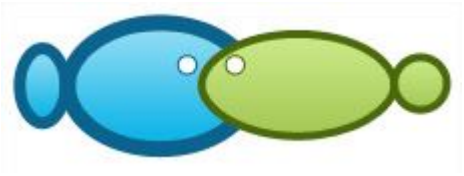

# The morphometric characters of the *Macrobrachium idae* population of Lake Tempe, Sulawesi, Indonesia

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**Abstract**. The present study aimed to evaluate the morphometric character ratios of *Macrobrachium idae* prawn, an indigenous species of Lake Tempe. Evaluation was conducted on eighteen morphological character ratios, namely $CF_1$ (circumference of the first segment), $CF_2$ (circumference of the second segment), $CF_3$ (circumference of the third segment), $CF_4$ (circumference of the fourth segment), $CF_5$ (circumference of the fifth segment), $CF_6$ (circumference of the sixth segment), $WS_1$ (width of the first segment), $WS_2$ (width of the second segment), $WS_3$ (width of the third segment), $WS_4$ (width of the fourth segment), $WS_5$ (width of the fifth segment), $WS_6$ (width of the sixth segment), $LS_1$ (length of the first segment), $LS_2$ (length of the second segment), $LS_3$ (length of the third segment), $LS_4$ (length of the fourth segment), $LS_5$ (length of the fifth segment), and $LS_6$ (length of the sixth segment) against the standard abdominal length (SAL) in 147 *M. idae* individuals from Lake Tempe in Sulawesi. The average, standard deviation (SD), and coefficient of variation (CV) of the morphometric character ratios were conducted descriptively; the differentiating character of the morphometric character ratio was conducted using Discriminant Analysis (DA) and evaluation of kinship was based on Agglomerative Hierarchical Clustering (AHC). The results of the analyses revealed that the morphometric character (the edible body proportion) ratio in the males was greater than in the females in all the size groups. The $LS_4$/SAL character contributed to the difference in the morphological character ratio. The six groups analyzed formed three clusters: I) small, medium, and large females; II) small males, and III) medium-sized and large males. In general, there were differences in the morphometric character ratios in the *M. idae,* an indigenous species of Lake Tempe.

**Key Words**: *Macrobrachium idae*, morphometric ratio, wild, South Sulawesi.

**Introduction**. Indonesia is rich in biodiversity, including in various kinds of freshwater prawn, some of which are often encountered are from the Atydae and Palaemonidae families (Holthuis 1980). *Macrobrachium* is one of the genera in the Palaemonidae family that is indicated in Indonesia (Holthuis 1950).

The *Macrobrachium* prawns distributed in Indonesia tend to have specific characteristics due to their specific habitat conditions. The specific habitats in each region in Indonesia allow the *Macrobrachium* species found in Sulawesi to have unique characteristics that add to the natural biodiversity of the *Macrobrachium* species in Indonesia. One of the species of the *Macrobrachium* is the *Macrobrachium idae* found in Lake Tempe, South Sulawesi. Information regarding *M. idae* has been reported, among others by Amutha (2019); Pahari et al (2018); Sudhakar et al (2014); Sudhakar et al (2013), and Wowor & Choy (2001). However, information about the species *M. idae* from Indonesia is very limited; it had been reported by Winarni et al (2011) in Kawung River and Luk Ulo River and by Purwanto et al (2013) in the Rawapening waters. Moreover, there is information that the population of *M. idae* living in Lake Tempe is declining, and there are concerns that they might become extinct.

One of the steps that could be made is to search for basic information related to *M. idae* in Lake Tempe as an indigenous species. The information could be used as basic data for domestication, culture, and breeding activities of the prawn. One type of important information that is required is the morphology of the *M. idae* prawn found in Lake Tempe.

