Horseshoe Crab

Limulus polyphemus

By Abigail Jaske

Background

Horseshoe crabs have often been called "living fossils". Some of the earliest horseshoe crab fossils ever found date back to over 360 million years ago. The species featured in this article, the *Limulus polyphemus*, is native to the Atlantic Ocean along the east coast of North America, but is also found in parts of the Gulf of Mexico. The perfect habitat for the horseshoe crab is warm, shallow oceans and coastal lagoons.

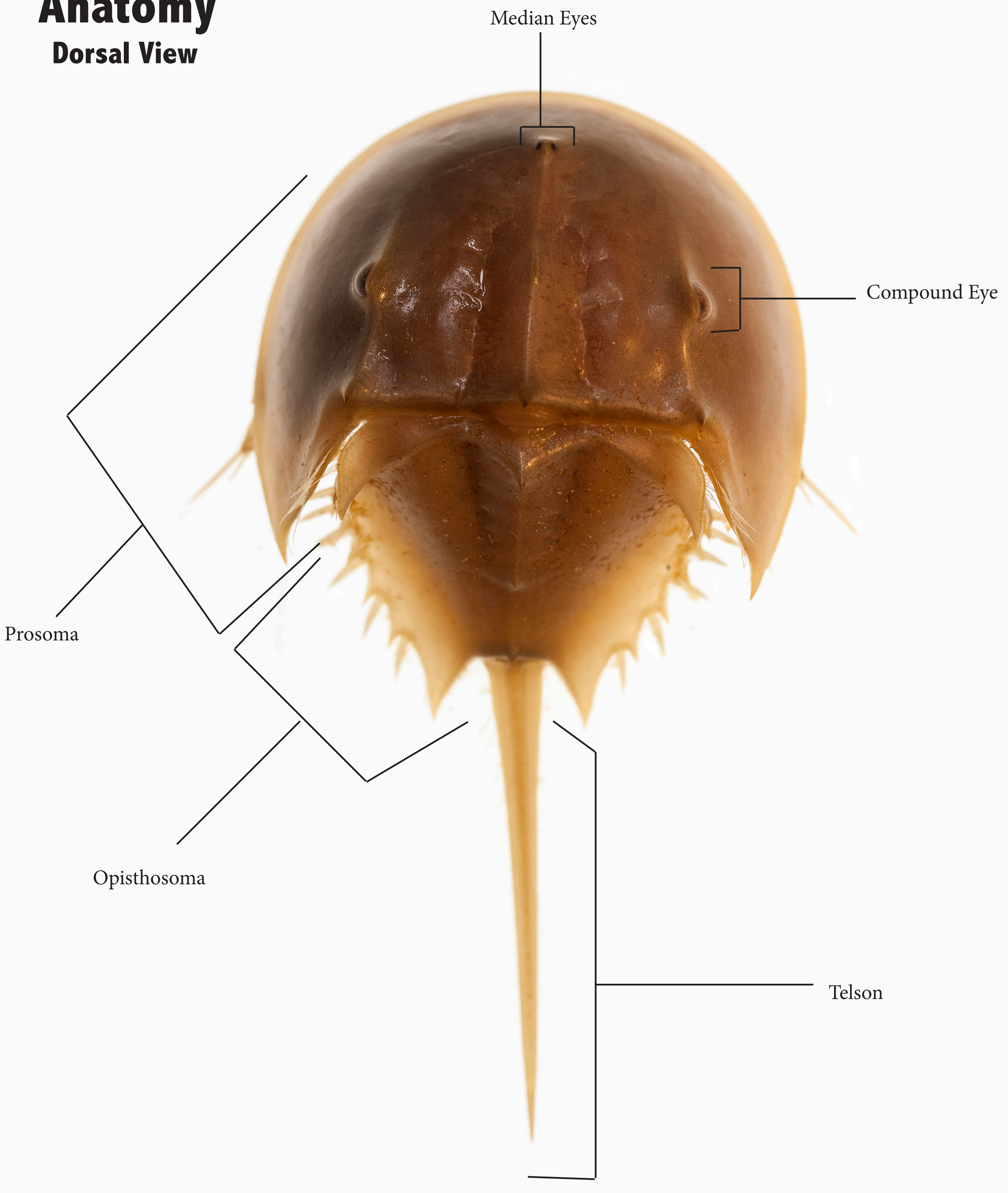
A horseshoe crab is a predator for the most part. Its diet primarily consists of small clams, crustaceans, and worms. However, they will also eat other animals and sometimes algae.

