

COMMUNICATION I

Discriminant Analysis of Morphometrics of *Nemipterus* Species

ABSTRAK

Ukuran-ukuran morfometrik ikan kerisi, *Nemipterus* spp. (*Nemipteridae*) di perairan Malaysia telah dianalisa menggunakan analisis (diskriminan) linear untuk mengenalpasti populasi homogenous. Peratus kelas kes-kes yang telah dikenalpasti adalah 52% bagi *N. marginatus*, 92% bagi *N. nemurus*, 66% bagi *N. nematophorus*, 76% bagi *N. tambuloides*, dan 90% bagi *N. peronii*.

ABSTRACT

Morphometric measurements of threadfin bream, *Nemipterus* spp. (*Nemipteridae*) in Malaysian waters were analysed using linear discriminant analysis in order to identify the homogenous populations. The percentages of cases correctly classified are 52% for *N. marginatus*, 92% for *N. nemurus*, 66% for *N. nematophorus*, 76% for *N. tambuloides*, and 90% for *N. peronii*.

INTRODUCTION

Importance and use of morphometric and meristic characters of *Nemipterus* species have been described (Mohd. Zaki *et al.* 1990). The purpose of this paper is to measure the morphological differences and divergence among the dominant species by using the discriminant functions analysis. In fishery science, analysis of morphometric measurements by using the linear discriminant method is very recent and gaining in popularity (Soriano *et al.* 1988; Helwig and Council 1979).

MATERIALS AND METHODS

The morphometric characters were measured to the nearest 0.1 mm and then expressed as a ratio of the standard length, so that means and variances could be calculated and legitimately employed in mathematical equation. A total of 50 specimens were taken for each species.

The species used in the discriminant functions analysis were assigned a number corresponding to the group (species) as follows:

- Group 1 - *N. marginatus*
- Group 2 - *N. nemurus*
- Group 3 - *N. nematophorus*
- Group 4 - *N. tambuloides*
- Group 5 - *N. peronii*.

The relevant statistics computed using the SPSS discriminate subprogramme included:

1. Eigenvalues and Cumulation Percentages
– measure the relative importance of the function.
2. Canonical correlation
– measures how closely the function and the species variables are related, or the function's ability to discriminate among the fish species.
3. Wilk's Lambda
– An inverse measure of the discriminating power in the original variables, hence, the larger the value, the less discriminating power is the function.

The following options available in the subprogramme were selected:

1. Computation and printing of standardized discriminant function coefficients.
2. Canonical discriminant functions.
3. Territorial map.
4. Discriminant scores.

RESULTS AND DISCUSSION

The discussion on variation among the dominant species is used mainly on outputs of the SPSS discriminant subprogramme. Table 1 shows the relevant statistics of the discriminant function analysis.

TABLE 1
Relevant statistics of the Canonical Discriminant Functions

Function	Eigenvalue	Per cent of Variance	Cumulative Per cent	Canonical Correlation	After : Function	Wilks' Lambda	Chi-squared	D.F.	Significance
1*	4.04761	72.88	72.88	0.8954811	0	0.0673768	570.51	24	.0000
2*	1.14733	20.66	93.54	0.7309617	1	0.3400921	228.11	15	.0000
3*	0.32572	5.87	99.41	0.4956763	2	0.7302894	66.48	8	.0000
4*	0.03288	0.59	100.00	0.17844320	3	0.9681620	6.84	3	0.0771

* marks the 4 canonical discriminant functions remaining in the analysis.

The relative importance of discriminant variables (functions) is determined on the basis of three measures: (1) the relative percentage of Eigenvalue and its percentage of variance existing in the discriminating values, (2) the associated canonical correlation, and (3) Wilk's Lambda and its corresponding Chi-square.

Using these criteria, the first two functions are found to be most important as they produce a very high degree of separation, as indicated by variance of Eigenvalue, canonical correlation and Wilk's Lambda.

In terms of relative percentage, the first and second functions account for about 93% of the total discriminating power. The relative percentages for third and fourth functions appear to be of no importance in discriminating the species.

