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External Anatomy and Physiology of a Three Spotted Swimming Crab (*Portunussanguinolentus)*

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Abstract: ***The crab fishery in India is fast developing, and there is a vast scope for the crab meat, both national and international markets. Crabs rank third next to the shrimps and lobsters for their esteemed seafood delicacy and also the value of fishery they support. The main species supporting the crab fisheries in India are Scylla serrata, S. tranguebarica, Portunus pelagicus, P. sanguinolentus, Charybdis feriata, C. lucifera and C. truncata. Crabs are consumed not only to fulfill the nutrient requirements but also to cure diseases. The therapeutic use of animal, animals' parts and their by products by ethnic groups to cure different diseases is known as ethnomedicine. The main objective of the present studyis to create a dynamic experience in understanding the external features of three spotted swimming crab (P. Sanguinolentus).***

1. Introduction

Crabs are decapod crustaceans of the infraorder Brachyura, which typically have a very short projecting "tail" (abdomen) (Greek: βραχύς, romanized: *brachys* = short, οὐρά / *oura* = tail' usually hidden entirely under the thorax. They live in all the world's oceans, in fresh water, and on land, are generally covered with a thick exoskeleton, and have a single pair of pincers. Many other animals with similar names – such as hermit crabs, king crabs, porcelain crabs, horseshoe crabs, stone crabs, and crab lice – are not true crabs, but many have evolved features similar to true crabs through a process known as carcinisation.Crabs are generally covered with a thick exoskeleton, composed primarily of highly mineralized chitin,and armed with a pair of chelae (claws). Crabs vary in size from the pea crab, a few millimeters wide, to the Japanese spider crab, with a leg span up to 4 m (13 ft).Crabs are found in all of the world's oceans, as well as in fresh water and on land, particularlyin tropical regions.About 850 species are freshwater crabs. Crabs typically walk sideways (a behaviour which gives us the word crabwise), because of the articulation of the legs which makes a sidelong gait more efficient. However, some crabs walk forwards or backwards, including raninids, *Libiniaemarginata* and *Mictyrisplatycheles*. Some crabs, notably the Portunidae and Matutidae, are also capable of swimming, the Portunidae especially so as their last pair of walking legs is flattened into swimming paddles.96Crabs are mostly active animals with complex behaviour patterns such as communicating by drumming or waving their pincers. Crabs tend to be aggressive towards one another, and males often fight to gain access to females on rocky seashores, where nearly all caves and crevices are occupied, crabs may also fight over hiding holes.Fiddler crabs dig burrows in sand or mud, which they use for resting, hiding, and mating, and to defend against intruders.Crabs are omnivores, feeding primarily on algae,and taking any other food, including molluscs, worms, other crustaceans, fungi, bacteria, and detritus, depending on their availability and the crab species. For many crabs, a mixed diet of plant and animal matter results in the fastest growth and greatest fitness.However, some species are more specialised in their diets. Some eat plankton, some eat primarily shellfish such as clams, and some even catch fish.Crabs are known to work together to provide food and protection for their family, and during mating season to find a comfortable spot for the female to release her eggs.

2. Materials and Methods

Description of the experimental animal

Systematic position
Phylum: Arthropoda
Order: DecapodaLatreille
Family: Portunidae Rafinesque
Genus: *Portunus* Weber
Species: *P. sanguinolentus* Herbst
Nomenclature: Common and vernacular names of *P.sanguinolentus* in India are given below:
Common name-Three spotted crab (or) Blood spotted crab
Gujarathi-Karachla
Marathi-Khekhada
Kannada-Denji
Malayalam-Kavalannjandu
Tamil-Mukkannunandu
Telugu-Chukkalapeeta
Oriya-Kankda/Cheralapetta
Bengali-Lajjabotikankra
The three spotted swimming crab, *P. sanguinolentus*, is one of the most common and commercially important crab found along the east cost of India It is commonly known as three-spot swimming crab In Tamil Nadu, the local fisherman calls as "Mukkannunandu". This crab got its common name from three prominent red to maroon spots on the posterior part of the carapace. They are widely distributed in the Indo-pacific region from the east coast of South Africa to Hawaician waters

Distribution: Geographical distribution of *P. sanguinolentus* ranges from Indo–Pacific, Southern Africa, Red sea, Persian Gulf, India, Pakistan, China Sea, Philippines, Japan, Australia and Tahiti.

