



## SOME ANATOMICAL STUDIES ON THORACIC LEGS OF THE EGYPTIAN RED SWAMP CRAYFISH

El-Gendy, E.M.,<sup>1</sup> Eissa, A.A.,<sup>2</sup> El-Bably, S. H.<sup>1</sup> and Sary, R.G.<sup>1</sup>

<sup>1</sup> *Anatomy and Embryology Department, Faculty of Veterinary Medicine, Cairo University*

<sup>2</sup> *fish diseases and management department, Faculty of Veterinary Medicine, Cairo University*

### ABSTRACT

This study was conducted on the red swamp crayfish (*procambarus clarckii*) as one of crustacean covered by a hard chitinous exoskeleton which divided the body into, the cephalothorax and the abdomen. The cephalothorax consisted of the cephalic region and the thoracic region. The part of the exoskeleton that covered the cephalothorax called the carapace. The abdomen located behind the cephalothorax and consisted of six clearly divided segments. The ventral aspect of the cephalothorax was represented by the sternum which was triangular in shape with it's apex rostrally and it's base caudally, consisted of five fused sternebra. Each sternebra gave one pair of preopodes or walking legs connected by membranous joint. The chelipeds were the largest claws that the crayfish used for defence and to capture prey. Each of the four remaining segments contained a pair of walking legs. The walking leg composed of six segments, the coxa, basis, ischium, merus, carpus and the palm, these segments connected with each other by membranous joints.

**Key words:** Procambarus Clarckii, Preopodes, Chelipeds, Coxa, Basis, Ischium, Merus, Carpus and Palm

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### 1. INTRODUCTION

The red swamp crayfish have been introduced to Egypt during early 1980's [1] and studied the feeding behaviour of the exotic crayfish *Procambarus clarkii* and it's prospect in the bio-control of local vector snails and they found that smaller snails were easier preys to be attacked by the crayfish. Moreover, [2 and 3] studied the selectivity of this species for combating certain freshwater snails, which are vectors of parasitic diseases. [4] reported that the crayfish have since spread from the Delta to Bani Swaif, 500 km to the south of Cairo, with densities as high as 0.65/m<sup>2</sup>. The crayfish damaged earth dams, irrigation canals and fish stock, and though marketed, were considered of little commercial value. Such an introduction is now recognized to have bad consequences on biodiversity without economical profits.

The flesh of *P. clarkii* was recommended to stand as a source of animal protein for Egyptian citizens and it's carapace can be used as forage for animals, Crayfish can be used as bio-indicator of trace metals pollution in aquatic environment [5]. The chelipeds were the largest claws that the crayfish used for defence and to capture prey [6]. While [5] reported that the palm of chelipeds came with a row of tubercles along the mesial margin of palm; there were hooks on the Ischia of the male at the 3rd and 4<sup>th</sup> pereopods. [7] reported that dactylus was the ultimate segment of a pereopod; in a chela the dactylus is the movable finger, coxa was the basal segment of a pereopod, the seventh counted from the tip of the leg; it was followed by the basis, Carpus was the third segment of a pereopod counted from the tip of the leg; it was situated between the propodus and merus, merus was the middle segment of a

pereiopod, the fourth counted from either end and ischium was the fifth segment of a pereiopod counted from the tip of the leg; it was situated between merus and basis. In this study we will deal in detail with the anatomy and morphology of the red swamp crayfish and its thoracic legs that was the most important organ in fighting, catching of prey and damaging earth dams and irrigation canals.

## **2. MATERIALS AND METHODS**

### *2.1. Sampling:*

Ten samples of different weight of fresh water crayfish (*procambarus clarckii*) were collected from different markets in Giza for examination of the external features and the walking legs.

The samples were transported to the laboratory of anatomy and embryology department faculty of Veterinary Medicine, Cairo University in isolated ice box for various examinations.

### *2.2. Preparation:*

The samples were prepared by washing under tap water for cleaning then dried by cotton.

### *2.3. Methods:*

The fresh water crayfish put in different positions using protective gloves to take photos of the different surfaces, dorsal, ventral, lateral and anterior surface. The walking legs or preopodes were separated using dissecting tray, scissors, forceps and dissecting needles to examine their regions or segments the coxa, basis, ischium, merus, carpus and the palm. The chelipeds were separated and put in different positions to take photos of the different surfaces, dorsal, ventral, lateral and anterior surface to examine their segments.

