INT. J. BOIL. BIOTECH., 13 (2): 257-260, 2016.

IMPLICATION OF ROLE OF STATISTICS IN FISH TAXONOMY

Musarrat-ul-Ain[1], Rehana Yasmeen Farooq[1], Zubia Masood[2] and Bushra Saleem[1]

[1]*Department of Zoology, University of Karachi, Karachi-75270, Pakistan*
[2]*Department of Zoology, Jinnah University for Women, Karachi, Pakistan*

ABSTRACT

Fish scales are remarkable structures which plays a significant role in fish taxonomy. Therefore, a study was carried out to notice the significance of different scale parameters such as; scale length (TLS), scale width (WDS), number of ctenii in horizontal row (HRS), number of ctenii in vertical row (VRS) and number of radii (RDS) in fish taxonomy using statistical calculations. A total of 54 specimens of *Scatophagus argus* were collected from the commercial landings at fish harbours of West Wharf and Korangi creek, Pakistan. Different parameters of scales (*i.e.*, TLS, WDS, HRS, VRS and RDS) were studied under compound microscope. The relationship among these scale parameters were studied with the help of linear regression equation ($Y = a + bX$). All results were found highly significant ($p<0.05$). The correlation between fish length and different parameters of fish scales showed moderate ($r=0.59$-0.50) to strong ($r>0.70$) correlations. The analysis showed that the growth of scale parameters are mostly proportional to fish body length.

Key words: Fish scale, scale parameters, statistical usage, fish taxonomy.

INTRODUCTION

Fish scales are derivations of dermal layer of skin. Different lines present on scale surface helps to study the age of fish while, there are some other structures which helps in fish taxonomy (Kaur and Dua, 2004). A general structure of scale can be explained as; it has a center portion, called focus which divides a scale into anterior, posterior, right lateral and left lateral fields. These fields have circular lines which are cut by several straight grooves called radii (Gholami *et al*., 2013). According to, Esmaeili and Gholami (2009) fish scales helps to study the feeding habits of some scale eating fishes and also helps to study the life history and age of fish. Several scientists such as, Esmaeili *et al*. (2009); Alkaladi *et al.* (2013); Johal *et al.* (2014) and Renjith *et al.* (2014) have been used scales for fish identification because scale collection does not involved in killing of fish and scale sample preparation for study is a simple procedure. In continuation of previous studies, this study provides a suggestion about the use of statistical calculations in fish taxonomy. That will enhance the procedures of identification and will give significant results in fish taxonomy.

MATERIALS AND METHODS

Sample Collection and Laboratory Processing

Fish samples of different lengths were collected from the commercial landings at fish harbours of West wharf and Korangi creek, Pakistan. Fish length were measure from the tip of the snout to the tip of caudal fin in mm. Scales from each fish sample were collected and washed with 10% NaOH. Mucous and dirt particles on scale surface were cleaned with soft brush. Three different grades of alcohol (30%, 50% and 70%) were used for dehydration process of scales. Cleaned and dehydrated scales were placed on glass slide and covered with another glass slide, preventing them from curling and from dust particles. Edges of glass slides were bound with tape. Prepared slides were studied under the compound microscope (10x4) and different parameters of scales were measured and counted (Fig. 1).

Statistical Analysis of Data

The linear correlation and regression analysis wase used for statistical analysis with scale parameters of *Scatophagus argus* after Niel (1995) and Zar (1999).

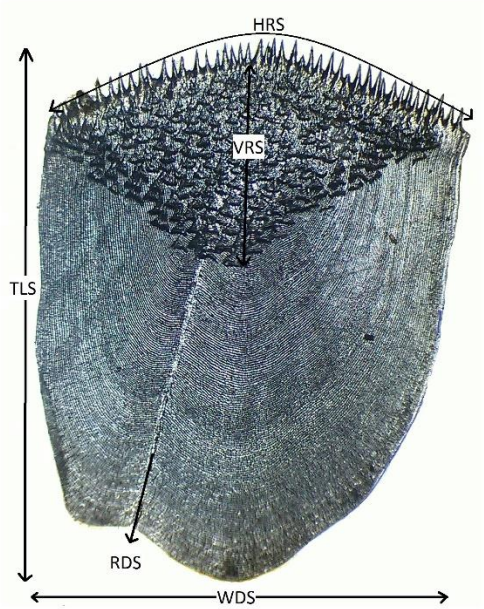

Fig. 1. Showing different parameters of scale.
TLS= scale length; WDS= scale width; HRS= horizontal row of ctenii; VRS= vertical row of ctenii; RDS= number of radii.

