Chapter

Crustacean

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Abstract

Crustaceans include all the animals of the phylum Arthropoda Crustacea; the word comes from the Latin *crusta*, which means shell. Crustaceans are a very diverse group of invertebrate animals which includes active animals such as the crabs, lobsters, shrimp, krill, copepods, amphipods, and more sessile creatures like barnacles. Arthropoda is the largest phylum of Animal Kingdom. It includes about 11,340,000 species in all habitats. This constitutes about 83% of all the known animal species on earth. Arthropoda includes spider, scorpions, prawns, crabs, millipedes, centipedes, and many other insects. Arthropoda is characterized by heteronomous metamerism, chitinous exoskeleton, and joined appendages. The evolutionary acquisition of these traits is known as arthropodization. In very small crustaceans, exchange of the respiratory gases occurs through the general body surface. Large aquatic arthropods respire through gills and book gills, whereas terrestrial forms respire through trachea and book lungs.

Keywords: Arthropoda, exoskeleton, crustacean: burrow, sedimentology, Ostracoda

1. Introduction

Crustaceans are cladocerans if they have 4–6 pairs of (thoracic) legs, lack any paired eyes, swim with their second pair of antennae, and have at least the head not covered by a carapace [1]. Crustaceans are some of the most important marine life to humans—crabs, lobsters, and shrimp are widely fished and consumed around the world.

There are more than 52,000 species of crustaceans in the world, which include popular marine animals like lobsters, crabs, shrimp, crayfish, and barnacles. Smaller crustaceans breathe through their bodies and larger ones breathe through gills. Most crustaceans are dioecious, meaning individuals are male or female. Reproduction varies among species. Most of them are the most important marine animals. Humans rely heavily on crustaceans for food; and crustaceans are also an important prey source for marine life in the ocean food chain for a variety of animals, including whales, fish, and pinnipeds; more diverse than any group of arthropods, crustaceans are second or third in abundance of all categories of animal life after insects and vertebrates. They live in inland and ocean waters from the Arctic to the Antarctic as well as from elevations in the Himalayas up to 16,000 feet to well below the sea level. All crustaceans have a hard exoskeleton which protects the animal from predators and prevents water loss. However, exoskeletons do not grow as the animal inside them grows, so crustaceans are forced to molt as they grow larger. The molting process takes between a few minutes to several hours. During molting, a soft exoskeleton forms underneath the old one and the old exoskeleton is shed. Since the new exoskeleton is soft, this is a vulnerable time for the crustacean until the new exoskeleton hardens. After molting, crustaceans typically expand their bodies almost immediately, increasing by 40–80%. Most crustaceans reproduce sexually with a separate male and female.

2. General characters of phylum Arthropoda

Arthropoda have the following description [2]:

1. Cosmopolitan in distribution is found in aquatic, terrestrial, and aerial forms.
2. Body has jointed appendages or legs.
3. Body is triploblastic.
4. Bilaterally symmetrical.
5. Organ system level of organization.
6. Body is divisible into head, thorax and abdomen.
7. Segmented.
8. Jointed appendages.
9. Hard external skeleton.
10. Three parts (head, thorax, and abdomen).
11. Exoskeleton composed of chitineous materials.
12. Growth type is by molting which sheds old skeleton and secretes a large one.
13. They are either oviparous or ovoviviparous.

3. Classification of phylum Arthropoda

Phylum Arthropoda have different views concerning their phylogeny. So there is no absolute system of classification for this phylum. The below given classification is the most accepted one. Arthropoda classified into subphylums and classes three subphyla namely Trilobita, Chelicerata, and Mandibulata are definitively arthropods, classes Trilobita, Xiphosura, Arachinida, Crustacea, Cheliopoda, Diplopoda, and Hexapoda [3] (**Table 1**).

4. Classification of the crustaceans

Crustaceans have been known to humans since ancient times and have provided us with sources of both food and legend. The classification of crustaceans has been quite variable; the system used by [4] presented an overview of crustacean classification, and readers are referred to that publication for a window into the labyrinthine history of this subphylum. This classification was recognized in [5, 6] (**Table 2**).

Phylum	**Arthropoda**		
Subphylum	Trilobata Ex. *Trithurus*	Chelicerata	Mandibulata
Class		Xiphosura Ex. *Limulus*	Crustacea Ex. *Palaemon*
		Arachinida Ex. *Palamnaeous*	Cheliopoda Ex. *Scolopendra*
		—	Diplopoda *Ex. Spirobolus*
		—	Hexapoda Ex. *Musca*

Table 1.
Classification of phylum Arthropoda.

Crustacean class	Subclass	Orders	Suborders
Remipedia			
Cephalocarida			
Branchiopoda		Anostraca	
		Notostraca	
		Diplostraca	Laevicaudata; Onychocaudata
Malacostraca	Phyllocarida	Leptostraca	
	Hoplocarida	Stomatopoda	
	Eumalacostraca	Bathynellacea	
		Anacpedacea	
		Euphausiacia	
		Amphionidacea	
		Decapoda	Dendrobranchiata; Pleocyemata
		Mysida	
		Lophogastrida	
		Cumacia	
		Tanaidacia	
		Mictacea	
		Spelaeogriphacea	
		Thermosbaenacea	
		Isopoda	Anthuridia; Asellota; Calbozoidea; Epicaridea; Gnathiidea; Limnoridea
		Amphipoda	Gammaridea; Hyperiidea; Capreliidea; Ingolfiellidea
Thecostraga	Facetotecta		
	Ascothoracida		
	Cirripedia		
Tantulocarida			
Barnchura			
Pentastomida			
Mystacocacida			
Copipoda	Progymnoplea	Platycopioda	
	Neocopepoda	Cyclopodia	
		Gelyellodia	
		Happaccticoida	
		Misophioida	
		Monstrilloida	
		Mormonilloida	
		Poecilostomatoida	
		Siphonostomatoida	
Ostracoda	Mydocopa	Mydocopida	
		Halocyprida	
	Podocopa	Podocopida	
		Platycopida	
		Plaeocopida	

Table 2.
Classification of the Crustacea [25].

