

Hyperosmotic living

Ionic & osmotic problems of hyperosmotic living

Organisms in hyperosmotic environment are few like marine lamprey, teleost fishes, grapsid crabs (Polygrapsus & Hemigrapsus), palaemonid prawns, coelacanth fish (Latimeria). Their body fluid is dilute than sea water & therefore there are living is hyperosmotic. Some organisms live in evaporating water of salt pans. for example Artemia (Brine shrimp) breeds in crystalline water. Aedes mosquito larvae (breeding in seawater)

- Artemia



- Latimeria



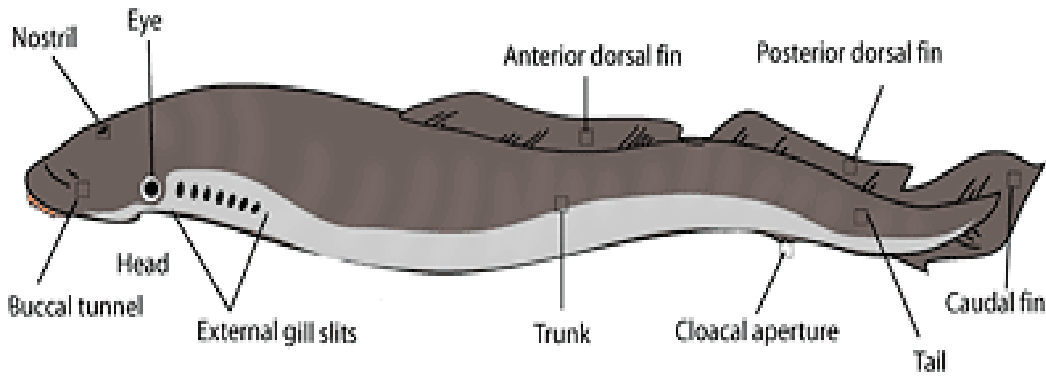
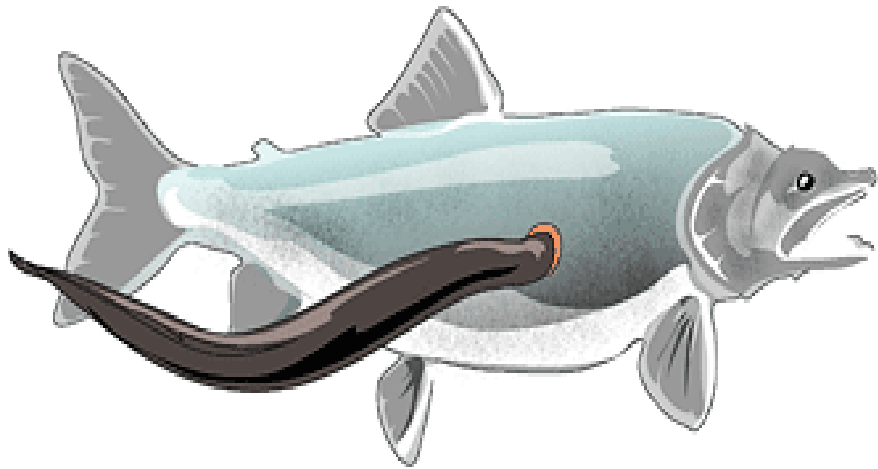
- Hemigrapsus



