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Morphometric Variation of *Physa acuta* Shells in Diyala River Basin, Iraq

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Abstract: ***Geometric morphometric techniques are widely used in systematic biology and represented as direct quantification and analysis of variation in biological shape and size , in present investigation were analyzed the variation in shell size and shape of Physa acuta in lotic and lentic ecosystem in Diyala River Basin , results indicated a significant differences in size of shell but no significance appeared in shell shape and the centriod size of the individual in lotic system larger than lentic system with absolute difference between them up to 6.96 µ .***

Keyword: Geometric Morphometric , landmarks , lotic , lentic , *Physa acuta*

1. Introduction

Shell of snails confirm information about their life histories and environmental habitats (Yousif ,2012) because it contact with its habitat .this is true even after death that make shells suitable to us as indicator to record information about snails life histories and environmental habitats**(** Astor , 2014)

The Morphometric technique measure morphological similarities between organism and capturing the variation of shell shape (Bocxlaer and Schultheiß , 2010) so it can give the answer to questions about structure, environments, classification, and biodiversity (Yousif ,2012).

Geometric Morphometric methods depend on indicated Landmark points either along axial sculpturing (if it available) or by in all outline of the shell that every point between two whorls is an appropriate landmark (Carvajal -Rodri´guez *et al* , 2005), and that point should be homologous between the specimens .

One of this technique advantage is to study the morphological diversity between the species . Minton et al. (2008) assessed Shell variation of *Elimia potosiensis* and *Lithasia geniculata* in relation to its position in the river and if the distance caused any changes in shells distance was in order of hundreds of river miles .Also Minton *et al* (2011) applied landmark-point-based morphometrics in the same species but on a much finer scale and proved similar phenotypic plasticity, in that upstream shells tend to be narrower and longer than downstream shells . They also referred to That a significant differences may notice the changes between the spring and tributary and drew attention to the fact that plasticity needs to be studied not only across large drainages, but also in the smaller components of aquatic systems.

Diyala River Basin is one of the most important tributaries of River Tigris , and is one of the main water bodies of Iraq , It runs through Iran and Iraq drains an area of 32600 $km^2$and covers a total distance of 445 km (Al-Adili and Al-Suhail ,2010) . The River basin is characterized by different natural aquatic habitats ranging from lotic system represented by the main stream of the Diyala River with its tributaries, and lentic system represented by lakes (Fig 1) .The aim of the current study is to investigate the variation of *Physa acuta* shells between different habitats by Geomatric Morphometric technique (Bocxlaer and Schultheiß , 2010) ; (Dillon and Jacquemin , 2015).

2. Materials and Methods

Shells were collected two sets of 16 individuals from two habitat along Diyala River as it passes through Baqubah city in (latitude 33° 45 N longitude 44° 38 E.) and Darbandikhan lake its a large freshwater reservoir created by the Darbandikhan Dam ,located in (35°06N 45°24E.) .

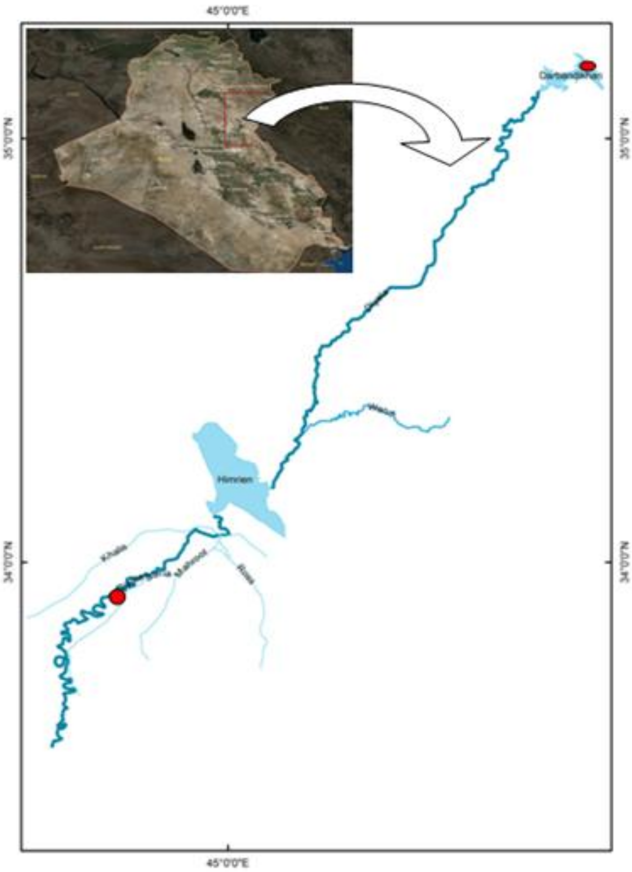


Figure 1: Diyala River Basin with both studied sites : Darbandikhan lake in the north and Diyala river in the south of Basin.