5. General characters of class Crustacea (Crusta = shell)

1. Class Crustacea head, or cephalon (plus the acron), thorax and abjedium (**Figure 2**).

2. They are found in marine, fresh water and terrestrial habitats.

3. Possess jaw, like appendages called mandibles.

4. Crustaceans have two pairs of antennae and two pair of maxillae.

5. Some of appendages are biramous.

6. Origin and application and crustacean

Crustaceans have important economic, ecological, and esthetic values and also can be appreciated from the perspective of bi-level functionality. Some larger crustaceans, including shrimp, lobsters, and crabs, are a major food commodity, while smaller crustaceans in their own way are integral to many food webs, sometimes considered a class or superclass rather than a subphylum. The scientific study of crustaceans is known as *carcinology*. Other names for carcinology are malacostracology, crustaceology, and crustalogy, and a scientist who works in carcinology is a carcinologist, crustaceologist, or crustalogist. The origin crustacean differs according to the order, suborder, or other taxons of the crustacean [7]. The earliest crustaceans are known from Cambrian sediments including the well-known Burgess Shale fauna. These primitive crustaceans are essentially worm-like in shape, but they do have many of the key features of crustaceans visible even on modern types such as shrimps [8]. So, the origin is based on the age of the genera and species. The small planktonic and free-swilling crustaceans were common in the Paleozoic era. It is relatively rare to find their skeletons entirely except in those places, like the Burgess Shale, where some catastrophic events smothered them quickly enough trevent their decay [9]. The crustaceans colonized mud firm grounds, which were formed by erosion during a rapid sea-level fall; thus, the burrows occur in direct association with erosional regressive surfaces and therefore are good stratigraphic indicators of abrupt paleoenvironmental change.

7. Ecology

The ecology of the crustacean differs from one type to another. They live in aquatic and terrestrial environments, and all are marine but a few groups have adapted to life on land, such as terrestrial crabs and terrestrial hermit crabs. They are also found as burrowed in the sand of beaches will near access of water. Some freshwater crustaceans are crawfish and fairy shrimp. Crawfish live in lakes and rivers hidden under rocks and sand. Fairy shrimp are found in vernal ponds which are temporary puddles made by rain water. Various species have occupied almost every conceivable niche within the aquatic environment. An enormous abundance of free-swimming (planktonic) species occupies the open waters of lakes and oceans. Other species live at the bottom of the sea, where they may crawl over the sediment or burrow into it. Different species are found in rocky, sandy, and muddy areas. Some species are so small that they live in the spaces between sand grains. Others tunnel in the fronds of seaweeds or into man-made wooden structures. Some members of the orders Isopoda and Amphipoda extend down to the greatest depths in the sea and have been found in oceanic trenches at depths of up to 10,000 m. Crustaceans colonize lakes and rivers throughout the world, even high mountain lakes at altitudes of 5000 m. They range widely in latitude as well: in the high Arctic, some crustaceans use the short summer to develop quickly through a generation, leaving dormant stages to overwinter [10].

8. Life cycle

The life cycle for different crustaceans may be different or they are similarities between one crustacean and the next when it comes to their lifecycles. The Crustacean class is the largest group of arthropods of a marine nature, and there are approximately 30,000 different species in this group alone. The life cycle for different crustaceans is going to have unique qualities, but there are also similarities between one crustacean and the next when it comes to their life cycles.

Nauplius stage—this stage of crustacean life cycle is perceived as being a defining link among all crustaceans. This is the first larval stage of crustaceans and consists only of crustacean head and telson as neither the abdomen nor the thorax has developed [11].

Zoea larval stage—the crustacean life cycle involves a larval stage that is known as a zoea. When the zoea name was given to the crustacean, naturalists believed that it was an entirely separate species.

Mysis or megalopa stage—the stage of growth following the zoea stage of growth is either the Mysis or megalopa stage development on what crustacean group is involved.

The crustacean is going will being to look more like to its adult form. This is also the stage of growth where the crustacean will depend more on foraging and grazing to feed.

Adult growth stage—the adult growth stage is reached by 1 year of age for the most crustacean. After a year has passed, most crustacean varieties will be capable of mating and reproducing [12].

8.1 Mating system

Crustacean produced by sexually: a small number is hermaphrodites, including Barnacles, Remipedes, and Cephalocarida. Some may even change sex during the course of their life. Parthenogenesis is also widespread among crustaceans, where viable eggs are produced by a female without needing fertilization by a male. This occurs in many branchiopods, some ostracods, some isopods, and certain “higher” crustaceans, such as the *Marmorkrebs* crayfish [13].

8.2 Eggs

The fertilized eggs are simply released into the water column, while others have developed a number of mechanisms for holding on to the eggs until they are ready to hatch. Most decapods carry the eggs attached to the pleopods, while peracarids, notostracans, anostracans, and many isopods form a brood pouch from the carapace and thoracic limbs. Female Branchiura do not carry eggs in external ovisacs but attach them in rows to rocks and other objects. Most leptostracans and krill carry the eggs between their thoracic limbs; some copepods carry their eggs in special thin-walled sacs, while others have them attached together in long, tangled strings [14] (**Figures 1** and **2**).