The horseshoe crab is primarily nocturnal and spends daytime hours buried in the sand. They will reach adulthood primarily between 9 and 12 years old. A full grown male can reach 14-15 inches long, while the females are about one third larger measuring in at 18-19 inches long. The life span of a horseshoe crab can proceed 20 years.

Taxonomic Classification

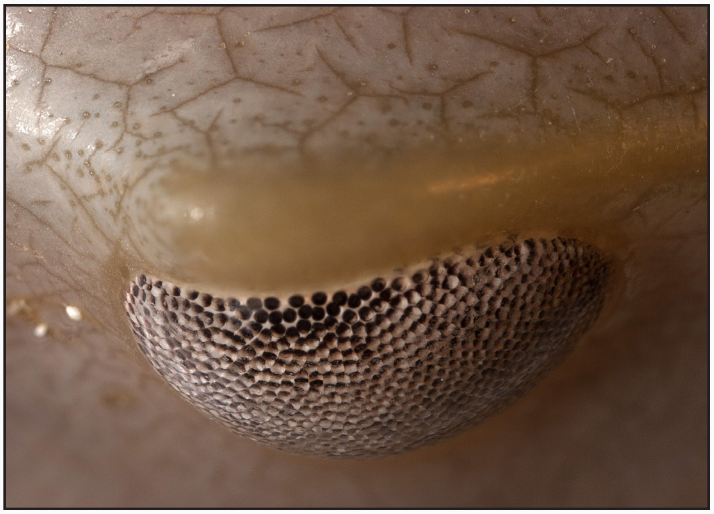
Kingdom - Animalia
Phylum - Arthropoda
Subphylum - Cheilcerata
Class - Merostomata
Subclass - Xiphosura
Order - Xiphosurida
Family - Limulidae
Genus - Limulus
Species - Polyphemus

Anatomy
Dorsal View



Eyes

Altogether horseshoe crabs have a total of ten eyes. The two most apparent eyes are the two lateral compound eyes. Each compound eye has about 1,000 ommatidia or photoreceptors. The cones and the rods in the lateral eyes are very similar to the structure of human eyes, except the horseshoe crab's receptors are about 100x larger. The ommatidia allow the eyes to adapt in a multitude of light situations. In low light situations, the eyes are chemically stimulated to increase the sensitivity of the photoreceptors; this allows more light to enter the eye. This capability allows the horseshoe crab to identify predators or other horseshoe crabs in the dark. These eyes also much resemble those possessed by insects.



Above: Pictured above is a close up shot of one of the lateral compound eyes. You can see the ommatidia, or photoreceptors. They have a honey graham cone like look to them. If you have ever seen a fly's eye up close this is very similar.

