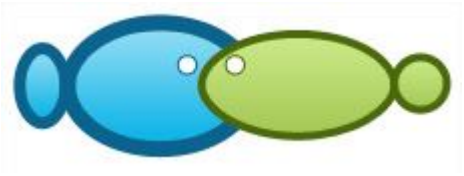

Edible trait of giant freshwater prawn *Macrobrachium rosenbergii* of Kariango River population in Pinrang Regency, Indonesia

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Abstract. This study aimed to evaluate edible trait of giant prawn *Macrobrachium rosenbergii* of Kariango population in Pinrang Regency, Indonesia, using morphometric and truss-morphometric methods. Eighty-eight (88) giant prawns were evaluated based on 5 morphometric characters and 8 truss-morphometric diagonal characters. The ranges of morphometric and truss morphometric values of male prawns were larger than females, indicating that the morphological size of male prawns tended to be larger than females. The value of coefficient of variation indicated that males were more heterogeneous than females. However, the value of the edible trait ratio showed females (morphometric 6.04; truss-morphometric 8.87) have greater value than males (morphometric 5.81; truss-morphometric 7.83. Therefore, Kariango female population can be used as brood stock for breeding purposes.

Key Words: giant freshwater prawn, edible trait, morphometric, truss-morphometric, Kariango.

Introduction. Giant freshwater prawns production of Indonesia is highly supported by grow-out and hatchery activities. Brood stock morphological performance plays an important role in achieving optimal aquaculture production for giant prawns. Several indicators of morphological performances of the brood stock were commonly used, including the size and proportion of the edible body parts. The edible trait can be evaluated through ratio between abdominal size and carapace (Dinh & Nguyen 2014).

One of the problems on breeding giant prawns is the unavailability of brood stock that have better morphological performance to produce high-quality offspring (Pillai et al 2015). The morphology of prawns tends to have larger size carapace. Therefore, evaluation related to the ratio between abdominal size and carapace in the giant prawn population is required. The result of the evaluation can be used as one of the criteria for selecting prospective brood stock of giant prawns.

Edible trait measurements are related to morphological characters. The measurement methods can be performed through morphometric and truss-morphometric. The morphometric technique is the measurement of the physical condition based on the characteristics relating to the size of the body or body parts, for example, the total length and standard length (Affandi et al 1992). The truss-morphometric technique is a measurement developed to describe the individual shape by measuring the parts of the individual body on the basis of the benchmark points. Furthermore, measurements of morphometric characters with truss network patterns are capable of providing a more comprehensive body image (Strauss & Bookstein 1982). The advantages of this technique are more consistent in measurement. Dots benchmark are used to approach a description of the actual geometric shapes (Bookstein 1991; Rohlf & Marcus 1993). Therefore, a more thorough morphological image can be obtained, which aims to describe the shape (Winfield & Nelson 1991; Bagherian & Rahmani 2009), and still rare (Bissaro et al 2012; Zimmermann et al 2012). Morphometric methods

have been used to measure the phenotypic diversity of *Macrobrachium australe* (Zimmermann et al 2012), *Alburnus chalcoides* (Mohaddasi et al 2013), *Penaeus semisulcatus* (Munasinghe & Senevirathna 2015) and *Macrobrachium nipponense* (Chen et al 2015).

Adopting several morphometric and truss-morphometric measurements of some species for morphological measurement of giant prawn can describe the morphology more comprehensively. Thus, measurements of giant prawn morphology associated with the edible trait are required. This study aimed to evaluate edible trait on giant prawn *Macrobrachium rosenbergii* of the Kariango population through morphometric and truss-morphometric methods.

Material and Method. The giant prawns were obtained from Kariango River, South Sulawesi. Total samples used were 88 (33 females and 55 males), and measured using digital callipers (accuracy 0.01 mm). Measurements of 5 morphometric characters (Table 1) were based on the standard morphology of the body (Figure 1), and measurements of 8 diagonal truss-morphometric characters (Table 2) were based on the truss points (Figure 2), which when mapped formed truss-morphometric.