8.3 Larvae

The visual systems of crustacean larvae concentrate on the compound eyes of decapod and stomatopod larvae as well as the functional and behavioral aspects of their vision. Larval compound eyes of these macrurans are all built on fundamentally the same optical plan, the transparent apposition eye, which is eminently suitable for modification into the abundantly diverse optical systems of the adults. Many of these

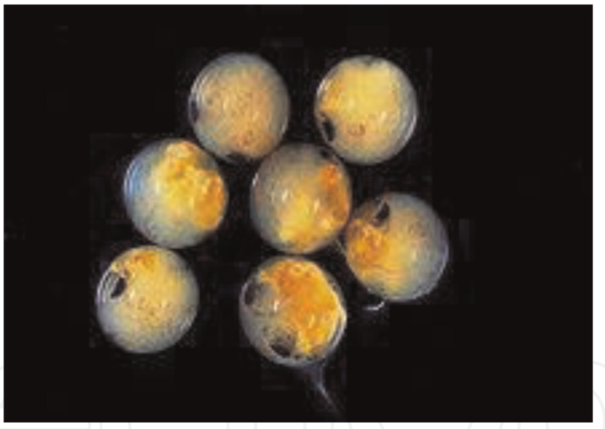

Figure 1.
Eggs of Potamon fluviatile*, a freshwater crab.*

Figure 2.
Zoea larva of the European lobster, Homarus gammarus.

eyes contain a layer of reflective structures overlying the retina that produces a counter illuminating eye shine, so they are unique in being camouflaged both by their transparency and by their reflection of light spectrally similar to background light to conceal the opaque retina. Besides the pair of compound eyes, at least some crustacean larvae have a non-imaging photoreceptor system based on a naupliar eye and possibly other frontal eyes. Larval compound eye photoreceptors send axons to a large and well-developed optic lobe consisting of a series of neuropils that are similar to those of adult crustaceans and insects, implying sophisticated analysis of visual stimuli. The visual system fosters a number of advanced and flexible behaviors that permit crustacean larvae to survive extended periods in the plankton and allow them to reach acceptable adult habitats, within which to metamorphose [15].

9. Crustacean burrow

Crustaceans are mainly males, excavate burrows largely in carbonate substrates, and are therefore referred to as the burrowing barnacles. While their greatest diversity is found in shallow tropical seas, the most generalized or primitive members are found for the most part in deep water (between 1000 and 3000 m). Trace fossils, ranging back to the Devonian if not the Ordovician [16], reveal that species once occupied relatively high latitudes in Northern Europe and Gondwanaland, and at least one extant species is known from Antarctic waters today.

Interpretation of the crustacean burrows from Mallorca makes them very comparable to some modern and fossil thalassinidean burrow systems [17, 18], and it is a direct consequence of the versatile behavior of fossorial shrimps. The helical burrows described herein were very likely part of complex burrow systems produced by thalassinideans. From an ichnotaxonomic point of view, these would be

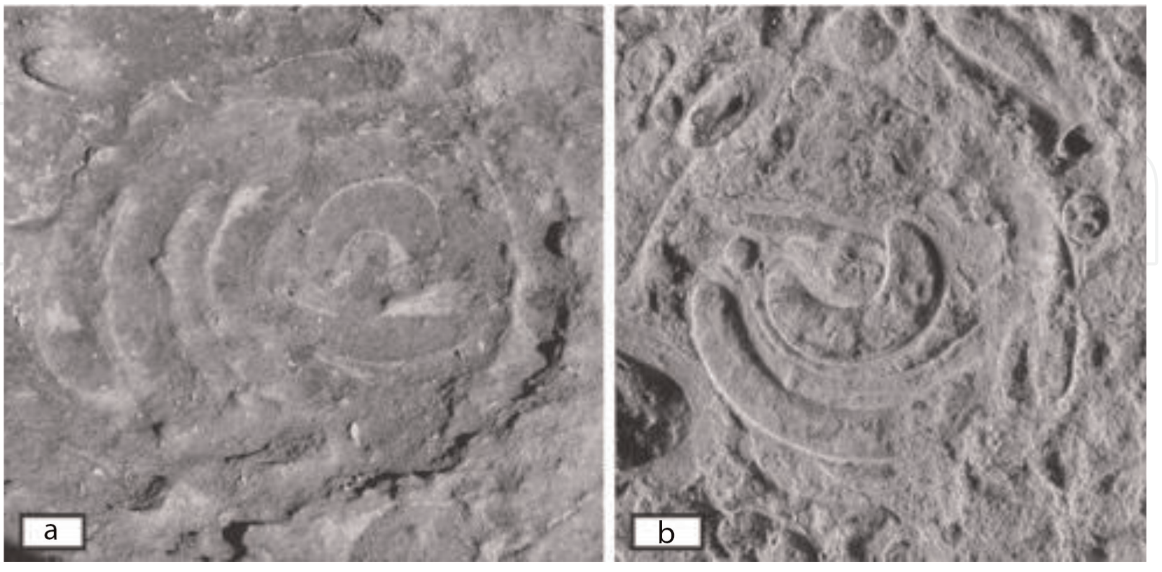

Figure 3.
Helical burrows. (a) and (b) Different parallel-to-bedding sections showing their architectural variability.

Figure 4.
Chthamalus stellatus *(Sessilia).*

Figure 5.
Cylindroleberididae.

compound structures composed of pellet-lined (Ophiomorpha) and unlined (Thalassinoides) branching tunnels, sometimes with spreiten due to vertical shifting (Teichichnus), or double (Lapispira) helical elements. Such double helix elements (Lapispira) were previously known only from the Jurassic as isolated burrows, also assigned to crustaceans [13]. Despite the lesser geometric regularity of the Mallorcan burrows, the presence of a knobby lining and the fact that these may

Figure 6.
Fossil remains of a barnacle (Cirripedia—left) and a crab (Decapoda—right) found in the UCMP teaching collection (images by Karen Osborn). Fossil stomatopod, center (image by Dr. Cees Hof, used with permission).

Figure 7.
Crayfish.

Figure 8.
Etyus martini.

