Migration in Fish

- Migration is the movement of large number of animals from one place to another for feeding, reproduction or to escape weather extremes. When large numbers of fishes come together and move socially it is called **shoaling.**
- But sometimes migrating fishes exhibit high degree of coordination in their movements and carry out synchronized manoeuvres to produce different types of shapes.
- This is called **schooling,** as seen in tunas and sardines.

- **Diadromons fishes** – migrate between sea and fresh water

  - **Anadromous** – major part sea but fresh water during breeding season e.g. Salmon and Hisla
  - **Catadromous** – major part fresh water but sea during breeding e.g. Anguilla (eel fish)
  - **Amphidramons** – fresh water to sea and vice versa. E.g. Gobies

- **Potamodromons** – migratory, confined to fresh water eg. Carps and trouts, Mahaseer move up stream along Himalaya rivers

- **Oceanodromons** – migratory, confined to sea only eg. Tunnas, Mackerels

Causes of migration in fishes

- **Gametic migration** (Spawning/breeding migration)
  - Better survival and proper development of egg/larva
  - Stop feeding prior to migration or reduced drastically
  - Energy requirement (fat deposit) e.g. Chum salmon spp. 25,810 Ca and 28,390 cal by male and female respectively

- **Alimental of Feeding Migration**
  - Due to shortage of food (Suitable/wintering/spawing)
  - Better food facilities, better survival and fast growth
  - Grow fast in size and mature and produce more eggs.

- **Climate or Wintering Migration**
  - Due to inactive physical condition and low BMR
  - Depends on fish condition and environment
  - Achieved by hormonal and physiological changes
  - Deposit mainly as fat deposits
  - Among freshwater species (Grass carp) more to wintering grounds.

- **Osmoregulatory or Protective Migration**
  - Spawning, feeding and wintering migration can all be regards as protection migration as they ensure further life of fish
  - These migration are not cyclical

Feeding or alimental migration

- **Feeding or alimental migration** takes place in fishes for feeding.
- In high populations fishes exhaust food resources in an area quickly and therefore must migrate constantly in search of new feeding resources.
- Salmons, cods and sword fish constantly migrate for food from one place to another in the sea.

Spawning migration

- **Spawning migration** takes place in breeding season in those fishes which have spawning grounds far away from feeding places.
- Migratory fishes such as eels and salmons and a large number of riverine fishes spawn in tributaries of river in hills and migrate in large number for laying eggs in these oxygen rich waters.

- **Juvenile migration**
- involves larval stages of fishes which hatch in spawning grounds and must migrate long distances in order to reach the feeding habitats of their parents.

- **Recruitment migration**
- takes place when large number of larvae moves from nursery habitat to the habitat of adults.
- which may sometimes be distinctly different.
- Adults of eels live in rivers in Europe and America but their larval stages live and grown in sea and migrate to reach rivers which may take one to two years.

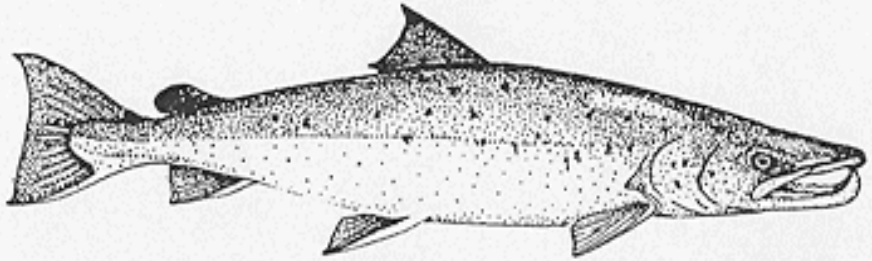
Seasonal migration

- takes place in fishes that inhabit arctic areas where in summer climate is conducive and food abundant but as winter approaches temperatures fall below zero and food becomes scarce.
- fishes must migrate towards subtropical and tropical areas to escape extremes of weather conditions.

TYPES OF MIGRATION IN FISHES

- Fishes live in two different types of aquatic habitats, namely, freshwater and marine habitats, which pose different osmotic problems because of which it is difficult to migrate from one type of habitat to another.
- some fishes species do migrate.

