

PRELIMINARY STUDIES ON PRAWN, *PENAEUS MERGUIENSIS*, FOR SELECTION OF BROODSTOCK IN GENETIC IMPROVEMENT PROGRAMS

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ABSTRACT

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Studies conducted on prawn, *Penaeus merguensis* (de Man, 1888), from Goa and Devgarh (Maharashtra) waters showed higher average values of tail weight and other morphometric characters in Devgarh. The coefficient of variation in females is almost twice that in males in both localities. Stepwise sequential regression analysis indicated that morphometric characters like partial carapace length (PCL), exopod of uropod length (EUL) and posterior abdominal circumference (PAC), either individually or in combination, give a more accurate estimate of tail weight than the other 14 possible variables, and can be used for selection of the broodstock in aquaculture.

INTRODUCTION

A program on genetic improvement of prawn, *Penaeus merguensis* (de Man, 1888), for greater growth in tail weight has been undertaken. This paper reports results of the initial phase of studies on estimation of the variability of the selected trait in nature and on the search for some morphometric characters which could be used for estimating quantum of variation in tail weight, without killing the animals, for selection of broodstock.

Earlier, Malecha et al. (1979), Horton and Lester (1982) and Lester (1983) described morphometric studies in *Macrobrachium rosenbergii*, *Penaeus vannamei* and *Penaeus stylirostris*.

MATERIAL AND METHODS

Ninety-six samples of adult prawns, *Penaeus merguensis* (de Man, 1888), constituted the material. Forty-six specimens were collected from Goa and fifty from the waters of Devgarh (Maharashtra) by trawl net. Equal numbers of male and female prawns were used for morphometric analysis. Eighteen

TABLE 1

Summary of metric data of *P. merguensis* from Goa and Devgarh regions used in calculating the correlation matrix

Variable	Goa				Devgarh			
	Male		Female		Male		Female	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1. Exopod of uropod length (EUL)	26.85	6.66	28.32	10.59	31.97	5.31	34.64	9.95
2. Endopod of uropod length (ENL)	21.97	7.05	22.73	9.76	24.85	8.73	27.56	12.04
3. Width of telson at base (WT)	5.50	10.54	5.81	16.20	6.58	7.84	7.27	13.75
4. Sixth segment length (SSL)	17.60	7.84	18.22	12.60	20.68	7.83	23.22	11.84
5. Sixth segment depth (SSD)	14.18	6.34	14.87	12.71	16.55	4.29	18.22	11.59
6. Posterior abdominal circumference (PAC)	34.87	6.51	36.80	12.20	42.02	5.11	46.86	10.47
7. Fifth segment length, flexed (FLF)	9.70	27.21	10.45	16.46	12.72	11.94	14.03	22.38
8. Second abdominal segment, depth (SAD)	19.59	13.47	20.29	14.65	23.39	9.23	27.80	14.28
9. Anterior abdominal circumference (AAC)	50.97	9.79	55.56	12.94	63.52	5.79	73.22	11.45
10. First segment length (FSL)	13.22	8.47	14.00	7.14	16.32	8.45	18.55	15.96
11. Carapace width (CW)	14.57	10.22	15.37	14.31	18.14	7.27	21.86	19.58
12. Carapace depth (CD)	17.57	12.67	19.14	13.16	21.97	7.73	25.94	12.45
13. Partial carapace length (PCL)	27.81	6.08	29.41	11.46	32.64	6.66	38.72	13.50
14. Rostrum length, tip—last dorsal tooth (RLT)	29.82	4.46	30.56	8.70	32.34	4.20	34.86	6.00
15. Rostral crest apex depth (RCAD)	3.61	16.89	3.83	15.40	4.29	10.80	5.49	16.66
16. Antennal scale length (ASL)	24.45	9.81	25.61	11.05	29.20	6.47	31.64	9.96
17. Partial total length (PTL)	103.52	6.53	109.60	12.03	128.36	5.14	144.12	9.12
18. Tail weight, without peeling (TW)	9.02	18.29	10.27	30.08	15.43	12.76	21.77	28.47

characters, selected on the basis of their possible relationship with size and practical convenience of measuring without injuring the animal, were as follows: EUL, ENL, WT, SSL, SSD, PAC, FLF, SAD, AAC, FSL, CW, CD, PCL, RLT, RCAD, ASL, PTL and TW. The complete terminologies of these abbreviations are included in Table 1. Other details of methodology are as described by Lester (1983).