Morphological evaluation could be conducted using morphometric techniques. This technique involves measuring physical traits based on the characteristics related to body size or body part size, for example, the total length and standard length (Affandi et al 1992). The morphometric measurement method in prawns has been employed to measure the diversity in *Macrobrachium rosenbergii* phenotype (Kuguru et al 2019; Wahidah et al 2018; Wahidah & Yusuf 2018; Wahidah et al 2017), *Macrobrachium nipponense* (Cheng et al 2015), *Macrobrachium lar* (Sethi et al 2013), *Macrobrachium australe* (Zimmermann et al 2011), *Penaeus semisulcatus* (Munasinghe & Senevirathna 2015), *Farfantepenaeus brasiliensis* and *Farfantepenaeus paulensis* (Carvalho et al 2019) and *Macrobrachium australe* and *M. ustulatun* (Castelin et al 2017). Adopting the morphometric measurement technique in several prawn species, the measurement of the giant freshwater prawn morphology related to the edible parts of the body (edible trait) is needed. Edible traits could be evaluated by calculating the ratio of the characters in the abdomen; therefore, the present study aimed to evaluate the morphometric character ratios of the *Macrobrachium idae* prawn, a natural species of Lake Tempe in South Sulawesi, Indonesia.

## Material and Method

***Sample collection***. This research was conducted from May to September 2019. The *M. idae* samples were collected from Lake Tempe in South Sulawesi, Indonesia. There were 147 samples, separated between 67 males and 80 females then grouped based on their body sizes, forming 6 groups: small males (SM), medium-sized males (MM), large males (LM), small females (SF), medium-sized females (MF) and large females (LF). Measurements of the 18 morphometric characters can be seen in Table 1.

***Morphological measurements***. Measurements of 18 morphometric characters were conducted on the *M. idae* that had been grouped based on their sex and body size. The morphometric character ratios were calculated based on the comparison between morphometric characters ($CF_1$, $CF_2$, $CF_3$, $CF_4$, $CF_5$, $CF_6$, $WS_1$, $WS_2$, $WS_3$, $WS_4$, $WS_5$, $WS_6$, $LS_1$, $LS_2$, $LS_3$, $LS_4$, $LS_5$, and $LS_6$) and SAL. Morphological measurement was based on Dall (1957) and Lester (1983) that was modified. Symbols and definitions of the morphological characteristics measured are presented in Table 1.

***Statistical analysis***. Morphological data were analyzed using Excel 2007, Xlstat 2014, and SPSS 16 programs. The mean, standard deviation (SD), and coefficient of variation (CV) were analyzed descriptively, and discriminating characteristic evaluation was based on discriminant analysis.

Avoiding the effects of different sizes and ages differences, characteristic values were standardized based on the equation $M_s = M_o(L_s/L_o)^b$ as formulated by Konan et al (2010). $M_s$ was the standardized individual characteristic, $L_s$ = standard average length, $M_o$ = the length of measured character $L_o$ = standard length of individual, b = slope of regression of $\log_{10}M_o$ on $\text{Log}_{10}L_o$ as formulated by Konan et al (2010); Lleonart et al (2000); Ferrito et al (2007).

Table 1

Symbol, characteristics, and definitions of the morphological characteristics of the *M. idae* population of Lake Tempe

| *Symbol* | *Characteristics* | *Definition of characteristic* |
|---|---|---|
| SAL | Standard abdominal length | The distance between the first segment and the tip of the sixth segment |
| $CF_1$ | Circumference of the first segment | The circumference of the first segment |
| $CF_2$ | Circumference of the second segment | The circumference of the second segment |
| $CF_3$ | Circumference of the third segment | The circumference of the third segment |
| $CF_4$ | Circumference of the fourth segment | The circumference of the fourth segment |
| $CF_5$ | Circumference of the fifth segment | The circumference of the fifth segment |
| $CF_6$ | Circumference of the sixth segment | The circumference of the sixth segment |
| $WS_1$ | Width of the first segment | The widest point of the first segment |
| $WS_2$ | Width of the second segment | The widest point of the second segment |
| $WS_3$ | Width of the third segment | The widest point of the third segment |
| $WS_4$ | Width of the fourth segment | The widest point of the fourth segment |
| $WS_5$ | Width of the fifth segment | The widest point of the fifth segment |
| $WS_6$ | Width of the sixth segment | The widest point of the sixth segment |
| $LS_1$ | Length of the first segment | The distance between the carapace and the boundary between the first and second segments |
| $LS_2$ | Length of the second segment | The distance between the boundary of the first and second segment and the boundary of the second and third segments |
| $LS_3$ | Length of the third segment | The distance between the boundary of the second and third segment and the boundary of the third and fourth segments |
| $LS_4$ | Length of the fourth segment | The distance between the boundary of the third and fourth segment and the boundary of the fourth and fifth segments |
| $LS_5$ | Length of the fifth segment | The distance between the boundary of the fourth and fifth segment and the boundary of the fifth and sixth segments |
| $LS_6$ | Length of the sixth segment | The distance between the boundary of the fifth and sixth segment and the telson |