## **3. RESULTS**

A crayfish has a fairly hard exoskeleton that covered its body which divided into two main parts, the cephalothorax (1/4) and the

abdomen (1/6). The cephalothorax consisted of the cephalic (head) region and the thoracic region. The part of the exoskeleton that covered the cephalothorax called the carapace. The ventral aspect of the cephalothorax was represented by the sternum (3/5) which was triangular in shape with its apex rostrally and its base caudally, measured about 5 cm long and its width differ from the base to the apex and consisted of five fused sternebra, the fusion was complete at the middle while leaving fissures between the sternebrae laterally so we have four sternal fissures. Each sternebra gave one pair of preopodes or walking legs connected by membranous joint (3/3, 1/5 and 2/4). There were five pairs of walking legs or preopodes each pair originated from sternebra ventrally, the first pair was modified and enlarged in size carrying indentations and ended with claws for fighting and catching of prey and called the chelipeds (1/1, 2/1 and 3/1). The walking leg (4 and 5) composed of six segments, the coxa, basis, ischium, merus, carpus and the palm, these segments connected with each other by membranous joints. The first walking leg was the largest leg which modified in size and shape called chelipeds to be used for defence, fighting and catching of prey, composed of six segments. The coxa was the first segment which cuboidal in shape yellowish brown in colour reached about 75 mm long, about 95 mm wide, connected with the first sternebra by membranous joints and it was freely movable thus move in different directions. The basis and the ischium (4/2 and 5/2) of the first walking leg were fused with each other, the basis reached about 5mm long, reddish brown colour and connected with the coxa by membranous joint while the ischium reached approximately 1 cm long and 1 cm width with convex ventral surface and flat dorsal surface, the medial and lateral border carried one longitudinal row of small spines (6/10), the ischium connected with the merus by membranous joint (6/1). The merus (4/3 and 5/3) was a large segment reddish black in colour with

smooth convex ventral surface carried two spines in its middle at the connection with carpus and the dorsal surface was flat carried five small spines and two large spines at its connection with the carpus, the medial and lateral border carried two rows of medium spines (6/2 and 7/1). The merus reached about 2.5 cm long, about 1 cm wide connected with the carpus by membranous joint. The carpus (4/4 and 5/4) measured about 1.5 cm long, about 1 cm wide with reddish black colour and had smooth and convex ventral surface, smooth lateral surface carried median groove and spiny medial and dorsal surface. The medial surface carried two large spines and six medium spines (6/3 and 7/3) while the dorsal surface carried two large spines and 9 small spines. The spines were conical in shape directed medially. The carpus connected with palm by membranous joint. The palm was the largest segment reddish brown colour had a body and two clews. The body (4/5 and 5/5) was oval in shape measured about 3 cm long and about 2 cm wide, The medial surface was convex carried 7 longitudinal rows of fine tubercles (5/8) and the lateral surface was also convex carried 9 longitudinal rows of fine tubercles (7/8) while the dorsal border was sharp carried one row of medium spines projects dorsally (6/11). The propodus (4/7 and 5/7) was the ventral clew that represented the continuation of the body ventrally, it was crescent in shape reached nearly 4 cm long with smooth lateral and medial surface. The ventral border was convex carried one row of fine tubercles while the dorsal border was concave and carried three spines the largest spine was the basal spine at the base of the propodus (6/9), the second at the middle (6/8) and the third spine at the free end of the propodus directed dorsally (6/7). The dactylus (4/6 and 5/6) was the dorsal clew connected with the palm by membranous joint, reddish black in colour reached about 4 cm long with two surfaces and two borders. The medial surface was smooth and convex except at the base of the dactylus carried six fine tubercles and the

lateral surface were smooth and convex except at the base of the dactylus carried 9 fine tubercles. The dorsal border was straight carried three medium spines on its base (7/8) while its free end formed a large spine directed ventrally (6/6), the ventral border was sharp and convex carried one longitudinal row of small spines (6/5) and a wide notch at the base (6/4). The angle between the propodus and the dactylus when they were extremely opened reached about 55 degree, the spines in the ventral border of the dactylus with the spines in the dorsal border of the propodus helped in fighting and cutting of food. The second and third walking legs were small legs carried no spines, yellow colour, ended by clew (8/8 and 8/9) called chelipeds and also consisted of six segments. The first segment was the coxa (8/1), it was cup shape measured about 5 mm long and about 5 mm wide carried fine cilia at its connection with the sternum. The coxa of the second leg articulated with the second sternite by membranous joint while the coxa of the third leg articulated with the third sternite by membranous joint. The basis (8/2) was pyramidal in shape with its base toward the coxa while its apex overlapped the ischium from the ventral surface, measured nearly 5 mm long and about 2 mm wide, carried no cilia and connected with the ischium by membranous joint. The ischium (8/3) was flattened segment measured about 1 cm long and about 3 mm wide, the medial surface smooth and flat while the lateral surface smooth and convex, it overlapped the basis dorsally and ended straight at its connection with the merus, the ventral ischial border of the third leg carried large spine (8/5) on its middle directed caudally. The merus (8/4) was elongated oval in shape with its medial surface smooth and flat while the lateral surface smooth and convex and measured nearly 2 cm long and about 3 mm wide. The carpus (8/6) was tubular segment with smooth surfaces measured about 5 mm long and 3 mm wide in the second leg, while in the third leg measured about 1 cm long and about 3 mm

