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SABAH D.SALEEM[1], *LAITH A.J.AL-HASSAN*[2], *MELCON K. MELKONIAN*[1]

MORPHOLOGICAL VARIANCE AND ENZYME HETEROZYGOSITY IN *ELEUTHERONEMA TETRADACTYLUM* AND *STRONGYLURA STRONGYLURA* COLLECTED FROM KHOR AL-ZUBAIR AREA, BASRAH, IRAQ

MORFOLOGICZNA ZMIENNOŚĆ I HETEROZYGOTYCZNOŚĆ ENZYMU U ELEUTHERONEMA *TETRADACTYLUM* I *STRONGYLURA STRONGYLURA* Z REJONU KHOR AL-ZUBAIR, BASRAH, IRAQ

1. Department of Mathematic, College of Science, University of Basrah, Iraq
2. Department of Fisheries a. Marine Resources, College of Agriculture, University of Basrah, Iraq

Eleutheronema tetradactylum and *Strongylura strongylura* were studied in testing the association of enzyme heterozygosity with the decreased morphological variance. Six polimorphic loci and three meristic characters were used in this test. The results shown that such a relationship although observed by several others workers may not be common one and hence such hypothesis was not confined.

INTRODUCTION

The relationship between morphological variance and genetical variability have been one of the major research topics among genetical and fisheries sciences. Both environment, in which the organisms developed, and its genetics have a profound effect on the morphological variation (Mitten, 1978).

Five polymorphic loci and seven morphological characters were examined in the fish *Fundulus heteroclitus* by (Mitten, 1978). He found that generally heterozygotes had lower phenotypic variation than homozygotes. A similar conclusion was reached by Eanes, 1978 after examining six polymorphic loci and two morphological traits in the monarch butterfly, *Danaus plexippus*. Hanford, 1980 on the other hand found no difference in phenotypic variability of eleven metric characters and four enzymatic loci in the rufeus-collared sparrows, *Zenotrichia capensis*. A lack of relationship between the morphological variance and enzyme heterozygosity in the Plaice, *Pleuronectes platessa*

was investigated by (McAndrew, Ward, Beardmore, 1982), this also true for the results of Al-Hassan and Saleem (In Preparation) for some member of the family *Clupeidae* from Basrah, Iraq in which they show that the hypothesis of association between enzyme heterozygosity and decreased morphological variance is not applicable.

In the present work a futher test of the hypothesis using three morphologica characters and six polymorphic loci for the populations of *Eleutheronema tetradactylum* and *Strongylura strongylura*.

MATERIAL AND METHODS

Table 1

Distribution of the morphological characters in *Eleutheronema tetradacylum* and *Strongylura strongylura*

Species	Meristic characters	N	$\bar{X}$	S^2	CV	Skew	Kurtesis
Eleutheronema tetradacylum	Dorsal Fin-ray	186	15 371	1.002	6.512	0.017	−0.100
	Anal Fin-ray	186	16.172	0.641	4.951	−0.031	−1.381
	Vertebral Number	186	22.984	0.935	4.207	−0.682	−0.507
Strongylura strongylura	Dorsal Fin-ray	165	13.164	0.491	5.323	−0.341	−0.572
	Anal Fin-ray	165	16.097	0.491	4.353	−4.500	0.101
	Vertebral Number	165	60.715	0.985	1.635	−0.229	−1.018

Table 2

Pearson (above diagonal) and Spearman (below diagonal) correlation coefficients for the meristic characters in the two species of fishes

	Eleutheronema tetradacylum			*Strongylura strongylura*		
	DFR	*AFR*	*VN*	*DFR*	*AFR*	*VN*
D F R	---	0.172	0.246	---	0.117	0.022
A F R	0.235	---	0.227	0.288	---	0.338
V N	0.316	0.233	---	0.041	0.296	---

Samples of *Strongylura strongylura* and *Eleutheronema tetradactylum* were collected by set net in Khor al-Zubair srea, North West of the Arabian Gulf.

Three meristic characters (Dorsal, Anal-finrays and vertebral numbers, DFR, AFR and VN respectively) were counted for all fish that assayed electrophoretically.