## Results

***Mean, standard deviation (SD), coefficient of variation (CV)***. The results of the general descriptive analysis revealed that the average ratios of the morphometric characters in the males were higher than those of the females. The highest average ratio was for the circumference of the second segment/standard abdominal length $CF_2$/SAL character which was found on SM (1.02) and SF (0.98). On the other hand, the lowest ratio was for the width of the first segment/standard abdominal length $WS_1$/SAL character found in MM and LM (0.12) and MF and SF (0.13) (Tables 2 and 3). The coefficient of variation (CV) average range in the males was higher than that of the females. The highest average CV ratio of the morphometric character was found in the MM (10.99) and LF (10.54). The highest CV value was found in the ratio of the width of the fifth segment/standard abdominal length $WS_5$/SAL character found in the MM (19.09) and the ratio of the width of the fourth segment/standard abdominal length $WS_4$/SAL character in the MF (16.58). The lowest coefficient of variation was found in the ratio of the circumference of the first segment/standard abdominal length $CF_1$/SAL character in SM (5.80) and the circumference of the third segment/standard abdominal length $CF_3$/SAL character in SF (4.03) (Tables 2 and 3).

Table 2

The mean, standard deviation (SD), coefficient of variation (CV) of the ratio of the morphological characters in the male *M. idae* population of Lake Tempe

| *Character* | *SM* | | | *MM* | | | *LM* | | |
|---|---|---|---|---|---|---|---|---|---|
| *ratios* | *Mean* | *SD* | *CV (%)* | *Mean* | *SD* | *CV (%)* | *Mean* | *SD* | *CV (%)* |
| $CF_1$/SAL | 0.97 | 0.06 | 5.80 | 0.96 | 0.08 | 8.24 | 0.96 | 0.11 | 10.99 |
| $CF_2$/SAL | 1.02 | 0.07 | 6.89 | 0.97 | 0.08 | 7.73 | 1.00 | 0.07 | 7.14 |
| $CF_3$/SAL | 0.97 | 0.06 | 5.88 | 0.94 | 0.07 | 7.61 | 0.98 | 0.08 | 8.36 |
| $CF_4$/SAL | 0.82 | 0.05 | 6.21 | 0.77 | 0.06 | 7.45 | 0.76 | 0.06 | 8.11 |
| $CF_5$/SAL | 0.62 | 0.05 | 7.67 | 0.60 | 0.07 | 11.51 | 0.57 | 0.04 | 6.38 |
| $CF_6$/SAL | 0.46 | 0.04 | 9.38 | 0.45 | 0.06 | 14.32 | 0.41 | 0.07 | 17.77 |
| $WS_1$/SAL | 0.14 | 0.01 | 10.98 | 0.12 | 0.02 | 13.62 | 0.12 | 0.01 | 11.06 |
| $WS_2$/SAL | 0.26 | 0.02 | 7.36 | 0.26 | 0.03 | 11.28 | 0.25 | 0.02 | 8.62 |
| $WS_3$/SAL | 0.21 | 0.03 | 12.50 | 0.21 | 0.02 | 9.25 | 0.19 | 0.02 | 8.81 |
| $WS_4$/SAL | 0.16 | 0.02 | 14.92 | 0.16 | 0.02 | 14.79 | 0.14 | 0.03 | 17.58 |
| $WS_5$/SAL | 0.13 | 0.01 | 9.72 | 0.14 | 0.03 | 19.09 | 0.13 | 0.02 | 12.38 |
| $WS_6$/SAL | 0.19 | 0.02 | 10.16 | 0.22 | 0.03 | 14.71 | 0.18 | 0.02 | 10.98 |
| $LS_1$/SAL | 0.38 | 0.03 | 7.86 | 0.39 | 0.02 | 6.33 | 0.37 | 0.03 | 7.58 |
| $LS_2$/SAL | 0.40 | 0.03 | 6.64 | 0.41 | 0.04 | 9.33 | 0.40 | 0.03 | 7.12 |
| $LS_3$/SAL | 0.40 | 0.03 | 7.09 | 0.41 | 0.03 | 7.00 | 0.39 | 0.02 | 6.19 |
| $LS_4$/SAL | 0.32 | 0.05 | 14.42 | 0.33 | 0.03 | 7.91 | 0.32 | 0.02 | 7.11 |
| $LS_5$/SAL | 0.27 | 0.05 | 18.01 | 0.34 | 0.04 | 13.10 | 0.24 | 0.03 | 10.90 |
| $LS_6$/SAL | 0.18 | 0.01 | 7.23 | 0.18 | 0.03 | 14.51 | 0.17 | 0.01 | 7.68 |
| Average | 0.44 | | 9.37 | 0.44 | | 10.99 | 0.42 | | 9.71 |
| Min | 0.13 | | 5.80 | 0.12 | | 6.33 | 0.12 | | 6.19 |
| Max | 1.02 | | 18.01 | 0.97 | | 19.09 | 1.00 | | 17.77 |

