DAUDNAGAR COLLEGE

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Topic

PHYLUM – CNIDARIA

SEA ANEMONE

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Sea-Anemone (*Adamsia sp.*)

Taxonomic positions:

Kingdom: Animalia

Phylum: Cnidaria

Class: Anthozoa

Sub-class: Hexa-corallia

Order: Actinaria

Genus: *Adamsia*

Species: *Sp.*

<u>Taxonomic salient features of Class – Anthozoa/ Actinozoa: Sea Anemone</u>

i. Solitary or colonial polyps without medusoid stage; exclusively marine; attached or fixed to the substratum; cylindrical body with biradial symmetry; about 6,100 species are known.

ii. Oral end is expanded to form an oral disc, bearing six to several hundred hollow tentacles surrounding the mouth; ectoderm and endoderm are separated by a strong mesoglea containing fibres and cells.

iii. Vertical partitions are present in the enteron.

iv. A skeleton may or may not be present. (Absent in Sea Anemone).

v. The free margins of the mesenteries bear coiled mesenteric filaments, which serve the function of gastric filaments.

vi. The mesenteries are formed of a double layer of endoderm with a supporting plate of mesogloea.

vii. The nervous system is a typical nerve net, central nervous system absent.

viii. The sex cells are endodermal in origin and the sexual products are discharged into the coelenteron; asexual reproduction by budding.

ix. The planula metamorphoses to adult form.

Subclass ii. Zoantharia or Hexacorallia:

i. Colonial or solitary polyps with usually 6 or its multiple un-branched tentacles.

ii. Skeleton present in some forms. Examples: Urticina, Adamsia, Metridium, Zoanthus, Cerianthus, Fungia, Madrepora, Antipathes, etc..

KEY CHARACRERS:

- **Habit and Habit:** It is commonly called **sea-anemone** and is a **marine commensal**. It is frequently seen attached to **empty gastropod shells** in which **hermit crabs (*Eupagurus prideauxi*)** live.
- **Best example of commensalism**: It is the best example of commensalism; both sea-anemone and hermit crab exhibit physiological treaty/understanding.
    - The **anemone is carried to distant places by hermit crab** and thus is helped in distribution and food finding and the **hermit crab is protected from enemies** because the anemone is unpalatable and possesses nematoblasts or stinging cells.

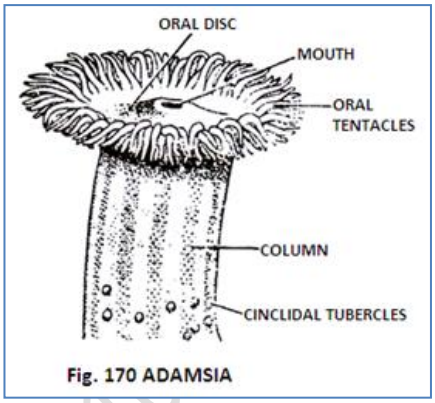

Fig. 170 ADAMSIA

- In many species, additional nourishment comes from a symbiotic relationship with single-celled dinoflagellates, zooxanthellae or with green algae, zoochlorellae, that live within the cells. Some species of sea anemone live in association with hermit crabs, small fish or other animals to their mutual benefit.
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- **Body structure:**
    - The adults are **exclusively polypoid** (i.e. **no medusoid stage**), s**olitary** and are **radially symmetrical**.
    - The body is cylindrical and is distinguished into a flat pedal disc, a column and an oral disc.
    - The oral disc is beset with a ring of hollow and un-branched tentacles and bears a large central mouth situated on a raised area.
    - At the joint of column and pedal disc, there are present a few rounded conical tubercles.

Body Form and Body Wall Internal structure and histology)

- **Body Form and Mesentery of Sea Anemone:**
    i. **Column-like body**, broader than high.
    ii. At the anterior end lies the **oral disc**.
    iii. In the middle of the oral disc lies the mouth.
    iv. From the edges of the oral disc are given off a number of **short conical tentacles**, arranged in **five rings.**
    v. Outermost whorl carries the maximum number of tentacles, which is forty-eight. The subsequent whorls bear successively lesser number of tentacles.