- Grapsid crab



- marine lamprey



palaemonid prawns

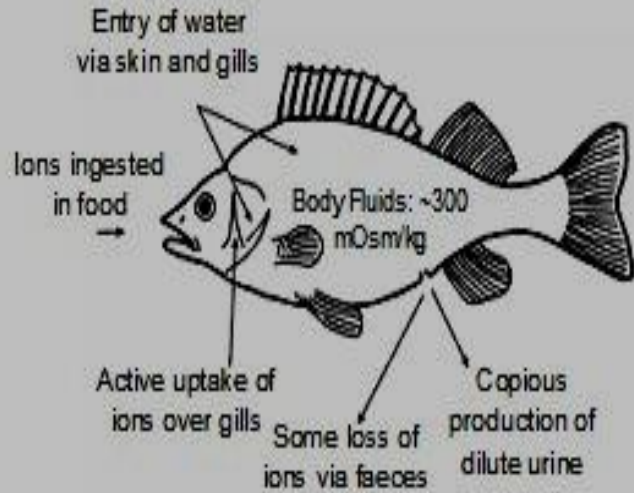


Problems the organisms phase -

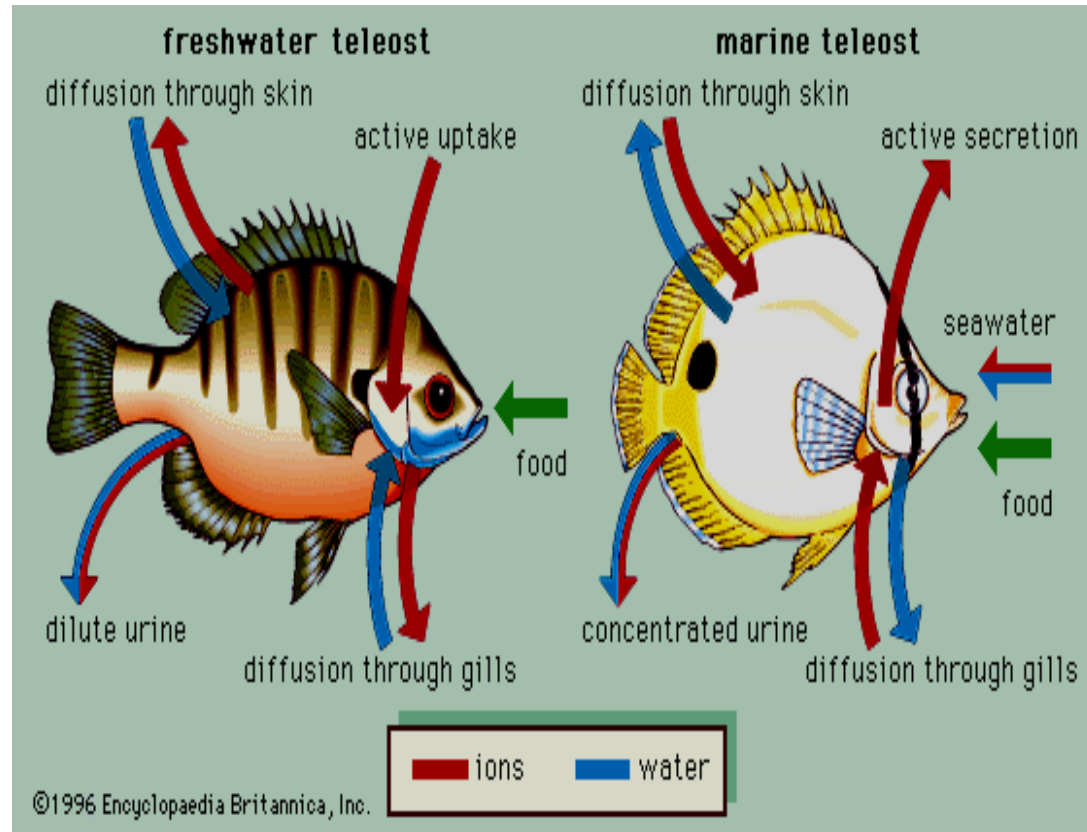
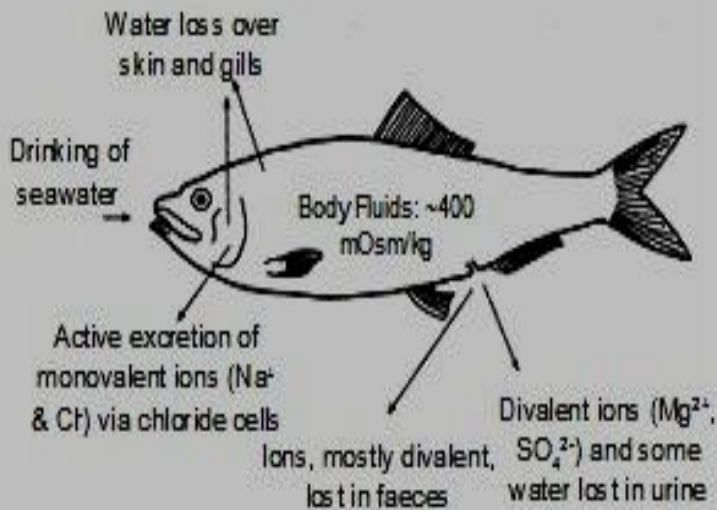
- **Water loss from body.**
- **Salt gain.**
- **Water loss is so severe that they have to drink water very often.**
- **Eel when in fresh water don't drink water but when in marine water it drinks salty water to overcome water loss which leads to the addition of salts in the body resulting in excess of salt in the body. The excessive salts are eliminated by acidophilic cells of gills.**