Six polymorphic enzyme loci (PGI 1, PGI 2, PGM 1, SOD 2) were assayed from muscle tissue. Details of the electrophoretic procedures followed are given in (Al-Hassan, Mahdi, Ibrahim, 1986) and (Al-Hassan, Mahdi, 1987). Cross tabulation and some statistical tests were performed using statistical package in Basrah University Computer Centre. Relationships between morphological variation and enzyme variation were analysed in a variety of ways. Firstly, for each locus the morphological variance of heterozygotes by a one-tailed F-test (H_o :S^2 homozygotes = S^2 heterozygotes, H_1: S^2 homozygotes S^2 heterozygotes). A two-tailed F-test was applied in the cases when heterozygotes were more variable than homozygotes. A second and probably more robust test of the null hypothesis was applied (Levene, 1960). For each morphological variable in either the homozygote or heterozygote rank a new variable was constructed, $Y_i = Xi - X$ for each case i, and the two Y values (homozygotes and heterozygotes) using one or two-tailed t-tests. Thirdly, by using a 2Xn Chi-square test, the distributions of fin-ray numbers in homozygous and heterozygous individuals were compared.

RESULTS

Dorsal and anal fin rays and vertebral number distribution of both *Strongylura strongylura* and *Eleutheronema tetradactylum* are given in table 1 and shown in figure 1 and 2. It seens that they show significant skewness or kertosis. The observed values were compared with their standard errors to asses the significant levels (Sokal, Rohlf, 1969). In particular, anal fin-rays in left skewed and peaked.

Table 2 shows that the three meristic characters used in this study have a weak correlation with each other with correlation coefficient between 0.172–0.316 for *E. tetradactylum* and 0.022–0.338 for *S. strongylura*. The correlations were in one direction (positive) in the two species under consideration. The DRF/VN in *S. strongylura* is sufficiently low thus, it would be possible to cons such meristic characters as independent characters for practical perposes.

Heterozygosities for each locus are generally similar over the two samples of the species in question. Heterozygosity levels can be assessed from table 3 which contains comparison of morphological variation in homozygotes and heterozygotes using the three tests outlined earlier.

Table 3 presents the results of 18 tests for each species of fish studied (3 meristic characters X 6 loci). It can be seen that the results of the F and t tests are in general agreement with one another, F values greater than one generally being associated with positive t values (Signifying greater homozygotes variability) and F value less than one associated with negative t value. F value greater than one and positive t value were

Table 3

Tests for differences in the distribution of different meristic characters between fish homozygotes or heterozygotes at each enzyme loci.

Heristic Character	N	Locus	S^2 Hom(n)	S^2 Het(n)	F	Levene t	X^2	df
Eleutheronema tetradacylum								
Dorsal Fin-ray	186	PCl 1	0.872(93)	0.912(93)	0.956	0.005	1.686	3
		PCl 2	0.912(93)	0.931(93)	0.980	−0.109	0.513	3
		PGM1	0.806(93)	0.704(93)	1.145	0.799	2.212	2
		PGM2	0.712(93)	0.743(93)	0.958	−0.046	0.197	2
		SOD 1	0.833(93)	0.778(93)	1.071	0.436	0.480	2
		SOD 2	0.972(93)	1.097(93)	0.886	−1.618	4.792	3
Anal Fin-ray	186	PGI 1	0.700(93)	0.659(93)	1.062	−0.061	0.985	2
		PGI 2	0.657(93)	0.716(93)	0.918	−0.983	2.654	2
		PGM1	1.309(93)	0.879(93)	1.489	2.525	10.850	3
		PGM2	0.806(93)	0.797(93)	1.011	0.413	2.650	3
		SOD 1	1.060(93)	1.009(93)	1.050	0.676	2.441	3
		SOD 2	0.813(93)	0.984(93)	0.826	−0.225	11.961	3
Vertebral-Number	186	PGI 1	0.948(93)	0.977(93)	0.970	−0.518	2.456	3
		PGI 2	1.064(93)	1.003(93)	1.061	0.312	3.383	3
		PGM1	0.945(93)	1.043(93)	0.906	−1.057	2.033	3
		PGM2	0.855(93)	0.967(93)	0.884	−0.657	2.149	3
		SOD 1	0.983(93)	0.935(93)	1.081	0.114	0.868	3
		SOD 2	1.016(93)	0.966(93)	1.052	0.607	0.867	3
Strongylura strongylura								
Dorsal Fin-ray	165	PGI 1	0.495(83)	0.401(82)	1.234	0.929	2.194	2
		PGI 2	0.412(82)	0.462(83)	0.892	−0.735	0.564	2
		PGM1	0.509(82)	0.441(83)	1.154	−0.605	2.185	2
		PGM2	0.482(82)	0.453(83)	1.064	0.403	0.195	2
		SOD 1	0.474(82)	0.566(83)	0.838	−1.244	17.417	2
		SOD 2	0.472(83)	0.601(82)	0.785	−0.580	11.340	2
Anal Fin-ray	165	PGI 1	0.618(83)	0.877(82)	0.705	−1.785	1.264	2
		PGI 2	0.417(82)	0.628(83)	0.664	−1.555	1.480	2
		PGM1	0.805(82)	0.482(83)	1.670	1.394	1.575	2
		PGM2	0.588(82)	0.499(83)	1.178	0.374	0.007	2
		SOD 1	0.468(83)	0.601(82)	0.779	−0.550	0.062	2
		SOD 2	0.505(82)	0.711(83)	0.710	−1.485	1.369	2
Vertebral Number	165	PGI 1	0.573(82)	0.710(83)	0.807	−1.029	1.277	3
		PGI 2	0.515(83)	0.858(82)	0.600	−2.160	4.048	3
		PGM1	0.962(82)	0.905(83)	1.063	5.569	1.183	3
		PGM2	0.778(82)	0.550(83)	1.415	1.699	3.139	3
		SOD 1	1.086(83)	0.846(82)	1.284	1.546	2.585	3
		SOD 2	0.869(83)	0.886(82)	0.981	−0.928	2.807	3