Computation of data

The variability in each of the 18 morphometric characters was examined by studying three statistics, viz. range, mean and 95% confidence limits for mean, for both localities. Analysis of covariance was used to discern morphometric differences between geographic regions as well as sex. All morphometric characters were log transformed. Differences in characters between male and female were tested by $2 \times k$ contingency table and their significance was tested by the Chi-square test (χ^2 test).

The morphometric characters were subjected to sequential multiregression analysis. Degree of relationship between the two variables was evaluated by examining the reduction in sum of squares of the dependent variables produced by the regression function. The reduction in total sum of squares due to linear regression was then computed; it is defined as:

$$\text{Reduction due to regression} = \frac{\text{Total sum of squares} - \text{Residual sum of squares}}{\text{Total sum of squares}}$$

RESULTS AND DISCUSSION

The values of the mean and coefficient of variation are given in Table 1, and the range and confidence limits are depicted in Figs. 1 and 2 for all 18 morphometric characters. It was noticed that in the Devgarh area the average values for all characters are comparatively greater than in Goa. This may be due either to different stocks involved or to different environments. Chromosomal studies made on the two populations, showing no differences in the details of the karyotype (unpublished), weakened the first hypothesis. Higher biological production in Maharashtra than in Goa waters (Bhargava et al., 1973; Chavan, 1979; Goswami, 1979; Achuthankutty, 1983) indicated the possible effect of availability of food on the higher growth rate in natural populations of *P. merguensis*. The pattern of variability in male and female is very similar in all characters ($CV_{\text{Dev}} < CV_{\text{Goa}}$ in most cases).

It was also observed that in both areas the coefficient of variation in tail weight in females was almost twice that in males. This seems to be due to the existence of varying degrees of ovarian development in the females. For both regions, the sex-wise difference in all 18 characters, tested by analysis of covariance, was not significant at the 5% level. Geographic differences in morphometric characters, irrespective of sex, were highly significant at the 5% level.

The magnitude of the relationship between the dependent character (TW) and the 17 independent characters was measured by calculating the correlation coefficient (r), given in Table 2. In the Goa area TW showed the highest correlation with PCL ($r = 0.95$) and the second highest with EUL ($r = 0.94$), while for the Devgarh region, TW showed the highest correlation with PAC ($r = 0.92$) and the second highest with EUL and PCL ($r = 0.89$).

The functional relationship of tail weight (dependent variable) with the other 17 morphometric characters (independent variables) was calculated by using stepwise regression analysis. This can be represented as:

$$TW = f(\text{EUL, ENL, WT, SSL, SSD, PAC, FLF, SAD, AAC, FSL, CW, CD, PCL, RLT, RCAD, ASL and PTL})$$

Since there was no significant difference in sex, the data were pooled for regression analysis.

The independent variables were taken in turn. The squared multiple correlation coefficient (R^2) was calculated for each relationship. The significance of R^2 was tested by variance ratios using the computed values of f and its degrees of freedom (Table 3). It was noticed that when all 17 variables were taken together, the R^2 was maximal (0.92 for Goa and 0.90 for Devgarh). Since the studies were planned to find the minimum number of characters