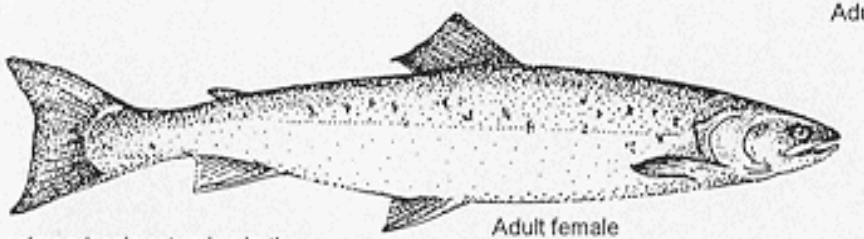
Figure 3.1: Life Cycle of the Atlantic Salmon (*Salmo salar*)



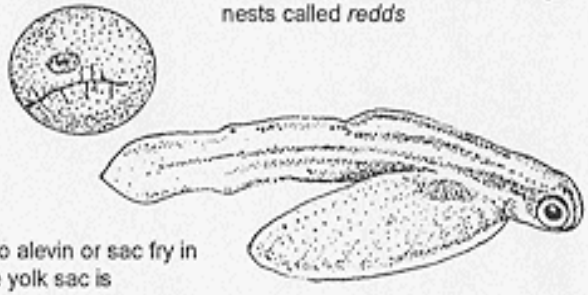
Spawned-out salmon, called *kelts* or *black salmon*, return to the ocean or overwinter in the river

Adult male

In late autumn, the female buries fertilized eggs in stream bottom gravel nests called *redds*

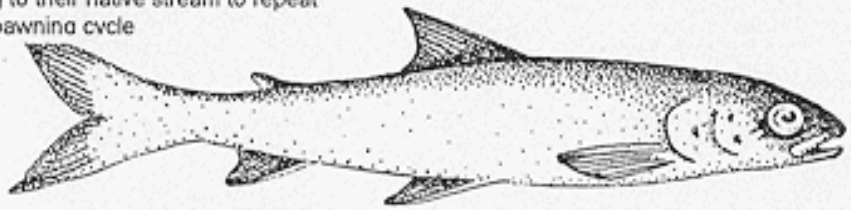


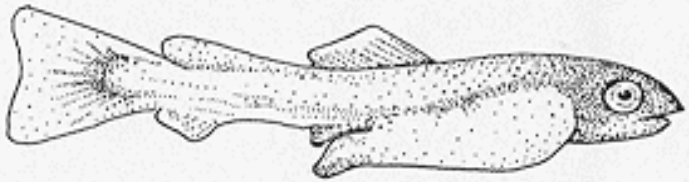
Adult female



The eggs hatch into alevin or sac fry in late spring, and the yolk sac is gradually absorbed

Adult salmon begin returning in the spring to their native stream to repeat the spawning cycle





Smolts are silver colored and approximately 6 inches long. In the spring, smolt body chemistry changes; they now weigh about 2 ounces and are ready to enter salt waters. They migrate to the ocean where they will develop in about 2-3 years into mature salmon weighting about 8-15 pounds.

Three to six weeks after hatching, alevins emerge from the gravel to seek food and are called fry

Fry quickly develop into *parr* with camoflaging vertical stripes. The parr are two inches long. They feed and grow for one to three years in their native stream before becoming *smolts*.