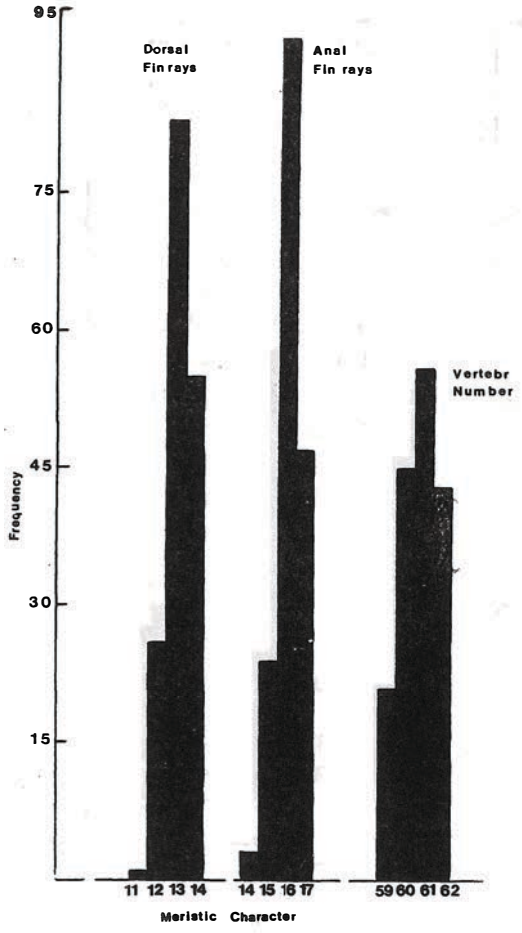

Fig. 1

observed in 9 instances for both species. Homozygotes were significantly more variable than heterozygotes in on one F-test and one t-test, and significantly less variable in one F test and one t-test. Four of the Chi-square tests demonstrated different fin-ray distributions between homozygous and heterozygous classes.

From the results it is possible to deduce that the hypothesis of homozygotes are significantly more variable morphologically than heterozygotes is not contined.

DISCUSSION

In *Eleutheronema tetradactylum* and *Strongylura strongylura* the distribution the three meristic character are independent of homozygosity or heterozigosity at three enzyme loci. So that, the hypothesis that heterozygotes should, in general, show reduced