wide. The palm (8/7) has flattened body measured about 1 cm long and about 3 mm wide in the second leg, while in the third leg measured about 1.5 cm long and about 2 mm wide, the medial surface smooth carried two rows of cilia while the lateral surface convex and smooth carried no cilia. The palm ended with two small clews, the propodus ventrally (8/9) and the dactylus dorsally (8/8), both measured nearly 4 mm long and about 1 mm wide; both carried cilia on the medial and lateral surfaces and both ended with tapered pointed end. The fourth and fifth legs were small reddish brown in colour consisted also of six segments but the last segment ended by one clew (8/10). The first segment was the coxa, cup shape measures about 5 mm long and about 5 mm wide carried fine cilia at it's connection with the sternum, the coxa of the fourth leg articulated with the fourth sternebra by membranous joint while the coxa of the fifth leg articulated with the fifth sternebra by membranous joint. The basis was pyramidal in shape with it's base toward the coxa while it's apex overlapped the ischium from the ventral surface, measured 5 mm long and 2 mm wide, carried no cilia and connected with the ischium by membranous joint. The ischium

of the fourth leg was flattened segment measured nearly 7 mm long and about 3 mm wide while the ischium of the fifth leg was pyramidal in shape measured about 5 mm long and about 2 mm wide, the medial surface smooth and flat while the lateral surface smooth and convex, it overlapped the basis dorsally while ended straight at it's connection with the merus, the ventral Ischial border of the fourth leg carried large spine (8/5) on it's middle directed caudally. The merus of the fourth segment was flattened in shape with it's medial surface smooth and flat while the lateral surface smooth and convex and measured about 1.5 cm long and about 3 mm wide while the merus of the fifth segment tubular in shape with smooth surfaces measured nearly 1 cm long and about 2 mm wide. The carpus was tubular segment with smooth surfaces measured in the fourth leg 8 mm long and 3 mm wide while in the fifth leg 5 mm long and 2 mm wide. The palm (8/7) of the fourth and fifth segment was tubular in shape measured about 1.5 cm long and 2 mm wide carried long cilia on it's ventral border and ended by one clew (8/10) dorsally which measured about 2 mm long and curved ventrally with pin pointed end.

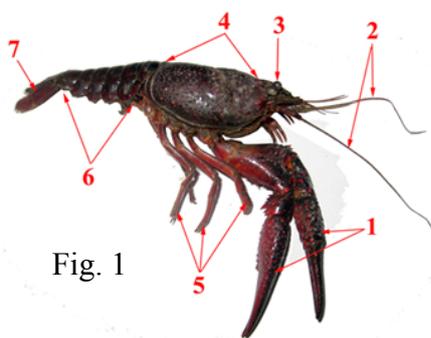


Fig. 1

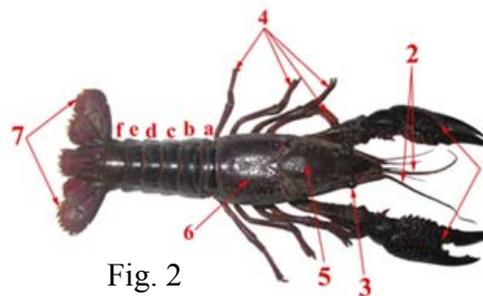


Fig. 2

Fig. 1: A photograph showing the red swamp crayfish (lateral view). 1. Chelipeds, the first pair of walking legs, 2. Antenna, 3. Compound eye, 4. Cephalothorax, 5. Walking legs, 6. Abdomen, 7. Tail fan

Fig. 2: A photograph showing the red swamp crayfish (dorsal view). 1- Chelipeds, the first pair of walking legs, 2- Antenna, 3- Two compound eyes, 4- Walking legs, 5- Cephalic tubercule, 6- Lateral tubercule, 7- Tail fan: a- The first abdominal segment, b- The second abdominal segment, c- The third abdominal segment, d- The fourth abdominal segment, e- The fifth abdominal segment, f- The sixth abdominal segments

