

Morphological traits Characterization of *Macrobrachium macrobrachion* (Herklots, 1851) and *Macrobrachium vollenhovenii* (Herklots, 1857) from Osun River, Southwestern, Nigeria

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Abstract: Morphological traits used in taxonomic separation of *M. macrobrachion* and *M. vollenhovenii* into two distinct species were reviewed. Observations from non-parametric traits revealed that *M. macrobrachion* exhibited absence of spinules on the palm; short and scanty pubescence on telson and uropod; a region of rostral spines discontinuity and presence of apical tooth on the dorsal part of rostrum which distinguished it from *M. vollenhovenii*. Measurements of parametric traits showed that there were no significant variations ($p>0.05$) in the mean total lengths, carapace lengths and rostral lengths between male to male and female to female specimens of the two prawns. Also, no significant variation ($p>0.05$) existed in their mean body weights, although specimens of *M. vollenhovenii* appeared more robust in body shape. Mean chela lengths (right and left) were higher for *M. macrobrachion* than for *M. vollenhovenii*. Meristic count of dorsal spines on rostrum ranged from 8-15 and 8-16 while that of ventral spines ranged from 3-7 and 3-8 for *M. macrobrachion* and *M. vollenhovenii* respectively. The results obtained in this study revealed that these prawns are easily separable based on their morphological traits. However, further study is recommended for their genetic characterization to validate their true existence as separate species.

Keywords: Osun River, Morphological traits, *Macrobrachium macrobrachion*, *Macrobrachium vollenhovenii*

Introduction

Macrobrachium prawns occur throughout the West African region (Etim and Sakare, 1998; Jimoh *et al.*, 2005). There are about 200 species that make up this genus, but only four species have been reported in Nigeria and they are *M. vollenhovenii*, *M. macrobrachion*, *M. felicinum*, and *M. dux* (Bello-Olusoji *et al.*, 2004). In Nigeria, the two largest species of the genus *Macrobrachium* are *M. vollenhovenii* and *M. macrobrachion* (Marioghae and Ayinla, 1995) and these prawns have an extensive distribution across southern region of Nigeria. Powell (1982) reported that these prawns enjoy wide ecological distribution in rivers, on tributaries and in fresh and brackish water lagoons across Southern, Nigeria. Jimoh *et al.*, (2012) collected specimen of these two species in mixed population around Badagry creek which is a brackish water lagoon.

Scientific information on the earlier taxonomic descriptions of these two species was based on some morphological traits like rostral shape, number of teeth on the dorsal and ventral part of rostrum, presence of apical tooth, body hue, egg colorations, and chelae characteristics and is already documented in literatures (Holthuis, 1951; Monod, 1964; Rutherford,

1971; Okera 1977). Jimoh *et al.*, (2013) established that brackish water populations of these two species are easily separable based on their morphological traits. It is thus imperative that the morphological status of fresh water populations of these two prawns be re-investigated bearing in mind that most available literatures on taxonomy of these prawns are long dated; and ecological changes or modifications over a long period of time have a way of influencing adaptation in organisms especially with recent phenomenon of climate change (Magalhaes, 2000; Okomus and Ciftci, 2003).

This will help to bridge the knowledge gap by cross checking or double checking the present status with existing records on their taxonomy and consequently provide platform for proper identification especially for researchers on quest for prawn aquaculture with beneficial morphological and genetic traits.

Materials and Methods

Description of Sampling Location

The study location is a section of Ogun-Osun River Basin Channel around Itokin community, Lagos State,

Nigeria (Fig. 1). It is a major tributary of Osun River which opens into Epe lagoon through Oruba riverine community on its left axis and Lekki Lagoon through Orugbo riverine community on its right axis. The sampling locations are: Itokin Section of Osun River (latitude N06°37.972' and longitude E003°47.994'); Oruba Section of Epe and Lekki Lagoon Confluence (latitude N06°37.292' and longitude E 003°48.505') and Orugbo Section of Lekki Lagoon (latitude N06°37.2161' and longitude E003°47.692'). Osun River is an exclusively fresh water ecosystem.