Table 3

The mean, standard deviation (SD), and coefficient of variation (CV) of the morphological character ratios in female *M. idae* population of Lake Tempe

| *Character* | *SF* | | | *MF* | | | *LF* | | |
|---|---|---|---|---|---|---|---|---|---|
| *ratios* | *Mean* | *SD* | *CV (%)* | *Mean* | *SD* | *CV (%)* | *Mean* | *SD* | *CV (%)* |
| CF1/SAL | 0.91 | 0.06 | 7.70 | 0.89 | 0.05 | 5.70 | 0.93 | 0.06 | 6.43 |
| CF2/SAL | 0.95 | 0.05 | 5.40 | 0.92 | 0.05 | 5.98 | 0.98 | 0.05 | 5.05 |
| CF3/SAL | 0.92 | 0.04 | 6.06 | 0.90 | 0.05 | 5.62 | 0.93 | 0.04 | 4.03 |
| CF4/SAL | 0.72 | 0.10 | 7.94 | 0.72 | 0.06 | 8.83 | 0.75 | 0.10 | 13.72 |
| CF5/SAL | 0.57 | 0.04 | 12.47 | 0.59 | 0.03 | 5.84 | 0.55 | 0.04 | 7.48 |
| CF6/SAL | 0.38 | 0.04 | 14.70 | 0.39 | 0.05 | 13.78 | 0.42 | 0.04 | 9.29 |
| WS1/SAL | 0.14 | 0.02 | 13.56 | 0.13 | 0.01 | 10.86 | 0.13 | 0.02 | 13.47 |
| WS2/SAL | 0.26 | 0.03 | 10.53 | 0.26 | 0.02 | 5.95 | 0.29 | 0.03 | 8.66 |
| WS3/SAL | 0.22 | 0.03 | 10.22 | 0.20 | 0.02 | 11.53 | 0.20 | 0.03 | 12.25 |
| WS4/SAL | 0.18 | 0.02 | 15.92 | 0.18 | 0.03 | 16.58 | 0.17 | 0.02 | 9.18 |
| WS5/SAL | 0.14 | 0.02 | 9.76 | 0.14 | 0.02 | 11.12 | 0.14 | 0.02 | 11.89 |
| WS6/SAL | 0.21 | 0.01 | 8.83 | 0.22 | 0.02 | 8.54 | 0.22 | 0.01 | 6.70 |
| LS1/SAL | 0.37 | 0.03 | 10.32 | 0.36 | 0.03 | 7.30 | 0.41 | 0.03 | 8.13 |
| LS2/SAL | 0.40 | 0.03 | 8.76 | 0.39 | 0.02 | 5.79 | 0.44 | 0.03 | 7.59 |
| LS3/SAL | 0.36 | 0.03 | 8.53 | 0.35 | 0.03 | 7.98 | 0.38 | 0.03 | 7.38 |
| LS4/SAL | 0.29 | 0.03 | 13.49 | 0.30 | 0.03 | 10.69 | 0.30 | 0.03 | 8.86 |
| LS5/SAL | 0.22 | 0.02 | 13.34 | 0.22 | 0.03 | 12.34 | 0.22 | 0.02 | 9.76 |
| LS6/SAL | 0.16 | 0.02 | 12.17 | 0.15 | 0.02 | 10.20 | 0.15 | 0.02 | 13.98 |
| Average | 0.41 | | 10.54 | 0.41 | | 9.15 | 0.42 | | 9.10 |
| Min | 0.14 | | 5.40 | 0.13 | | 5.62 | 0.13 | | 4.03 |
| Max | 0.95 | | 15.92 | 0.92 | | 16.58 | 0.98 | | 13.98 |