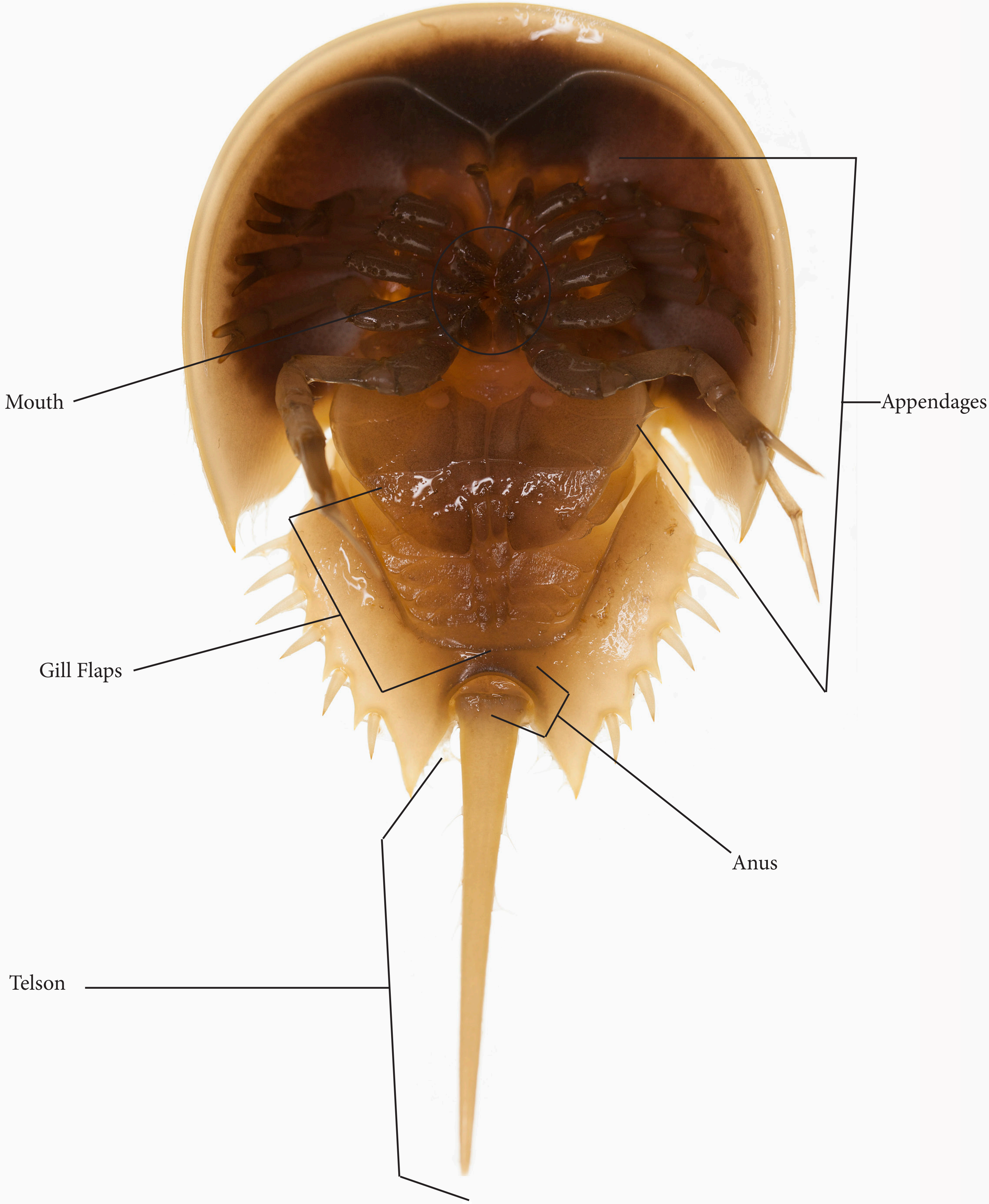
Located near the mouth are the two ventral eyes; their function is not clear.

The last eye is made up of multiple photoreceptors located on the tail. The purpose of these is believed to be to allow the brain to synchronize to the cycle of light and dark.

There is an additional five eyes on the top of the prosoma. These eyes allow the horseshoe crab to detect ultraviolet light from the sun or reflected moonlight. This allows for them to stay in sync with the lunar cycle which is especially important for their spawning period which is at its highest on the new and full moon.

Below: These are the median eyes. They are two out of the five eyes on the top of the prosoma. They help the horseshoe crab to detect UV light.