Fishery information: Caught all along the Indian Coasts. Common size is 10-12 cm in commercial catches; growing to a maximum size of 15 cm across the carapace.

Areas of abundance/landings: Along the coasts of Tamil Nadu (Chennai), Andhra Pradesh (Kakinada), Kerala and Karnataka.

Peak season: March–June and October to December. Caught in trawl, shore-seine and crab traps. The crabs for the present study was collected from Kasimedu fishing harbours landing centre (Lat.13.1280° N; Long. 80.2969° E) and brought to the laboratory by using plastic container.

3. Results and Discussion

Like most crustaceans, *P. Sanguinolentus* crabs had a hard outer covering called an exoskeleton made of chitin.The carapace is much broader than its length.Anterolateral border bears nine spines, of which the posterior most is the longest.The colouration of the carapace is characteristically in a dark greyground colouration, the posterior half of the carapace has three large reddish round spots, of which one is median and two laterals, each spot encircled by a whitish ring (fig 1)as it was observed by (Soundarapandian et al., 2013) in three spotted swimming crab, this exoskeleton provides protection from predators and the rigors of the physical environment (like cold, heat dryness, etc).

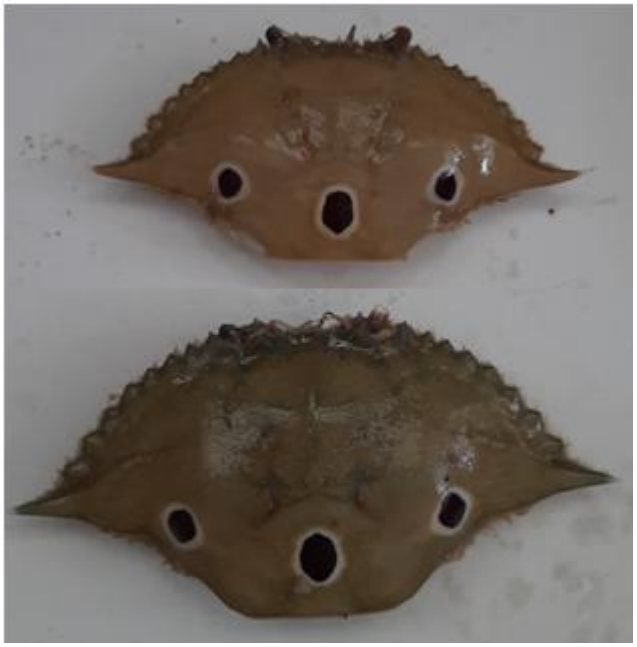

Figure 1: Carapace

It also serves as the basis for the attachment of the muscle system (fig 1) as it was reported by (Sumpton et al., 1989 and Reeby et al., 1990) in *P. Sanguinolentus* and *P. Pelagicus*crabs. Their body is divided into two main parts – the cephalothorax and the abdomen, as it was observed by (Campbell and Fielder, 1986) in Portunidcrabs, abdomen is the flap that is flexed underneath the body (fig 2)

Figure 2

Cephalothorax

The cephalothorax (cephalic+ thoracic) consists of the cephalic (or head) region and the thoracic (or chest) region as it was discussed by (Ahmed and Mustaquim., 1974) in Porcellanid crabs (fig 3).

Figure 3

Head-chest areas are basically ‘fused’ together. It means that the crab absolutely cannot turn its head as it was reported by (Morita et al., 2002) .The hard dorsal and lateral covering of the head and thorax of the body is also called the carapace as mentioned by (Duran et al., 1999) in crab. It protects their vital organs of the crab (brain, heart, stomach, bladder, testicular, or ovarian) from above but not ventrally as reported by (Mohammed and Rajeev., 2001) in crabs.