Anatomical studies on thoracic legs of the Egyptian red swamp crayfish

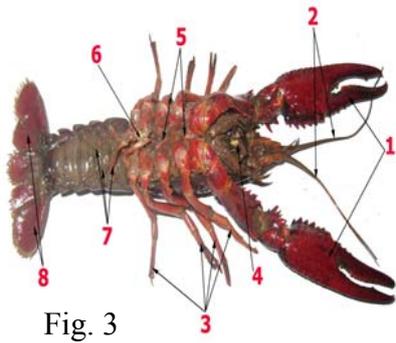


Fig. 3

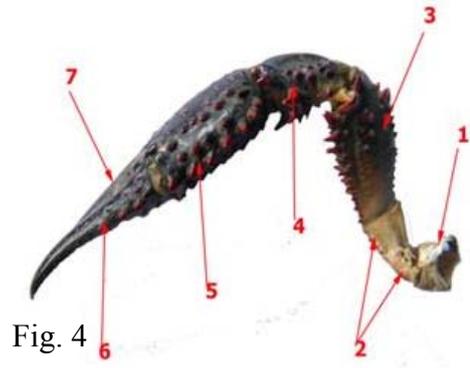


Fig. 4

Fig. 3: A photograph showing the red swamp crayfish (ventral view). 1- Chelipeds, the first pair of walking legs, 2- Antenna, 3- Walking legs, 4- Mouth parts, 5- Sternum, 6- Claspers, 7- Swimmerets, 8- Tail fan

Fig. 4: A photograph showing the chelipeds, the first pair of walking legs (dorsal view). 1- Coxa, the first segment, 2- Fused basis and ischium, the second and third segment, 3- Merus, the fourth segment, 4- Carpus, the fifth segment, 5- Palm, the body of the sex segment, 6- Dactylus, the mobile finger, 7- Propodus, the extension of the palm

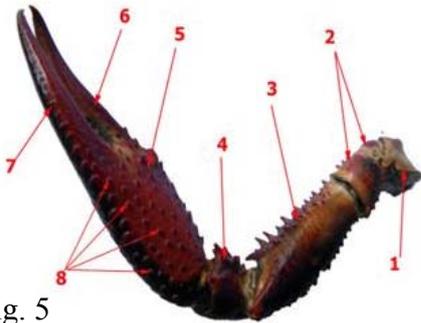


Fig. 5

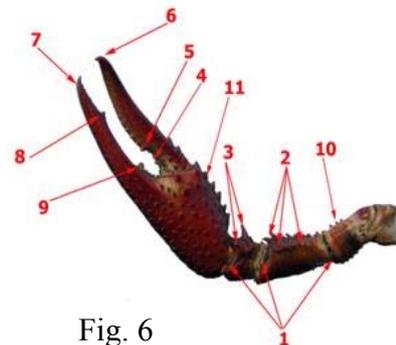
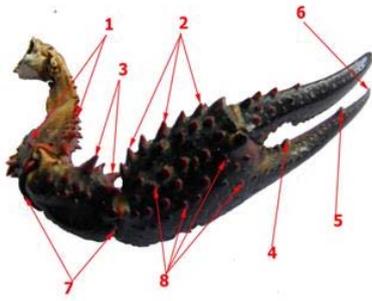


Fig. 6

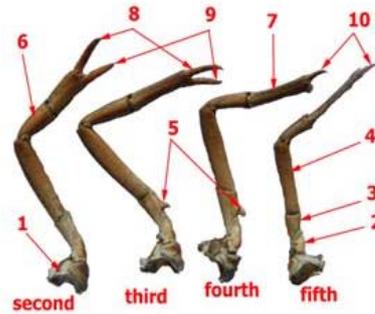
Fig. 5: A photograph showing the chelipeds, the first pair of walking legs (ventral view). 1- Coxa, the first segment, 2- Fused basis and ischium, the second and third segment carry small size spines, 3- Merus, the fourth segment carry medium size spines, 4- Carpus, the fifth segment carry large size spines, 5- Palm, the body of the sex segment carry fine tubercles, 6- Dactylus, the mobile finger, 7- Propodus, the extension of the palm, 8- Fine tubercles

Fig. 6: A photograph showing the chelipeds, the first pair of walking legs (medial view). 1- membranous joints, 2- medium size spines, 3- large size spine, 4- wide dactylar notch, 5- small size spines, 6- the pointed free end of the dactylus forming large spine, 7- the pointed free end of the propodus forming large spine, 8- the middle spine of the propodus, 9- the basal spine of the propodus, 10- small size spines, 11- medium size spines