Ventral View



Mouth/Legs

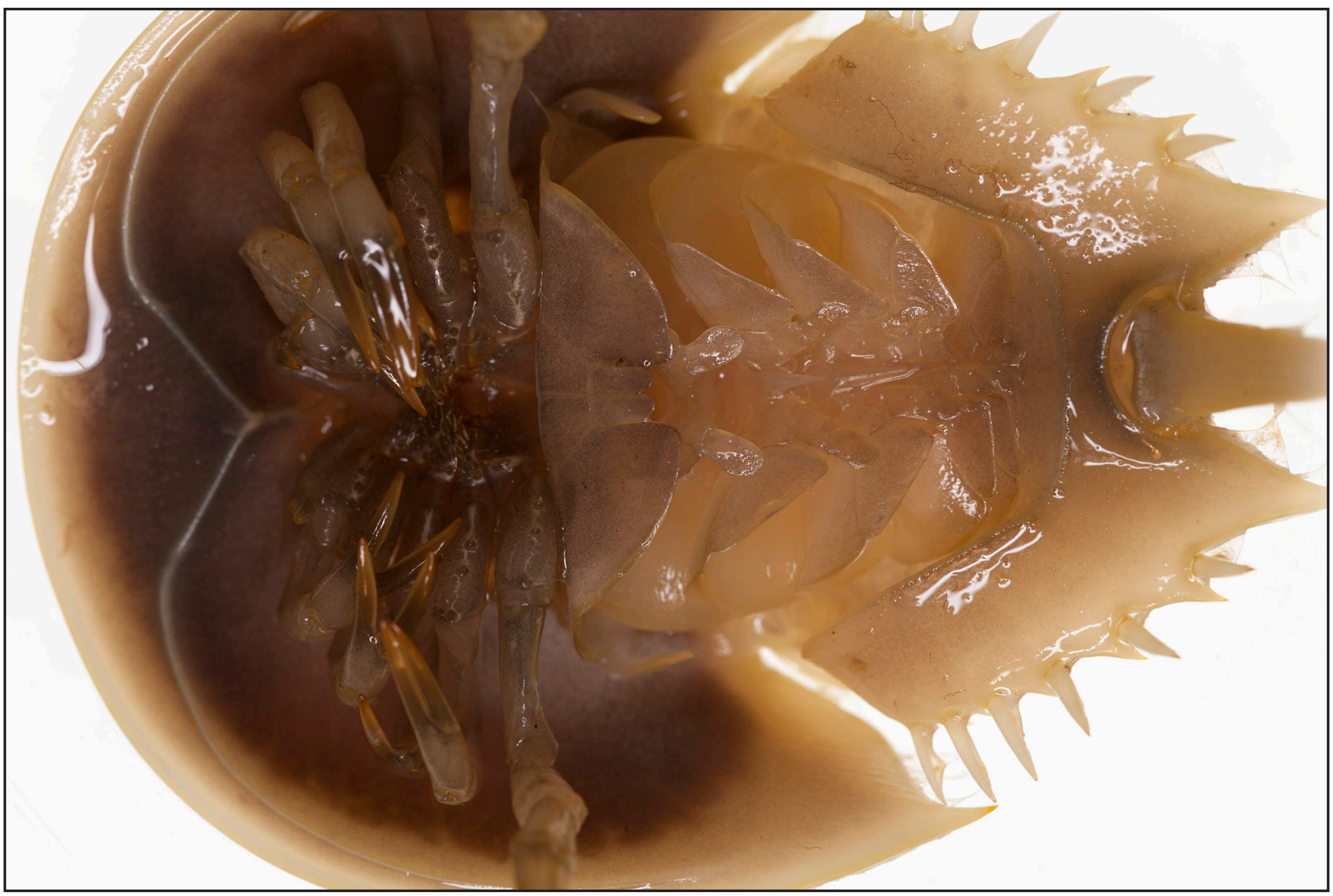
The horseshoe crab has 6 pairs of appendages on the posterior side of the prosoma. Five out of these six pairs are legs used for movement, in or through sediment. Each of these legs has a claw at the end. The last pair of legs is used to allow the crab to burrow into sand. The inward parts of the legs are covered with small spike like structures called gnathobases. These are used to help move food into the mouth.

Above: This is the mouth opening located on the ventral side of the crab. You can see the gnathobases that help move food towards the mouth as well as crush food up before it enters.