Table 1

Symbols, characters, and size of *Macrobrachium rosenbergii* morphometric of Kariango River

Symbols	*Characters*	*Morphometric measurement*
TBL	Total body length	The distance between the tip of the rostrum and the tip of telson, body straightened
SL	Standard length	The distance between the base of eye and the base of the uropode
HL	Head length	The distance between the tip of the rostrum and the base of the carapace
CL	Carapace length	The distance between the eye and the base of the carapace
SAL	Standard abdominal length	The distance between the first segment and the tip of the sixth segment

Table 2

Symbols and size of truss-morphometric *Macrobrachium rosenbergii* of Kariango River

Symbols	*Truss-morphometric measurement*
A1	The diagonal distance between the base of the rostrum and the widest part of the ventral head
A2	The diagonal distance between the base of the scaph and the widest part of the dorsal head
B1	The diagonal distance between the widest part of the dorsal head and the ventral head border
B2	The diagonal distance between the widest part of the ventral head and the back border of the dorsal head
C1	The diagonal distance between the borders of 1 dorsal abdomen segment and the back boundary of the ventral abdominal 3 segment
C2	The diagonal distance between the back boundary of the ventral abdominal 1 segment and the back border of the 3 dorsal abdominal segment
D1	The diagonal distance between the front border of 4 dorsal abdominal segment and the back boundary of the 6 ventral segment
D2	The diagonal distance between the front border of the 4 ventral abdominal segment and the boundary of the 6 dorsal abdominal segment

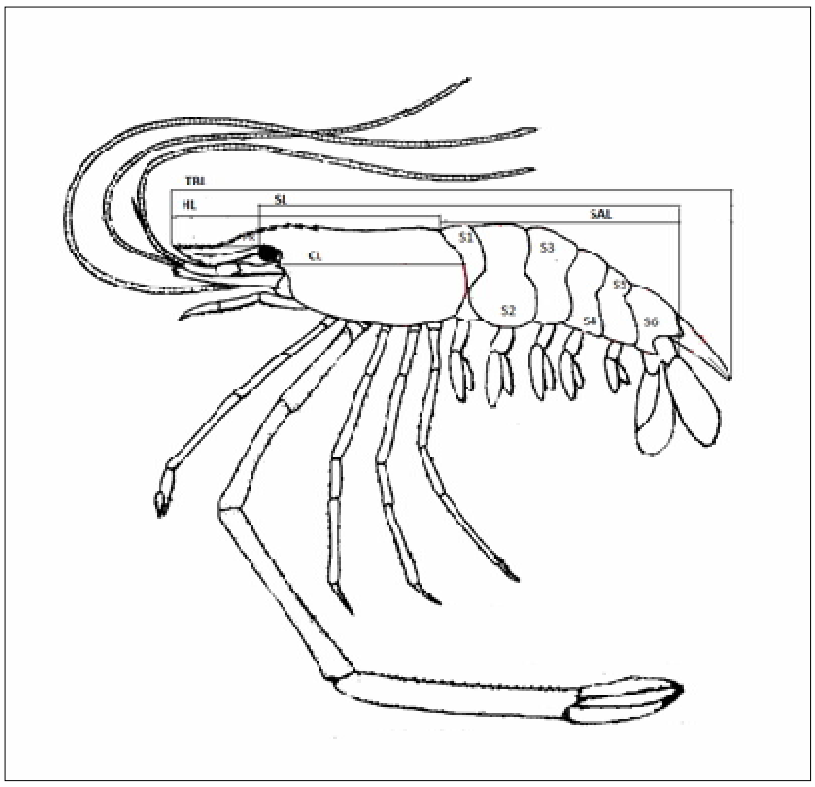

Figure 1. Mapping morphometric characters of *Macrobrachium rosenbergii*.