Head

Crabs are characterized by a joined head and chest. The head segment (cephalic) has several appendages, the 1st and 2nd antennae (antennule and antenna), (fig 4) andall mouthparts (mandible, 1st and 2nd maxilla, 1st to 3rd maxilliped). It also bears the (usually stalked) compound eyesas it was demonstrated by (Xiao and Kumar., 2004) in *P. Sanguinolentus*crabs.

Figure 4: Head- Dorsal view Head –Ventral view

Chest

The chest segment (thoracic) is the most calcified upper part of the crab's body. It is thicker than the shell elsewhere on the crab and connects to 5 pairs of appendages (peraeopods) as it was observed by (Soundarapandian et al., 2013) in *P.Sanguinolentus.*In most cases, the first peraeopods have enlarged pincers (chelae) and are therefore called chelipeds. The next four pairs of pereiopods (fig 5) are mostly used for walking and sometimes for gathering food.

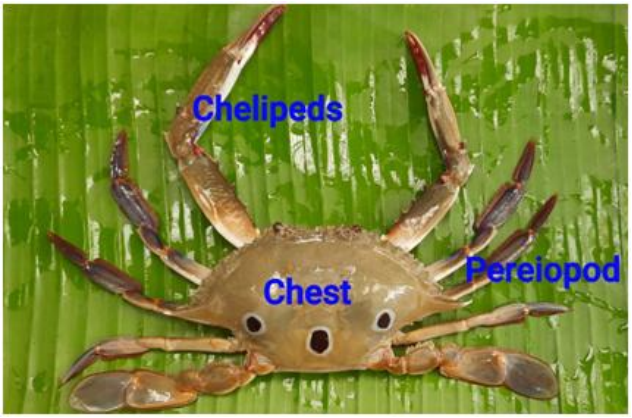

Figure 5

Stalked Eyes

The eyes are located on the short, independently movable, and adjustable eyestalks (fig 4) Crabs can fold their eyes into sockets in the shell for protection. Having eyes on stalks also means crabs have a better field of vision.Crabs have compound eyes, which give them panoramic vision as it was discussed by (Mohammed and Rajeev., 2001) in crabs. Even though compound eyes do not focus well, they are very sensitive. It helps them to detect UV light in low light conditions and notice the slightest movements around them. The eye-stalks of the crabs produce a special hormone that regulates the metabolism and moltingprocess in the body as reported by (Morita et al., 2002). Crabs can regenerate their lost limbs (claws or legs) with every molting process. However, unlike other body parts, they cannot regenerate their eyes as mentioned by (Campbell and Fielder, 1989) in crabs.

Antennae and Antennule

Crustaceans like crabs generally have two pairs of antennae (also called "feelers") (fig 4).Two sets of short antennules (first antennae).One set of long antennae (second antennae), their antennae and antennule are pretty small as mentioned by (Sumpton et al., 1989 and Reeby et al., 1990) in *P. sanguinolentus* and *P.pelagicus*crab. Even more, in some species, they are so small that we can barely see them at all.They use long antennae to orientate in murky environments and gather tactile information as reported by (Xiao and Kumar., 2004) in*P.pelagicus* crab. Antennae can easily catch water vibrations around the crab. The short ones also help crabs to assess the suitability of food and provide chemical information ("taste" and "smell") about what they are touching. That is why they are also called chemoreceptors as discussed by (Ahmed and Mustaquim., 1974) in porcellanidcrabs.

Mouthparts (Mandible, Maxillae, and Maxilliped)

Crabs have modified feeding appendages called mandibles and maxillae. Maxilliped (jawfoot, and foot jaw Origin: [Maxilla + L. pes, pedis, foot.]) is one of a pair of 3 sets of mouth appendages on the head of the crab (fig 6) modified to rummage and bring food to the mouth as observed by (Duran et al., 1999).

