ECOLOGICAL ADAPTATIONS IN FRESH WATER HABITATS

'Adaptations are the adjustments of an organism to its environment. They undergo profound changes for successful living**'.**

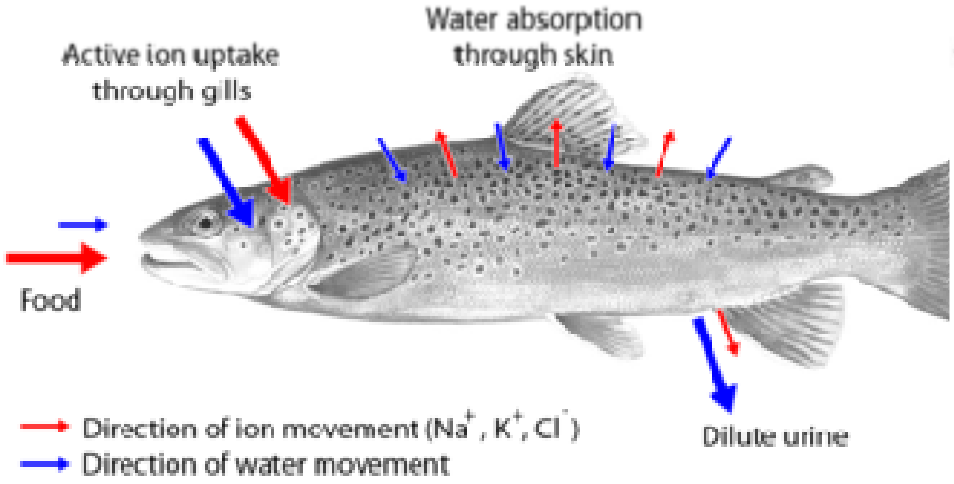
1. **<u>Aquatic adaptations</u>:**

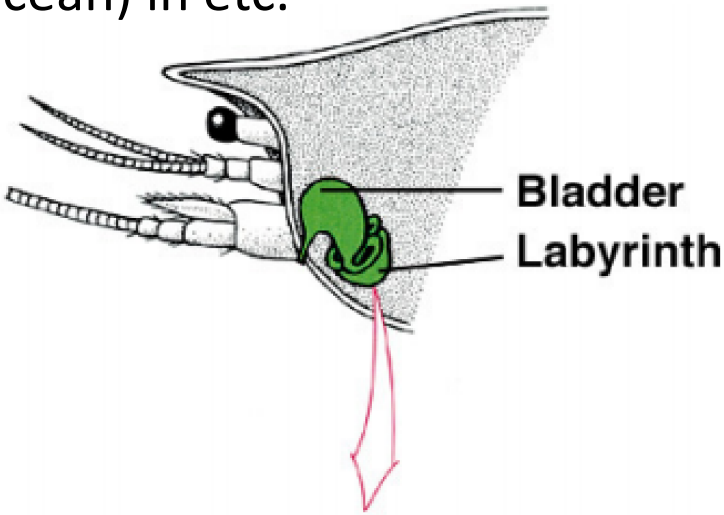
a. **Streamlined bodies** with more or less spindle shape – offers minimum ***resistance*** to the flowing water around it.

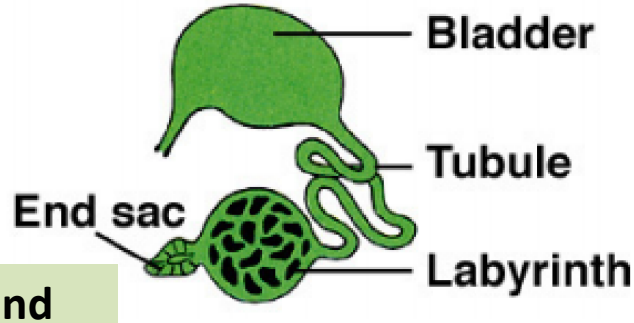
b. Flattened bodies helps the organism to hide under the stones / crevices.