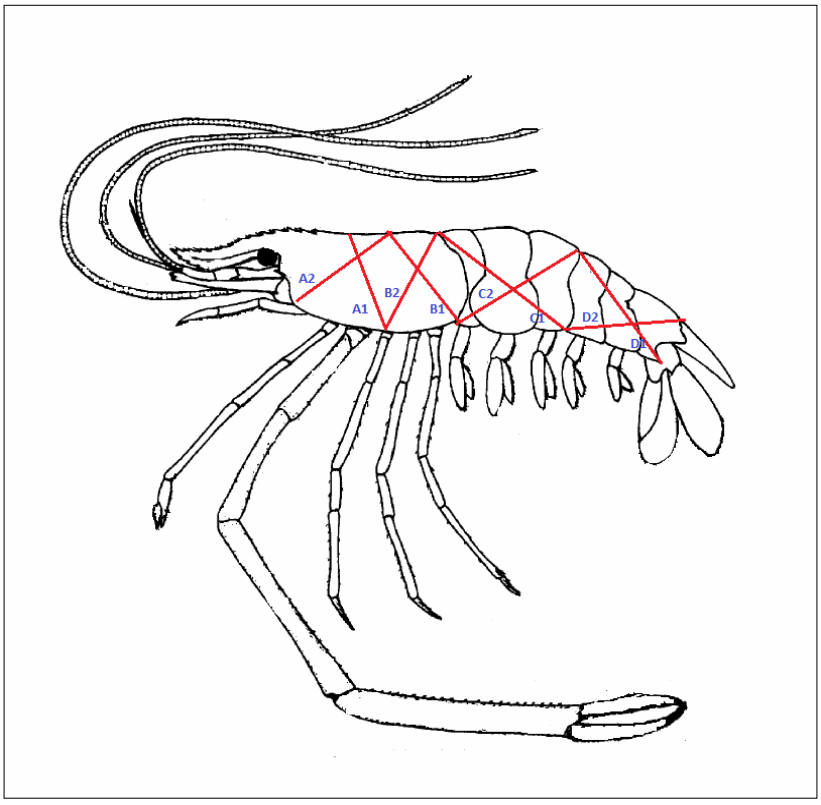

Figure 2. Mapping truss-morphometric characters of *Macrobrachium rosenbergii*.

Statistical analysis. Morphometric and truss-morphometric analyses were using Excel 2007 program. Mean value, standard deviation, coefficient of variation and proportion of edible trait were differentiated by sex and descriptively analyzed.

In order to avoid the influence of different sizes and ages of samples, the character values were standardized by equation Ms = Mo(Ls/Lo)b (Konan et al 2010), where: M_s = standardized individual character, M_o = length of measured characters, L_s = mean of standard length, L_o = standard length of individual, b = slope of regression $\log_{10}M_o$ on $\text{Log}_{10}L_o$ (Lleonart et al 2000; Ferrito et al 2007; Konan et al 2010).

Results. The result of descriptive analysis showed the range of morphometric characters (total body length, TBL 132.13-145.52; standard length, SL 88.46-101.80; head length, HL 62.84-69.86; carapace length, CL 34.43-41.29; standard abdominal length, SAL 52.59-53.61). The range of morphometric values in males (41.29-145.5 mm), was higher than the female (34.43-132.13 mm), indicating that the size of male prawn tended to be larger than females. The lowest values were obtained on the character of carapace length (CL), while the highest value was the total body length (TBL) (Table 3). Similarly, the mean value of truss-morphometric characters of the male tend to be higher than the female, except for the characters C1, C2, D1 and D2 (Table 4).

The value of the diversity coefficient of male with morphometric measurement was 39.61-51.86% and female was 29.10-38.67% (Table 3), while with the truss-morphometric measurement, and the coefficient of variation the male was 36.90-44.61%, higher than the female of only 8.27-38.12% (Table 4).

Table 3

Mean, standard deviation (sd), the coefficient of variation (cv), and morphometric characters of giant prawns *Macrobrachium rosenbergii* of Kariango River

Characters	*Male*			*Female*		
	mean (mm)	*sd*	*cv (%)*	*mean (mm)*	*sd*	*cv (%)*
TBL	145.52	64.60	44.39	132.13	45.16	34.18
SL	101.80	40.63	39.91	88.46	28.79	32.54
HL	69.86	36.23	51.86	62.84	24.30	38.67
CL	41.29	19.49	47.20	34.43	12.59	36.56
SAL	53.61	21.24	39.61	52.59	15.31	29.10

Table 4

Mean, standard deviation (sd), the coefficient of variation (cv), and truss-morphometric characters of giant prawns *Macrobrachium rosenbergii* of Kariango River

Characters	*Male*			*Female*		
	mean (mm)	*sd*	*cv (%)*	*mean (mm)*	*sd*	*cv (%)*
A1	35.05	15.64	44.61	28.13	9.78	34.77
A2	30.13	13.11	43.53	25.69	8.12	31.59
B1	30.95	13.57	43.86	23.84	8.97	37.62
B2	32.03	14.23	44.42	27.58	10.51	38.12
C1	34.49	14.64	42.43	39.76	5.25	13.20
C2	36.50	14.64	40.12	39.91	4.41	11.05
D1	25.82	9.53	36.90	29.07	3.07	10.55
D2	28.18	10.46	37.11	28.28	2.34	8.27

The total edible body parts based on the ratio of morphometric and truss-morphometric characters values obtained females higher than males. The male and female morphometric character ratios were 5.81 and 6.04, respectively (Table 5). Moreover, the male and female truss-morphometric character ratios were 7.83 and female 8.87, respectively (Table 6).