The canonical correlation is a measure of association which summarizes the degree of relatedness between the groups (species) and the discriminant function. The larger the value, the higher is the degree of association, with 1.0 being the maximum. Wilk's Lambda is an inverse measure of the discriminating power in the original variables. Hence, the larger the value, the less discriminating is the function.

Table 2 presents the standardized discriminant function coefficient. Each coefficient describes the relative contribution of its associated variables to the function; the sign indicates positive or negative contribution. The larger the magnitude of the coefficient (disregarding the sign), the greater is the variables' contribution to the function, while the opposite is true for the lowest coefficients. For example standard length/pectoral length ratio (PL/SL) (Fig. 1) makes the greatest contribution to the first function (0.70) and standard length/head length ratio (HL/SL) is of

very little importance to the first function (0.06). Standard length/head depth ratio (HD/SL) makes its greatest contribution to the second function (0.83) and standard length/head length ratio (HL/SL) contributes very little to this function (0.04).

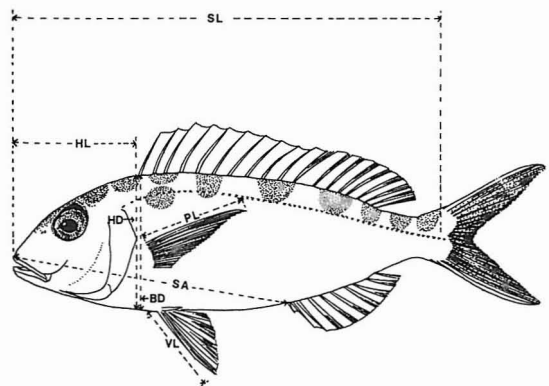


Fig 1 : Measurement of different lengths.
SL = Standard length; HL = Head length;
BD = Body depth; HD = Head depth,
SA = Snout-anal length;
VL = Ventral fin length

The separation of the species based on morphometric characters can be viewed further from the territorial map (Fig. 2). The map provides an understanding of the relative position of the fish with the axis of the model scaled in relation to the first and second canonical discriminant function. Each point (representing a fish specimen) in the model is classified according to the centroid to which it is closest. The territorial map appears reasonably good and useful in identifying the degree of similarity and divergence between the species.

