Journal of the Indian Fisheries Association
20, 1990, 1-5

MORPHOMETRIC STUDIES IN *PENAEUS MERGUIENSIS* FROM RATNAGIRI WATERS FOR SELECTION OF THE BROOD STOCK IN GENETIC IMPROVEMENT PROGRAMMES

USHA GOSWAMI, S.C. GOSWAMI AND S.G. DALAL
National Institute of Oceanography, Dona-Paula,Goa 403 004

ABSTRACT

Studies on genetic improvement of penaeid prawns for the character higher tail weight using methods of selective breeding were undertaken. Prior to the actual breeding experiments it was necessary to find out the quantum of available variability in the character tail weight amongst the natural populations of *Penaeus merguiensis* from the Indian waters. Presently, studies were made on the prawn stocks from the Ratnagiri waters. Thirteen morphometric variables were measured and various statistical analyses were carried out. The tail weight showed almost double values of coefficient of variation in the females than the males (C.V. = 20.37 & 11.08 respectively). The combination of the characters viz. sixth segment length (SSL), sixth segment depth (SSD) and posterior abdominal circumference (PAC) gave the highest R^2 values. These variables were easy to measure and gave maximum variation in the character tail weight without sacrificing the breeders in the brood stock. The quantitative character tail weight was influenced by both genetic and environmental factors was statistically ascertained by applying 2-Factor analysis. The details were incorporated in the paper.

INTRODUCTION

Application of genetics in aquaculture for improvement of stocks was an important development in the recent years. A survey of the market indicated that the prawns with higher tail weight was of importance to the farmers and the entrepreneurs for getting high prices in the local and foreign markets. Hence, genetic improvement programs using methods of selection were undertaken at NIO and " Higher tail weight" was selected as the desired character of improvement. As the initial step, for selection of the brood stocks from the wild, any possibility of the character already being reached to its optimum level due to the natural selection was to be ruled out. So prior to the actual breeding experiments it was necessary to find out the quantum of available variability in the trait tail weight amongst the wild populations from the Indian waters. Earlier, the penaeid prawn stocks from different locations along the central west coast of India were analysed by adopting a morphometric and statistical criteria (Goswami, 1986 and Goswami *et al.*, 1986). In continuation to that the present paper gives information on *Penaeus merguiensis* from Ratnagiri waters.

MATERIAL AND METHODS

Thirty specimens of *P. merguiensis* were collected from Ratnagiri waters and thirteen morphometric variables were measured (Table I). For computation of data, the former twelve characters were taken as the independent variables and the last one (tail weight, TW) as the dependant variable. The variability in each variable was examined statistically by studying range, mean and 95% confidence limits for mean in both the sexes. Since measuring tail weight involved sacrificing the animals and for all experimental purposes live specimens were needed, a search was made for a combination of some other morphometric characters which would give the indication of the higher tail weight. This was tried by calculating simple and multiple correlations amongst the characters and with the tail weight. Further since tail weight was a quantitative character, its variability will be affected by several extrinsic and intrinsic factors. Two important factors i.e. genetical and environmental were identified and their influence on the quantum of variation

explained the tail weight in connection to the twelve independent characters and was statistically analysed using 2-Factor analysis. The other details of methodology were as described elsewhere (Goswami 1986 and Goswami *et al.*, 1986).

and posterior abdominal circumference (PAC) showed higher values in the females from Ratnagiri as earlier observed by Goswami *et al.* (1986) for *P. merguiensis* from Goa and Devgarh waters. However, the EUL and PCL showed poor correlation in the case of the

Table I : *Summary of metric data of P. merguiensis male and female from Ratnagiri region used in calculating the correlation matrix.*

Variable	Male		Female	
Mean	Mean	C.V.	Mean	C.V.
Exopod of uropod length (EUL)	34.10	05.97	38.77	05.80
Endopod of uropod length (ENL)	26.46	07.46	31.67	06.80
Sixth segment length (SSL)	23.40	08.32	27.30	08.67
Sixth segment depth (SSD)	18.76	08.35	21.60	06.44
Posterior abdominal circumference (PAC)	46.23	06.40	52.10	10.23
Second abdominal segment depth (SAD)	26.80	09.02	31.70	07.32
Anterior abdominal circumference (AAC)	66.70	06.74	79.53	09.26
First segment length (FSL)	18.45	08.41	21.03	05.12
Carapace width (CW)	19.43	08.96	23.30	09.59
Carapace depth (CD)	22.00	05.15	26.93	07.32
Partial carapace length (PCL)	36.40	03.57	44.40	07.56
Fifth segment length flexed (FLF)	14.77	11.07	17.10	12.61
Tail weight without peeling (TW)	15.57	11.08	24.53	20.37

RESULTS AND DISCUSSION

From the values of the mean and coefficient of variation of all the thirteen variables (Table 1) and the range and confidence limits in the Dice-Lerass diagram (Fig. 1), it has been noticed that the pattern of variability in most of the characters in both male and female sexes was similar. Except for posterior abdominal circumference (PAC), partial carapace length (PCL) and tail weight (TW) the variability in females was almost the double as compared to the males. Chavan (1979) had earlier described this to be due to the differential rate of growth in the two sexes during their life history.