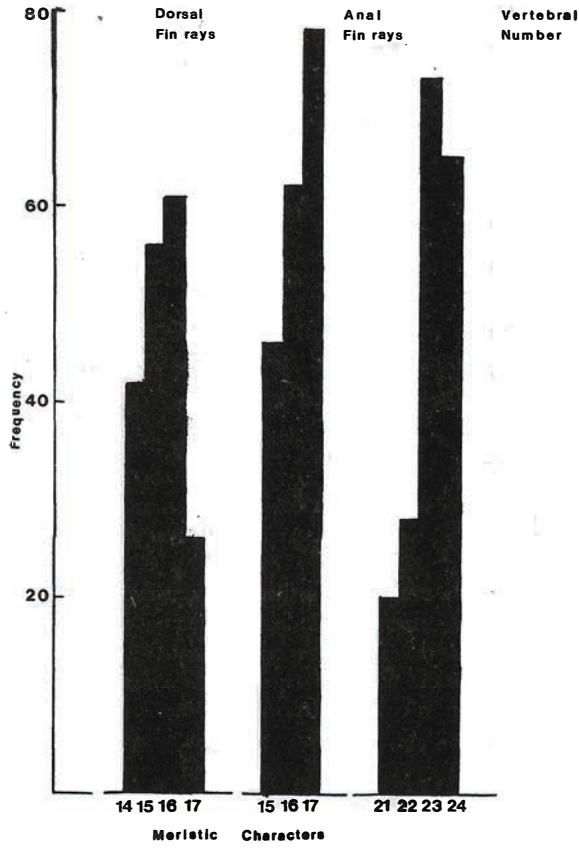

Fig. 2

morphological variance in comparison with homozygotes is not stand. The present findings agree with those of (Handfor, 1980) for bird *Zenatrichia capensis,* for the fish *Pleuronectes platessa* (McAndrew, Ward, Beardmore, 1982) and for some Clupeid fishes from Basrah, Iraq (Al-Hassan Saleem, In preparation), but contrast with the results of (Mitton, 1978) for the fish *Fundulus heteroclitus* and for butterfly *Danaus plexippus* (Eanes, 1978). The results of the latter two authors were consistent with the hypothesis.

The is a good deal of difficulty in direct comparison between studies that fellow different experimental designes, method and analysis, thus it is not easy to account for these varying results. Seven meristic characters and five polymorphic enzymes were studied (Mitton, 1978), eleven metric characters and four enzymes (Handford, 1980), on the other hand a large smaple size was used with three meristic characters and eight enzymes (McAndrew, Ward, Beardmore, 1982).

During his stury (Eanes, 1978) measured two metric characters and about 1300 individuals those assayed at each of six loci. Both (Mitton, 1978) and (Eanes, 1978) reached to a conclusion that make them unable to account for their finding that enzyme heterozygotes are more variable morphologically than homozygotes. Handford (1980) on the other hand, suggested that the reason he failed to find any associations may be because he was examining a homiotherm, and that any such association may be more impressive in invertebrate and poikilotherms. The present study, the study of Al-Hassan a. Saleem (In preparation) and that of (McAndrew, Ward, Beardmore, 1982) show that the hypothesis may not, in fact, hold generally even for poikilotherm.

Many more studies are needed to fulfill many questions such as the matter of operation of stabilising selection on a quantitative characters in the fish species used for such studies. In others such (Beardmore a. Shami, 1979) and (McAndrew, Ward, Beardmore, 1982) the stabilising selection shown to operate on a quantitative characters when an association between heterozygosity and phenotypic variation in that characters is more likely to be found than in casses where no stabilizing selection is demonstrable.

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S.D. Saleem, L.A,J. Al-Hassan, M.K. Melkonian

MORFOLOGICZNA ZMIENNOŚĆ I HETEROZYGOTYCZNOŚĆ ENZYMU U *ELEUTHERONEMA TETRADACTYLUM* I *STRONGYLURA STRONGYLURA* Z REJONU KHOR AL-ZUBAIR, BASRAH, IRAK

STRESZCZENIE

Badano *Eleutheronema tetradactylum (Beloniformes)* i *Strongylura strongylura, (Mugiliformes)*, aby przeanalizować związek heterozygotycznego enzymu ze zmniejszaniem się zmienności morfologicznej.
W badaniach użyto sześć polymorficznych "lcci" i trzy merystyczne cechy. Na podstawie wyników można stwierdzić, że taka zależność, choć obserwowana przez kilku innych autorów, nie zawsze występuje, stąd taka hipoteza nie została potwierdzona.

Authors' address:
L.A.T.Al-Hassan
Department of Fisheries and
Marine Resources
College of Agriculture.
Univ. of Basrah
Basrah – Iraq

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