Figure 9.
Spiny lobsters.

be connected to branching systems. The new occurrence of this unusual ichnogenus may record a case of behavioral convergence expressed in burrow architecture [19] (**Figures 3–6**). While most crustaceans are marine, a large number of crayfish live in freshwater, including crayfish (**Figure 7**). *Etyus martini* is one of the more common crabs in the Gault Clay (**Figure 8**). Spiny lobsters are among the larger crustaceans. Big specimens can weigh several kilograms and make very good eating (**Figure 9**).

10. Geological history

The crustaceans, such as crabs and lobsters, that have hard exoskeletons reinforced with calcium carbonate tend to preserve well as fossils, but many crustaceans have only thin exoskeletons. Most of the crustacean fossils known are from coral reef or shallow sea-floor environments, but many crustaceans live in open seas, on deep sea floors, or in burrows. Crustaceans tend, therefore, to be rare in the fossil record than trilobites. Some crustaceans are reasonably common in Cretaceous and Cenozoic rocks, but barnacles have a particularly poor fossil record, with very few specimens from before the Mesozoic era. The Late Jurassic lithographic limestones of Solnhofen, Bavaria, which are famous as the home of *Archaeopteryx,* are relatively rich in decapod crustaceans (five pairs of legs), such as *Eryon* (an eryonoid), *Aeger* (a prawn), or *Pseudastacus* (a lobster). The "lobster bed" of the Greensand formation from the Cretaceous period, which occurs at Atherfield on the Isle of Wight, contains many well preserved examples of the small glypheoid lobster *Mecochirus magna*. Crabs have been found at a number of sites, such as the Cretacoues Gault clay and the Eocene London clay.

11. Crustacean example: ostracods

Ostracods are tiny crustaceans, typically about one to two millimeters in length, with a well-documented fossil record beginning in the early Ordovician (e.g., [20–24]). During the Ordovician period, ostracods already possessed a global biogeographical distribution from high southern latitudes to the palaeo-tropics [26]. Crustacean ostracods are variously represented in washing residue and thin sections, two valves (left and right valves), the two valves being joined together along the hinge line. The body covered by external shell called Carapace is composed of two valves connected in the Dorsal side. Two valves are equal in the genus ***Amphisites*** or overlapping in *Cytherella.* Ovoid shape or semi ovoid, 0.5–4 mmlength to about 30 mm. Articulation along the dorsal margin is further characterized by development of teeth, socket, ridges, and grooves all together called hinge element (hinge elements: teeth, socket, grooves, and ridge-bar). The body is subdivided into Cephalon, Thorax, and Posterior, seven pairs appendages (antenna, antennule, mandible, maxilla, 1st thoracic leg, 2nd thoracic leg, and 3rd thoracic leg), one eye center, and two lateral calcareous part—internal and outer lamella with the valves are hard calcareous part, Carapace—right and left valve connected with hinge (**Figure 10**).

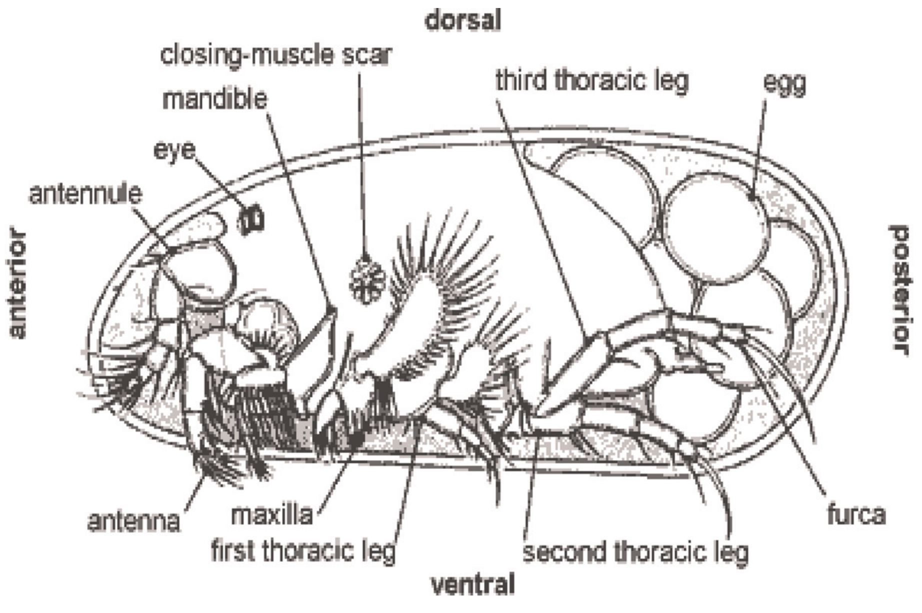

Figure 10.
Ostracoda shell.

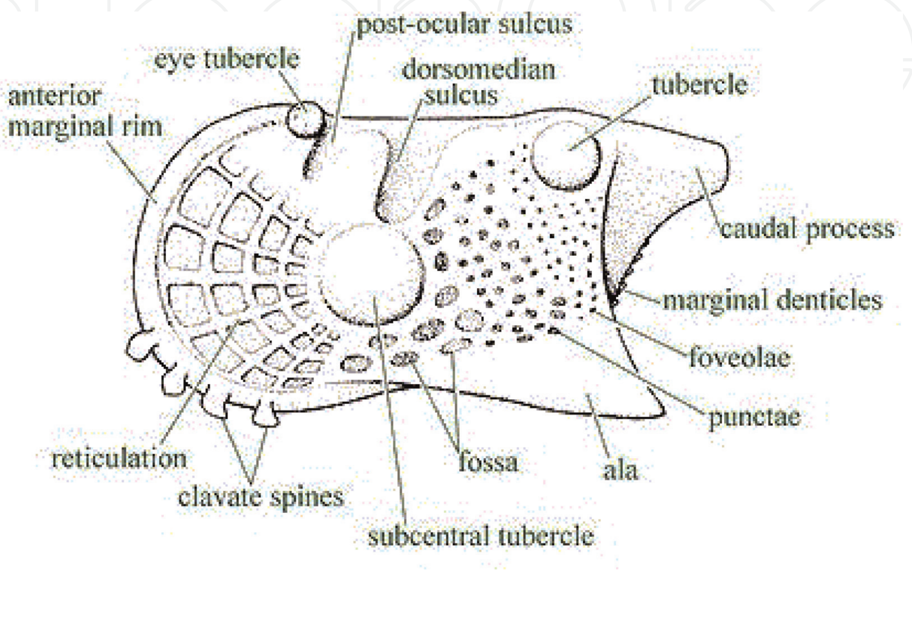

Figure 11.
Ornamentation in some species of Ostracoda.