Ex: Planaria, nymphs of aquatic insects like stoneflies, dragonflies, Mayflies.

c. Osmoregulation: The body fluid of the freshwater animal is ***hypertonic*** while the surrounding water is ***hypotonic*** resulting in 'ENDOSMOSIS'. To avoid excess water entering, organisms are equipped with organs of Osmoregulation like; Contractile vacuole - *Protozoans*, kidney - *fishes*, green gland – *Astacus* (Crustacean) in etc.







Green or Coxal gland

Along with urine, some amount of salt is also lost.
*To compensate **salt loss,** organisms restore salt from special cells – CHLORIDE CELLS present in the gills of fishes and crustaceans,*

d. Presence of fins – locomotion

e. Lateral sense organs

f. Swim bladder assists in buoyancy by altering the hydrostatic pressure & breathing in fishes *(Amia, Lepidosteus)*

g. Ammonotelism- Ammonia is readily soluble in water & easily diffusible through the body. Organisms excreting ammonia as waste – Ammonotelic.

h. Respiration - gills, spiracles in fishes, crustaceans & insects.

Abdominal gills – Mayfly larva, Rectal gills – Dragonfly nymph, Respiratory siphons –Mosuito larva

* **Accessory respiration** is enabled by those fishes which reside in the ponds that dry up by extra coating of MUCUS. Ex: *Clarias* (Arborscent organ), *Anabas* (Labyrinthine organ), *Ophiocephalus.*

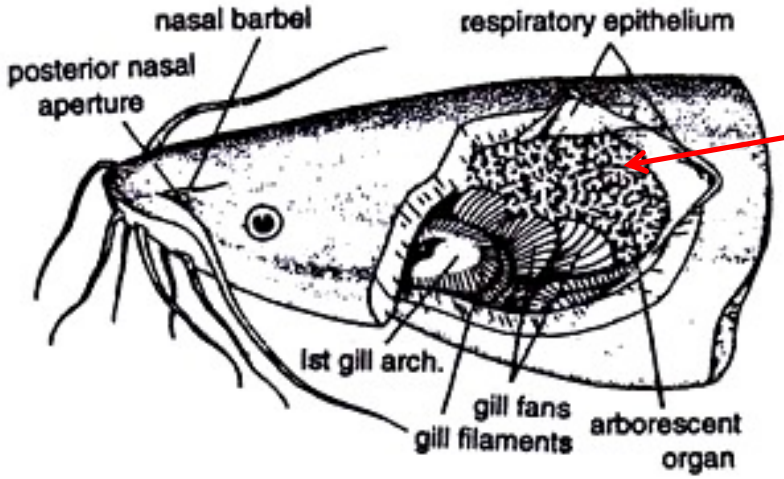


Fig. 29.4 : Clarias sp. (Magur fish). Accessory respiratory organ

i. Aestivation: Few poikilothermic vertebrates like Lung fishes, frogs undergo summer sleep by burrowing in damp soil in order to avoid desiccation. They form ***cocoon*** around themselves & remain **dormant** till monsoon returns.

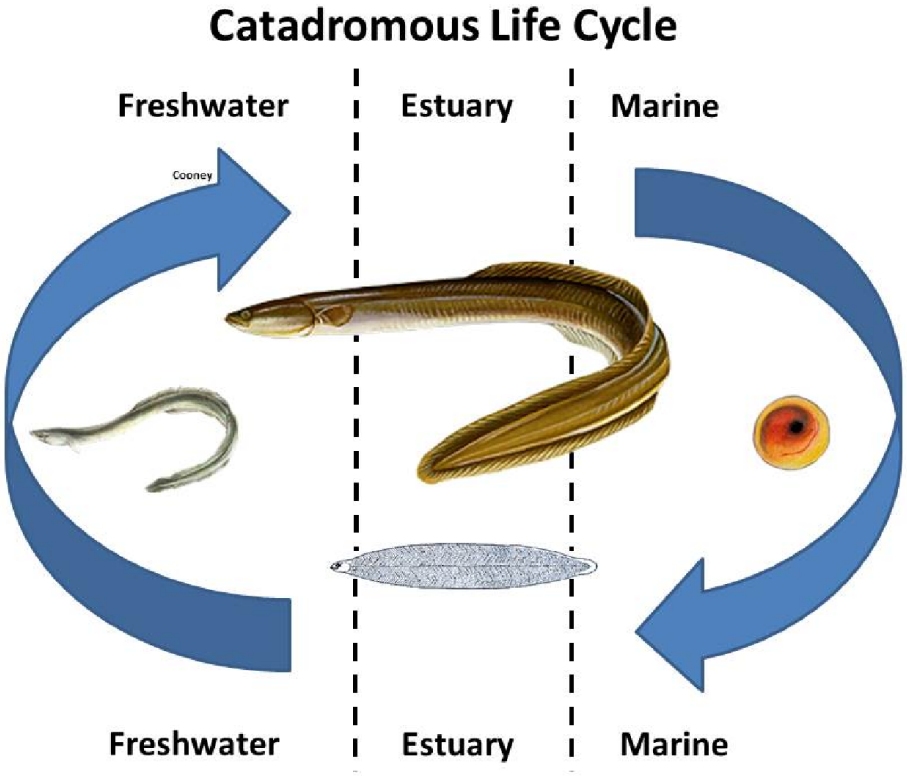
j. Encystment: *Amoeba*, *Euglena* form cyst, *Scypha* (Gemmule) to get protection from heat & cold.