Canonical Discriminant Function 1

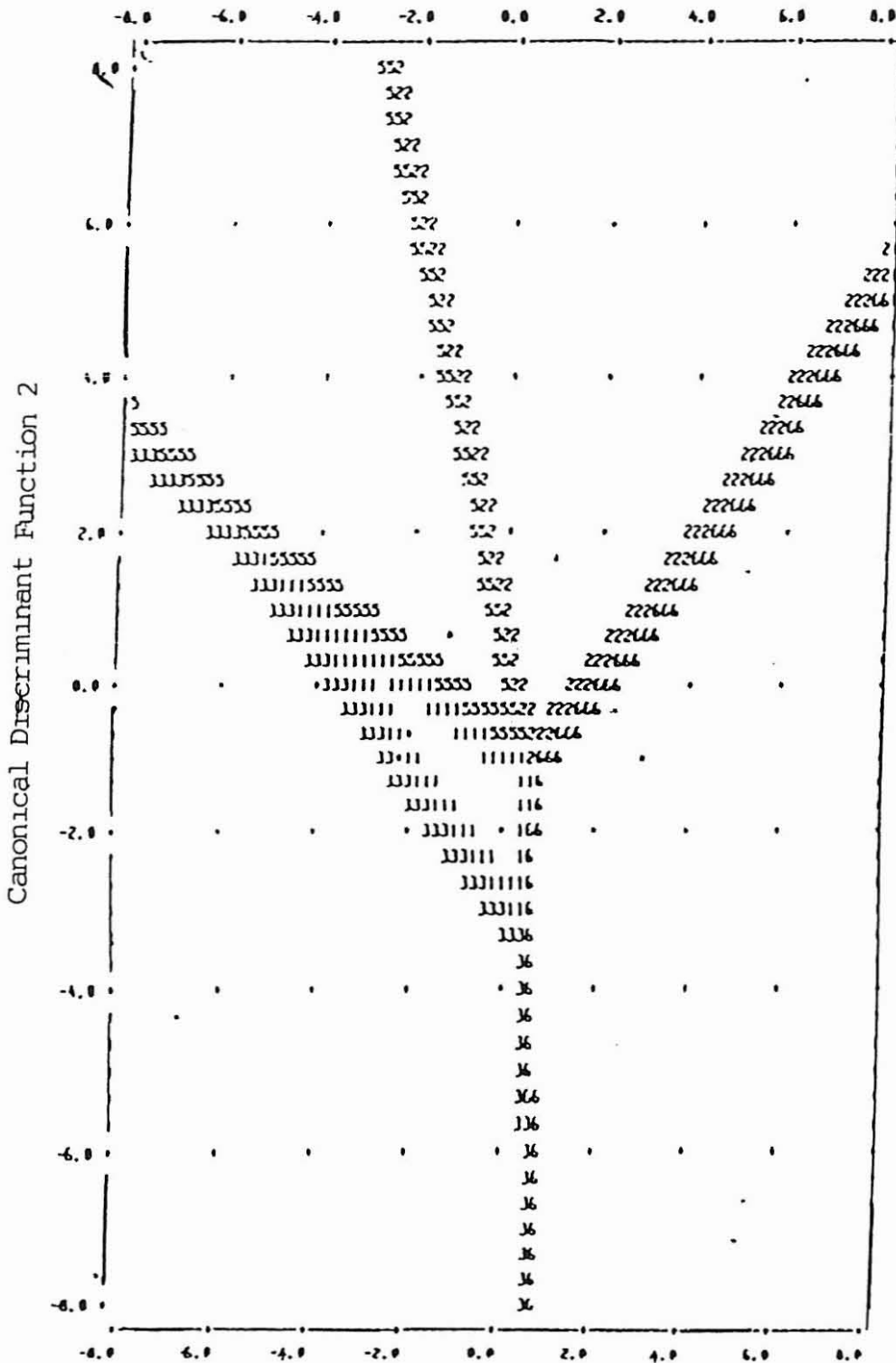


Fig 2: Territorial map showing the relationship between five species of *Nemipterus* : 1 - *N. marginatus*, 2 - *N. nemurus*, 3 - *N. nematophorus*, 4 - *N. tambuloides* and 5 - *N. peronii*.

TABLE 2
Standardized canonical discriminant
function coefficients

*	Function 1	Function 2	Function 3	Function 4
HL/SL	.05654	.04206	-.18898	.73158
SA/SL	-.07813	-.25348	-.11138	.28262
DB/SL	-.49221	.33037	.58373	-.14727
HD/SL	.06372	.83471	-.59739	-.28295
VL/SL	.41580	.33363	.50635	.50130
PL/SL	.70470	-.32874	.26674	-.32142

* Discriminating variable expressed as ratio of standard length.

HL/SL = Standard length/head length ratio

SA/SL = Standard length/snout-anal length ratio

DB/SL = Standard length/body depth ratio

HD/SL = Standard length/head depth

VL/SL = Standard length/ventral length ratio

TL/SL = Standard length/pectoral fin length ratio

The discriminant function analysis also allows classification of a case (fish) into one of the species. This is done by placing a case into the group of which it has the highest probability of belonging based on discriminating score. The proportion (percentage) of cases correctly classified can be used as an indication of the accuracy of the procedure and indirectly confirms the degree of group separation.

In this study, the percentages of cases correctly classified are 52%, 92%, 66%, 76%, and 90% for *N. marginatus*, *N. nemurus*, *N. nematophorus*, *N. tambuloides* and *N. peronii* respectively. The low scores could be due to mixed populations of *N. marginatus* - *N. tambuloides* and *N. nematophorus* - *N. nemurus*. The study was based on preserved specimens and identification was mainly based on the coloration of the body. The colour of these species fades very easily when kept in formalin.

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