***Differentiating character***. The unidimensional test of equality of the means of the classes revealed that all the characters contributed to the population grouping except for the $WS_5$/SAL character ratio (Table 4).

Table 4

Unidimensional test of equality of the means of the classes of the morphological character ratios in the male and female *M. idae* population of Lake Tempe

| *Variable* | *Lambda* | *F* | *DF1* | *DF2* | *p-value* |
|---|---|---|---|---|---|
| $CF_1$/SAL | 0.8152 | 6.3945 | 5 | 141 | < 0.0001 |
| $CF_2$/SAL | 0.7686 | 8.4889 | 5 | 141 | < 0.0001 |
| $CF_3$/SAL | 0.8641 | 4.4356 | 5 | 141 | 0.0009 |
| $CF_4$/SAL | 0.7577 | 9.0171 | 5 | 141 | < 0.0001 |
| $CF_5$/SAL | 0.8230 | 6.0656 | 5 | 141 | < 0.0001 |
| $CF_6$/SAL | 0.7350 | 10.1663 | 5 | 141 | < 0.0001 |
| $WS_1$/SAL | 0.8952 | 3.3013 | 5 | 141 | 0.0075 |
| $WS_2$/SAL | 0.7614 | 8.8371 | 5 | 141 | < 0.0001 |
| $WS_3$/SAL | 0.9026 | 3.0419 | 5 | 141 | 0.0122 |
| $WS_4$/SAL | 0.8063 | 6.7754 | 5 | 141 | < 0.0001 |
| $WS_5$/SAL | 0.9456 | 1.6228 | 5 | 141 | 0.1578 |
| $WS_6$/SAL | 0.6965 | 12.2895 | 5 | 141 | < 0.0001 |
| $LS_1$/SAL | 0.7582 | 8.9918 | 5 | 141 | < 0.0001 |
| $LS_2$/SAL | 0.4995 | 28.2614 | 5 | 141 | < 0.0001 |
| $LS_3$/SAL | 0.5905 | 19.5586 | 5 | 141 | < 0.0001 |
| $LS_4$/SAL | 0.1206 | 205.6541 | 5 | 141 | < 0.0001 |
| $LS_5$/SAL | 0.3351 | 55.9601 | 5 | 141 | < 0.0001 |
| $LS_6$/SAL | 0.6677 | 14.0350 | 5 | 141 | < 0.0001 |

The eigenvalue showed that the function of the two variances was explained by up to 92.28%, where 70.74% of the variance was explained by function 1 and the remaining 21.55% by function 2 (Table 5).

Table 5

The eigenvalue of the ratio of morphological characters in the male and female *M. idae* population of Lake Tempe

| *Value* | *Function* | | | | |
|---|---|---|---|---|---|
| | *F1* | *F2* | *F3* | *F4* | *F5* |
| Eigenvalue | 15.4979 | 4.7205 | 0.8599 | 0.6715 | 0.1595 |
| Discrimination (%) | 70.7361 | 21.5457 | 3.9249 | 3.0651 | 0.7282 |
| Cumulative % | 70.7361 | 92.2819 | 96.2068 | 99.2718 | 100.0000 |

The matrix structure analysis showed the characters that had a role in forming the discriminant function (Table 6). The characters which had an important role in the grouping was the length of the fourth segment/standard abdominal length $LS_4$/SAL character ratio in function 1 and the length of the fifth segment/standard abdominal length $LS_5$/SAL character ratio and the length of the sixth segment/standard abdominal length $LS_6$/SAL in function 2. The $LS_4$/SAL character ratio had the greatest contribution in the population grouping, where function 1 could explain 70.74% of the diversity.