k. Parental Care: Many organisms relatively produce lesser no. of eggs, extend extensive care until they hatch. Ex: *Rotifers, Cladocera, Copepods, Isopods* etc.

l. Organs of attachment: **Hold fast** helps the organisms to attach themselves to the substratum. **Hooks & Suckers** - Caddis fly; **Sticky Ventral Surfaces** – Snail.

m. Rheotrophism: Organisms **inherent behavior** to move upstream, against the water current.

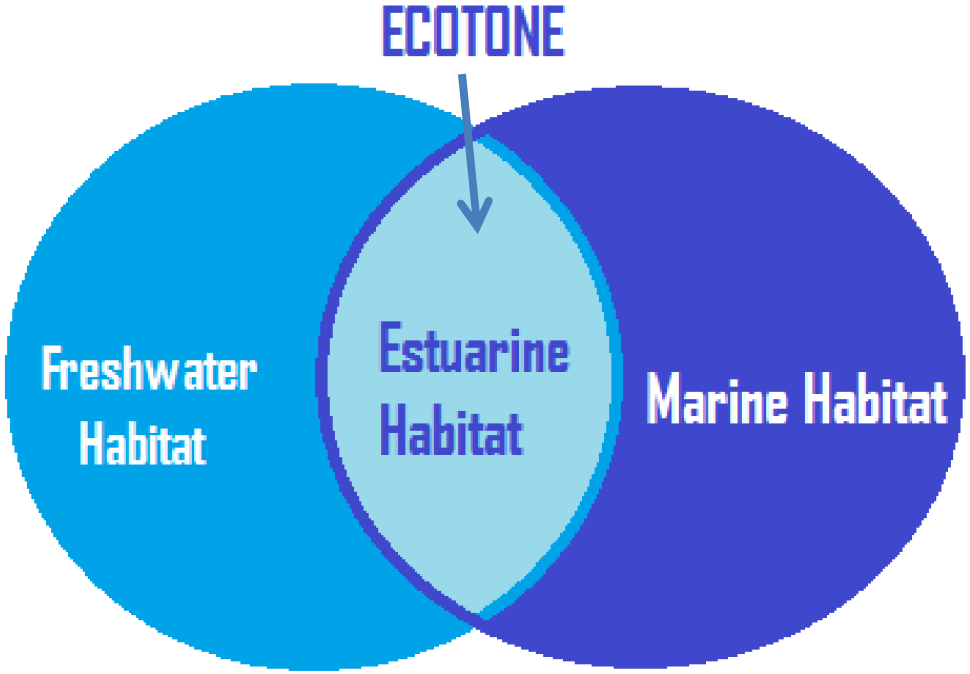
n. Thigmotrophism: Organisms keep close contact to the substratum so that, they don't get washed away due to current. Ex: Nymph of Stone fly, May fly etc.



Migration: Anguilla – oscillates between **breeding** & **feeding** grounds. They live in freshwater but migrate to sea for breeding.