11.1 Important part in the general shape of ostracods, on the external surface of the test

1. Marginal denticulation: most of the species in Ostracoda have more denticulations (resemble to tooth) accumulated on the external margin of the valves; the number and shape of these denticulation differ from one sp. to another sp. and these denticulation are more accumulated on the anteroventral and posteroventral of the test.

2. Caudal process: some of the species in Ostracoda are characterized by having elongated end that is long and narrow and ended by anus. This caudal process is on the mid-posterior or on the posterodorsal side or posteroventral side.

3. Hinge ears: some species of Ostracoda have protuberance on anterior side of the hinge line which is formed by addition of calcareous materials.

4. Posteroventral spine: it is an calcareous spine on the posteroventral side, usually to the posterior side.

5. Eye tubercle: it is a protuberance on the anterior side which is the position of eye.

6. Anteroventral beak-rostrum (*Cypridea*): some genera of Ostracoda are characterized by having protuberance resembling to beak, which is most abundant in the genus *Cypridea.*

11.2 Ornamentation

Is shown in the carapace view. The outer surfaces of the ostracod valves can be smooth or ornamented with pits, striations, reticulations, spines, sulci, tubercles, and wing-shaped (alae) (**Figure 11**) [22].

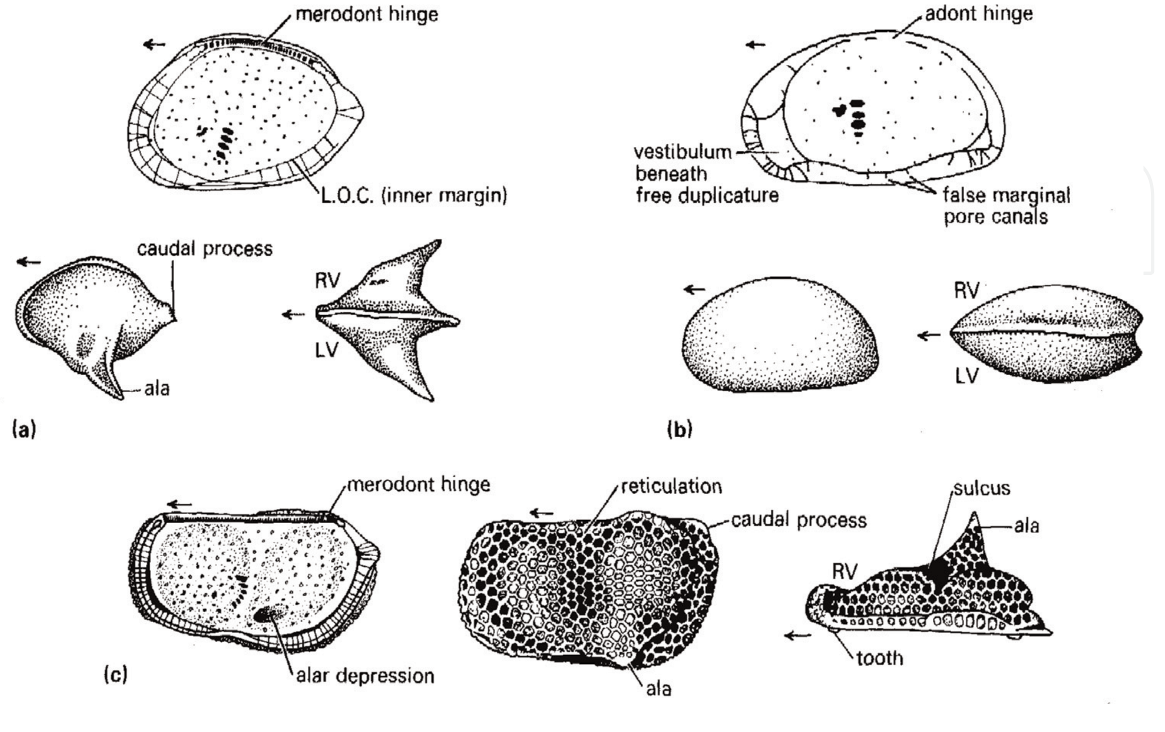

Figure 12.
Important parts in Ostracoda. (a) Caudal process and alae structure (b) Side view showing right and left valves (c) Merodont hinge and alae structure, reticulation.