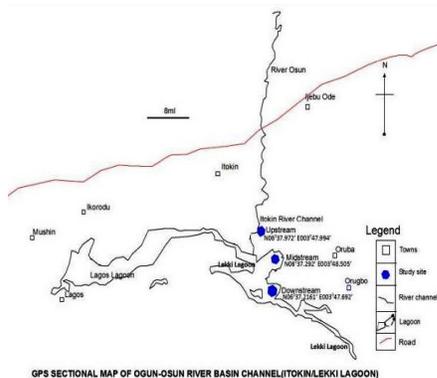


Fig.1: Geographic Positioning System Map of the study Section on Osun River.

Prawn Sampling Technique

Prawn specimens were collected with the assistance of fishermen fishing on these study locations. Prawn basket traps were used across the three sampling stations by the fishermen for specimen collection. Traps were set on river substrate and left for minimum of 72 hours before being hulled up to collect the catches. Life specimens were first identified using two important keys according to the descriptions of Powell, (1982): a) the presence or absence of discontinuity region for spines on the dorsal part of rostrum, b) the presence or absence of apical tooth.

Specimens were then preserved in labeled sample bottles containing 10% formaldehyde solution for further laboratory based morphological examinations.

Non-Parametric Traits as Identification Keys

Non-parametric traits study for the two *Macrobrachium* prawns sampled across the study locations were done using prawns' taxonomic guide by Rutherford, (1971), F.A.O. (1981) and Powell, (1982). Nominal and meristic characters were linked to the available keys provided in these manuals for identification. Morphological traits on the second pereopods of the prawns were examined for possible

presence or absence of the following characters according to the works of Hernandez *et al.*, (2007): a) Fixed finger (Non-jointed projection on the propodus (palm) of the cheliped), b) Close finger (Cutting edges of fixed finger and dactylus which are straight and have no space in-between), c) Gaping finger (Cutting edges of fixed finger and dactylus which are arched with clear space), d) Spine (A stout, sharp process, found mostly on carapace, pereopods, chelae and telson), e) Spinules (Slender small spine, found mostly on pereopods and chelae), f) Pubescence (Small and numerous seta-like structure)

Nominal characters such as; body coloration, egg coloration, shape of rostrum, presence of spines, spinules and pubescence on some body appendages were viewed under a Vista vision stereoscopic microscope (Model number 0608340 VWR, U.S.A.). Also meristic counts of dorsal and ventral spines on rostrum and number of abdominal somites were examined using a Jinxiang 90mm magnifying lens. The presence or absence of any observable morphological traits provided in identification keys on referenced literatures are documented for each species using pictorial plates in Jpeg format. Morphological traits not described in the identification keys but observed are noted and were documented in pictorial plates using Jpeg format.

Parametric Traits

The parametric characters examined in this study were:

Total length (from tip of rostrum to the tip of telson) was measured to sensitivity of 0.1cm using vernier caliper

Standard length (from tip of rostrum to the edge of the last somite)

Carapace length (from eye socket to mid dorsal margin of carapace)

Rostral length (from the tip to posterior margin of the orbit) were measured to the nearest 0.1cm using venire caliper)

Body weight (measured to the nearest 0.01g with a top loading Mettler balance Sartorius Model E12000).

Water Characteristics

Analysis of some water quality parameters at sampling sites were carried out in-situ using Hydro lab water quality meter (Electronic Probe Type Hanna H198106 model). These measurements were done in triplicates at each sampling station. Parameters measured were: Temperature (°C), pH, Conductivity

(mΩ/cm), Dissolved Oxygen (ppm), Salinity (ppm) and Total Dissolved Solid (ppm). Also, colorimetric Test kit methods (Pond Lab NT200) were in-situ engaged to determine water chemistry values for Total water Hardness (ppm), Alkalinity (ppm), Ammonia level (ppm), Nitrate and nitrite levels (ppm). Titrimetric method was used to analyze for Sulphates (ppm), Carbonates (ppm) and Phosphates (ppm) following standard procedures (AOAC, 1997).