ESTUARINE ADAPTATIONS

Pritcheard (1967), defined estuary as **'semi-closed'** coastal body of water which has a free connection with open sea and within which the sea water is diluted with freshwater derived from land drainage.



FORCES LEADING TO ADAPTATION

1. **Anoxia**: lack of oxygen
2. **Salinity**: fluctuating or high salinity
3. **Soil toxins:** sulfide, methane, etc.
4. **Nutrient stress:** low nitrogen or phosphorus availability
5. **Submergence:** anchorage, locomotion, change in **C** source, wave energy, light
6. **Herbivory /Predation**

Telescopium telescopium
– Mangrove Indicator species.

Fiddler crab

- Most of the organisms burrow into the mud to escape from the water currents.

Ex. Crabs, Mud skippers, Gastropods.

Mud skipper

• Trochophore larva of some polychaetes lives in the mud instead of leading a **pelagic life**. This habit protects the larva from water current.

• River water bring sediments rich in organic content. Hence, estuarine organisms are adapted in **detritus feeding** & **ciliary feeding**.

• ***Periophthalmus*** **sp (Mud skipper)** use accessory respiratory organs when there is scarcity of water.

Euryhalines tolerate wide range of fluctuations in salinity. Osmoregulators & **Osmoconformers** - <u>tolerator</u> (maintains osmotic balance in their body fluid, irrespective of changes in the external medium)

- O_2 concentration in the lower part of the water column is constantly less than in the surface water. They can survive in **anoxic** water condition (low O_2).
- Estuarine fishes carry their fertilized eggs in their mouth cavity till they hatch, to prevent them being washed away.

FLORA

- Mangrove vegetation have well adapted with **pneumatophores** (air breathing roots).
- Arenchymous tissue, lenticels, adventitious roots, stem elongation, shallow rooting, hypertrophy.
- **Viviparity** is an special adaptation – the zygote once formed develops ‘uninterruptedly’ into the seedling without the intervention of a resting stage. The roots sprout up in the seeds when they are still attached to the parental plants.

Waxy leaves and
Viviparous seedlings

Lenticels

Specialized Root
Structures

Prop roots and pneumatophores of ***Rhizophora stylosa***

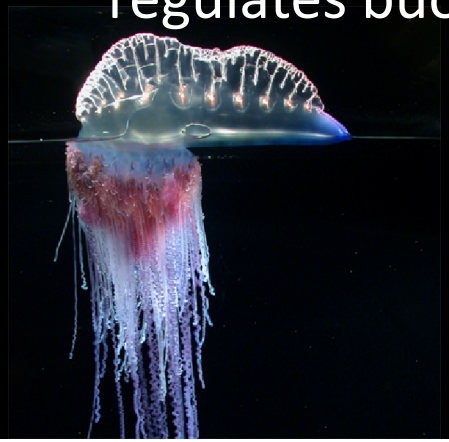
ADAPTATIONS IN MARINE HABITATS

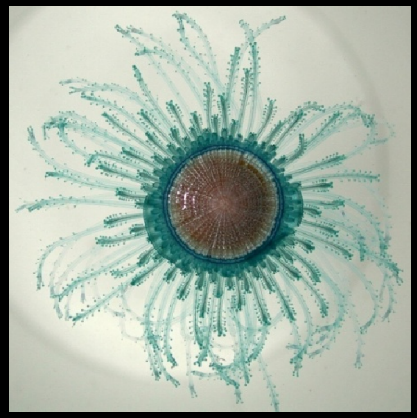
Pelagic Adaptations

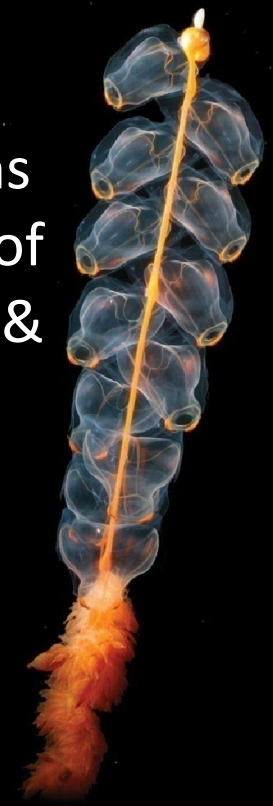
1. **Shape**: Planktons with hair or ribbon-like structures, flattened body do not sink and drift on the surface of water. **Medusae, Phyllosoma larvae, Tomopteris.**
2. **Shell:** Organisms with thin shell, reduces the weight help to float, prevent from sinking.

