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PREDICTION OF HIND-FEMUR LENGTH FROM KNOWN ELYTRON/BODY LENGTH IN THE AAK GRASSHOPPER *POEKILOCERUS PICTUS* (FABR.) (ORTHOPTERA : PYRGOMORPHIDAE)

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ABSTRACT

Biometrical relationship in between elytron length and hind-femur length, and body length and hind-femur length, have been worked out in a population of aak grasshopper, *Poekilocerus pictus* (F.). The regression coefficient 11.241+ 0.3306 multiplied with elytron length in first case, and 20.5575+0.075 multiplied with body length in second case, gave estimated value of hind-femur length in mm. When compared with actual observed values, the estimated values varied from —2.8 to 2.2 mm. and the sum of differentiation was 0.0 mm. in the sample of 20 specimens. Data for construction of the prediction formulae have been provided.

INTRODUCTION

Among the orthopteran insects, the length of hind-femur is an important taxonomic character. It is used in segregating different taxa, as well as in distinguishing the different phases of locusts. The length of hind-femur is also used in conjunction with elytron length and width of head for these purposes. However, it is common experience that the pinned specimens are often found with broken hind-femora, as it get easily detached. In such specimens, thus, the length of hind-femur remains an unknown character.

With the biometrical principle of the regression coefficient, it has become possible to work out the relationship between two morphometric characters of a species distributed in the normal manner. In such cases, the estimated value of a missing character can be calculated from the known value of the other related character. During the present study, it has been applied in the case of the aak grasshopper, *Poekilocerus pictus*.

MATERIAL AND METHODS

Twenty adult unbroken specimens were selected at random from a population of the

aak grasshopper, collected from Baikathpur, Fatwah, Distt. Patna (Bihar) (ZSI GPRS Regd. No. A—352 to A—355, dry material). These were grouped elytron length-wise, with accurate measurement (in mm.) taken of elytron, body and hind-femur in each case. The data obtained are given in the Table 1.

The data of sample given in Table I shows that

(1) $n=20$

(2) $\sum_{1}^{n} E=787$

Table 1. Data of sample for construction of the prediction formulae for the length of hind-femur in *Poekilocerus pictus*

Specimen No.	Length of elytron (E) in mm.	Length of body (B) in mm.	Length of Hind-Femur (F) in mm.	E x F	B x F
1.	37	49	23	851	1127
2.	37	54	24	888	1296
3.	37	48	24	888	1152
4.	38	44	21	798	924
5.	38	49	23	874	1127
6.	38	49	23	874	1127
7.	38	48	24	912	1152
8.	38	50	24	912	1200
9.	38	57	26	988	1482
10.	39	48	22	858	1056
11.	39	51	23	897	1173
12.	40	48	23	920	1104
13.	40	52	24	960	1248
14.	41	54	25	1025	1350
15.	41	58	26	1066	1508
16.	41	57	26	1066	1482
17.	41	53	27	1107	1431
18.	42	56	25	1050	1400
19.	42	56	25	1050	1400
20.	42	57	27	1134	1539
	787	1038	485	19118	25278

Observations And Results

To know the estimated value of the length of missing hind-femur ($\hat{F}$), its relationship with known value of elytron length (E) or length of the body (B) was worked out. This relationship is linear and fits into formulae $\hat{F}=a_1+b_1 E$, or $\hat{F}=a_2+b_2 B$, as the case may be, where a_1, b_1, and a_2 and b_2 are constants.