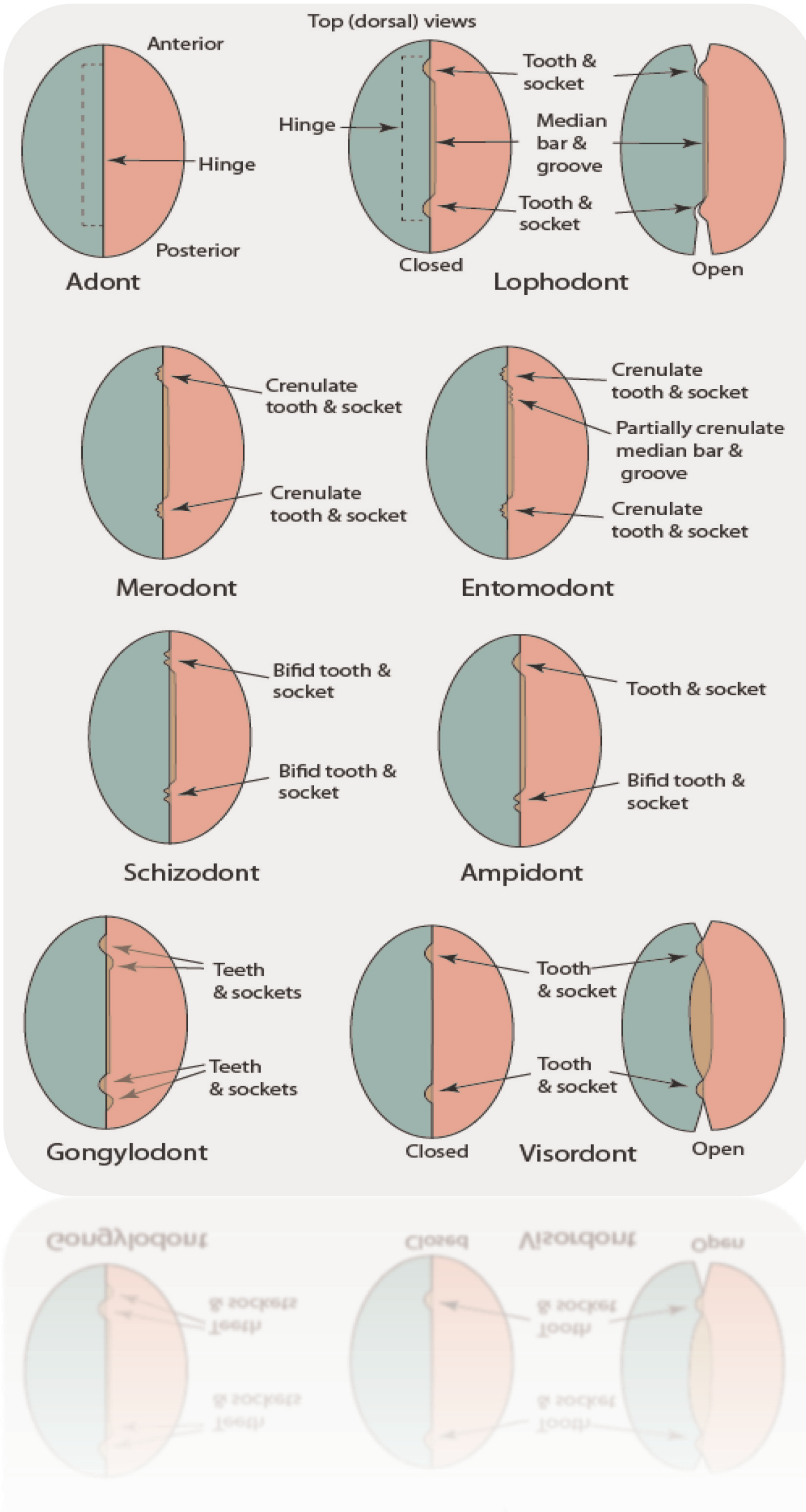

Figure 13.
Teeth types in Ostracoda.

11.3 Pores in ostracods

Normal pores (open normal pores and sieve normal pores) and open normal pores: these pores penetrated the carapace, but sieve normal pores penetrated the wall. Marginal pores: these pores penetrated the test wall vertically and are distributed on the external surface; the number of the pores differ from family, genus species, and important in classification. Marginal pore canal: long pores distributed on the marginal zone; more pores on the anterior part than the other parts are also important in the classification. Test in ostracods is composed of calcareous material with chitineous test around them which helps to fix the hinge. Hinge elements are (Hinge elements: teeth, socket, grooves, ridge-bar) (**Figure 12**).

11.4 Teeth

The teeth in crustacean differ from one taxon to another; for example, ostracods have Adont hinge which is the simplest, without teeth or sockets, and often form part of a contact groove on the larger valve and a corresponding ridge on the smaller valve. The Merodont hinge is composed of a tooth and socket at each end of a groove or ridge structure (complementary negative and positive structures in left and right valves). The Entomodont hinge differs from the merodont hinge style by having a coarsely crenulated anterior portion of the median groove/ridge element. The Amphidont hinge has a more complex median structure with an anterior tooth and socket (**Figure 13**).

11.5 Distribution and ecology of ostracods

Ostracods as a mode of life are pelagic (planktonic) by using organic-walled shell (less $CaCO_3$) or by producing oil droplets. Pelagic ostracods are not preserved in the sediments, or benthic on/in the sea floor. They can burrow, swim near the sea-bed, or crawl on or through the sediment. Benthic forms occur in all the aquatic environments from the abyss to the shoreline. They also occur in estuaries, lagoons, freshwater lakes, ponds and streams, salt lakes, hot springs, and damp vegetation (**Figure 14**).

Ostracods can be influenced ecologically by various factors such as [27]:

1. Type of the substrate: swimmers have smooth, thin, bean-shaped carapace; fine-grained (mud) dwellers have flattened ventral, wing-shaped carapace;