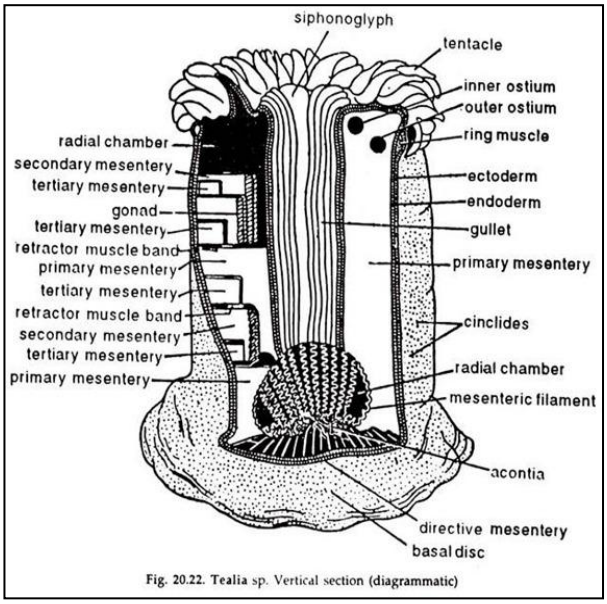
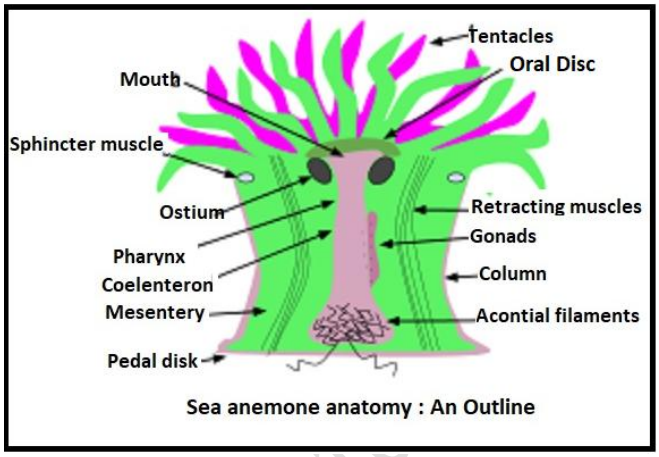


Fig. 20.22. Tealia sp. Vertical section (diagrammatic)

vi. The posterior region of the body is flattened to **form a basal disc for the purpose of attachment**.

vii. The oral disc invaginates to form a **gullet or food tube**, suspended into the general cavity.

viii. The gullet has on its either side a pair of smooth, heavily ciliated furrows placed one at each end of the long diameter, through which the water passes to the enteron, the **siphonoglyph.**



Sea anemone anatomy : An Outline

ix. The **general cavity is subdivided into radial compartments** by **six distinct septa**, each of which **extends from the wall to the gullet**. The **septa are complete** and known as **primary mesenteries**.

x. In between the primary mesenteries, two types of **incomplete partition** walls are found to be inserted; some are larger than the other. The larger partition wall is known as **secondary mesentery** and the smaller as the **tertiary mesentery**.

Thus the gastro vascular cavity is subdivided into a number of vertical chambers by projecting partitions.

xi. Each septum has a **pair of Ostia beneath the oral disc**, for direct communication of the inter-mesenteric compartments.

xii. The thick free inner margin of the septum convolutes to from **mesenteric filament**, and continues posteriorly as thread-like **acontium**. Acontium protrudes either through the mouth or through cinclides (openings in the body wall) for subduing prey.