Statistical Analysis

Data obtained from measurement of parametric features were subjected to descriptive statistics to obtain mean values among sex groups. Also water quality characteristics of the study locations were

subjected to Analysis of Variance and Duncan Multiple Range Test to determine any significant difference ($p \leq 0.05$) in water quality parameters. These were done using SPSS 17.0 software. Results generated were presented in table format using Microsoft word package (2010).

Results

Non-Parametric Traits

Morphological observations of non-parametric traits on second pereiopods of the two *Macrobrachium* prawns revealed that both exhibited closed fingers, with presence of numerous spinules clearly observed on the palm of *M. vollenhovenii*. These spinules are completely absent on the palm of *M. macrobrachion* (Tab. 1; Figs. 2 and 3).

Tab. 1: Morphological trait indicators for characterization of *Macrobrachium* prawns on second pereiopods.

Species	Sex	F.F	C.F	G.F	SPNLS	PUB	C	P	CH	TEL	Carpus
MAC	M	-	+	-	-	+	-	+	+	+	Long
	F	-	+	-	-	+	-	+	+	+	Long
Vol	M	-	+	-	+	+	-	+	+	+	Short
	F	-	+	-	+	+	-	+	+	+	Short

MAC: *M. macrobrachion*; VOL: *M. vollenhovenii*
 M: Male; F: Female
 F.F = Fixed Finger, C.F = Close Finger, G.F = Gaping Finger
 SPNLS = Spinules, PUB = Pubescence, C = Carapace, P = Pereiopods
 CH = Chela, TEL = Telson
 - = Absent, + = Present

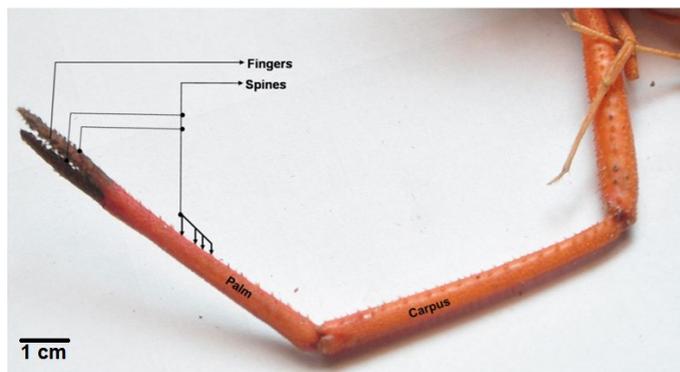


Fig. 2: Left Chelae of *M. macrobrachion* showing numerous setae-like projections on the closed finger (Mg = X 2.3)

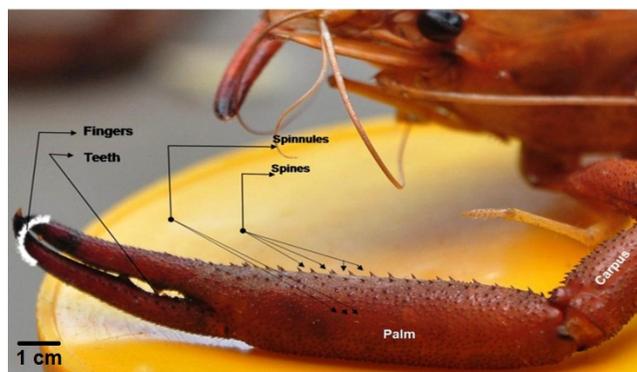


Fig. 3: Left Chelae of *M. vollenhovenii* showing teeth on the inner part of the closed finger (Mg = X 3.2).

