Anthropology GS 1 · 10 marks · Concept of genetic polymorphism and selection, Mendelian population, Hardy-Weinberg law

9.3 Concept of genetic polymorphism and selection, Mendelian population, Hardy-Weinberg law; causes and changes which bring down frequency-mutation, isolation, migration, selection, inbreeding and genetic drift. Consanguineous and non-consanguineous mating, genetic load, genetic effect of consanguineous and cousin marriages.

Core demand of the question

- Write a note on balanced and transient genetic polymorphism
- Keep the note to a 10-mark length of about 150 words

Revision summary

Polymorphism is lasting allelic diversity at one locus.

Balanced polymorphism keeps alleles, classically by heterozygote advantage.

Sickle-cell and malaria is the human type case.

Transient polymorphism is a passing stage while one allele replaces another.

Lactase persistence is a human illustration of a sweep still in motion.

Introduction

Polymorphism means two or more alleles at one locus stay at frequencies that mutation alone cannot explain. Balanced and transient name two different fates of that variation.

Body**Balanced polymorphism**

- Heterozygote advantage holds both alleles. **A. C. Allison** linked sickle-cell haemoglobin to malaria. AS people resist falciparum; SS is costly; A and S both remain.
- **E. B. Ford** and **R. A. Fisher** framed the idea. **PTC** tasting and some **HLA** alleles are taught as further human cases, with weaker proof than sickle cell.
- Frequency-dependent selection, as in some immune loci, is another balancing path.

Transient polymorphism

- A new advantageous allele rises and the older one falls. The population is polymorphic only while replacement is unfinished.
- Industrial melanism in **Biston betularia**, used by **Kettlewell**, is the animal textbook. In humans, lactase persistence alleles are still spreading in some dairying populations.

Distinction

- Balanced variation is maintained. Transient variation is a stage on the way to fixation or loss.

Flow diagram

Polymorphism -> Balanced heterozygote
Polymorphism -> Transient sweep
Balanced heterozygote -> Sickle malaria
Transient sweep -> Lactase rise

Conclusion

Sickle-cell malaria is balanced polymorphism. A sweeping advantageous allele is transient polymorphism. Both produce diversity, but only one is an equilibrium.

Facts & figures

Allison

Showed the geographic fit of haemoglobin S and falciparum malaria, the classic balanced case.

Ford

Defined genetic polymorphism as the occurrence of two or more forms in frequencies too high for recurrent mutation alone.

Kettlewell

Peppered-moth studies illustrated a visible transient change under industrial selection.

HLA

High diversity at immune loci is often read as balancing selection, though not all alleles are proven balanced.

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