Freshwater: less than 5 mOsm/kg



Seawater: around 1000mOsm/kg



- In case of cyclostomata & fishes when salt water is ingested it creates another problem. Water absorption in the intestine becomes difficult due to salty contents of the lumen. To overcome this problem salts are actively absorbed in anterior oesophagus and then water is absorbed in the intestine. The excessive absorbed are excreted through gills. Apart from this specialized salts excreting glands help in elimination of salts.

- **Cyclostomata
(Lamprey)**



- **In Eel it has been shown that when in fresh water the oesophagus is permeable to water & salts.**
- **But when In marine water oesophagus is impermeable to water & absorb only salt so that ingested marine water gets diluted & water absorption is possible in rectum.**

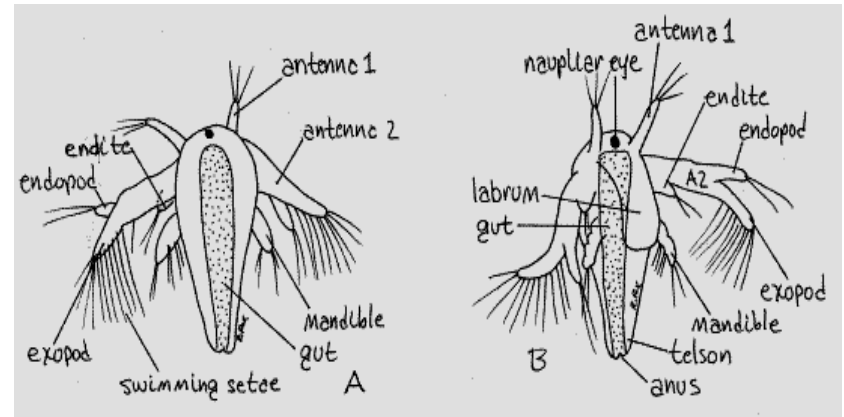
- **The organisms in hyperosmotic environment try to reduce water loss by reducing the quantity of urine produced . For this purpose they show modification in their kidney where the less amount of urine is produced.**
- **For example in some animals the number of glomeruli is less or in some glomeruli are present but their neck is constricted so that there is no ultrafiltration.**

- **While in some fishes like Toad fish (Opsanus) glomeruli are altogether absent.**
- **It is always found that the kidneys are well modified. They eliminate monovalent ions while gills eliminate SO_4^{--} or Mg^{++} .**



courtesy U.S. Geological Survey

- In Artemia salina is a Euryhaine animal, it can live in glass distilled water or crystalizing marine water. In crystalizing marine water it drinks salty water & excess NaCl is excreted through gills or branchial glands. In these glands it is seen that the Cl is given out actively & Na is given out passively. Salt excretion is very rapid. In larval Artemia branchial gland is absent. In them neck gland & cephalothorax does the excretory function.



- **Aedes larvae** – In marine water they drink excess salt water & eliminate salts by producing salty excreta. For this purpose their posterior part of rectum secretes unwanted salts in excreta. (When in fresh water anterior rectum absorbs salts.) These larvae also have anal papillae which help in ionic & water regulation.



- **The organisms in hyperosmotic living have one more mechanism to minimize ionic and osmotic problems. They accumulate metabolites so as to maintain the body fluid concentration similar to concentration of water in which they live.**
- **In some organism trimethylamine oxide – TMAO & NPS – ninhydrin positive substance like Taurin & glycoxilic acid stored in tissue so as to make tissue isoosmotic & prevent salt loss.**

- **Specially molluscs show accumulation of NPS.**
- **NPS accumulation is also shown by green toad *Bufo viridis* which also accumulates urea & salts in its body.**
- **The cartilaginous fishes like shark accumulate urea in their bodies to make their body fluid isosmotic to the environment.**