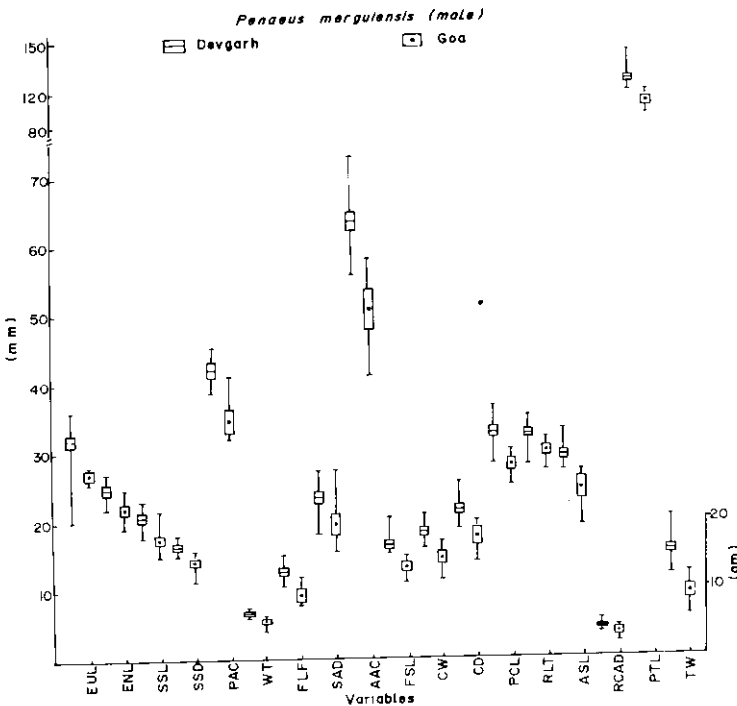


Fig. 1. Dice-Lerass diagram showing the variation trend amongst *Penaeus merguensis* males from Goa and Devgarh waters.

which could explain comparatively most variation, a stepwise search was made, discarding characters by examining the significance of R^2 . The variables PCL and PAC were dominant in Goa and Devgarh waters, respectively, in view of their occurrence in combination with two and three variables at a time (Table 3). In Goa, PCL was followed closely by EUL and in Devgarh region PAC was followed closely by CW. The third variable, CD, in combination with PCL and EUL, gave 2% less reduction in R^2 than two variables (PCL and EUL) taken together for the Goa region. However, in Devgarh CD explained considerably less variation.

The stepwise sequential regression analysis indicated that PCL or EUL or PAC or a combination of all three give comparatively the most accurate estimation of tail weight. All these characters can be measured without damaging or sacrificing the live prawns. Hence, they are suggested as the best indicators for broodstock selection in aquaculture.

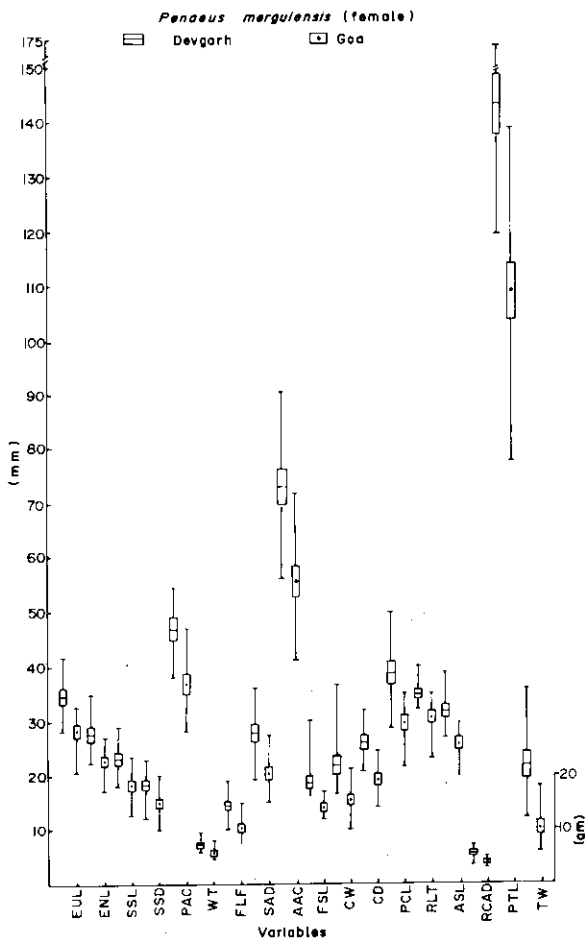


Fig. 2. Dice-Lerass diagram showing the variation trend amongst *Penaeus merguensis* females from Goa and Devgarh waters.

TABLE 2

Simple correlation matrix between different morphometric characters measured in *Panaeus merguensis* from Goa and Devgarh waters