Specimens Processing

The shells were oriented in such a way that the spire was at 90° of the x axis with the ventral side of the shell facing the top. All shells were captured in the same position . The camera was constant focal length and mounted on a tripod to maintain a constant distance from the top of the shell and in order to obtain good images to minimize measurement error.

Data Collection

After photographing the shells of species , the data of each individual of both sites collected separately by using CLIC program (Collecting Landmark for Identification and Characterization) specialized for morphometric analysis that described by Dujadin *et al* (2010) and Dujardin (2014) that available in web site(http://mome-clic.com/)

Seven Landmark at the special point in the margin of the shell and digitize them by using COO unite (Collection of Coordinates) found in program that is specialized to put coordinate landmark and then integrate the data of the to set of individual after that many operation done by using the program to obtained centriod size and shape variables for the shells .

3. Results and Discussion

Geometric morphometric techniques used in systematic biology and represented as direct quantification and analysis of variation in biological shape and size (Klingenberg, 2010) , (Cruz *et al* ,2012) . In the current study this technique on *Physa acuta* shells from habitat in different aquatic system (river and lake **) .**

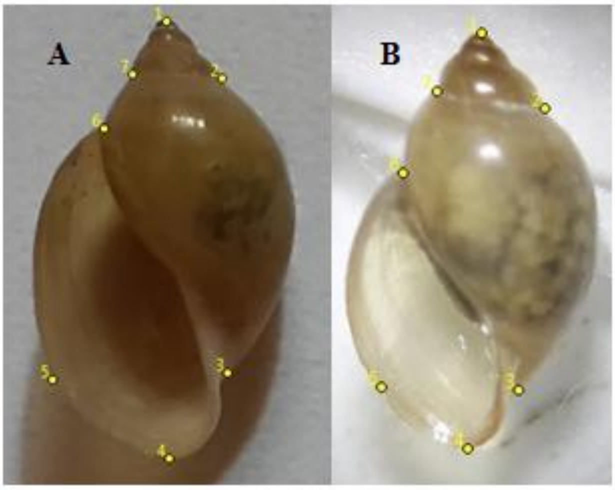
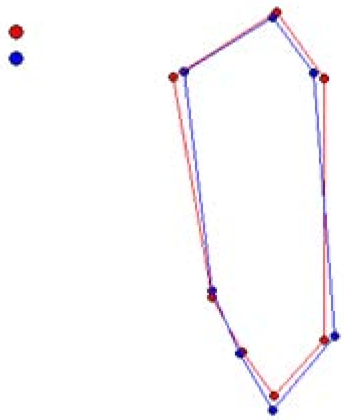


Figure 2: Seven landmarks on the shell of the ***P.acuta*** used in geometric analysis, A the shell from Darbandikhan lake , B the shell from Diyala river

Seven Landmarks selected on the shell in each individual (Fig.2), and after the matching between the shells of the two sites by using Geometric analysis through the MOG unit and as observed in (Fig 3) which appear the mean coordinate of the landmark of the two sectors that difference in a degree of matching of the Landmark between the individual in different sectors.



X=from -190.884 to 161.089 Y= from -406.679 to 453.009

Figure 3: Mean coordinates of landmark on the Shell of ***P.acuta,*** red color represents individuals in Darbandikhan lake and blue color represents individuals in the Diyala river.

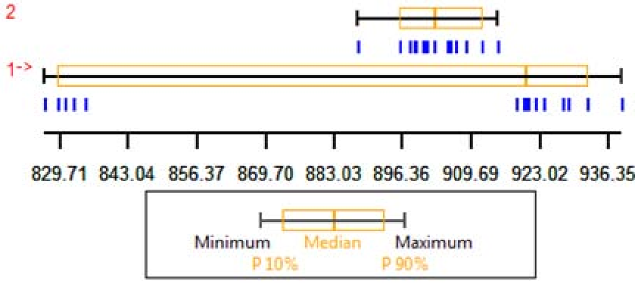
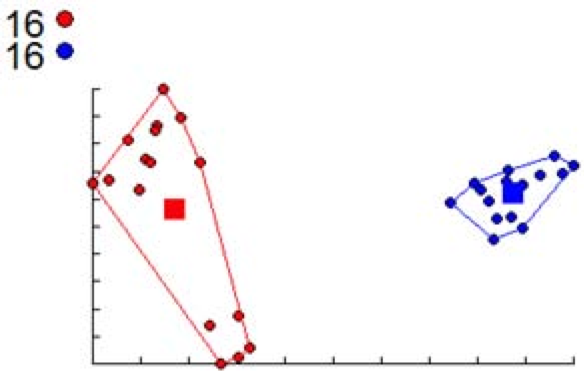