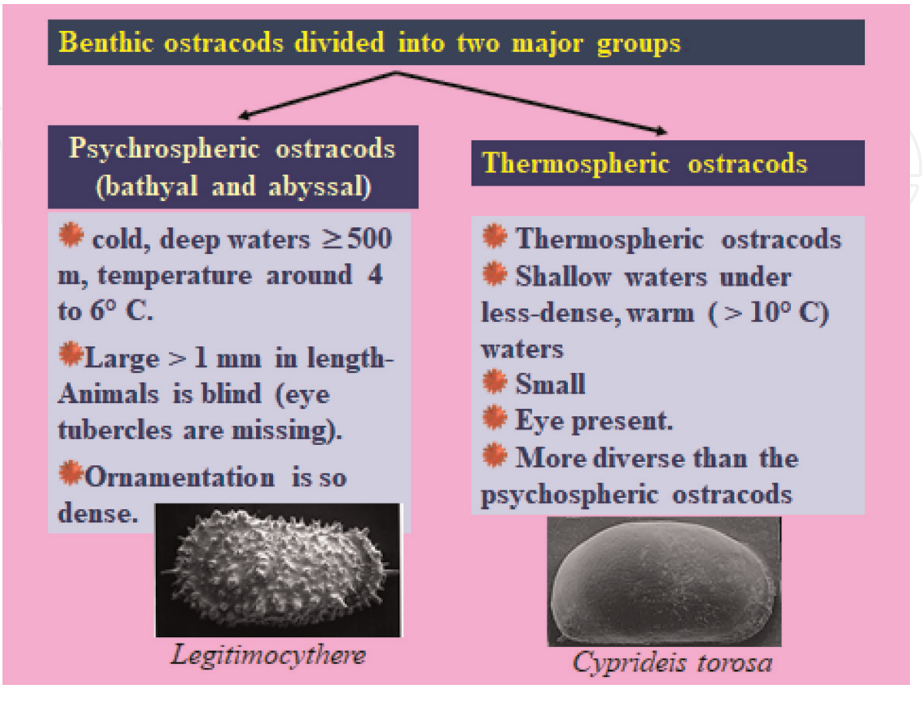

Figure 14.
Psychrospheric and thermospheric ostracods.

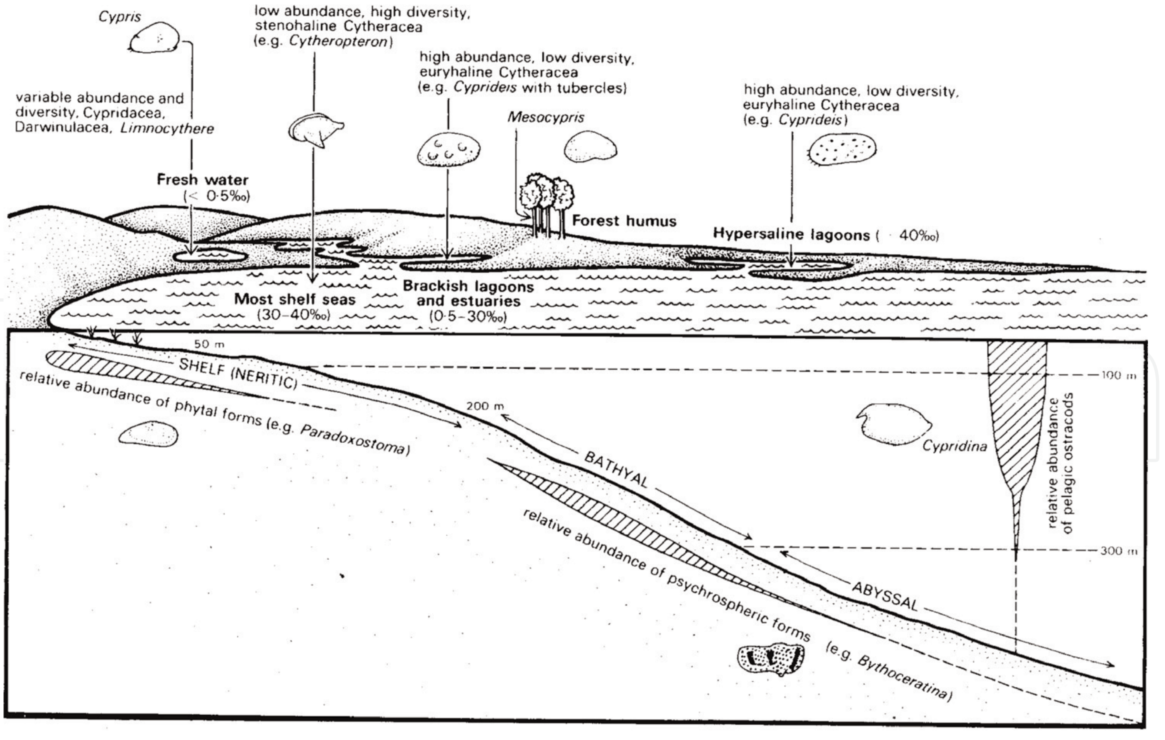

Figure 15.
The ecological distribution of recent Ostarcoda with some tropical represented, Brassier. 2004.

coarse-grained (sand) dwellers have thick carapace with coarse ornamentation; and interstitial ostracods are small, long, and robust.

2. Salinity: ostracods carapace morphology tends to vary according to variation in salinity. They occur in fresh water (0.0–0.5‰) of rivers and estuaries, brackish water (0.5–30‰) of lagoons and marshes, normal sea water (35–45‰), and hypersaline water bodies (up to 57‰) of the closed seas, lakes, lagoons, and marginal bays.

Fresh water ostracods—simple morphology, hinge adont, thin carapace, no marginal pores, and other weakly developed variable abundance and diversity.

Most shelf seas ostracods: low abundance, high diversity, stenohaline *Cytheropteron*.

Brackish lagoon and estuaries ostracods: thick shell, weakly ornamented, marginal pore canal, amphidont hinge. High abundance, low diversity, euryhaline, *Cyprideis* with tubecles.

Hypersaline lagoons ostracods, high abundance, low diversity, euryhaline, *Cyprideis*.

Marine ostracods-continental shelf: strongly calcified carapace, strongly ornamented, hinge well developed (**Figure 15**).

11.6 Application

They occur in the sedimentary column since the early Ordovician; hence, they can be used as: stratigraphic markers, paleo-salinity indicators, paleo-depth indicators, biostratigraphy, biostratigraphic correlation, and in paleoecology.

