

The applicability of the linear discriminant function to the identification of *Goniocotes chrysocephalus* and *G. gallinae* (*Ischnocera*, *Goniodidae*)

Przydatność funkcji dyskryminacji do diagnozowania *Goniocotes chrysocephalus* i *G. gallinae* (*Ischnocera*, *Goniodidae*)

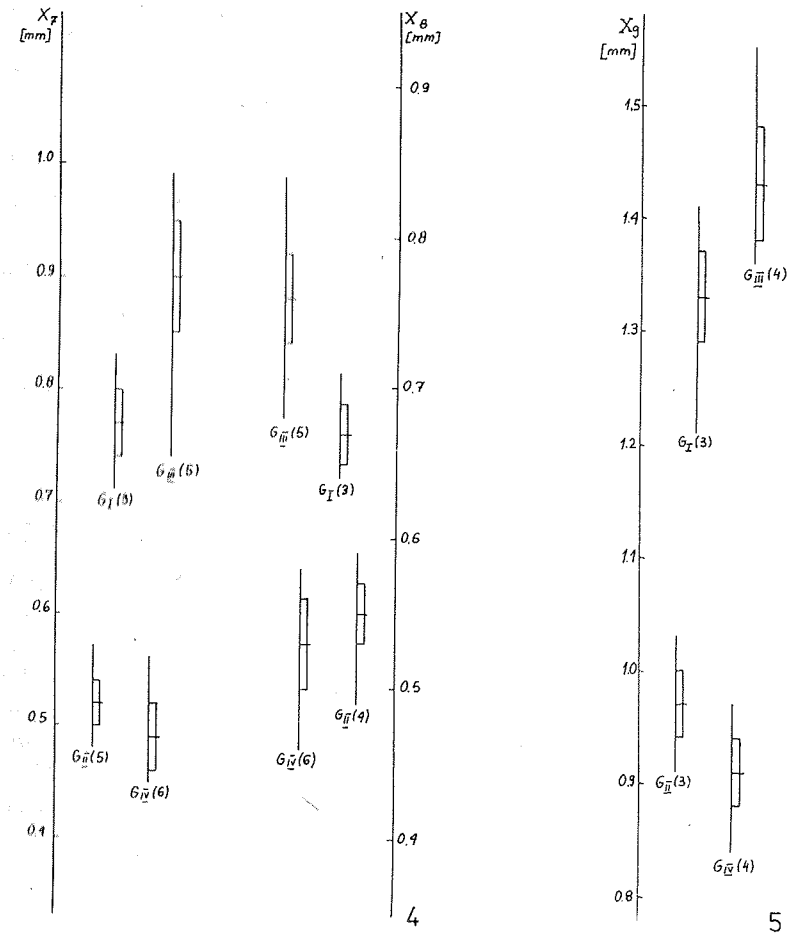
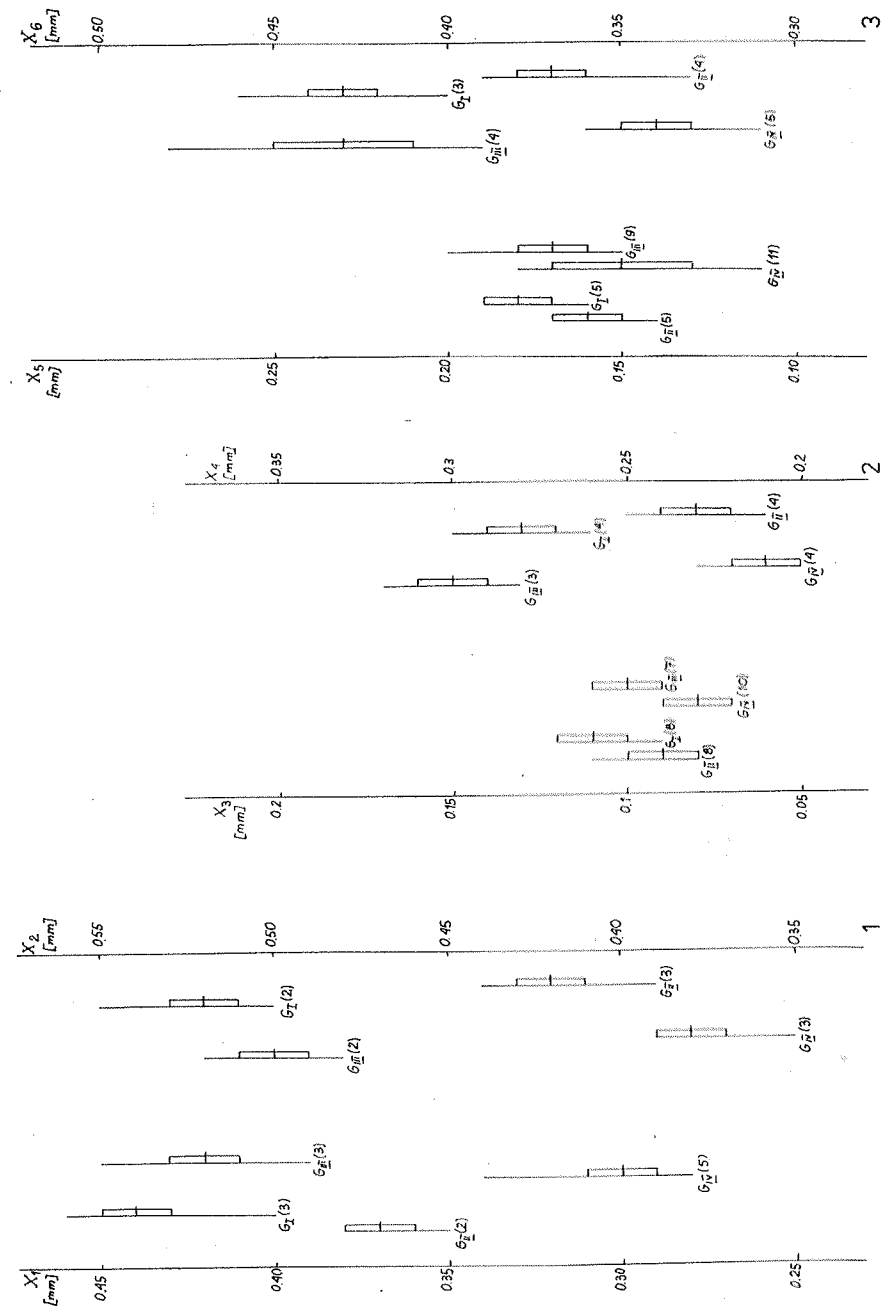
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ABSTRACT. Linear discriminant analysis was used to determine the most suitable metrical characters for separating the individuals within and between the allied species of chewing lice: *Goniocotes chrysocephalus* and *G. gallinae* (*Ischnocera: Goniodidae*). It was stated that dimensions of head, abdomen and total body length were the best characters to distinguish the imagines of both species.