Table 5

Ratio edible trait of giant prawns *Macrobrachium rosenbergii* from Kariango River based on morphometric characters

Ratio of characters	*Male*	*Female*
TBL/HL	2.04	1.94
SL/CL	2.47	2.57
SAL/CL	1.30	1.53
Total	5.81	6.04

Table 6

Ratio edible trait of giant prawns *Macrobrachium rosenbergii* from Kariango River based on truss-morphometric characters diagonal

Ratio of characters	*Male*	*Female*
C1 / A1	0.98	1.17
C1 / B1	1.11	1.39
D1 / A1	0.74	0.86
D1 / B1	0.83	1.02
C2 / A2	1.21	1.33
C2 / B2	1.14	1.24
D2 / A2	0.94	0.96
D2 / B2	0.88	0.90
Total	7.83	8.87

Discussion. Giant prawn samples were grouped by sex. The clustering was done due to growth differences associated with morphology, in which the male prawns tend to have greater morphological performance than the female. These results are similar to the finding of Fransozo et al (2004) in *Macrobrachium iheringi*, and Mantelatto & Barbossa (2005) in *Macrobrachium brasiliensis*. In the present study, the size of the male prawns was greater than the females. This is in accordance with Banu et al (2015) and Ranjeet & Kurup (2002) who claimed that male prawns grow faster than the females.

The value of the coefficient of variation of the male population was higher than the female in this study. In other words, the male population has heterogeneous morphological characters compared to females. This is in line with Banu et al (2015) who reported that the growth of male prawns is more heterogeneous than females. The coefficient of variation value for the giant prawns population from Kariango River was higher than *Macrobrachium vollenhovenii* (1.93-19.83%) (Konan et al 2010) and *Macrobranchium lar* (9.46-20.48%) (Sethi et al 2013). The high value of the diversity coefficient indicated that giant prawn morphology associated with edible trait tends to be heterogeneous.

High values of the diversity coefficient also suggested that the population has high heritability. The greater the value of heritability in the superior traits of the population, the offspring may have superior traits similar to the parental (Wahidah 2017). Thus, the population of giant prawns of Kariango River is expected to have high heritability value as well as the superior traits.

The coefficient of variation value was morphometrically evaluated. The highest value of the coefficient of variation of the male and female population was obtained from the total length character of the carapace. While the coefficient of variation, which was truss-morphometrically evaluated, the highest value was found in the male population (character A1) and female (character B2). The characters relate to the edible body parts of prawns. Therefore, it can be used as a reference in the evaluating the morphological characters of giant prawns.

The highest ratio of edible body part was found in the female population. The value can be used as reference criteria for determining prospective broodstock for breeding purposes.

Conclusions. The results of this study suggested that male prawns of Kariango River are larger in size and heterogeneous than female, whereas the female prawns have a greater ratio in term of edible body part. Therefore, it can be used as broodstock for breeding purpose.

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References

Affandi R., Sjafei D. S., Rahardjo M. F., Sulistiono, 1992 [Ichthyology: a guideline laboratory work]. Ministry of Education and Culture, Directorate General of Higher Education, Center for Life and Science University of Bogor, Bogor Agricultural University, Bogor, 344 pp. [in Indonesian]

Bagherian A., Rahmani H., 2009 Morphological discrimination between two populations of shemaya, *Chalcalburnus chalcoide*s (Actinopterygii, Cyprinidae) using a truss network. Animal Biodiversity and Conservation 32:1-8.

Banu R., Siraj S. S., Christianus A., Ikhsan N. F. M., Rajaee A. H., 2015 Genetic variation among different morphotypes of the male freshwater prawn *Macrobrachium rosenbergii* (De Man). Aquaculture Reports 1:15-19.

Bissaro F. G, Gomes Jr. J. L., Di Beneditto A. P. M., 2012 Morphometric variation in the shape of the cephalothorax of shrimp *Xiphopenaeus kroyeri* on the east coast of Brazil. Journal of the Marine Biological Association of the UK 93(3):683-691.

