Crimson Publishers
Wings to the Research

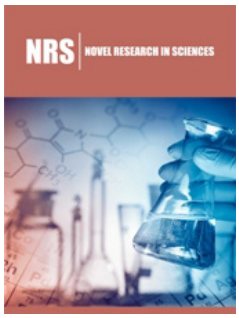
Mini Review

Important Genetic Parameters and their Implications in Fish Breeding Programs

Raju Ram*, Chandan Haldar and Vikash Chahar

Fish Genetics and Biotechnology Division, ICAR-Central Institute of Fisheries Education, Versova, Mumbai, Maharastra-400061, India

ISSN: 2688-836X



***Corresponding author:** Raju Ram, Fish Genetics and Biotechnology Division, ICAR-Central Institute of Fisheries Education, Versova, Mumbai, Maharastra-400061, India

Submission: April 22, 2022

Published: May 31, 2022

Volume 11 - Issue 2

How to cite this article: Raju Ram*, Chandan Haldar, Vikash Chahar. Important Genetic Parameters and their Implications in Fish Breeding Programs. Nov Res Sci. 11(2). NRS. 000757. 2022.
DOI: 10.31031/NRS.2022.11.000757

Abstract

Investigating genotype by environment interactions is vital when genetically improved animals will be used for culture purpose across many heterogeneous environments. Information on genetic parameters for essential traits in different breeding programs may help define selection criteria for aquatic animals. Estimating genetic correlations and GXE interaction for selected traits at different farming periods is a strategy to accelerate the selection of superior animals, thereby reducing breeding program costs. In this mini-review, the importance of various genetic parameters has been discussed.

Keywords: Selective breeding; Heritability; Breeding value; Traits; G × E interactions

Mini Review

The essential genetic parameters to be considered in a selective breeding program are heritability, genetic & phenotypic correlations, breeding values etc. Heritability is the most important genetic parameter that indicates the amount of additive genetic variance present in the population, suggests the type of selection method to adopt, and helps estimate the accuracy of selection. It provides us insight into the response obtained in the next generation. The genetic correlation between two traits is the correlation between the gene effects influencing them [1]. Genetic correlations among traits arise from the pleiotropic effects of genes on multiple traits and linkage disequilibrium among distinct loci, each affecting a single member of the character complex [2]. Genetic correlations help understand the performance of genotypes in response to different environments and accompany the identification of G × E interactions because they clarify the relationship across multiple environments [3]. A single trait expressed in multiple environments may be treated as two different traits. A high genetic correlation between them is expected as the same set of genes influences them. The low correlation indicates an inconsistency in the performance of genotypes across environments. Genetic correlation also has its implication in selective breeding. Genetic correlation is vital to investigate the change that may occur in other trait/s when we improve the actual trait of interest. Phenotypic correlation is defined as the sum of genetic and environmental correlation.

Heritability Estimates of Different Traits in Fish

In breeding programs, heritability estimates vary (are reduced) from generation to generation due to the reduction of genetic variation [4]. It is essential to estimate heritability for a selected species in each generation to ensure enough selective response. The reviewed literature proposed the significant role of estimating genetic parameters in fishes. Sang et al. [5] reported the heritability estimates for harvest body weight in striped catfish reared under mono and polyculture systems using both full-sib model and animal model. The heritability

estimate of body weight at one year, raised under monoculture system was 0.63 ± 0.09 using the full-sib model and 0.46 ± 0.12 under poly culture system. Srimai et al. [6] in African catfish reported the heritability estimates of body weight, total length and standard length at 138 days post-hatch as 0.35 ± 0.07, 0.34 ± 0.07, and 0.29 ± 0.07, respectively. Moreover, another important term, "Realised heritability," for a trait across different generations, calculated based on the following equation [7].

$$\text{Realised } h2 = R/S$$

where R = response to selection, i.e. (overall mean for F2 fish) – (overall mean for F1 fish) and S = selection differential, i.e. (mean for F1 fish selected to produce F2) – (overall mean for F1 fish).

Genetic Correlations Between the Different Traits Reported in Fish

Genetic correlation plays an important role when multiple traits are interested in a breeding program. Several earlier reports show the genetic correlation between different traits in various fishes. The genetic correlations between body weight, total length, and standard length in African catfish were positive and high Srimai et al. [6]. Sang et al. [5] found positive and high genetic correlations between body weight and other economically important traits in striped catfish. The reviewed literature suggests that the genetic correlations between body weight and body size traits are positive and high. In contrast, the genetic correlations between the body weight and body size with the reproductive traits were low and inconsistent concerning the direction Navarro et al. [8].

References

1. Pirchner F (1969) Population genetics in animal breeding. In: S Chand (eds.), India, pp. 128-136.
2. Falconer DS (1981) Introduction to Quantitative Genetics. (3rd edn), Oliver & Boyd, UK.
3. Sgrò CM, Blows MW (2004) The genetic covariance among clinal environments after adaptation to an environmental gradient in Drosophila serrata. Genetics 167(3): 1281-1291.
4. (2005) Selection and breeding programs in aquaculture. Gjedrem T(eds.), Springer, Netherlands, 2005: 360.
5. Sang NV, Klemetsdal G, Ødegård J, Gjøen, HM (2012) Genetic parameters of economically important traits recorded at a given age in striped catfish *(Pangasianodon hypophthalmus)*. Aquaculture 344-349: 82-89.
6. Srimai W, Koonawootrittriron S, Aphai WM, Chatchaiphan S, Koolboon U, et al. (2019) Genetic parameters and genotype environment interaction for growth traits of North African catfish, Clarias gariepinus *(Burchell,1822)*. Aquaculture 501: 104-110.
7. Tave D (1993) Genetics for fish hatchery managers. Springer, New York.
8. Navarro A, Zamorano MJ, Hildebrandt S, Ginés R, Aguilera C, et al. (2009) Estimates of heritabilities and genetic correlations for growth and carcass traits in gilthead seabream *(Sparus auratus L.)*, under industrial conditions. Aquaculture 289(3-4): 225-230.