INTRODUCTION

Two species of chewing lice (*Ischnocera*): *Goniocotes chrysocephalus* GIEBEL, 1874 and *G. gallinae* (DE GEER, 1778) the ectoparasites of pheasants (*Phasianus colchicus* L.) and hens (*Gallus gallus domesticus* (L.)), respectively are morphologically similar. The only diagnostic characters, cited by ZŁOTORZYCKA (1972), are the shape of conus (acute in *G. gallinae* and blunt in *G. chrysocephalus*) as well as the shape of lateral spots on the head (oval in *G. gallinae* and round in *G. chrysocephalus*). Dimensions are more differentiated. The total body lengths of *G. gallinae* are: male — 1.0 mm, female — 1.6 mm and for *G. chrysocephalus* — 0.9 and 1.3 mm respectively. The original descriptions are not very helpful in separating these species and new redescriptions, such as that provided by KÉLER (1938), deal only with *G. gallinae*.



1-5. Variation of nine metrical characters in both sexes of *G. chrysocephalus* and *G. gallinae*. Vertical line equals range; horizontal mean; white bar twice the standard deviation and coefficient of variation (%) in brackets

The aim of this study is the finding the best metric characters which would provide the most reliable criteria to separate the sexes within and between those closely related species.

MATERIAL AND METHODS

The objects of this study were the following groups of the chewing lice:

- G_I: *G. chrysocephalus* — 30 ♀♀
- G_{II}: *G. chrysocephalus* — 30 ♂♂

G_{III}: *G. gallinae* — 30 ♀♀

G_{IV}: *G. gallinae* — 20 ♂♂

Material consisted of slide-mounted specimens from museum collection of the Department of Parasitology, University of Wrocław. The following nine characters were measured: length of head (x_1), width of head (x_2), length of prothorax (x_3), width of prothorax (x_4), length of pterothorax (x_5), width of pterothorax (x_6), length of abdomen (x_7), width of abdomen (x_8), total body length (x_9). All measurements are in millimeters.