They are used as:

1. Tools for biozonation of marine strata, as they occur from Cambrian to the present.

2. Indicators of ancient marine shorelines salinity, relative sea-floor depth.

Ostracods are used for ecostratigraphy. Ecostratigraphy is the study of the occurrence and development of fossil communities throughout geologic time, as evidenced by biofacies, with particular reference to its relevance in stratigraphic correlation and other fields, such as biogeography and basin analysis. Ecostratigraphic studies by ostracods are based on their morphological changes and ornamentations, which are divided into different biozones and as environmental zone based on, diversity, community, and species abundant, range of the species and environment.

11.7 Ostracods and sedimentology

The genera *Karsteneis karsteni* and *Cythereis longaeva* shows that the ratio of closed valves that the ratio of closed valves (carapace) of high percent and thick in the center of the cretaceous basin (rapid rate of deposition) in bohemia than the other deposits along the sides which are thin sediment and of low rate of deposition.

Example no. 1. Some ostracods in the Garagu Formation, Dhouck City, Kurdistan Region, North Iraq (**Figure 16**) [28].

Example no. 2. The biostratigraphic distribution of Late Ordovician ostracod faunas from the Ellis Bay Formation on western Anticosti Island are described. Some 62 species are recorded. The EllisBay Formation can be subdivided into three ostracod biozones (these being partial range zones) and an interregnum, in ascending stratigraphical order these being the *Longiscula subcylindrica* biozone, the *Eurychilina erugoface* biozone, the *Tetradella anticostiensis* biozone and an interregnum in the uppermost part of the succession, marked by the local extinction of several taxa at the terminus of the *T. anticostiensis* biozone. These intervals are only locally developed, and are not useful for inter-regional correlation. A small number of the Ellis Bay Formation ostracod species are recorded elsewhere, from Sandbian and Katian age successions. These include *Aechmina richmondensis*, *Aechmina maccormicki*, *Baltonotella parsispinosa*, *Macrocyproides trentonensis*, *Microcheilinella lubrica* and *Spinigerites unicornis* [29].

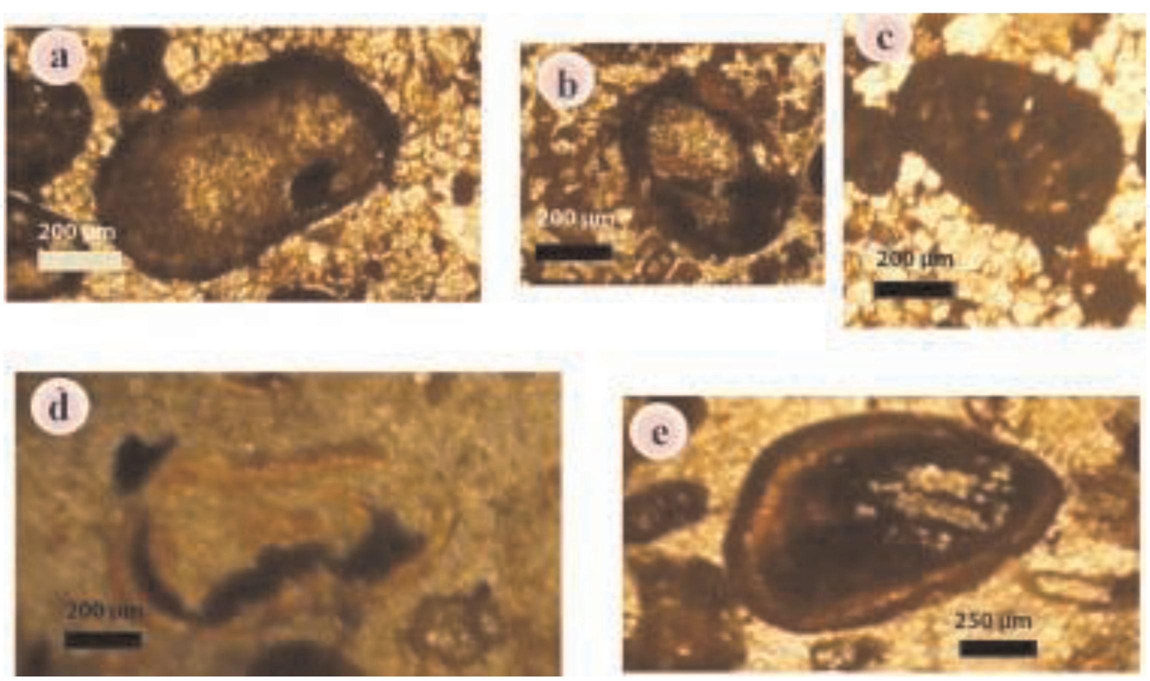

Figure 16.
(a) Cytherella *sp., (b)* Neocythere cf. gottisi *Damotte & Grosdidier, 1963, (c)* Protocythere bedoulensis *Moullade 1966, (d)* Rehacythereis bernardi*, (e)* Cypridea bispinosa *(Jones 1878) [28].*

12. Conclusions

This chapter has the following conclusions:

Crustaceans (Arthropods) are a group of animals with an armored external skeleton (called an exoskeleton),

1. The hard exoskeleton is the part that is preserved as a fossil. Arthropod comes from the Greek words “arthro” meaning joint and “poda” meaning foot or leg.

2. Arthropoda is the largest phylum of Animal Kingdom. It includes about 11,340,000 species in all habitats.

3. Arthropoda is characterized by heteronomous metamerism, chitinous exoskeleton, and joined appendages.

4. In very small crustaceans, exchange of the respiratory gases occurs through the general body surface.

5. Large aquatic arthropods respire through gills and book gills, whereas terrestrial forms respire through trachea and book lungs.

6. The earliest crustaceans are known from Cambrian sediments.

7. A majority of crustaceans habitats are aquatic and they live in either marine or freshwater environments, but a few groups have adapted to life on land, such as terrestrial crabs, terrestrial hermit crabs, and marine environments.

8. The life cycle for different crustaceans starts from the nauplius stage, followed by the zoea larval stage and post-larval stage, and finally ends with the adult growth stage.

9. Ostracoda is an important example in crustacean.

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