RESULTS

The descriptive statistics of different parameters of scales were presented in Table.1. The total length of scales (TLS) was observed ranging 2-4.1mm and width of scale (WDS) was observed ranging 1.9-4.1mm. The horizontal row of ctenii (HRS) and vertical row of ctenii (VRS) were found 25-57 and 6-16 respectively. It was investigated that most of the scales lack radii (RDS). The number of radii on scales was counted ranging 0-5.

Table. 1. Descriptive statistics for different parameters of scales of *Scatophagus argus*.

Scale parameter	Mean	S.E	S.D. (±)	Mode	Min.	Max.
TLS	3.07	0.098	0.724	3	2	4.1
WDS	2.62	0.068	0.506	3	1.9	4.1
HRS	42	1.00	7.35	39	25	57
VRS	10	0.422	3.099	6	6	16
RDS	2	0.206	1.517	2	0	5

S.E= Standard Error, S.D = ± Standard Deviation

The regression analysis between total length of fish (TL) and different parameters of scales such as; TLS, WDS, HRS, VRS and RDS were presented in Table.2. The coefficient of determination (r^2) represents the variations in total length of fish (TL) with total length of scale (TLS) and width of scale (WDS) described to the level of 42% and 45%, respectively. The variations in total length of fish (TL) and horizontal row of ctenii (HRS) explained to the extent of 30% and variations in length of fish (TL) and vertical row of ctenii (VRS) clarified to the degree of 62%. While the variations in total length of fish (TL) and number of radii (RDS) is described to the range of 29%.

The coefficient of correlation (r) shows moderate (r=0.59-0.50) to strong (r>0.70) correlation between total length of fish and different parameters of scales. Results for all correlations were found to be positive except for

radii on scales, which show the negative correlation. The values of t-test was investigated highly significant ($p<0.05$) for all parameters of fish scales.

Table. 2. Regression analysis of the total length of fish and parameters of scales of *Scatophagus argus*. All measures were in mm. N = Number of samples. CT= correlation type.

N = 54						Significance of correlation			
X	Y	a	b	r	r^2	S.E (b)	t-test	p-value	CT
TL	TLS	1.352	0.0075	0.652	42.55	0.001	6.21	0.000[a]	**
TL	WDS	1.379	0.0054	0.676	45.7	0.000	6.62	0.000 [a]	**
TL	HRS	27.62	0.0644	0.549	30.15	0.0136	4.74	0.000 [a]	*
TL	VRS	1.07	0.0389	0.788	62.07	0.0042	9.23	0.000 [a]	***
TL	RDS	4.96	-0.0131	-0.542	29.37	0.0028	-4.65	0.000 [a]	*

shows significant ($p<0.05$); *** shows strong correlation ($r>0.70$); **shows high correlation ($r=0.69$-0.60); *shows moderate correlation ($r=0.59$-0.50).

The regression analysis between scale length (TLS) and different parameters of scales (WDS, HRS, VRS and RDS) were presented in Table.3. The coefficient of determination (r^2) represents the variations in total length of scale (TLS) with width of scale (WDS) designated close to 49%. The variations in total length of scale (TLS) and horizontal row of ctenii (HRS) clarified to the degree of 53% and variations in length of scale (TLS) and vertical row of ctenii (VRS) clarified to the extent of 47%. While, the variations in total length of scale (TLS) and number of radii (RDS) is defined to the level of 2%.

The correlation between total length of scale and different parameters of scale was observed positive while, radii on scales shows the negative correlation. Strong correlation ($r>0.70$) was studied between total length of scale and horizontal row of ctenii while, high correlations ($r=0.69$-0.60) was observed for total length of scale and width of scale and for vertical row of ctenii. However, correlation between total length of scale and radii on scale was observed weak ($r<0.50$).