Table 1. The best characters for discriminating of the species of biting lice

Paired comparisons	Sets of the best characters			
	single	pair	three	four
G _I vs G _{III}	X ₇	X ₁ , X ₈	X ₁ , X ₂ , X ₈	X ₁ , X ₂ , X ₈ , X ₉
G _{II} vs G _{IV}	X ₁	X ₁ , X ₈	X ₁ , X ₂ , X ₈	X ₁ , X ₂ , X ₃ , X ₈
G _I vs G _{II}	X ₇	X ₂ , X ₇	X ₂ , X ₆ , X ₉	X ₁ , X ₂ , X ₆ , X ₇
G _{III} vs G _{IV}	X ₉	X ₂ , X ₉	X ₂ , X ₆ , X ₉	X ₂ , X ₆ , X ₈ , X ₉

Discriminant analysis was carried out using the linear discriminant function (DF) for two groups with selection of variables according to computer program dis2 (BARTKOWIAK, 1982). DF procedures followed those used in previous study (LONC and MODRZEJEWSKA, 1986). All computations were made on Odra 1204 computer of Wrocław University.

RESULTS

The graphic analysis of variability of the characters included in DF procedures is presented at Fig. 1–5. The total range of variation is shown by the vertical line, mean — horizontal line, white bar — one standard deviation at the each side of mean and coefficient of variation (%) in brackets.

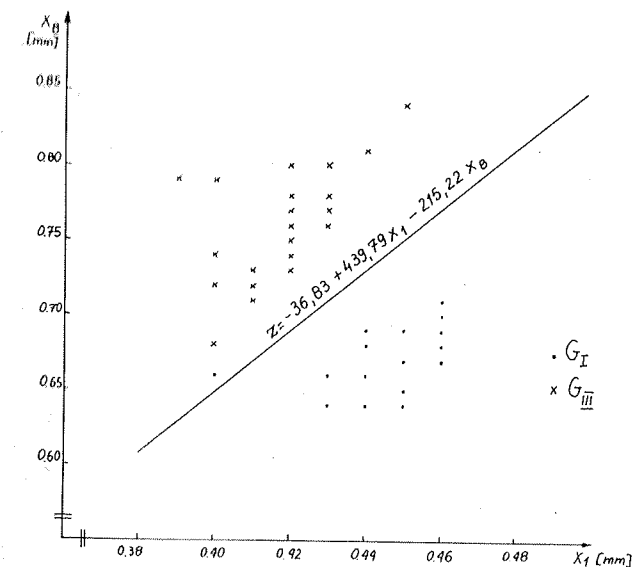
The different sets of metric characters chosen to be used as good discriminators within and between species are listed in Table 1. The DF equations based on the best pairs of characters were developed to identify the specimens that could be any one of two of the species (Table 2). If value $z \geq 0$, the unknown female or male is most probably *G. chrysocephalus*; otherwise ($z < 0$) it may be identified as *G. gallinae*. The only one specimen of both species was misidentified (98% agreement). The discrimination of the sexes within the species is in a 100% agreement with the previous classification. The separation of the groups based on the best pair of characters is plotted in Fig. 6–9.

Table 2. The equations of discriminant function based on the best pair of characters