POTAMODROMOUS MIGRATION

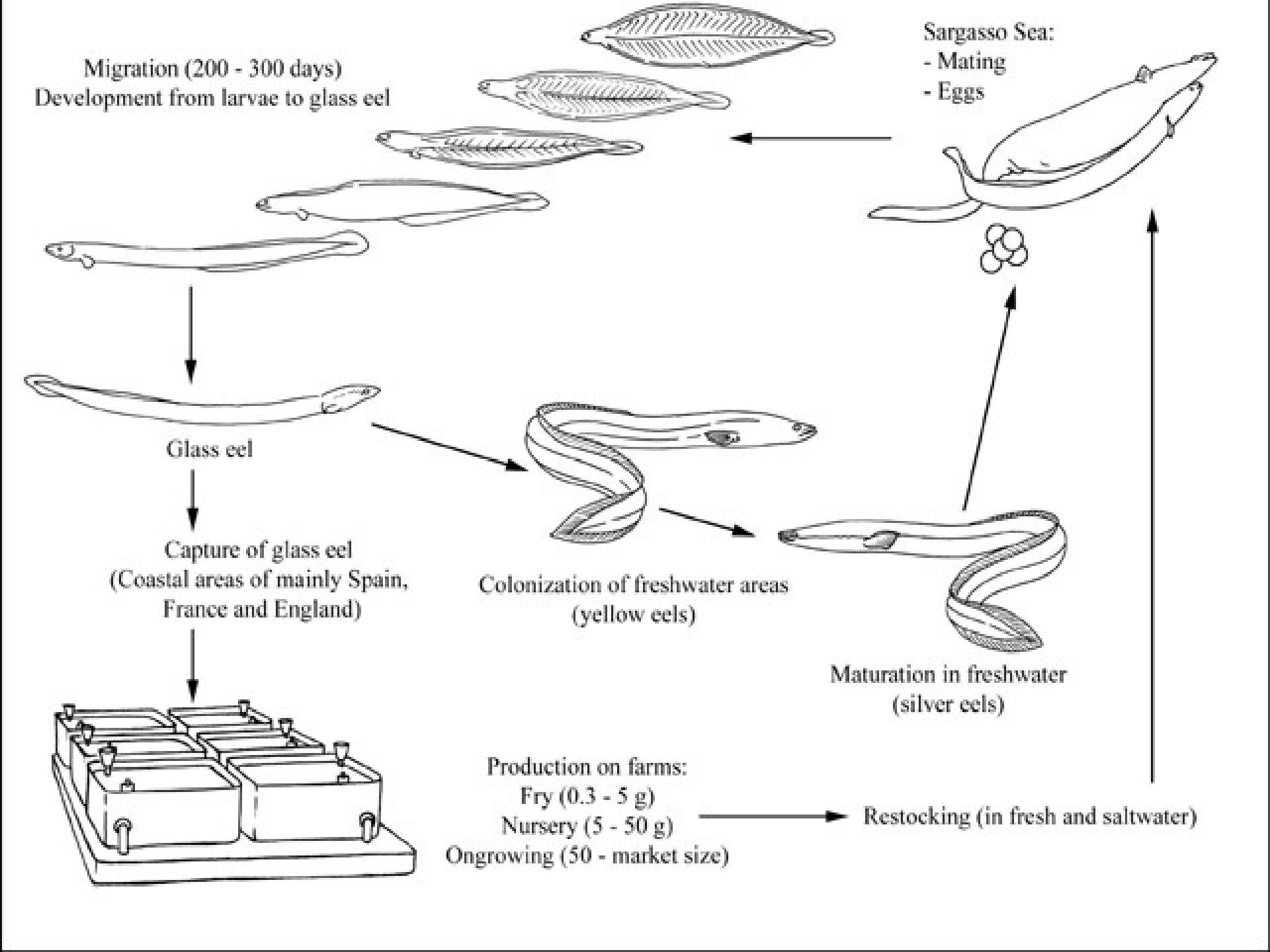
- When fishes migrate from **one freshwater habitat to another freshwater habitat** in search of food or for spawning, it is called potamodromous migration.
- There are about 8,000 known species that migrate within lakes and rivers, generally for food on daily basis as the availability of food differs from place to place and from season to season.
- Fishes also must migrate to lay their eggs in places where oxygen concentration in water is more and where there is abundance of food for juveniles when they hatch from eggs.

OCEANODROMOUS MIGRATION

- This migration is **from sea water to sea water**. There are no barriers within the sea and fishes have learned to migrate in order to take advantage of favourable conditions wherever they occur.
- Thus there are about 12,000 marine species that regularly migrate within sea water.
- Herrings, sardines, mackerels, cods, roaches and tunas migrate in large numbers in search of food by way of **shoaling** (migrating together socially but without much coordination) or **schooling** (swimming with high degree of coordination and synchronized manoeuvres).

DIADROMOUS MIGRATION

- When fishes can migrate **from fresh water to sea or from sea to fresh water,** it is called diadromous migration.
- There are about 120 species of fishes that are capable of overcoming osmotic barriers and migrate in these two different types of habitats. This migration is of two types.
- **Catadromous migration**
- **Anadromous migration**


Migration (200 - 300 days)
Development from larvae to glass eel
Sargasso Sea:
- Mating
- Eggs
Glass eel
Capture of glass eel
(Coastal areas of mainly Spain,
France and England)
Colonization of freshwater areas
(yellow eels)
Maturation in freshwater
(silver eels)
Production on farms:
Fry (0.3 - 5 g)
Nursery (5 - 50 g)
Ongrowing (50 - market size)
Restocking (in fresh and saltwater)

Catadromous migration

- This type of migration involves movement of large number of individuals from fresh water to sea water, generally for spawning as happens in the case of eels *(Anguilla)* inhabiting European and North American rivers.
- Both European eel *(Anguilla anguilla* or *Anguilla vulgaris)* and the American eel *(Anguilla rostrata)* migrate from the continental rivers to Sargasso Sea off Bermuda in south Atlantic for spawning, crossing Atlantic Ocean during the journey and covering a distance of about 5,600 km.
- The adult eels that inhabit rivers are about a metre long, yellow in colour and spend 8-15 years feeding and growing.