- **Body Wall of Sea Anemone:**

i. The epidermis and gastrodermis are separated by a very thick and tough layer of **mesoglea.**

ii. The **epidermis and gastrodermis** consist mainly of very long, columnar, ciliated epitheliomuscular cells.

iii. The **mesoglea**, being traversed by a network of delicate fibres with interspersed cells, has assumed the characteristics of an intermediate cell layer.

iv. The body wall encloses a **single internal cavity** lined by **gastro dermis** called **coelenteron or gastro vascular cavity**, which opens outside only by a single opening, the mouth.

v. **Stinging capsules** occur in the **epidermis**, and are also abundant in the mesenteric filaments.

vi. **Gland cells** are abundant in the epidermal lining of the gullet and in the mesenteric filaments.

vii. **Each septum** has got **three sets of muscles, retractor (vertical), transverse (across) and parietal (oblique).**

viii. **Nerve net** occurs both in ectoderm and endoderm.

ix. The **gonads are endodermal in origin** and the **sexes are separate**. Only sexual reproduction is found.

x. Sea anemones breed by liberating sperm and eggs through the mouth into the sea. The resulting fertilized eggs develop into **planula larvae** which, after being planktonic for a while, settle on the seabed and **develop directly into juvenile polyps**.

xi. **Developmen**t with complicated **metamorphosis and planula stage**.

Digestive system

- Sea anemones have an incomplete gut; the gastrovascular cavity functions as a stomach and possesses a single opening to the outside, which operates as both a mouth and anus.
- Waste and undigested matter is excreted through this single opening.
- The mouth is typically slit-like in shape, and bears a groove at one or both ends. The groove, termed a *siphonoglyph*, is ciliated, and helps to move food particles inwards and circulate water through the gastrovascular cavity.
- The mouth opens into a flattened pharynx. This consists of an in-folding of the body wall, and is therefore lined by the animal's epidermis. The pharynx typically runs for about one third the length of the body before opening into the gastrovascular cavity that occupies the remainder of the body.
- The **gastrovascular cavity itself is divided into a number of chambers by mesenteries** radiating inwards from the body wall. Some of the mesenteries form complete partitions with a free edge at the base of the pharynx, where they connect, but others reach only partway across. The mesenteries are usually found in multiples of twelve, and are symmetrically arranged around the central lumen. They have stomach lining on both sides, separated by a thin layer of mesoglea, and include filaments of tissue specialised for secreting digestive enzymes.
- In some species, these filaments extend below the lower margin of the mesentery, hanging free in the gastrovascular cavity as thread-like acontial filaments. These acontia are armed with nematocysts and can be extruded through cinclides, blister-like holes in the wall of the column, for use in defence.

Nervous system

- A **primitive nervous system**, **without centralization**, coordinates the processes involved in maintaining homeostasis, as well as biochemical and physical responses to various stimuli.
- There are **two nerve nets**, one in the epidermis and one in the gastrodermis; these unite at the pharynx, the junctions of the septa with the oral disc and the pedal disc, and across the mesoglea.
- **No specialized sense organs are present** but **sensory cells** include nematocysts and chemoreceptors.

Musculature:

- The muscles are also much simpler than those of most other animals, although more specialised than in other cnidarians, such as corals.
- Cells in the outer layer (**epidermis)** and the **inner layer (**gastrodermis) **have microfilaments** that group into **contractile fibers**. These fibers are **not true muscles** because they are not freely suspended in the body cavity (as they are in more developed animals).

- **Longitudinal fibres** are found in the **tentacles and oral disc**, and also **within the mesenteries**, where they can **contract the whole length of the body**.
- **Circular fibers** are found in the **body wall** and, in some species, around the **oral disc**, allowing the animal to **retract its tentacles** into a protective sphincter.

Since the anemone lacks a rigid skeleton, the contractile cells pull against the fluid in the gastrovascular cavity, forming a **hydrostatic skeleton**. The sea anemone inflates its body to extend its tentacles and feed, and deflates it when resting or disturbed.

Movement & Locomotion

- A sea anemone is capable of changing its shape dramatically. The column and tentacles have longitudinal, transverse and diagonal sheets of muscle and can lengthen and contract, as well as bend and twist. The gullet and mesenteries can evert (turn inside out), or the oral disc and tentacles can retract inside the gullet, with the sphincter closing the aperture; during this process, the gullet folds transversely and water is discharged through the mouth.
- Although some species of sea anemone burrow in soft sediment, the majority are **mainly sessile**, attaching to a hard surface with their pedal disc.
- They can move however, being able to creep around on their bases by gliding.