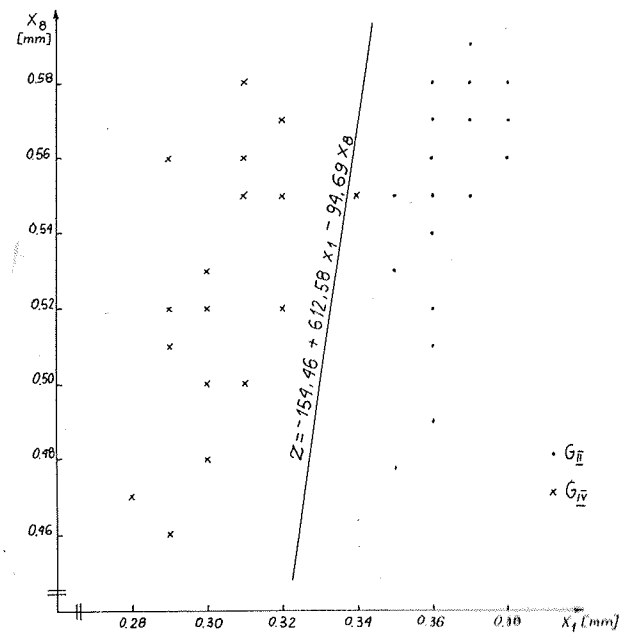
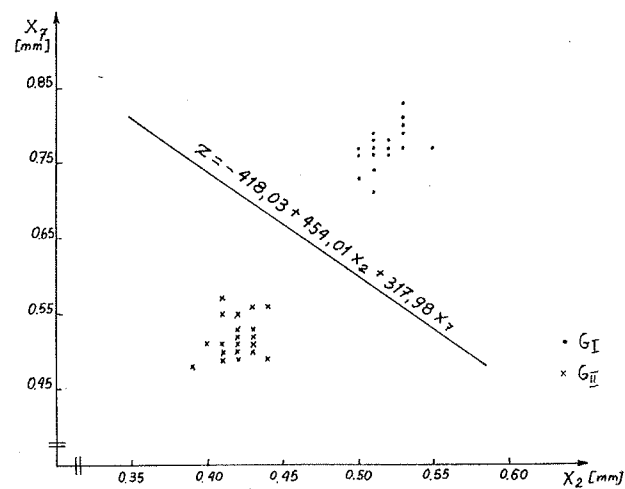
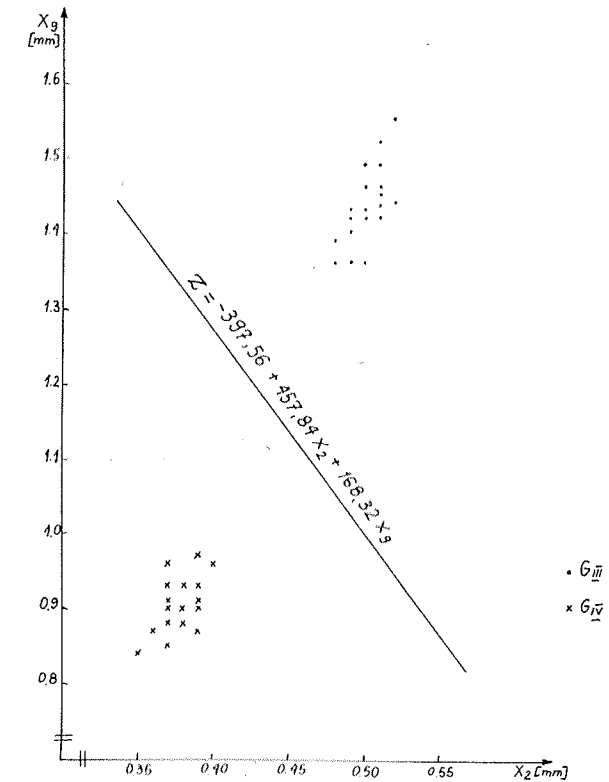
Paired comparisons	The coefficients of the discriminant function and value $z = b_0 + b_1x_1 + b_2x_2$ for the best pair of characters	The degree of conformity with previous identification (%)
1	2	3
G _I vs G _{III}	$z = -36,83 + 439,79x_1 + (-215,22)x_8$	98,3
G _{II} vs G _{IV}	$z = -154,46 + 612,58x_1 + (-94,69)x_8$	98,0
G _I vs G _{II}	$z = -418,03 + 454,01x_2 + 317,98x_7$	100
G _{III} vs G _{IV}	$z = -397,56 + 457,84x_2 + 168,32x_9$	100

DISCUSSION AND CONCLUSIONS

The discriminant analysis used by LONC and MODRZEJEWSKA (1985) to separating the nymphs within and between the closely related taxa of *Mallophaga* was very helpful for the identification of the adult species. Dimensions of head as well as lengths of abdomen and total body make a set of diagnostic characters with the biggest discriminant power. Dimensions of thorax of *G. chrysocephalus* and *G. gallinae* do not permit the identification of individuals.



6. Discrimination between the females of *G. chrysocephalus* and *G. gallinae*

7. Discrimination between the males of *G. chrysocephalus* and *G. gallinae*8. Discrimination between the sexes in *G. chrysocephalus*9. Discrimination between the sexes in *G. gallinae*

Results of discriminant analysis based on the choice of the best metric characters led to conclusion that differences between *G. chrysocephalus* and *G. gallinae* are evident contrarily to morphological characters. Similarly, the recognition of the differences between the sexes of the same species, in the material examined, was defined more accurately.

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