Figure 4: Variation of the centroid size of shell for ***P. acuta*** in the two sites , Each box shows the group of median separating the 10th and 90th quartiles. Vertical bars under the boxes represent individuals numbers , 1 and 2 represent individuals in the Darbandikhan lake and Diyala river respectively.

The comparative range of the cenroid size of the shells as showed in (fig 4) indicated that most of the individual were within the median rang of the centriod size of each sector as it represented by the blue bar under the box in the except for two individuals from each sector



X= from -0.048 to 0.045 Y= from -0.032 to 0.022

Figure 5: Scatter plot of the principle component analysis of ***P.acuta*** individuals on Geometric Morphometric data, red spots represent individuals in the Darbandikhan lake and blue spots represent that in Diyala River , red square represent mean centroid size of the individual in the Darbandikhan lake = 894.80 and blue square represent mean centroid size of individual in Diyala river = 901.76

Also the Discriminative analysis showed there were variation in centriod size of the shell between the two sites (fig 5) with mean centriod size of Darbandikhan lake individual up to 894.80 and for the Diyala river individual was 901.76 Table (1) show that absolute difference between them was 6.96 but that difference not regard as significance as it showed by use F and t - test .

Table (2) and (3) show the variance analysis for symmetry shells between the Lake and River by using ASI unit in morphometric program ,the results indicated significant difference in shell size but no differences in shell shape between the individuals in the two sites .

Table 1: Comparison of the centroid size of the individuals shells of ***P.acuta*** between Darbandikhan lake and Diyala river . M.CS: Mean centroid size, St.d: Standard Deviation, V.: Variance, P :Probability, A.D : Absolute differences .

Group	M.CS.	St.d.	V.	F	P	T	P	A.D.
Darbandikhan lake	894.80	43.06	1854.47	47.81	1.17	0.63	0.52	6.96
Diyala river	901.76	6.22	38.78					

Table 2: Analysis of variance for asymmetry shell size of ***P.acuta*** between individuals in Darbandikhan lake and Diyala river

Source	SS	df	MS	F	Signification
Model	0.0003	3	0.0011	0.70	0.56
Individual	0.0003	1	0.0031	2.02	0.16
Side	0.0000	1	0.00007	0.04	0.83
Side*I	0.0000	1	0.00005	0.03	0.85
Residue	0.0044	28	0.00015		

Table 3: Analysis of variance for asymmetry shell shape of ***P.acuta*** between individuals in Darbandikhan lake and Diyala river

Source	SS	df	MS	F	Signification
Model	0.0011	30	0.000038	0.32	1.000
Individual	0.0009	10	0.000093	0.57	0.8387
Side	0.0001	10	0.000011	0.07	1.0000
Side*I	0.0001	10	0.00009	0.06	1.0000
Residue	0.0459	280	0.000164		

As it appeared in fig (3) there were no matching between the coordinate landmarks in the species in two sites and that lead to variance in centroid size of *P.acuta* as it appeared in table (1) that may be belong to variance in ecological environments between sectors which that agree with Kitthawee and Rupgsri (2011) whom referred to the not matching between the identical landmark as due to the differences of environmental between the studied area.

The results indicated a significant variation in size of shell but no significance in shell shape that may be due to the shell shape is the result of a complex interaction between genotype and environment (Clain *et al* , 2004), (Camama *et al* , 2014) and according to Johnson and Brown (1997) that found a relation between the current and size of the shell ,so in lotic system the size of the shell increase and as the current increase the size of shell being larger , (Menton *et al* ,2008) also support that relation and they returned that to environmental stresses so the larger shell protect the snail from damage in current water so as the thickness of the shell increase to reduce the injury that cause by fast current , also Trussell *et al* (2000) and Jamasali *et al* (2014) referred to presence phenotypic plasticity among the species from different geographical location that cause variation in species .that is because many possible factors including genetic, biotic and abiotic factors (Sobrepeña and Demayo , 2014).

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