Feeding and diet

- Sea anemones are typically predators, ensnaring prey of suitable size that comes within reach of their tentacles and immobilizing it with the aid of their nematocysts. The prey is then transported to the mouth and thrust into the pharynx.

Lifecycle

- Unlike other cnidarians, anemones (and other anthozoans) entirely lack the free-swimming medusal stage of their lifecycle.
- The polyp are entirely responsible for sexual reproduction and produces eggs and sperm, and the fertilized egg develops into a planula larva which drifts for a while before sinking to the seabed and undergoing metamorphosis into a juvenile sea anemone (i.e. develops directly into another polyp young one).
- The sexes in sea anemones are separate in some species, while other species are sequential hermaphrodites i.e. maturity of sex organ at separate time.
- Asexual reproduction is rare. Sea anemones have **great powers of regeneration** and thus, can **reproduce asexually, by budding, fragmentation**, or by longitudinal or transverse binary fission. E.g. *Anthopleura* divide longitudinally. Some species can also reproduce **by pedal laceration**. In this process, a ring of material may break off from the pedal disc at the base of the column which then fragments, the pieces regenerating into new clonal individuals.
- Alternatively, fragments detach separately as the animal creeps across a surface. In *Metridium dianthus*, fragmentation rates were higher in individuals living among live mussels than among dead shells, and all the new individuals had tentacles within three weeks.

Mutualistic relationships

- Although not plants and therefore incapable of photosynthesis themselves, many sea anemones form an important **facultative mutualistic relationship** with certain **single-celled algae species** that reside in **the animals' gastrodermal cells**, especially in the **tentacles and oral disc.** These algae may be either **zooxanthellae, zoochlorellae or both.** The sea anemone benefits from the products of the algae's photosynthesis, namely oxygen and food in the form of glycerol, glucose and alanine; the algae in turn are assured a reliable exposure to sunlight and protection from micro-feeders, which the sea anemones actively maintain. The algae also benefit by being protected by the sea anemone's stinging cells, reducing the likelihood of being eaten by herbivores.
- **Examples:**In the aggregating anemone (*Anthopleura elegantissima*), the **colour of the anemone** is largely dependent on the proportions and identities of the zooxanthellae and zoochlorellae present. The hidden anemone (*Lebrunia coralligens*) has a whorl of seaweed-like pseudotentacles, rich in zooxanthellae, and an inner whorl of tentacles. A daily rhythm sees the pseudotentacles spread widely in the daytime for photosynthesis, but they are retracted at night, at which time the tentacles expand to search for prey.
- Several species of fish and invertebrates live in symbiotic or mutualistic relationships with sea anemones, most famously the **clownfish.** The symbiont receives the protection from predators provided by the anemone's stinging cells, and the anemone utilises the nutrients present in its faeces.
- Other animals that associate with sea anemones include cardinalfish (such as Banggai cardinalfish), juvenile threespot dascyllus, incognito (or anemone) goby, juvenile painted greenling, various crabs (such as Inachus phalangium, *Mithraculus cinctimanus* and *Neopetrolisthes*), shrimp (such as certain Alpheus, Lebbeus, Periclimenes and Thor), opossumshrimp (such as Heteromysis and Leptomysis), and various marine snails.
- Two of the more unusual relationships are those between certain anemones (such as Adamsia, Calliactis and Neoaiptasia) and **hermit crabs or snails**, and *Bundeopsis* or *Triactis* anemones and *Lybia* boxing crabs. In the former, the anemones live on the shell of the hermit crab or snail. In the latter, the small anemones are carried in the claws of the boxing crab.

Relationship with humans: Bionomics

- Sea anemones and their attendant anemone fish can make attractive aquarium exhibits and both are often harvested from the wild as adults or juveniles.
- These fishing activities i.e. collection from the wild for use in reef aquaria significantly impact the populations of anemones.
- The sea anemones are also threatened by alterations to their environment by human activity.
- Those living in shallow water coastal locations are affected directly by pollution and siltation, and indirectly by the effect these have on their photosynthetic symbionts and the prey on which they feed.
- In southern Italy and southwestern Spain, the snakelocks anemone *(Anemonia viridis*) is consumed as a delicacy.