(Fig. 7): A photograph showing the chelipeds, the first pair of walking legs (lateral view)

- 1- small size spines
- 2- medium size spine
- 3- large size spine
- 4- basal spine of the propodus
- 5- middle spine of the propodus
- 6- the pointed free end of the propodus forming large spine
- 7- membranous joints
- 8- the lateral surface of the palm carry fine tubercles



(Fig. 8): A photograph showing the walking legs, the second, third, fourth and fifth pair

- 1- Coxa, the first segment
- 2- Basis, the second segment
- 3- Ischium, the third segment carry large spine in the third and fourth legs
- 4- Merus, the fourth segment
- 5- Ischial spines
- 6- Carpus, the fifth segment
- 7- Palm, the body of the sex segment carry fine cilia
- 8- Dactylus, the mobile finger of the second and third legs
- 9- Propodus, the extension of the palm present in the second and third while absent in the fourth and fifth
- 10- Dactylus, the mobile finger of the fourth and fifth legs

#### 4. Discussion

In agreement with Rees and Vines (6), the red swamp crayfish had five pairs of walking legs or preopodes, the first pair was the chelipeds that modified and enlarged in size carried indentations and ended with claw for fighting and catching of prey. In accordance with Holthuis (7), the walking leg composed of six segments, the coxa, basis, ischium, merus, carpus and the palm which ended with two fingers, the propodus was the fixed finger while the dactylus was the movable one, these segments connected with each other by membranous joint. This study added that, the coxa was the first segment which cuboidal in shape yellowish brown in colour reached about 75 mm long, about 95 mm wide, connected with the first sternite by membranous joints and it was freely movable thus move in different directions. The basis and the ischium of the first walking leg were fused with each other,

the basis reached about 5mm long, reddish brown colour and connected with the coxa by membranous joint while the ischium reached approximately 1 cm long and 1 cm width with convex ventral surface and flat dorsal surface, the medial and lateral border carried one longitudinal row of small spines, the ischium connected with the merus by membranous joint. The dorsal border of the palm was sharp carried one row of medium size spines projects dorsally. While in this study, the palm was the largest segment reddish brown colour had a body and two claws. The body was oval in shape measured about 3 cm long and about 2 cm wide, The medial surface was convex carried 7 longitudinal rows of fine tubercles and the lateral surface was also convex carried 9 longitudinal rows of fine tubercles while the dorsal border was sharp carried one row of medium spines projects dorsally. The propodus was the ventral claw that represented the continuation of the body ventrally, it was crescent in shape

reached nearly 4 cm long with smooth lateral and medial surface. The ventral border was convex carried one row of fine tubercles while the dorsal border was concave and carried three spines the largest spine was the basal spine at the base of the propodus, the second at the middle and the third spine at the free end of the propodus directed dorsally. The dactylus was the dorsal clew connected with the palm by membranous joint, reddish black in colour reached about 4 cm long with two surfaces and two borders. The medial surface was smooth and convex except at the base of the dactylus carried six fine tubercles and the lateral surface were smooth and convex except at the base of the dactylus carried 9 fine tubercles. The dorsal border was straight carried three medium spines on its base while it's free end form a large spine directed ventrally, the ventral border was sharp and convex carried one longitudinal row of small spines and a wide notch at the base. The angle between the propodus and the dactylus when they were extremely opened reached about 55 degree, the spines in the ventral border of the dactylus with the spines in the dorsal border of the propodus helped in fighting and cutting of food.

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بعض الدراسات التشريحية على الأرجل الصدرية لاستاكوزا المياه العذبة المصرية

## الملخص العربي

اجريت هذه الدراسة على عشرة من صراصير البحر كواحد من القشريات المغطاة بهيكل خارجي كيتيني صلب الذي يقسم جسمها الى المنطقة الرأس صدريه مندمجة بدون فاصل ومنطقة البطن. تم تجميع صراصير البحر من مختلف الأسواق في الجيزة لإجراء البحث عليها. تم وضع صراصير البحر في مختلف الأوضاع لأخذ صور للأسطح المختلفة لها سواء كان السطح العلوي او السفلي أو الجانبي أو الأمامي كما تم فصل الأرجل الصدرية لصراصير البحر لفحص الأسطح والجوانب ووصف المناطق والمعالم المختلفة بها. تم وضع الأرجل الصدرية لصراصير البحر في مختلف الأوضاع لأخذ صور مختلفة لها كما تم مناقشه النتائج التي تم الحصول عليها مع الباحثين السابقين في هذا العمل.

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