Ex: **Foraminiferans**.

3. **Air bladder: G**as filled air sacs as dorsal out growths add to buoyancy. Some fishes alter the amount of gas in their air bladder, change the specific gravity & regulates buoyancy.







4. Storage of Fat & Oil drops: Accumulation of fat or oil drops reduces the specific gravity in many planktons & crustaceans.

Cod fish & many **selachians** store fat in the liver in large quantities. **Sun fish, *Cetorhinnus maximus*.**

6. Jet Propulsion: The animal takes in water & expel with force, which enables it to propel either forwards or back wards. **Loligo, Octopus**

7.Circadian periodicity: Organisms like **amphipods, copepods, decapod larvae, pteropods, chaetognaths, polychaetes, siphonophores** shift to the surface waters at night & to deeper waters at the break of the day.

NEKTONS

Animals that are capable to move against the water currents are provided with efficient locomotory organs.

Organisms other than plankton are nektons

Adaptation in Intertidal animals

1. Temperature fluctuation
2. Light fluctuation
3. Tolerance to High & low salinity
4. Desiccation
5. Anoxic condition
6. Pelagic mode of life

Adaptation in Intertidal animals

1. **Temperature fluctuation:** Molluscs of intertidal zone can tolerate temperatures up to **50˚C**.

Modiolus demissus (22 to 50 ˚C)

Other organisms with moderate & low Temperature tolerance:

Limpets, Barnacles

2. Light fluctuation:

Fiddler crab (*Uca pugmax*) is attracted to light in the morning, but avoids light during hotter part of the day by retiring into the burrow.

3. Tolerance to variation in salinity

Intertidal animals can tolerate wider ranges of salinity.

Uca rapax can survive in extreme saline water(90% salinity).

- They **transport salts actively** from the medium to the body fluids.
- They secrete **hyposmotic urine**.
- **Permeability** of the body surface to the salts to water or to both is reduced.

4. **Desiccation** forms a serious hazard for intertidal animals. They **move along the tides** to prevent drying.
5. **Anoxic:** Intertidal organisms face serious **low O_2 stress.**
6. **Pelagic mode:** Most of the animals lead pelagic (free floating) life. They slightly orient themselves according to the water current for survival.

Adaptations in Intertidal Rocky Shore

1. Loss of locomotory organs & Sedentary life.
2. Desiccation
3. Defensive organs
4. Flattened body – reduce friction
5. Regeneration power

- Rich diversity can be seen in this zone.
- They have stable & constant substratum compared to intertidal fauna.
- Animals of this zone are sedentary.

Adaptations in Intertidal Rocky Shore

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- **They have stable & constant substratum compared to intertidal fauna.**
- **Animals of this zone are sedentary.**

Ex. Sea anemone, Zoanthus, Lepas, Balanus.