Both morpho-types were observed with numerous spines on the merus, carpus and palm. Carpus and palm are longer in *M. macrobrachion* than in *M. vollenhovenii* (Figs. 2 and 3). Pubescence was densely observed on the telson and uropods of *M. vollenhovenii* (Figs. 4 and 5). The carapace of both prawns appeared smooth without the presence of spine or spinules (Figs. 6 and 7). Specimens of *M. macrobrachion* were observed with dorsal part of rostrum having discontinued spines portion followed by two apical teeth (Fig. 6). Egg colouration in *M.*

macrobrachion was greenish while it is pinkish or orange colour in *M. vollenhovenii* (Tab. 2).

Parametric Traits

Results on parametric traits measurements showed that mean total lengths for males and females *M. vollenhovenii* within this population equal 87.36 ± 1.19 mm and 75.26 ± 1.38 mm while that of *M. macrobrachion* equal 86.10 ± 1.17 mm and 75.70 ± 1.30 mm. Also, carapace lengths equal 24.23 ± 0.40 mm and 20.33 ± 0.42 mm for male and female specimens of *M.*

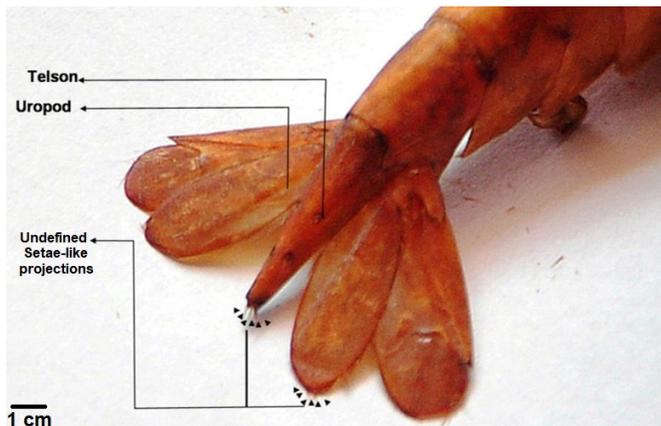


Fig. 4: *M. macrobrachion* with lesser setae-like projections (pubescence) on telson and uropod (Mg = X 2.7).

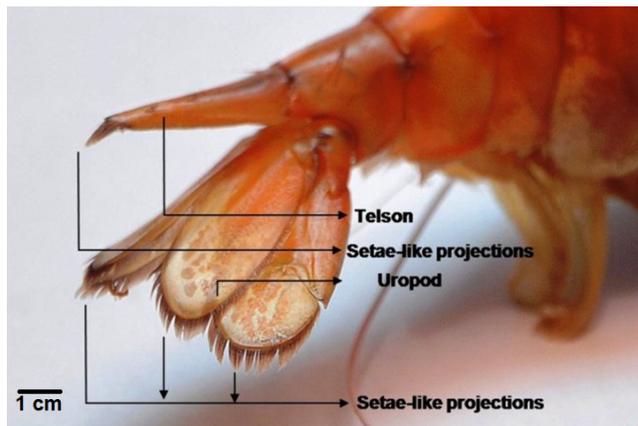


Fig. 5: *M. vollenhovenii* with setae-like projections (pubescence) on telson and uropods (Mg = X 2.4).



Fig. 6: Specimen of *M. macrobrachion* collected from Osun River, Nigeria with rostrum having toothless portion and followed by one or two apical tooth (Mg = X 2.6).



Fig. 7: Specimen of *M. vollenhovenii* collected from Osun River, Nigeria with rostrum lacking toothless portion (Mg = X 3).

Tab. 2: Identification Pathway for *Macrobrachium* prawns collected from sampling locations based on existing literatures and observations from this study.