The magnitude of inter-relationship between the independent variables was studied by calculating coefficient of correlation (Table II). The character exopod of uropod length (EUL), partial carapace length (PCL)

males. In the case of the females PCL, SAD and CW showed highest correlation with the tail weight (TW) (r values = 0.91, 0.78 & 0.74 respectively) and in the case of the males posterior abdominal circumference PAC, second segment depth (SSD) and endopod of uropod length (ENL) had highest correlation. All these characters showing high correlation with tail weight, showed high r values with other morphometric characters also. Hence the combination of characters were selected on the basis of r values and practical feasibilty of measuring them in the field and R^2 and variance ratio (F values) were calculated (Table III & IV). It was found that the sixth segment length (SSL), and the posterior abdominal circumference (PAC) showed maximum values and all the values were significant at the 5% level (F (12,3) $P< 0.05=3.49$). Hence these characters should

Table II : *Simple correlation matrix between different morphometric characters measured in P. merguiensis (male & female) from Ratnagiri*

	EUL	ENL	SSL	SSD	PAC	SAD	AAC	FSL	CW	CD	PCL	FLF	TW
EUL	1.00	0.35	0.47	0.14	0.41	0.75	0.57	0.29	0.77	0.17	0.40	-0.14	-0.01
ENL	0.63	1.00	0.06	0.10	0.29	0.33	0.51	0.38	-0.04	0.27	0.02	-0.44	0.43
SSL	0.61	0.48	1.00	0.52	0.75	0.47	0.56	0.18	0.05	0.34	0.33	0.24	0.27
SSD	0.73	0.59	0.90	1.00	0.58	0.14	0.40	0.37	0.21	0.17	0.48	0.44	0.51
PAC	0.63	0.31	0.86	0.83	1.00	0.64	0.43	0.25	-0.04	0.16	0.37	0.33	0.55
SAD	0.75	0.43	0.74	0.89	0.77	1.00	0.41	0.17	0.16	0.11	0.46	-0.02	0.02
AAC	0.56	0.51	0.84	0.80	0.69	0.71	1.00	0.56	0.37	0.55	0.43	-0.23	0.02
FSL	0.52	0.51	0.44	0.51	0.25	0.57	0.49	1.00	0.27	0.51	0.54	0.04	0.32
CW	0.62	0.40	0.76	0.68	0.62	0.70	0.68	0.48	1.00	0.18	0.18	-0.15	-0.26
CD	0.60	0.44	0.77	0.66	0.56	0.53	0.61	0.59	0.86	1.00	0.27	0.08	-0.07
PCL	0.59	0.71	0.74	0.68	0.59	0.68	0.64	0.38	0.77	0.62	1.00	0.55	0.23
FLF	0.64	0.52	0.67	0.66	0.70	0.59	0.50	0.53	0.75	0.80	0.64	1.00	0.26
TW	0.69	0.60	0.69	0.66	0.65	0.78	0.68	0.45	0.74	0.58	0.91	0.65	1.00

be measured while sorting out animals to be included in the parental brood stocks for selective breeding experiments. Earlier Lester (1983) had analysed 10 variables out of the thirteen included in the present study (EUL, ENL, CD are new addition). All these variables showed high correlation with tail weight in *Penaeus vannamei* and *Penaeus stylirostris* from temperate waters. The similarities noticed in morphometric variables amongst species of the same genus *(Penaeus)* even in samples from different waters throw light upon the reliability of the variables selected. The accumulation of similar data on stocks from other geographical locations would certainly help in deriving at uniform morphogenetic criteria for selection of the brood stocks from Indian waters. The statistical 2-factor analysis made (Table V) showed that 74% of the variation in females and 52% of the variation in males of the character tail weight was explained by genetic and environmental factors (Female : 57.73 & 16.65 and Male : 26.73 & 25.73 respectively). These results indicated the significance of maintaining totally similar environmental factors while assessing genetic heratabilities for selective breeding experiments.

Table III : *Multiple correlation coefficient (R^2) and variance ratio (F) in P. merguiensis (male) from Ratnagiri.*

Variables			Constant	In-combination		R^2	F
ENL	SSD	PAC	ENL	SSD	PAC	0.09	0.59
			SSD	ENL	PAC	0.34	3.09
			PAC	ENL	SSD	0.39	3.84
PAC	PCL	SSD	PAC	PCL	SSD	0.34	3.09
			PCL	PAC	SSD	0.23	1.79
			SSD	PAC	PCL	0.42	4.34
FSL	CD	PCL	FSL	CD	PCL	0.43	4.53
			CD	FSL	PCL	0.26	2.10
			PCL	FSL	CD	0.29	2.45
SSL	SSD	PAC	SSL	SSD	PAC	0.57	7.95
			SSD	SSL	PAC	0.37	3.52
			PAC	SSL	SSD	0.61	9.38