$\sum_{1}^{n} E^2=31069$

$\bar{E}=39.35$

(3) $\sum_{1}^{n} B=1038$

$$\sum_1^n B^2 = 55284$$

$$\bar{B} = 51.9$$

(4) $$\sum_1^n F = 485$$

$$\sum_1^n F^2 = 11811$$

$$\bar{F} = 42.25$$

In the regression analysis, the following three values, A—C, need to be calculated, to estimate the constants. When we take the case of known elytron length, a_1 and b_1 are calculated as follows :

(A) $e_1 = E - \bar{E}$

$$\sum_1^n e_1^2 = \sum_1^n (E-\bar{E})^2 = \sum_1^n E^2 - \frac{(\sum_1^n E)^2}{n}$$

$$= 31069 - \frac{(787)^2}{20} = 100.55\ldots \quad \text{(i)}$$

(B) $f_1 = F - \bar{F}$

$$\sum_1^n f_1^2 = \sum_1^n (F-\bar{F})^2 = \sum_1^n F^2 - \frac{(\sum_1^n F)^2}{n}$$

$$= 11811 - \frac{(485)^2}{20} = 49.75\ldots \quad \text{(ii)}$$

Table 2. Data showing the estimated and observed values of length of the hind-femur in *Poekilocerus pictus*

Specimen No.	Length of elytron (E) in mm.	Observed length of hind femur (F) in mm.	Estimated length of hind femur ($\hat{F}$) in mm.	$F-\bar{F}$	$(F-\bar{F})^2$
1.	37	23	23.5	—0.5	0.25
2.	37	24	23.5	0.5	0.25
3.	37	24	23.5	0.5	0.25
4.	38	21	23.8	—2.8	7.84
5.	38	23	23.8	—0.8	0.64
6.	38	23	23.8	—0.8	0.64
7.	38	24	23.8	0.2	0.04
8.	38	24	23.8	0.2	0.04
9.	38	26	23.8	2.2	4.84
10.	39	22	24.1	—2.1	4.41
11.	39	23	24.1	—1.1	1.21
12.	40	23	24.5	—1.5	2.25
13.	40	24	24.5	—0.5	0.25
14.	41	25	24.8	0.2	0.04
15.	41	26	24.8	1.2	1.44
16.	41	26	24.8	1.2	1.44
17.	41	27	24.8	2.2	4.84
18.	42	25	25.1	—0.1	0.01
19.	42	25	25.1	—0.1	0.01
20.	42	27	25.1	1.9	3.61
	SUM :	485.0	485.0	0.0	

$$(C)\quad \sum_1^n e_1 f_1 = \sum_1^n (E-\bar{E})\,(F-\bar{F})$$

$$= \sum_1^n EF - \frac{(\sum_1^n E)\,(\sum_1^n F)}{n}$$

$$= 19118 - \frac{787 \times 485}{20} = 33.25 \ldots . \text{(iii)}$$

The regression coefficient becomes :

$$b_1 = \frac{\text{(iii)}}{\text{(i)}} = \frac{33.25}{100.55} = 0.3306$$

and, $a_1 = 24.25 - (b_1 \times 39.35)$

$$= 24.25 - (0.3306 \times 39.35) = 11.241$$

The equation for the regression line, in this case, thus becomes :

$$\bar{F} = a_1 + b_1 E$$
$$= 11.241 + 0.3306 \times E$$

It was further examined by the authors that how far the calculated values of the length of hind-femur compare with that's actual observed values. The data on the basis of above elytron : hind-femur case are given in the Table 2.

The estimate of the standard error for it was also calculated as follows :

$$\bar{\sigma}\, e = \sqrt{\frac{(F-\bar{F})^2}{n-2}}$$

$$= \sqrt{\frac{34.3}{18}} = 1.379$$

Therefore, for each value of known elytron length (E), an estimated value of the length of hind-femur $\hat{F}$ can be predicted by the above procedure.

Similarly, the authors surmised that for each value of known body length (B), an estimated value of hind-femur ($\bar{F}$) may also be predicted by the following equation :

$$\bar{F} = a_4 + b_2 \times B$$
$$= 20.5575 + 0.075 \times B.$$

It may be added that as the dependant variable F is almost always affected by variables other than E or B, hence, the prediction might be made more perfect by using these other concomitant variates.

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