Table. 3. Regression analysis of the different parameters of scales of *Scatophagus argus*. All measures were in mm. N = Number. of scale samples examined. CT= correlation type.

N = 54						Significance of correlation			
X	Y	a	b	r	r2	S.E (b)	t-test	p-value	CT
TLS	WDS	1.27	0.4624	0.697	48.62	0.0815	5.67	0.000[a]	**
TLS	HRS	18.30	7.88	0.732	53.61	1.26	6.27	0.000 [a]	***
TLS	VRS	2.18	2.738	0.688	47.32	0.495	5.53	0.000 [a]	**
TLS	RDS	2.242	-0.224	-0.139	1.94	0.273	-0.82	0.418[NS]	♣

[a] shows significant ($p<0.05$); [NS] shows insignificant ($p>0.05$); *** shows strong correlation ($r>0.70$); **shows high correlation ($r=0.69$-0.60); ♣ shows weak correlation ($r<0.50$).

DISCUSSION

The regression analysis between total length of fish (TL) and different parameters of scales (TLS, WDS, HRS, VRS and RDS) shows linear relationship while the correlation between them was observed moderate to strong,

represents that the growth of different parameters of scales were mostly proportional to the length of fish. The t-test and p-value specifies the significance of results. The regression analysis between total length of scale (TLS) and different parameters of scales (WDS, HRS, VRS and RDS) were also found linear. The correlation between total length of scale and different parameters of scales were studied high to strong except for radii which shows weak and negative correlation with scale length. The t-test was also observed negative and insignificant for scale length and number of radii. However, the overall results confirms the implication of statistical analysis of different parameters of fish scales for fish identification and taxonomy.

CONCLUSIONS

The results of present investigations shows that statistical analysis of different parameters of fish scales is a useful technique in systematic classification of fishes.

REFERENCES

Alkaladi, A., A.S.A. Harabawy and I.A.A. Mekkawy (2013). Scale characteristics of two species, *Acnthopagrus bifasciatus* (Forsskal, 1775) and *Rhabdosargus sarba* (Forsskal, 1775) from the Red Sea at Jeddah, Saudi Arabia. *Pakistan Journal of Biological Sciences*, 16(8): 362-371.

Esmaeili, H.R. and Z. Gholami (2009). Scanning electron microscopy of scales in cyprinid fish, *Alburnoides bipunctatus* (Blotch, 1782). *Ferdowsi University International J. Biol. Sci*., 1: 19-27.

Esmaeili, H.R., B. Samaych, Z. Halimeh, and S. Fatemah (2009). Scale morphology of Tank Goby *Glossogobius giuris* (Hamilton-Buchanan, 1842) (Perciformes: Gobiidae) using scanning electron microscope. *J. Biol. Sci*., **9**(8): 899-903.

Gholami, Z., A. Teimori, H.R. Esmaeili, T. Schulz-Mirbach and B. Reichenbacher (2013). Scale surface microstructure and scale size in the tooth-carp genus *Aphanius* (Teleostei, Cyprinodontidae) from endorheic basins in Southwest Iran. *Zootaxa*, 3619 (4): 467–490.

Johal, M.S., Y.K. Rawal, A. Kaur and A. Kaur (2014). Ultrastructure of the focus region of the regenerated cycloid scale of an exotic fish, *Cyprinus carpio communis* L. as a possible key to comprehensive understanding of populations. *Current Science*, 106(5): 744-748.

Kaur, N. and A. Dua, (2004). Species specificity as evidenced by scanning electron microscopy of fish scales. *Current Science*, 875: 692-696.

Niel, A.W. (1995). *Introductory Statistics*. 4th edition. Addison-Wesley Publishing Company. Inc. New York. pp: 938.

Renjith, R.K., A.K. Jaiswar, S.K. Chakraborty, S. Jahageerdar and G.B. Sreekanth (2014). Application of scale shape variation in fish systematics - an illustration using six species of the family Nemipteridae (Teleostei: Perciformes). *Indian J. Fish.*, 61(4): 88-92.

Zar, J.H. (1999). *Biostatistical Analysis*. 4th edition. Prentice-Hall, Englewood Cliffs, New Jersey.

(*Accepted for publication March 2016*)