Murex altispira

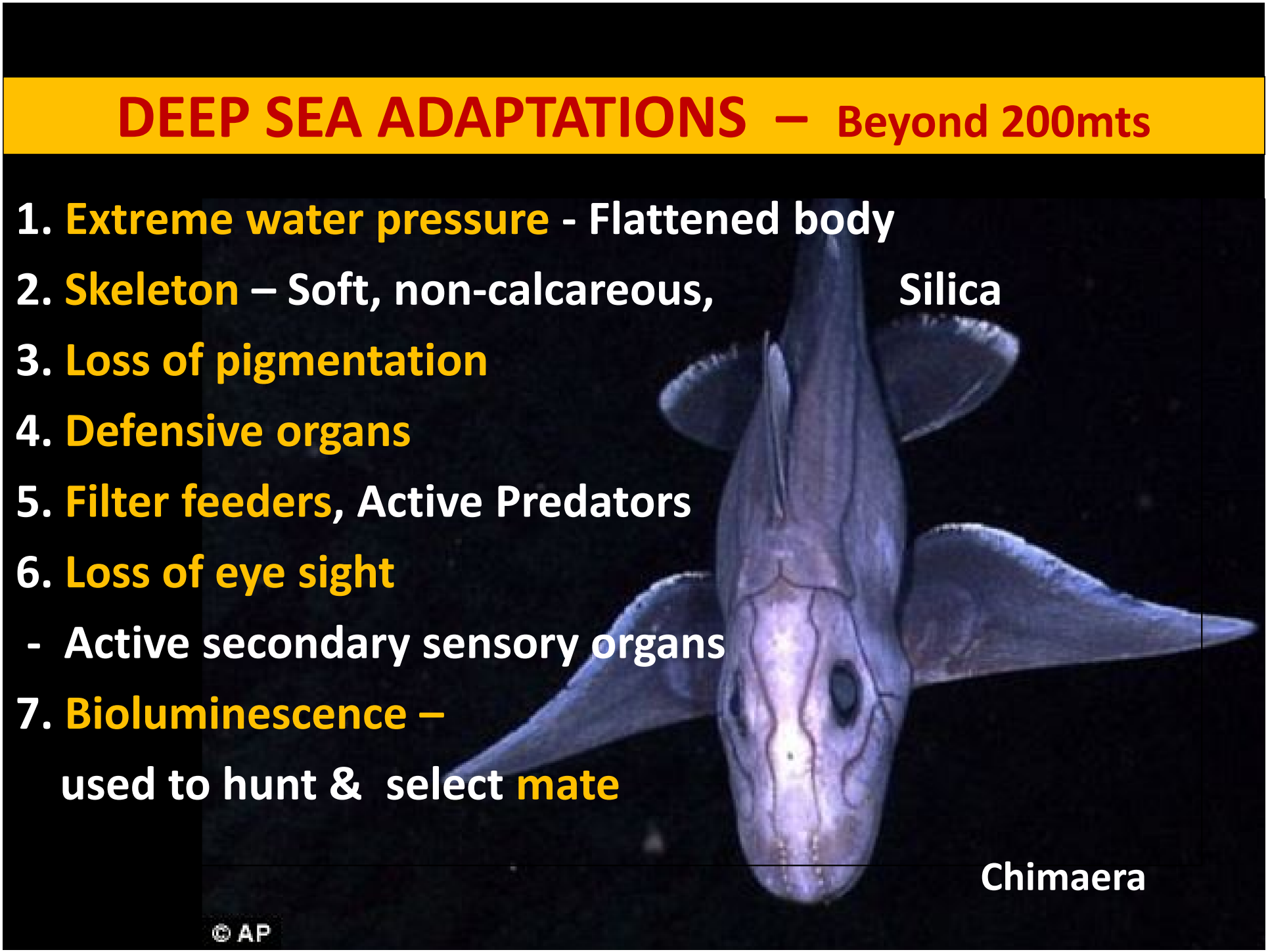
- **Desiccation:**

Animals secrete excess mucous to avoid increased temperature.

- **Defensive organs:** **Sea anemones with nematocysts in their tentacles. Sponges & Ascidians possess spicules.**

DEEP SEA ADAPTATIONS – Beyond 200mts

1. Extreme water pressure - Flattened body
2. Skeleton – Soft, non-calcareous, Silica
3. Loss of pigmentation
4. Defensive organs
5. Filter feeders, Active Predators
6. Loss of eye sight
   - Active secondary sensory organs
7. Bioluminescence –
   used to hunt & select mate



Chimaera

Forest Adaptations

Forest animals are arboreal and naturally they are adapted for arboreal life.

- **Opposite toes**
- **Claws - Gripping**
- **Prehensile tail –** acts as fifth arm for extra support
- **Syndactyly –** fusion of digits (Chameleon)
- **Adhesive discs -** (Rhacophorus)
- **Patagia –** parachute
- **High Sense of hearing**
- **Reproduction specially adapted for arboreal life.** (*Phyllomedusa* – Gliding tree frog)

Forest Adaptations

Draco Vs Chrysopelea (Flying snake)

Desert Adaptation

Animals are adapted to its extreme climatic conditions and water scarcity.

- **Water Conservation**
- **Water procurement**
- **Tolerance of Heat**
- **Protection**