- Before migration the following changes take place in their bodies:
- They deposit large amount of fat in their bodies which serves as reserve food during the long journey to Sargasso Sea.
- Colour changes from yellow to metallic silvery grey.
- Digestive tract shrinks and feeding stops.
- Eyes are enlarged and vision sharpens. Other sensory organs also become sensitive.
- Skin becomes respiratory.
- Gonads get matured and enlarged.
- They become restless and develop strong urge to migrate in groups.

Anadromous migration

- Adults of anadromous fishes live and feed in ocean waters but their spawning grounds lie in the tributaries of rivers. Salmons, sturgeons, Hilsa and lampreys are some of the marine fishes that undertake anadromous migration to spawn in rivers.
- Atlantic salmon *(Salmo salar)* migrates to the North American rivers for spawning while six species of Pacific salmon*(Onchorhynchus)* migrate to various rivers of Asian countries.

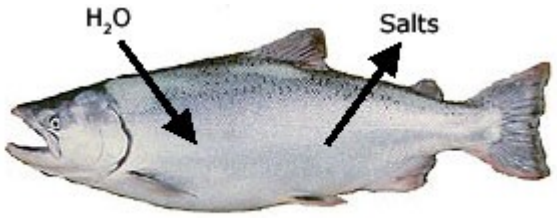
- Salmons living in sea are metallic silvery grey in colour but before migration they turn reddish-brown in colour. During fall, they enter rivers and swim energetically against water currents (**contranatent**), clearing all obstacles, including waterfalls and reach tributaries in hilly areas where they make a saucer-like pit in which female lays eggs and male releases smelt over them.

- Eggs take 2-3 months to hatch in the following spring, when the juvenile stage called **Alvin** emerges out but remains within the nest, obtaining its nourishment from the yolk sac attached to its belly.

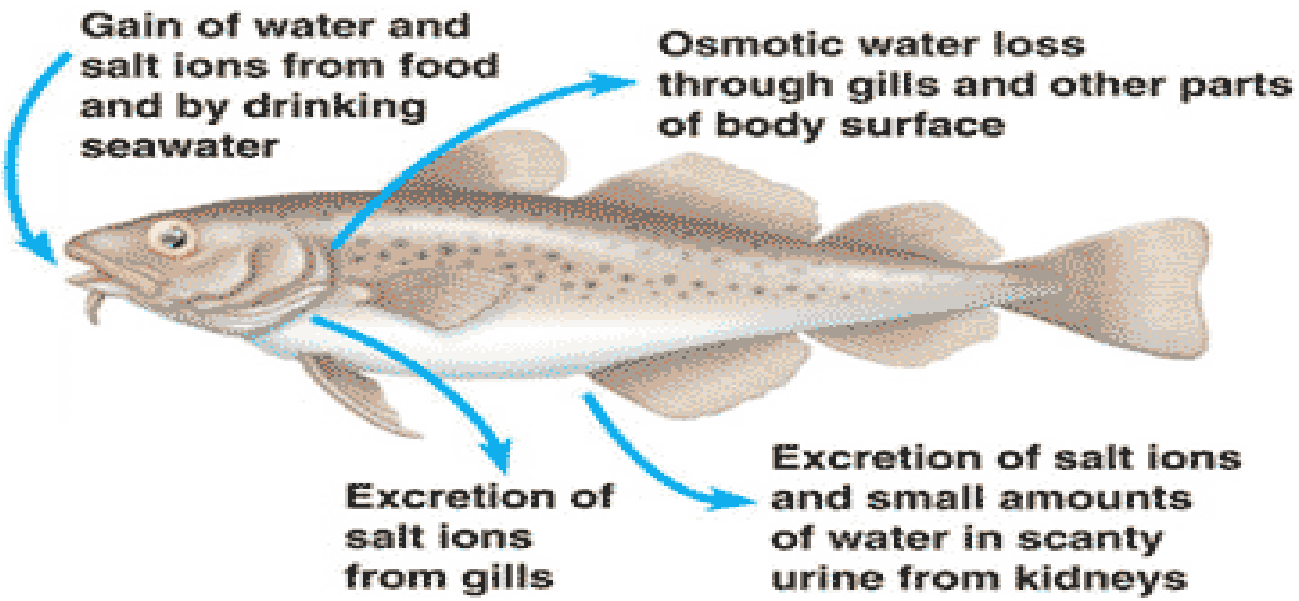
- Alvin then transforms into **Fry** which feed on planktons. Fries are **denatant** (they swim along with water current) and feed and grow into fingerlings which take the shape of adult fish. They change into **Smolt** which congregate at the river mouth in large numbers and then enter sea water in to metamorphose into adult salmons.