Species	F.A.O	Native name	Key Identification	MAX. TLs	Ref.
MAC	Brackish River Prawn	Sahoro/Ede	M: Rostrum straight or with tip curved slightly. Often an un-toothed portion followed by 1 or 2 apical tooth. F: Rostrum the same as in males. Ovigerous females carry greenish colour eggs	M:118mm F: 122mm	Code: PALAEM Macro 32
VOL	African River Prawn	Sahoro/Ede	M: Rostrum convex with tip lacking prolonged toothless portion. Fingers of 2 nd Cheliped dark blue with yellow patch at articulation with palm. F: Rostrum same as in male. Eggs red or orange in colour	M: 122 F:119	Code: PALAEM Macro 49

MAC: *M. macrobrachion*; VOL: *M. vollenhovenii*
 1: Rutherford, 1971; Holthuis, 1980 and Powell, 1982
 Total Length: TL
 M: Male; F: Female
 Ref: Holthuis, 1980 and Powell, 1982

vollenhovenii while mean carapace lengths of 22.34 ± 0.44 mm and 18.77 ± 0.40 mm were recorded for male and female specimens of *M. macrobrachion*. Rostral length averages 22.86 ± 0.36 mm and 20.06 ± 0.37 mm for male and female specimens of *M. vollenhovenii* while *M. macrobrachion* have average rostral length values of 24.09 ± 0.40 mm and 20.78 ± 0.37 mm for male and female specimens. The mean body weights of these prawns have values of

9.60 ± 0.45 g and 6.61 ± 0.48 g for male and female specimens of *M. vollenhovenii* while mean values of 7.88 ± 0.39 g and 5.46 ± 0.38 g were obtained for *M. macrobrachion* (Tab. 3).

Meristic Counts

The number of abdominal somites recorded for all length and age classes of the two prawns was six. Dorsal spine counts on rostrum of males and females

M. macrobrachion ranged between 8 and 15 with the presence of 1 or 2 apical tooth, while that of *M.*

vollenhovenii ranged between 8 and 16 lacking apical tooth (Tab. 4).

Tab. 3: Parametric traits measurement for the two *Macrobrachium* prawns.

Species	Sex	RCHL ¹	LCHL ¹	TL ²	CL ²	BW ²	SL ²	RL ²
MAC	M	68.96 (±22.63)	70.44 (±22.83)	86.10 (±1.17)	22.34 (±0.44)	7.88 (±0.39)	73.10 (±1.03)	24.09 (±0.40)
	F	54.19 (±16.64)	55.80 (±17.84)	75.70 (±1.30)	18.77 (±0.40)	5.46 (±0.38)	64.34 (±1.16)	20.78 (±0.37)
VOL	M	59.20 (±17.09)	60.69 (±17.28)	87.36 (±1.19)	24.23 (±0.40)	9.60 (±0.45)	73.94 (±1.01)	22.86 (±0.36)
	F	49.65 (±13.05)	47.25 (±14.36)	75.26 (±1.38)	20.33 (±0.42)	6.61 (±0.48)	63.35 (±1.22)	20.06 (±0.37)

MAC: *M. macrobrachion*; VOL: *M. vollenhovenii*

M: Male; F: Female

Number of Males and Females *M. Macrobrachion*: Males = 269; Females = 435

Number of Males and Females *M. vollenhovenii*: Males = 186; Females = 222

RCHL: Right Chelae; LCHL: Left Chelae

TL: Total Length (mm), CL: Carapace Length (mm), BW: Body Weight (g), SL: Standard Length (mm), RL: Rostral Length (mm)

1: measure with SD, 2: measure with SE

Tab. 4: Meristic counts (Mean ± SD and Range) of some non-parametric traits for *Macrobrachium* prawns.