Table 6

The matrix structure of the morphological character ratios for the male and female *M. idae* populations of Lake Tempe

| *Character ratios* | *Function* | | | | |
|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* |
| $LS_4$/SAL | **-0.676*** | 0.188 | 0.219 | -0.017 | -0.079 |
| $LS_5$/SAL | -0.095 | **0.601*** | 0.041 | -0.433 | 0.257 |
| $LS_6$/SAL | -0.087 | **0.279*** | 0.082 | 0.076 | 0.169 |
| $LS_1$/SAL | 0.021 | 0.042 | 0.587* | -0.088 | 0.119 |
| $LS_2$/SAL | -0.223 | -0.034 | 0.492* | -0.106 | 0.275 |
| $WS_2$/SAL | 0.048 | -0.130 | 0.475* | -0.039 | -0.092 |
| $LS_3$/SAL | -0.072 | 0.323 | 0.373* | 0.005 | 0.008 |
| $WS_4$/SAL | 0.071 | -0.149 | -0.254* | -0.054 | 0.015 |
| $CF_1$/SAL | -0.027 | 0.185 | 0.215* | 0.134 | 0.136 |
| $WS_6$/SAL | 0.089 | -0.072 | -0.122 | -0.638* | -0.098 |
| $CF_2$/SAL | -0.023 | 0.136 | 0.361 | 0.370* | 0.083 |
| $CF_4$/SAL | -0.002 | 0.195 | 0.228 | 0.370* | -0.150 |
| $WS_1$/SAL | 0.047 | -0.082 | -0.022 | 0.274* | 0.034 |
| $CF_3$/SAL | -0.047 | 0.113 | 0.156 | 0.249* | 0.090 |
| $WS_3$/SAL | 0.047 | 0.020 | -0.028 | 0.094 | 0.639* |
| $CF_6$/SAL | 0.014 | 0.229 | 0.297 | 0.143 | -0.365* |
| $CF_5$/SAL | 0.020 | 0.179 | -0.154 | 0.180 | -0.306* |

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions. Variables ordered by the absolute size of correlation within the function. *Largest absolute correlation between each variable and any discriminant function.

***Similarity***. The scatter plot for the morphological characters based on the discriminant function showed that small males were very dissimilar to the other groups which were separated by function 1. The MM and LM groups were not separate but were separate from the (SF, MF, and LF) groups by function 2 (Figure 1).

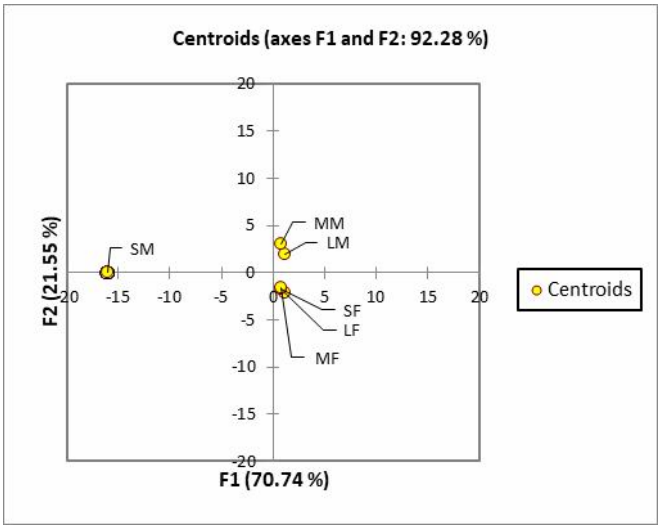


Figure 1. The scatter plot of morphological character ratios for the male and female *M. idae* populations of Lake Tempe based on the discriminant 1 function and discriminant 2 function (SM = small males; MM = medium-sized males; LM = large males; SF = small females; MF = medium-sized females; LF = large females).

The dissimilarity dendrogram showed that 3 clusters were formed: I. SF, MF and LF; II. SM, and III. MM and LM (Figure 2).