Figure 6: Dissected mouth parts

One of the functions of the 3rd maxilliped is to protect the more delicate appendages anterior to it. The 1st and 2nd maxillipeds are smaller, they primarily take part in the feeding process. They also pump water over the crab's gills, so the crab can breathe while eating as mentioned by (Sumpton et al., 1989 and Reeby et al., 1990)in *P. Sanguinolentus*and *P.pelagicus.* Axillipeds are almost in constant movement as crab finds and manipulates tiny morsels of food to its mouth. They are fused to each other and to the head as mentioned by (Mohammed and Rajeev., 2001) in crabs. The mandibles are heavily calcified and equipped with powerful muscles. They are the most anterior of the mouthparts. The mandibles shred food into pieces. Opposed to a human's jaw, the crab's mandibles move side to side as observed by (Campbell and Fielder., 1986) in Portunid crabs.

Pereiopods (Legs) and Chela

Crabs have 5 pairs of jointed legs attached to the thorax. However, they have a different function:the first pair of pereiopods have claws/pincers (chelipeds) as it reported by (Xiao and Kumar., 2004) in *P.pelagicus.* There is no spine on the posterior border of the arm of the cheliped.Behind the chelipeds, the three pairs of legs are normal, and the last pair is oar-like for swimming as it was mentioned by (Soundarapandian et al., 2013) in *P. Sanguinolentus.* Crabs use them for catching food, defending, and fighting between themselves, the next 4 pairs of pereiopods (fig 7) are used for walking as well as for "sensing" the environment as it was observed by (Ahmed and Mustaquim., 1974) in Porcellanid crabs.

Figure 7: Dissected pair of legs (1-Coxa, 2-Basi -ischium,3-Merus,4-Propodus and 5- Dactyl

In some aquatic crab species, the last pair of pereiopods are flattened, it lets them push themselves through the water and move faster. This pair is often called swimming legsand this swimming leg has 5 parts they are coxa, basi-ischium, Merus, propodus and dactyl (fig 7) as mentioned by (Soundarapandian et al., 2013).Crabs typically walk sideways. This is because their legs are located on the sides of their bodies and their joints point upwards. In addition, at some point in evolution, sideways movement is quicker and more efficient as mentioned by (Morita, 2002). Typically most crabs have one crushing claw and one cutting claw.

Abdomen

In crabs, the abdomen is located beneath the cephalothorax and usually includes the 7-segmented pleon (abdominal segments).The small, triangular, terminal portion is the telson (the tail), which is not a true segment and the anterior pair of abdominal appendages is slender and straight with marginal spines at the tipas observed by (Sumpton et al., 1989 and Reeby et al., 1990) in *P. Sanguinolentus*crab. The segmentation of the thorax is apparent ventrally where it is not covered by the carapace as described by (Xiao and Kumar, 2004). As with cephalothorax, these segments are partially or completely fused (fig 8).

Figure 8

It means that crabs sacrificed their swimming ability (compared to shrimp and crayfish) for flexibility and mobility as reported by (Campbell and Fielder., 1986).

Gonophores

Crabs often show marked sexual dimorphism. Males often have larger claws a tendency that is particularly pronounced as observed by (Mohammed and Rajeev, 2001) in fiddler crabs. In fiddler crabs, males have one greatly enlarged claw used for communication, particularly for attracting a mate Another conspicuous difference is the form of the pleon (abdomen); in most male crabs, this is narrow and triangular in form, while females have a broader, rounded abdomen (fig9) as it was reported by (Soundarapandian et al., 2013) in *P.Sanguinolentus*.

Figure 9

This is because female crab brood fertilised eggs on their pleopods. Crabs often show marked sexual dimorphism as reported by (Duran et al., 1999).

4. Conclusion

Crab species have segmented bodies (up of 20 body segments grouped into two main body parts the cephalothorax (head and chest) and the abdomen). Crabs have wide, flat bodies with no obvious tail. The head and thorax are merged together under the carapace.Crabs are ten-footed crustaceans or decapods. They have 5 pairs of legs: four pairs of walking legs and one pair of front legs are called chelipeds, they have a pair of claws on them. The focus of the present study aims on the present day aquaculture which was moving towards the development of hatchery crab farming to meet the human protein demand. So, the production of crab in a controlled condition is essential. Before that it is important to know the morphology and physiology of a particular crab.

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