Species	Sex	DSCR	VSCR	NAS
MAC	M.	11.16±2.22 (8-15)	4.74±0.74 (3-7)	6
	F.	10.73±2.22 (8-15)	4.74±0.69 (3-7)	6
VOL	M.	13.46±1.51 (8-16)	4.38±0.85 (3-8)	6
	F.	13.21±1.74 (8-16)	4.50±0.91 (3-8)	6

MAC: *M. macrobrachion*; VOL: *M. vollenhovenii*

M: Male; F: Female

DSCR: Dorsal spine counts on rostrum

VSCR: ventral spine counts on rostrum

NAS: Number of Abdominal Somites

Water Quality

Water quality characteristics revealed mean temperature range of 28.05±1.49 °C to 28.59±1.82 °C, pH range between 6.26±0.31 to 6.39±0.38, dissolved oxygen range of 1.68±1.65 mg/l to 2.02±1.68 mg/l. Mean salinity value range of 0.11±0.04 ppm and 0.34±0.49 ppm (Tab. 5).

Discussion

The morphological indices for *Macrobrachium* prawns' identification presented on tables and figures above gave basic descriptions of traits observed on the two morpho-types collected from the studied section of Osun River, Southwestern Nigeria. Jimoh et al., (2012) grouped morphological traits into non-parametric and parametric features. Observations from megascopic view of the non-parametric traits on the specimens', revealed variations with the arrangement of spines on the dorsal and ventral parts of rostrum for these prawns and that differences

existed with some of the morphological traits on second pereopods. Some of these observed variations had been documented by earlier studies on taxonomy of *M. macrobrachion* and *M. vollenhovenii* endemic to West Africa (F.A.O. 1981). These morphological traits (presence or absence of apical tooth, continuous spine arrangement on dorsal part of rostrum, rostrum having toothless portion, merus, carpus and palm longer in one morpho-type than the other and so on) still serve as major clues for easy identification of these prawns (Rutherford, 1971 and Powel, 1982).

Further observations from this study revealed the presence of numerous spinules on the palm of *M. vollenhovenii* and its absence in *M. macrobrachion* (Figs. 2 and 3). Records on this particular non-parametric trait have not been documented in previous studies. However, it appeared conspicuous as an additional feature to be considered for separation of clusters of these two prawns existing in

Tab. 5: Water Quality Characteristics (Mean \pm SD) of the Sampling Stations on a Section of Osun River, Southwestern, Nigeria.

Parameters	Itokin ¹	Oruba ²	Orugbo ³
Temp(°c)	28.05 ^a (± 1.49)	28.24 ^a (± 1.62)	28.59 ^a (± 1.82)
pH	6.26 ^a (± 0.31)	6.37 ^a (± 0.36)	6.39 ^a (± 0.38)
Conductivity (m μ cm ³)	0.0049 ^a (± 0.00)	0.0056 ^a (± 0.00)	0.0046 ^a (± 0.00)
D.O ₂ (ppm)	1.82 ^a (± 1.95)	1.68 ^a (± 1.65)	2.02 ^a (± 1.68)
Salinity (ppm)	0.11 ^a (± 0.04)	0.20 ^a (± 0.26)	0.34 ^b (± 0.49)
Tds (ppm)	121.23 ^a (± 49.54)	212.43 ^{ab} (± 258.85)	352.56 ^b (± 494.36)
Hardness (ppm)	71.20 ^a (± 14.78)	80.10 ^a (± 30.91)	106.80 ^b (± 69.33)
Alkalinity (ppm)	41.53 ^a (± 22.58)	50.43 ^a (± 24.32)	44.50 ^a (± 22.78)
Ammonia (ppm)	0.03 ^a (± 0.07)	0.03 ^a (± 0.75)	0.00 ^a (± 0.00)
Nitrates (ppm)	0.04 ^a (± 0.09)	1.66 ^a (± 1.89)	1.16 ^a (± 1.26)
Nitrites (ppm)	1.66 ^a (± 1.89)	0.45 ^b (± 0.93)	0.04 ^a (± 0.099)
Sulphates (ppm)	95.00 ^a (± 0.41)	147.00 ^b (± 0.85)	81.00 ^a (± 0.50)
Carbonates (ppm)	22.13 ^a (± 5.80)	37.69 ^b (± 10.09)	21.38 ^a (± 10.22)
Phosphates (ppm)	0.00 ^a (± 0.00)	0.00 ^a (± 0.00)	0.00 ^a (± 0.00)

1: Upstream, 2: Midstream, 3: Downstream

Duncan Multiple Range Test (P = 0.05).