F (12, 3) P< 0.05 = 3.49

Table IV : *Multiple correlation coefficient (R^2) and variance ratio (F) in P. merguiensis (female) from Ratnagiri.*

Variables			Constant	In-combination		R^2	F
EUL	SSD	CW	EUL	SSD	CW	0.56	7.63
			SSD	EUL	CW	0.62	9.79
			CW	EUL	SSD	0.50	6.00
ENL	CW	CD	ENL	CW	CD	0.20	1.50
			CW	ENL	CD	0.74	14.07
			CD	ENL	CW	0.75	18.00
EUL	CW	PCL	EUL	CW	PCL	0.42	4.34
			CW	EUL	PCL	0.64	10.10
			PCL	EUL	CW	0.61	9.38
SSL	SSD	PAC	SSL	SSD	PAC	0.85	34.00
			SSD	SSL	PAC	0.82	27.33
			PAC	SSL	SSD	0.76	19.00

F (12, 3) P< 0.05 = 3.49

Table V : *Factor loading matrix-after Varimax rotation (P. merguiensis male and female from Ratnagiri)*

Variables	Sum of the squares	Male Factor 1	Loadings 2	Sum of the squares	Female Factor 1	Loadings 2
EUL	0.58	-0.74	-0.17	0.66	-0.76	0.30
ENL	0.43	-0.65	0.01	0.58	-0.55	0.52
SSL	0.58	-0.44	-0.63	0.88	-0.94	0.01
SSD	0.66	-0.15	-0.81	0.86	-0.92	0.10
PAC	0.68	-0.40	-0.72	0.81	-0.89	-0.14
SAD	0.53	-0.72	-0.11	0.75	-0.85	0.19
AAC	0.79	-0.85	-0.26	0.76	-0.87	-0.04
FSL	0.42	-0.51	-0.40	0.74	-0.43	0.74
CW	0.13	-0.36	0.05	0.85	-0.25	-0.89
CD	0.27	-0.48	-0.21	0.64	-0.74	0.30
PCL	0.52	-0.19	-0.70	0.72	-0.79	0.30
FLF	0.81	0.48	-0.76	0.67	-0.74	0.35
TW	0.40	0.02	-0.63	0.74	-0.80	0.33
Sum of the squares of columns		3.475	3.344		7.505	2.164
Variance%		26.73	25.73		57.73	16.65

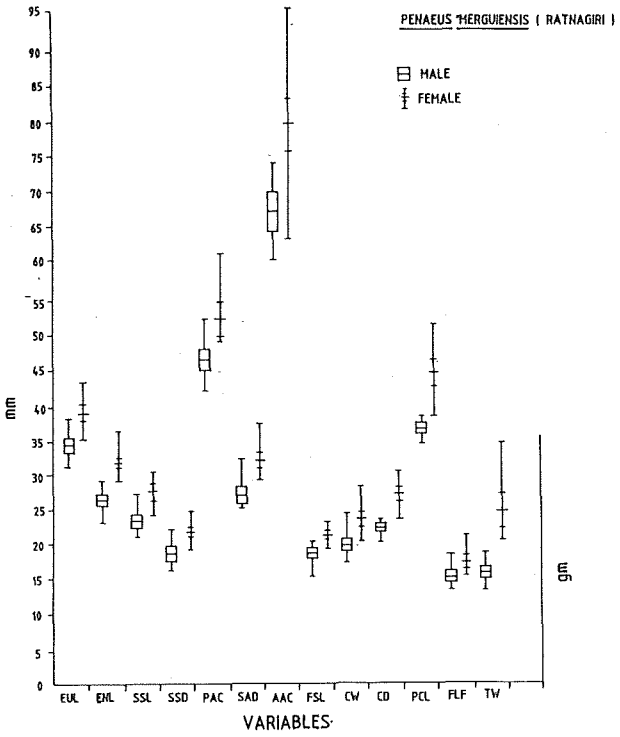

Fig. 1. *Dice lerass diagram showing the variation trend in P. merguiensis males and females from Ratnagiri.*

ACKNOWLEDGEMENTS

The authors are grateful to Dr. B.N. Desai, Director, National Institute of Oceanography, Goa, for the laboratory facilities and to Dr. A.H. Parulekar, Head, Biological Oceanography Division, for encouragement.

REFERENCES

Chavan, H.S. 1979. Studies on environmental and nutritional physiology of banana shrimp *Penaeus merguiensis* (de man). *Ph.D Thesis, Konkan Krishi Vidyapeeth, Dapoli,* 271 pp.

Goswami, U. 1986 Studies on morphometric traits in penaeid prawns for selective breeding programme. In *Proc. 3rd world congress on genetics applied to live-stock production, Lincoln, Nebraska, USA July 16-22.* **10** : 423 PP.

Goswami, U., Dalal, S.G. and Goswami, S.C. 1986 Preliminary studies on prawn *Penaeus merguiensis* for selection of brood stock in genetic improvement programmes *Aquaculture.* **53** (1) : 41.

Lester, L.J. 1983. Developing a selective breeding programme for penaeid shrimp mariculture. *Aquaculture.* **33** : 41.