DEVGARH

	EUL	ENL	WT	SSL	SSD	PAC	FLF	SAD	AAC	FSL	CW	CD	PCL	RLT	RCAD	ASL	PTL	TW
EUL	1.00	0.93	0.70	0.83	0.86	0.84	0.74	0.75	0.85	0.75	0.85	0.84	0.86	0.86	0.67	0.74	0.91	0.89
ENL	0.90	1.00	0.65	0.83	0.86	0.79	0.69	0.70	0.80	0.67	0.80	0.78	0.86	0.84	0.66	0.69	0.87	0.84
WT	0.74	0.63	1.00	0.66	0.70	0.80	0.73	0.66	0.66	0.74	0.73	0.57	0.69	0.71	0.42	0.61	0.71	0.79
SSL	0.63	0.46	0.51	1.00	0.88	0.86	0.78	0.80	0.76	0.75	0.78	0.70	0.84	0.81	0.67	0.69	0.82	0.84
SSD	0.52	0.55	0.38	0.41	1.00	0.84	0.75	0.78	0.81	0.72	0.85	0.77	0.85	0.86	0.67	0.73	0.86	0.85
PAC	0.83	0.68	0.75	0.77	0.57	1.00	0.76	0.78	0.80	0.80	0.81	0.73	0.84	0.86	0.49	0.72	0.87	0.92
FLF	0.41	0.23	0.26	0.51	0.29	0.60	1.00	0.69	0.73	0.81	0.71	0.50	0.67	0.71	0.57	0.49	0.78	0.72
SAD	0.77	0.60	0.74	0.71	0.51	0.86	0.56	1.00	0.66	0.66	0.79	0.70	0.68	0.70	0.66	0.76	0.72	0.78
AAC	0.79	0.73	0.73	0.64	0.60	0.85	0.45	0.77	1.00	0.79	0.81	0.75	0.81	0.78	0.71	0.63	0.87	0.85
FSL	0.59	0.52	0.50	0.39	0.48	0.63	0.49	0.63	0.72	1.00	0.74	0.60	0.72	0.70	0.56	0.49	0.78	0.82
CW	0.84	0.74	0.76	0.67	0.58	0.89	0.47	0.77	0.79	0.60	1.00	0.78	0.80	0.75	0.67	0.72	0.84	0.88
CD	0.87	0.81	0.70	0.62	0.55	0.80	0.46	0.79	0.82	0.68	0.80	1.00	0.72	0.73	0.65	0.79	0.70	0.80
PCL	0.89	0.81	0.73	0.64	0.59	0.86	0.47	0.82	0.85	0.65	0.86	0.87	1.00	0.89	0.60	0.66	0.85	0.89
RLT	0.68	0.65	0.60	0.56	0.40	0.68	0.40	0.60	0.62	0.58	0.73	0.74	0.73	1.00	0.59	0.68	0.81	0.85
RCAD	0.68	0.66	0.48	0.42	0.34	0.57	0.15	0.58	0.65	0.58	0.56	0.74	0.71	0.67	1.00	0.55	0.59	0.56
ASL	0.87	0.79	0.75	0.60	0.54	0.78	0.43	0.74	0.79	0.60	0.62	0.83	0.86	0.60	0.60	1.00	0.64	0.76
PTL	0.85	0.74	0.71	0.72	0.52	0.84	0.45	0.81	0.88	0.67	0.81	0.83	0.92	0.63	0.69	0.84	1.00	0.87
TW	0.94	0.88	0.75	0.66	0.63	0.88	0.45	0.80	0.86	0.65	0.87	0.91	0.95	0.77	0.74	0.88	0.90	1.00

TABLE 3
 Reduction of sum of squares in tail weight (TW) — sum of squares attributed to 17 morphometric characters along with values of R^2

Locality	EUL	ENL	WT	SSL	SSD	PAC	FLF	SAD	AAC	FSL	CW	CD	PCL	RLT	RCAD	ASL	PTL	R^2	Variance ratio
Goa	EUL	ENL	WT	SSL	SSD	PAC	FLF	SAD	AAC	FSL	CW	CD	PCL	RLT	RCAD	ASL	PTL	0.92	19.8
	EUL											CD	PCL					0.88	183.8
												CD	PCL					0.68	171.0
	EUL											CD	PCL				PTL	0.69	34.4
	EUL												PCL					0.90	145.3
	EUL											CD	PCL				PTL	0.91	115.3
Devgarh	EUL	ENL	WT	SSL	SSD	PAC	FLF	SAD	AAC	FSL	CW	CD	PCL	RLT	RCAD	ASL	PTL	0.90	13.6
						PAC					CW							0.86	143.2
						PAC							PCL					0.82	100.0
						PAC					CW						PTL	0.86	134.0
						PAC					CW							0.84	75.5
						PAC					CW							PTL	0.87
					PAC					CW							PTL	0.79	89.3

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