Means with different superscripts are significantly different across rows at P \leq 0.05.

Mean value equal to 0.00 connotes undetected parameter.

mixed populations, especially in adult sizes. *Hernandez et al.*, (2007) reported on the usefulness of non-parametric traits in the taxonomic separation of six *Macrobrachium* prawn species in Baja California Peninsula, Mexico after years of confusion on morphological separation of *M. rosenbergii* and its closely related morpho-types.

The presence of setae-like projections (pubescence) on the telson and uropod of *M. vollenhovenii* are more pronounced than observed in *M. macrobrachion* (Figs. 4 and 5). This particular feature was observed prominent as an additional trait for separation of clusters of these two morpho-types. However, there has not been previous emphasis on the use of this trait in resolving taxonomic issues of fresh water prawns in West Africa.

Parametric measurements of lengths were documented for some important body features where relative differences were observed on the specimens of the two *Macrobrachium* morpho-types. Observations revealed that the maximum total lengths

obtained for both male and female specimens of *M. vollenhovenii* are 122 mm and 119 mm while the maximum total lengths obtained for male and female specimens of *M. macrobrachion* was 118mm and 122mm. This finding is within the range of lengths observed by Lawal-Are and Owolabi, (2012) for these two *Macrobrachium* morpho-types around the interphase of Lagos and Lekki lagoon system. Also, Jimoh *et al.*, (2012) observed that the mean total length recorded for the brackish water populations of *M. macrobrachion* and *M. vollenhovenii* on Badagry Creek equals 83.1 \pm 1.42 mm and 74.5 \pm 0.84 mm for males and females *M. macrobrachion* and 82.5 \pm 1.18 mm and 78.8 \pm 1.14 mm for males and females *M. vollenhovenii* and were synonymous to mean total length values obtained for both morpho-types in this study (Tab. 3).

Consequently, analysis of variance for means of total length, carapace length, rostral length and body weight revealed that there are no significant differences (p>0.05) in the mean values of these traits obtained for the two morpho-types. Mean body weights for male and female specimens of *M. vollenhovenii* are 9.60 \pm 0.45 g and 6.61 \pm 0.48 g and for *M. macrobrachion* (7.88 \pm 0.39 g and 5.46 \pm 0.38 g) which infer that adult sizes of *M. vollenhovenii* grow bigger in weights than *M. macrobrachion*. These observations are synonymous with the report of Jimoh *et al.*, (2012) on the brackish water population of these two morpho-types.

Furthermore, the second pereopods (right and left Chela) in both sexes of *M. macrobrachion* was observed longer than those of *M. vollenhovenii*. The number of abdominal somites for all sizes of specimens of these two morpho-types was six. Mean dorsal spine counts on rostrum of males and females *M. macrobrachion* was 11.16 \pm 2.22 and 10.73 \pm 2.22 with additional presence of 1 or 2 apical tooth. *M. vollenhovenii* had mean counts of 13.46 \pm 1.51 and 13.21 \pm 1.74 in male and female specimens, lacking apical tooth. The ventral spine counts ranged between 3-7 in *M. macrobrachion* and 3-8 in *M. vollenhovenii* (Tab. 4). Water quality characteristics of the three sampling stations revealed that it is an exclusively fresh water ecosystem (Tab. 5).

Conclusion

Morphological traits characterization of fresh water populations of *M. Macrobrachium* and *M. vollenhovenii* on the studied section of Osun River Southwestern, Nigeria revealed that these two

morpho-types are distinctively separated based on their morphological traits. However, further studies aimed at characterizing the genome of these prawns is required to validate their true existence as separate species and clear the bias of possible interbreeding or hybridization within this mixed population.

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