Gills

A horseshoe crab breathes by absorbing oxygen from the water by using the gills located on its undercarriage. The gills are divided into five pairs. Each pair has a membrane like covering called a lamellae. This is the site that the gaseous exchange will occur while the gills are moving. These gills also function as additional propellers, as they swim through the water, for juvenile horseshoe crabs.

Below: Featured here is an image of the gill flaps when they are actually moving up and down. On the surface of these flaps is where oxygen exchange will occur.

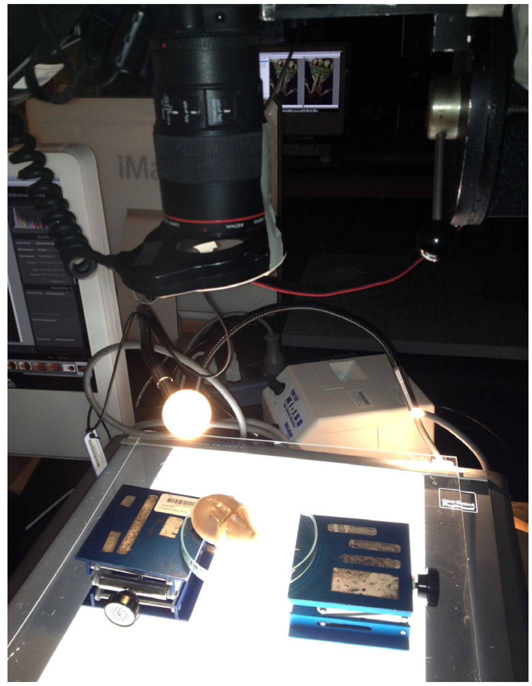


Photographic Technique

I photographed my horseshoe crab live. This created numerous difficulties when trying to photograph specific parts of him, as he was a moving subject. I used a light table for the background, fiber optic lights as top light and a ring flash. I removed the horseshoe crab from the water and placed him on an optically clear petri dish. He did try to crawl out of the dish so I suggest not leaving your specimen unattended if it is alive, or I would put it in something that has higher edges so they cannot crawl out. I then placed the petri dish on two lab jacks to create some distance between the background(light table) and the specimen. I taped the ring lite flash to my Canon 100mm macro lens, since it is not made to attach to that focal length lens. I placed my camera on a copy stand and shot tethered using Lightroom 4.

For the compound lateral eye shot I used the Canon 65 mm Macro Lens. I attached the ring flash to this and left the rest of my setup the same. Make sure your setup is stable. I was shooting at about 3x and captured multiple images at different planes of focus by moving my specimen bit by bit. I then brought these images into Lightroom to convert them from Raw files to JPEGs so I could more easily load them into stacking software. I then used Zerene Stacker to create a "stack" or multiple plane focus image. This was one of the few stacks I did, because of my specimen being alive. It is very important to not have any movement in your setup when shooting to make a stack as this will cause the stack to not align properly or it may create artifacts in your final image. I also shot a few other stacks, but due to my living specimen they did not come out as well as I would have liked.

If you're interested in photographing horseshoe crabs I might recommend ordering a preserved specimen; it would make subject handling much easier. I would have liked to shoot both to compare the samples, but unfortunately was not able to obtain a preserved specimen in the time alotted for my class.



Above: Image of my photographic setup.

Photographic Equipment Used:

Camera: Canon 5D Mark II

Lenses: Canon EF 100 mm Macro Lens, Canon MPE 65mm Macro Lens

Light Table

Canon MR-14EX TTL Macro Ring Lite Flash

Fiber Optic Lights

Copy Stand

About Me

I am a fourth year Biomedical Photographic Communications Major, recieving a minor in Criminal Justice. I will be graduating in the Spring of 2013 from the Rochester Institute of Technology. I just completed a co-op over the summer with Nikon Instruments Inc. and am interested in photomicroscopy as well as certain aspects of forensic and medical photography.

Contact Me

If you have any questions, or would like to request rights to use any of the images in my article please contact me via email at : agj1675@rit.edu

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