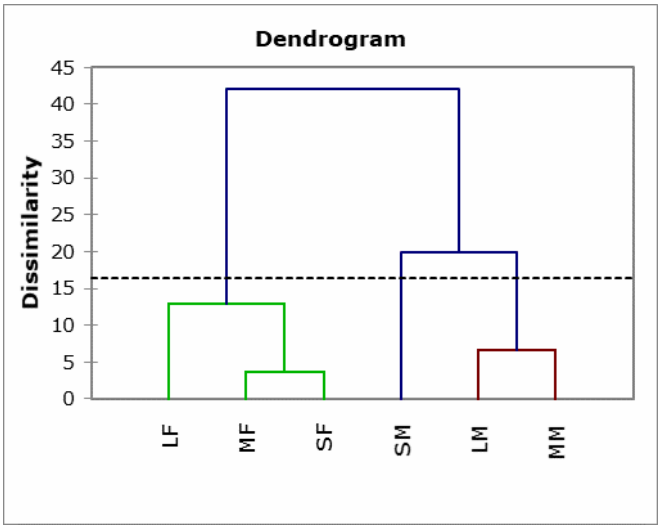


Figure 2. The dissimilarity dendrogram for the morphological character ratios of the male and female *M. idae* populations of Lake Tempe (SM = small males; MM = medium-sized males; LM = large males; SF = small females; MF = medium-sized females; LF = large females).

**Discussion**. There were differences in body size based on sex differentiation in the Macrobrachium prawn; therefore. The samples were separated based on sex. Differences in body size based on sex differentiation was found at a certain age, in which the males had larger bodies than the females. This is also found in fish, as Shireman & Smith (1983) reported that the factors that influence the growth of fish are the fish's age, sex and environmental conditions.

The descriptive analysis of 18 ratios of the abdominal morphometric characters revealed that the average and coefficient of variation of *M. idae* males tended to be greater than those of the females. The greatest average ratio of the morphometric characters in the males and females was for the $CF_2$/SAL character, whereas the smallest was for $WS_1$/SAL. The greatest coefficient of variation in males and females was found in the ratio of the WS/SAL character, in the males being the ratio of the $WS_5$/SAL character and in the females $WS_4$/SAL. This showed that the character width had great variance.

The results of the discriminant analysis revealed that *M. idae* had different morphological characters. All the morphological character ratios contributed to the differences between groups, except the ratio of the $WS_5$/SAL character. The characters that had a great contribution to differentiating population groups were $LS_4$/SAL, $LS_5$/SAL, and $LS_6$/SAL. The ratio of the ($LS_4$/SAL) character was the differentiating character between (SM and MM; LM), and (SF; MF and LF). On the other hand, the ratios of the characters ($LS_5$/SAL) and ($LS_6$/SAL) were the differentiating character between (SF, MF, LF) and (MM, LM). The LS character was the character related to the abdominal segment length. The differentiating character in the abdomen was also discovered by Winarni et al (2011) who evaluated the morphometric characters of *M. idae* prawns based on the truss morphometric method, where the parts which were significantly different were the distance between the ventral frontal border of the abdominal segment 4 and the ventral caudal border of the abdominal segment 6.

The dissimilarity analysis resulted in 3 clusters of *M. idae* prawn. Cluster I: SF, MF and LF. The presence of the three size groups in a single cluster (Cluster I) in the females was possibly because they all had nearly similar body growth (morphological ratios). Cluster II: SM, and Cluster III: MM and LM. The SM were placed in a different cluster than MM and LM, and this was probably caused by differences in the body development between SM and MM and LM. As it has been known, in *Macrobrachium* male prawns there is a difference in growth in certain different body sizes. Another possible explanation is different habitats/environments between SM and MM and LM. The SM were usually found in the middle of the lake, whereas the MM and LM were commonly found in the water outlet area of Lake Tempe (Walannae River flow) toward Teluk Bone. The presence of *M. idae* in the Lake Tempe water outlet area is suggested

to be related to reproduction, as the *Macrobrachium* prawns migrate from freshwater to brackish water to reproduce (Dinakaran et al 2013).

The lowest dissimilarity was found in Cluster I between the MF and SF. The highest dissimilarity was found between the SF, MF in Cluster I and the SM in Cluster II. The difference in the morphometric character ratio groupings was based on sex difference.

**Conclusions**. The total value of the edible body parts in males was higher than the females in all the size groups. The $LS_4$/SAL character ratio had the largest contribution to the *M. idae* grouping. Three clusters were formed based on the grouping: I. small, medium-sized, and large females; II. small males; and III. medium-sized and large males.

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