Behavioral and physiological adaptations

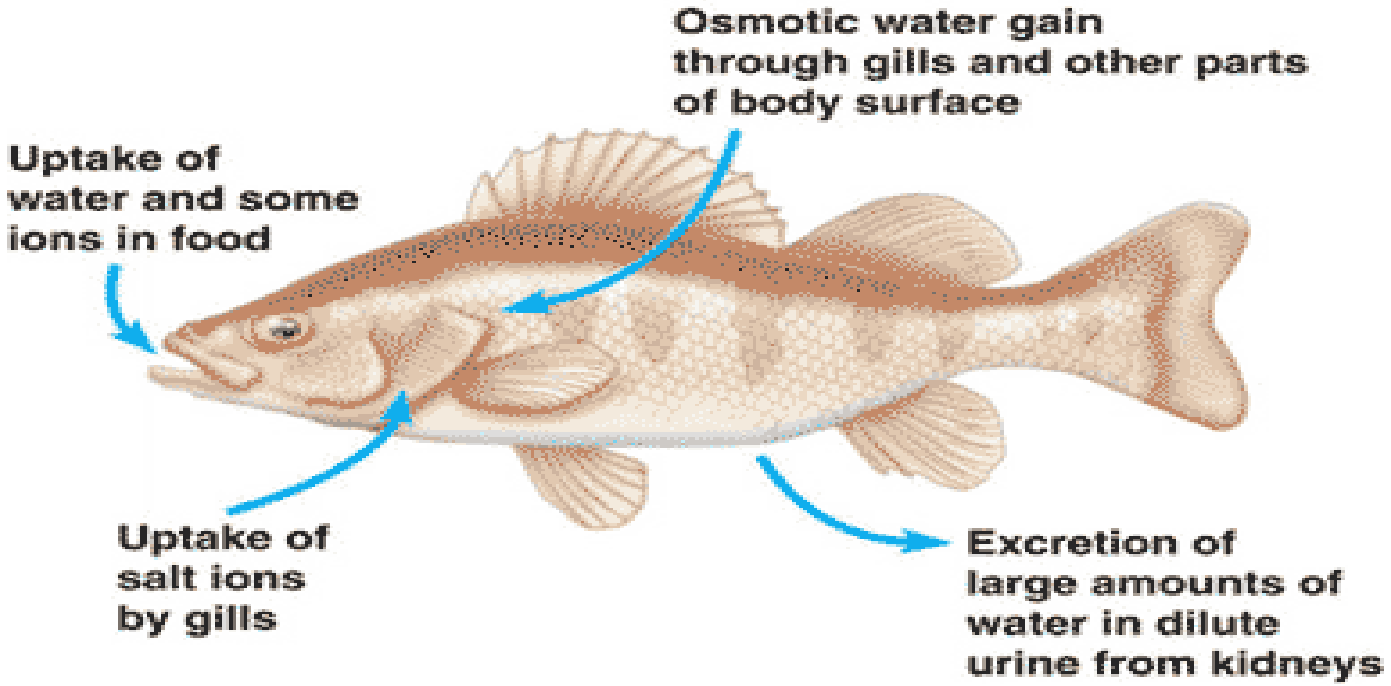
- Fresh water



- In salt water…reverse of it



(a) Osmoregulation in a saltwater fish



(b) Osmoregulation in a freshwater fish

- The behavioral (drinking or not drinking) and physiological changes a salmon must make when moving from fresh water to salt water and *vice versa.*
- young salmon on its seaward journey first reaches the saline water at the mouth of its home stream, it remains there for a period of several days to weeks
- gradually moving into saltier water as it acclimates.

- During acclimation
- it begins drinking the water.
- its kidneys start producing
- concentrated, low-volume urine,
- NaCl pumps in its gills now pumping NaCl out of the blood and into the surrounding water.

- Likewise, when an adult salmon is ready to spawn and reaches the mouth of its home stream, it once again remains in the brackish (= less concentrated than full-strength sea water) water zone of the stream's mouth
- until it is able to reverse the changes it made as a juvenile invading the ocean for the first time.