Bookstein F. L., 1991 Morphometric tools for land mark data: geometry and biology. Cambridge University Press, Cambridge, 435 pp.

Chen P. C., Tzeng T. D., Shih C. H., Chu T. J., Lee Y. C., 2015 Morphometric variation of the oriental river prawn (*Macrobrachium nipponense*) in Taiwan. Limnologica - Ecology and Management of Inland Waters 52:51-58.

Dinh H., Nguyen N. H., 2014 Genetic inheritance of female and male morphotypes in giant freshwater prawn *Macrobrachium rosenbergii*. PLoS ONE 9(2):e90142.

Ferrito V., Mannino M. C., Pappalardo A. M., Tigano C., 2007 Morphological variation among populations of *Aphanius fasciatus* Nardo, 1827 (Teleostei, Cyprinodontidae) from the Mediterranean. Journal of Fish Biology 70:1-20.

Fransozo A., Rodrigues F. D., Freire F. A. M., Costa R. C., 2004 Reproductive biology of the freshwater prawn *Macrobrachium iheringi* (Ortmann, 1897) (Decapoda: Caridea: Palaemonidae) in the Botucatu region, São Paulo, Brazil. Nauplius 12:119-126.

Konan K. M., Adépo-Gourène A. B., Ouattara A., Nyingy W. D., Gourène G., 2010 Morphometric variation among male populations of freshwater shrimp *Macrobrachium vollenhovenii* Herklots, 1851 from Côte d'Ivoire Rivers. Fisheries Research 103:1-8.

Lleonart J., Salat J., Torres G. J., 2000 Removing allometric effects of body size in morphological analysis. Journal of Theoretical Biology 205:85-93.

Mantelatto F. L. M., Barbosa L. R., 2005 Population structure and relative growth of freshwater prawn *Macrobrachium brasiliense* (Decapoda, Palaemonidae) from São Paulo State, Brazil. Acta Limnologica Brasiliensia 17(3):245-255.

Mohaddasi M., Shabanipour N., Abdolmaleki S., 2013 Morphometric variation among four populations of shemaya (*Alburnus chalcoides*) in the south of Caspian Sea using truss network. The Journal of Basic and Applied Zoology 66:87-92.

Munasinghe D. H. N., Senevirathna J. D. M., 2015 Phenotypic plasticity and genetic variation of two wild populations of green tiger shrimp (*Penaeus semisulcatus* - De Haan, 1844). International Journal of Marine Science 5(5):1-8.

Pillai B. R., Mahapatra K. D., Ponzoni R. W., Sahoo L., Lalrinsanga P. L., Mekkawy W., Khaw H. L., Nguyen N. H., Mohanty S., Sahu S., Patra G., 2015 Survival, male morphotypes, female and male proportion, female reproductive status and tag loss in crosses among three populations of freshwater prawn *Macrobrachium rosenbergii* (de Man) in India. Aquaculture Research 46(11):2644-2655.
Ranjeet K., Kurup B. M., 2002 Heterogeneous individual growth of *Macrobrachium rosenbergii* male morphotypes. Naga, the ICLARM Quarterly 25(2):13-18.
Rohlf F. J., Marcus L. F., 1993 A revolution morphometrics. Trends in Ecology and Evolution 8:129-132.
Sethi S. N., Ram N., Venkatesan V., 2013 Morphometric relationships of the monkey river prawn *Macrobrachium lar* (Fabricius, 1798) (Decapoda, Palaemonidae) from the Andaman Islands. Indian Journal of Fisheries 60(2):157-161.
Strauss R. E., Bookstein F. L., 1982 The truss: body form reconstructions in morphometrics. Systematic Biology 31:113-135.
Wahidah, Omar S. B. A., Trijuno D. D., Nugroho E., Amrullah, 2017 The morphological characteristics of South Sulawesi's giant freshwater prawn *Macrobrachium rosenbergii*. AACL Bioflux 10(4):820-829
Winfield I. J., Nelson J. S., 1991 Cyprinid fishes: systematics, biology and exploitation. Chapman and Hall, Fish and Fisheries Series 3, 667 pp.
Zimmermann G., Bosc P., Valade P., Cornette R., Ameziane N., Debat V., 2012 Geometric morphometrics of carapace of *Macrobrachium australe* (Crustacea: Palaemonidae) from Reunion Island. Acta Zoologica 93:492-500.

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